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ECONOMETRIC MODELING OF MANAGERIAL DECISIONS AT THE MACRO AND MICRO LEVELS

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Most research in decision making focuses on the application of systems and situational approaches to decision making. However, the information environment, the emergence of Big Data, the growth of the rate of change, crisis phenomena, etc. these are the conditions in which the manager is forced to make decisions on a daily basis. Generally accepted decision-making approaches are losing their effectiveness, because for the effective and competitive functioning of the organization, the manager needs to make informed decisions in a short time. Thus, we propose a new approach to solving the issues of making managerial decisions in a crisis – the econometric approach.
The theoretical and practical aspects of the application of the econometric approach to making managerial decisions in a crisis at the micro and macro levels are highlighted.
The author's understanding of the concepts «econometric approach to managerial decision making», «information and analytical support of managerial decisions» is proposed.
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ABSTRACT

The theoretical and practical aspects of the application of the econometric approach to making managerial decisions in a crisis at the micro and macro levels are highlighted. Theoretical aspects determine the basic categories of the research problem: managerial decision, stages of managerial decision-making to determine the feasibility of using econometric methods, crisis and crisis phenomena, econometric approach. The specifics of making managerial decisions in a crisis at the micro and macro levels have been determined; the characteristic features, areas of problem solving and methods for solving managerial problems are considered, depending on the level of their formalization. Practical aspects highlight the rationale for the use of econometric methods at the stage of problem identification: identification of crisis phenomena in the relevant areas; a quantitative analysis of the crisis made it possible to identify and determine the imbalances. The advantages and disadvantages of the econometric approach to managerial decision-making are determined; general econometric methods of substantiating managerial decisions and their consequences are described. The features and advantages of Data-driven decision-making over Highest Paid Person's Opinion are determined; the types of information and analytical support of managerial decisions and the methods used for its formation are determined.

The author's understanding of the concepts «econometric approach to managerial decision making», «information and analytical support of managerial decisions» is proposed.

Practical aspects highlight the feasibility of using econometric methods and at the stage of justifying managerial decisions — the use of econometric methods in accordance with the scope of application, taking into account its specificity and state: a matrix «economic security — standard of living — innovative development» has been developed to justify the decision on the application of strategies to ensure economic security through changes in the level of innovative development and the standard of living of the population of the region (transformation strategy, innovative development strategy, human development strategy and growth strategy) on the basis of correlation-regression analysis, calculation of partial elasticity coefficients, a potentially most effective variant of reconfiguring the functional components of the innovation infrastructure was established; a model of authentic management of the development of the Ukrainian tourist services market has been developed, which assumes the use of specific mechanisms of authentic management and accounting for the authenticity of the cultural and historical resources of local tourism markets, the asymmetry of infrastructural and socio-economic development of markets, the spatial polarization of the location of climatic and recreational factors of local tourist markets; based on the results of the taxonomic analysis of the state of the hotel and restaurant industry, managerial solutions were proposed for the implementation of the strategy for the development of the hotel and restaurant industry for the coming period, including activities at the national level and at the level of individual business entities; an algorithm for making optimal decisions based on the

development of the innovative potential of personnel has been developed: defining the problems of enterprise development; search for the reasons for the retardation of the development of the enterprise; determination of the reasons for the retardation of the development of the enterprise; determination of optimal solutions depending on the formulated problem; development of recommendations for achieving strategic goals, based on the construction of a «tree of opportunities»; a cognitive map (graph) of the process of making strategic decisions in the sphere of making strategic changes at mining and processing enterprises was built taking into account the influence of the following concepts: goals of strategic changes; the goals of the enterprise strategy implementation; the duration of the change lag; the level of encouragement of the team of changes; threshold opportunities for strategic change; unique opportunities for strategic change; average opportunities for strategic change; sufficiency of the potential for strategic changes; resistance to change; fiduciary corporate culture.

KEYWORDS

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CIRCLE OF READERS AND SCOPE OF APPLICATION

The theoretical and scientific-applied provisions presented in the monograph will be useful for researchers, teachers, graduate students, applicants for higher education, and is intended for decision-makers in companies, non-profit organizations and government.

The practical significance of those obtained in the monograph lies in the fact that the proposed scientific and practical recommendations and conclusions can be used to form and implement decision-making models for solving such problems.

INTRODUCTION

N. Ivanova, T. Kozhukhova

Most research in decision making focuses on the application of systems and situational approaches to decision making. However, the information environment, the emergence of Big Data, the growth of the rate of change, crisis phenomena, etc. are conditions in which the manager is forced to make decisions on a daily basis. Generally accepted decision-making approaches are losing their effectiveness, because for the effective and competitive functioning of the organization, the manager needs to make informed decisions in a short time. Thus, we propose a new approach to solving the issues of making managerial decisions in a crisis – the econometric approach.

The proposed econometric approach to managerial decision-making is a combination of the properties and principles of systemic (acceptance and understanding of the hierarchy of variables and their relationships, preservation of the principle of consistency) and situational approaches (accounting for system analysis, analysis of the content and dynamics of each individual situation) with an emphasis on the use of econometric methods and models. The advantage of the combined approach is that it reduces personal bias and allows comparison of dissimilar alternatives when using quantitative analysis.

The theoretical basis for the study of the econometric approach to decision making was the work of leading scientists and economists, namely: Altman, M., Shalabh, McKenna, R. J., Saaty, T. L., Cooke, S., Slack, N. and others.

Paying tribute to the developments of domestic and foreign scientists on the issues under study and the significance of the scientific results obtained, it should be noted that certain theoretical, methodological and practical issues of using the econometric approach for making managerial decisions remain unresolved. There is an objective need for further research on the conditions and features of the application of econometric methods in the field of managerial decision-making.

The theoretical and methodological basis of the study was the provisions of economic theory, macro- and microeconomics, management theory, the works of leading domestic and foreign scientists on managerial decision-making.

To achieve the set scientific objectives, the following research methods were used in the work: generalization and systematization (to determine the essence of the concepts «econometric approach to managerial decision-making», «information and analytical support for managerial decision-making»); calculation and analytical and comparative (to study the dynamics and structure of economic indicators at the micro and macro levels); economic and mathematical (to justify the choice of managerial decisions); matrix (to determine the relationship between strategic priorities, the level of innovative development and the standard of living of the population); graphic and tabular (for a visual representation of statistical material, visualization of theoretical and practical provisions); cluster analysis (for grouping regions) system analysis and synthesis;

systems approach. Data processing was carried out using MS Excel modules and STATISTICA 10.0 application software.

The information and regulatory framework for the study was the laws of Ukraine, decrees of the President of Ukraine, regulatory documents of the Cabinet of Ministers of Ukraine, official materials of the State Statistics Service of Ukraine, official materials of territorial bodies of the State Statistics Service of Ukraine, official materials and publications of international organizations, scientific publications of domestic and foreign scientists, collections scientific and practical results of the authors' own research.

The monograph is a collective work of the teachers of the Donetsk National University of Economics and Trade named after Mykhailo Tugan-Baranovsky. The authors of the monograph are:

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1 FEATURES OF MAKING MANAGERIAL DECISIONS IN A CRISIS AT THE MICRO AND MACRO LEVELS

O. Chernega, Uy. Yakovenko, A. Chepurnova, O. Makieieva

ABSTRACT

The analysis of the interpretation of the concept of «managerial decision» in scientific sources is carried out. A generalized classification of managerial decisions has been formed. The parameters influencing the adoption of managerial decisions at the micro (organizational structure of the enterprise, qualifications and personal characteristics of personnel; efficiency of information acquisition channels; provision of means and objects of labor) and the macro level (competence of employees of public authorities; rationality of structure and bureaucratic procedures, decision-making, technical means, information support; decision-making and implementation environment; requests from stakeholders; regulatory framework for the functioning of public authorities, political situation; financial and economic situation). The main methods and models used in making managerial decisions are generalized. The main stages of managerial decision-making are highlighted. It has been substantiated that one of the directions of managerial decisions at the macro level is migration policy. The stages of making managerial decisions in the migration policy of the European Union are considered. The main challenges for the migration policy of the European Union as a managerial decision at the macro level have been identified (numerous uncontrolled flows of illegal migrants and refugees following the countries of Africa and Asia, the need to ensure effective control over the borders of the EU member states). The analysis of the migration policy of Ukraine from the point of view of the effectiveness and efficiency of managerial decision-making at the macro level is carried out. It is determined that the main task of the migration policy of Ukraine is to reduce labor emigration. Measures and directions for the implementation of the migration policy of Ukraine in the European migration policy have been developed.

KEYWORDS

Managerial decisions, migration, migration policy, managerial decision-making model, managerial decision-making mechanism.

1.1 PECULIARITIES OF INTERPRETATION AND ESSENTIAL CHARACTERISTICS OF MANAGERIAL DECISIONS

The process of making managerial decisions is an important component of the functioning of any economic entity. At the enterprise level (micro level), the process of making managerial decisions and the procedure for their implementation depends on many factors: organizational structure;

the level of risk; information environment; human capital, etc. However, the process of making managerial decisions at the state level (macrolevel) and a number of factors influencing their adoption, especially during a crisis period, require detailed study.

Highlighting the features of managerial decisions in a crisis at the micro and macro levels will allow developing a general algorithm for their adoption at all levels, establishing the degree of their impact on the environment (business, society) and defining a general approach to making effective managerial decisions when implementing the migration policy of Ukraine in the EU.

A critical analysis of scientific sources [1–7] made it possible to establish that, despite the diversity of the interpretation of the concept of «managerial decision» depending on the level of its implementation, the resulting result is a choice. Best, E. notes that «decision making is a special type of human activity, which consists in choosing one of several decisions» [4]. Grover, J. somewhat expanded the interpretation of the concept, emphasizing that a managerial decision «is the choice of an acceptable alternative among possible, the choice of effective actions to achieve the goal of the activity» [6].

Agreeing with the opinion of Leoveanu, A. C. that «state managerial decisions are a conscious choice, a voluntary act, the end result of discussion, the activities of decision-makers whose object of activity is state business… decisions made by the mayor, president, minister, state secretary, civil servants who are part of the public sector» [1] it should be noted that managerial decisions in Ukraine at the state level are made by the President, the Verkhovna Rada and the Cabinet of Ministers.

At the same time, it is fair to note that «the concept of a solution in the context of public-state relations is a constant concept, which, however, does not have an established definition in the scientific literature… and is a process of choosing between alternative scenarios aimed at solving problems, performing functions, achieving certain results or effect» [8].

Managerial decisions, as an economic category, are one of the tools for responding to changes in the external or internal environment. At the same time, the versatility of managerial decisions allows to single out the criteria by which they can be classified (**Table 1.1**).

The mechanism for making managerial decisions at the micro and macro levels has a number of features. At the micro level, the process of making a managerial decision depends on the parameters:

1. The organizational structure of the enterprise. The organizational structure of the enterprise determines the centers for making and executing decisions. With a linear structure, managerial decisions are made solely by the head. The functional structure provides for the distribution of decision-making capabilities at the grassroots management level. Linear staff, divisional and matrix organizational structures of management provide for a clear separation of the possibilities for making managerial decisions at the highest, middle and lower levels.

2. Qualifications and personal characteristics of personnel.

3. Effectiveness of channels for obtaining information.

4. Provision with means and objects of labor.

At the same time, an important parameter that encourages entrepreneurs to make managerial decisions is also the need to ensure economic security. Agreeing with the opinion of Ivanova, N.,

Pryimak, N. it should be noted that «economic security is the core of the formation of motivational processes and sustainable development of enterprises… the importance of economic security consists of business entity profit motivation and increase of the income amount (revenue) from the product sale (goods, work, services), the need to overcome existing risks – devastation of economic activity has to be taken into consideration as well» [12].

● **Table 1.1** General classification of managerial decisions

No.	Criterion	Type
1	By the level of acceptance	General
		Private
2	By the level of influence	Decisions affecting the environment
		Decisions affecting the internal environment
3	By level of taking	Decisions at the highest (institutional) level of management
		Decisions at the middle (managerial) level of management
		Decisions at the grassroots (technical) management level
4	By the way of taking	Rational
		Intuitive
		Analytical
5	By the time interval	Short-term
		Long-term
6	By the organizational structure level	Centralized
		Decentralized
		Combined
7	By the degree of novelty	Innovative
		Standardized
8	By the area of implementation	Economic
		Social
		Technological
		Organizational

Source: compiled by the authors based on these sources [6, 9–11]

At the macro level, the process of making managerial decisions, especially in a crisis, has a number of features. Nedelko, I. notes that a managerial decision at the state level must meet the following requirements: the presence of a scientific justification for the feasibility of the decision and its expected results; the possibility of implementation, will provide the best solution to the problem,

taking into account the actual situation in the environment; timeliness of implementation [13]. Another feature of the process of making managerial decisions at the macro level is the need to understand the responsibility for their implementation. The state managerial decision must be clearly communicated to citizens and implemented in accordance with all legislative requirements [1].

The third feature of the process of making managerial decisions at the macro level is the specificity of the organization and distribution of powers between government bodies. So, «the distribution of the state apparatus into state power bodies (legislative and executive) and local self-government determines the scale of managerial decisions and the nature of the procedures, it is possible to apply» [8].

At the same time, the list of mechanisms for making managerial decisions that can be used at the macro level is quite diverse and significantly different from each other. The direct decision-making process is influenced by the following factors of the internal and external environment:

1. «Factors of the internal environment: the competence of employees of public authorities; structure rationality and bureaucratic procedures; the level of motivation when making decisions; technical means; information support» [8].

2. «Factors of the external environment: environment of decision-making and implementation; stakeholder inquiries; legal and regulatory framework for the functioning of public authorities; political situation; financial and economic situation» [8].

Tsuji, G. Y., Hoogenboom, G., Thornton, P. K. summarized the factors influencing managerial decisions into four large groups: «rational factors: quantitative factors such as price, time, forecasts, and the like; psychological factors: the personality of the manager, his/her personality traits, experience, perceptions, values, goals and roles are important factors in decision making; social factors: the consent of performers, especially those influencing decisions, is important. Taking these issues into account reduces potential negative consequences and controversies regarding such a decision; cultural factors: cultural characteristics of the region, country and integration association, as well as the culture of the decision-making organization. These cultures influence individual/organizational decisions in the form of socially accepted values, trends and shared values» [14].

Scientific sources provide a list of principles that must be followed when making managerial decisions at the macro and micro levels. So, Leoveanu, A. C. and Miroiu, A. identified the following principles for making managerial decisions:

1. «The principle of effective means. Due to a specific objective and more alternatives (means of achieving that objective) the principle requires adopting the alternative that best meets the purpose» [3].

2. «The principle of comprehensiveness. An alternative is preferable to another if its application would result in the application of all the goals we attain the other application and other purposes, in other words it is the preferable alternative that has the required comprehensive consequences» [3].

3. «Higher probability principle. If the goals we can achieve by two alternatives are generally the same, but it's a greater chance to achieve those goals by applying one of the two alternatives, then it is rational to choose this one» [1, 3].

1.2 MODELS OF MANAGERIAL DECISION-MAKING AT THE MICRO AND MACRO LEVELS

Many different models are used to make managerial decisions at the micro and macro levels in times of crisis. The general classification of models of managerial decisions is presented in **Table 1.2**.

● **Table 1.2** General classification of managerial decision-making models

No.	Criterion	Type
1	Depending on the tasks (functions) of management	Calendar planning model
		Enterprise development management model
		Product quality control model
2	Depending on the stage (procedure) of automation control	Information
		Mathematical
		Programmatic
3	Depending on the approach to decision making	Rational
		Intuitive

Source: compiled by the authors based on these sources [*6, 9, 10, 15–19*]

1. Calendar planning model.

The model assumes the adoption of managerial decisions, taking into account the «distribution of the quarterly production program for months in the context of production units, as well as in the establishment of schedule standards for organizing the production process (the duration of the production cycle for the manufacture of products, the size of work in progress, the size of the batch of products, etc.)» [20].

2. Enterprise development management model.

The model assumes that «the development of an organization depends on… the strategic directions of development… the concept of management of the development of an enterprise implies the definition of the goal of the activity, tasks for its achievement and substantiation of the directions of effective development» [21].

3. Product quality control model.

The model presupposes making managerial decisions aimed at maintaining or improving product quality. Provides for the implementation of managerial decisions in control centers and responsibility centers.

4. Information model of managerial decision making.

The model assumes that the process of making managerial decisions consists of 6 main stages: «determination of information needs; collection of information; organization and storage of information; development of information products and services; dissemination of information; and use of information» [22].

The main goal of this model is to provide the organization with a sufficient amount of information data for the qualitative improvement of personnel, understanding the potential directions of the organization's development, finding solutions to existing current problems.

5. Mathematical model of managerial decision making.

Mathematical models that serve as the basis for making managerial decisions can be divided into five large groups.

«Extreme models include models that give the possibility of finding an extreme of a function or a functional. This includes models built using graphical methods, Newton's method and its modifications, methods of the calculus of variations, etc.» [6].

«Models of mathematical programming (planning) include models of linear programming, nonlinear programming, and dynamic programming» [22].

«Probabilistic models include models constructed using the apparatus of probability theory, random Markov type models (Markov chains), queuing theory models, and others» [6].

«Statistical models include models of sequential analysis, the method of statistical tests, Monte-Carlo, etc.» [9]. «Random search methods are used to find extreme values of complex functions that depend on a large number of arguments… at the heart of these methods is the use of the mechanism of random choice of arguments, on which the minimization is carried out. Methods of random search are used, for example, in modeling organizational management structures» [9].

6. Program model of managerial decision making.

Program models of managerial decision making can be divided into three main groups.

Rational Unified Process (RUP). This is a model that was designed by Rational Software Company… and involves large amount data and formal processes. This is the reason why software designed with this model has high level of details. This model has a bigger difference with other major software model because it does not use waterfall approach. The main phases in RUP are requirement, analysis, design, implementation, integration and testing [23].

Structured Systems Analysis and Design Methodology (SSADM). SSADM is a software project development model that is widely used. SSADM unlike RUP it is standard open software implying that it is free for use that has enabled it to stabilize because many companies have supported it. SSADM take an approach of waterfall systems development where there are sequences of steps which are to be accomplished one after another. SSADM can be used in all projects of all sizes small, medium or large [24].

EXtreme Programming (XP). Software project management can use this model in designing their software project. This model is aimed at reducing risks in the software development and management process. In project management, delays in making decisions can result into huge losses. This model pays attention to the cost and revenues of design decisions [23].

7. Rational model.

This model assumes that managerial decisions are made after the establishment of the main social values and goals. For democratic societies, the main tasks of this model are equality, development, and effective operation of state institutions.

The theory of rationalism presupposes an integrated rational approach to decision making. The main characteristic of this theory is a reasoned choice according to the desirability of taking different directions of action to solve social problems [8]. In addition, a rational decision-making model assumes that the main problems of government organizations and managers are the choice of methods for solving problems. However, «rational model, it may encounter many barriers, and that in practice we can not speak of absolute rationality but only a limited one, if we start from the premise that decision making is a process of logical type» [1].

The general algorithm for making managerial decisions in a rational model at the macro level assumes: «Decision initiation, defining objective decision and the means of achieving it, documentation in order to formulate the decision, selection and analysis of collected information, outlining and analyzing decision alternatives, decision adoption, decision application, observing the implementation of the decision, formulating the conclusions applying the decision» [1].

In order for public administration decisions to be effective, rational and consistent, it is necessary to comply with a number of requirements:

1) an individual or collective decision maker must identify a policy problem on which there is consensus among all relevant stakeholders;

2) an individual or collective decision maker must define and consistently rank all goals and objectives whose attainment would represent a resolution of the problem;

3) an individual or collective decision maker must identify policy alternatives that may contribute to the attainment of each goal and objective;

4) an individual or collective decision maker must forecast all consequences that will result from the selection of each alternative;

5) an individual or collective decision maker must compare each alternative in terms of its consequences for the attainment of each goal and objective;

6) an individual or collective decision maker must choose that alternative which maximizes the attainment of objectives [25].

8. Intuitive model.

The model assumes that managerial decisions are made through intuitive perception of the problem. Managers develop a course of action based on their previous experience. Thanks to continuous training, experience and knowledge, managers have an idea of the effectiveness and timeliness of the decision. A feature of the model is that only one choice is considered in advance [26].

The key stage in making a managerial decision at the micro and macro level is the control over its implementation. In general, monitoring «is considered as one of the most effective tools for continuous observation over managerial processes in the sphere of public administration. Continuity and regularity of monitoring makes it possible to accumulate large amounts of information on the status of the observation object» [8].

In addition, at the macro level, control is an effective tool with which it is possible to establish not only the effectiveness of the adopted managerial decision, but also «to track the real status of program implementation, achieving goals and objectives» [8].

Timely ongoing monitoring of the implementation of managerial decisions at the macro level also makes it possible to establish deviations from planned results and identify potential opportunities for their improvement.

The general system of internal control over the implementation of managerial decisions at the state level should include: «subject of control – internal divisions of the government authority, which are endowed with the appropriate powers; object of control – managerial decision-making processes, including preparation and implementation; subject matter – managerial decisions regarding the direct activities of government authorities; external environment, including the culture of managerial decision-making processes by government authorities; risks that could potentially reduce the effectiveness of adopted managerial decisions in government authorities; direct control procedure, which is usually prescribed in regulations or instructions; monitoring of the internal control system; information system» [8].

1.3 THE MECHANISM FOR MAKING MANAGERIAL DECISIONS AND EXAMPLES OF THEIR APPLICATION IN THE CONTEXT OF THE IMPLEMENTATION OF THE MIGRATION POLICY OF UKRAINE IN THE EU

The necessity of creating a general approach to making management decisions is caused by the diversity of their types and methods. In general, the process of making managerial decisions includes approaches:

1) use of hierarchy in decision-making process [5];

2) use of target interfunctional groups [7];

3) «using formal rules and procedures in decision-making» [7];

4) «the use of spikes in decision-making is aimed at coordinating the activities of the firm in the cents» [27].

The general mechanism for making managerial decisions at the micro-level in a crisis requires compliance with the following requirements:

1) «the overall leadership of decision-making assumes is in the hands of one linear (general) leader» [5];

2) «rules of decision-making or standards usually developed and published by the firms themselves» [28];

3) «plans are a means of coordinating the activities of various divisions in making managerial decisions» [5];

4) «adoption of bilateral decisions by leaders of the same level on the basis of individual interaction is carried out without agreement with their general managers» [4];

5) «the target groups act on the basis of group interaction and make decisions concerning specific issues of joint activities in order to achieve the set goals» [5];

6) «in matrix structures the project manager is granted linear rights similar to those given

to the heads of functional units… network structure is emerging that makes it possible to make decisions in ever more complicated conditions, concerning increasingly complex problems» [6, 29].

The mechanism for making managerial decisions consists of nine main stages [1]:

1. Initiation of the need to make a decision in response to changes in the environment.
2. Determination of an objective managerial decision and means of achieving it.
3. Documenting the managerial decision.
4. Implementation of selection and analysis of information, which is the basis for decision-making.
5. Determination of alternative options for managerial decisions.
6. Adoption of a single managerial decision.
7. Preparation for the implementation of a managerial decisions.
8. Supervision (control) over the implementation of managerial decisions.
9. Formation of conclusions and determination of the consequences of the implementation of managerial decisions.

At the macro level, the result of managerial decisions is the adopted state strategies, which are legislatively enshrined. One example of a managerial decision taken at the macro level in a crisis is the EU migration policy.

Formation of the main provisions of the EU migration policy, determination of strategic directions of development, consolidation of all EU member states for its effective implementation is entrusted to the European Council. In addition, as the main decision-making body for EU migration policy, the European Council «provides the mandates for negotiations with third countries and adopts legislation and defines specific programs» [30].

The migration policy of the EU, as a kind of managerial decision at the macro and mega levels, has changed quite intensively. At the initial stage of formation (1951–1959), the EU was a customs union, the main task of which was to remove barriers to the circulation of production resources and ensure sufficient mobility of human capital between the member states of the EU. However, no special emphasis was placed on the development of a common migration policy within the framework of the integration association. Each member state of the EU has implemented a migration policy separately. Since the 60s of the twentieth century, to ensure economic growth, the EU countries «started to increasingly recruit workers from Turkey, Morocco, Algeria and Tunisia as well as from particular former colonies» [31].

After the 80s of the twentieth century, structural economic shifts took place in the member states of the EU, which led to an increase in the demand for highly skilled labor. This led to the adoption of managerial decisions in many EU states to reorient the migration policy to maximize the stimulation of immigration of highly qualified personnel from other countries of the world.

The first joint managerial decisions within the EU in terms of migration policy were the conclusion of an agreement «On the abolition of passport control between the countries of the European Union» or the «Schengen Agreement» in 1985. According to the agreement, Belgium, Luxembourg, the Netherlands, Germany and France abolished border controls at their common borders and introduced joint control rules on the crossing of citizens of other non-European Community coun-

tries. It was the Schengen Agreement, and later the Schengen Convention, that made it possible to formulate uniform rules for crossing the borders of the countries of the European Community, including for the purpose of labor migration.

In particular, Article 7 of the Schengen Agreement determines that «the Parties shall endeavor to approximate their visa policies as soon as possible in order to avoid the adverse consequences in the field of immigration and security that may result from easing checks at the common borders. They shall take, if possible by January 1, 1986, the necessary steps in order to apply their procedures for the issue of visas and admission to their territories, taking into account the need to ensure the protection of the entire territory of the five States against illegal immigration and activities which could jeopardize security» [32].

Article 17 of the Schengen Agreement established a mechanism for harmonizing the movement of persons. The outlined joint managerial decision provides that «the Parties shall endeavor to abolish checks at common borders and transfer them to their external borders. To that end they shall endeavor first to harmonize, where necessary, the laws, regulations and administrative provisions concerning the prohibitions and restrictions on which the checks are based and to take complementary measures to safeguard internal security and prevent illegal immigration by nationals of States that are not members of the European Communities» [32].

The next stage of making a managerial decision on the EU migration policy was the issue of granting political asylum and integration of third-country nationals legally residing in the EU countries in 2003. According to the decision of many summits, it was accepted the need to develop an Integration Plan and improve the directive on standard requirements for obtaining refugee status.

In 2003, in Thessaloniki, at the July summit of the EU member states, the proposal of the European Commission on the adoption of the next managerial decision was supported – the development of a common policy to combat illegal immigration, protect external borders, repatriate illegal immigrants and cooperate with third countries. The policy of combating illegal migration should provide for the following areas of implementation: to develop a regulation on Visa Information Systems (VIS) to form a biometric data base.

In 2004 in Madrid at the next Summit of the EU member states the «Hague Program» for 2005–2010 was adopted. This program aimed to ensure: the preservation of the basic rights and freedoms of citizens of the EU member states, persons in need of shelter and migrants; joint protection of the EU borders.

The Hague Agenda set a number of objectives: «to develop a common European asylum system for political refugees, including a common asylum procedure; determine the possibilities of foreigners to work in the European Union in accordance with the established demand in the labor market; establish common European standards for the integration of migrants in host countries; strengthen partnerships with «third countries» to counter illegal immigration; develop a policy for the return of illegal immigrants to their country of origin; more efficient use of biometric and information systems» [33].

Understanding the need to consolidate efforts to exercise control over the EU borders has become the reason for the formation of new executive bodies to ensure the safety of citizens

of the EU member states. That is why in 2004 the European Agency for the Protection of the External Borders of the Member States of the European Union (Frontex) was established, which is entrusted with the function of ensuring control over the borders of the EU against threats, including illegal migration.

However, despite progress in the formation of a common EU migration policy, many key areas, including immigration policy, remained in the competence of the national governments of the EU member states. Another problem also remained the issue of lifting restrictions on migration movements of the population from the countries that joined the EU in 2004.

In 2005, the European Commission prepared two key migration policy documents: «Priority Actions in Responding to the Challenges of Migration» and an appendix «Global Approach to Migration: Priority Actions for Africa and the Mediterranean». In total, these documents indicated the directions of managerial decisions in the field of migration policy: «deepening cooperation between the African and the European Union regarding migration movements; development of joint initiatives and strengthening of cooperation between countries of origin of migration flows, transit and final destination, including with the aim of countering illegal migration and human trafficking; conducting a dialogue with ACP countries in the areas of facilitating the implementation of remittances from migrants to their countries of origin, making national legislation more effective to prevent and combat illegal immigration, and to strengthen the fight against criminal activities, organized crime and corruption, institution building and technical assistance to strengthen developing countries' capacities to combat the trafficking and smuggling of human beings» [34].

In 2007–2010, the EU migration policy was aimed at consolidating the efforts of all EU member states to combat illegal migration. At the same time, at the EU summits, the need to develop a common policy on legal migration was identified.

An important managerial decision to attract legal migrants to the EU was the introduction in 2009 of the Council Directive 2009/50/EU «on the conditions of entry and residence of third-country nationals for the purposes of highly qualified employment» and the start of the EU Blue Card. The main purpose of the EU Blue Card implementation is «addressing labor shortages by fostering the admission and mobility – for the purposes of highly qualified employment – of third-country nationals for stays of more than three months, in order to make the Community more attractive to such workers from around the world and sustain its competitiveness and economic growth» [35].

The EU migration policy has undergone significant changes after 2015, it was caused by the need to make a managerial decision: the need for a managerial decision was established (a qualitative change in the EU migration policy) as a result of an intensive change in the external environment (aggravation of hostilities in Syria and an increase in the number of refugees heading to countries EU) documenting a managerial decision (A European Agenda On Migration COM (2015) 240 from 13.05.2015; Roadmap of The European Agenda on Migration from 23.04.2015) making and implementing a managerial decision (improving the EU migration policy in relation to illegal migrants and refugees, which should be implemented in the following areas: the creation of the European Border and Coast Guard, the allocation of additional funds to finance the Frontex Triton and

Poseidon programs; readmission agreements (EU – Turkey Readmission Agreement), deepening relations between EU countries and countries of intermediate deployment).

At the EU summits during 2015, a number of progressive decisions were made, in particular, the deployment of additional points of initial reception of immigrants, which are entrusted with the role of identification, registration and distribution of migrants to refugees and illegal migrants; granting expanded powers to Frontex to carry out the deportation of illegal migrants; continued cooperation with Turkey; introduction of a mechanism for distributing refugees between EU cranes.

To counteract illegal migration through the Western Balkan route, a General Action Plan was adopted in 2015. This plan includes 17 main points, among which the key ones are: «Nominating contact points within 24 hours to allow daily exchanges and coordination to achieve the gradual, controlled and orderly movement of persons along the Western Balkans route; Submitting joint needs assessments for EU support within 24 hours; Increasing the capacity to provide temporary shelter, food, health, water and sanitation to all in need; triggering the EU Civil Protection Mechanism where necessary; Greece to increase reception capacity to 30,000 places by the end of the year; Financial support for Greece and UNHCR is expected; Working with the UNHCR who will support the increase of reception capacities by 50,000 places along the Western Balkans route» [36].

In the period from 2015 to 2020, the governing bodies of the EU adopted a number of key documents that consolidated managerial decisions on migration policy (**Table 1.3**).

In 2020, the European Commission developed a New Pact on Migration and Asylum. This document is of great strategic importance, since it summarizes the directions for the implementation of the EU's common migration policy, including in the event of migration crises. The New Pact on Migration and Asylum assumes the achievement of the following results: «robust and fair management of external borders, including identity, health and security checks; fair and efficient asylum rules, streamlining procedures on asylum and return; a new solidarity mechanism for situations of search and rescue, pressure and crisis; stronger foresight, crisis preparedness and response; an effective return policy and an EU-coordinated approach to returns; comprehensive governance at EU level for better management and implementation of asylum and migration policies; mutually beneficial partnerships with key third countries of origin and transit; developing sustainable legal pathways for those in need of protection and to attract talent to the EU; and providing effective integration policies» [37].

After the stabilization of the migration situation, the governing bodies of the EU continued to consolidate efforts to integrate a common migration policy in all EU member states. Among the main priorities of the migration policy, it is possible to single out the following areas: ensuring the implementation of the provisions of the New Pact on Migration and Asylum in all EU member states; expanding the list of categories of persons who can receive the Blue Card; increasing multilevel dialogues with countries of origin of migration and countries of intermediate deployment; determination of the threshold value of the migration inflow, upon reaching which the resettlement of refugees should take place; the launch of the Talent Partnership program, which provides for the active attraction of talented youth from third countries; diverse, including financial support from

third world countries (donor countries) in order to reduce migration flows to the EU; monitoring the number of illegal labor migrants in the EU; expansion of channels for legal immigration to the EU; integration of migrants into the social environment of the EU countries.

● **Table 1.3** The main regulatory legal acts of the EU bodies on the regulation of migration processes in 2015–2020

No.	Name	Basic provisions
1	A European Agenda On Migration 2015–2020, COM (2015) 240 (13.05.2015)	Specifies the areas of management of migration processes (improving the asylum system, issuing visas, helping migrants to integrate into the societies of the EU countries, strengthening cooperation with global partners, identifying the reasons for migration, promoting forms of legal migration)
2	Regulation (EU) 2019/1240 of the European Parliament and of the Council of 20 June 2019 on the creation of a European network of immigration liaison officers	The program provides for joint mechanisms for countering illegal migration for all EU member states (identifying the main reasons for illegal and forced movement in third countries, combating smugglers and traffickers; unifying the return procedure)
3	New Pact on Migration and Asylum, COM (2020) 609 (23.09.2020)	Regulates the mechanism for better coordination and optimization of the use of the network of liaison officers deployed in third countries by the competent authorities of the member states in order to more effectively combat illegal immigration, cross-border crime (smuggling of migrants, human trafficking)
4	Action plan on Integration and Inclusion 2021–2027, SWD (2020) 290 (24.11.2020)	Provides for the establishment of a link between the key processes of regulating migration flows, in particular, asylum (integration) and return. Includes the following activities: relocation (return) of newly arrived persons; creation of the Eurodac system for migrants; development of a strategy for the return and reintegration of migrants in countries of origin of migration; creation of the EU Asylum Monitoring Agency

Source: compiled by the authors based on these sources [*37–40*]

Another example of a managerial decision at the macro level is the implementation of the migration policy of Ukraine in the European migration policy. After the conclusion of the Association Agreement between Ukraine and the EU, as well as the EU liberalization of the visa regime for citizens of Ukraine in 2017, the adoption of the Law of Ukraine «On Amendments to the Constitution of Ukraine (regarding the strategic course of the state to acquire full membership of Ukraine in the European Union and the North Atlantic Agreement)» in 2019, the issue of the implementation of the migration policy of Ukraine in the European migration policy has become strategically important.

In 2017, the Strategy of the State Migration Policy of Ukraine for the period up to 2025 (Strategy) was adopted as a managerial decision on migration policy in Ukraine. Despite the huge number of innovations, the Strategy contains a number of disadvantages. Its implementation is planned in 2 large stages, but there is no clear distinction between primary, intermediate and secondary tasks.

Let's consider the process of implementation of the migration policy of Ukraine in the European migration policy in accordance with the general mechanism for making managerial decisions.

Stage 1. Initiation of the need to make a decision in response to changes in the environment.

The initiation of the need to make a managerial decision on the implementation of the migration policy of Ukraine in the European migration policy was caused by such factors as: the proclamation of a nationwide course towards the integration of Ukraine into the EU; an increase in the number of Ukrainian labor migrants to the EU countries (in 2017 – 580.1 thousand people; in 2018 – 535 thousand people; in 2019 – 659.6 thousand people) [41].

Stage 2. Determination of an objective managerial decision and means of achieving it.

The implementation of the migration policy of Ukraine in the European migration policy should be implemented at several levels. At the legislative level, the Verkhovna Rada of Ukraine should initiate the adoption of a set of normative legal acts that have harmonized the current legislation of Ukraine in accordance with the requirements of the EU. The Cabinet of Ministers of Ukraine and the State Migration Service of Ukraine should develop programs for the implementation of the adopted regulatory legal acts on migration policy.

Stage 3. Documenting the managerial decision.

The adoption of a managerial decision on the implementation of the migration policy of Ukraine in the European migration policy should be reflected in a set of normative legal acts called «Migration Policy of Ukraine» and in the normative legal act «Action Plan for the Implementation of the Migration Policy of Ukraine with EU Requirements». In addition, the foundations for the implementation of the migration policy of Ukraine in the European migration policy are laid down in Article 16 «Cooperation in the field of migration, asylum and border management» of the Association Agreement between Ukraine and the EU. In particular, this article states that «the parties confirm the importance of joint management of migration flows between their territories and further develop a comprehensive dialogue on all issues in the field of migration, in particular illegal migration, legal migration, illegal transfer of persons across the state border and human trafficking, as well as the inclusion of problematic issues in the field of migration… the joint introduction of effective and preventive policies to combat illegal migration, illegal smuggling of illegal migrants across the state border and human trafficking» [42].

Stage 4. Implementation of selection and analysis of information, which is the basis for decision-making.

The information basis for making a managerial decision on the implementation of the migration policy of Ukraine in the European migration policy is the official statistics of the European Statistical Office, the State Statistics Service of Ukraine, the State Border Service of Ukraine, as well as analytical centers on migration, integration and reintegration of immigrants, refugees and migrants.

Stage 5. Determination of alternative options for managerial decisions.

The formation of the migration policy of Ukraine can be implemented in several ways:

1. Implementation of the migration policy of Ukraine in the European migration policy with the subsequent formation of Ukraine as an EU member state.

2. Implementation of the migration policy of Ukraine in the European migration policy with the subsequent formation of Ukraine as a partner country of the EU.

3. Development of Ukrainian migration policy only in accordance with the current problems of Ukraine.

Despite the proclaimed and legislatively enshrined the European integration direction of Ukraine, the Ukrainian migration policy should be implemented to the European migration policy with the subsequent formation of Ukraine as an EU member state.

Stage 6. Adoption of a single managerial decision.

The adoption of a managerial decision on the implementation of the migration policy of Ukraine in the European migration policy must be legislatively adopted and enshrined by the Verkhovna Rada of Ukraine.

Stage 7. Preparation for the implementation of a managerial decision.

General preparation for the implementation of a managerial decision on the implementation of the migration policy of Ukraine in the European migration policy should be provided by the executive authorities (profile committees of the Cabinet of Ministers of Ukraine; State Migration Service of Ukraine; State Border Guard Service of Ukraine).

The implementation of the migration policy of Ukraine in the European migration policy should be carried out in the following areas:

1. Strengthening cooperation between the State Migration Service of Ukraine, the Ministry of Social Policy of Ukraine; State Labor Service of Ukraine; The State Border Guard Service of Ukraine and the European Agency for the Protection of the External Borders of the Member States of the European Union; The Asylum Agency; The European Labor Office with the aim of implementing multi-level management of migration flows, developing a common mechanism for the exchange of information.

2. Implementation of joint patrols of the land and sea borders of Ukraine by the State Border Guard Service of Ukraine and the European Agency for the Protection of the External Borders of the Member States of the European Union. The implementation of this direction will reduce the number of cases of illegal crossing of the borders of Ukraine and the EU; prevent the formation of a new migration corridor in the EU.

3. High-quality renovation and deployment of temporary accommodation centers for refugees in Ukraine. As of the beginning of 2021, three points of temporary accommodation of refugees in Ukraine were officially operating in Ukraine: in the Zakarpattia region (designed for 120 people); in the Odesa region (designed for 200 people) and Kyiv region (designed for 101 people). However, the integration of Ukraine into the EU, the large length of Ukraine's borders with non-EU states, as well as the presence of uncontrolled sections of the state border in the east of Ukraine create a number of prerequisites for an increase in the number of refugees and illegal migrants. At the same time, the number of temporary accommodation centers for refugees in Ukraine is insufficient and requires a qualitative expansion in all border regions.

Stage 9. Formation of conclusions and determination of the consequences of the implementation of a managerial decision.

The implementation of the migration policy of Ukraine in the European migration policy will contribute to:

1) implementation of an effective policy to combat illegal migration and flows of illegal migrants;

2) strengthening cooperation in the field of border management and the implementation of joint security;

3) counteraction to illegal employment of migrants;

4) gaining experience in consolidated cooperation between executive bodies in the field of migration;

5) unification of Ukrainian normative legal acts of EU normative legal acts;

6) reducing the «migration burden» on the EU borders.

Thus, the main directions of the EU migration policy as a managerial decision at the macro and mega levels are the fight against illegal migration, the regulation of the procedure for the legalization of refugees who have entered the territory of the EU member states, ensuring effective control over the borders of the EU member states, strengthening cooperation with the countries of origin of migration flows and countries of intermediate deployment. The main threat to Ukraine is the growth in the number of labor emigrants. The migration policy of Ukraine in the context of the implementation of the European migration policy should combine not only a set of measures to reduce labor emigration from Ukraine, but also measures of the EU migration policy.

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2 QUANTITATIVE CRISIS ANALYSIS: IDENTIFYING AND DEFINING IMBALANCES

O. Nieizviestna, N. Ivanova, V. Koverza, V. Kotkovskyi, Ye. Tryhubchenko

ABSTRACT

Dedicated to the study of the possibility of using quantitative analysis tools to determine macroeconomic imbalances as potential harbingers of the spread of the crisis. It is noted that in modern conditions of a rapid course of crisis situations, it is advisable to use nonlinear models, an example of which is nonparametric models based on the signaling approach, providing for the use of macroindicators (indicators) characterizing the economy's resistance to crises. To predict the emergence of negative trends in the development of the economy in the future, the authors developed and proposed for use a regression model with performance indicators, which reflects the dependence of the probability of the onset of the period of «crisis» on a number of economic indicators and carried out its approbation for the Ukrainian economy. Forecasting results for 2021–2022 made it possible to determine the deviations of the Ukrainian economy from the trajectory of sustainable development. The authors indicated the corrective measures of economic policy on the part of the macroeconomic regulation authorities in order to suspend the inertial development of the forecast situation.

KEYWORDS

Crisis, crisis phenomena, symptoms of crisis phenomena, causes of crisis phenomena, factors of crisis phenomena, channels of transmission of crisis phenomena, macroeconomic imbalances, indicator for determining macroeconomic imbalances, signal approach, regression model.

2.1 ESSENTIAL CHARACTERISTICS OF CRISIS PHENOMENA AND CHANNELS OF THEIR DISTRIBUTION

The emergence of the modern world economy inevitably leads to an increase in crisis trends. The magnitude of these trends can vary. Macrolevels are characterized by large volumes of problems that cover the socio-economic system as a whole. Microcrisis captures only a single problem or a group of problems. The crisis is seen as one of the phases of the economic development cycle, it is inevitable, but it performs a progressive function of replacing non-viable elements with more efficient ones. That is why, even if sustainable development is achieved, cyclical-crisis development will not disappear.

However, we can say that the timely identification of pre-crisis factors and the formation of an effective measure of instruments will reduce the negative consequences of crises. In this aspect, it is very important to know the signs (symptoms) of the onset of crisis situations, to anticipate

their occurrence, to prevent their occurrence, and, provided that the crisis is already unfolding, to assess the possibilities of its solution.

We agree with the opinion [1] that «symptoms are the first, external manifestation of crisis phenomena, not always characterizing the true causes of the crisis, but on the basis of which some reasons can be established. Causes are phenomena or events that result in the symptoms and factors of the crisis. The factors are events, or tendencies have been established that indicate the emergence of a crisis». **Table 2.1** shows the classification of factors that determine the emergence and development of crisis phenomena.

● **Table 2.1** Classification of factors that determine the emergence and development of crisis phenomena

Classification feature	Elements of the classification feature
Depending on the residence	Internal
	External
Depending on the action in time	Permanent
	Temporary
Depending on the scale of the crisis aggravation	Local
	Global
Depending on the degree of interconnectedness of factors	Independent
	Derivatives
Depending on the degree of influence on the development of crisis phenomena	Main
	Minor
Depending on the area of origin	Economic
	Social
	Ecological
	Political
	Technological
	Structural
Depending on the recognition capabilities	Explicit
	Hidden
Depending on the level of occurrence	Microlevel
	Macrolevel
	State
	Interstate

Source: developed on the basis of data [2–4]

The question of determining the distribution channels of crisis phenomena remains relevant. Modern scientific thought identifies two concepts that reveal the essence of the spread of eco-

nomic crises. According to the first, the spread of the crisis between countries is based on fundamental macroeconomic characteristics [5–8], and the second – the crisis is a consequence of globalization, financial integration, externalities, changes in the behavior of investors or other financial agents [9–12]. Analysis of certain concepts allows to identify the following channels of transmission of crisis phenomena (**Fig. 2.1**).

It is possible to study the nature and causes of the emergence of crisis phenomena, check the operation of certain channels of the spread of the crisis and obtain a mechanism for preventing the crisis using a model test.
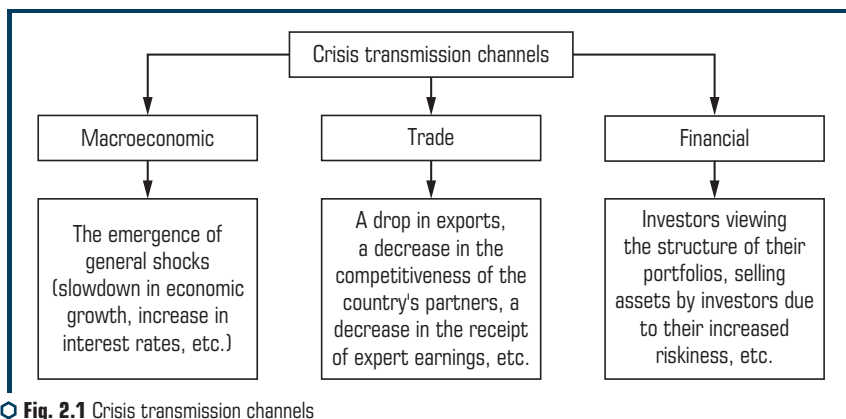
○ **Fig. 2.1** Crisis transmission channels
Source: developed on the basis of data [13–15]

2.2 JUSTIFICATION OF THE ADVISABILITY OF USING NONPARAMETRIC MODELS BASED ON THE SIGNALING APPROACH TO IDENTIFY AND DETERMINE IMBALANCES

The problem of identifying crisis phenomena in the economies of the countries of the world at the moment remains unresolved both in practical and theoretical aspects. There is an opinion widespread in the scientific literature that global imbalances are a prerequisite and cause of crisis phenomena in the world economy [9–12]. And this is natural, because the categories «equilibrium», «imbalances» and «crisis» are inextricably linked in the context of the dualistic nature of cyclical development. Macroeconomic imbalances that can lead to negative social and economic phenomena, it is necessary to identify in time and develop measures to neutralize the negative impact in order to mitigate possible crisis phenomena and their consequences.

The cornerstone of any science, the criterion of the truth of its provisions is the ability to predict with a certain level of reliability the course of future events, taking into account the variety of influencing factors that affect these events. It becomes obvious that the usual linear extrapolation of the past to future events is erroneous, since it can focus on the wrong strategy and erroneous

decisions. Modern conditions of the rapid course of crisis situations require the use of nonlinear models, an example of which is nonparametric models based on the signaling approach. The main advantage of the signaling approach is the assessment of the predictive strength of each indicator individually, which makes it possible to rank the variables. In this case, it is important to determine a set of input variables that are hypersensitive to abrupt changes, and indicative limits of fluctuations of macro indicators (indicators) that characterize the economy's resistance to such changes. With this approach, various numerical characteristics are developed, which make it possible to identify in advance the vulnerability of the economy to the crisis. Within the framework of this approach, two main directions can be distinguished: the construction of the limiting values of indicators – harbingers of the crisis on the basis of various criteria, as well as the development of consolidated indices of financial stability [16, 17]. We share the opinion that the mechanism for describing such models should be intuitive and have a clear economic interpretation to ensure that the results obtained can be used by decision-makers. Also, when choosing mathematical tools, one must take into account the limited amount of data suitable for calculations. This is due to the heterogeneity of statistical information in the context of the countries of the world (differences in units of measurement, calculation methods, etc.) [18].

The world practice of studying crisis phenomena and the mechanism of their prevention testifies to the absence of a generally accepted list of the main macroeconomic indicators that would be used in the monitoring system of crisis recognition. In this regard, it becomes necessary to search for the existing positive practice of constructing early warning indicators in order to assess the feasibility of using it for making managerial decisions. An example of such an effective practice can be considered the European mechanism for the timely recognition of serious imbalances – the Macroeconomic Imbalance Procedure (MIP) (procedure (order) for determining macroeconomic imbalances) [19–21]. The procedure defines a mechanism for identifying potential risks at an early stage and monitoring (monitoring) to prevent the appearance of negative macroeconomic imbalances and to correct the already existing distortions.

MIP as a block of economic management has three components [19]:

1) a warning mechanism that facilitates early detection and monitoring of imbalances based on qualitative economic analysis and financial assessments;

2) a table of indicators indicating a set of indicators and threshold values used at the initial stage of identifying external and internal imbalances and which are differentiated for the countries of the Eurozone and countries outside it;

3) a thorough review, which implies determining the status of a potential imbalance – regulated at an early stage or problematic.

Let's dwell in more detail on financial indicators for revealing macroeconomic imbalances in European practice. The indicators that were selected for the Scoreboard (tables/dashboards) were grouped according to four principles:

1) the selected indicators determine the most important aspects of macroeconomic imbalances and loss of competitiveness, which may pose a threat to the normal functioning of the euro;

2) indicators and thresholds on the panel are chosen so as to provide reliable signals about potential imbalances and losses of competitiveness already at an early stage of their occurrence;

3) as we have already noted, the selected indicators should be intuitive and have a clear economic interpretation to ensure that the results obtained can be used by decision-makers. Therefore, the number of such indicators is limited, their choice and the table plays an important role in communication. For this purpose, the table includes a limited number of indicators, their selection and transformation should be of minimal complexity, easily interpreted by third parties, and statistical data for their calculation should be available;

4) to calculate the indicators, high quality statistical data should be used and be comparable for different countries [19, 20].

Thus, the MIP Scoreboard panels/tables provide indicators reflecting external imbalances, internal imbalances and competitiveness positions (**Table 2.2**).

● **Table 2.2** Indicators for determining macroeconomic imbalances and formulas for their calculation

Indicators	Data transformation formulas	Threshold limits of indicator changes
Net international investment position, as % of GDP	$\dfrac{NIIP_t}{GDP_t} \times 100$	−35 %
Private sector credit flow, annual increase as % of GDP	$\dfrac{PSCF_t - PSCF_{t-1}}{GDP_t} \times 100$	+14 %
Private sector debt, as % of GDP	$\dfrac{PSD_t}{GDP_t} \times 100$	133 %
Gross external debt, as % of GDP	$\dfrac{GED_t}{GDP_t} \times 100$	60 %
Total financial sector liabilities, non-consolidated, % year-on-year change	$\dfrac{FSL_t}{FSL_{t-1}} \times 100 - 100$	16.5 %

Source: based on data from [*19*]

The selected indicators and the procedure for their calculation are capable of reflecting both a short-term rapid deterioration of the situation and a gradual accumulation of imbalances in the long term [20]. The Procedure (order) for determining macroeconomic imbalances (MIP Scoreboard) describes the procedure for assessing imbalances and determines that these indicators do not serve political purposes and are not political instruments, they need to be taken on their own, but additional information should be taken into account in order to draw broad conclusions. The threshold limits indicated in **Table 2.2** are obtained on the basis of research by European experts and are not very strict in order to avoid a large number of false alarms.

2.3 RESULTS OF USING NONPARAMETRIC MODELS BASED ON THE SIGNALING APPROACH TO DETERMINE MACROECONOMIC IMBALANCES

Tables 2.3–2.7 present the indicators of these indicators in order to determine the macroeconomic imbalances of Ukraine, Poland and Germany (calculations were carried out on the basis of official data from the NBU, the World Bank, and the statistical office of the European Union (Eurostat)). The data in **Table 2.3** give an idea of the external imbalances of countries.

● **Table 2.3** Indicator of net international investment position for Ukraine, Poland and Germany, % of GDP

Years	Threshold	Net international investment position, % of GDP		
		Ukraine	Poland	Germany
2006		−17.8	−10.0	15.4
2007		−18.0	−13.0	21.1
2008		−21.4	−20.9	15.4
2009		−28.8	−22.4	21.0
2010		−24.8	−24.5	20.9
2011		−24.7	−25.6	15.5
2012		−28.0	−26.5	22.1
2013	−35 %	−35.1	−27.2	29.5
2014		−37.6	−26.4	31.7
2015		−36.1	−26.0	34.5
2016		−29.1	−22.9	37.9
2017		−24.1	−20.7	43.0
2018		−16.8	−16.8	45.7
2019		−18.0	−12.5	51.1
2020		−13.6	−5.5	53.4

Source: developed on the basis of data [22–24]

Ukraine and Poland show the same trends in the dynamics of the indicator of net international investment position. A negative indicator of the indicator indicates that both countries are active net borrowers and that their national economies are open to capital flows. However, during the analyzed period, Poland never exceeded the threshold value of the given indicator, while in Ukraine it went beyond the limit borders three times (during 2013–2015). In **Table 2.3**, the values of the indicators that have exceeded the corresponding threshold values are highlighted by shading. 2014 became especially indicative for Ukraine, because it was during this period that the annexation of the Autonomous Republic of Crimea took place, an armed confrontation began in eastern Ukraine, political uncertainty took place, which caused a macroeconomic shock. In addition, foreign

investment in Ukraine is mostly carried out according to the model of underdeveloped countries. Ukraine is a place of struggle for the sale of products, and Poland is considered a place of capital investment with the aim of establishing production or with the aim of effectively integrating into the world division of labor. As a result, we can speak of a greater likelihood of macroeconomic imbalances occurring in Ukraine than in Poland, although the countries have significantly improved the indicator indicators since 2016 compared to the beginning of the analyzed period. In addition, the forecast of the indicator for 2021 based on linear and polynomial trends in Ukraine does not show its crossing of the limit value line of −35 % (**Fig. 2.2**). The positive value of the indicator of net international investment position in Germany indicates the absence of manifestations of external economic imbalances for the analyzed period. The country is an active net creditor and is gradually improving the value of the indicator.
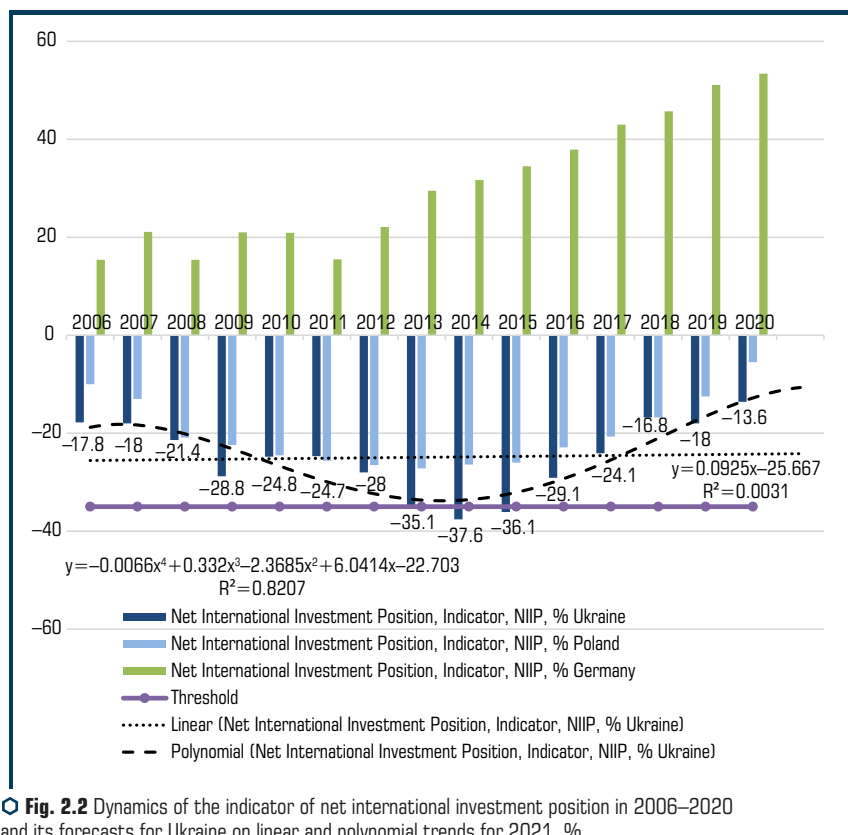
○ **Fig. 2.2** Dynamics of the indicator of net international investment position in 2006–2020 and its forecasts for Ukraine on linear and polynomial trends for 2021, %
Source: developed by the authors

Internal imbalances, according to the results shown in **Table 2.1**, are signaled by such an indicator as the indicator of lending to the private sector of the economy (**Table 2.4**).

Ukraine during the analyzed period cyclically demonstrates a significant excess of the threshold value of the indicator of lending to the private sector of the economy.

● **Table 2.4** Indicator of lending to the private sector of the economy for Ukraine, Poland and Germany, annual growth in % of GDP

Years	Threshold	Lending to the private sector of the economy, % of GDP		
		Ukraine	**Poland**	**Germany**
2006		90.1	10.1	0.9
2007		119.9	12.0	3.6
2008		161.2	12.1	3.0
2009		−17.0	3.9	1.8
2010		5.0	3.6	3.1
2011		39.1	7.1	4.8
2012		8.9	3.4	6.1
2013	+14 %	48.5	3.0	2.8
2014		78.4	2.9	−1.4
2015		−30.2	3.2	3.0
2016		24.6	4.7	3.8
2017		16.5	2.7	4.9
2018		27.3	3.4	6.6
2019		30.0	3.3	3.8
2020		29.4	3.5	4.0

Source: developed on the basis of data [25, 26]

In **Table 2.4**, the values of the indicators that have exceeded the corresponding threshold values are highlighted by shading. So, in 2006–2008, there is a phase of credit expansion and a phase of excessive credit expansion. During these periods, real estate prices are growing rapidly, the level of credit depth is increasing, indicating the transition of the private sector of the economy to unsecured financing. The level of overdue debts is also significantly increasing. In 2008, the credit cycle reaches a phase of «overheating», when it reaches its highest point of development and a rapid decline in lending volumes begins. The phase of the credit crunch begins. At the same time, there is an increase in the level of overdue debts and most loans are issued for the restructuring of existing debts (in 2009). As a rule, the phase of credit contraction in the private sector occurs against the

background of a shortage of working capital among enterprises in the real sector of the economy, which is not covered by bank lending, and a crisis in the financial sector can provoke a crisis in the sector of the real economy. Since 2010, a phase of stagnation begins, followed by a gradual recovery. According to **Table 2.4**, we can say that in 2020 Ukraine on lending to the private sector will again gradually enter the phase of «overheating», which is a signal of the emergence of crisis phenomena and the possibility of a financial crisis. The polynomial forecast for 2021 confirms the cyclical nature of the indicator of lending to the private sector of the economy and entering the «overheating» phase. The linear forecast indicates a drop in the values of the indicator of lending to the private sector of the economy in 2021 to almost a negative level (**Fig. 2.3**). Credit cycles in Poland and Germany are smoother and do not pose a threat of imbalances in the financial sector.
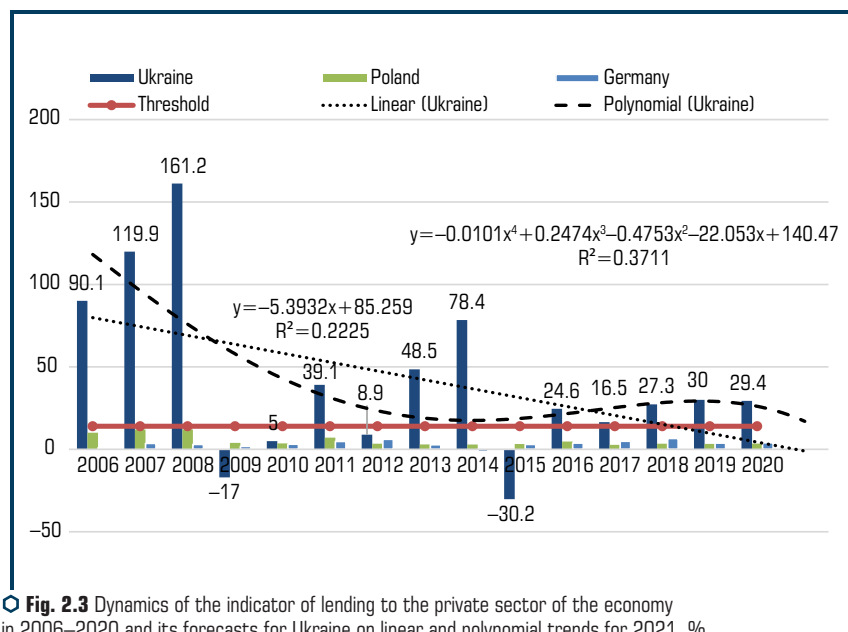
Fig. 2.3 Dynamics of the indicator of lending to the private sector of the economy in 2006–2020 and its forecasts for Ukraine on linear and polynomial trends for 2021, %
Source: developed by the authors

One of the indicators characterizing internal imbalances in the country is the indicator of gross external debt, which is primarily an indicator of the public sector's solvency (**Table 2.5**).

Most of the developed countries of the world have the largest government borrowings. The leaders among the world's debtors are Japan and the United States, and this is positive evidence that the presence of public debt is a useful stimulating factor in the period of economic growth, if it is aimed at investment purposes, and not covering budget deficits. However, ineffective gov-

ernment borrowing management poses a threat to the economic security of the state. The data in **Table 2.5** indicate that since 2009 Ukraine has exceeded the threshold value of the indicator of gross external debt (shaded values indicate the values of indicators that have exceeded the corresponding threshold values). At the same time, Germany has the opposite trend in the dynamics of this indicator and since 2006 has been bringing its value closer to the threshold value. In order to assess the justification for the growth of external debt, it is advisable to study the dynamics of the GDP of each country, which is presented in our study (**Table 2.6**).

● **Table 2.5** Indicator of gross external debt for Ukraine, Poland and Germany, % of GDP

Years	Threshold	Gross external debt, % of GDP		
		Ukraine	Poland	Germany
2006		50.6	47.3	66.9
2007		56.0	44.5	64.2
2008		56.5	46.7	65.7
2009		88.2	49.8	73.2
2010		86.0	53.5	82.5
2011		77.4	54.7	79.7
2012		76.8	54.4	81.2
2013	60 %	77.8	56.5	78.8
2014		95.8	51.1	75.7
2015		131.0	51.3	72.3
2016		121.7	54.2	69.3
2017		103.9	50.6	65.1
2018		87.7	48.8	61.8
2019		79.2	59.7	59.7
2020		80.8	69.8	57.5

Source: developed on the basis of data [*27, 28*]

As the data in **Table 2.6** show, Germany directed the increase in gross public debt specifically for investing in economic growth, as evidenced by the growing values of the country's GDP. As for Ukraine, we can assess the level of government of Ukraine's management of public debt as threatening the country's debt security, since it does not lead to sustainable growth in GDP. So, in 2020, the gross external debt of Ukraine increased by 3.2 % compared to 2019, while GDP grew by only 1.2 % [29, 30]. Describing the dynamics of the gross external debt indicator, it should be noted that the forecast for both the linear and the polynomial trend line indicates its further growth in 2021 for Ukraine (**Fig. 2.4**).

● **Table 2.6** The value of the gross domestic product of Ukraine, Poland and Germany for 2006–2020, million USD

Years	GDP, million USD		
	Ukraine	Poland	Germany
2006	107,753	344,622	3,328,000
2007	142,719	429,029	3,427,000
2008	179,992	533,609	3,460,000
2009	117,228	439,738	3,260,000
2010	136,419	479,834	3,400,000
2011	163,160	528,301	3,749,315
2012	175,781	498,524	3,527,143
2013	183,310	521,016	3,733,805
2014	133,503	572,477	3,889,093
2015	91,031	477,812	3,357,586
2016	93,356	472,630	3,469,853
2017	112,190	526,509	3,682,602
2018	130,832	587,409	3,963,767
2019	153,781	595,862	3,861,124
2020	155,582	594,165	3,806,060

Source: developed on the basis of data [*29, 31*]

The chart shows trend equations:
$y = 0.0065x^5 - 0.2699x^4 + 3.9824x^3 - 25.543x^2 + 73.863x - 7.9378$, $R^2 = 0.7382$
$y = 2.8668x + 61.692$, $R^2 = 0.3279$
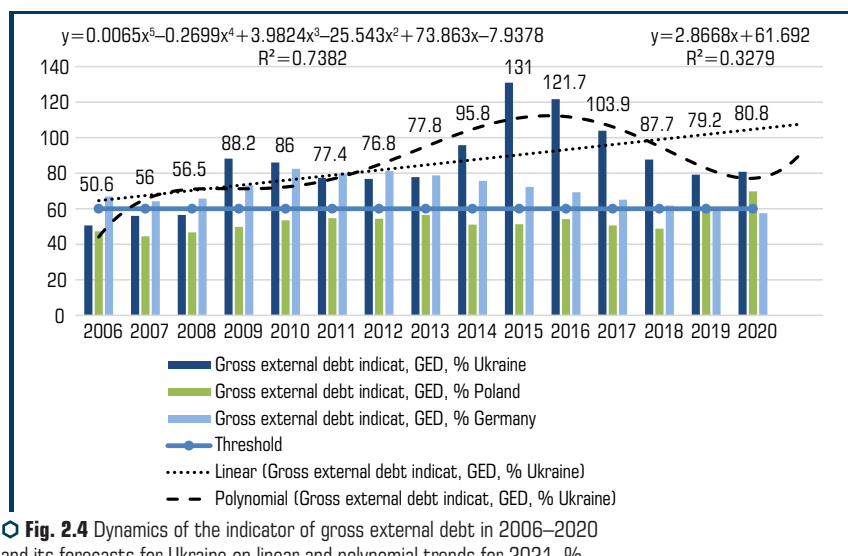
○ **Fig. 2.4** Dynamics of the indicator of gross external debt in 2006–2020 and its forecasts for Ukraine on linear and polynomial trends for 2021, %
Source: developed by the authors

The next indicator characterizing internal imbalances in the country is the indicator of total liabilities of the financial corporations sector (**Table 2.7**).

As for Ukraine, in the estimated time period 2006–2020, the indicator value only once, in 2015, exceeded the threshold value of 16.5 %, for Poland the indicator value was above the threshold only in 2006–2007. In **Table 2.7** shading is the indicator values, which are highlighted that have exceeded the corresponding thresholds. In terms of future risks of instability, greater emphasis should be placed not on the rate of change in liabilities, but on the presence of imbalances in the structure of the financial corporations sector. As of 01.01.2021 in Ukraine, depository corporations own 53.97 % of assets and 60.32 % of liabilities. Consequently, the fate of the second financial corporations is practically equal to the share of depository institutions. This testifies to the development of the financial sector in Ukraine as a whole, but emphasizes the role of deposit corporations in ensuring financial stability and economic growth.

The absence of imbalances in Ukraine and a decrease in the values of the indicator of total liabilities of the financial corporations sector in the future is also shown by the forecast along the linear and polynomial trend lines (**Fig. 2.5**).

● **Table 2.7** Indicator of total liabilities of the financial corporations sector for Ukraine, Poland and Germany, change over the year, %

Years	Threshold	Total liabilities of the financial corporations sector, change for the year, %		
		Ukraine	Poland	Germany
2006		7.9	24.3	4.8
2007		7.3	18.9	5.9
2008		5.9	7.1	1.9
2009		2.8	9.6	−1.1
2010		11.4	13.3	0.1
2011		10.5	4.4	2.1
2012		4.3	9.6	4.4
2013	16.5 %	13.6	8.0	5.0
2014		11.0	7.6	−0.1
2015		17.7	2.4	2.8
2016		10.2	8.9	5.2
2017		2.7	6.3	4.0
2018		3.8	3.0	2.0
2019		1.69	4.2	7.3
2020		2.67	4.3	13.1

Source: developed on the basis of data [*30, 32, 33*]
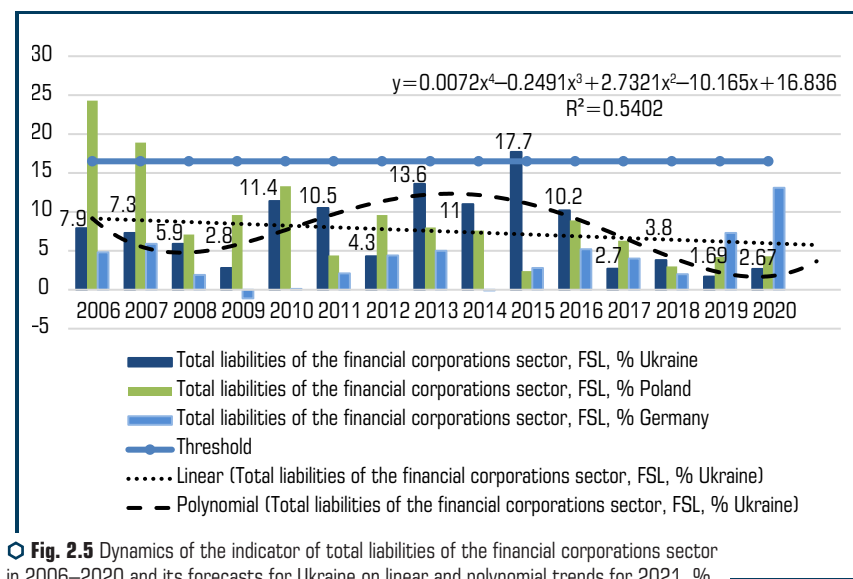
Fig. 2.5 Dynamics of the indicator of total liabilities of the financial corporations sector in 2006–2020 and its forecasts for Ukraine on linear and polynomial trends for 2021, %
Source: developed by the authors

The private sector debt indicator characterizes the domestic and foreign debt liabilities of the non-financial corporations sector, the household sector and the non-profit organizations sector serving the household sector.

According to **Table 2.8**, it can be concluded that during the periods under consideration, the value of this indicator for Ukraine and Poland does not cause concern, but for Germany from 2006 to 2014 it significantly exceeded the threshold value (shaded values indicate the values of indicators that exceeded the corresponding threshold values). It was during these periods in Germany that the highest values of the indicator of gross external debt were observed. We can draw conclusions about the high level of investment in the growth of the economy of this country during 2006–2014. As for Ukraine, according to the forecast of the polynomial trend, the private sector debt will increase, which is demonstrated by the value of R^2. This testifies to the ability of the household sector to act as a source of investment in the economy (**Fig. 2.6**).

In general, during 2006–2021 in Ukraine, over the span of three years (2013–2015), simultaneously, three out of five indicators assessing macroeconomic imbalances indicated the presence of crisis phenomena (**Tables 2.3–2.5, 2.7**). This situation can be regarded as a period of «crisis», especially considering the fact that the dynamics of GDP during this period (**Table 2.6**) had a negative character. In other years, there were also signals of imbalances, but a more thorough assessment of crisis exacerbations can only be given by taking into consideration all the indicators of the MIP Scoreboard panel/table.

● **Table 2.8** Indicator of debt of the private sector of the economy for Ukraine, Poland and Germany, %

Years	Threshold	Debt of the private sector of the economy, % of GDP		
		Ukraine	**Poland**	**Germany**
2006		96.5	52.3	215.0
2007		101.8	58.6	224.1
2008		105.2	72.0	237.4
2009		122.9	72.0	250.5
2010		111.3	74.2	244.0
2011		104.5	79.5	237.6
2012		106.6	76.7	239.0
2013	133 %	112.5	75.0	235.1
2014		123.9	74.9	222.6
2015		121.6	79.0	98.9
2016		110.6	81.6	99.3
2017		92.6	76.4	100.1
2018		43.7	76.1	102.4
2019		44.8	74.0	105.4
2020		45.9	72.0	100.4

Source: developed on the basis of data [34–36]
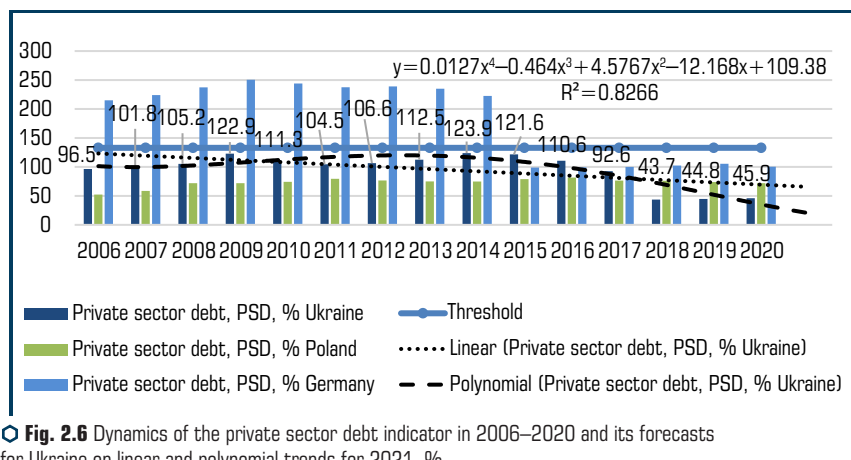
○ **Fig. 2.6** Dynamics of the private sector debt indicator in 2006–2020 and its forecasts for Ukraine on linear and polynomial trends for 2021, %
Source: developed by the authors

2.4 JUSTIFICATION OF THE ALGORITHM AND THE RESULTS OF USING A REGRESSION MODEL WITH PERFORMANCE INDICATORS TO PREDICT THE EMERGENCE OF NEGATIVE TRENDS IN THE DEVELOPMENT OF THE ECONOMY IN THE FUTURE ON THE EXAMPLE OF UKRAINE

To predict the emergence of negative trends in the development of the Ukrainian economy in the future, a regression model with performance indicators can be used, reflecting the dependence of the probability of the onset of the «crisis» period on a number of economic indicators. This theoretical model can be written in the form of formula (2.1):

$$Y_t = C_0 + C_1 NIIP_t + C_2 PSCF_t + C_3 GED_t + C_4 PSD_t + C_5 FSL_t. \tag{2.1}$$

The authors propose to determine the dependent variable Yt on the basis of the real effective exchange rate (REER) — the calculated exchange rate, which is an indicator of changes in the price competitiveness of domestic goods in relation to the products of the country's main trading partners [37]. the exchange rate makes it possible to determine the price competitiveness of the country in relation to the countries — major trading partners, because it reflects not only the change in the exchange rate, but also takes into account inflation indicators. REER shows how overvalued or underestimated the national currency. Since Ukraine has a raw material export orientation, the underestimation of its national currency contributes to a decrease in the cost of raw materials on the international market, which poses a threat to the volume of foreign exchange inflows into the country. valuation of the national currency, the cost of imports is high, which contributes to the redistribution of the national income of Ukraine in favor of the countries-trade importers. As a result, the problem of finding funds to finance the negative balance of the current account is intensifying in the national economy, and the revenue side of the budget is shrinking. Therefore, according to the authors, ensuring the optimal dynamics of the REER should be the main guideline in the implementation of macroeconomic policy. The dynamics of the REER in Ukraine is shown in **Fig. 2.7**.

The data presented in **Fig. 2.7** allow to conclude that the dynamics of the REER during 2011–2020 are similar to the dynamics of the analyzed indices/signals of macroeconomic imbalances. It was in 2013–2015. There is a «compression» of the indicator, and as we have already noted, such reasons are not global financial and economic processes, but internal instability.

Let's calculate a certain regression model (2.1) for Ukraine using Microsoft Excel tools. The data for the calculations are presented in **Table 2.9** (the values of the indicators that have exceeded the corresponding threshold values are highlighted in shading).

The simulation results are as follows (2.2):

$$Y_t = 153.377 + 0.445x_1 - 0.157x_2 - 0.77x_3 + 0.168x_4 + 0.585x_5. \tag{2.2}$$

It is necessary to assess the reduced model (2.2) for the significance of the relationship between the reduced dependent and independent factors (**Table 2.10**).
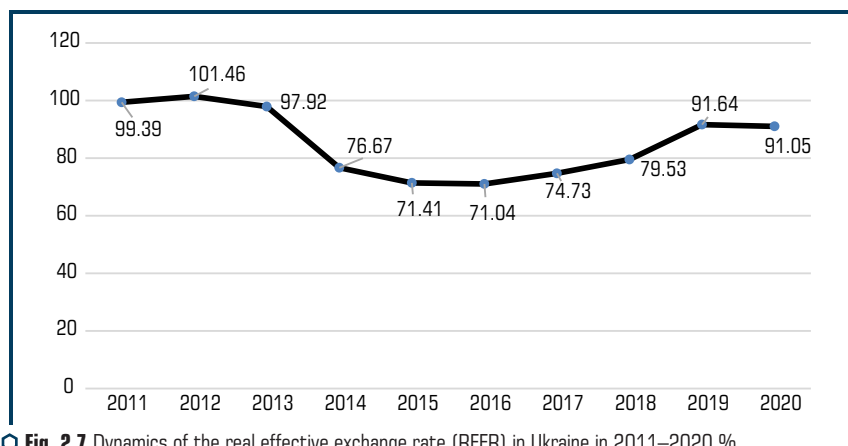
○ **Fig. 2.7** Dynamics of the real effective exchange rate (REER) in Ukraine in 2011–2020 %
Source: based on data from [38]

● **Table 2.9** Initial data for calculating the regression model with performance indicators, reflects the dependence of the probability of the onset of the «crisis» period for the Ukrainian economy on a number of economic indicators

Indicator	Net international investment position	Private sector loan	Gross external debt	Private sector debt	Total liabilities of the financial corporations sector	Real effective exchange rate
Presentation format	% of GDP	annual growth in % of GDP	% of GDP	% of GDP	% change from previous year	%
Legend	*NIIP*	*PSCF*	*GED*	*PSD*	*FSL*	*REER*
Threshold values	**−35**	**14**	**60**	**133**	**16.5**	**121.4005**
2011	−24.7	39.1	77.4	104.5	10.5	99.39
2012	−28	8.9	76.8	106.6	4.3	101.46
2013	−35.1	48.5	77.8	112.5	13.6	97.92
2014	−37.6	78.4	95.8	123.9	11	76.67
2015	−36.1	−30.2	131	121.6	17.7	71.41
2016	−29.1	24.6	121.7	110.6	10.2	71.04
2017	−24.1	16.5	103.9	92.6	2.7	74.73
2018	−16.8	27.3	87.7	43.7	3.8	79.53
2019	−18	30	79.2	44.8	1.69	91.64
2020	−13.6	29.4	80.8	45.9	2.67	91.05

Source: developed by the authors

● **Table 2.10** Assessment of the significance of the indicators of the developed regression model (2.2) with effective indicators, reflects the dependence of the probability of the onset of the «crisis» period for the Ukrainian economy on a number of economic indicators

Indicator	Value
Multiple regression coefficient R	0.979345871
Coefficient of determination R-squared	0.959118334
Normalized coefficient of determination R-square	0.908016252
Standard error	3.655754917
Number of observations	10

According to **Table 2.10**, it can be seen that the multiple determination coefficient is 0.959118334, therefore, the effective indicator depends on the factors by 95.9 %. The multiple correlation coefficient 0.979345871 indicates a strong (close) relationship between the indicators. Checking the relevance of the relationship by the F-criterion shows that $3.65754917 \leq 5$. So, the relationship between the indicators that are included in the multivariate regression model is significant (not random). Checking the model (2.2) according to actual data confirms the results of the assessment given in **Table 2.10** (**Fig. 2.8**).
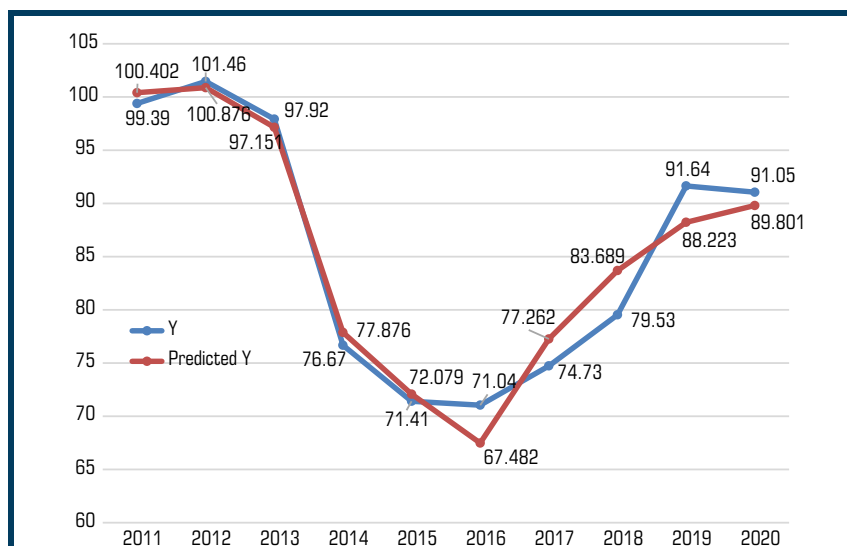
○ **Fig. 2.8** Assessment of the model of indicators of the developed regression model (3.2) with effective indicators reflects the dependence of the probability of the onset of a period of «crisis» for the Ukrainian economy on a number of economic indicators
Source: developed by the authors

The selected set of indicators for identifying macroeconomic imbalances provides a basis for building and forming a base of scenarios of possible economic behavior under the influence of external disturbances. In fact, the value of these indicators at the end of the period in the absence of other corrective actions (macroprudential government policies) determine the reaction and stability of the economy during the crisis. The authors carried out forecasting of macro-indicators that allow assessing the spread of crisis phenomena for the Ukrainian economy during the next two years after the analyzed period (**Table 2.11**).

The practical implementation of the economic and mathematical (regression) model with performance indicators reflects the dependence of the probability of the onset of the period of «crisis» for Ukraine on a number of economic indicators is shown in **Fig. 2.9**.

● **Table 2.11** Forecast data of the regression model with performance indicators reflects the dependence of the probability of the onset of the «crisis» period for the Ukrainian economy on a number of economic indicators for 2021–2022

Indicator	Net international investment position	Private sector loan	Gross external debt	Private sector debt	Total liabilities of the financial corporations sector	Real effective exchange rate
Presentation format	% of GDP	annual growth in % of GDP	% of GDP	% of GDP	% change from previous year	%
Legend	*NIIP*	*PSCF*	*GED*	*PSD*	*FSL*	*REER*
Threshold values	**−35**	**14**	**60**	**133**	**16,5**	**121.4005**
2011	−24.7	39.1	77.4	104.5	10.5	99.39
2012	−28	8.9	76.8	106.6	4.3	101.46
2013	−35.1	48.5	77.8	112.5	13.6	97.92
2014	−37.6	78.4	95.8	123.9	11	76.67
2015	−36.1	−30.2	131	121.6	17.7	71.41
2016	−29.1	24.6	121.7	110.6	10.2	71.04
2017	−24.1	16.5	103.9	92.6	2.7	74.73
2018	−16.8	27.3	87.7	43.7	3.8	79.53
2019	−18	30	79.2	44.8	1.69	91.64
2020	−13.6	29.4	80.8	45.9	2.67	91.05
2021	−9.73	17.38	74.35	18.09	5.16	95.13
2022	−10.02	0.12	118.09	6.28	11.13	65.53

Source: developed by the authors

Forecasting results for 2021–2022 (**Table 2.11**) make it possible to determine the deviations of the Ukrainian economy from the sustainable development trajectory in 2021, as evidenced by the values of the indicators of gross external debt and lending to the private sector of the economy, which deviate from the threshold values (the values of the indicators that have exceeded the corresponding threshold values are highlighted in shading). According to forecasts in 2021, Ukraine will improve the indicator of its net international investment position, but its value will still take a negative value, which means that it will maintain its position as an active net borrower and a consistently high amount of external debt required to equalize the balance of payments. This situation will continue to put pressure on the national currency, causing assessment processes and increasing the private sector's need for additional resources, while reducing the private sector's ability to act as a source of investment in the economy, including through financial intermediaries (financial corporations).
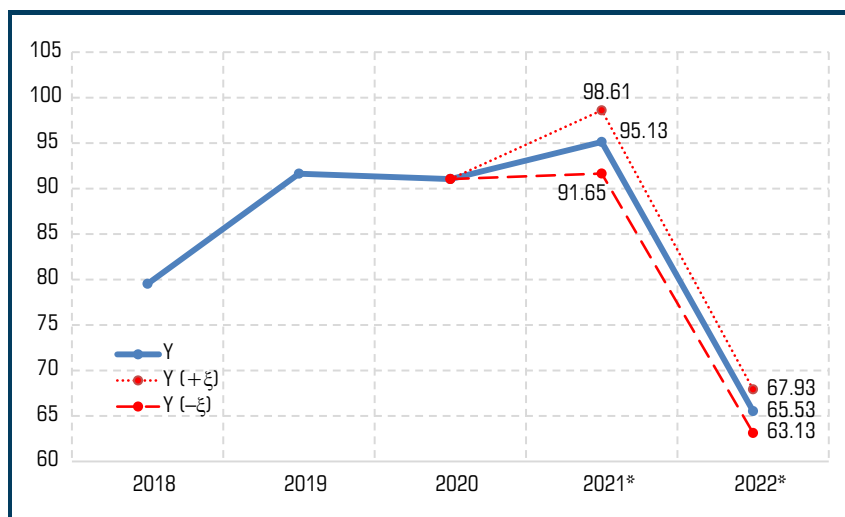
○ **Fig. 2.9** Practical implementation of the developed regression model (2) with effective indicators reflects the dependence of the probability of the onset of a period of «crisis» for the Ukrainian economy on a number of economic indicators
Source: developed by the authors

The combination of these factors allows the authors to predict the REER at the level of 95.13 %. Strengthening REER in 2021 compared to 2020 worsens the conditions of foreign trade for domestic exporters, mainly due to a decrease in the competitiveness of their goods in foreign markets, and at the same time improves them for importers. As a result, this situation causes an excess of demand for foreign currency over its supply in the domestic foreign exchange market,

again intensifies the assessment of the national currency and will force the National Bank of Ukraine to intervene in the foreign exchange market and look for sources of funds to replenish gold and foreign exchange reserves (again, this is for account of external borrowings). As a result, the forecast for 2022 provides for an increase in the volume of external debt, an increase in the negative value of the net investment position, a reduction in the possibilities of the private sector of the economy, and a strengthening of the REER against the background of the assessment of the hryvnia.

However, the inertial development of the forecast situation can be suspended by corrective measures of economic policy on the part of the macroeconomic regulation bodies, namely:

1) curtailing anti-crisis measures introduced as a result of the COVID-19 pandemic (curtailing such anti-crisis monetary instruments as long-term refinancing and interest rate swap with the NBU);

2) increase in the discount rate, since the real discount rate is 7.5 % lower than its estimated neutral level;

3) restoration of cooperation with the IMF;

4) development of measures aimed at ensuring the protection of the national interests of Ukraine in the context of increased protectionism of other countries, as well as in emergency situations;

5) development of a common Ukraine-EU roadmap for the further development of trade and economic ties and smoothing out the negative impact of measures taken to combat COVID-19.

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3 IDENTIFICATION OF MANAGERIAL PROBLEM

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ABSTRACT

The object of research is the process of identification of managerial problems. Research methods are based on general scientific principles and fundamental provisions of economic theory, decision-making theory, works of leading Ukrainian and foreign scientists. The dialectical method of scientific knowledge, methods of scientific abstraction, analysis and synthesis (to study the theoretical foundations of solving managerial problems), systemic generalization (to systematize the categorical apparatus of studying the identification of managerial problems, improve the classification of managerial problems) are applied.

The stages of the process of identification of managerial decisions are highlighted, covering: definition of the problem; classification of the problem; ascertaining the facts, evaluating and analyzing the data concerning the problem. The content of the stages of identification of managerial decisions is considered.

The classification of managerial problems has been improved by including such characteristics as: focus on the goals of the enterprise, the degree of importance and urgency, the magnitude of the consequences in cases of making or rejecting decisions and the number of organizations and individuals affected by these problems, risks associated with solving the problem and the opportunity emergence of new problems on this basis, the degree of structuring and reflection through qualitative and quantitative indicators, the level of decision-making and risks, types of activities, the level of participation in the study of the problem and discussion on its solution.

The characteristic features, areas of problem solving and methods for solving managerial problems, depending on the level of formalization, are considered.

KEYWORDS

Solution of managerial problems, identification of managerial problems, classification of managerial problems, methods of solving managerial problems.

3.1 REVIEW OF RESEARCH ON PROBLEM SOLVING AND DECISION MAKING

As it is known, the process of making managerial decisions is defined as a process that encompasses a set of actions for collecting information, analyzing, setting goals, forming and choosing alternatives from possible options for actions aimed at achieving the set goals, implementing the decision. It should be noted that, in contrast to domestic scientific literature, in foreign scientific

works, separate processes are considered: decision-making, supports the general management process, since it is used to collect relevant data, analyze important information and choose the most acceptable solution, and solve problems, which is described with the point of view of identifying the problem, diagnosing the causes, developing and choosing alternatives, implementing the chosen alternative [1].

An extremely important stage in the problem solving process is the identification of managerial problems, since their correct definition and analysis can affect the efficiency and efficiency of problem solving, and therefore is the key to success in the further decision making process. The wrong definition of the problem can lead to the implementation of the wrong managerial decision and additional unjustified costs and efforts of the enterprise.

The work of many foreign and domestic scientists is devoted to the study of issues related to solving problems and making managerial decisions. Problematic issues of making managerial decisions were considered by Drucker, R. [2, 3], Shubin, O. O., Guseva, O. Y. [4, 5], Abedin, B., Kordnaeij, A., Fard, H. D., Hoseini, S. H. K., who reviewed and classified modern research on the formation and identification of strategic issues in organizations [6], Bakumenko, V. D., who proposed theoretical and methodological approaches to the formation of public administration decisions as one of the main directions of the type of activity and branch of science of public administration [7], McKenna, R. J., who investigated the processes of finding problems and making decisions [8], Jackson, M. C., who analyzed system approaches in solving managerial problems [9].

The question of defining managerial problems was studied by Smith, G. F. [10, 11], attention to forms (structure and semantics) and functions (goals and areas of application), the formulation of problems in their planning and solution was focused by Volkema, R. J. [12], Moral Intensity and Managerial Problem Solving was studied by Dukerich, J. M., Waller, M. J., George, E., Huber, G. P. [13], the issue of solving managerial problems, the use of models and decision-making methods were considered by Galli, M. [14], Lang, J. R., Dittrich, J. E., White, S. E. [15], The financial and managerial problems of social enterprises and their optional solutions were analyzed by Bozsik, S., Szemán, J., Musinszki, Z. [16].

The issues of classification of managerial problems are given attention in the scientific works of Mindlin, Y. B., Litvinenko, I. L., Zhangorazova, Z. S., Shichiyakh, R. A., Veselova, N. Yu., Petruk, G. V. in the study of the formation and development of cluster management in the regional economy [17], Abu Omar, M. M. M., Abdullah, K. A. in the development of a new integrated model to improve the use of the classical approach to the design of management information systems [18], Balfe, A. J. in his study of Problem-Solving Theory [1].

Vitlinskyi, V. V. considered the conceptual provisions for building a decision-making system using artificial intelligence tools, the principles of building intelligent systems for making managerial decisions [19], effective means of identifying a problem in the form of its monitoring, which is carried out in an iterative mode, analyzing and evaluating the current state of the organizational system, situational analysis of the development of the problem and diagnosis of the state of the organizational system, proposed by Galitsyn, V., Suslov, O., Samchenko, N. [20].

Paying tribute to the scientific developments of scientists, it should be noted that the issue of solving problems, in particular the content of the process of identifying strategic and operational managerial problems, has not been considered in detail. It is necessary to clarify the classification of managerial problems, which will allow for their more accurate identification. It is also advisable to streamline the stages of identification of managerial problems, which will improve the efficiency of managerial decision-making in enterprises in the future.

3.2 STAGES OF IDENTIFICATION OF MANAGERIAL DECISIONS

The process of solving a problem begins after its identification, so first it is necessary to establish all those factors that could create it, and those that can be included in a possible solution.

In general, according to Smith, G. F., «managerial problem solving can be understood as reasoned action that works from a mental representation of a problem situation to a more-or-less well-defined goal state» [11].

Balfe, A. J. defines the problem solving process as identifying the gap between the desired and the actual state and further taking steps to close the gap [1].

In the works of scientists, the definitions of the process by which a person realizes the problem are presented in different ways, including due to the lack of a clear conceptualization of the corresponding processes and opportunities in the field of solving managerial problems. Scientists use terms such as «finding», «sensing», «recognition», «learning», «exploration», «formulating» and «identification» depending on the arbitrary choice of the term from many existing ones or due to alternative ways of dividing processes into components [11, 15].

It should be noted that all of the above terms are important, since they reveal the multifaceted essence of the process of solving managerial problems. However, this study will use the term «identification», which, in our opinion, more accurately reflects the process of understanding managerial problems. Identification (from the Latin identifico) means identification, establishment of coincidence, correspondence of something with something, recognition. In control theory, the identification of systems consists in the construction (refinement of parameters and/or structure) of a model of the system based on the results of measurements [21].

Analysis of scientific works [11, 15] made it possible to establish that there is no consensus among scientists regarding the stages and actions in the process of identifying problems. So, in the scientific sources of the first stage (phase) decision-making (the stage of preparing a decision) regarding the identification of problems, the following are defined:

1) collection of information about the situation (problem), analysis, diagnosis of the situation (identification of the problem field, its structure, structure of constituent problems, factors of influence) [22];

2) definition of the problem, analysis of problems [2];

3) analysis of the situation [23];

4) clarification of the problem, covers the collection of information; analysis of information; finding out its relevance; determining the conditions under which the problem will be solved [24];

5) overview of the situation and problem-investigation analysis between events at the enterprise, covers the following stages: identification of the problem object; localization of the problem; identifying key differences; clarification of deviations; identification of possible causes and their verification; confirmation by probable cause [25].

According to the Dictionary of System Analysis in Public Administration, the analytical study of a problem involves three stages aimed at solving it – the perception of the problem situation, the understanding of the problem, the search for solutions to the problem, and the solution of the problem [22]. At the same time, the technology of analytical research of the problem covers the operations:

1) formulation of the problem as a situation that does not satisfy social needs, or such that it conditions the setting of new goals and objectives;

2) definition of clear subject and space-time boundaries of the problem;

3) clarification of the system characteristics of the problem (structure, functions, specific target characteristics, etc.);

4) development of possible solutions to the problem (achievement of certain target characteristics) and assessment of the corresponding resources;

5) selection of the optimal solution to the problem;

6) choice of management technologies for the implementation of this option [22].

Based on the foregoing, it can be stated that in scientific works, despite the difference in views regarding the stages of identifying problems, there is a certain sequence of steps leading from the definition of the problem to its analysis. However, a certain multidirectionality requires a certain systematization of this issue. Taking into account the above, it is advisable to single out the following stages of identification of managerial problems:

1) definition of the problem;

2) classification of the problem;

3) finding out the facts, evaluating and analyzing the data concerning the problem.

Let's take a closer look at the content of each stage:

Stage 1 – Problem definition.

Problem (*from the Greek. Problema – task, difficulty*) – in a broad sense – a complex theoretical or practical issue that requires study, resolution [21]; the discrepancy between the desired and the existing state of affairs in the cognitive or practical sphere is fixed, formalized in the form of a certain syntactic structure (interrogative or descriptive) [22]; a class of problems requiring practical solutions in non-standard conditions, or a heuristic situation associated with ambiguity, the possibility of alternative solutions [26]. Based on the general definition of the concept of «problem», under the managerial problem it is necessary to understand the fixed discrepancy between the desired and the existing state of any activity of the control object, which prevents its effective functioning and development.

Speaking of strategic and operational problems, it should be noted that in a general sense, these terms mean the inconsistency of the current state of an object with certain strategic and operational goals. It should be noted that scientists focus on certain aspects of problem definition. Thus, Drucker, P. F. notes that the correct formulation of the question, the setting of goals and the definition of rules allow to define the problem [2].

According to Chornous, H., «the identification of the problem should be accompanied by a list of its sources, causes and parameters, as well as the determination of the vectors of the development of the situation and its consequences, taking into account and not taking into account control actions» [25].

Consideration of the root causes of managerial problems is necessary at the stage of problem definition. The use of the scheme of the four-factorial profile of causes (indicating 4 groups of causes, depending on the specifics) or the Ishikawa structural diagram (cause-effect diagram) will visually display the content of the problems.

Scientists believe that the main causes of managerial problems are:

1) initial false goals of the organization, methods and timing of their achievement;

2) wrong principles and methods of employees' activity;

3) incorrect criteria for assessing the capabilities of the enterprise and employees;

4) intentional violations in engineering, technology, finance, etc.;

5) changes in the policy and economy of the state;

6) natural disasters and catastrophes [17].

Thus, taking into account the above, we believe that at the stage of defining the problem, such actions are necessary:

1) identification and description of the problem situation (awareness and reflection in any form of the contradiction between changes in the environment of the enterprise's functioning and its ability to ensure in such conditions the achievement of its goal);

2) setting the goal of solving a problem situation (determining the desired end result of solving a problem situation);

3) identification of decision-making criteria (determination of the features on the basis of which the assessment of the solution to a problem situation will be carried out, as well as the ordering of these features according to the degree of importance) [27].

Stage 2 – Classification of the problem.

As Drucker, P. F. notes, «the problem needs to be classified in order to understand who should make a decision, who should be consulted when making a decision, and who should be informed. Mind can show who should do what, so that the decision turns into a practical action that will give the desired result» [2].

The study of scientific papers on managerial problems showed that there is no unity of views of scientists regarding the criteria for classifying problems. Thus, Manning, R. E., Anderson, L. E., Pettengill, P. classify managerial problems into three categories: resources, experience, funds/services [28].

Drucker, P. F. identifies four types of problems: typical; typical in nature, but unique to a specific operating system; are unique; new standard [3].

The classification of managerial problems developed by Abu Omar, M. M. M., Abdullah, K. A. [18] encompasses two categories:

1) control problems are subdivided according to their nature and corresponding solutions (first order problem – the solution is clear and unique, you only need the necessary information about this problem to solve it (direct solution), second order problem – the solution is clear, but there is a list of several solutions (indirect solution));

2) control problems are divided by the type and nature of the computer program (software) that will be used to solve them. In addition, scholars identify combined control problems arising from the combination of two different control problems.

Balfe, A. J. classifies managerial problems by decision-making levels:

1) strategic level (long-term high-risk problems, poorly structured rare solutions);

2) tactical level (medium-term problems with medium risk, and problems that are recurring);

3) administrative level (short term low risk problems, recurring);

4) operational level (very short-term problems with minimal risk, extremely repetitive) [1].

Managerial problems are also divided according to the degree of structuredness into the following types [8, 19, 22, 29, 30]:

1) standard – the solution to these problems is distinguished by the clarity and unambiguity of goals, alternatives and necessary costs (when developing solutions, predefined procedures and rules are applied);

2) well-structured (completely formalized, quantitatively structured) – the elements of the problem and significant dependencies between them can be qualitatively determined and quantitatively described (multivariate solutions are used);

3) unstructured (non-formalized, qualitatively expressed) – the problem can be reflected through a general qualitative description, the elements and connections between them are not defined qualitatively and quantitatively, there is significant uncertainty and the impossibility of formalizing both goals and directions of action (when solving unstructured problems, the decisive importance has judgments, experience, intuition of leaders and experts, a creative approach);

4) poorly structured (mixed) – the problem contains elements and connections that cannot be described quantitatively (they are solved using the methods of systems analysis, which combine complex mathematical calculations with a large volume of subjective judgments of experts).

The most detailed classification of managerial problems is Mindlin, Y. B., Litvinenko, I. L., Zhangorazova, Z. S., Shichiyakh, R. A., Veselova, N. Yu., Petruk, G. V. [17] using the following criteria: degree of importance and urgency; the magnitude of the consequences in cases of making or rejecting decisions and the number of organizations and individuals affected by these problems; the ability to solve problems at the lowest cost and in the best possible time; the risk associated with solving this problem and the possibility of new problems arising on this basis; the degree of structuredness and formalization; the ability to express the problem in quantitative

and qualitative terms; depending on the decision; depending on the type of problem (strategic, aimed at building a strategic database, understanding, studying, evaluating and using them; tactical, the solution of which occurs in a shorter time than strategic; long-term, medium-term and short-term, current).

Drucker, P. F. notes four principles of problem classification (the time horizon of the solution, the impact of the decision on other areas and functions of the company, the number of qualitative considerations that make up a given decision; the uniqueness or frequency of a given decision), noting that such a classification guarantees the real benefit of the business decision as a whole, and not only aimed at solving the current (local) problem at the expense of the whole, since it divides problems according to the principle of compliance with the goals of the company (department) [3].

Lang, J. R., Dittrich, J. E., White, S. E. note that problem solving research and discussion can be conveniently divided into three levels of complexity, depending on who is involved in solving the problem:

1) an individual level, including one leader;

2) group level, including a small group or task force;

3) more organizational level, which covers more than one group [15].

Taking into account the above-mentioned division of problems, the variety of signs by which they are grouped, it is advisable to classify managerial problems according to the following criteria: focus on the goals of the enterprise, the degree of importance and urgency, the scale of consequences in cases of making or rejecting decisions and the number of organizations and persons affected by these problems, risks associated with solving the problem and the possibility of new problems arising on this basis, the degree of structuredness and reflection through qualitative and quantitative indicators, the level of decision-making and risks, types of activities, the level of participation in the study of the problem and discussion on its solution (**Table 3.1**).

Stage 3 – Fact finding, evaluating and analyzing data related to the problem.

At this stage, it is necessary to collect data on the problem that is being considered. In order for the solution to the problem to be of high quality, the collected data must be of high quality. Assessment of data quality must be carried out based on the principle of objectivity, it consists in understanding the specific subjectivity of information, the ability to assess the degree of this subjectivity, to minimize any subjectivity when searching for a real situation.

In our opinion, taking into account the general requirements for the quality of information, the data on the problem should have such fundamental and amplifying qualitative characteristics as:

1) topicality – the property of data to be in a state corresponding to modern reality;

2) relevance (the essence of confirming and predictive value) – the ability to influence decisions will be made;

3) true representation (completeness, neutrality, absence of errors) – truthful disclosure of the problem;

4) comparability – the ability to identify and understand the similarities of problems and differences between them;

5) timeliness – the ability to timely receive information that may affect the decision.

● **Table 3.1** Classification of managerial problems

Criterion	Types of problems
By the focus on the goals of the enterprise	Strategic
	Operational
By the degree of importance and urgency	The main
	Minor
By the magnitude of the consequences in cases of making or rejecting decisions and the number of organizations and individuals affected by these problems	Minor
	Average
	Significant
By the risks associated with solving the problem, and the possibility of new problems arising on this basis	With a high risk of new problems
	Medium risk of new problems
	With minimal risk of new problems
By the degree of structuredness and display through qualitative and quantitative indicators	Standard
	Well structured (formalized, quantitatively structured)
	Unstructured (non-formalized, qualitatively expressed)
	Weakly structured (mixed)
By the level of decision-making and risk	Strategic level issues (long term high risk issues)
	Tactical Level Issues (Medium Term Issues with Medium Risk)
	Administrative-level problems (short-term, low-risk problems)
	Operational level issues (current minimum risk issues)
By the type of activity	Administrative
	Production
	Financial
	Investment
	Marketing
By the degree of participation in the study of the problem and discussion of its solution	Problems identified at the individual level (by the leader)
	Problems identified at the group level (small group)
	Problems identified at the organizational level (by more than one group)
By the scale of the manifestation of the crisis phenomenon	General
	Local

Source: compiled by the authors based on [*1, 3, 7, 15, 17–19, 22, 28–30*]

The need for a direct analysis of the problem is emphasized by Drucker, P. F., since «different business problems can show the same set of symptoms, the same problem manifests itself in very different forms» [2].

It is worth noting that if it is impossible to obtain all the necessary information for any reason (its inaccessibility, time-consuming, etc.) and making a decision based on assumptions,

it is important to understand what kind of data is missing – to determine the degree of risk for decision taken in the future, the sufficiency and correctness of the measures that will be applied to solve the problem.

Having considered the main stages of identification of managerial problems, one should dwell on the methods of their solution.

One of the above stages of identification of managerial problems – the classification of managerial problems – allows to highlight the characteristics of the problems and determine the methods of their solution.

As it is known, managerial decision making is based on intuitive and rational technologies. Intuitive decision-making technology is based on the experience gained and is portrayed by scientists as a technology that covers the stages of registration of changes, selection of decisions, which contain the memory of the subject of management, decision-making [23].

However, scientists, noting the complexity and multifacetedness of economic problems depend on many external and internal factors that affect the efficiency of the enterprise in different ways and change rapidly over time, speak of the impossibility of only the experience and intuition of managers to ensure the adoption of an adequate managerial decision in the appropriate situation [25].

In the absence of experience, the likelihood of erroneous decisions may increase, which negate the advantage in the speed of response to management challenges [23].

Compared to intuitive technology, rational decision-making is characterized by a sequence of operations:

– obtaining information about the situation;

– analytical processing of information, modeling of the situation;

– defining goals (building a tree of goals, defining tasks) developing a forecast for the development of a situation (using expert methods) developing alternatives for decisions (management influences);

– creation of a system for their assessment (definition of criteria, indicators, rating scales, etc.);

– selection of the main options (expert assessment);

– optimization of the solution according to certain criteria (expert assessment);

– decision-making by the responsible person [22].

Considering that, in general, problems can be divided depending on the level of their formalization, it is necessary to dwell in more detail on formalized and non-formalized problems and acceptable methods for their solution (**Table 3.2**).

Thus, the study of the process of identification of managerial decisions made it possible to:

1) establish the stages of the process of identifying managerial decisions – defining the problem, classifying the problem, clarifying the facts, evaluating and analyzing data related to the problem;

2) clarify the classification of managerial problems by including such signs as: focus on the

goals of the enterprise, the degree of importance and urgency, the scale of the consequences in cases of making or rejecting decisions and the number of organizations and individuals affected by these problems, the risks associated with solving the problem and the possibility of new problems arising on this basis, the degree of structuring and reflection through qualitative and quantitative indicators, the level of decision-making and risks, types of activities, the level of participation in the study of the problem and discussion on its solution, the scale of manifestation of the crisis phenomenon;

3) highlight the characteristic features, areas of problem solving and methods for solving managerial problems, depending on the level of formalization.

● **Table 3.2** Methods for solving managerial problems depending on the level of formalization

Problem identification	Type of problem		
	formalized	**informal**	**mixed**
Characteristic features	The presence of elements in a quantitative form (complete definition of essential dependencies, expression in numbers / symbols), easy standardization and programming, the possibility of full automation in information systems	The presence of elements in a qualitative form (resources, signs, properties). High level of information uncertainty	The presence of elements in quantitative and qualitative forms
Scope of the problem	Accounting, production preparation, personnel system, warehouse accounting (accounting, control, paperwork)	Problems of relations in a team, strategic, long-term tasks (forecasting, long-term planning, organizational transformations)	Decision for the future with an investment of large resources associated with risk
Solution methods	Network methods Graphic methods Linear programming Nonlinear programming Dynamic programming Math modeling Methods of the theory of mass Service	Sensitivity analysis Statistical analysis methods Social psychology methods Sociological methods Heuristic methods Goal tree type methods	Math modeling Optimization methods Game theory methods Simulation modeling Cost-benefit analysis Cost-effectiveness analysis Goal tree type methods

Source: compiled by the authors based on [7]

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4 ECONOMETRIC APPROACH TO JUSTIFICATION OF MANAGERIAL DECISIONS

N. Ivanova, T. Kozhukhova, V. Barabanova, V. Yankovsky

ABSTRACT

The analysis of existing approaches to making managerial decisions was carried out; their content and properties are determined. The author's understanding of the concept of «econometric approach to managerial decision-making» is proposed as a combination of the properties and principles of systemic (acceptance and understanding of the hierarchy of variables and their relationships, preservation of the principle of consistency) and situational approaches (accounting for system analysis, analysis of the content and dynamics of each individual situation) with an emphasis on application of econometric methods and models. The advantages and disadvantages of the econometric approach to managerial decision-making are determined. The general econometric methods of substantiating managerial decisions and their consequences are described.

A review of the practices of applying the econometric approach to substantiate managerial decisions has been carried out, as a result of which the expediency and effectiveness of using econometric models and methods at all stages of managerial decision-making have been determined, but they acquire special significance in the process of substantiating managerial decisions.

The methodological tools of the econometric approach to substantiating strategic decisions to ensure economic security, namely, taxonomic and canonical analyzes, have been determined. The statement about the existence of a connection between the standard of living of the population and the level of innovative development of the regions was proved, which made it possible to formulate strategic solutions for ensuring economic security. The matrix «economic security – standard of living – innovative development» is proposed to justify the decision to apply strategies to ensure economic security through changes in the level of innovative development and the standard of living of the region's population (transformation strategy, innovative development strategy, human development strategy and growth strategy).

KEYWORDS

Econometric approach, managerial decision making, econometrics, canonical analysis, taxonomic analysis, economic security, innovative development, living standards of the population.

4.1 ECONOMETRIC APPROACH: ADVANTAGES AND DISADVANTAGES

In the previous chapters, it has been proven that managerial decision making is a complex, multifaceted, uncertain and risky process. Decisions can be made either personally by managers

who are fully responsible for them, or with the participation of a large or small group. In the theory of managerial decision-making, two basic approaches are usually distinguished: systemic and situational approaches.

A systematic approach is a certain systematized way of thinking for decision-making, which is based on determining the overall goal of the system and consistent subordination of the activities of subsystems to it, plans for their development, indicators and labor standards [1]. The situational approach is based on system analysis, allows the manager to understand and take into account the specifics of the situation, the dynamics of its changes, and the like. The expediency of using systemic and situational approaches to decision-making in various fields and at different levels is described in the works of domestic and foreign scientists [1—9].

So Feldman, G., Shah, H., Chapman, C., Pärn, E. A., Edwards, D. J. [3], in contrast to others, emphasize the definition of the system of occurrence of problems, which consists of interacting parts; the authors propose to use the proposed approach for identifying problems, analyzing their boundaries, designing interventions, predicting and measuring the expected impact, their implementation and monitoring and assessing their success/failure.

In turn, Salhieh, S. M. [4] proposes a managerial decision model for concentrating organizational resources for maximum benefit, which is presented as a multi-criteria choice model and is built using the hierarchy analysis method.

The proposed econometric approach to managerial decision-making is a combination of the properties and principles of systemic (acceptance and understanding of the hierarchy of variables and their relationships, preservation of the principle of consistency) and situational approaches (accounting for system analysis, analysis of the content and dynamics of each individual situation) with an emphasis on the use of econometric methods and models (**Fig. 4.1**).
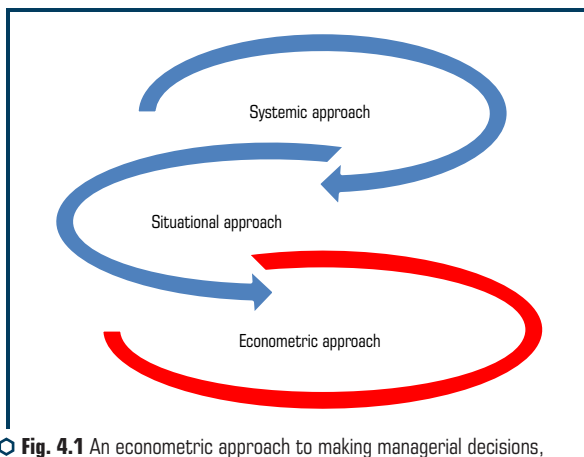
○ **Fig. 4.1** An econometric approach to making managerial decisions, as a combination of systemic and situational

The advantage of the mixed approach [10, 11] is the reduction of personal bias and the possibility of comparing dissimilar alternatives using quantitative analysis [12].

As noted in the previous chapters, the result of the activity (product) of management activity is a managerial decision. For a long time in domestic practice, the prevailing opinion about management as something more intuitive than analytical. The reason for highlighting and focusing on the econometric approach to managerial decision-making is the need for domestic managers to understand the importance of a quantitative justification for choosing a decision based on an analysis of the situation, identifying connections, assessing the risks and consequences of alternative decisions.

The main purpose of the econometric approach is to justify (argumentation) the choice of a specific managerial decision, taking into account the priorities and strategic goals of the organization's development using econometric methods.

Analysis of scientific developments on the application of econometric methods and models in management activities [13–23] made it possible to prove the feasibility of introducing an econometric approach to substantiate managerial decisions.

The application of generic econometrics to the general field of managerial decision making, where above all methods play a role in facilitating the overall data analysis process, was described in 1974 by Ball, R. J. and Burns, T. in their research study «Econometric analysis and managerial decision making» [11]. Econometric analysis describes quantitative relationships between economic variables and can provide important inputs to the decision-making process of managers. Usually, econometrics differs from other aspects of management science in that it considers problems primarily from an economic point of view, and not from other directions [18].

A supporter of quantitative methods for the study of economic processes, incl. in the field of management is Morris Altman, according to which «... the bounded rationality approach holds most promise, with its focus on methodology and related causal analysis and modeling, smart decision makers, capabilities, and institutional design» [19] and heuristics with given appropriate decision-making capabilities and institutional settings can produce better decision-making results.

That is why applied work in business requires a deep understanding of econometric decision-making methods. The combination of econometric methods with systemic and situational approaches provides the manager with an increase in the efficiency of the organization and contributes to being competitive.

Econometrics deals with the measurement of economic relationships, is the integration of economics, mathematical economics and statistics in order to provide numerical values for the parameters of economic relationships. The links of economic theories are usually expressed in mathematical forms and in combination with empirical economics. To obtain values, econometric methods are used, parameters, which are essentially the coefficients of the mathematical form of economic relations. Statistical methods that help explain an economic phenomenon, adapted like econometric methods [20].

The use of the econometric approach makes it possible to make decisions in the face of uncertainty, because the existence of ambiguity presents a challenge for those who make decisions,

since it makes it impossible to apply standard approaches to optimization (based on the calculation of objective expected values of alternative actions) [22]. The modern environment is characterized by a high level of uncertainty, which is exacerbated by the existing crisis phenomena. Arend, R. J. «... outline a multi-step, logical approach for addressing such problems in theory with the goal of providing an improved basis for practical decisions that should increase organizational performance» [22].

Modeling decisions is not so obviously expedient and straightforward, some of the models are very complex, but this does not mean that they are necessarily realistic. The modeling methods used by different people and in different situations can be different through individual schemes, personality, values, etc., as well as different internal and external environments [24].

Various econometric methods and their implications are presented in **Table 4.1**.

● **Table 4.1** Application of econometrics to substantiate managerial decisions

Applications	What it does
Linear model	Determination of independent drivers, degree of causality and preparation of forecasts with cross section data
Segmentation and Clustering Analysis	Identification of homogenous customer and product groups for strategic marketing and pricing initiatives
Time Series Modeling	Preparation of forecasts by building various time series models with a variety of distributional assumptions
Constrained Optimization	Creation of business rules by accounting for dynamic business constraints for an effective solution
GARCH (Generalized autoregressive conditional heteroscedasticity)	Identification of independent drivers, direction and degree of causality for parameter estimation in volatile environments
Neural Network Techniques	Development of machine learning based estimation techniques to help in pattern identification, sequence recognition and knowledge discovery in databases
Game Theoretic Applications	Identification of dominant and next-best strategies in a dynamic business environment with realistic asymmetric information assumptions
Non Linear Modeling	Key parameters estimations requiring high degree of precision
Response Modeling	Estimation of response probabilities to key marketing, pricing and operation strategies

Source: [18]

Cooke, S. and Slack, N. [25] classifies quantitative models into two vectors [24] (**Table 4.2**):
1) according to the type of solution;
2) the degree of uncertainty of the model presented.

● **Table 4.2** Classification of models in relation to the type of decision and the degree of uncertainty of the model

Model	Deterministic	Probabilistic
Optimizing	Linear programming	Decision trees Decision analysis
Satisficing	Corporate modeling Heuristic models Summary statistics	Queuing theory Statistical analysis Stochastic simulation Risk analysis

Source: [24]

So, among the advantages of the econometric approach are:

— unlike others, the econometric approach belongs to the mixed group, which gives it a wider range of methods and properties;

— econometric approach assumes that the problem can be described by a set of characteristics that are related by balance, functional or stochastic relationships, it allows to create a mathematical description (function) of the problem/solution and predict the result for various options;

— quantitative description of alternatives to managerial decisions allows to make a more informed choice, taking into account the priorities of a particular organization (for example, the risk-return ratio: for organizations with different goals — then reducing risk or increasing profitability — under the same conditions there will be different choices of decisions among the alternatives);

— are becoming more extensive and reliable, which can be processed thanks to new technologies and get a more accurate result of problem analysis and quantitative characteristics of solution alternatives.

Oddly enough, one of the main drawbacks of the econometric approach is the «human factor» — a decision-maker or analyst processes the databases.

The choice of modeling methods, the period of data sampling, the choice of variables and their number, the interpretation of the results, etc. carried out directly by the manager or analyst. Therefore, the econometric approach to managerial decision-making is the integration of not only mathematics, economics, statistics, management theory, but also the professionalism of a manager (decision-maker, analyst, etc.).

Existing examples of the application of the econometric approach in the theory of managerial decision making are presented in the next chapter.

4.2 REVIEW OF PRACTICES OF APPLYING THE ECONOMETRIC APPROACH TO JUSTIFY MANAGERIAL DECISIONS

The use of the econometric approach to making managerial decisions is possible at all its stages, but it acquires special significance in the process of substantiating managerial decisions.

Justification of management provides for the support of convincing evidence of the compliance of the proposed decision with the specified criteria and real-life restrictions.

The growing influence of uncertainty and risk factors has led to an interest in econometric methods that allow them to be taken into account and the application of which will allow the decision-maker to obtain information about the possible spheres of their occurrence, the likely degree of their influence, and the necessary measures to eliminate or mitigate the consequences of their action.

Unlike other approaches, within the framework of the econometric method of application does not depend on the competence, knowledge, skills and experience of the decision-maker, but on the content of the problem with all its characteristics.

In this chapter, an attempt is made to consider examples of the application of the econometric approach in making managerial decisions, to highlight the features.

It is appropriate to note scientific developments in decision-making in conditions of ambiguity, which is an insufficiently studied problem. Ambiguity is a more important type of context of uncertainty faced by managers making strategic decisions [25]. Arend, R. J. [22] proposes a new approach to solving the issues of strategic decision-making under ambiguity (SDMUA), which has not yet been practically tested, is a purely theoretical development. In the presented study, it is proposed to apply game theory when making investment decisions under conditions of ambiguity. «To maximize the payoff in an interdependent setting, the manager has to compare payoffs in each interdependent interaction. The simplest way to visualize this is as a normal form game where the interactions are the cells (i.e., the intersection of each row and column action choice in the table of possible actions by the players). Each cell contains a specific sub-set of the full investment choice set, where the sub-sets are mutually-exclusive and collectively-exhaustive. The full SDMUA then entails finding not only the best investment within each cell to fill out the game table, but it also entails identifying the Nash equilibrium choice for the competitive game as a whole» [22].

Thathsarani, U., Wei, J., Samaraweera, G. [23] investigate the problem of financial inclusion (the process of facilitating banking and financial services for individuals), as a result of which by analyzing the main components using an econometric approach to panel data with vector error correction models and a causality test Granger's Financial Inclusion Index was developed. Based on the information received, scientists have discovered the presence of a long-term impact on the development of human capital in South Asian countries, and a short-term positive impact on economic growth, is the basis for making managerial decisions at the state level.

Larsson, A.-S., Edwards, M. R. [16] carry out research in the field of personnel management and strategic personnel management, trying to identify the relationship between investments in HR and the performance of the firm. Research is conducted using Insider Econometrics «… an approach used in Personnel Economics to produce empirical estimates of the value of HR practices, to highlight longitudinal intra-firm research in economics that could provide insights to research exploring the HR investment-performance link (important in both SHRM and People Analytics fields)» [16].

Voloshyna, S., Provolotska, O., Lazaryshyna, I., Nieizviestna, O., Skliar, N. [26] in the process of researching the jewelry market determined that the development of effective managerial

decisions by all subjects of the jewelry market is hampered by ignorance the cause-and-effect relationship between its parameters is a consequence of the existence of systemic scientific gaps. Based on the econometric approach (regression analysis), it is determined that the price factor has a significant impact. The results of the regression analysis made it possible to formulate key solutions for the development of the Ukrainian jewelry market, which correlate with the systemic problems of its functioning.

When applying multivariate regression models, it is necessary to take into account multicollinearity and its negative impact. It is the study of multicollinearity in multifactorial regression economic and mathematical models of activity and the reduction of its negative impact based on the application of the parameterization method that the scientific work [27] is devoted to. For the first time, the application of the parameterization method is proposed, which makes it possible to simplify the construction of an economic and mathematical model in the form of regression equations. The use of the parameterization method makes it possible to reduce the uncertainty in the synthesis of multivariate regression equations, ensuring the appropriate adequacy, which increases the reliability of the information obtained for making managerial decisions.

Applying the methods of system-structural analysis and modeling of complex systems Barabanova, V. V., Bohatyryova, G. A. and Gorina, G. O. identified the potential opportunities for the development of industrial tourism at the city level, which are the basis for managerial decisions in the marketing strategy of the studied tourist region [27].

One of the guidelines for making managerial decisions is profit and its derivatives, from this point of view Chernega, O. B., Voloshyna, S. V., Kostakova, L. D. reveal the managerial significance of the profit of the enterprise [28], show the need to improve the methods of marginal analysis. The advantage of the presented results is the theoretical model of marginal analysis, which is formalized in the form of an industry methodology developed taking into account the specifics of the mining and processing plant for the extraction of iron ores. Classes of managerial decisions that can be implemented in structural divisions of an enterprise based on the method of margin analysis have been determined.

The use of the tools of the econometric approach allowed [29] to identify the main trends in the development of the European aviation network, a regression model for further improvement is presented, taking into account the results of the optimal placement of aviation hubs.

The development of additive and multiplicative models is characteristic of the econometric approach. Domestic scientists [30] for the first time used the apparatus of econometric modeling to study the influence of the components of production potential on the financial performance of an enterprise in the iron ore industry of the Kryvyi Rih region, taking into account the factor of scientific and technological progress, carried out a detailed economic and mathematical analysis of the results and made forecasts based on the obtained models. The results obtained are of practical value for the management of large industrial enterprises of the iron ore industry and can be used by them in the process of forming strategic plans for the management of financial and economic activities.

The econometric approach to substantiating managerial decisions takes place not only at the micro level; econometric tools are successfully used at the macro level as well. For example, using the regression analysis method Garbowski, M., Mironova, D., Perevozova, I., Khrushch, N., Gudz, I. [31], a relationship was established between macroeconomic stability and the economic development of IPO, which is described by mathematical regression models. The developed models make it possible to predict the level of macroeconomic stability as a result of IPO changes and timely adjust decisions at the state level.

A scientific study [32] proposed a methodological approach to assessing the regional level of human development, based on the improvement of mathematical tools for predicting the vectors of the country's development. It is based on the grouping of the country's regions according to certain demographic parameters. Common and peculiar issues of human development indifferent regions of Ukraine are systematized upon the basis of clusterization. The established regularities of demo-economic development of entire Ukraine and regional features, the levers of state regulation of human potential formation of Poland were taken into account and laid as the basis of scientific and practical recommendations for adjusting the Strategy of Sustainable Development of Ukraine [32].

4.3 METHODOLOGICAL TOOLS OF THE ECONOMETRIC APPROACH TO SUBSTANTIATE STRATEGIC DECISIONS TO ENSURE ECONOMIC SECURITY: TAXONOMIC AND CANONICAL ANALYZES

The analysis of theoretical sources on approaches to assessing and predicting the level of economic security of the national economy and regions made it possible to conclude that, in general, models for assessing the level of economic security have additive or multiplicative forms, qualitative and quantitative methods are used to assess the economic security of systems at various levels of hierarchy. However, despite the fact that qualitative methods are widely used to analyze economic security, their application will bring the greatest effect only in combination with quantitative methods [33].

The economic security of a system at any level of the hierarchy is characterized by a significant number of indicators that complicate its analysis and assessment. In order to fully take into account the influence of all indicators participating in the study, without significant loss of information, it is advisable to use the procedures of multivariate statistical analysis to assess the level of economic security.

This research is based on the methods of multivariate modeling and the matrix method.

Thus, based on the analysis of existing approaches and methods for assessing and predicting the economic security of systems at various levels of the hierarchy, it has been determined that the methods of multidimensional statistics are the most appropriate for research and modeling of the integral indicator of the economic security of regions. In this study, let's consider the application of taxonomic and canonical analysis.

Taxonomic analysis is used to assess and form the integral value of the level of economic security of regions according to certain indicators of the socio-economic development of regions, the forecast of which we have proposed using the method of regression modeling. The importance of the taxonomic method for economic sciences was separately noted by the Polish scientist Plyuta, V. in his work «Comparative multidimensional analysis in economic research. Methods of taxonomy and factor analysis» [34]. The author notes that most economic phenomena are actually characterized by a large number of different features, the number of which often reaches several dozen. In such conditions, the use of traditional methods becomes impossible. To solve such problems, the author suggests using the taxonomy method.

Kuz'minchuk, N. V., Dolya, D. G. formulated the advantages of the taxonomic method: «Based on the taxonomy method, which is able to organize multidimensional statistical material into a single quantitative characteristic, it is possible to build a generalized assessment of a complex object or process» [35].

The method is based on the definition of the so-called taxonomic distance, that is, the distance between points of a multidimensional space, the dimension of which is determined by the number of features that characterize the studied one. Determining these distances makes it possible to determine the location of each specific point relative to others, and, thus, structure the entire set of points. There are several objects of the same type with a certain set of essentially different features.

Data on these objects and their characteristics can be presented in the form of a matrix, in which objects form rows, and characteristics – columns.

This matrix is called the observation matrix, which, as a rule, has the form:

$$x = \begin{pmatrix} x_{11} & x_{12} & \dots x_{1j} \\ x_{21} & x_{22} & \dots x_{2j} \\ x_{i1} & x_{i2} & \dots x_{ij} \end{pmatrix}, \tag{4.1}$$

where i – serial number of the investigated object from 1 to n;

j – ordinal number of the investigated feature for each object from 1 to p.

For complex objects (such as the economic security of a region), indicators are indicators that characterize various properties of an object and, as a result, have different meanings, units of measurement, and sizes of quantitative indicators.

Combining such indicators into one is not possible without preliminary conversion procedures (reduction) to one measurement base.

For this, according to the rules of the taxonomy method, the standardization of features is carried out, in which the value of the indicator is replaced by a coefficient characterizing the ratio of the deviation of each specific feature from the average value of the feature for all objects in the root-mean-square (standard) deviation for this feature.

Mathematically, this transformation is:

$$Z_{ij} = \frac{x_{ij} - \overline{x_j}}{S_j}, \qquad (4.2)$$

where Z_{ij} – standardized value of feature j for object i;

x_{ij} – value of the feature j for the i-th object;

x_j – arithmetic mean of the feature j;

S_j – standard deviation of features j.

The arithmetic mean value of the attribute j is determined by the formula:

$$\overline{X_j} = \frac{1}{n}\sum_{i=1}^{n} x_{ij}, \qquad (4.3)$$

where n – the number of objects under study.

The standard deviation for each characteristic is calculated by the formula:

$$S_j = \left[\frac{1}{n}\sum_{i=1}^{n}\left(x_{ij} - \overline{x_j}\right)^2 \right]^{1/2}. \qquad (4.4)$$

The final procedure is the formation of a distance matrix, on the basis of which, subsequently, the location of each specific object in the entire set of objects under study is determined. The distance for each attribute of an object is determined as the difference between the standardized value of this attribute and the standardized value of this indicator for a neighboring or reference object (the object is selected based on the research objectives):

$$C_{ik} = \left| Z_{ij} - Z_{kj} \right|, \qquad (4.5)$$

where Z_{ij} – value of the standardized j-th feature for the i-th object;

Z_{kj} – value of the standardized j-th feature for the object selected as the comparison base.

The elements of the distance matrix serve as the basis for the final calculations to determine the taxonomic indicator, which can be determined [36]:

– as the average absolute difference in feature values:

$$C_t = \frac{1}{p}\sum \left| Z_{ij} - Z_{kj} \right|, \qquad (4.6)$$

where p – the number of features by which objects are characterized;

– as the square root of the mean square of the difference in feature values:

$$C_t = \left[\frac{1}{p} \sum \left(Z_{ij} - Z_{kj} \right)^2 \right]^{1/2} ; \qquad (4.7)$$

– as the sum of the absolute differences in characteristic values:

$$C_t = \sum \left| Z_{ij} - Z_{kj} \right| ; \qquad (4.8)$$

– as the square root of the sum of the squares of the differences in feature values:

$$C_t = \left[\sum \left(Z_{ij} - Z_{kj} \right)^2 \right]^{1/2} . \qquad (4.9)$$

The use of certain formulas in practice depends on the objectives of the study, and the requirements put forward by the researcher to the resulting taxonomic indicator.

The undoubted advantage of the taxonomic method, which allows its widespread use, is the process of the so-called standardization of indicators, as a result of which the properties of an object, described by various qualitative and quantitative indicators, are transformed into a single standardized measurement system.

The standardization of indicators (characteristics) is a necessary procedure, since it brings all indicators to a comparable form. However, as Plyuta, V. notes from the standpoint of mathematics, this procedure also has negative consequences, which are that each of the standardized values equally affects the distance between the objects under study [34]. To get rid of this negative influence of the process of standardization of features, allow the so-called coefficients of the hierarchy, in the economic literature better known as the coefficients of weighting of an indicator (feature).

The taxonomic indicator is calculated using the classical taxonomic analysis algorithm [37].

Canonical analysis. When analyzing the economic security of regions, an important task is to study the influence of many of these factors on the performance indicators of this process. One of the methods for solving this problem is canonical correlation analysis. The most acceptable in this case is the canonical correlation method, since it allows to establish the relationship between datasets. In addition, being a generalization of multiple linear regression, this method allows to determine in each set of variables those of them that most affect the opposite set of indicators, without breaking the latent relationships between the data sets.

Canonical correlation analysis is widely used to study the relationships between multiple socio-economic processes. One of the advantages of this method is the ability to determine the in-

fluence of many factors not into one indicator characterizing the phenomenon under study, but several at once.

With the help of canonical correlation analysis, the relationships between the indicators of both sets are simultaneously investigated and the closest ones, that is, with the highest correlation coefficient, are determined. On the basis of the results obtained, the main and secondary factors of influence are distinguished, and if the latter have weak connections between the canonical values, they can be discarded. Thus, the study of the economic process will not be overloaded with unnecessary factors.

In this study, the task is set to investigate such components of the economic security of regions as innovative development and the standard of living of the population.

According to the method of canonical analysis, the main indicators of socio-economic development are divided into 2 groups:

1) indicators Y_i, which are parameters of the living standards of the population of the region and refer to the metric scale, serve as the basis for assessing the level of the latent variable, is investigated. They form the first (small) group of performance indicators;

2) signs X_i refer to the second (large) group of primary factors-symptoms of the economic security of the regions and characterize the innovative development of the regions of Ukraine.

Unlike traditional correlation-regression analysis, canonical analysis allows determining the influence of factors not in one effective indicator, but in several, which increases the practical significance of the calculations [38].

The result of the canonical analysis of two groups of variables — $Y_1, Y_2, \ldots, Y_9$ and $X_1, X_2, \ldots, X_7$ is a linear combination of features of the first group $Y_1, Y_2, \ldots, Y_s$:

$$Z_Y = a_1 Z_{Y_1} + a_2 Z_{Y_2} + \ldots + a_S Z_{Y_S}. \qquad (4.10)$$

The standardized Z_Y value can be considered as one of the estimates of the latent indicator. In this case, the canonical coefficients $\alpha_1, \alpha_2, \ldots, \alpha_s$ play the role of statistical weights of individual factor-symptoms Y_i.

In the process of research, the following tasks are solved:

– assess the tightness of the canonical correlation between the first (Y_i) and the second (X_i) groups of features;

– check the statistical reliability;

– reduce the number of indicators that affect the main criteria for changing the economic security of the regions.

Matrix methods are a set of methods for research and analysis of economic processes based on the construction of economic tables (matrices, scales). The result of the application of the matrix method for predicting the economic security of the region is a matrix of strategies for increasing the level of economic security, taking into account the living standards of the population and innovative development.

4.4 DESCRIPTION OF THE RELATIONSHIP BETWEEN THE STANDARD OF LIVING OF THE POPULATION AND THE INNOVATIVE DEVELOPMENT OF REGIONS IN THE CONTEXT OF ENSURING THEIR ECONOMIC SECURITY

Within the framework of this study, let's put forward a hypothesis about the existence of a connection between the standard of living of the population and the level of innovative development of the regions, which will make it possible to formulate strategic solutions for ensuring economic security.

To do this, it is necessary to complete the following tasks:

1) determine the level of economic security of the regions by the method of taxonomic analysis [37];

2) build canonical models of the living standards of the population and innovative development of regions (canonical analysis);

3) build a matrix «economic security – living standards – innovative development» (matrix method).

Analysis of the taxonomic indicator of the level of economic security of the regions. The results of calculating the taxonomy coefficients according to the indicators of the socio-economic development of the regions of Ukraine for the period 2008–2019 are shown in **Table 4.3**.

● **Table 4.3** Results of calculating the taxonomic indicator

Region	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
1	2	3	4	5	6	7	8	9	10	11	12	13
Vinnytsia	0.28	0.27	0.26	0.29	0.28	0.30	0.31	0.33	0.32	0.31	0.34	0.35
Volyn	0.17	0.16	0.17	0.18	0.17	0.17	0.16	0.19	0.18	0.19	0.20	0.18
Dnipropetrovsk	**0.67**	0.58	**0.70**	**0.72**	**0.67**	**0.67**	**0.59**	**0.65**	**0.51**	**0.65**	**0.72**	**0.71**
Donetsk	0.66	**0.62**	0.64	0.70	0.58	0.59	0.52	0.28	0.33	0.26	0.29	0.27
Zhytomyr	0.19	0.19	0.20	0.21	0.20	0.20	0.19	0.20	0.18	0.21	0.23	0.23
Zakarpattia	0.18	0.16	0.17	0.17	0.15	0.16	0.14	0.17	0.16	0.18	0.17	0.18
Zaporizhzhia	0.37	0.36	0.37	0.37	0.36	0.37	0.36	0.40	0.36	0.38	0.38	0.36
Ivano-Frankivsk	0.19	0.21	0.22	0.22	0.21	0.21	0.22	0.23	0.20	0.23	0.22	0.21
Kyiv	0.38	0.49	0.46	0.49	0.53	0.54	0.53	0.52	0.55	0.57	0.56	0.55
Kirovograd	0.18	0.18	0.19	0.21	0.19	0.19	0.19	0.19	0.17	0.18	0.20	0.20
Luhansk	0.32	0.28	0.29	0.32	0.28	0.26	0.16	**0.05**	**0.06**	**0.04**	**0.07**	**0.07**
Lviv	0.34	0.36	0.38	0.40	0.40	0.39	0.37	0.41	0.42	0.42	0.45	0.43
Mykolaiv	0.23	0.24	0.25	0.26	0.23	0.24	0.23	0.26	0.25	0.27	0.25	0.26
Odesa	0.40	0.43	0.42	0.40	0.42	0.42	0.38	0.41	0.40	0.41	0.43	0.42
Poltava	0.32	0.34	0.36	0.38	0.37	0.37	0.37	0.35	0.32	0.40	0.39	0.37

● **Continuation of Table 4.3**

1	2	3	4	5	6	7	8	9	10	11	12	13
Rivne	0.17	0.16	0.19	0.19	0.17	0.18	0.15	0.18	0.16	0.17	0.19	0.18
Sumy	0.19	0.20	0.19	0.22	0.21	0.21	0.20	0.20	0.16	0.23	0.22	0.20
Ternopil	0.15	0.13	0.15	0.17	0.16	0.16	0.14	0.15	0.14	0.17	0.17	0.20
Kharkiv	0.42	0.47	0.42	0.46	0.48	0.48	0.47	0.46	0.43	0.46	0.46	0.42
Kherson	0.18	0.17	0.19	0.20	0.17	0.17	0.18	0.17	0.16	0.18	0.20	0.20
Khmelnitskyi	0.22	0.22	0.23	0.24	0.24	0.24	0.25	0.25	0.23	0.24	0.26	0.24
Cherkasy	0.26	0.27	0.27	0.27	0.26	0.25	0.25	0.25	0.24	0.25	0.28	0.29
Chernivtsi	**0.14**	**0.12**	**0.13**	**0.13**	**0.12**	**0.11**	**0.10**	0.12	0.09	0.12	0.12	0.12
Chernihiv	0.18	0.17	0.18	0.20	0.20	0.20	0.17	0.18	0.17	0.22	0.21	0.20
Maximum	0.67	0.62	0.70	0.72	0.67	0.67	0.59	0.65	0.55	0.65	0.72	0.71
Minimum	0.14	0.12	0.13	0.13	0.12	0.11	0.10	0.05	0.06	0.04	0.07	0.07
Divergence	0.53	0.50	0.56	0.59	0.55	0.55	0.49	0.60	0.49	0.61	0.65	0.64

Source: calculated by the authors based on the data [39]

For the entire period of the study, a high value of the integral indicator of economic security is observed in the Dnipropetrovsk region, the average value of which for 2008–2019 is 0.65; the next value in the Kyiv region is at the level of 0.51 points, that is, the gap is 0.14 points. The value of Donetsk region is lower by 0.03 points relative to the Kyiv region. The least value of the integral indicator of economic security was recorded in the Chernivtsi region – 0.12 points (**Fig. 4.2**).

The discrepancy between the maximum and minimum values of the integral indicator of economic security fluctuates on average at the level of 0.53 points from 0.49 (2014) to 0.64 (2019). This is a fairly significant deviation. At the same time, according to the results of the calculations, it can be argued that there is a tendency for an increase in disproportions to ensure the economic security of the regions after the reform of the decentralization of public administration.

Canonical models of living standards of the population and innovative development of regions. The list of indicators characterizing the standard of living of the population (Y_i) and innovative development (X_i) is presented in **Table 4.4**.

Indicators Y_1, Y_2, Y_3, Y_4, Y_5, Y_6, Y_7, Y_8, Y_9 are particular signs of the economic security of regions – the standard of living of the population related to the metric scale and serve as the basis for assessing the level of the latent variable is being investigated. They create the first (small) group of performance indicators in accordance with the definition of the economic security of the region. The signs X_1, X_2, X_3, X_4, X_5, X_6, X_7 belong to the second group of primary factors-symptoms of the economic security of the region and characterize the innovative development of the regions of Ukraine. In the process of practical solution of the set tasks, the STATISTICA 10.0 system was used, in particular, the Canonical Analysis module [40].
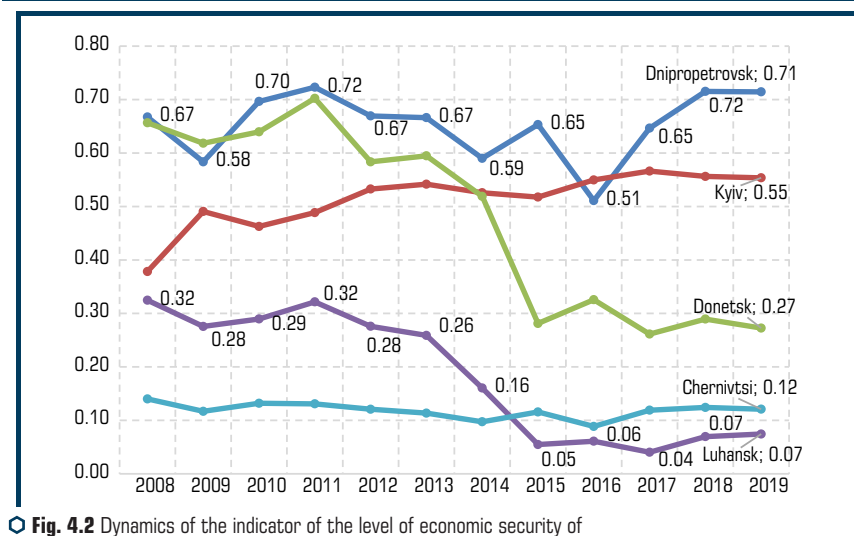
○ **Fig. 4.2** Dynamics of the indicator of the level of economic security of Dnipropetrovsk, Kyiv, Donetsk, Chernivtsi, Luhansk regions

● **Table 4.4** Groups of indicators of private signs of the standard of living of the population of the regions (Y_j) and primary symptom factors (X_i)

Private features group		Group of primary symptom factors	
Y_1	The volume of expenditures of local budgets (including interbudgetary transfers) per person, hryvnia	X_1	The number of innovatively active enterprises for internal research and development
Y_2	Expenses of the population per person, UAH	X_2	The number of innovatively active enterprises for external research and development
Y_3	Migration growth (reduction) of the population	X_3	The number of innovatively active enterprises by purchased machines, equipment and software
Y_4	Number of people employed in economic activity, thousand people	X_4	The number of innovatively active enterprises based on acquired by other external knowledge
Y_5	Disposable income of the population per person, UAH	X_5	The number of other innovatively active enterprises
Y_6	Average monthly salary, UAH	X_6	Industrial innovation spending
Y_7	Consumer price index, percent	X_7	The volume of sold innovative products (goods, services) of industrial enterprises
Y_8	Average assigned monthly pension for pensioners		
Y_9	Proportion of population with per capita equivalent total income		

The results of calculations of the canonical analysis of the factors of economic security of the regions – the standard of living of the population and innovative development – indicate a strong relationship between the canonical variables, confirmed by the value of the canonical correlation coefficient (Canonical R) – 0.883. The total excess for the variables of the first group ($X_1–X_7$) is 35.7 %, and the total excess for the variables of the second group ($Y_1–Y_9$) is 56.64 %.

This means that 88.23 % of the variation in effective living standards is explained by variations in seven symptom factors ($X_1–X_7$).

In turn, the effective indicators of regional economic security describe 56.64 % of variations in symptom factors. Such values of the indicators indicate the accuracy of the obtained canonical models, 43 % of the variance of the effective indicators of the standard of living of the population depends on other factors not taken into account in the model, which is quite true.

To construct a mathematical expression of models for assessing the standard of living of the population and the innovative development of regions, the coefficients of the canonical variables were determined, which made it possible to write down the mathematical expressions of the models. The obtained canonical models of regional economic security in a standardized form are written as follows (4.11), (4.12):

$$Z_Y = -0{,}28Y_1 + 0{,}278Y_2 + 0{,}6Y_3 + 0{,}76Y_4 + 0{,}115Y_5 - 0{,}21Y_6 + 0{,}37Y_7 + 0{,}004Y_8 - 0{,}021Y_9; \quad (4.11)$$

$$Z_X = 0{,}304X_1 + 0{,}348X_2 + 0{,}93X_3 + 0{,}65X_4 + 0{,}71X_5 + 0{,}03X_6 + 0{,}11X_7. \quad (4.12)$$

The practical implementation of the presented models is complicated by the standardized values of Y and X provided in it and, therefore, it is advisable to carry out the procedure of transition from standardized variables to ordinary ones according to formula (4.2).

The mathematical notation of the models takes the following form (4.13), (4.14):

$$Z_Y = -0{,}22Y_1 + 0{,}016Y_2 + 0{,}067Y_3 + 0{,}002Y_4 + 0{,}01Y_5 - 0{,}208Y_6 + 0{,}164Y_7 + 0{,}012Y_8 - 0{,}003Y_9; \quad (4.13)$$

$$Z_X = 0{,}06X_1 + 0{,}15X_2 + 0{,}079X_3 + 0{,}362X_4 + 0{,}154X_5 + 0{,}000043X_6 + 0{,}0001X_7. \quad (4.14)$$

The results of the implementation of the models (4.13, 4.14) according to the data of 2017–2019 are presented in **Table 4.5**.

Thus, the range of fluctuations of the calculated indicators of the level of investment development of the regions during the study period 2017–2019. It is characterized: according to 2017, a low value of the indicator is observed in the Luhansk region – 0.71; 2018 – Volyn region – 0.65; according to 2019 – Khmelnytskyi region – 0.58 points. The maximum value of the level of innovative development throughout the entire period of the study is observed in the Kharkiv

region – 13.23, 9.68 and 9.55, respectively. In addition, the calculation results indicate significant deviations between the minimum and maximum values – on average 94 % (**Fig. 4.3**).

● **Table 4.5** Implementation of models Z_{Xi} (4.13), Z_{Yi} (4.14) according to 2017–2019 data

Region	Z_{X2017}	Z_{Y2017}	Z_{X2018}	Z_{Y2018}	Z_{X2019}	Z_{Y2019}
Vinnytsia	3.50	17.24	3.34	16.19	3.64	15.34
Volyn	1.16	16.99	**0.65**	15.73	1.17	15.01
Dnipropetrovsk	6.97	**21.24**	3.89	18.74	8.99	17.70
Donetsk	4.24	15.54	3.50	15.29	5.74	14.95
Zhytomyr	1.85	17.21	1.96	16.17	1.96	15.43
Zakarpattia	1.27	17.41	0.67	16.68	1.32	15.34
Zaporizhzhia	6.74	17.86	5.27	16.71	7.35	15.89
Ivano-Frankivsk	2.17	17.67	3.16	16.37	1.69	15.69
Kyiv	5.27	19.85	5.24	18.66	6.21	17.99
Kirovograd	3.12	16.97	1.63	15.76	2.06	14.92
Luhansk	**0.71**	**14.70**	0.96	**14.39**	1.12	**14.24**
Lviv	7.96	18.91	8.70	18.14	7.18	17.37
Mykolaiv	3.49	17.26	1.42	16.31	3.28	15.20
Odesa	4.07	19.36	4.13	18.59	4.37	17.92
Poltava	4.24	17.01	3.23	16.09	4.42	15.66
Rivne	1.13	17.19	1.36	15.73	2.72	15.03
Sumy	4.27	17.21	3.29	16.12	3.73	15.69
Ternopil	2.85	16.98	2.29	16.08	2.59	15.31
Kharkiv	**13.23**	20.66	**9.68**	19.51	9.55	**18.78**
Kherson	1.96	17.48	1.84	16.38	1.71	15.56
Khmelnitskyi	0.85	17.15	0.87	16.29	**0.58**	15.67
Cherkasy	2.77	17.36	2.09	16.22	1.67	15.40
Chernivtsi	1.67	16.95	1.43	16.14	1.52	15.47
Chernihiv	1.18	17.05	3.05	15.99	1.27	15.35
Maximum	13.23	21.24	9.68	19.51	9.55	18.78
Minimum	0.71	14.70	0.65	14.39	0.58	14.24
Divergence	95 %	31 %	93 %	26 %	94 %	24 %
Average value	3.61	17.64	3.07	16.59	3.58	15.87
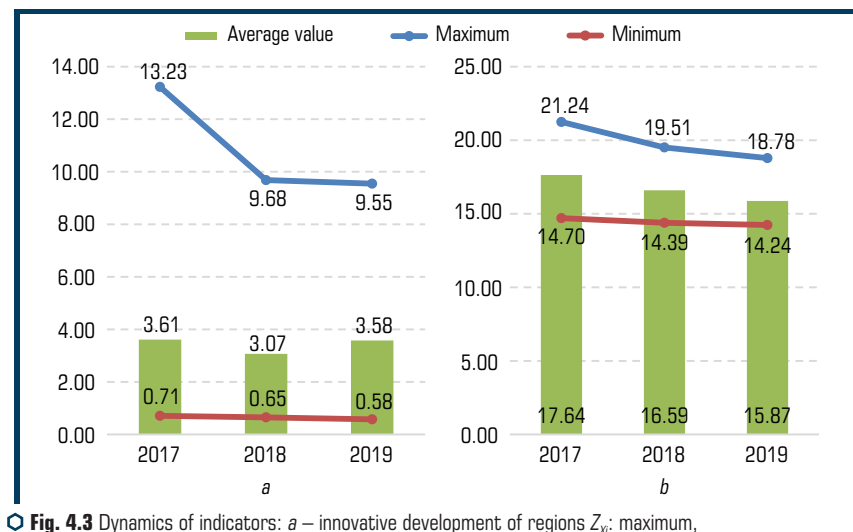
Fig. 4.3 Dynamics of indicators: a — innovative development of regions Z_{Xi}: maximum, minimum and average values, 2017–2019; b — standard of living of the population Z_{Yi}

The applied application of models for assessing the living standards of the population Z_{Yi} (b) and innovative development of regions Z_{Xi} for 2019 is presented in **Fig. 4.4**.
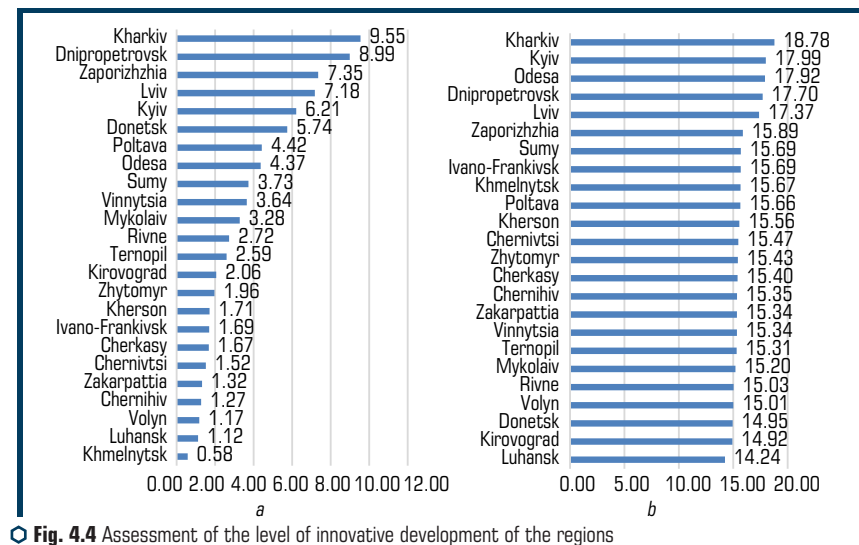
Fig. 4.4 Assessment of the level of innovative development of the regions of Ukraine: a — model Z_{Xi}; b — model Z_{Yi} (based on the results of 2019)

The results allow to assess the place of the region in the plane of economic security from the standpoint of the level of innovative development and the standard of living of the population, to determine the presence of disparities between regions. Based on the calculations and their visualization, it was established that the Dnipropetrovsk region occupies a leading position in terms of economic security, while in terms of the level of innovative development it is the second after the Kharkiv region and the fourth in the standard of living of the population (after Kharkiv, Kyiv and Odesa). The lowest level of innovative development was recorded according to the data of the Khmelnytskyi region and according to the standard of living of the population — the Luhansk region.

Thus, the obtained calculation results do not represent a comprehensive idea of the policy of ensuring the economic security of the regions by regulating innovative development and ensuring the standard of living of the population. The next chapter presents the results of a comprehensive econometrics for choosing a strategy for increasing the level of economic security of regions by constructing a matrix «economic security – standard of living – innovative development».

4.5 COMPREHENSIVE ECONOMETRICS FOR CHOOSING A STRATEGY FOR INCREASING THE LEVEL OF ECONOMIC SECURITY OF REGIONS: THE MATRIX "ECONOMIC SECURITY – STANDARD OF LIVING – INNOVATIVE DEVELOPMENT"

The use of economic and mathematical methods made it possible to comprehensively determine the level of economic security of the regions. The use of existing methods of system analysis and synthesis made it possible to monitor the level of economic security of the regions, the standard of living of the population and the innovative development of the regions.

It is proposed to determine strategies for increasing the level of economic security of regions using a matrix management strategy, which is based on the values of the level of economic security (taxonomic indicator), the model of the level of innovative development Z_{Xi} and the standard of living of the population Z_{Yi}. The matrix of the ratio of these indicators with the allocation of the corresponding zones is presented in **Fig. 4.5**.

Level of innovative development Z_{Xi}	
Innovative development strategy	Growth strategy
Transformation strategy	Human development strategy

Fig. 4.5 «Economic security – living standards – innovative development» matrix

Transformation strategy. The peculiarities of the transformation of regional economic systems in the context of innovative development include the following factors: entrepreneurship, informatization, new technologies, labor organization, structural transformations [41, 42], it should be noted that the transformation strategy is focused on the formation of the economic security of the region through transformation processes in the formation of potential innovative development of the region and/or the efficiency of using the existing potential. Taking into account the specificity of the factors of economic development of each region, it is advisable to form the directions of transformation processes based on the analysis of the main indicators of the socio-economic development of the region and monitoring the level of economic security. The spheres of transformation processes, again taking into account the specifics of the region, can be the following: industry, entrepreneurship, informatization, new technologies, labor organization, structural transformations. At the same time, the directions of transformation are determined at the regional level, and the spheres of transformation processes are determined at the national level.

The strategy is based on the principles of polarized development, support for regional initiatives, and synchronization of actions. The scope of application is determined in accordance with the specifics of the economic system of the region. One of the options is transformation processes in the sectoral structure of the region, involving the use of new technologies, the development of entrepreneurship, and the like. The programs of the proposed strategies are presented in **Table 4.6**.

Growth strategy. According to the proposed matrix, it is characterized by the development and implementation of a growth strategy. Economic security, in its essence, does not have a completed stage, the conditions and sphere of its occurrence provide for constant changes in the value of its level – any subject of the economic security system strives to a safe level of its functioning and development. The system for developing a strategy for the growth of the economic security of the region, in contrast to the previous strategies, is based on the existing strategy of economic development and ensuring the economic security of the region and provides for the implementation of preventive measures to prevent the possible negative impact of threats. The results of applying the proposed matrix are presented in **Fig. 4.6–4.8**. According to **Fig. 4.6–4.8** during 2017–2018 the best state in terms of innovative development and quality of life of the population to ensure the level of economic security is observed in two regions: Lviv and Kharkiv regions. According to the matrix «economic security – living standards – innovative development», built on the 2019 database, it was found that most regions of Ukraine require the use of a transformation strategy.

This necessitates the development and implementation of transformation strategies, taking into account such destabilizing factors:

– decrease in the level of human development;

– increase in the level of poverty of the population;

– determination of the spheres and directions of transformation processes within each separate region;

– formation of sources of investment funds for the implementation of innovations;

– reducing the level of control over corruption and the quality of regulation.

● **Table 4.6** Programs for the implementation of strategies for ensuring economic security: innovative development — living standards of the population

Strategy name	Transformation strategy	Innovative development strategy	Human development strategy	Growth strategy
Problem	**Ensuring the economic security of the region**			
Strategy goal	Intensification of innovative activity in various fields with the implementation of structural transformations; improving the living standards of the population	Improving the efficiency of using the innovative potential of the region	Creation of conditions for the comprehensive development of a person throughout the life, expanding opportunities for the realization of individual freedom, business and civic activity in the harmonious, balanced and sustainable development of the country	Building up the margin of safety for the region's economic security
Strategy task	Structural transformation	Reconstruction transformations	Reconstruction transformations	Preventive measures, functioning on warning
Stages of strategy implementation	1) design and research; 2) pilot projects; 3) systemic transformations	1) research; 2) corrective actions; 3) reconstruction transformations	1) research; 2) corrective actions; 3) reconstruction transformations	1) monitoring; 2) corrective actions; 3) improvement (clarification) of the current Strategy
Main activities	– implementation of priority programs and projects; – performance of research works; – transfer of innovations; – solving infrastructure problems and increasing infrastructure potential; – formation of a positive investment image; – development of measures to improve the system of attracting investment resources; – training of specialists; – increase in labor and intellectual potential; – formation of a margin of safety to resist destabilizing factors of various types	– implementation of priority programs and projects; – reconstruction of the existing investment image of the region; – adjustment of the system of attracting investment resources for the introduction of innovations; – using a margin of safety to resist destabilizing factors of various types	– implementation of priority programs and projects to ensure a high standard of living of the population; – reforming the healthcare sector; – development of educational space; – improving the standard of living, enhancing employment and providing social support to citizens	– implementation of priority programs and projects; – support for the existing investment image of the region; – improving the system of attracting investment resources; – increase in labor and intellectual potential; – using a margin of safety to resist destabilizing factors of various types
Sources of funding for the strategy	Funds of the state, regional and local budgets, extrabudgetary funds	Mainly funds of regional and local budgets, extra-budgetary funds, state budget funds	Funds of the state and local budgets, funds of the Pension Fund of Ukraine and state social insurance funds, international technical assistance, loans from international financial organizations, from other sources not prohibited by law	Mainly funds of regional and local budgets, extra-budgetary funds, state budget funds

Source: compiled based on [33]

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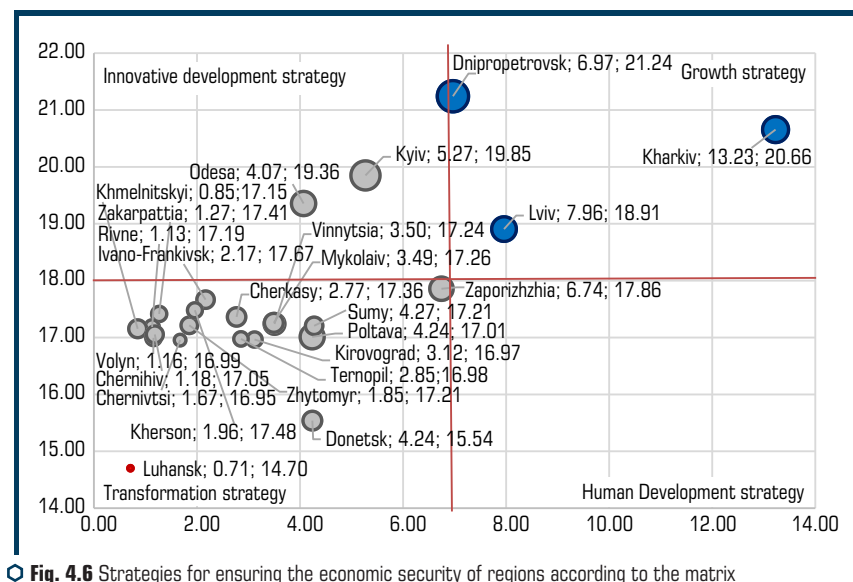
Fig. 4.6 Strategies for ensuring the economic security of regions according to the matrix «economic security – standard of living – innovative development» in 2017
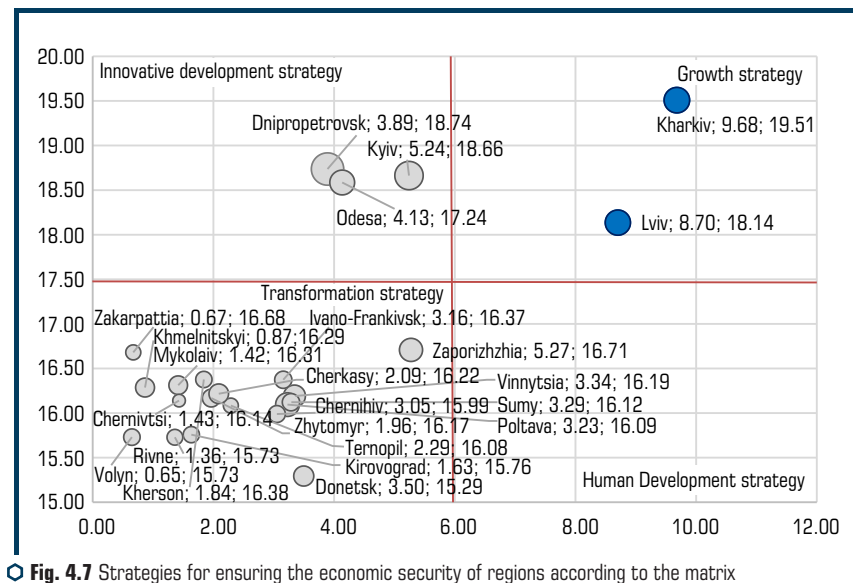
Fig. 4.7 Strategies for ensuring the economic security of regions according to the matrix «economic security – standard of living – innovative development» in 2018
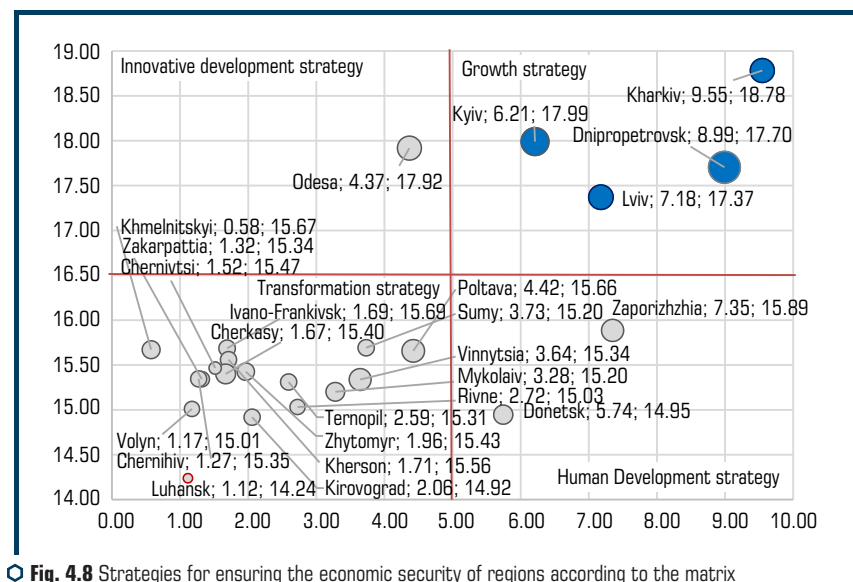
Fig. 4.8 Strategies for ensuring the economic security of regions according to the matrix «economic security – standard of living – innovative development» in 2019

Analysis of the strategies of the regions [43, 44], for which it was recommended to implement the transformation strategy, made it possible to determine the strategic priorities:

1) development of small and medium-sized businesses on an innovative basis;

2) development and modernization of infrastructure, primarily transport communications and housing and communal services;

3) harmonious development of the leading sectors of the region's economy (industrial sector, agricultural sector, construction, high-tech services and forestry);

4) development of tourist (historical, cultural and natural and recreational) potential.

According to **Fig. 4.6–4.8** the exception is Kharkiv, Dnipropetrovsk, Lviv and Kyiv regions. It was found that the most acceptable is the growth strategy, the implementation of which ensures the preservation of the existing level of economic security and the prevention of possible threats. A significant factor at the regional level is the growth of the disposable income of the population of the regions per capita (wages, profits, mixed income, balance of property income, etc.) and the export of services.

Analysis of the existing strategies for the economic development of the regions, for which the growth strategy is recommended for use, made it possible to determine their strategic priorities:

1) development of human capital;

2) reduction of intraregional economic imbalances;

3) development of rural areas;

4) environmental and energy security.

The implementation of the Strategy will make it possible to transform the economy of regions with a rather slowly growing economy with a large asymmetry in the development of individual territories of the region into a more modern economy based on innovation, the activity of entrepreneurs, based on the optimal location of economic entities and the economical use of the region's natural resources. The implementation of the strategy contributes to an increase in the level of economic security of the region.

So, the econometric approach made it possible to determine the general dynamics of the level of economic security, life of the population and innovative development; identify links between various groups of economic security features and form a matrix that is quite applied in nature.

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5

INFORMATION AND ANALYTICAL SUPPORT FOR THE DEVELOPMENT OF A STRATEGY FOR THE DEVELOPMENT OF THE INNOVATIVE INFRASTRUCTURE OF UKRAINE

Yu. Bocharova, Yu. Lyzhnyk, Yu. Vorobiova, V. Koshel

ABSTRACT

The analysis of the process of making managerial decisions was carried out; its varieties are determined depending on the type of managerial decisions; the types used in the process of making managerial decisions are determined. The features and advantages of Data-driven decision-making over Highest Paid Person's Opinion are determined. The author's approach to understanding the concept of «information and analytical support of managerial decisions» is proposed, the types of information and analytical support of managerial decisions and the methods used for its formation are determined. The analysis of the features of the innovative development of the countries of the world is carried out. Based on the cluster analysis, three groups of countries were identified (countries that are leaders in innovative development, countries that are moderate innovators, countries that are modest innovators), which are characterized by similar parameters and results of innovative development. Identified and ranked (based on the results of the correlation analysis) the main factors that determine the features of the innovative development of the leading countries of innovative development.

Based on the method of the main components, it has been established that the country's innovative development is more not deterministic, but a controlled process, the main objects of which are the architecture of the innovation infrastructure, the volume of public expenditures on R&D. The analysis of the state and peculiarities of the development of the innovative infrastructure of Ukraine is carried out.

The strategic directions for the development of the innovative infrastructure of Ukraine (development of the institutional environment for the development of the innovative infrastructure, reconfiguration and diversification of the functional components of the innovative infrastructure, increasing the competitiveness of the structural elements of the functional components of the innovative infrastructure) have been determined.

On the basis of correlation-regression analysis, calculation of partial coefficients of elasticity, the potentially most effective variant of reconfiguration of the functional components of the innovation infrastructure has been established.

KEYWORDS

5.1 THE THEORETICAL BASIS FOR THE FORMATION OF INFORMATION AND ANALYTICAL SUPPORT FOR MANAGERIAL DECISIONS

The most important result of management activities of all types and levels are managerial decisions. There are six types of managerial decisions, depending on their focus:

1. Policy and Implementation Decisions.
2. Tactical and Strategic Decisions.
3. Programmed and Non-programmed Decision.
4. Basic and Routine Decisions.
5. Organizational and Personal Decisions.
6. Reactive and Planned Decisions [1].

Management activity associated with making a managerial decision is a decision-making process (DMP). Depending on the type of managerial decision generated, the types of DMP are distinguished (**Fig. 5.1**).
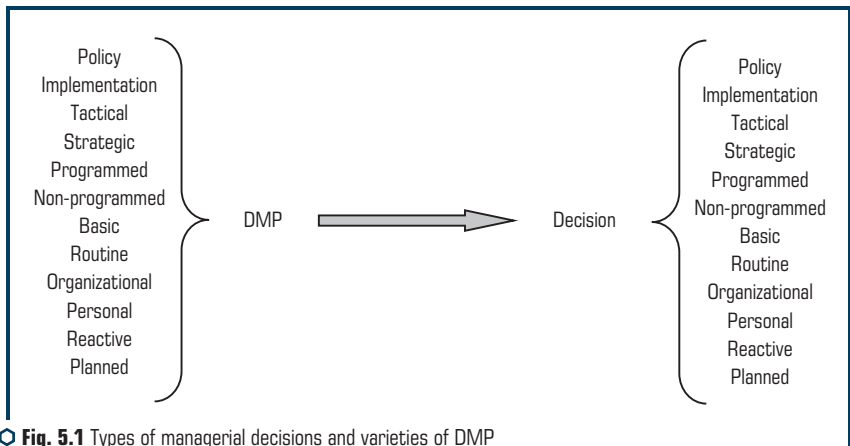
○ **Fig. 5.1** Types of managerial decisions and varieties of DMP
Source: compiled by the author based on data [1–20]

Each type of DMP has specific features that are determined by the type of managerial decision made by its object, subject and subject matter of it.

From the standpoint of economic theory and the rational model of decision making, any type of DMP is a multistage process that includes the following stages:

1. Formulating a goal(s).
2. Identifying the criteria for making the decision.
3. Identifying alternatives.
4. Performing an analysis.

5. Making a final decision [1].

However, as practice shows, in reality, DMP rarely fully consists in rational model of decision making, and, as a consequence, decisions are made in conditions of limited rationality.

There are the following most common non-rational decision making models:

1. Bounded rationality model (the rationality of the decision is limited by such factors as the cognitive capacity of managers and time constraints, under such conditions managers seek alternatives only until they find one that looks satisfactory, rather than seeking the optimal decision).

2. Incremental model (the rationality of the solution is limited by a number of factors, including the reluctance of managers to solve a certain problem, the desire to reduce it to an acceptable level).

3. Garbage-can model (the rationality of the solution is limited by the lack of strategic vision, understanding of the problem, interests, and the practice of those who were involved in solving it).

4. Negotiated Order (the rationality of the decision is limited by the lack of evidence, facts, data, compromise, it is determined in terms of involving various groups of people in the decision-making process) [1].

Understanding that DMP rarely fully consists in rational model of decision making, the presence of a significant number of non-rational decision making models does not mean that the management process does not need to strive to rationalize the decision made, but indicates that certain difficulties arising from ensuring this. A key element in the rationalization of DMP is Situation Awareness or situation assessment [13]. A Situation Awareness or Situation Assessment cannot be carried out without relevant information.

The concept of «information» is not clearly defined today. However, most often it means data, facts about a situation, object of research, etc. [21, 22].

Most often, there are 6 types of information, data:

1. Quantitative data (information that seems to be the easiest to explain).

2. Qualitative data (information that consist of words, pictures, and symbols, not numbers, can't be expressed as a number and can't be measured).

3. Nominal data (information that is used just for labeling variables, without any type of quantitative value).

4. Ordinal data (information that shows where a number is in order).

5. Discrete data (information that involves only integers).

6. Continuous data (information that could be meaningfully divided into finer levels. It can be measured on a scale or continuum and can have almost any numeric value) [23].

In addition, at the present stage of development, the 7th type of data is distinguished – Big Data, which is digitized, heterogeneous data characterized by specific properties (Volume (starting from petabytes, which is equivalent to 10^{15} bytes); Velocity (as the rate of receipt, accumulation data and the speed of their processing in order to obtain final results); Variety; Veracity; Value (according to IBS estimates, only 1.5 % of the accumulated data arrays have informational value); Variability; Volatility; Vulnerability; Validity; Visualization), which cannot be processed by traditional methods [24].

Data-driven decision-making (DDDM) or evidence-based decision making [4, 8, 9].

As modern management practice shows, DDDM is an alternative to HiPPO (Highest Paid Person's Opinion), that is, a decision that is made based on the opinion of a manager, an intuitive decision. As Charles Yoe notes, HiPPO or «… have relied on such things as precedent, trial and error, expert opinion, professional judgment, compromise, safety assessment standards, precaution, inspection, zero tolerance» [14].

DDDM results are more objective, transparent, reasonable, successful [3], less risky compared to HiPPO. Despite the significant advantages of DDDM over HiPPO, «The Harvard Business Review found that while 80 % of survey respondents rely on data in their roles and 73 % rely on data to make decisions, 84 % still said managerial judgment is a factor when making key decisions» [3].

Still significant popularity of HiPPO, as noted by Welle, J. is associated with a low level of data culture, significant interorganizational and intercountry asymmetries of its development. According to Welle, J. developing a data culture is a phased process:

1) data Denial (the organization starts with an active distrust of data and does not use it);

2) data Indifference (the organization has no interest in whether data is collected or used);

3) data Aware (the organization is collecting data and may use it for monitoring, but the organization does not base decisions on it);

4) data Informed (managers use data selectively to aid decision making);

5) data Driven (data plays a central role in as many decisions as possible across the organization) [25]. At the same time, it notes that as the culture of data develops, they actively begin to perform an administrative function [4].

DDDM includes seven main stages of decision making:

1. Definition of the problem, the purpose of management activities.

2. Formulation of the hypothesis or the initial decision matrix [12], the study of the ontology of the problem.

3. Determination of the list of necessary information, data.

4. Construction of the data transfer process.

5. Collection of information, formation of a database, information support for managerial decisions. The effectiveness of managerial decisions is closely related to the quality of the research information base. The quality of the existing research information base depends not only on its quantitative parameters, but also on its relevance and pertinence.

6. Analysis of information support. The quality of the analysis of information support is determined by the relevance of the methods used, the relevance of the results obtained to the purpose of the study. The end result of this step is the construction of the Decision Matrix, which may differ from the initial decision matrix, and the Risk Matrix. However, as Yoe, C. notes, Risk=Consequence×Probability. «… Risk analysis is a process for decision making under uncertainty that consists of three tasks: risk management, risk assessment, and risk communication… risk analysis adds the most value to decision making. This value depends on how much uncertainty the organization faces and the consequences of making a wrong decision» [14].

7. Making managerial decisions based on the assessment and analysis of available alternatives, criteria and other framework conditions for decision-making (Multicriteria Decision-Making (MCDM)) and Effects matrix [4, 7, 12].

The effectiveness of managerial decisions based on information and analytical support, in addition, depends on the data-driven decision making capability (DDDMC) [8] institutions or the subject making the decision. As noted by the team of authors [8], DDDMS institutions or a decision-maker depends on their 5 capabilities:

1) data governance capability;

2) data analytic capability;

3) insight exploitation capability;

4) performance management capability;

5) integration capability [8]. These capabilities are closely related to the stages of DDDM and determine their effectiveness.

DDDMC institutions or a decision-maker can form the basis for the explanation of «The Decision-Making Paradox» [12].

Thus, in order to make an effective managerial decision based on data, the subject, the organization that makes the decision, must have the necessary knowledge, data and information.

Taking into account all of the above, as well as the turbulence of the external environment, bias in judgments, difficulties in intuitive understanding of significant amounts of quantitative and qualitative information, difficulties in making consistent decisions in conditions of uncertainty, entropy [11], the need for transparency and validity of managerial decisions, today there is an urgent need for information and analytical support of managerial decisions.

Information and analytical support of managerial decisions – information about the object of management, obtained from various sources, using various economic and statistical, economic and mathematical methods and models, performs four main functions (descriptive, diagnostic, predictive and administrative [2]) is the basis for making managerial decisions.

In accordance with the functions of information and analytical support, the following types are distinguished:

«Descriptive Analytics: The preliminary stage of data processing in which one extracts historical insights from data and prepares it for more advanced forms of analysis.

Diagnostic Analytics: The branch of data analytics that focuses on determining the causes of phenomena.

Predictive Analytics: The branch of data analytics that focuses on extracting patterns from historical data with the aim of predicting future events.

Prescriptive Analytics: The branch of data analytics that focuses on using data to determine the most appropriate course of action when there's a decision to make» [4].

Today, 90 % of organizations use Descriptive Analytics for DMP [20].

Methods for the formation of information and analytical support were elaborated long time ago, in 1930 [19], depend on its type, the type of managerial decision and other factors.

Most often, when forming information and analytical support, the following methods are used: Factor analysis, Main component analysis (PCA), Correspondence analysis, Canonical analysis, Cluster analysis, Corellium analysis, regression analysis, spectral analysis, Artificial neural networks, network analysis, pattern recognition other.

Thus, the information and analytical support of managerial decisions depends on the subject-object structure of management activities, the subject of managerial decisions, time and other resources, the methodology for collecting and processing information necessary for decision-making.

Public administration as a type of management activity is no exception, and, as a result, requires information and analytical support for managerial decisions.

5.2 INFORMATION AND ANALYTICAL SUPPORT OF MANAGERIAL DECISIONS ON INNOVATIVE DEVELOPMENT AND DEVELOPMENT OF THE INNOVATIVE INFRASTRUCTURE OF UKRAINE

One of the most pressing problems that Ukraine faces today require informed managerial decisions, is the country's innovative development, because it is the country's innovative development and innovativeness that are today the determining factors of socio-economic development, economic growth, components of global competitiveness and ensuring economic security of any country in the world. In 2012–2020 Ukraine has significantly improved its position in the global innovation index, moving from 63rd place in 2012 to 45th place in 2020. As the analysis of the dynamics of the components of the global innovation index shows, the improvement took place both in terms of the available resources and conditions for the implementation of innovative activities (entry sub-index) and the results achieved by this activity (output sub-index). At the same time, the main catalysts for the positive trends in Ukraine's position in the rating were: the institutional environment, the results of creative activity, and market experience was the destructor (**Table 5.1**).

Despite the presence of significant positive trends, Ukraine today is not included in the group of countries leading innovative development, requires further development of its innovative potential, a clear understanding of the country's position in the world, its strategic goal, tools to achieve goals.

The analysis of the dynamics of the global indices of innovativeness of countries, the share of countries in the gross value added created in knowledge-intensive and high-tech industries as the most authoritative and representative indicators of innovative shifts in the development of countries of the world allows to state that modern countries of the world are very differentiated in terms of the level of innovative development.

Based on the clustering method (*K*-means clustering algorithm), three clusters of countries were identified (**Table 5.2**), which differ significantly among themselves in terms of indicators such as the level of innovativeness of the country (according to the World Intellectual Property Organization, as well as the country's share in the gross value added created in knowledge-intensive (knowledge-intensive) and high-tech industries in 2016 and 2018 (2016 and 2018 was selected as the most relevant time interval for which there are relevant statistical observations).

● **Table 5.1** Global Innovation Index of Ukraine

Indicator	Years										Absolute deviation	
	2012		2014		2016		2018		2020			
	score	place	score	place	score	place	score	place	score	place	score	place
General index	36.1	63	36.3	63	35.7	56	38.5	43	36.3	45	0.22	18
Subindex input1	38	78	38.2	88	38.9	76	40.5	75	40.1	71	2.14	7
Institutional environment	40	117	52.9	103	48.7	101	49.1	107	55.6	93	15.6	24
Human capital and research	42.2	48	36.6	45	40.8	40	37.9	43	40.5	39	−1.7	9
Infrastructure	27.1	98	27.1	107	32.3	99	38.1	89	33.1	94	6	4
Market dawn	38.7	68	45.1	90	42.1	75	42.7	89	42.1	99	3.4	−31
Business dawn	42.3	51	29.1	87	30.6	73	34.5	46	29.5	54	−12.8	−3
Subindex input2	34.2	47	34.4	46	32.5	40	36.6	35	32.5	37	−1.71	10
Scientific and technological results	39.2	30	38.2	32	34.1	33	36.7	27	35.1	25	−4.1	5
Results of creative activity	29.2	83	30.6	77	31	58	36.5	45	29.9	44	0.7	39
Efficiency of Innovation	0.9	14	0.9	14	0.8	12	0.9	5	n/a	n/a	–	–

Source: compiled and calculated by the author based on the source data [26, 27]
Note: "+" sign indicates improvement of positions; sign "−" – deterioration

● **Table 5.2** Cluster analysis results

Cluster	Cluster parameters	Country	Note
2016 (73 countries)			
1st Leading countries of innovative development (24)	Average indicator of innovativeness – 55.8 (max – 66.28, min – 49.19) The average share of value added, created in knowledge-intensive and high-tech industries – 3.5 % (max – 31.6%, min – 0.21 %)	Switzerland, Sweden, United Kingdom, United States of America, Finland, Singapore, Ireland, Denmark, Netherlands, Germany, Korea, Canada, Japan, New Zealand, France, Australia, Austria, Israel, Norway, Belgium, China, Czech Republic, Spain, Italy	
2nd Moderate innovators (28)	Average indicator of innovativeness – 37.6 (max – 47.17, min – 33.61) The average share of value added created in knowledge-intensive and high-tech industries – 0.35 % (max – 3.07%, min – 0.03 %)	Portugal, Hungary, Malaysia, Slovakia, Bulgaria, Poland, Greece, United Arab Emirates, Turkey, Russia, Chile, Costa Rica, Romania, Saudi Arabia, Qatar, Thailand, South Africa, **Ukraine**, Bahrain, Vietnam Mexico, Uruguay, Colombia , Georgia, India, Kuwait, Panama, Brazil	
3rd Modest innovators (21)	Average indicator of innovativeness – 27.6 (max – 33.49, min – 22.32) The average share of value added created in sci-ence-intensive and high-tech industries – 0.14 % (max – 2.9%, min – 0.01 %)	Peru, Morocco, Oman, Philippines, Tunisia, Iran, Kenya, Argentina, Indonesia, Sri Lanka, Ecuador, Honduras, Ghana, Senegal, Egypt, Bolivia, Nigeria, Bangladesh, Cameroon, Pakistan, Venezuela	
2018 (72 countries)			
1st Leading countries of innovative development (23)	Average indicator of innovativeness – 56.2 (max – 68.4, min – 48.68) The average share of value added, created in knowledge-intensive and high-tech industries – 3.62 % (max – 26.2 %, min – 0.09 %)	Switzerland, Sweden, United Kingdom, United States of America, Finland, Singapore, Ireland, Denmark, Netherlands, Germany, Korea, Canada, Japan, New Zealand, France, Australia, Austria, Israel, Norway, Belgium, China, Czech Republic, Spain	Italy (1→2)
2nd Moderate innovators (24)	Average indicator of innovativeness – 38.95 (max – 46.32, min – 34.27) The average share of value added created in knowl-edge-intensive and high-tech industries – 0.48 % (max – 2.56 %, min – 0.05 %)	Portugal, Hungary, Malaysia, Slovakia, Bulgaria, Poland, Greece, United Arab Emirates, Turkey, Russia, Chile, Costa Rica, Romania, Saudi Arabia, Qatar, Thailand, South Africa, **Ukraine**, Vietnam, Mexico, Uruguay, India, Kuwait, Italy	Georgia (n/a), Italy (1→2), Brazil (2→3), Colombia (2→3), Panama (2→3), Bahrain (2→3)
3rd Modest innovators (25)	Average indicator of innovativeness – 29 (max – 33.44, min – 23.06) The average share of value added created in sci-ence-intensive and high-tech industries – 0.17 % (max – 0.86%, min – 0 %)	Peru, Morocco, Philippines, Tunisia, Iran, Kenya, Argentina, Indonesia, Sri Lanka, Ecuador, Honduras, Senegal, Egypt, Bolivia, Bangladesh, Cameroon, Pakistan, Brazil, Colombia, Panama, Bahrain, Jamaica, Peru, Jordan Zimbabwe	Oman (n/a), Ghana (n/a), Nigeria (n/a), Venezuela (n/a), Brazil (2→3), Colombia (2→3), Panama (2→3), Bahrain (2→3)

Source: compiled and calculated by the authors based on [26–28]

The results of cluster analysis give grounds to assert that in 2016–2018:

1. Countries leading innovative development (Cluster 1) remain almost unchanged. In 2016–2018, this group of countries included such countries as Switzerland, Sweden, Great Britain, the United States of America, Finland, Singapore, Ireland, Denmark, the Netherlands, Germany, Korea, Canada.

2. On the basis of the correlation analysis, the closeness of the relationship between the above factors and the level of innovativeness of the «leading countries of innovative development» was established (**Fig. 5.2**).

1 – Innovative companies
2 – Accelerators
3 – Startups
4 – Park structures
5 – HEI
6 – Science parks
7 – Technological parks
8 – Business angels
9 – Venture funds
10 – The economic growth,%
11 – Productivity (GDP per hour worked), USD
12 – Government spending on R&D, billion USD
13 – Number of engineering firms
14 – Number of consulting firms
15 – GDP per capita, USD per capita

16 – Industrial value added (% of GDP)
17 – Added value created in knowledge-intensive and high-tech industries, billion USD
18 – Export of medium- and high-tech products, billion USD
19 – Import of medium- and high-tech products, billion USD
20 – Foreign trade balance in medium and high-tech goods, billion USD
21 – Exports of high-tech products, billion USD
22 – Import of high-tech products, billion USD
23 – Foreign trade balance in high-tech goods, billion USD
24 – Competitiveness Index (World Economic Forum)
25 – Human development index

○ **Fig. 5.2** Factors affecting the innovative development of countries in Cluster 1
Source: compiled by the author based on [*26*]

It was found that the list of factors that are characterized by:

– inversely related to the level of innovation of the country, include: the number of technology parks; added value created in industry; the economic growth; the balance of foreign trade in medium- and high-tech goods; balance of foreign trade in high-tech goods, billion dollars;

– direct dependence on the level of innovation of the country, include: the number of innovative companies, accelerators, startups, park structures (science parks), HEI, business angels, venture funds, engineering and consulting firms, labor productivity, GDP per capita, value added, created in science-intensive and high-tech industries, export/import of medium and high-tech products, export/import of high-tech products, the level of human development and competitiveness of the country.

At the same time, it was found that the relationship can be characterized as:

– weak (according to the Chaddock scale, the value of the correlation coefficient varies within 0.1–0.3) between the level of innovation and such indicators of innovative leader countries as: the number of technology parks, value added created in industry; export of medium and high-tech products;

– moderate (in accordance with the Chaddock scale, the value of the correlation coefficient varies between 0.3–0.5) between the level of innovation and such indicators of innovative leaders as: the number of innovative companies, venture capital funds, economic growth, productivity (GDP per hour working hours), the balance of foreign trade in medium- and high-tech goods, billions of dollars;

– a noticeable connection (according to the Chaddock scale, the value of the correlation coefficient varies within 0.5–0.7) between the level of innovation and such indicators of innovative leading countries as: the number of accelerators, start-ups, park structures, business angels, engineering and consulting firms , government spending on R&D, GDP per capita, value added created in science-intensive and high-tech industries, imports of medium and high-tech products, exports and imports of high-tech products, foreign trade balance in high-tech goods, the level of competitiveness and human development;

– a significant relationship (according to the Chaddock scale, the value of the correlation coefficient varies within 0.7–0.9) between the level of innovation and such indicators of innovative leader countries as: the number of HEIs, science parks.

Based on the method of the main components, it was found that the main factors that determined the high level of innovativeness of the countries-innovative leaders are two orthogonal factors: innovation policy and its results; the achieved level of socio-economic development (**Table 5.3**).

The factor «Innovation policy and its results» includes the following components: innovation infrastructure and its architecture, the volume of government spending on R&D; the volume of imports of medium and high-tech goods, exports and imports of high-tech goods; the amount of added value created in knowledge-intensive and high-tech industries.

The factor «Achieved level of socio-economic development» includes: the size of GDP per capita, the level of competitiveness of countries and the level of human development.

These two orthogonal factors together account for more than 86 % of the total variation in the feature sets, vary in their influence on the level of innovativeness of countries. The factor «Innovation policy and its results» is more influential. Thus, the variance of the factor «Innovation policy and its results» is 6.59, the factor «The achieved level of socio-economic development» – 2.89, the contribution of the first factor to the total variance is 60 %, the second – 26 % (**Table 5.4**).

● **Table 5.3** Results of the implementation of factor analysis

Results of applying factor analysis (principal component analysis) Variable	Factor Loadings (Varimax raw) Extraction: Principal components (Marked loadings are >0.700000)	
	Factor (1)	Factor (2)
Providing component	0.893781	0.329961
Provided component	0.850802	0.350842
Dual-use component	0.723705	−0.404705
Government spending on R&D	0.932129	−0.323633
Socio-economic development level	−0.055482	0.841673
Added value created in knowledge-intensive and high-tech industries	0.987200	−0.094614
Import of medium and high-tech goods	0.942007	−0.270160
Export of high-tech goods	0.674127	−0.613621
Import of high-tech goods	0.806931	−0.515512
Level of competitiveness	0.205941	0.830507
Human development level	−0.307267	0.916569
Expl.Var	6.022753	3.462962
Prp.Totl	0.547523	0.314815

Source: compiled by the author based on [26]

● **Table 5.4** Results of applying the method of principal components

Value	Eigenvalues Extraction: Principal components			
	Eigenvalue	Total (variance) (%)	Cumulative (Eigenvalue)	Cumulative (%)
1	6.592982	59.93620	6.592982	59.93620
2	2.892733	26.29758	9.485715	86.23377

Source: compiled by the author based on [26]

The results obtained indicate that the country's innovative development is largely not a deterministic, but a controlled process, the main objects of which are the architecture of the innovation infrastructure, the volume of government spending on R&D.

The importance of innovations, ensuring the innovative and technological development of Ukraine is enshrined in a number of strategic regulatory documents: the Strategy for the Development of the Sphere of Innovation for the Period until 2030 [29], the National Economic Strategy for the Period until 2030 [30], the National Security Strategy of Ukraine [31], Human Development Strategy [32], State Strategy for Regional Development for 2021–2027 [33] and others.

Among these strategic regulatory documents, the most systemic, cross-sectoral nature and a decisive importance for ensuring the innovative development of Ukraine is the Strategy for the Development of the Sphere of Innovation for the Period up to 2030 [34], adopted on July 10, 2019. This strategic document aims to ensure «development national innovation ecosystem to ensure the rapid and high-quality transformation of creative ideas into innovative products and services, increasing the level of innovativeness of the national economy…» [34].

One of the main places in this document belongs to the innovation infrastructure as an important condition for ensuring economic growth and development of Ukraine, increasing the level of its innovativeness (the concept of «innovation infrastructure» is found in the Strategy for the Development of the Sphere of Innovation for the Period up to 2030 24 times).

Despite the emphasized importance of the development of innovation infrastructure in the Strategy for the Development of the Sphere of Innovation for the Period up to 2030, the innovation infrastructure today is not a separate object of public administration.

It should be noted that in 2008–2013 there was such an experience in Ukraine – there were special targeted programs for the development of innovative infrastructure: the State Target Economic Program «Creation of Innovative Infrastructure in Ukraine for 2008–2012» and the State Target Economic Program «Creation of Innovative Infrastructure in Ukraine» for 2009–2013 [26].

Failure to understand the importance of considering the innovation infrastructure as a separate object of management leads to a number of negative trends and processes, and, as a result, negatively affects the innovative development of the country and the development of its economy [35–37]. So, in 2008–2018 in Ukraine, there is a decrease in the share of enterprises that produced and sold products new to the market (32.4 % in 2008 and 28.4 % in 2018), a decrease in absolute values and the share of volumes of sold innovative products in the total volume of sold industrial products 5.9 % in 2008 and 0.8 % in 2018) [26, 38].

Under such conditions, managerial decisions on the development of innovative infrastructure require new approaches to their adoption and implementation, and, consequently, to review information and analytical support.

Analysis of factual information presented in sources [26, 38, 39] suggests that in 2008–2018 the innovative infrastructure of Ukraine is characterized by:

1. Deployment. During the analyzed period, the total number of structural elements of the innovation infrastructure increased by 2,551 units: out of 11,574 elements in 2008 up to 14,125 elements (**Table 5.5**).

● **Table 5.5** Architecture of the innovation infrastructure of Ukraine in 2008–2018

Structural elements of innovation infrastructure	Years										Absolute deviation, 2008–2018	
	2008–2010		2010–2012		2012–2014		2014–2016		2016–2018			
	units	%	units	%	units	%	units	%	units	%	units	%
General index	7,057	61	6,930	63.4	4,084	51	5,195	54.8	8,173	57.9	1,116	–3.1
Subindex input1	4,555	39.4	3,405	31.1	3,278	40.9	3,278	34.6	2,937	20.8	–1,618	–18.6
Institutional environment	4,477	38.7	3,964	36.2	3,876	48.4	4,226	44.5	5,876	41.6	1,399	2.9
Human capital and research	882	7.6	809	7.4	776	9.7	657	6.9	652	4.6	–230	–3
Infrastructure	69	0.6	73	0.7	67	0.8	55	0.6	61	0.4	–8	–0.2
Market dawn	3,526	30.5	3,082	28.2	3,033	37.9	3,514	37	5,163	36.6	1,637	6.1
Business dawn	40	0,3	44	0.4	48	0.6	66	0.7	76	0.5	36	0.2
Subindex input2	92	92	94.7	94.8	85.1	85.1	86.2	86.2	88.6	88.6	–3.4	–3.4

Source: compiled by the authors based on data from [*26, 38, 39*]

2. A significant level of imbalance and asymmetry. The innovation infrastructure of Ukraine during the analyzed period is not homogeneous, which is objectively evidenced by the dynamics of the coefficient of variation.

The provided component prevails in the country's innovation infrastructure (on average, 57.62 % of the total number of structural elements of the innovation infrastructure), the smallest is the share of dual-purpose (binary) structures (on average, 0.5 % of the total number of structural elements of the innovation infrastructure).

It should be noted that the leading innovative development countries should have a similar architecture of innovation infrastructure – in the architecture, most of the total number of structural elements of the innovation infrastructure falls on the provided component, the least – on dual-purpose structures. However, the share of dual-use structures and provided structures is much higher.

Thus, the share of structural elements of the provided component accounts for 84.1 % of the total number of structural elements of the innovation infrastructure, which provides 11.9 %, dual-use structures – 4 % [26].

3. The predominance of volumes, an increase in the number of structural elements of the providing component of the innovation infrastructure. During the analyzed period, the number of structural elements of the provided component of the innovation infrastructure increased by 1,116 units, the number of structural elements of the providing component of the innovation infrastructure – by 1,399 units, the number of structural elements of the dual-use component – by 36 units.

It should be noted that the increase in the number of structural elements of the provided component of the innovation infrastructure during the analyzed period occurred due to the increase in the number of enterprises with non-technological innovations. The number of enterprises with technological innovations, also referred to the component «provided structures», is actively decreasing (by 1,618 units), which is a very negative process, because it is this category of enterprises that has the most technologically innovative potential.

The most numerous group of enterprises engaged in innovative activities are small enterprises, as well as enterprises with marketing and organizational innovations [26]. The increase in the number of structural elements of the providing component of the innovation infrastructure is associated with an increase in the group of structural elements of the specified component, with the exception of the HEI and business incubators. The number of HEIs and business incubators during the analyzed period decreased by 230 and 8 units, respectively. Development of innovation infrastructure in 2008–2018 was characterized by significant regional and sectoral asymmetry.

In 2008–2018 the highest level of innovation activity of enterprises was recorded in such regions as the Dnipropetrovsk region (on average 15.5 % of the total number of surveyed enterprises in the corresponding region), Zaporizhzhia region (14.32 % of the total number of surveyed enterprises in the corresponding region), Ivano-Frankivsk region (14.28 % of the total number of surveyed enterprises in the corresponding region), Kyiv region (15.6 % of the total number of surveyed enterprises in the corresponding region), Kirovohrad region (14.32 % of the total number of surveyed enterprises in the corresponding region), Lviv region (14,92 % of the total number of surveyed enterprises in the corresponding region), Rivne region (14.04 % of the total number of surveyed enterprises in the corresponding region), Kharkiv region (18.1 % of the total number of surveyed enterprises in the corresponding region), Kyiv city (21.04 % of the total number of surveyed enterprises about the region).

The lowest level of innovation activity of enterprises was recorded in such regions as Cherkasy region (9.84 % of the total number of surveyed enterprises in the corresponding region), Chernivtsi region (9.74 % of the total number of surveyed enterprises in the corresponding region) (**Table 5.6**). The largest number of innovatively active enterprises during the analyzed period was recorded in Dnipropetrovsk, Kyiv, Lviv, Odesa, Kharkiv regions, Kyiv city, the smallest — Kherson, Chernivtsi regions.

During the analyzed period, the number of innovatively active enterprises in Ukraine as a whole increased, which was associated with the corresponding trends in the Dnipropetrovsk, Zhytomyr, Zaporizhzhia, Ivano-Frankivsk, Kyiv, Kirovohrad, Lviv, Poltava, Ternopil, Kharkiv, Kherson, Khmelnytskyi, Chernihiv regions.

The largest volumes of sold innovative products were recorded in Donetsk, Dnipropetrovsk, Zaporizhzhia and Kharkiv regions [26].

The leading regions in terms of the share of the volume of sold innovative products in the total volume of products sold by industrial enterprises of the region are Donetsk, Zakarpattia, Zaporizhzhia, Ivano-Frankivsk, Kirovohrad, Sumy, Ternopil, Kharkiv, Cherkasy regions [26].

● **Table 5.6** Innovative activity of enterprises by region, % of the total number of surveyed enterprises in the corresponding region

Region	2008–2010		2010–2012		2012–2014		2014–2016		2016–2018		Average value		Absolute deviation	
	%	unis	%	unis	%	unis	%	unis	%	unis	%	unis	%	unis
Total	21	7,640	20.4	6,930	14.6	4,084	18.4	5,095	28.1	8,173	20.5	6,384	7.1	533
Autonomous Republic of Crimea	2.5	188	2.2	151	n/a	n/a	n/a	n/a	n/a	n/a	2.35	68	—	-188
Vinnytsia	3.1	240	3	208	17.3	146	15.2	123	24.2	203	12.56	184	21.1	-37
Volyn	2.2	170	1.9	135	13.3	74	14.4	75	26	143	11.56	119	23.8	-27
Dnipropetrovsk	8.3	631	7.9	545	13.3	343	19	476	29	776	15.5	554	20.7	145
Donetsk	7.9	603	8.1	564	12.9	45	11	86	17.9	145	11.56	289	10	-458
Zhytomyr	1.8	139	2	139	13.9	99	17.7	137	23.7	187	11.82	140	21.9	48
Zakarpattia	2.1	164	1.4	100	11.9	66	13.8	78	26.9	149	11.22	111	24.8	-15
Zaporizhzia	1.7	133	4.9	338	18.8	244	17.5	206	28.7	352	14.32	255	27	219
Ivano-Frankivsk	0.9	69	2.6	178	21.1	134	19.7	121	27.1	177	14.28	136	26.2	108
Kyiv	4.8	364	6.6	455	18.1	268	17.7	260	30.8	520	15.6	373	26	156
Kirovohrad	1.2	94	1.4	95	16.9	84	19.3	92	32.8	164	14.32	106	31.6	70
Lugansk	3.9	297	2.9	201	15	6	12.6	34	21.8	61	11.24	120	17.9	-236
Lviv	5	381	6.2	432	15.9	304	18.4	336	29.1	544	14.92	399	24.1	163
Mykolaiv	2.1	162	2.6	181	16.3	109	15.4	96	20.9	133	11.46	136	18.8	-29
Odesa	5.9	448	3.8	261	12.6	215	16.3	267	22.7	357	12.26	310	16.8	-91
Poltava	2.3	175	1.7	117	6.6	60	18.4	157	23.6	217	10.52	145	21.3	42
Rivne	2.2	166	2.5	171	23.9	149	23.8	137	17.8	105	14.04	146	15.6	-61
Sumy	1.9	144	1.5	107	11.5	65	17.2	93	25.4	142	11.5	110	23.5	-2
Ternopil	1.6	123	1.4	95	15.2	78	19.9	97	31.6	156	13.94	110	30	33
Kharkiv	7.5	571	8.6	596	20.9	457	23.4	479	30.1	670	18.1	555	22.6	99
Kherson	1.2	88	1.4	94	14.7	73	16.1	78	26.1	127	11.9	92	24.9	39
Khmelnytskyi	1.9	142	2.4	166	10.9	80	12.8	86	23.6	166	10.32	128	21.7	24
Cherkasy	2.1	158	2	142	11.6	85	11.8	81	21.7	155	9.84	124	19.6	-3
Chernivtsi	1.2	94	1.3	93	16.4	66	9.7	36	20.1	76	9.74	73	18.9	-18
Chernihiv	1.4	105	1.8	127	17.7	101	16.5	89	24.4	140	12.36	112	23	35
Kyiv City	21.9	1,672	16.8	1,166	11.4	733	21.4	1,375	33.7	2,308	21.04	1,451	11.8	636
Sevastopol City	1.6	121	1.1	73	n/a	—	n/a	n/a	n/a	n/a	1.35	n/a	—	n/a
KVIIR	113.7	113.7	93.7	93.7	25.1	98.1	21.5	133.6	17.2	138.8	20.2	113.6	113.7	113.7

Source: compiled by the authors based on data from [26, 38, 39]

As of 01.01.2019, the leading regions (**Table 5.7**) by: the number of business centers were Dnipropetrovsk, Donetsk, Kharkiv regions, Kyiv; the number of business incubators was Dnipropetrovsk, Zaporizhzhia, Sumy regions; the number of technoparks/industrial parks was Donetsk, Kyiv, Poltava, Kharkiv regions, Kyiv; the number of innovative funds and companies were Donetsk, Poltava, Cherkasy regions, Kyiv; the number of information and consulting institutions were Vinnytsia, Donetsk, Poltava, Kharkiv, Kherson regions, Kyiv; the number of leasing centers was Donetsk and Dnipropetrovsk regions; the number of higher educational institutions were Dnipropetrovsk, Zaporizhzhia, Lviv, Odesa, Kharkiv regions, Kyiv [38].

● **Table 5.7** Regional features of the development of individual elements of the innovation infrastructure (as of 01.01.2019)

Regions	Business centers	Business incubators	Technoparks / industrial parks	Leasing centers	Entrepreneur-ship support funds	Investment funds and companies	Innovation funds and companies	Information consulting institutions	Total public associations of entrepreneurs	Coordination councils
Vinnytsia	5	–	4	3	9	48	33	457	80	34
Volyn	2	2	–	–	5	–	–	1	28	15
Dnipropetrovsk	54	7	1	19	1	1	–	10	58	39
Donetsk	20	3	9	30	1	237	121	599	65	19
Zhytomyr	2	1	2	4	2	7	8	257	112	29
Zakarpattia	2	2	–	3	3	27	22	117	–	–
Zaporizhzhia	2	6	–	2	1	20	2	15	75	27
Ivano-Frankivsk	18	3	2	4	7	–	–	78	64	20
Kyiv	9	5	26	12	8	10	4	88	78	38
Kirovohrad	5	–	1	–	3	–	12	47	52	26
Luhansk	9	–	–	–	–	–	–	13	38	4
Lviv	17	1	3	9	8	2	–	22	60	32
Mykolaiv	14	2	–	1	8	14	62	65	–	
Odesa	31	–	–	–	4	–	–	–	38	1
Poltava	11	4	6	5	13	62	35	615	2,708	32
Rivne	1	1	1	–	–	24	2	10	42	21
Sumy	4	5	–	3	7	5	2	21	76	26
Ternopil	7	3	–	–	1	10	–	18	30	17
Kharkiv	26	1	18	9	8	142	2	328	48	15
Kherson	1	3	1	–	7	19	9	1	112	23
Khmelnytskyi	3	1	2	4	1	–	1	151	62	27
Cherkasy	5	3	–	3	2	1	38	5	56	26
Chernivtsi	7	1	1	1	10	2	2	26	57	13
Chernihiv	2	–	–	–	2	–	–	4	47	24
Kyiv City	157	13	33	429	57	1,466	476	658	310	11

Source: [*26, 39*]

In 2008–2018, most of the innovatively active enterprises were concentrated in the processing industry (23.9 % of the total number of surveyed enterprises of the corresponding type of

activity), information and telecommunications (22.9 % of the total number of surveyed enterprises of the corresponding type of activity), financial and insurance activities (26.6 % of the total number of surveyed enterprises of the corresponding type of activity) (**Table 5.8**).

● **Table 5.8** Innovative activity of enterprises by type of activity, in % of the total number of surveyed enterprises of the corresponding type of activ

Indicators	2008–2010	2012–2014	2014–2016	2016–2018	Absolute deviation	Average value
Total	21	14.6	18.4	28.1	7.1	20.5
Mining and quarrying	12.8	11.9	14.2	21.9	9.1	15.2
Processing industry	21.5	20.3	21.9	31.8	10.3	23.9
Supply of electricity, gas and air conditioning	n/a	18.6	15.4	20	–	18.0
Water supply, sewerage, waste management	n/a	10.2	9.8	15.8	–	11.9
Wholesale trade, except trade in motor vehicles and motorcycles	15.9	11.2	17.3	30.1	14.2	18.6
Transport, warehousing, postal and courier activities	12.9	7.3	9.7	15.5	2.6	11.4
Information and telecommunications	21.7	16.3	22.1	31.5	9.8	22.9
Financial and insurance activities	19.7	n/a	21.7	38.3	18.6	26.6
Architectural activities, technical testing and research, research and development, advertising and market research	n/a	12.8	20.1	27.1	–	20.0
Coefficient of industry variation of the structural elements of the provided component of the innovation infrastructure	25.4	32.7	29.3	26.4	–	28.45

Source: compiled and calculated by the author based on these sources [26, 38]

5.3 STRATEGY FOR THE DEVELOPMENT OF INNOVATIVE INFRASTRUCTURE IN UKRAINE

The presence of significant asymmetries and imbalances in the development of the innovation infrastructure of Ukraine, the low efficiency of its development, the presence of threatening trends determine the need to develop a strategy for the development of the innovation infrastructure (**Fig. 5.3**).

Taking into account all of the above, incl. features of the development of the innovative infrastructure of the leading countries of innovative development, the strategy for the development of the innovative infrastructure of Ukraine to provide for the cumulative nature of the transformations, which means it is an iterative model of actions and a set of mechanisms for implementing strategic priorities that ensure the achievement of long-term goals for the development of the innovative infrastructure of the national economy, their congruence with opportunities and limitations the functioning of the innovation infrastructure on the principles of synergy and self-organization, multilevel; cyclicality; the priority of ensuring national security; taking into account the influence of globalization, vectors (external, internal) and dimensions (temporal, material, spatial, structural) of the innovation infrastructure.

Internal environment

Subjects of the strategy: Verkhovna Rada of Ukraine, central executive authorities, specialized structures of authorities; structural elements of the functional components of the innovation infrastructure

Indicators of the success of the cumulative development strategy implementation: the level of innovative activity of enterprises; the number and proportion of structural elements of the functional components of the innovation infrastructure are effective and competitive (in the international dimension), carrying out technological innovations; the magnitude of economic and social effects from the functioning of the innovation infrastructure; the level of integration in global value chains; the level of economic security, innovation and competitiveness of Ukraine

Beneficiaries: society as a whole, scientific community, business, authorities, territorial communities

Development goals of the innovation infrastructure of the national economy

Iterative action model of the cumulative strategy for the development of the innovation infrastructure of the national economy

Creation of conditions for supporting and stimulating the development of the innovative infrastructure of the national economy

Improvement of the existing innovation infrastructure of the national economy

Priority directions of the cumulative strategy for the development of the innovative infrastructure of the national economy

Modernization of the development environment

Reconfiguration and diversification of functional components of the innovation infrastructure of the national economy

Increasing the level of integration of innovative infrastructures of Ukraine and the countries of the European Union

A set of mechanisms for implementation of the cumulative strategy for the development of the innovation infrastructure of the national economy

The economic mechanism (taxes, benefits, material incentives, etc.)

Organizational and legal mechanism (permissions, prohibitions, restrictions, etc.)

Information and psychological mechanism (consultations, explanations, non-material incentives, etc.)

External environment

Objects of the strategy: Environment for the development of the innovation infrastructure of the national economy; attributes and results of the functioning of the innovation infrastructure of the national economy; functional components of the innovation infrastructure and their structural elements; links between the functional components of the innovation infrastructure; links between the structural elements of the innovation infrastructure

The principles of the strategy for the development of the innovative infrastructure of the national economy: synergy and self-organization; multilevel; cyclicality; the priority of ensuring national security; taking into account the influence of globalization and taking into account the vectors and dimensions (temporal, material, spatial, structural) of the innovation infrastructure

The most interesting foreign experience: Denmark, Germany, Ireland, Singapore, Finland, Great Britain, Sweden, Switzerland, USA

○ **Fig. 5.3** Cumulative strategy for the development of the innovative infrastructure of the national economy [26]

A cumulative strategy for the development of an innovative infrastructure of Ukraine should focus on the following areas: reconfiguration and diversification of functional components of the infrastructure, improving the institutional environment for the development of innovative infrastructure [26], increasing the competitiveness of the structural elements of the innovation infrastructure.

At the same time, the reconfiguration of the functional components of the infrastructure should be carried out taking into account the availability of strategic alternatives presented in **Fig. 5.4**.
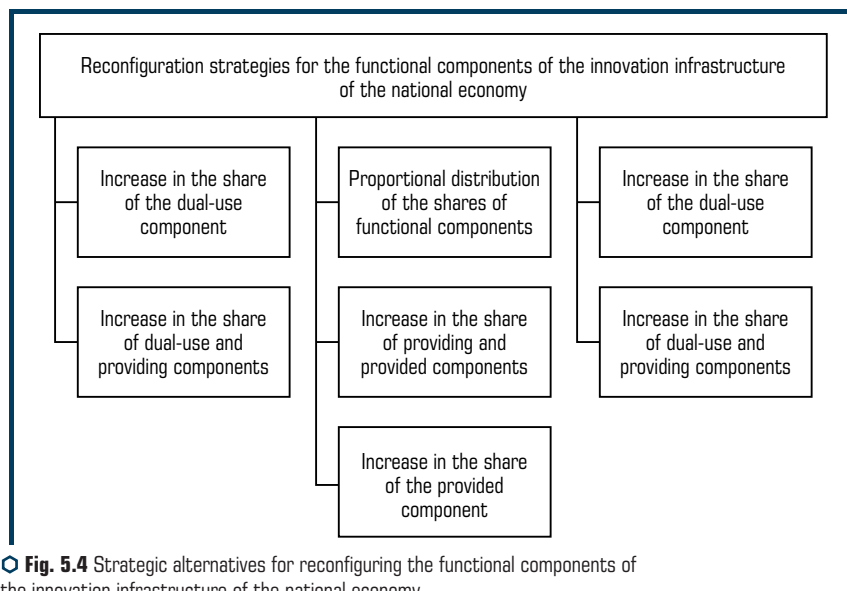
○ **Fig. 5.4** Strategic alternatives for reconfiguring the functional components of the innovation infrastructure of the national economy
Source: compiled by the authors

On the basis of correlation-regression analysis, calculation of partial elasticity coefficients, it was found that the greatest value for increasing the volume of added value in knowledge-intensive and high-tech industries, the export of medium- and high-tech goods, high-tech exports, and, as a consequence, the country's innovativeness has an increase in the number, primarily turn, competitive providing structures (higher education institutions (HEI), business angels, venture capital funds), dual-use structures, as well as enterprises engaged in innovative activities [26] (**Table 5.9**).

Thus, the reconfiguration of the functional components of the infrastructure of Ukraine should be carried out on the basis of increasing the share of the dual-use component and the providing component of the innovation infrastructure.

● **Table 5.9** Justification of the directions of reconfiguration and diversification of the functional components of the infrastructure

Variables		X								Providing structures						Provided structures		Dual-use structures	
		Provided/Providing structures	Provided/Dual-use structures	Dual-use structures/Providing structures/supporting structures	Providing structures	Provided structures	Dual-use structures	Accelerators	HEI	Business angels	Venture funds	Engineering firms	Consulting firms	Enterprises engaged in innovative activities	Startups	Science parks	Technological parks
		X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}
Value added in knowledge-intensive and high-tech industries, billion USD	n	24			24			24						24		24	
	Regression	$Y_1=1072.975-164.0281X_1+ +14.4036X_2+1.095.6028X_3$			$Y_1=-96.0589+ +30.776X_4-3.215X_5+ +25.189X_6$			$Y_1=-30.4915-2.5892X_7+ +300.2626X_8+127.0497X_{10}-243.2102X_{12}$						$Y_3=72.331+16.9934X_{13}+ +0.306X_{14}$		$Y_1=-64.6338+ +78.1943X_{15}+11.5146X_{16}$	
	Standardized regression	$b_{y1}=-0.356x_1+0.32x_2+0.282x_3$			$b_{y1}=2.08x_4- 1.451x_5+0.379x_6$			$b_{y1}=-0.052x_7+0.36x_8+3.402x_9+0.541x_{10}- -1.752x_{11}-1.564x_{12}$						$b_{y1}=0.839x_{13}+0.128x_{14}$		$b_{y1}=0.776x_{15}+0.0876x_{16}$	
	R^2	0.07761			0.9032			0.996						0.8945		0.6739	
	$E_i, \|E_i\|>1$	−1.43	0.58	0.56	1.99	−1.47	0.55	−0.05	0.54	1.49	0.38	−0.72	−0.64	0.79	0.13	0.97	0.11
	$F>F_{cr}$ (λ¹)	0.56<3.1			62.21>3.1			699.36>2.7						88.99>3.49		21.7>3.49	
Export of medium and high-tech goods, billion USD	n	12			12			12						12		12	
	Regression	$Y_2=227.2455-55.5567X_1+ +5.1591X_2+455.5594X_6$			$Y_2=84.8916+4.7974X_4- -0.7565X_5+4.7963X_6$			$Y_2=33.047-3.9453X_7+3.1882X_8+46.1313X_9+ +28.2505X_{10}-36.5865X_{11}-50.611X_{12}$						$Y_2=131.8074+2.4685X_{13}- -0.217X_{14}$		$Y_2=63.9054+3.0235X_{15}+ +4.9408X_{16}$	
	Standardized regression	$b_{y2}=-1.056x_1+0.915x_2+ +0.923x_6$			$b_{y2}=3.438x_4-3.717x_5+ +0.696x_6$			$b_{y2}=-0.846x_7+0.637x_8+5.774x_9+1.272x_{10}- -2.971x_{11}-3.617x_{12}$						$b_{y2}=1.263x_{13}-0.981x_{14}$		$b_{y2}=0.301x_{13}+0.371x_{16}$	
	R^2	0.79			0.6847			0.915						0.6154		0.305	
	$E_i, \|E_i\|>1$	−2.36	0.96	1.14	2.40	−2.69	0.81	−0.60	0.72	2.11	0.77	−1.01	−1.17	0.96	−0.69	0.28	0.37
	$F>F_{cr}$ (λ²)	10.03>4.07			5.79>4.07			8.97>4.95						7.2>4.26		1.97<4.26	
High-tech export, billion USD	n	12			12			12						12		12	
	Regression	$Y_3=88.9693-41.6957X_1+ +5.1203X_2+442.7499X_6$			$Y_3=38.2255+2.7751X_4- -0.4325X_5+4.2026X_6$			$Y_3=124.7457-3.7634X_7-7.0783X_8+ +50.1658X_9+3.4608X_{10}+12.8027X_{11}- -89.3891X_{12}$						$Y_3=92.3422+1.5422X_{13}- -0.1034X_{14}$		$Y_3=237489+2.8197X_{15}+ +5.2696X_{16}$	
	Standardized regression	$b_{y3}=-0.947x_1+1.085x_2+ +1.073x_6$			$b_{y3}=2.37bx_4-2.526x_5+ +0.728x_6$			$b_{y3}=-0.964x_7-0.0187x_8+7.502x_9+0.186x_{10}+ +1.242x_{11}-7.633x_{12}$						$b_{y3}=0.943x_{13}-0.555x_{14}$		$b_{y3}=0.335x_{15}+0.473x_{16}$	
	R^2	0.7757			0.587			0.9699						0.3764		0.445	
	$E_i, \|E_i\|>1$	−2.26	1.22	1.42	1.77	−1.96	0.901	−0.73	−0.02	2.93	0.12	0.45	−2.63	0.76	−0.42	0.33	0.5
	$F>F_{cr}$ (λ³)	9.22>4.07			3.79<4.07			26.84>4.95						2.72<4.26		3.61<4.26	

Note: n – the number of observations; R² – coefficient of determination; Ei – coefficient of elasticity; F – F-criterion (empirical value); Fcr – F-criterion (critical value)
Source: [26]

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6 THE USE OF CLUSTER ANALYSIS TOOLS IN SUBSTANTIATING MANAGERIAL DECISIONS FOR THE FORMATION OF LOCAL STRATEGIES FOR THE DEVELOPMENT OF TOURISM SERVICES MARKETS

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ABSTRACT

The necessity of taking into account spatial polarization as an objective condition for the adaptation of managerial decisions to manage the development of local markets of tourist services has been substantiated. Clustering of the regional markets of tourist services in Ukraine was carried out according to the indicators of the functioning of the subjects of tourist activity (the number of tour operators and travel agents, the number of travel packages sold by tour operators and travel agents, the cost of travel packages sold by tour operators and travel agents, the number of tourists served by tour operators and travel agents, the number of collective accommodation facilities, the number of persons in collective accommodation facilities). The calculations made it possible to identify 6 clusters of local markets of tourist services in Ukraine, formed at a threshold distance of 2, namely: Cluster 1 – Kyiv city; Cluster 2 – Odesa and Zaporizhzhia regions; Cluster 3 – Lviv, Dnipropetrovsk and Kyiv regions; Cluster 4 – Kharkiv, Kyiv, Mykolaiv, Kherson and Donetsk regions; Cluster 5 – Poltava, Cherkasy, Zakarpattia, Khmelnytskyi and Volyn regions; Cluster 6 – Chernivtsi, Ternopil, Luhansk, Chernihiv, Kirovohrad, Zhytomyr, Sumy, Rivne and Vinnytsia regions.

A model of authentic management of the development of the Ukrainian tourist services market has been developed, which involves the use of specific blocks of managerial decisions of authentic management and accounting for the authenticity of cultural and historical resources of local markets of tourism services, asymmetry of infrastructural and socio-economic development of markets, spatial polarization of the location of climatic and recreational factors of development local tourism markets allows for the formation of competitive advantages through the use of specific tourism determinants of local tourism markets.

KEYWORDS

Cluster analysis, managerial decisions, development management, local development strategies, regional tourism markets, tourism.

6.1 SPATIAL POLARIZATION AS AN OBJECTIVE CONDITION FOR THE ADOPTION OF MANAGERIAL DECISIONS TO MANAGE THE DEVELOPMENT OF LOCAL MARKETS FOR TOURISM SERVICES

Local markets for tourism services are characterized by uneven development caused by differences in the distribution of natural resources, climatic characteristics of regions, cultural and historical conditions, uneven distribution of transport, communication, resort and entertainment

infrastructure, asymmetry in the distribution of recreational resources, and the like. In this regard, the polarization aspects of spatial development, the growth of disproportions and asymmetries in the «Center-periphery» system of the tourism market is a prerequisite for the adoption of managerial decisions on the development of local tourism markets. All this emphasizes the need to apply differentiated specific models and concepts for the formation and management of the development of local markets for tourism services, taking into account different approaches and mechanisms for achieving general goals, objectives and expected effects.

Conducting a cluster analysis of the national market of tourism services based on the grouping of regional markets according to the performance indicators of the subjects of tourism activities should become the basis for substantiating managerial decisions for the formation of local strategies and concepts for the development of markets, including authentic ones, aimed at ensuring sustainable, permanent development in crisis conditions.

Agreeing with the opinion of Bocharova, Y. G. that «at the present stage of development of the world economy and international economic relations, one of the most important tasks for any country is to create and maintain conditions for the development of competition» [1], it should be noted that Ukraine has sufficient natural, climatic, historical and cultural resources for development competitive tourism industry of the state. At the same time, the uneven development of the tourist services market is caused by differences in the distribution of natural resources, climatic characteristics of regions, cultural and historical conditioning, disproportion in the location of transport, communication, resort and entertainment infrastructure, asymmetry in the distribution of recreational resources, and the like. In this regard, the polarizing aspects of spatial development are a prerequisite for the adoption of managerial decisions for the development of local markets for tourism services.

Based on the analysis of the works of a number of regionalist scientists: Krugman, P. R. [2], Richardson, H. W. [3], Hirshman, A. O. [4], Friedmann, J. [5], two main types of territorial organization of economic space are distinguished: the core is more developed («Center») and the «periphery» closely related to it. Within the framework of the national market of tourist services, the «center» is a local market, region, district, destination, where national tourist flows, directed inbound tourist flows are generated and concentrated, natural, recreational, cultural and historical resources are concentrated, tourist and related infrastructure is being located hotel and restaurant chains and consortia, national ones are created, rational standards of service and creation of an integrated tourist product are formed, which, in the process of spatial diffusion, spread to the peripheral local markets of tourist services.

Thus, the main manifestation of the polarization of the tourism market is the formation of a hierarchical economic space according to the «Center-Periphery» model. The country's tourist market, on the one hand, occupies a certain place in the polarized hierarchical structure of the world tourist space, and on the other hand, in terms of its internal structure and architectonics, it constitutes a similar spatial-polarization system, the main elements of which are local markets.

The starting points for the formation of the national market of tourist services according to the «Center-Periphery» model are as follows:

1. The position of local tourist markets in the national tourist space, basically, determines the dynamics of their development – the remoteness of the market from the centers of tourism development slows down their formation.

2. The remoteness of the local tourist market from the «center» in the hierarchical structure of the tourist space is determined not so much by the geographical gap as by the tightness of ties with other internal and external systems (economic, administrative, social, etc.).

3. Tourism centers are local markets for tourism services, on the basis of which the main volume of tourist demand is formed, tourist infrastructure is concentrated, tourist flows are concentrated, the main innovations in the field of tourism are generated and mastered, advanced standards are created for creating an integrated tourist product and serving tourists as a result of the process spatial diffusion extends to peripheral destinations and tourism markets.

4. Natural and recreational determinants of the development of the tourist services market are only the basis for its formation, while its competitiveness and place in the hierarchical structure of the national tourist market are determined by factors of an innovative and investment nature.

The systematization of the existing theoretical apparatus, taking into account the current trends in heterogeneity, unevenness, differentiation and polarization of the tourist space, makes it possible to single out models for the development of local markets for tourist services based on the patterns of interaction between the core and the periphery. It is proposed to determine the main characteristics of the models using the following features that determine the typical properties of their formation and development: the intensity of market growth, the intensity of tourist flows, the concentration of tourist demand, the innovativeness of tourism development, involvement in the world tourism market, the contribution of tourism to the socio-economic development of the state, diversification tourist offer, development of new tourist and recreational zones, transnationalization of the tourist business (**Table 6.1**).

Spatial polarization of the tourist services market at any level is formed under the influence of objective and subjective factors, which directly or indirectly affect trends towards sustainable development or polarization. Under the influence of leading factors, poles (centers) are formed, which extend their influence to the periphery, leveling or increasing disparities in the level of market development.

The global crisis caused by the coronavirus pandemic has radically changed the travel industry around the world, and Ukraine is no exception.

Tourism is one of those sectors of the global economy that has suffered more due to the imposed restrictions on movement.

Local features of the development of tourist services markets, strengthened by the coronavirus pandemic and quarantine restrictions, require the development and implementation of adequate managerial solutions of the Development Department at the local level.

● **Table 6.1** Models of spatial-polarization development of local markets for tourism services [6–8]

Sign of the proposal	«Center» model	«Semi-periphery» model	«Advanced periphery» model	«Deep periphery» model
Market growth rate	Slow intensity, maintains established market proportions	High intensity, uneven, unstable development	Moderate intensity of growth of the tourism market with the support of the state	Low intensity, tourism development is enclave
Intensity of tourist flows	High intensity, simultaneous generation and direction	High intensity of foreign tourist exchanges	Moderate intensity, accelerated growth in inbound tourism	Low intensity
Concentration of tourist demand	High concentration of tourist demand	Moderate concentration of tourist demand	Moderate concentration of tourist demand	Tourism demand is elite
Innovativeness of tourism development	Generating innovations	Diffusion of innovations	Diffusion of innovations	Slow diffusion of innovations
Engagement in the global travel market	Membership in international tourism organizations, international multilateral cooperation	Membership in international tourism organizations, international multilateral cooperation	Membership in regional organizations, promotion of bilateral cooperation	Insignificant
Contribution of tourism to the socio-economic development of the state	Significant contribution of tourism to GDP, high employment in the tourism sector	Insignificant, but it is a highly profitable sector of the economy	Significant impact on the economy and is seen as an important source of foreign exchange earnings	Minor
Diversification of the tourist offer	High diversification of the tourist offer	A wide range of products that meet international standards	Limited diversification of the tourist offer	Monodiversified tourist offer
Development of new tourist and recreational zones	Gradually decreasing	Increasing the rate of development of tourist and recreational zones	Slow or almost nonexistent	Almost absent
Transnationalization of the tourism business	Leading role of tourist TNCs, international hotel and restaurant chains	Expansion of the presence of TNK, international hotel and restaurant chains	Insignificant transnationalization of business, attraction of foreign capital for infrastructure development	Single presence of TNCs and international networks in the market

The fragmentation and inconsistency of the approaches of scientists to the methodological foundations and categorical apparatus of researching the process of managing the development of the tourism services market hinder the ability of business entities to introduce comprehensive approaches to improving their activities, introduce the latest mechanisms, strategies and management concepts, encourages systematization and critical analysis of the existing apparatus.

In this regard, the clarification of the conceptual-categorical apparatus of the study of the management of the development of the tourist services market is of high importance.

Since the term «management of the development of the tourist services market» is a complex concept, the key elements of which are «development», «market development», «management», «market management», and as a result «management of the development of the tourism services market», its identification is logical conduct through the analysis of these components. The sequence of research of the concepts considered to reveal the content of the corresponding conceptual apparatus is shown in **Fig. 6.1**.
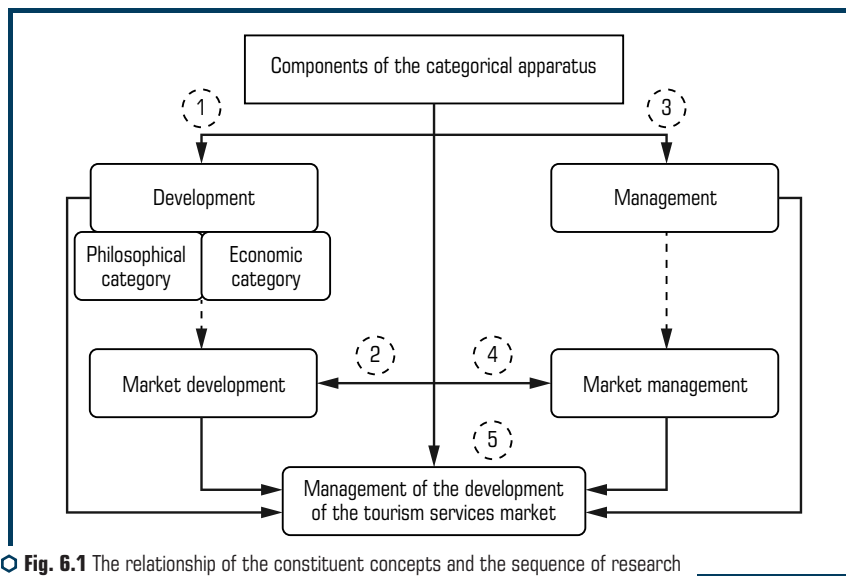
○ **Fig. 6.1** The relationship of the constituent concepts and the sequence of research of the term «management of the development of the tourism services market» [8]

The study of the etymology of the concept of «management» made it possible to form the author's vision of the conceptual construction of «market management», which in general form should be considered as a purposeful process, which manifests itself in a set of interrelated, interdependent, coordinated actions aimed at improving and streamlining the system of economic ties and relations that are developing in the process of production, circulation and distribution of goods

and services, as well as the movement of funds, the creation of mechanisms for the implementation of entrepreneurial activities.

In turn, «market development management» is a complex of purposeful management actions aimed at achieving permanent, competitive, optimal market functioning in a changing external environment and the multidimensional impact of the determinants of its development.

Thus, the analysis of the constituent components of the multi-aspect concept of «management of the development of the market for tourism services», the key elements of which were the terms «market», «market of tourism services», «development», «market development», «management», «market management», «market development management» allowed to identify this category as a set of targeted management actions aimed at achieving permanent, competitive, optimal functioning of an integrated system for transforming natural and recreational resources into cash in the process of economic relations between tourism business entities regarding the production, sale and consumption of tourism products and services in the context of a changing external environment and the multidimensional impact of historically established basic and current innovative determinants.

The need to take into account the spatial and polarization determinants of the development of local markets for tourism services is justified by their increased influence on the activities of the subjects of the tourism industry, the policy of state and local authorities in the field of tourism, purchasing power and consumer preferences, and the like. Factors of the formation of the spatial polarization of the tourist services market have a direct impact on the spatial structure of the tourist system, cause and intensify its polarization.

One of the current trends in the development of the tourist services market is the transition from historically established basic determinants (factors of «first nature») to innovative (factors of «second nature»). Thus, the advantageous recreational and geographical position, the availability of natural and cultural resources, favorable climatic conditions are only the basis, a prerequisite for the development of tourism. While the competitiveness of the local tourism market is made up of innovative factors:

– developed tourism infrastructure;
– modern innovative technologies for the creation and promotion of a diversified tourist product;
– encouraging investment in the development of the tourism industry;
– availability of research structures on tourism issues;
– an effective system of training tourist personnel;
– the presence of transnational tourist corporations;
– the application of modern standards in the field of safety for the implementation of tourist activities, the ability to quickly adapt to the fast external environment, and the like.

The presence of a heterogeneous spatial structure and hierarchical structure of the tourist services market in Ukraine testifies to the need to form an effective local tourism policy, to adapt managerial decisions to manage the development of local markets of tourist services, and to apply authentic management of their development.

6.2 CLUSTERING REGIONAL TOURISM MARKETS IN UKRAINE AS A PREREQUISITE FOR SUBSTANTIATING MANAGERIAL DECISIONS ON THEIR DEVELOPMENT

The high degree of regional differentiation of the tourist services markets in Ukraine makes it ineffective to use unified approaches in substantiating managerial decisions for the local development of tourist services markets. Ensuring the achievement of the strategic goals of state policy in the field of tourism is possible through the development and implementation of optimal specific models of local assistance to the development of business processes in the tourism industry. In this regard, the question of identifying clusters of local markets of tourist services in Ukraine similar to the trends and indicators of tourism activity becomes relevant. The use of cluster analysis and profiling of each selected segment serve as an information and analytical basis for substantiating managerial decisions on the formation of a local strategy for the development of tourist services markets.

A detailed review of works on the use of cluster analysis and clustering methods in the studies of domestic and foreign scientists devoted to the study of the tourism industry was carried out in the work «Clustering regional markets of tourism services by indicators of the functioning of tourism entities» [9], which allows to conclude that this econometric approach. Golovkova, L. S., Yuhnovska, Y. O. [10] propose an algorithm for the formation and development of the region's tourism industry based on a cluster approach, insist that the structure of the region's tourism cluster should be based on enterprises (organizations, firms) that are geographically close, tourism infrastructure, local labor markets and a tourism product that is the geographical and historical component of the region. The question of the influence of the clustering of the tourism sector on the formation of a regional image, the spread of clustering processes through the promotion of the image of the territory was raised in the work of Kolyadenko, S. V. [11]. General trends in the development of national and cross-border recreational and tourist clusters as an effective tool for interregional and international cooperation are investigated by Andrusiak, N. S [12]. Ocheretin, D. V. [13] carried out a cluster analysis of tourist flows in the context of the regions of Ukraine, the task of which is to find such groups of objects in the sample and allows to identify the place of each region in the tourist flow. Chernega, O. B., Gorina, G. O., Romanukha, O. M., Bohatyryova, G. A., Nikolenko, K. V. [14] carried out zoning of the territory of Ukraine for the development of cultural and educational tourism, which is based on the calculation of average statistical data on the number of museums by region, analysis of their visits and the volume of tourist streams. Ivanova, N. [15] develops mathematical models for the authentication of regions in relation to the state of their economic security using discriminant analysis, and the clustering of a region is an indicator of the grouping. Okhrimenko, A. H. [16] substantiates the relevance and need for the development of tourism clusters at the regional level, emphasizes their advantages and importance. A number of domestic scientists, using the methods of cluster analysis and clustering in their research, focus in their works on certain regions of Ukraine. Thus, Parfinenko, A., Bosenko, K. [17] investigate the potential of tourist clustering in the Podolsk region of Ukraine, Romaniv, P. V. [18] studies the

cluster model for managing tourist activities in the Lviv region, and also analyzes the role of cluster formations in the economic development of regions.

Cluster analysis and clustering methods are widely used by foreign scientists in the study of tourism activities at all economic levels of its implementation. Navarro Chávez, J. C., Zamora Torres, A. I., Cano Torres, M. [19] focus on the analysis of 14 factors of tourism competitiveness for 20 countries participating in the Asia-Pacific Economic Cooperation Forum. The authors analyze the secondary data of the Travel and Tourism Competitiveness Index, creating clusters, using multidimensional scaling methods to identify effective determinants of the competitiveness of destinations. Yalçınkaya, T., Güzel, T. [20] focus on a global overview of tourism clusters. The authors propose a definition of a tourist cluster, describing the functioning of its network system, provide a classification of tourist clusters. Koľveková, G., Liptáková, E., Štrba, Ľ., Kršák, B., Sidor, C., Cehlár, M. et. al. [21] explore 54 regions of Central and Eastern Europe (Czech Republic, Slovakia, Hungary, Poland, Estonia, Lithuania, Latvia, Slovenia, Romania and Bulgaria), clusters them according to the indicators used by the European Statistical Agency (Eurostat) to assess tourism. As a result of cluster analysis, six clusters were identified, consisting of regions with similar statistical characteristics of indicators. Lascu, D.-N., Manrai, L. A., Manrai, A. K., Gan, A. [22] identify the characteristics of the most attractive tourist destinations in Spain, using a two-stage cluster analysis to establish the relative importance of natural and cultural factors for target consumers. Ramires, A., Brandão, F., Sousa, A. C. [23] segmenting international tourists visiting the World Heritage City of Porto based on their travel motives associated with specific destination attributes, as well as their satisfaction with the travel experience. Iswandhani, N., Muhajir, M. [24] use the K-means method to conduct a cluster analysis of a tourist destination in a special region of Yogyakarta using a spatial approach and analysis of social networks. The results of this study were the determination of the top 10 most popular destinations in Yogyakarta, the construction of a map of the distribution of tourist destinations based on html, consisting of 121 tourist destinations and forms 3 clusters. Rodríguez, J., Semanjski, I., Gautama, S., Van de Weghe, N., Ochoa, D. [25] to develop and implement a hierarchical approach for clustering geolocalized smartphone data to identify significant market segments related to tourism. Application of the proposed approach on the example of the province of Zeeland in the Netherlands made it possible to identify two main clusters and four sub-clusters, which were interpreted on the basis of their spatial-temporal models and the frequency of their visits in the region. So, the content analysis of modern domestic and foreign studies on the diagnosis of tourism activity has made it possible to confirm the hypothesis about the widespread use of methods of multivariate statistical analysis, in particular, cluster analysis.

Taking into account the local specifics of the development of the tourism industry should not be based only on the administrative-territorial division of the country. Local markets of tourist services in Ukraine with similar trends in tourism may not be related to territorial or administrative grounds. The use of cluster analysis tools to identify groups of regions with similar trends in the development of tourism entities is the optimal econometric approach in substantiating managerial decisions for the formation of local strategies for the development of tourism services markets.

As objects of the sample, 24 regions of Ukraine and the Kyiv city were proposed, the signs for which the groupings were carried out in 2020 are: the number of tour operators and travel agents, the number of travel packages sold by tour operators and travel agents, the cost of travel packages sold by tour operators and travel agents, the number of tourists served tour operators and travel agents, the number of collective accommodation facilities, the number of persons in the collective accommodation facilities. Output statistical data for the cluster analysis of regional tourism markets are shown in **Table 6.2**. Preliminary standardization of the initial data in order to eliminate disagreements in the units of measurement of indicators was carried out according to the formula:

$$Z = \frac{(x - \mu)}{\delta},$$
(6.1)

where Z – value of the standard normalized distribution;

x – value of the output distribution;

μ – average value of the output distribution;

σ – standard deviation of the original distribution.

The dendogram of the hierarchical clustering of regional markets for tourism services was built in the STATISTICA 12 software product by sequentially combining into a cluster, first close, and then more and more distant from each other objects. The Ward method was chosen as the clustering algorithm, and the Euclidean distance was chosen as a measure of distance. The matrix of Euclidean distances for the objects under consideration (regional markets of tourist services) is provided in **Table 6.3**.

To determine the enlarged number of clusters, it is advisable to choose a threshold distance of 2 and higher, while for a more detailed and fundamental analysis of the tourist services market, which is necessary for the development of local development strategies, it is advisable to choose a threshold distance of 1 or lower, which will make it possible to determine the optimal composition of clusters by performance indicators subjects of regional markets of tourist services. The constructed dendrogram is shown in **Fig. 6.2**.

With a threshold distance of 2, 6 clusters are formed on the Ukrainian tourist services market.

Cluster 1 – Kyiv city, which, according to all indicators of the functioning of tourism entities (the number of tourism entities, the number of staff members of tourism entities, income from the provision of tourism services, the number of tourists served with travel vouchers) takes the first place.

Cluster 2 is formed by the Odesa and Zaporizhzhia regions.

Cluster 3 includes Lviv, Dnipropetrovsk and Kyiv regions.

Cluster 4 unites Kharkiv, Ivano-Frankivsk, Mykolaiv, Kherson and Donetsk regions.

Cluster 5 includes Poltava, Cherkassy, Zakarpattia, Khmelnytskyi and Volyn regions.

The most numerous is Cluster 6, which accumulates Chernivtsi, Ternopil, Luhansk, Chernihiv, Kirovohrad, Zhytomyr, Sumy, Rivne and Vinnytsia regions (**Table 6.4**).

● **Table 6.2** Output statistical data for the cluster analysis of regional tourism markets in Ukraine, 2020

Region	Number of tour operators and travel agents, units	Number of travel packages sold by tour operators and travel agents, units	The cost of travel packages sold by tour operators and travel agents, thousand UAH	Number of tourists served by tour operators and travel agents, people	Number of collective accommodation facilities, units	Number of persons staying in collective accommodation facilities, units
Vinnytsia	79	12,098	12,177	24,275	10	23,499
Volyn	70	4,401	4,471	8,872	36	28,323
Dnipropetrovsk	431	36,603	37,034	73,637	87	151,077
Donetsk	82	9,328	9,410	18,738	65	73,285
Zhytomyr	59	5,031	5,090	10,121	16	17,719
Zakarpattia	72	7,188	7,260	14,448	48	47,266
Zaporizhzhia	147	19,019	19,166	38,185	119	92,794
Ivano-Frankivsk	104	56,767	56,871	113,638	50	123,876
Kyiv	220	21,307	21,527	42,834	80	189,169
Kirovohrad	57	3,918	3,975	7,893	20	19,266
Luhansk	37	1,769	1,806	3,575	7	6,600
Lviv	265	69,155	69,420	138,575	111	229,963
Mykolaiv	89	5,741	5,830	11,571	83	72,898
Odesa	194	18,405	18,599	37,004	147	138,618
Poltava	124	8,512	8,636	17,148	43	87,745
Rivne	102	8,268	8,370	16,638	13	12,779
Sumy	85	7,334	7,419	14,753	17	27,160
Ternopil	65	3,168	3,233	6,401	13	15,609
Kharkiv	234	24,854	25,088	49,942	66	80,153
Kherson	54	6,928	6,982	13,910	70	66,506
Khmelnytskyi	63	5,893	5,956	11,849	28	49,591
Cherkasy	99	8,739	8,838	17,577	43	52,433
Chernivtsi	55	4,259	4,314	8,573	11	11,024
Chernihiv	57	6,754	6,811	13,565	22	34,354
Kyiv city	1,023	1,062,591	1,063,614	2,126,205	132	566,876

Source: compiled by the authors based on data from [*26, 27*]

● **Table 6.3** Matrix of Euclidean distances for regional markets of tourist services in Ukraine

Region	Vinnytsia	Volyn	Dnipro-petrovsk	Donetsk	Zhytomyr	Zakarpattia	Zapori-zhzhia	Ivano-Frankivsk	Kyiv	Kirovohrad	Luhansk	Lviv	Mykolaiv	Odesa	Poltava	Rivne	Sumy	Ternopil	Kharkiv	Kherson	Khmel-nytskyi	Cherkasy	Chernivtsi	Chernihiv	Kyiv city
Vinnytsia	0.0	0.6	2.79	1.4	0.2	0.9	2.7	1.4	2.3	0.3	0.3	3.20	1.8	3.5	1.0	0.2	0.2	0.1	1.6	1.5	0.5	0.8	0.2	0.3	11.3
Volyn	0.6	0.0	2.43	0.8	0.5	0.3	2.1	1.0	1.9	0.4	0.7	2.75	1.2	2.9	0.6	0.6	0.5	0.6	1.2	0.9	0.3	0.3	0.6	0.3	11.2
Dnipropetrovsk	2.8	2.4	0.00	1.9	2.8	2.2	1.7	1.9	1.1	2.7	3.0	1.25	1.8	1.9	2.0	2.7	2.6	2.8	1.3	2.1	2.5	2.2	2.9	2.6	9.7
Donetsk	1.4	0.8	1.94	0.0	1.3	0.5	1.4	0.7	1.3	1.2	1.5	2.04	0.4	2.1	0.6	1.4	1.2	1.4	0.8	0.2	0.9	0.6	1.4	1.1	10.9
Zhytomyr	0.2	0.5	2.78	1.3	0.0	0.8	2.6	1.3	2.3	0.1	0.3	3.16	1.7	3.4	0.9	0.2	0.2	0.1	1.6	1.4	0.4	0.7	0.1	0.2	11.4
Zakarpattia	0.9	0.3	2.22	0.5	0.8	0.0	1.8	0.8	1.6	0.7	1.1	2.45	0.9	2.6	0.5	0.9	0.8	0.9	1.0	0.6	0.5	0.2	1.0	0.6	11.1
Zaporizhzhia	2.7	2.1	1.69	1.4	2.6	1.8	0.0	1.7	1.3	2.5	2.9	1.40	0.9	0.8	1.8	2.7	2.6	2.7	1.4	1.3	2.3	1.9	2.7	2.4	10.5
Ivano-Frankivsk	1.4	1.0	1.87	0.7	1.3	0.8	1.7	0.0	1.1	1.3	1.6	1.92	1.0	2.4	0.5	1.4	1.2	1.4	0.9	0.8	1.0	0.8	1.4	1.1	10.4
Kyiv	2.3	1.9	1.12	1.3	2.3	1.6	1.3	1.1	0.0	2.2	2.5	0.94	1.2	1.7	1.3	2.3	2.2	2.3	1.0	1.4	1.9	1.6	2.4	2.1	10.1
Kirovohrad	0.3	0.4	2.73	1.2	0.1	0.7	2.5	1.3	2.2	0.0	0.3	3.09	1.6	3.3	0.9	0.3	0.2	0.2	1.5	1.3	0.3	0.7	0.2	0.1	11.4
Luhansk	0.3	0.7	3.03	1.5	0.3	1.1	2.9	1.6	2.5	0.3	0.0	3.41	1.9	3.7	1.2	0.4	0.4	0.2	1.9	1.6	0.6	1.0	0.1	0.4	11.5
Lviv	3.2	2.7	1.25	2.0	3.2	2.4	1.4	1.9	0.9	3.1	3.4	0.00	1.8	1.3	2.2	3.2	3.1	3.2	1.7	2.1	2.8	2.4	3.3	3.0	9.5
Mykolaiv	1.8	1.2	1.85	0.4	1.7	0.9	0.9	1.0	1.2	1.6	1.9	1.83	0.0	1.7	1.0	1.8	1.6	1.8	0.8	0.4	1.4	1.0	1.8	1.5	10.8
Odesa	3.5	2.9	1.88	2.1	3.4	2.6	0.8	2.4	1.7	3.3	3.7	1.30	1.7	0.0	2.6	3.5	3.3	3.5	2.0	2.1	3.1	2.7	3.5	3.2	10.2
Poltava	1.0	0.6	1.95	0.6	0.9	0.5	1.8	0.5	1.3	0.9	1.2	2.23	1.0	2.6	0.0	1.0	0.8	1.0	0.8	0.8	1.0	0.3	1.1	0.8	10.8
Rivne	0.2	0.6	2.71	1.4	0.2	0.9	2.7	1.4	2.3	0.3	0.4	3.17	1.8	3.5	1.0	0.0	0.2	0.2	1.6	1.5	0.5	0.8	0.2	0.4	11.3
Sumy	0.2	0.5	2.65	1.2	0.2	0.7	2.6	1.2	2.2	0.2	0.4	3.05	1.6	3.3	0.8	0.2	0.0	0.2	1.5	1.3	0.3	0.7	0.3	0.2	11.3
Ternopil	0.1	0.6	2.82	1.4	0.1	0.9	2.7	1.4	2.3	0.2	0.2	3.22	1.8	3.5	1.0	0.2	0.2	0.0	1.6	1.4	0.5	0.8	0.1	0.3	11.4
Kharkiv	1.6	1.2	1.26	0.8	1.6	1.0	1.4	0.9	1.0	1.5	1.9	1.74	0.8	2.0	0.8	1.6	1.5	1.6	0.0	0.9	1.3	0.9	1.7	1.4	10.4
Kherson	1.5	0.9	2.06	0.2	1.4	0.6	1.3	0.8	1.4	1.3	1.6	2.08	0.4	2.1	0.8	1.5	1.3	1.4	0.9	0.0	1.0	0.7	1.5	1.2	10.9
Khmelnytskyi	0.5	0.3	2.49	0.9	0.4	0.5	2.3	1.0	1.9	0.3	0.6	2.78	1.4	3.1	0.6	0.5	0.3	0.5	1.3	1.0	0.0	0.4	0.5	0.2	11.2
Cherkasy	0.8	0.3	2.15	0.6	0.7	0.2	1.9	0.8	1.6	0.7	1.0	2.45	1.0	2.7	0.3	0.8	0.7	0.8	0.9	0.7	0.4	0.0	0.9	0.6	11.0
Chernivtsi	0.2	0.6	2.90	1.4	0.1	1.0	2.7	1.4	2.4	0.2	0.1	3.29	1.8	3.5	1.1	0.2	0.3	0.1	1.7	1.5	0.5	0.9	0.0	0.3	11.4
Chernihiv	0.3	0.3	2.64	1.1	0.2	0.6	2.4	1.1	2.1	0.1	0.4	2.97	1.5	3.2	0.8	0.4	0.2	0.3	1.4	1.2	0.2	0.6	0.3	0.0	11.3
Kyiv city	11.3	11.2	9.71	10.9	11.4	11.1	10.5	10.4	10.1	11.4	11.5	9.48	10.8	10.2	10.8	11.3	11.3	11.4	10.4	10.9	11.2	11.0	11.4	11.3	0.0

Source: compiled by the authors
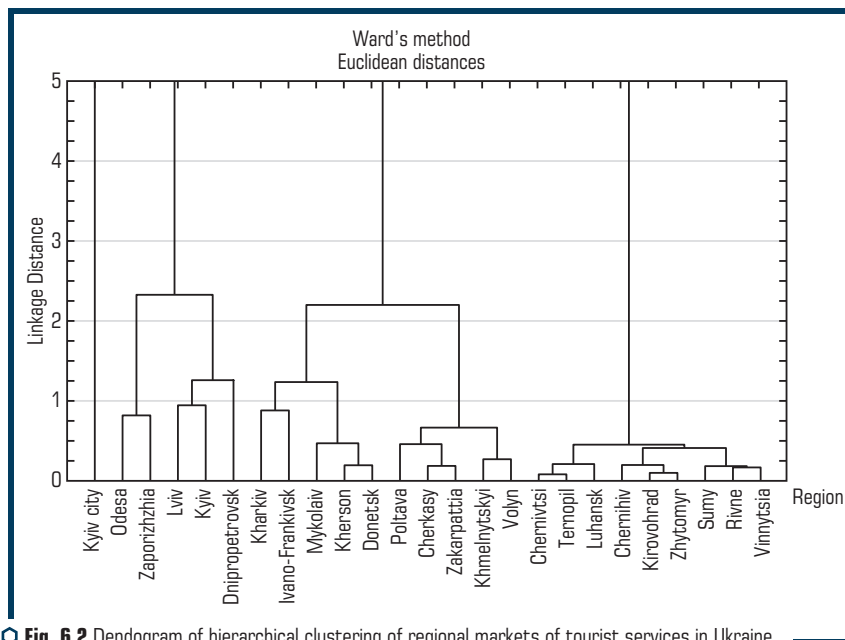
○ **Fig. 6.2** Dendogram of hierarchical clustering of regional markets of tourist services in Ukraine
Source: compiled by the authors

It should also be noted that when the regional markets of tourist services were combined into clusters, according to the indicators of the functioning of the subjects of tourist activity, the geographical feature was not taken into account, only the economic indicators of their activity were applied.

● **Table 6.4** Output statistical data for the cluster analysis of regional tourism markets in Ukraine, 2020

Threshold distance — 2

Cluster	Cluster union level	Sample objects
Cluster 1	–	Kyiv city
Cluster 2	0.8190739	Regions: Odesa, Zaporizhzhia
Cluster 3	1.260179	Regions: Lviv, Dnipropetrovsk, Kyiv
Cluster 4	1.237030	Regions: Kharkiv, Ivano-Frankivsk, Mykolaiv, Kherson, Donetsk
Cluster 5	0.6664612	Regions: Poltava, Cherkasy, Zakarpattia, Khmelnytsky, Volyn
Cluster 6	0.4530085	Regions: Chernivtsi, Ternopil, Luhansk, Chernihiv, Kirovohrad, Zhytomyr, Sumy, Rivne, Vinnytsia

Source: compiled by the authors

6.3 MODEL OF AUTHENTIC MANAGEMENT OF THE DEVELOPMENT OF LOCAL MARKETS OF TOURIST SERVICES IN UKRAINE

In the context of globalization and integration of the tourism industry of Ukraine into the world tourism space, the issue of effective and competitive management of the development of local markets as components of a complex multi-level system of the national market of tourist services becomes extremely urgent.

The spatial polarization of the socio-economic development of local tourism markets, the authentic features of their cultural and historical potential, the peculiarities of the spiritual and religious values of the multinational composition of the population, the differences in the natural and climatic conditions of the formation of tourism markets give rise to the need to apply differentiated specific models and concepts of the formation and management of their development, taking into account various approaches and mechanisms for achieving general goals, objectives and expected effects.

Managing the development of local tourism markets through authentic management will allow the use of national cultural identities as a competitive advantage while encouraging both foreign and domestic tourists. Moreover, the positioning of the local tourist market as an authentic destination should be based on the development of a positive attitude towards representatives of other nations and cultures; desire to learn about the culture and customs of peoples, reducing negative perceptions and stereotypes in relation to other peoples and cultures; spreading understanding, respect and tolerance for the culture of other peoples; increasing self-esteem of local residents and their perception of world living standards; psychological satisfaction from interaction with representatives of other cultures (**Fig. 6.3**).

It is proposed to implement the model on the basis of taking into account the specific features of local markets for tourism services, namely: the authenticity of the cultural and historical resources of local markets for tourism services (spiritual and religious values, cultural and tourist resources, historical and tourist resources), the asymmetry of infrastructural and socio-economic development markets (transport infrastructure, infrastructure of accommodation facilities, cultural and entertainment infrastructure, food infrastructure, socio-economic situation), spatial polarization of the location of natural-climatic and recreational factors for the development of local tourism markets (natural-geographical potential, natural-climatic potential and recreational potential) (**Fig. 6.3**).

The synthetic interaction of these features forms the outline framework of the model, determines the integrated components of ensuring competitive advantages and destructive determinants of the formation of local tourism markets.

The model of authentic management of the development of the tourism services market should be based on and take into account as much as possible:

1) the regional specifics of the development of tourism business entities and related industries;

2) principles of rational use and protection of tourist and recreational resources of local markets, preservation of objects of national cultural heritage;

3) advanced European and world achievements and developments in the systematic management of the quality of tourism services, the provision of tourism services, the creation of an integrated tourism product;

4) mechanisms of interaction and regulation of powers of central and local executive authorities, local governments, subjects of tourism activities, scientific institutions and educational institutions;

5) mechanisms to ensure maximum safety of tourists, protection of their rights and interests during travel;

6) the needs of local markets in the professional training of specialists in the field of tourism, in particular, hotel, restaurant, cultural and entertainment and other types of activities;

7) strategic prospects for the development of industries and types of economic activities adjacent to tourism, which are of a strategic nature for the study area;

8) comprehensive theoretical and methodological, analytical, sociological studies of the local tourism business, the market of tourism services, subjects of tourism activities.
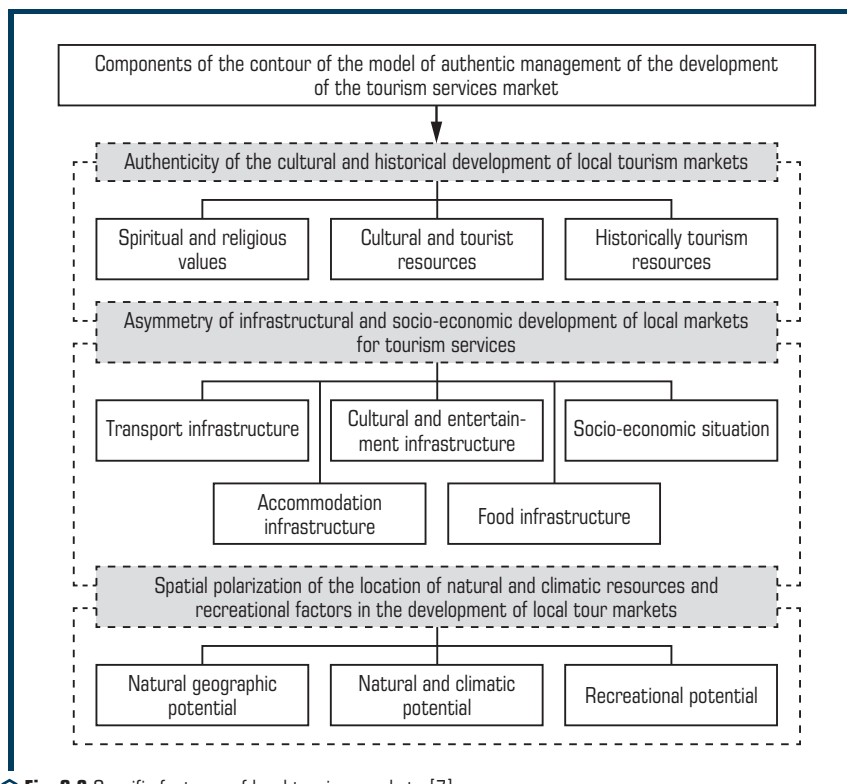
○ **Fig. 6.3** Specific features of local tourism markets [7]

Taking into account the authenticity of the cultural and historical development of local markets for tourist services presupposes the management's orientation towards spiritual and religious values and cultural and historical tourist resources of a certain territorial space. In this regard, the development of local programs for the development of tourism should be based on the existing cultural, value, spiritual, moral and religious guidelines of society, the unique, cultural and traditional heritage of the local community. Compliance with the authentic component in the management and formation of local markets for tourist services will ensure the preservation of unique cultural ethnic groups, on the one hand, and serve as a tool to encourage tourists motivated by the desire to learn the cultural heritage, historical descendants and ethnographic value of certain regions of the country.

Taking into account the asymmetry of the infrastructural and socio-economic development of local markets for tourism services, namely: transport, cultural and entertainment infrastructure, infrastructure of accommodation facilities, food, the socio-economic situation of the region in management will ensure the development of programs, concepts and strategies that take into account urgent needs and the potential for their solution, relying on the resources and factors of a certain territorial economic space.

Taking into account the spatial polarization of the location of natural, climatic and recreational factors in managing the development of local tourism markets is a key factor in the formation of a tourism business based on characteristic types of tourism, namely: recreational and health-improving, mountain, water (underwater), rural exotic, adventure, hunting, ecological (green), etc.

Determination of the sufficiency of the provision of the territorial space with natural, climatic and recreational factors for the development of tourism is the primary task of the initial stage of the formation of the tourism market. Depending on what type of tourism is planned to be developed in a certain territory, an assessment of its provision with certain necessary resources and factors is carried out. So, at the first stage, it is advisable to assess the availability of natural-climatic, recreational and cultural-historical resources, the second stage is characterized by the study of the quality of infrastructural support, the final third – by the diagnosis of the socio-economic situation.

The conceptual content of the model is provided by the integrated relationship of its main components: the goal, which is manifested in ensuring the sustainable, competitive development of local markets for tourism services, tasks, functions, principles, involved subjects, control units, the expected effects of its implementation (**Fig. 6.4**). The model of authentic management of the development of the tourist services market is designed to perform the following functions: organizational and managerial, analytical and diagnostic, predictive, information and resource, innovation and technological, communication. Among the main tasks of the model of authentic management of the development of the tourist services market, the following are identified:

1) improving the institutional support for the development of local tourism markets, strengthening the interaction of national and local government authorities, creating a local authority for regulating tourism, managing its development (management, tourism department as part of regional state administrations, local tourism administrations);

2) development of tourist and related infrastructure of Ukrainian cities;

3) restoration of abandoned tourist sites, their inclusion in excursion service programs by attracting national and foreign investors, the use of public-private partnerships.

4) inclusion in the tourism industry of non-traditional for tourism in Ukraine destinations – industrial, agricultural, environmental regions, did not fully use the existing recreational potential, affected the fragmented nature of the development of the tourism business or its complete absence;

5) dissemination of information about the tourism brand of local destinations, raising the awareness of the population about the tourist attractions of Ukraine, which will allow reorienting outbound tourist flows to flows within the state, supporting the domestic sector of tourism and resorts;

6) increasing the interest of citizens in the cultural heritage, history and modernity of their native land, country will provide not only a socio-economic effect, but also a patriotic and educational function – to contribute to the revival of spirituality, morality, national consciousness, culture, respect for the native land and state.

The organizational and managerial function is expressed in the creation of a single management space capable of ensuring the integrity of the management system of the market, the effectiveness of the relationship of its components, coordination and interconnection of the subjects of tourism activities, to achieve the most optimal conditions for the rational organization, coordination and management of the development of the tourism services market.

The analytical and diagnostic function is manifested in the collection and analysis of information on the efficiency of management of the tourism services market, identification of existing positive and negative trends, existing threats, assessment of compliance with certain vectors of market formation, and determination of the reasons for deviations from the conceptual and strategic programs of its development.

The predictive function predicts the development of the market in the future, showing regular trends, rink-forming factors and specific properties of each stage of its formation; forms strategic development goals and defines conceptual guidelines for management activities.

The information resource function involves the mobilization and redistribution of material, financial, informational, intellectual, human resources; provision of regulatory, informational, methodological, consulting, financial and credit support.

The innovative and technological function involves the generalization of advanced European and world management experience, modern technologies and mechanisms for creating an integrated tourism product, standards of tourist service, ensuring the spread of acquired progressive technological and organizational practices in order to stimulate, provide support for the activities of the subjects of local markets of tourism services, its permanent competitive development.

The communication function acts as an integrating component that unites the role of management and communication, ensures the exchange of information and feedback, the management of communication processes occurring between the subjects of the tourism services market, allows to achieve consistency of interests, cooperation on an equal footing, alignment of differences in initial awareness, maintain sustainable production-business connections.

CONCEPTUAL FILLING OF THE MODEL	Goal: ensuring sustainable, competitive development of local tourism markets

Tasks:
- improving the institutional support for the development of local tourism markets
- development of tourist and related infrastructure of Ukrainian cities
- restoration of abandoned tourist sites
- inclusion in the tourism industry of cities that are not traditional for tourism in Ukraine – industrial regions, etc.
- dissemination of information about the tourism brand of local destinations
- increasing the interest of citizens in the cultural heritage, history and modernity of their native land, state
- raising awareness of the population about the tourist attractions of Ukraine, etc.

Functions:

Organizational and managerial	Analytical and diagnostic	Predictive	Information resource	Innovative and technological	Communication

Principles:

Integrativity	Optimality	Adaptability	Rationality	Authenticity
	Unity	Flexibility	Complexity	Multiculturalism

Blocks of management decisions:

Restructuring	Activation	Supportive	Stimulating	Self-sustaining

Subjects:

Verkhovna Rada of Ukraine	Ministries	SATD	Local government administrations	Local governments	Local authorities regulating tourism

Expected results:
- increasing the rates of economic growth of the regions
- increasing employment of the population, reducing unemployment, reducing poverty, increasing effective demand
- increasing revenues to local budgets
- increasing the investment attractiveness of regions, attracting investments
- assistance in the development of educational institutions due to the need to increase the quality of training and retraining of personnel involved in tourism, improve their qualifications
- an increase in tourist flows - national, inbound, within the country
- multiplier effect on related tourism industries

○ **Fig. 6.4** Conceptual content of the model of authentic management of the development of the tourism services market [8]

An important research task of modeling the authentic management of the development of the tourist services market is to determine the continuum of principles, the main of which are the principles: integrability, the optimal combination of centralization and decentralization of management, adaptability, rationality, unity, flexibility, complexity, authenticity and multiculturalism.

The principle of integrativity substantiates the expediency of combining the interaction of all elements of the market system, in turn generates a new quality of the spatial and economic development of the region, an increase in the synergistic effect.

The principle of the optimal combination of centralization and decentralization of management presupposes a clear regulation of the powers of state authorities and local authorities that regulate tourism in the formation and management of the development of local markets for tourism services.

The principle of adaptability is manifested in the ability of the local tourism market to adapt to changes in internal and external circumstances, the emergence of destructive factors and negative trends in the national tourism market without deteriorating the performance and stability of its functioning.

The principle of rationality presupposes a balance of production capacities and production volumes of products, the provision of tourist services at an appropriate quality.

The principle of unity implies the need to consider the national market of tourist services as an integral system, which consists of different quality, at the same time collegial elements – local markets of tourist services, which are interrelated, interacting components of one whole. In the authentic management of the development of the tourist services market, the principle of unity is complemented by the need to take into account national characteristics and complement their ethnic traditions of the regions.

The principle of flexibility determines the ability of the local market of tourist services to self-regulation, change the priority directions of development, the ability of its potential to return to a state of balance after adaptation to negative environmental factors, emerging unforeseen destabilizing factors and development determinants.

The principle of complexity presupposes the holistic use of the natural resource, recreational potential of the local tourism market, the rational attraction of labor resources, the activation of economic ties between the subjects of the tourism business, the creation of an end-to-end infrastructure of the tourism market, which takes into account the production and social potential of the territory.

The principle of authenticity provides for taking into account the cultural, religious, ethnic specificity, which has a significant impact on the spiritual development of society, the worldview of people, the development of art in the territory of a particular region or ethnic group; building a socio-cultural construct that takes into account the uniqueness of traditions, customs, cultural heritage, as well as the peculiarities of business etiquette of doing business and the culture of communication.

The principle of multiculturalism provides for the formation of a tolerant attitude towards cultural characteristics and differences; awareness of the importance of intercultural interaction; popularization of the cultural space of individual regions, familiarization with which contributes to the expansion of the worldview of the individual, generates respect for the circle of cultures and

civilizations; encourages the bilingual development of the nation, the awareness of individuals and society as a whole that they are carriers and representatives not only of their native, but with most interconnected cultures.

The choice and application of certain managerial decisions for authentic management of the development of the tourism services market is based on the type, model of the local market, taking into account the presence of market-forming and destructive factors, the stage of market formation and current trends in its development. The proposed list of managerial decisions in the model of authentic management of the development of the tourism services market has not been exhausted. Within each block of managerial decisions, sub-blocks can be created to target the features and properties of local markets.

It is proposed to apply the restructuring block of managerial decisions for tourism markets at the stage of modernization, which are characterized by ineffective management, unproductive use of the natural, climatic and recreational potential, low quality of infrastructure support for the tourism business, limited internal activity and the lack of inbound tourist flows. In the process of restructuring, a purposeful change or significant improvement of the market management system is carried out, the development of a qualitatively new institutional support for the development of the tourism services market, the development and implementation of a strategy for the effective, environmental, sustainable use of climatic and recreational potential, the development of a mechanism for spatial and infrastructural support of the tourism business or significant optimization of the existing infrastructure.

The activation block of managerial decisions is used for tourism markets at the initial stage or the stage of modernization, which are characterized by restrained development, characterized by consistently low tourist flows within the market or their gradual decrease, the absence or sporadic nature of entry, low seasonal employment of the population in the tourism industry, and a decrease in revenues to local budgets from the tourism industry with a sufficiently high-quality tourism logistics, satisfactory actual availability of tourist infrastructure facilities, the presence of local authorities regulating tourism.

The supporting block of managerial decisions is used for tourism markets at the stage of consolidation, natural-recreational and socio-economic potential, which cannot be exceeded by the true scale of growth. The use of the appropriate block of managerial decisions is aimed at ensuring the acceleration of the development rate of the local tourism market, which are manifested in a gradual increase in domestic tourist flows and a stable dynamics of inbound, stable employment of the population in the tourism and related industries, the shares of tourism receipts in local budgets have been preserved. The effectiveness of the local Administration and the quality of institutional support for the functioning of the tourist services market is assessed as quite high.

A stimulating block of managerial decisions is used for tourism markets at the accumulative and consolidation stages. Management of the socio-economic, organizational, recreational, innovative and investment development of the local market of tourist services is carried out by local authorities, relying on the availability of climatic, cultural, historical, economic, social resources

and production factors. State support is provided in the introduced gradations of the system of benefits, preferential vacations, easing tax policy, attracting tourism business entities to fulfill government orders for the supply of services, helping to increase the competitiveness of domestic tourism enterprises in the international tourism market, stimulating domestic local tourism by subsidizing part of the cost or full financing tourist and related services for low-income groups of the local population and the like.

It is advisable to use a self-sustaining block of managerial decisions for local tourism markets with high efficiency of local authorities, building management and regulation in the field of tourism, relying on active resources. These markets are characterized by a stable, gradually increasing intensity of domestic tourist flows, a developed tourist infrastructure, optimal institutional support for business, and efficient tourism logistics. Development management should be aimed at developing bilateral and multilateral international cooperation, attracting foreign investment, using modern channels for disseminating and disseminating information about the uniqueness and authenticity of tourist and recreational market resources in foreign countries, introducing modern technologies to encourage and attract foreign tourists, etc.

One of the variable methodological techniques for determining the optimal block of managerial decisions for authentic management of the development of the tourism services market is the matrix method, the basis of which is a two-factor matrix. The vertical axis of the matrix is formed by the proposed stages of development of the tourist services market (initial stage, cumulative stage, stage of consolidation and modernization), the horizontal axis is the model of its spatial and polarization development («Deep Periphery» model, «Advanced Periphery» model, «Semi-periphery» model, «Center» model). The congruence of the constituent components of both axes on the matrix field makes it possible to determine the necessary control unit inherent in a particular model at a particular stage in the development of the tourist services market (**Fig. 6.5**).

Stages of formation and development of the tourist services market	Modernization stage	Restructuring	Activation	Supporting	Supporting
	Consolidation stage	Stimulating	Supporting	Stimulating	Self-sustaining
	Accumulative stage	Activation / Stimulating	Stimulating	Stimulating	Self-sustaining
	Initial stage	Restructuring / Activation	Restructuring / Activation	Activation	Supporting
		«Deep Periphery» model	*«Advanced Periphery» model*	*«Semi-periphery» model*	*«Center» model*
		Models of spatially polarization formation and development of tourist services markets			
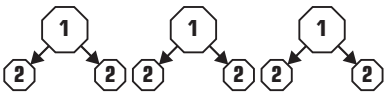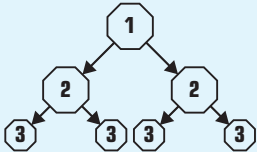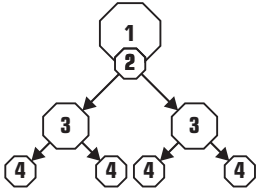
○ **Fig. 6.5** Two-factor matrix of attribution of relevant blocks of managerial decisions of authentic management of the development of local markets for tourism services [8]

At the same time, it should be emphasized that the determination of the optimal block of managerial decisions should be based on taking into account the characteristics and development trends of a particular local market, taking into account the influence of internal and external factors and forecast indicators of its development. The proposed matrix method is designed to ensure the selection of a common block of managerial decisions for its further adaptation to a specific market.

The proposed two-factor matrix should be a directional guideline for the selection of relevant blocks of managerial decisions for authentic management of the development of the tourism services market. In practice, it is advisable to choose the appropriate block of managerial decisions, taking into account the inherent trends in the development of the market, factors, destructors and factors of producers, the main directions and strategic vectors of the formation and development of the market.

In the organization of management of local tourism development, three main models have been identified (**Table 6.5**), the choice and application of which depends on the state strategy for the development of the tourism services market of the national economy, the degree of market development, the competitiveness of the subjects of tourism activities, the attraction of the state's tourism industry to the world tourism space, etc.

● **Table 6.5** Models of state participation in the regulation and management of the development of local markets for tourism services [8]

Model name	Visualization of model	Subjects
Decentralized governance model		1 – Local authorities to ensure the formation and implementation of regional policy in the field of tourism 2 – Market entities
I Centralized Management Model		1 – Profile Ministry of Tourism 2 – local authorities to ensure the formation and implementation of regional policy in the field of tourism 3 – market entities
II Centralized Management Model		1 – Multidisciplinary ministry 2 – Department, structural unit of the Ministry for ensuring the formation and implementation of state policy in the field of tourism 3 – local authorities to ensure the formation and implementation of regional policy in the field of tourism 4 – market entities

The model of decentralized management of the development of local markets for tourism services assumes the absence of a central national body for the formation and implementation of state policy in the field of tourism.

Development and implementation of programs for the development of tourism, culture, leisure is carried out locally on the principles of market self-organization. The use of such a model is advisable when the tourism industry is not strategically important for the national economy or the subjects of the tourism market are able to ensure sustainable and competitive development on a national and international scale without state protection.

I model of centralized management of the development of local markets for tourism services presupposes the presence of a line ministry for tourism and related policies, which oversees the activities of local authorities. A similar model is inherent in the tourism markets of countries for which tourism is the main source of foreign currency replenishment of the budget, constitutes a significant share of revenues in GDP, and is characterized by high employment in the tourism industry. The characteristic features of the model are the definition of the tourism industry as a priority for the country, a clear distribution of powers between the relevant ministry and local authorities that ensure the formation and implementation of regional policy in the field of tourism.

II model of centralized management of the development of local markets for tourism services presupposes the presence of a department, an independent structural unit within a multidisciplinary ministry to ensure the formation and implementation of state policy in the field of tourism, responsible for the development of tourism, and directs its activities in two directions: solving general issues of market development management tourism services and coordination of marketing activities.

The effectiveness of the implementation of the proposed model of authentic management of the development of the tourist services market depends on a clear regulation of the powers of state authorities and local authorities, the determination of the optimal volumes of centralization and decentralization of management.

The main local subject of institutional support for the authentic management of the development of the tourism services market is the local authority that regulates tourism, which can be the administration, the department of tourism as part of regional state administrations, local tourism administrations.

The purpose of creating or improving a local governing body for local tourism development is to ensure the adoption and implementation of effective managerial decisions that can contribute to the sustainable development of economic, social and infrastructural components.

Improvement of active local authorities that regulate tourism is advisable in the case when the general goals, set objectives and target priorities of market development are not achieved, regional programs are not implemented due to subjective reasons, etc. The formation of a local management system for local tourism development is proposed to be carried out in stages (**Fig. 6.6**).

The expected results of the introduction of a model of authentic management of the development of the tourist services market is the emergence of social and economic effects.

Stage I – **analytical** – involves the diagnosis of local functioning bodies, identification of existing problems of their activities and the destructive basis

Stage II – **program** – the creation of a program mechanism for the consistent formation of the governing body of local tourism development

Determination of the place and subordination of the body in the regional structure of power	Choosing a local authority design method	Coordination of the structure and quantitative composition of the administrative apparatus of the body
Preparation of proposals for the approval of a candidate for the position of head and staff	Approval of candidates for the position of head and administrative staff	Development of regulations and job descriptions

Stage III – **implementation** – provides for the introduction of management and organizational activities of the created body

Fig. 6.6 A simplified scheme for the formation of a local management system for local tourism development [8]

The economic effect is manifested in:

1) increasing the rates of economic growth of the regions;

2) creating a favorable institutional and organizational climate to ensure economic conditions for the development of priority areas of tourism in the region;

3) increasing revenues to local budgets;

4) increasing the investment attractiveness of regions, attracting investment;

5) increasing the tourist flows – national, inbound, within the country;

6) multiplier effect on the accompanying tourism industries;

7) establishment of a sustainable image of the region, the city as a tourist-attractive destination, and the like.

The social effect is manifested in:

1) increasing employment of the population, reducing unemployment, reducing poverty, increasing effective demand;

2) improvement of the existing system of research cooperation, professional training, retraining of specialists and advanced training of personnel in the tourism sector;

3) assistance in the development of educational institutions due to the need to increase the quality of training and retraining of personnel involved in tourism, improve their qualifications;

4) achieving social satisfaction of local residents in meaningful leisure, health-improving recreation, staying in an ecologically sustainable environment.

Authentic management of local tourism markets, taking into account the specific tourism opportunities of local markets, will contribute to the development of innovative sectors of the Ukrainian tourism market, and will activate the development of non-traditional types of tourism for the state.

At the same time, the formation of innovative sectors of the tourism services market requires the development of an appropriate methodological and conceptual framework that can provide a theoretical and methodological platform for its development.

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7 TAXONOMIC ANALYSIS OF STRATEGIC DECISIONS FOR THE DEVELOPMENT OF THE HOTEL AND RESTAURANT INDUSTRY

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ABSTRACT

The object of research is the strategy for the development of the hotel and restaurant industry in Ukraine. To achieve this goal, the methods of theoretical generalization, analysis and synthesis, logical generalization, analogies, comparison, grouping, the method of taxonomic analysis, and system analysis were used. The use of the method of taxonomic analysis made it possible to obtain a generalized assessment of the development strategy of the domestic hotel and restaurant industry. The method of retrospective analysis made it possible to analyze the dynamics and identify trends in changes in the integral indicator of the development strategy of the domestic hotel and restaurant industry.

The application of the taxonomy method for diagnosing the development strategy of the hotel and restaurant industry has been substantiated; for this, it is proposed to use a conceptual descriptive model of taxonomic analysis. Indicators of diagnostics of the development strategy of the hotel and restaurant industry have been identified, which are grouped according to the dominant directions: structural, scale of production activities, marketing, personnel, investment attractiveness and financial performance. The interpretation of the values of the integral taxonomic indicator of the development strategy of the hotel and restaurant industry in Ukraine has been substantiated. In accordance with the value of the integral indicator, it is proposed to divide into four states of the industry development, which correspond to certain strategies and managerial decisions for their implementation. The integral indicator of the hotel and restaurant industry development strategy was calculated using the taxonomy method for the period 2013–2019. Based on the results of the calculations, it was concluded that the development of the hotel and restaurant industry in Ukraine is uneven. The largest share is taken by observations with an insufficient state of development of the industry – 57.1 %, a crisis state of development was observed in 28.6 % of periods and a sufficient state of development was recorded in 14.3 % of observations. This indicates the existing problems in the development of the domestic hotel and restaurant industry.

Managerial solutions are proposed for the implementation of the strategy for the development of the hotel and restaurant industry for the coming period, including activities at the national level and at the level of individual business entities.

The applied nature of the proposed methodology is justified by its practical application based on the actual data of the development of the hotel and restaurant industry in Ukraine for 2013–2019.

KEYWORDS

Taxonomic analysis, development strategy, reference vector, hotel and restaurant industry.

7.1 ANALYSIS OF THE PRACTICES OF APPLYING TAXONOMIC ANALYSIS TO SUBSTANTIATE MANAGERIAL DECISIONS ON THE DEVELOPMENT STRATEGY OF THE HOTEL AND RESTAURANT INDUSTRY

At the present stage of economic relations, the development of the domestic hotel and restaurant industry is accompanied by cyclical processes that are intensified by world integration phenomena, increased competition and turbulence in the external environment, and the socio-economic crisis in the country.

The industry is a complex economic system that requires its constant monitoring and the use of a system of dissimilar indicators for this, which must be systematized and constantly analyzed to make rational managerial decisions.

To work with large amounts of information, it is customary to use algorithms and optimal mathematical models in the field of level assessment. The most acceptable in these conditions is the method of taxonomic analysis, which allows the construction of a generalized assessment of a complex object or process. The method has a powerful arsenal of systematization algorithms and can solve the problem of assessing the development strategy of the hotel and restaurant industry.

In the scientific literature, there are no generally accepted methods for assessing the development strategy of the hotel and restaurant industry. In the existing methods, a different composition of indicators is proposed and do not contain the benchmarks of the integral indicator of the level of the development strategy, which complicates analytical and management procedures. However, there is a need to develop a methodology for assessing the development of the hotel and restaurant industry and obtain a generalized indicator of its development.

The object of research is the strategy for the development of the hotel and restaurant industry in Ukraine.

The aim of research is to determine and analyze the integral indicator of the development strategy of the hotel and restaurant industry in Ukraine and substantiate, on this basis, management measures to implement the industry development strategy for the coming period.

To achieve the set research aim, the following tasks have been identified:

1) development of a conceptual descriptive model of taxonomic analysis of the hotel and restaurant industry development strategy;

2) formation of a sample of data on the development strategy of the hotel and restaurant industry in Ukraine for 2013–2019;

3) calculation of the integral indicator of the hotel and restaurant industry development strategy using the taxonomy method;

4) interpretation of the results of the analysis of the integral indicator for 2013–2019;

5) development of proposals for the implementation of the industry development strategy for the coming period.

The works of many well-known domestic and foreign scientists are devoted to the study of various aspects of the development strategy of the hotel and restaurant industry of the enterprise.

The problems of applying the methods of multidimensional analysis are highlighted in the works of Ayvazyan, S., Bazhaeva, Z., Staroverova, O. [1], Pluta, W. [2] and others.

Olsen, M. D., Roper, A. [3] conducted research on strategy in four main areas – strategic planning, competition and competitive advantage, internationalization and strategy implementation. It has been established that in the field of hospitality it is necessary to take into account the influence of international transactions.

Doctoral research by Schmelzer, C. [4], conducted in three restaurant firms in the United States, is an empirical study of the implementation of strategy in the field of hospitality. This study aims to develop an implementation strategy. Based on the analysis of several framework works on the implementation of the strategy, the author identified 10 variables for the implementation of the strategy, and then divided them into two groups: context and process variables. Data from three restaurant companies were collected and analyzed. Based on the results of her research, Schmelzer has developed a framework for strategy implementation, consisting of a number of variables for strategy implementation, such as structure, culture, learning, etc. [5].

Wong, K. K. F., Kwan, C. [6] analyzed the competitive strategies of hotels and travel agents using the Asia-Pacific context (Hong Kong and Singapore). They identified the cost of competitiveness as mobilizing staff and partners and building a robust service delivery system as a key competitive strategy.

Garrigós-Simón, F. J., Palacios Marqués, D., Narangajavana, Y. [7] studied the competitive strategies and performance of Spanish hospitality firms.

Further research on strategy implementation in the sector was conducted by Jessica Hwang, L., Lockwood, A. [8], who studied hospitality and tourism firms to uncover the challenges of implementing best practices in hospitality and tourism. Seven key capabilities are found to underpin the adoption / implementation of best practices, including customer-centric objectives, planning and control, partnerships and networking, internal and external communication, achieving agreed standards, strategic personal management, cash flow and performance management.

Kandampully, J., Duddy, R. [9] identified the service system as a key factor in maintaining competitive advantage. The authors' research envisioned a model of interlinked empowerment, service warranties, and service recovery to deliver outstanding service to hospitality and tourism establishments as a means of maintaining a competitive advantage.

Gursoy, D., Swanger, N. [10] empirically investigated the managerial perspectives of internal strategic factors that can affect the financial performance of companies in the hospitality and tourism industry. The relationships between internal strategic factors and financial performance were examined, and it was found that four internal strategic success factors (sales, R&D and disruption, IT and human resources) had a significant impact on the financial performance of the company.

The study by Ottenbacher, M. C. [11] analyzed data on 185 innovations in the field of hospitality and identified three dimensions of efficiency: market efficiency, improved financial performance, employees and customers. With 23 potential determinants of success, 12 have been recognized as performance drivers.

In [12], the methodological foundations for determining the competence-based readiness of an enterprise for strategic changes in the context of a high dynamism of the business environment are investigated.

In subsequent works of researchers [13], on the basis of the author's economic and mathematical model, the optimization of the key parameters of the basic strategy of enterprise changes was carried out.

The work of Balatska, N. [14] analyzes the functioning of the restaurant business, emphasizes the importance of Internet technologies and alternative online services for reengineering the main business processes and repurposing the usual operating mode of restaurant business establishments.

Ostapenko, Y., Paranitsa, N., Makarenko, O. [15] analyzed the development of the tourism business in Ukraine. It is determined that due to the growth in the volume of tourism business and the need to accommodate tourists, it is necessary to more direct the state management of tourism on the creation of a competitive hotel industry. The analysis of the structure of the hotel business in Ukraine was carried out and the development of hotel enterprises was assessed, the shortcomings and prospects for the development of the hotel industry were identified.

In the work of Zavidna, L. D. [16], practical recommendations are given on the strategy of ensuring the competitiveness of enterprises in the sphere of hotel services and effective management of the resource potential of an enterprise in the hotel business. The methodological and methodological approaches to the formation and implementation of the development strategy of the hotel business enterprise have been substantiated. The modeling of the process of managing the strategic development of a hotel business enterprise using economic and mathematical methods is proposed.

The article by Dekaliuk, O. V. [17] considered methodological approaches to choosing a strategy for the development of a hotel and restaurant enterprise. The model of integrated strategic management of the hotel and restaurant business has been determined. The analysis of corporate strategies is carried out and conclusions are drawn on the implementation of the latter at the enterprises of the hospitality industry.

In the article by Mylko, I. [18] considered the general aspects of developing a strategy for the development of the hotel and restaurant complex in Ukraine. The mission of the hotel and restaurant complex of the country was formed, the goals, priorities and tasks of the activity were clarified, the SWOT-matrix of the enterprises of the hotel and restaurant complex of the country was built. The structure of the strategy for the development of the hotel and restaurant complex of the country is proposed.

Dyshkantiuk, O., Potemkin, L., Vlasiuk, K. [19] analyzed the world experience and found two approaches to overcoming the crisis: the first approach — affordable credit lines, the second — deferred payment of tax and debt obligations, considered the dynamics of indicators of the development of the domestic hospitality and tourism industry and emphasized the importance of finding new approaches and business models.

Korzh, N., Onyshchuk, N. [20] analyze the activity of hotel establishments in quarantine conditions and determine the main directions of their transformation.

The team of authors Charkina, T., Martseniuk, L., Zadoia, V., Pikulina, O. [21] primed the implementation of strategies and directions for overcoming the crisis in the hotel and restaurant business, in order to ensure the possibility of functioning of hotels and restaurants in the new quarantine conditions.

The work [22] systematizes the main strategies for the development of the hotel and restaurant business during the Covid-19 period, identifies two groups of development strategies: a strategy for maintaining a positive image in the market and a strategy for overcoming the negative consequences of the Covid-19 pandemic.

Methods of multivariate statistical analysis, in particular the taxonomy method, are used in the works of foreign and domestic scientists to study various aspects of strategic management in the hospitality industry. In particular, in the work of Bowen, J. T. [23] used taxonomic analysis to form the marketing strategy of hotel and restaurant establishments. The authors created regression models for each of three different grouping methods (taxonomic, strategic, and sectoral) using ROI as the dependent variable. Taxonomic groups were found to explain most of the changes, followed by strategic groups and industry groups.

The work [24] presents a taxonomic analysis that includes seven practical indicators and a decision tree to measure the use of Revenue Management for various enterprises. The analysis was carried out on the basis of a survey of 232 enterprises. The findings provide insight into how Revenue Management practices differ in different settings.

In the work of the team of authors, chaired by Nikolskaya, E. Yu. [25] used the method of taxonomic analysis to assess the level of innovation potential of hotel enterprises.

In the work of Seliutin, S. V. [26] carried out a taxonomic analysis of the effectiveness of the strategic management of the establishments of the restaurant industry in Kharkov and revealed a tendency for the growth of the values of the integral indicator in more complex and clustered in the form of enterprises. In order to increase the efficiency of strategic management of restaurant enterprises, matrices of possible changes in their values have been developed, which orientate to specific strategic goals of fractal determinants, and priority strategic directions for the development of selected enterprises have been proposed.

Davydova, O. Yu. [27] analyzed the state of efficiency of the components of innovative management of the development of hotel and restaurant enterprises using the taxonomy method. As a result, an assessment of the level of the general integral indicator of the effectiveness of the components of innovative management of the development of hotel and restaurant enterprises was obtained.

In the article by Shykina, O. [28] considered the application of taxonomic analysis as a method for assessing the competitiveness of small hotels in Odesa. A grouping of 75 small hotels was carried out according to the results obtained and the prospects for choosing development strategies for individual groups based on the results of the study were substantiated.

In the work of Chernikova, I. B., Kvasha, O. O., Kirilieva, L. O. [29] the issue of the application of the method of taxonomic analysis in the information system of enterprises of the Kharkiv region and Kharkiv. The taxonomic analysis of the enterprises of the restaurant industry in Kharkiv and the Kharkiv region was carried out and the indicator of the level of economic development of the studied set of enterprises was determined. As a result of the calculations, two groups of enterprises were obtained — with a more and less stable level of development.

Analysis of scientific literature indicates the diversity of approaches to assessing the development of the hotel and restaurant industry. The results of the analysis allow to conclude that it is advisable to use multivariate statistical methods in the study of various types of strategies through the multicriteria of their measurement. As for the methods of taxonomic analysis, it should be noted that they are predominantly used for research at the level of hospitality institutions, and not in the industry as a whole. Moreover, in general, the existing methods do not contain benchmarks, an integral indicator of the level of the development strategy, which complicates analytical and managerial procedures.

Scientific and methodological approaches to assessing the development strategy of the hospitality industry at the sectoral level by methods of taxonomic analysis have not yet been implemented. These shortcomings necessitate the development of scientific and methodological approaches to assessing the development strategy of the hotel and restaurant industry using taxonomic analysis.

7.2 METHODOLOGY FOR TAXONOMIC ANALYSIS OF THE HOTEL AND RESTAURANT INDUSTRY DEVELOPMENT STRATEGY

To solve the tasks, the following methods were used: analysis and synthesis, theoretical and logical generalization, analogies, comparisons, groupings, the method of taxonomic analysis, system analysis, and the like.

To form an integral indicator of the development strategy of the hotel and restaurant industry, it is proposed to use the taxonomy method.

The main purpose of using the taxonomy method is to build a generalized assessment of a complex object or process.

The taxonomic indicator is calculated according to the classical algorithm of taxonomic analysis [1]: formation of the observation matrix, standardization of the values of the elements of the observation matrix, identification of the reference vector, determination of the distance between individual observations and the reference vector, calculation of the taxonomic development coefficient, formulas (5.1)–(5.9) [30].

The construction of a number of indicators that are different in their characteristics to a single generalizing indicator makes it possible to determine the difference between the achieved state and the comparison base as a whole for the group of indicators.

7.3 DIAGNOSTICS OF THE DEVELOPMENT STRATEGY OF THE HOTEL AND RESTAURANT INDUSTRY USING THE TAXONOMY METHOD AND JUSTIFICATION OF MANAGERIAL DECISIONS FOR THE IMPLEMENTATION OF THE STRATEGY FOR THE FURTHER DEVELOPMENT OF THE INDUSTRY

Based on the analysis of literary sources, expert assessment and the available information base according to the State Statistics Service of Ukraine, a list of indicators for diagnosing the strategy of development of the hotel and restaurant industry in the dominant directions was formed (**Table 7.1**).

● **Table 7.1** Indicators of the dominant directions of diagnostics of the development strategy of the hotel and restaurant industry in Ukraine

№	Assessment component	Indicators
1	Structural	Number of business entities ($X1$) Share of the number of entities in this type of economic activity in the total number of entities, % ($X2$) Share of individual entrepreneurs in the total indicator of economic entities of the corresponding type of activity, % ($X3$)
2	Scale of production activities	The volume of products (goods, services) produced by business entities for this type of economic activity ($X4$) Share of products (goods, services) in GDP, % ($X5$)
3	Marketing	The volume of products (goods, services) sold by business entities in this type of economic activity ($X6$)
4	Personnel	The number of employees employed by business entities in this type of economic activity ($X7$) Labor productivity of employed workers ($X8$) Personnel costs of business entities for this type of economic activity ($X9$) Average monthly salary of 1 employed employee at business entities for this type of economic activity ($X10$) Coefficient of the ratio of the average monthly salary of 1 employed employee among business entities for this type of economic activity and the minimum wage ($X11$) Coefficient of comparison of growth rates of labor productivity and growth rates of average monthly wages ($X12$)
5	Investment attractiveness	Capital investments in industry enterprises ($X13$) Value added in terms of production costs for business entities in this type of economic activity ($X14$) Share of value added in the proceeds from sold products (goods, services), % ($X15$)
6	Financial performance	Net profit (loss) of enterprises ($X16$) Level of profitability (loss ratio) of operating activities of enterprises ($X17$) Level of profitability (loss ratio) of all activities of enterprises ($X18$) Share of enterprises that have made a profit to the total number of enterprises, % ($X19$)

Source: developed by the author

The key components that provide an effective strategy for the development of the hotel and restaurant industry are structural, scale of production activities, marketing, personnel, investment attractiveness and financial performance. The proposed list of components is universal and can be used to diagnose the development strategy of any type of economic activity.

Assessment of the development strategy of the hotel and restaurant industry and its backbone components using the method of taxonomic analysis is carried out in order to identify the prerequisites for its formation. Taking into account the indicators of dominant directions influencing the strategic guidelines for the development of the hotel and restaurant industry, we have proposed a conceptual descriptive model for taxonomic analysis of the strategy for the development of the hotel and restaurant industry, which is shown in **Fig. 7.1**.
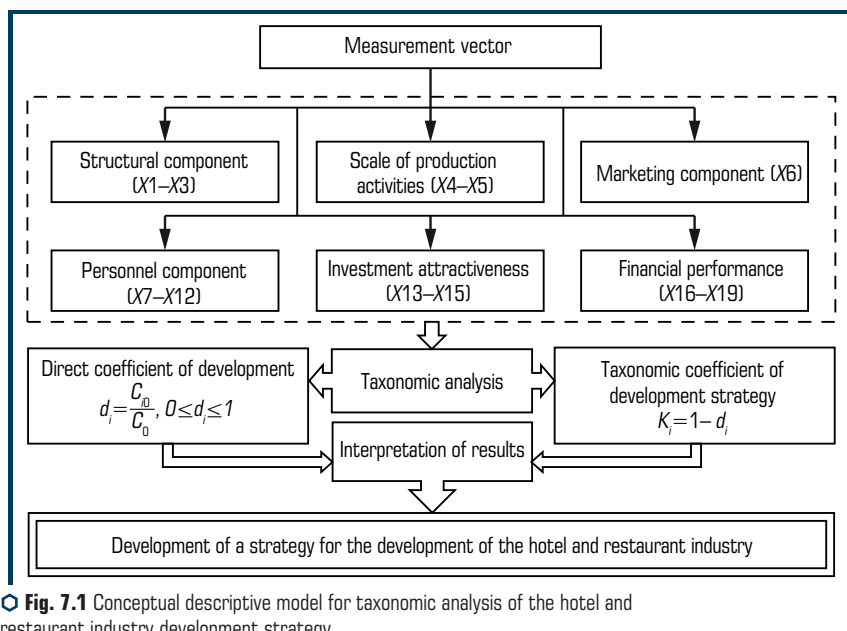
Fig. 7.1 Conceptual descriptive model for taxonomic analysis of the hotel and restaurant industry development strategy
Source: built by the author

Using our proposed conceptual descriptive model of taxonomic analysis, the identification of taxonomic development factors for key components of the hotel and restaurant industry was carried out.

Sample of data for 2013–2019 is presented in **Table 7.2**. It should be noted that for the purpose of comparability of value indicators in dynamics, they were listed in US dollars at the average annual rate of the NBU.

● **Table 7.2** Initial data for calculating the taxonomic indicator of the development strategy of the hotel and restaurant industry in Ukraine

Year	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17	X18	X19
2013	52,077.0	3.0	80.6	2,414,728.8	1.32	3,793,627.8	267,487	9.03	763,989.8	238.01	1.66	1.00	874,807.4	23.06	300,203.928	−177.245.7	−2.8	−6.8	58.4
2014	57,553.0	3.0	86.3	1,065,359.7	1.06	1,439,378.0	213,197	5.00	300,001.1	117.26	1.52	1.12	356,823.8	24.79	89,419.0355	−421,436.4	−25.8	−28.9	58.5
2015	58,436.0	3.0	86.8	877,207.7	0.96	1,331,012.3	195,194	4.49	224,778.9	95.96	1.72	1.23	294,300.2	22.11	49,270.7875	−314,783.4	−17.3	−22.6	71.6
2016	57,696.1	3.1	88.7	1,041,575.1	1.12	1,469,273.4	207,863	5.01	217,569.9	87.22	1.54	1.51	419,021.7	28.52	58,745.7031	−77,464.4	−0.8	−6.5	71.4
2017	57,578.3	3.2	87.3	1,416,340.6	1.26	1,840,795.6	224,220	6.32	301,828.3	112.18	0.93	1.48	571,466.7	31.04	77,561.1278	66,672.2	7.8	5.0	69.3
2018	61,761.3	3.4	87.8	1,730,940.9	1.32	2,337,921.9	269,741	6.42	386,658.3	119.45	0.99	1.42	645,541.5	27.61	91,975.9926	86,428.7	8.6	5.8	71.1
2019	69,689.3	3.6	88.7	2,165,131.9	1.40	3,017,950.5	281,789	7.68	469,452.8	138.83	0.86	1.46	720,573.3	23.88	93,552.8682	164,558.3	10.1	9.3	70.5

Column descriptions:
- **X1** Number of business entities, units
- **X2** The share of the number of entities in this type of economic activity in the total number of entities, %
- **X3** The share of individual entrepreneurs in the total indicator of economic entities of the corresponding type of activity, %
- **X4** Volume of products (goods, services) of business entities, thousand USD
- **X5** Share of industry production in GDP, %
- **X6** Volume of products (goods, services) sold by business entities, thousand USD
- **X7** The number of employees employed by business entities, persons
- **X8** Labor productivity of 1 employed employee, thousand USD
- **X9** Personnel costs of business entities, thousand USD
- **X10** Average monthly salary of 1 employed worker at business entities in this type of economic activity, USD
- **X11** Ratio of average monthly and minimum wages, coeff.
- **X12** Coefficient of comparison of growth rates of labor productivity and growth rates of wages (2013 – base)
- **X13** Added value in terms of production costs of business entities, thousand USD
- **X14** Share of value added in revenue, %
- **X15** Capital investments of enterprises, thousand USD
- **X16** Net profit (loss) of enterprises, thousand USD
- **X17** The level of profitability (loss ratio) of operating activities of enterprises, %
- **X18** The level of profitability (loss ratio) of all activities of enterprises, %
- **X19** Share of enterprises that have made a profit to the total number of enterprises, %

Source: compiled by the author according to [31]

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Elements of observation matrices have different units of measurement, to align the values of features, a standardization procedure is carried out, the results of data standardization are presented in **Table 7.2**.

Obtained from the **Table 7.2** the data made it possible to determine the reference vector: for factor-stimulants – the maximum value of the standardized indicator; for destimulators – the minimum value. According to the selected indicators-determinants of the development strategy of the hotel and restaurant industry, all factors are stimulants.

According to the **Table 7.3** it can be concluded that most of all the indicators for 2013 and 2019 serve as the benchmark. By 2013, the benchmark indicators are the following: volume of products (goods, services) produced by economic entities for the given type of economic activity ($X4$); volume of products (goods, services) sold by economic entities for the given type of economic activity ($X6$); labor productivity of employed workers ($X8$); personnel costs for business entities for this type of economic activity ($X9$); average monthly salary of 1 employed employee for business entities for this type of economic activity ($X10$); capital investments for enterprises of the industry ($X13$); the share of value added in the proceeds from sold products (goods, services), % ($X15$).

For 2019, the following indicators are benchmark: the number of business entities ($X1$); the share of the number of entities in this type of economic activity in the total number of entities, % ($X2$); the share of individual entrepreneurs to the total indicator of business entities of the corresponding type of activity, % ($X3$); the share of products (goods, services) in GDP, % ($X5$); number of employees employed by business entities in this type of economic activity ($X7$); net profit (loss) of enterprises ($X16$); level of profitability (loss-making) of operating activities of enterprises ($X17$); level of profitability (loss-making)) all activities of enterprises ($X18$).

The obtained data on the reference values of the key indicators of the development strategy of the hotel and restaurant industry for 2013–2019 allowed to determine the distance between individual observations and the reference vector (CiO) and the deviation of the i-th year from the ideal.

At the next stage, the taxonomic coefficients of the strategy for the development of the hotel and restaurant industry in Ukraine (Ki) were calculated according to the presented scheme (**Fig. 7.2**).

The value of the taxonomic indicator takes values from 0 to 1. The value of the taxonomic indicator, which is close to 0, indicates an unsatisfactory state with respect to the optimal indicators. Conversely, if the value of a taxonomic indicator is close to 1, this indicates a positive situation in a certain period compared to others. The calculation results are shown in **Table 7.4**.

Thus, the results of calculating the integral indicator of the development strategy of the hotel and restaurant industry in Ukraine indicate an uneven state of development of the industry. In 2013, the value of the indicator is 0.38. During 2014–2015, the indicator decreased, reaching the minimum value for the entire study period in 2015, 0.09. These trends are explained by a drop in the tourist flow as a result of the annexation of Crimea, military events in the East of the country and a difficult socio-economic situation.

● **Table 7.3** Matrix of standardized indicators

Indicator	2013	2014	2015	2016	2017	2018	2019	Reference (Z0j) (stimulant – max; stimulant – min)
X1	−1.33	−0.31	−0.15	−0.29	−0.31	0.46	**1.93**	1.93
X2	−0.63	−0.83	−0.91	−0.34	0.09	0.81	**1.82**	1.82
X3	−2.15	−0.11	0.07	0.75	0.25	0.43	**0.75**	0.75
X4	**1.49**	−0.78	−1.10	−0.82	−0.19	0.34	1.07	1.49
X5	0.68	−0.92	−1.50	−0.55	0.35	0.71	**1.22**	1.22
X6	**1.73**	−0.79	−0.91	−0.76	−0.36	0.17	0.90	1.73
X7	0.87	−0.68	−1.20	−0.84	−0.37	0.93	**1.28**	1.28
X8	**1.68**	−0.78	−1.09	−0.78	0.02	0.09	0.86	1.68
X9	**2.01**	−0.42	−0.82	−0.85	−0.41	0.03	0.47	2.01
X10	**2.14**	−0.25	−0.67	−0.84	−0.35	−0.21	0.18	2.14
X11	0.92	0.54	**1.08**	0.60	−1.03	−0.87	−1.23	1.08
X12	−1.59	−0.97	−0.42	**0.97**	0.82	0.48	0.70	0.97
X13	**1.53**	−0.94	−1.24	−0.65	0.08	0.43	0.79	1.53
X14	−0.86	−0.33	−1.15	0.81	**1.59**	0.54	−0.61	1.59
X15	**2.22**	−0.22	−0.69	−0.58	−0.36	−0.19	−0.18	2.22
X16	−0.37	−1.48	−1.00	0.09	0.74	0.83	**1.19**	1.19
X17	0.01	−1.65	−1.04	0.15	0.77	0.83	**0.94**	0.94
X18	−0.03	−1.53	−1.10	−0.01	0.77	0.83	**1.07**	1.07
X19	−1.46	−1.45	**0.71**	0.69	0.34	0.63	0.53	0.71

Source: calculated by the author based on the data [*31*]

Since 2016, a gradual growth of the integral indicator of the development strategy of the hotel and restaurant industry in Ukraine has been recorded. The high values of the taxonomic indicator obtained according to the data of 2019 – 0.56, however, indicate an insufficiently high level of development of the industry.

To interpret and analyze the obtained assessment results based on a certain level of the hotel and restaurant industry development strategy, a scale of intervals of the integral indicator was used. To solve this problem, the method of grouping the obtained data was used.

○ **Fig. 7.2** Integral indicator of the development strategy of the hotel
and restaurant industry in Ukraine in 2013–2019
Source: built by the author

● **Table 7.4** Determination of the distance between the indicator and the standard

Year	$\sum_{i=1}^{m}(Z_{ij} - Z_{0j})^2$	CiO	CO	di	Ki
2013	47.26	6.87	11.15	0.62	0.38
2014	95.62	9.78	11.15	0.88	0.12
2015	102.04	10.10	11.15	0.91	0.09
2016	68.28	8.26	11.15	0.74	0.26
2017	47.48	6.89	11.15	0.62	0.38
2018	31.77	5.64	11.15	0.51	0.49
2019	24.36	4.94	11.15	0.44	0.56

Source: calculated by the author based on the data [31]

The interpretation of the values of the integral indicator of the development strategy of the hotel
and restaurant industry in Ukraine is given in **Table 7.5**. Depending on the quantitative value of the
integral indicator of the development strategy of the hotel and restaurant industry, it is proposed to
divide into four zones corresponding to different states of the industry development and for which the
corresponding strategies and managerial decisions for their implementation have been established:

1) high level of development – a growth strategy that provides for a solution with an emphasis
on improvement and proactive measures;

2) sufficient level of development – a restructuring strategy, according to which it is necessary
to carry out active measures in all components;

3) satisfactory level of development – a stabilization strategy with an emphasis on adaptation
to changes in the external environment;

4) pre-crisis level of development – a survival strategy that provides for the implementation
of anti-crisis changes concerning the necessary measures to counter the destabilizing factors of
development of various types.

● **Table 7.5** Initial data for calculating the taxonomic indicator of the development strategy of the hotel and restaurant industry in Ukraine

Integral indicator value	The degree of compliance of the determinants of the development strategy with the maximum value	The state of development of the hotel and restaurant industry in Ukraine	Relevant industry development strategy	Managerial solutions for the further development of the industry
0.75–1	Parameters approaching maximum values	High	Growth strategy	Focus on improvement and proactive measures: further increasing the volume of sales and marketing of products (goods, services) by increasing the competitiveness and quality of products (goods, services), searching for new / non-traditional types of services, using innovations; increase in human and intellectual potential and further improvement of motivation, continuous improvement of personnel qualifications; improving the system of attracting investment resources; search for new / unconventional types of income, cost reduction to increase profit growth
0.5–0.74	Most of the parameters are at the level of fairly high values	Sufficient	Restructuring strategy	Focus on active activities: activation of innovative activities for the implementation of structural transformations, an increase in the volume of production of products (goods, services) by expanding the range, improving the quality of services, entering new sales markets; raising the qualification and professional level of personnel, improving the motivational mechanism; further attraction of various types of investments; increase in income, decrease in expenses for profitable activities
0.25–0.49	Most of the parameters are at a satisfactory level, some indicators may correspond to a sufficient level	Satisfactory	Stabilization strategy	Focus on adaptive measures: implementation of improvement in development indicators; measures for the sustainability of production volumes and sales of products (goods, services) for their further increase; building human resources, using an effective motivation system; measures to attract investment; recovery and growth of income, saving resources, looking for opportunities to reduce costs
0–0.24	Most of the indicators correspond to a low level	Crisis	Survival strategy	Focus on anti-crisis measures: focusing on profitable and rejection of unprofitable types of products, goods, services, activities; changes in marketing activities; measures to preserve human resources; optimization of business processes, hard economy of all types of resources to reduce costs

Source: compiled by the author according to [31]

Using the data in the **Table 7.5**, the distribution of observations for the period under study was carried out according to the value of the integral indicator of the development strategy of the hotel and restaurant industry in Ukraine (**Fig. 7.3**).
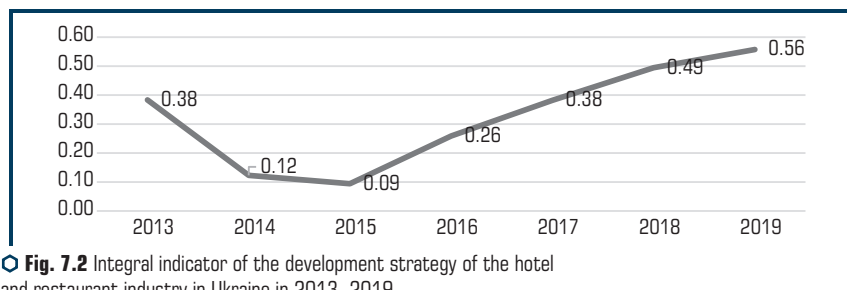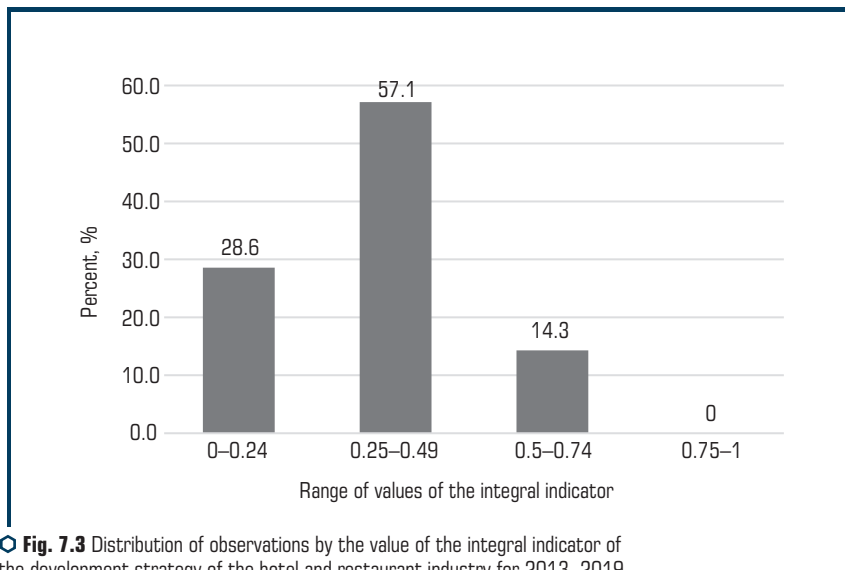

⭕ **Fig. 7.3** Distribution of observations by the value of the integral indicator of the development strategy of the hotel and restaurant industry for 2013–2019
Source: built by the author

Thus, the obtained values of the integral indicator for the period under review indicate: the largest share is occupied by observations with an insufficient state of development – 57.1 %, in second place with a crisis state of development – 28.6 %, respectively. The smallest number of observations falls on periods with a sufficient state of development (only 14.3 %). At the same time, during the entire study period, a high level of development of the hotel and restaurant industry was not observed at all.

The low values of the integral indicators of development indicate the existing problems in the development of the hotel and restaurant industry.

Moreover, for the last studied period – 2019, the integral indicator of development indicates a sufficient level of development of the industry.

Therefore, it is necessary to develop managerial decisions for the implementation of a development strategy for the future, which made it possible to neutralize the negative phenomena of the external environment and overcome the irrationality of the development of internal problems of business entities in the industry.

The proposed managerial solutions are shown in **Table 7.6**. They can be divided into national and at the level of individual business entities.

● **Table 7.6** Managerial decisions for the implementation of the development strategy of the hotel and restaurant industry in Ukraine

Assessment component	Managerial decisions	
	Nationwide	**At the level of individual business entities**
Structural	Support activities: government projects for training small business organizations wishing to; simplification of procedures for organizing, doing business, reporting; investment in the industry, preferential taxation, preferential lending, business consulting and support, assistance in the development of infrastructure for supporting small businesses	–
Scale of production activities	Marketing activities to popularize the domestic tourist product, modernize the tourist infrastructure, support tourist areas (destinations) and projects at the national and regional level, promote the development of non-traditional types of tourism, introduce mechanisms to promote and stimulate the use of the latest technologies and technologies in production by subjects that ensure quality improvement goods (works, services)	Increasing the volume of production of products (goods, services) by expanding the range of products / services, diversifying the price offer, improving the quality of services based on compliance with international service standards, the use of innovation and digitalization
Marketing		Active marketing activities based on digital tools of Internet marketing, using new sales channels for products (goods, services), attracting new groups of consumers, increasing the competitiveness of products (goods, services)
Personnel	Organization of training, retraining and advanced training of personnel for business entities of the region	Measures to improve the qualification and professional level of personnel, improve the motivational mechanism (primarily material motivation), create a favorable psychological climate
Investment attractiveness	Attraction of investments, especially in regions with low rates of development of the hotel and restaurant business; measures to stimulate investment activities of entities (preferential taxation, preferential lending, business consulting and support), assistance in the development of public-private partnerships, crowdfunding, grant activities	Measures to increase investment in the industry through cooperation with authorities of various levels and other investors in order to attract various types of investments, attract grant funds
Financial performance	Measures for state support of business, optimization of the tax burden, provision of preferential loans, etc	Measures to optimize business processes, increase income, reduce costs to improve the financial and economic condition and increase the financial result of the activities of business entities

So, the proposed managerial solutions for the implementation of the strategy for the development of the hotel and restaurant industry in Ukraine at the national level include measures for state support of business, marketing activities to popularize the domestic tourism product, modernize the tourism infrastructure, promote the development of non-traditional types of tourism, introduce mechanisms to promote and encourage use in production by subjects of the latest technologies and technologies that ensure an improvement in the quality of goods (works, services), measures to organize training, retraining and advanced training of personnel, attracting investments in regions with low rates of development of the hotel and restaurant business, measures to stimulate investment activities of subjects of objects, assistance development of public-private partnerships, crowdfunding, grant activities and the like.

The main management measures at the level of individual business entities are: expanding the range of products/services, improving the quality of services based on compliance with international service standards, using innovations, active marketing activities based on digital tools of Internet marketing, using new sales channels for products (goods, services), attracting new consumer groups, increasing the competitiveness of products (goods, services), improving the qualification and professional level of personnel, improving the motivational mechanism, creating a favorable psychological climate, attracting various types of investments, attracting grant funds, optimizing business processes, increasing income, reducing costs to improve the financial and economic condition and increase the financial result of the activities of business entities.

The scientific novelty is the application of the taxonomy method for diagnosing the development strategy of the hotel and restaurant industry, for this it is proposed to use a conceptual descriptive model of taxonomic analysis. The paper identifies indicators for diagnosing the development strategy of the hotel and restaurant industry, which are grouped according to the dominant directions: structural, scale of production activities, marketing, personnel, investment attractiveness and financial performance. The proposed list of components and indicators is universal and can be used to diagnose the development strategy of any type of economic activity.

The interpretation of the values of the integral indicator of the development strategy of the hotel and restaurant industry in Ukraine has been substantiated. Depending on the quantitative value of the integral indicator of the hotel and restaurant industry development strategy, it is proposed to divide into four zones corresponding to different states of the industry development, for which the corresponding strategies and managerial decisions for their implementation have been established. The conducted studies have shown the uneven development of the hotel and restaurant industry in Ukraine during the study period: in 2013, the value of the integral indicator of the development strategy of the hotel and restaurant industry was 0.38, in 2014–2015. The indicator was decreasing, reaching a minimum value in 2015 of 0.09 and, starting in 2016, it gradually grew. The high values of the taxonomic indicator obtained according to the data of 2019 are 0.56, which indicates an insufficiently high level of development of the industry. The largest share is taken by observations with an insufficient state of development – 57.1 %, a crisis state of development was observed in 28.6 % of periods. Only in period 1 (14.3 % of observations) a sufficient state

of development was recorded. This indicates the existing problems in the development of the domestic hotel and restaurant industry and actualizes the problem of making appropriate managerial decisions for their successful solution.

The proposed managerial solutions for the implementation of the development strategy of the hotel and restaurant industry include events at the national level and at the level of individual business entities. National decisions include measures for state support of business, marketing measures to popularize the domestic tourism product, modernize tourism infrastructure, promote the development of non-traditional types of tourism, introduce mechanisms to promote and stimulate the use of innovations in production, measures to organize training, retraining and advanced training of personnel, measures to stimulate investment activities of entities, assistance in the development of public-private partnerships, crowdfunding, grant activities, and the like. The necessary managerial decisions at the level of individual economic entities are: diversification of the range of products/services and price proposals, improving the quality of services based on compliance with international service standards, using innovations, using digital tools for Internet marketing, using new sales channels for products (goods, services), attracting new groups of consumers, improving the qualification and professional level of personnel, improving the motivational mechanism, attracting various types of investments, optimizing business processes, measures to increase the financial result of the activities of business entities.

The results of the study prove the applied value of the taxonomic method for diagnosing the development strategy of the hotel and restaurant industry. The directions of further research are the development of scientific, methodological and practical recommendations for the formation and implementation of the development strategy of the hotel and restaurant industry, depending on the level of the value of the integral coefficient of the development strategy.

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8 MAKING OPTIMAL DECISIONS BASED ON THE DEVELOPMENT OF THE INNOVATIVE POTENTIAL OF PERSONNEL

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ABSTRACT

In order to effectively develop enterprises to ensure the adoption of optimal decisions, a theoretical and methodological approach has been developed to assess the components of the innovative potential of personnel, which are decisive for making optimal decisions based on the «tree of opportunities» and the integral indicator of the innovative potential of personnel, contains complex indicators for assessing innovative activity personnel, innovative development of the enterprise, the degree of development of the enterprise.

Based on the process-analytical generalization, an algorithm for making optimal decisions based on the development of the innovative potential of personnel has been developed, namely: identifying the problems of enterprise development; search for the reasons for the retardation of the development of the enterprise; determination of the reasons for the retardation of the development of the enterprise; determination of optimal solutions depending on the formulated problem; development of recommendations for achieving strategic goals, based on the construction of a «tree of opportunities».

To solve the tasks and test the initial assumptions, a set of methods was used that reflect the unity of the theoretical and empirical levels of knowledge. Theoretical: methods of scientific analysis and generalization of experience in making managerial decisions, comparative method, modeling method; empirical methods: experiment, testing, questioning, content analysis, expert assessments, as well as mathematical and statistical methods for processing experimental data using the SPSS application package and logical and mathematical modeling using the construction of Euler circles.

KEYWORDS

Making optimal decisions, innovative potential of personnel, «Tree of Opportunities».

8.1 INITIAL PROVISIONS FOR MAKING OPTIMAL DECISIONS BASED ON THE DEVELOPMENT OF THE INNOVATIVE POTENTIAL OF PERSONNEL

The search for new ways of enterprise development, along with the growing dynamism of the environment, urgently requires constant improvement of existing forms and methods of management, as well as the development of fundamentally new approaches to management, adequate to new realities.

Improvement of management at all levels is a huge and still insufficiently demanded reserve of effective activity of the enterprise. Against this background, the adoption of optimal managerial decisions based on the development of the innovative potential of personnel is actualized. That is why, on the basis of the process-analytical generalization, an algorithm for making optimal decisions based on the development of the innovative potential of personnel is proposed, namely: determining the problems of enterprise development; search for the reasons for the retardation of the development of the enterprise; determination of the reasons for the retardation of the development of the enterprise; determination of optimal solutions depending on the formulated problem; development of recommendations for achieving strategic goals, based on the construction of «Opportunity Trees».

The aim of research is to develop conceptual provisions and methodological proposals for making optimal decisions based on the innovative potential of personnel, based on the latest trends in the development of the domestic and world economies, as well as management theory.

One of the most urgent for all business entities is the problem of studying the possibilities of survival in the context of the global economic crisis. A review of data from economic periodicals shows that crisis situations are becoming more frequent, and their consequences are gaining greater proportions. In this context, enterprises should wash themselves to adapt to changes in the external environment, and internal controllable factors should determine the ability of business entities to adapt. Considering not this, the role played by managerial decisions in the management system and the activities of the enterprise can hardly be overestimated, since balanced and rational decisions are able to become the starting point for overcoming a crisis situation. Under such conditions, the role in the development of the innovative potential of personnel significantly increases, on whose decision the construction of an optimal strategic future in difficult and unfavorable conditions depends, or in general, depriving the enterprise of the prospects for overcoming the crisis.

Therefore, we consider it appropriate, within the framework of this study, to clarify the concept of «innovative potential» in general and, in particular, personnel. The need to substantiate this concept within the framework of the definition of personnel is primarily due to the fact that when making optimal decisions on the development of enterprises and their management, which, from our point of view, should be associated with innovative potential, this category is not given due attention and the appropriate regulations, namely: in the formation of the structure of economic potential [1]; when disclosing the value of innovative technologies, researching innovative activity, substantiating innovative blocks of enterprises [2]; when looking for ways to form the potential of an enterprise, management and development using innovative resources [3]; when recognized among the components of the development potential of the enterprise innovative, but without its characteristics [4]; when forming a strategy for managing the economic potential of an enterprise [5]; when revealing the essence of the enterprise's potential and its structure [6]; when substantiating the theoretical foundations of innovation policy [7] and modern approaches to the management of innovation processes at trade enterprises [7]; when disclosing the essence of innovative activities of enterprises [8] and the formation of methodological foundations for managing the effectiveness of innovative activities on them [8].

We believe that in solving these problems by scientists, it would be necessary to pay attention to the innovative potential of personnel and determine their role in the described processes. Unfortunately, however, this important category has been ignored.

Therefore, taking into account the above scientific problems, he considers it appropriate to present the definition of «innovative potential» and «innovative potential of personnel». At the same time, proceeding from the natural signs of the development of the enterprise, the condition is accepted that the general potential must be formed at the enterprise. This determines the presence of driving forces (in particular, educated, qualified and creative personnel capable of introducing innovations, and it (potential) must be realized provided there is a sufficient number of driving forces; the effectiveness of its (potential) implementation allows to obtain the desired result of enterprise development.

Proceeding from the disclosed essence of potential as «the aggregate of available means and possibilities…» [9], «a complex economic system…» [10], «aggregate of factors…» [11] or «the internal capacity of the system…» [12], to substantiate the innovative potential, it is advisable to choose the first and last essential characteristics of the potential.

Taking into account these natural features and essential characteristics of potential, and proceeding from the need to eliminate the contradictions established when disclosing the essence of innovation potential and its definitions, we present the following definition: «innovation potential is the internal capabilities of the «enterprise» system to introduce innovations in order to form and implement the potential of the enterprise to ensure intensive development through the generation of knowledge and the commercialization of personnel ideas».

In turn, no less problematic, as it was established above, is the understanding by scientists of the innovative potential of personnel. The concept of «innovative potential of personnel» is most clearly substantiated by such scientists as Dziubina, A. V. [13] and Krasnokutska, N. V. [14]. Revealing the essence of the innovative activity of the enterprise, Dziubina, A. V. singles out the personnel component in it together with others and operates with two terms («personnel component» and «human potential») to determine the important place of personnel in the innovative potential of the enterprise [13]. In turn, Krasnokutska, N. V., when disclosing the essence of innovation potential, notes that «…the innovation potential is based on personnel and material and technical components… It is especially important to have personnel… providing the innovation process with new knowledge, ideas, inventions, know-how, new technologies. It is to this component of the innovative potential that the main attention should be paid in the strategy of its support, development and restructuring» [14]. The scientist operates with the term «creative potential» and uses it in relation not to the personnel of the enterprise as a whole, but in relation to certain categories — «…researchers have a critical mass of ideas that provides a viable new technical solution…», and «…specialists committed to innovations… have a certain level of scientific and technical competence of creative activity and possess the methods of innovative management…» [14]. The use of two terms («personnel components» and «human resources») can be considered debatable. In the first case [13], and limiting the categories of personnel to researchers and specialists when

using the term «creativity» – in the second [14]. We believe that the use of any of these terms does not fully correspond to the role of personnel in the formation and implementation of innovative potential, thanks to which the development of enterprises takes place.

The importance of the innovative component in the process of personnel potential formation is highlighted by individual economists when revealing the foundations of personnel potential formation. In particular, Lukianchenko, N. D., Antoniuk, V. P., Shaulska, L. V., Shamilova, L. L. in their research, the very process of formation of labor potential at the enterprise characterizes as «...the acquisition of features by a person, necessary for use in labor, obtaining certain knowledge and skills, physical, emotional, spiritual and professional development» [15]. At the same time, they put this process in direct dependence on «...educational and professional training» [15], as well as the influence of such factors as «...scientific and technological progress, innovative processes... the need to introduce new technologies...» [15].

In turn, Shcherbak, V. H. considering the process of formation of labor potential as «...taken in their unity methods, procedures, methods of influencing the employees of the enterprise in order to use their potential to achieve the strategic and tactical goals of the enterprise» – on the one hand and as «...the function of the enterprise aimed at ensuring an effective and continuous balance between the availability of employees and the needs for them in terms of number and qualifications...» [16] – on the other hand, draws attention to its ability to introduce innovations and determines labor potential (staff – author) as «...a powerful factor of socio-economic development» [16].

Such reasoning confirms that the innovative potential of personnel is an integral part of the overall potential of personnel (or – «labor potential»). The innovative component in the very process of forming the potential of the personnel of the enterprise is also observed in the evolutionary aspect of the development of scientific schools [17, 18–20].

So, Vihanskiy, O. S., Naumov, A. I. and Walker, J. W. identified among the basic principles a clear division between mental and manual labor, between low- and medium-skilled labor and the need for managers to apply a scientific approach in the process of building personnel potential [19, 20].

Pul, M., Uorner, M. drew attention to encouraging the personnel of the enterprise to introduce innovations in production to improve product quality and improve the organizational structure, highlighted such a necessary feature in the process of building personnel potential as the need to improve the professionalization of workers, paid special attention to the process development of personnel in order to ensure its ability to introduce innovations [21].

Mincer, J. drew attention to the practice of managers using such approaches as encouraging and encouraging each employee to fully realize their capabilities to achieve the business goal, for which the practice of training and raising the level of education of personnel was introduced without fail [22].

Hence, it becomes obvious that in the evolutionary aspect, the process of building personnel potential is focused on their ability to introduce innovations, is associated with the need to im-

prove skills and use by managers scientific approaches in personnel management [19, 20], the development of personnel motivation to improve product quality (and improve the organizational structure, the development of professionalism [18], stimulation to increase the level of education [22]. The listed aspects of the process of formation of personnel potential with its focus on innovation are characteristic of enterprises of any industry. The process can be recognized as the primary basis for the formation of the innovative potential of the enterprise as a whole. The tagline goal of the formation of other innovative potential of personnel is to ensure precisely this type of development.

The most convincing studies of Krasnokutska, N. V. according to which, for the formation of the innovative potential of the enterprise, the potential of innovation management is important (i.e. the ability of managers to master innovations in their work activities – author) and the personnel that provide the innovation process at the enterprise with new knowledge, ideas, technologies, inventions, know-how [14].

In the studies of Hutkevych, S. O. and Androsiuk, L. A. the dependence of the formation of the innovative potential of the enterprise on the innovative features of the personnel accounts for the competencies (the ability of personnel to solve creative problems) and the ability of managers to organize the introduction of innovations at the enterprise [12].

Consideration of the innovative potential of personnel as a component of the overall potential of the enterprise, we have, is quite logical and presents an opportunity to assert the following: despite the fact that the innovative potential of personnel is formed simultaneously with the general, it is this potential that is the decisive internal factor in the formation of the latter, since it contains basic elements (determined by the abilities, opportunities and competencies), is determined by labor and innovative resources, in the presence of which others are rationally used, the needs of consumers are satisfied.

Consequently, the formation of the innovative potential of personnel consists in the development of personnel on the basis of increasing their experience, knowledge, skills, abilities, qualifications – features, which allow the introduction of innovations, as well as the ability of managers to ensure such development and motivate personnel accordingly.

Solving this scientific problem, the starting points for making optimal decisions based on the development of the innovative potential of personnel should recognize the following theoretical provisions: when making optimal decisions, it is necessary to take into account such important features of personnel as qualifications, professional level and level of education, which determine its ability to introduce innovations; when making an assessment, the assessment should establish a relationship between the level of staff motivation to introduce innovations and, accordingly, an increase in innovative activity, with a change in productivity; based on the very definition of the concept of «innovative potential», the assessment should determine the ability of personnel to develop their entrepreneurial abilities and generate knowledge for the commercialization of creative ideas in innovations of their various types and types in order to form the potential of the enterprise and its implementation for development.

8.2 JUSTIFICATION OF THE ALGORITHM FOR MAKING THE OPTIMAL DECISION BASED ON THE INNOVATIVE POTENTIAL OF PERSONNEL

Proceeding from well-grounded theoretical provisions and taking into account the conducted empirical studies on the problems of making optimal decisions, in **Fig. 8.1**, a flowchart for assessing the development of the innovative potential of personnel is proposed. At the same time, the grouping of the subject of assessment according to certain blocks (A, B, C) correlates with certain priority management methods at the enterprise.

According to empirical studies, we have made the distribution of indicators by blocks. The indicators of block A include:
- the average number of personnel;
- the ratio of those taken to quiet, who dropped out;
- demand for workers;
- the number of employees by educational level;
- trained in new professions;
- the number of employees who have improved their qualifications;
- working time fund;
- average monthly salary;
- personnel costs involved in the innovation process;
- the number of personnel involved in the implementation of innovations;
- expenses for training and professional development of personnel.

In block B:
- the number of created innovations;
- the number of innovations offered by the employees of the enterprise;
- capital expenditures for the introduction of innovations;
- the volume of sold innovative products.

Block C:
- net sales proceeds;
- financial results;
- net profit;
- fixed assets;
- long-term financial investments;
- total costs;
- payroll fund;
- the share of the wage fund in total costs;
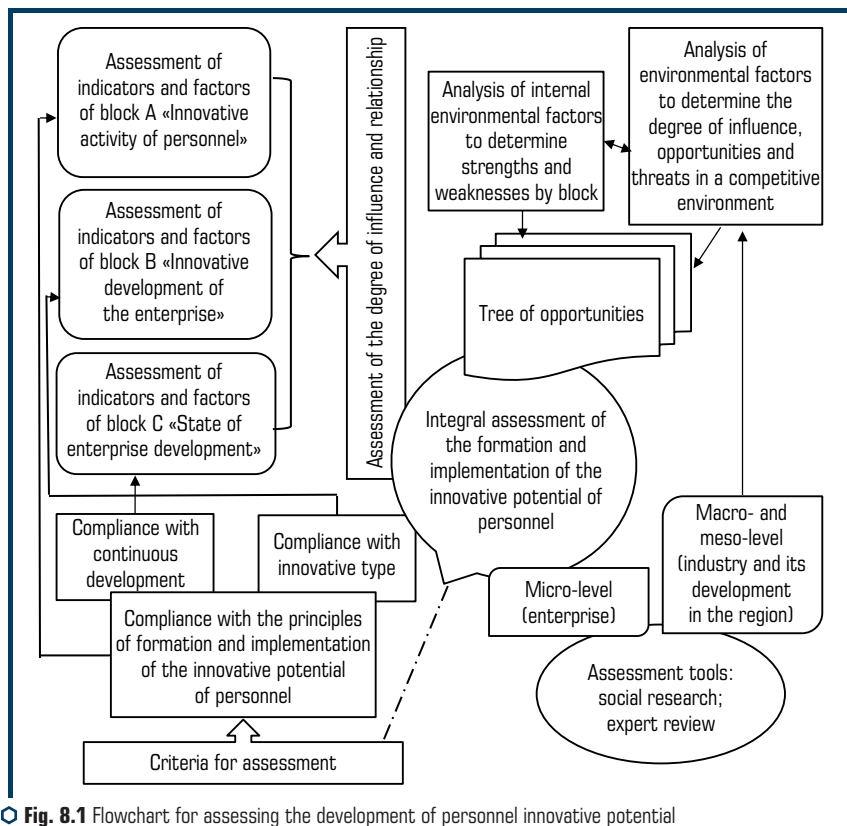- cumulative performance.

The block diagram developed by us is the basis for making an optimal managerial decision when conducting a comprehensive analysis of the development of an enterprise based on the innovative potential of personnel, where block A is the key communication of the external envi-

ronment with blocks B and C for any enterprise in order to build «Trees of Opportunities» and obtain an integral assessment of the formation and implementation of the innovative potential of personnel at the enterprise.

In order to confirm the practical value of the proposed block diagram (**Fig. 8.1**) and, accordingly, to obtain an integral assessment of the formation and implementation of the innovative potential of personnel, taking into account the levels, tools and criteria, as well as taking into account the need for the degree of influence and relationship between indicators and factors of certain blocks, we consider it expedient to determine the basic methodological approaches using the most effective mathematical apparatus. In this context, the results of scientific research containing scientific approaches to assessing the development of enterprises based on innovation potential are of certain interest [10, 16]. It should be noted that there is no unity among scientists in the classification of approaches to assessing the very potential of an enterprise. So, for example, according to Honcharov, V. M. and Savchenko, M. V. such approaches include factor, criterion, normative, balance, index and cost [10]. In turn, Yaremenko, M. O. measures the potential of enterprises based on such approaches as cost, output and comparative [3]. But, through the use of any of the approaches, its effect is determined by using certain calculation methods and, in particular, a synergistic effect is determined, which reflects several groups of analyzed factors or parameters.

In our case, proceeding from the substantiated starting points for the development of a methodology for assessing the development of the innovative potential of personnel and the developed scheme (**Fig. 8.1**), with the parameters that determine the synergistic effect, include: the obtained assessment of the innovative activity of personnel in block A; an assessment of the innovative development of the enterprise in block B was obtained; an assessment of the overall development of the enterprise in block C was obtained. Taken together, they all make it possible to determine an integral assessment of the formation and implementation of the innovative potential of personnel, and the synergetic effect itself as consisting of two components – a social component (block A) and an economic component (blocks B and C). In turn, the social component contains the effect of the implementation of the labor and innovation potential of the personnel, as well as the tendency to introduce innovations by them, and the economic component – the effect of the implementation of innovations and the result obtained from them, are reflected in the development of the enterprise, the improvement of indicators in blocks B and C.

We believe that such a scientific approach to determining the synergistic effect for making optimal decisions based on the innovative potential of personnel does not contradict the existing scientific approaches contained in the content of works [6, 10, 13, 16, 18], but deepens them taking into account the object of our research. So, in particular, Honcharov, V. M. and Savchenko, M. V., the synergy effect is measured through the real potential of the enterprise, which should be as close as possible to a certain standard (=1.0), and consists of three blocks (labor potential, potential of fixed assets and material resources). At the same time, scientists use both calculations of economic indicators and the results of expert assessments of the factors that form the corresponding blocks [10].

Fig. 8.1 Flowchart for assessing the development of personnel innovative potential
Source: suggested by the authors

The results of research by Akmaiev, A. I., Kliyanenko, B. T., Osyka, O. P., Akhromkin, Ye. M., Fesenko, I. A. in which: firstly, the economic efficiency of innovation is determined by comparing the results with the costs that provided this result (in our case, this approach correlates with the «total productivity» indicator); secondly, in the economic effect in value terms, all types of results and costs due to the introduction of innovations are taken into account (including – in profit, sales volumes, labor productivity); thirdly, the social effect takes into account the social results from the introduction of innovations – an increase in workers 'incomes, an increase in the degree of satisfaction of workers' needs, an improvement in the conditions of their work and rest, the quality of life [23], which, in our case, directly indicates the synergy between blocks A and B.

To measure the social effect of the introduction of innovations at the enterprise (the synergy effect in block A), the results of studies by Shcherbak, V. H. are of certain interest [16]. It is

obvious that to determine the social effect from the implementation of the innovative potential of personnel at the enterprise, both the method of calculating the selected indicators contained in the statistical database and the method of sociological research and expert assessment are used to determine the level of motivation of personnel in innovative activities.

The combination of social and economic effects based on the calculation of selected indicators, from our point of view, will reduce to a minimum the inaccuracies of the assessment itself by the key block A when solving the scheme algorithm (**Fig. 8.2**) and, accordingly, determine the synergistic effect and the integral indicator of the formation and implementation of innovative potential staff.

Indicators for determining the economic effect of the introduction of innovations

The economic effect of the introduction of innovations;
Payback period;
Net income from the introduction of innovations;
Average annual profitability of innovation implementation

Indicators for determining the social effect of the innovation implementation

The social effect of the implementation of the innovative potential of personnel;
The aggregate productivity of the innovative staff;
Personnel costs involved in the implementation of innovations;
The productivity of the staff involved in the implementation of innovations;
The level of innovative activity of the personnel;
The level of staff motivation to innovative activities;
Cost effectiveness level for personnel development

○ **Fig. 8.2** Scorecard for determining the economic and social impact of innovation
Source: improved by the authors

So, based on the generalization of scientific approaches, taking into account the justified starting points for the development of a methodology for assessing the development of the innovative potential of personnel and the developed scheme (**Fig. 8.1**), we present the following logical and mathematical expression for measuring the synergistic effect (E_s), (8.1):

$$\max A = \sum \left(A_i A_j \right),$$

$$\max B = \sum \left(B_i B_j \right), \qquad (8.1)$$

$$\max C = \sum \left(C_i C_j \right),$$

$$E_S = \sqrt[3]{\max A * \max B * \max C},$$

where A — total assessment of indicators (i) and factors (j) for block A, which characterizes the innovative activity of personnel, coefficient; In the total assessment of indicators (and) and factors (j) for block B — characterizing the innovative development of the enterprise, coeff.; C — total assessment of indicators (i) and factors (j) for block C, which characterizes the general development of the enterprise, coeff. The optimal (maximum) value for each block is equal to one in accordance with the established standard values for each of the analyzed indicators («and») and factors («j»), calculated on the basis of statistical data («and») and sociological and expert research («j»).

Based on the obtained value «E_s», the degree of development of the innovative potential of personnel is established by restoring the quadrant of dependence between the total estimates for blocks A, B, C using logical and mathematical modeling using the construction of Euler circles [24]. Graphically, the result of the obtained integral assessment of the innovative potential of personnel using this type of modeling is reflected in **Fig. 8.3**.
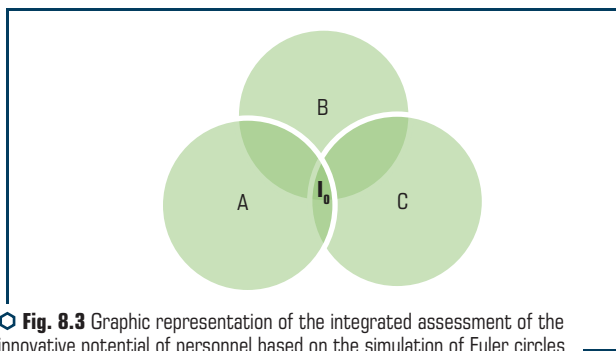
○ **Fig. 8.3** Graphic representation of the integrated assessment of the innovative potential of personnel based on the simulation of Euler circles
Source: compiled by the authors based on [*25, 26*]

It should be noted that an integral assessment of the innovative potential of personnel is necessary as a basis for making optimal decisions based on the implementation of the innovative potential of personnel by selecting dominants for each of the selected blocks (**Fig. 8.1**), based on

the real state of development and certain problems. This makes it possible to select the most effective principles and methods of management to overcome existing problems, to determine the appropriate strategic directions for the leaders' actions for the further development of enterprises.

Based on the foregoing, an appropriate algorithm for making an optimal decision is proposed based on the innovative potential of personnel (**Fig. 8.4**), which is implemented and mobilized by managers to solve strategic tasks at each stage of the enterprise life cycle and at each workplace in order to solve the dominant problems of general development, will allow increase overall productivity, improve key performance indicators, ensure the continuous development of the enterprise.

Thus, considering the need to make optimal decisions at any enterprise as a way of further development, this process can be recognized as the main one, because it is of paramount importance in comparison with any others. So, in our case, in order to make an optimal decision, it is necessary to select the dominants of the formation of the innovative potential of personnel, it is a basic condition for developing a management strategy for these enterprises based on the implementation of the innovative potential of personnel. Thus, the strength in the study is the proposed integral assessment of the innovative potential of personnel based on modeling Euler circles, which is the basis for making optimal decisions based on the implementation of the innovative potential of personnel by selecting dominants for each of the selected blocks. The weak side is that the proposed integral assessment of the innovative potential of personnel has no practical approbation. Opportunities for further research are the development of an enterprise development strategy based on the proposed algorithm for making an optimal decision based on the innovative potential of personnel.

There are no threats to the results of the research, because it has been proved by modeling that at each enterprise it is necessary to increase the level of implementation of the formed innovative potential of personnel in order to activate innovative activities and increase the level of innovative development of the enterprise. Summarizing the foregoing, we conclude that in order to achieve the goal of the conducted research, the basic concept is justified, namely: «innovative potential», which is the internal ability of the «enterprise» system to introduce innovations in order to form and realize the potential of the enterprise to ensure intensive development through the generation of knowledge and the commercialization of staff ideas.

Proceeding from well-grounded assumptions, a flowchart has been developed for assessing the development of the innovative potential of personnel, in which the subject of assessment correlates with certain blocks (A, B, C), the use of which will allow for a comprehensive analysis of the development of an enterprise based on innovative potential of personnel, where the key is block A, to establish the factors of influence and interrelation of the external environment with blocks B and C and to carry out an integral assessment of the formation and implementation of the innovative potential of personnel at the enterprise.

Using logical and mathematical modeling using the restoration of Euler circles in the research process, a logical and mathematical expression is presented to measure the synergistic effect by modeling values for blocks and factors affecting their parameters, which will significantly simplify the process of making optimal decisions by the management of the enterprise.

1 Identification of enterprise development problems

Common | Innovative development | Personnel innovation activity

2 Search for the causes of enterprise development problems

Inhibition of continuous development | Slowing down innovative development | Insufficient innovative activity of personnel

No

3 Establishing the causes of enterprise development problems

Yes

4 Determination of the general goal and the strategic whole of the enterprise

General goal:
Ensuring the continuous development of the enterprise

Strategic goal: solving problems in block A (increasing the innovative activity of personnel) | Strategic goal: solving problems in block B (ensuring the innovative development of the enterprise) | Strategic goal: solving problems in block C (ensuring the continuous development of the enterprise)

5 Determination of dominant activities using a «tree of opportunities» for each block

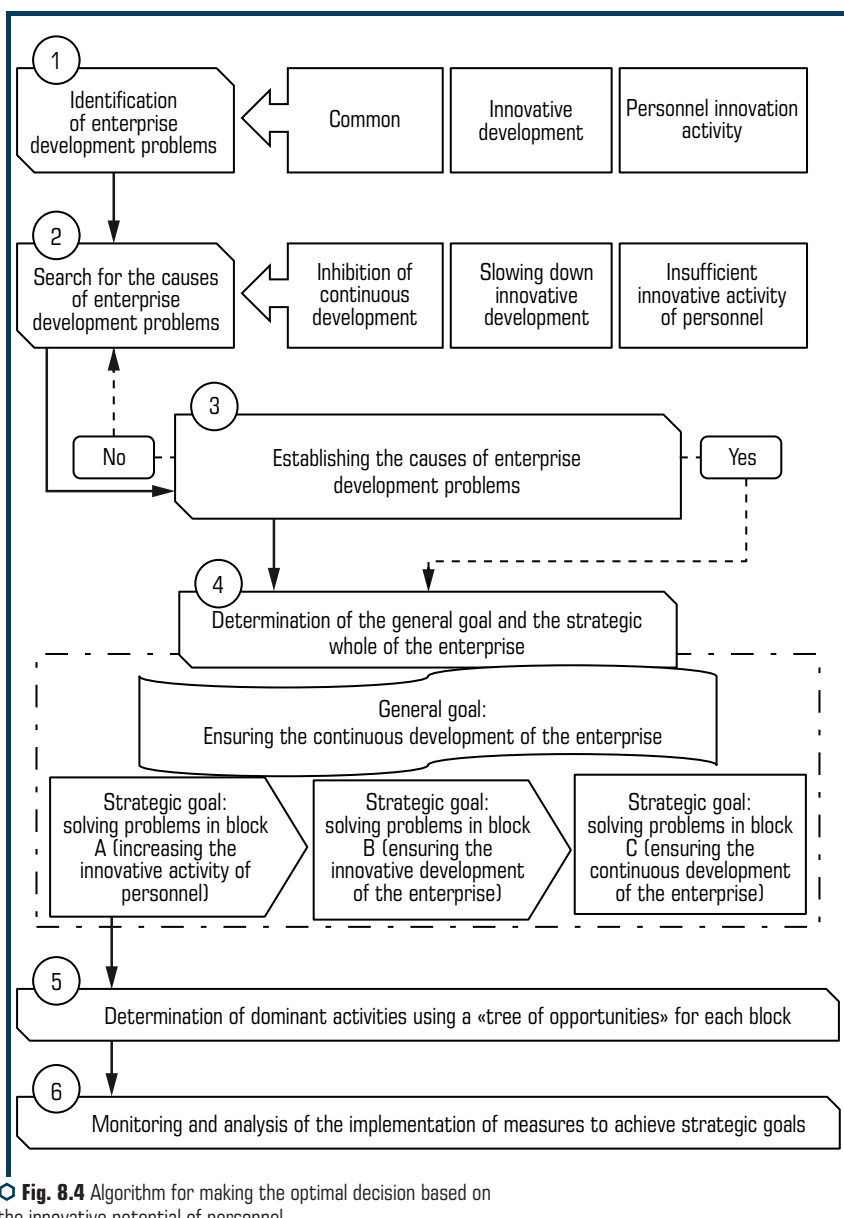**6** Monitoring and analysis of the implementation of measures to achieve strategic goals

○ **Fig. 8.4** Algorithm for making the optimal decision based on the innovative potential of personnel
Source: suggested by the authors

To make optimal decisions based on the development of the innovative potential of personnel, an algorithm has been proposed, which consists of 6 stages, starting with identifying the problems of enterprise development and ending with the control and analysis of the implementation of measures and the achievement of strategic goals, and a «tree of opportunities» for determining the dominant measures for the development of the enterprise itself.

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9 MAKING OPTIMAL STRATEGIC DECISIONS IN CONDITIONS OF WEAKLY STRUCTURED SYSTEMS USING COGNITIVE MODELING TECHNIQUES

N. Pryimak, K. Khavrova, A. Kravtsov, Eu. Klevtsov

ABSTRACT

The section studies the processes of making managerial decisions using the cognitive modeling methodology, which, given the prevalence of qualitative decision-making criteria, allows to ensure the achievement of strategic goals, taking into account the similarities and differences in the influence of factors on the strategic process. Based on the results of the study, the main stages of building a cognitive model were identified, key concepts were identified and a cognitive graph was built for the strategic behavior of enterprise, taking into account the current situation for the subject of the state and the market.

The aim of this research was to build a cognitive model of managerial decision-making in conditions of semi-structured systems, subdued by the polymorphic influence of the functioning environment.

To achieve this aim, the methods of theoretical analysis, generalization and systematization were used – to build an algorithm for the application of cognitive modeling of strategic management; graphic and tabular methods – for a visual presentation of statistical material, visualization of the obtained theoretical and practical provisions; cognitive modeling – to formalize decision-making processes in the field of strategic management by building a cognitive map.

In the course of the study, the relevance of the use of cognitive modeling to substantiate optimal strategic decisions in the conditions of management systems operating on the uncertainty and polymorphism of the environment and the factors that form it was determined. It is proved that the strategic management process meets the requirements for semi-structured systems, the advantages of the cognitive modeling methodology for the strategic process are determined on the example of the situation of production of strategic changes. The construction of a cognitive map (graph) of the process of making strategic decisions in the field of production of strategic changes at mining and processing enterprises, taking into account the following concepts: goals of strategic changes; the goals of the enterprise strategy implementation; the duration of the change lag; the level of encouragement of the team of changes; threshold opportunities for strategic change; unique opportunities for strategic change; average opportunities for strategic change; sufficiency of the potential for strategic changes; resistance to change; fiduciary corporate culture. The target concepts in the model define the goals of strategic changes and the goals of the enterprise strategy. All other concepts of the model are defined as unmanageable.

The applied nature of the proposed methodology is justified by its practical application based on the actual data of the implementation of the strategic process in the conditions of the mining and processing industry of Ukraine. Based on the results of modeling the influence of the indicators of the cognitive model on the factors of managing strategic changes, it is recommended to take priority into account in the course of the implementation of managerial impact: the duration of the

lag of strategic changes; threshold level of opportunities for strategic change; the laughter of the change team. The strengths of the application of the cognitive modeling methodology for making optimal managerial decisions are determined by its universality and the possibility of taking into account subjective models of managerial situations and managerial activity in general, built on the professional (cognitive) experience of the person making a managerial decision.

KEYWORDS

Strategic management, cognitive model, strategic process concept, strategic decision, strategic changes.

9.1 OBJECTIVE NECESSITY AND FEATURES OF THE USE OF COGNITIVE MODELING IN STRATEGIC MANAGEMENT

Crisis phenomena in economic systems are permanent processes, the accounting of which leaves an imprint on all elements of the management cycle — assessment of the decision-making environment, determination of factors influencing the process and procedures for making managerial decisions, the behavior of persons who are authorized to make and make economic decisions, etc. Such circumstances require the use, in addition to the standard, time-tested and management practice, methods of substantiating economic decisions, the use of non-standard, non-traditional methods for established economic systems, designed to take into account heuristic, non-standard approaches to assessing a managerial decision and its consequences. Such methods not only increase the reliability and efficiency of decision-making, but also reduce the time required to consider existing alternatives, which means they shorten the management cycle and ensure the timely response to the development of a crisis situation in its varied filling of components and consequences.

One of the most effective modern methods of substantiating economic decisions under the conditions of the above conditions and limitations is the use of cognitive modeling of problem situations based on the construction of cognitive maps (graphs), which are a powerful tool not only for disaggregating the most problematic management situation for the purpose of its detailed analysis, but and carrying out a targeted synthesis of the development of its components. It is cognitive modeling that makes it possible to maximize the scenario approach and identify key economic strategies for solving a problem situation in accordance with the goals, priorities and resources of all participants in the strategic process.

An analysis of recent studies and publications devoted to the use of cognitive modeling for the analysis and forecasting of phenomena and processes in semi-structured open systems, which include, among others, socio-economic systems, has shown that there is a significant number of scientists' developments in this direction. These include: research by Axelrod, R. (1976) [1]

(analysis of decision making in various fields using cognitive maps and models); Roberts, F. S. (1986) [2] (development of the theory of fuzzy cognitive maps); Avdeeva, Z. K., Kovriga, S. V., Makarenko, D. I. (2006) [3]; Verba, V. A. (2011) [4]; Savchuk, O. V., Ladaniuk, A. P., Hrytsenko, N. H. (2009) [5] (study of the foundations of the application of cognitive models in the management process); Kadiyevskiy, V. A., Perkhun, L. P., Izosimov, O. N. (2016) [6]; Maliarets, L. M., Lebediev, S. S. (2017) [7]; Rozenberg, I. N. (2015) [8] (studying the possibilities of using cognitive models to control systems of various levels and various spheres of production and economic activity), etc. Despite the rather deep research of the cognitive modeling methodology, various aspects of the use of cognitive models for making strategic decisions of development and activities semi-structured systems in market conditions require more in-depth research and refinement.

The aim of this research is to build a cognitive model of managerial decision-making in conditions of semi-structured systems, subdued by the polymorphic influence of the functioning environment.

The modern strategic management system is going through an era of restructuring, changes in approaches to understanding both the very essence of strategy (the main basic element of strategic management) and the tools for its development, implementation and justification. Organizational design, within which the processes of development, assessment and managerial decision-making take place, requires taking into account an increasing number of factors and situations in the external and internal environment of business entities. The factors themselves are multicomponent, unstable, dynamic and often do not provide opportunities for formalized assessment. All this prompts managers to make decisions based on a scenario approach, which is based on five basic components, which can be formulated as follows:

– the environment of activity is changing, but the problems of control systems conceptually remain constant;

– in modern society there is a tendency to overestimate technological changes and underestimate the technological capabilities of supporting management processes;

– simple decision-making tools are suitable for complex management tasks;

– the basis for an effective solution – the problem is correctly and timely identified and the person's habitual thinking is canceled, is engaged in making managerial decisions;

– strategic management is a transition from expectation to action by assigning (tools, methods, results) [9].

One of the functions of strategic management is to eliminate two mistakes, which can be called «hammer risk» and «nail dream». In other words, we forget what the function of the hammer is despite the nail (the dream of the nail), or we know how to use the hammer and imagine that each problem is like a nail (the risk of the hammer). In our case, the modern strategic management system seeks to develop simple tools that can be adequate to the conditions prevailing in the business environment. However, these simple tools require the development of a balanced management approach, which, first of all, allows to correctly set management tasks and is based on the intuition of the decision maker, her experience and completeness of information [10].

One of the modern methods for solving complex strategic tasks of business entities is the method of cognitive modeling, which allows, in conditions of weak structuring of the processes of making economic decisions and the absence of stable formalized procedures for their substantiation, to ensure the transfer of the control object to the desired state, taking into account the similarities and differences in the influence of factors on this an object of administrative influence (in our case, a strategic process). Cognitive modeling allows a management task to be considered as a set of variables (factors) having different sources of origin, but at the same time they are considered as interrelated – changes in one control variable (factor) are determined through a complex set of cause-and-effect changes in a set of other control variables (factors). When using the method, two types of causal relationships are considered: positive and negative. Positive relationships determine that with the growth of the factor-cause, the growth of the factor-effect occurs. Negative relationships lead to the opposite process – a decrease in the factor-effect [2, 6].

«The cognitive approach to supporting strategic decision-making is focused on activating the intellectual processes of the subject of management and helping him to fix its view of the problem situation in the form of a formal model. As such a model, the so-called cognitive map of the situation is usually used, which represents the basic laws and patterns of the studied situation known to the subject in the form of an oriented sign graph, in which the vertices of the graph are factors (signs, characteristics of the situation), and the arcs between factors are causal relationships between factors» [2].

There are five types of cognitive maps according to the type of relationships used in the process of developing and making strategic decisions [11, 12]:

1) those that evaluate the focus of attention, associations and the importance of factors (concepts);

2) those that demonstrate the sizes of categories and cognitive taxonomies;

3) those that demonstrate the level of influence, causality and system dynamics (causal cognitive maps);

4) those that reflect the structure of the arguments and conclusions;

5) those that illustrate frames and codes of perception.

The practice of using cognitive maps by leading companies shows that for the study of semi-structured open systems, it is advisable to use maps of the third type in the strategic process, that is, causal cognitive maps [11].

9.2 METHODS FOR CONSTRUCTING COGNITIVE MAPS IN SEMI-STRUCTURED SYSTEMS

Cognitive modeling is based on the method of constructing a cognitive map (graph) «which is a model of experts' ideas and knowledge about the laws of development and the properties of the situation under consideration in the form of elementary semantic categories linked by relationships» [13]. The cognitive map can be presented in the following form:

$$G = \langle V, E \rangle, \tag{10.1}$$

where:

1. V – the vertices of the graph, or the so-called «concepts» $V_i \in V, i = 1,2,3……k$, which in fact are elements (factors) of the studied situation or system. In the case of strategic decisions, the concepts may include «strategy», «strategic opportunities», «strategic potential of the enterprise», etc.

2. E – connections between the vertices of the graph in the form of a set of arcs $e_{ij} \in E, i, j = 1,2,……N$, which are mutual cause-and-effect connections between the concepts of the studied situation V_i and V_j.

3. Influence of V_i and V_j on the cognitive map can be of three types: positive, negative or absent (determined by the method of linguistic heuristic modeling).

9.3 APPLICATION OF COGNITIVE MODELING TECHNIQUES FOR STRATEGIC DECISION-MAKING IN SEMI-STRUCTURED SYSTEMS

The implementation of the approach to substantiate strategic decisions using the cognitive modeling methodology in this study will be done for the problems of implementing strategic changes in the conditions of mining and processing enterprises in Ukraine. Strategic changes are inevitable with a situation that all subjects of strategic decision-making face without exception, since an effective strategy today is a dynamic, flexible and multicomponent structure that, as a result of a number of factors, moves from one state to another target state. It is these characteristics of the strategy that determine the existence of strategic changes and make it possible to use cognitive maps (graphs) to substantiate the directions for the implementation of strategic changes. Strategic changes should be understood as the processes of strategic management aimed at achieving goals for a business entity, due to the influence of the external and internal environment, which determine the content and tools for implementing the strategy, in the current or future state, as a means of achieving these goals [14]. The main parameters for the implementation of strategic changes in the conditions of mining and processing enterprises, as the basis for constructing a cognitive map (graph) are given in **Table 9.1**.

The situation of strategic changes takes into account as much as possible the requirements for the use of cognitive modeling, namely: there is a socio-humanitarian aspect of managerial decision-making associated with the competence of persons involved in the process of making decisions on strategic changes [15], their professional skills both in implementing the cycle of strategic changes and managing team of change and resistance; strategic changes fully correspond to the factor of uncertainty, including the stochasticity of the strategic environment, the riskiness of the situation of changes, the lack of complete information and the instability of the strategic situation [4]; focus on specific conditions for the development of enterprise strategy [5].

● **Table 9.1** Basic parameters for the implementation of changes in mining and processing enterprises for 2014–2018 [14]

Enterprise	period				
	2014	2015	2016	2017	2018
Utilization rate of the potential for strategic change (kpsc)					
CJSC «Northern GOK»	0.75	0.87	0.83	0.69	0.57
CJSC «Central GOK»	0.75	0.53	0.31	0.38	0.87
OJSC «South GOK»	0.78	0.81	0.82	0.64	0.68
CJSC «InGOK»	0.82	0.76	0.99	0.70	0.61
CJSC «PoltGJK»	0.66	0.60	0.72	0.77	0.75
Utilization rate of the unique level of opportunities for strategic change (dusc)					
CJSC «Northern GOK»	0.95	0.66	0.63	0.57	0.96
CJSC «Central GOK»	0.40	0.54	0.83	0.49	0.29
OJSC «South GOK»	0.63	0.55	0.50	0.59	0.69
CJSC «InGOK»	0.67	0.68	0.38	0.12	0.60
CJSC «PoltGJK»	0.69	0.90	0.82	0.58	0.64
Utilization rate of the threshold level of strategic change opportunities (dtsc)					
CJSC «Northern GOK»	2.44	1.45	2.39	5.21	3.32
CJSC «Central GOK»	1.04	1.19	3.16	4.46	1.01
OJSC «South GOK»	1.61	1.92	1.92	5.40	2.38
CJSC «InGOK»	1.72	1.72	1.44	3.84	2.09
CJSC «PoltGJK»	1.75	1.98	3.13	5.27	2.22
Utilization rate of the average level of opportunities for strategic change (dusc)					
CJSC «Northern GOK»	1.42	0.99	0.99	1.08	1.51
CJSC «Central GOK»	0.61	0.81	1.31	0.92	0.46
OJSC «South GOK»	0.94	0.83	0.80	1.12	1.08
CJSC «InGOK»	1.00	1.03	0.60	0.79	0.60
CJSC «PoltGJK»	1.03	1.35	1.30	1.09	2.22
The level of lability to strategic changes (L)					
CJSC «Northern GOK»	0.96	1.00	0.98	0.99	0.96
CJSC «Central GOK»	0.98	1.05	0.96	1.00	0.96
OJSC «South GOK»	0.98	1.01	0.97	0.97	1.04
CJSC «InGOK»	0.99	1.07	0.95	0.96	1.00
CJSC «PoltGJK»	0.96	1.02	1.01	0.95	1.01

Source: compiled on the basis of data [16–20]

The purpose of using cognitive modeling during the implementation of strategic changes in the activities of an enterprise is to generate and test hypotheses regarding the combination of interaction of factors for the implementation of strategic changes that can explain the dynamic directions of development (a possible vector of development) of the situation of strategic changes and the achievement of their goals.

During the production of strategic changes at the enterprise, all the signs of semi-structured systems are observed:

1) the implementation of changes is influenced by a significant range of factors, which can be defined as a set of external and internal drivers of strategic changes. At the same time, the influence of factors on the processes of strategic changes is not entirely predictable, and the connections between them are complex and dynamic;

2) the influence of factors on the process of strategic changes and the goals of strategic changes (and hence the goals of the strategy) cannot be measured quantitatively, most of them relate to qualitative factors;

3) situations of strategic changes are uncertain, multivariate and have a complex structure;

4) to assess the components of the processes of strategic changes, experts are involved, whose assessments are mainly of a qualitative, linguistic nature (due to the specifics of the factors and situations under study), are subjective.

The use of cognitive modeling of enterprise behavior in the process of implementing strategic changes in activities has a number of advantages, the characteristics of which and the features of manifestation for the implementation of strategic changes are summarized in **Table 9.2**.

Are given in **Table 9.2** data allow to actualize the practical significance of the cognitive modeling methodology for the process of implementing strategic changes in the activities of the enterprise.

Generalization of the methodological apparatus of cognitive modeling of complex systems [2, 6, 7, 13] made it possible to structure the algorithm for constructing a cognitive model for the process of implementing strategic changes in the activities of an enterprise (**Fig. 9.1**).

Thus, the algorithm for creating a cognitive model is reduced to the sequential implementation of the following stages:

1. A qualitative description of the problem situation, the introduction of strategic changes containing the structuring of the views of the change team, the change leader and the head of the enterprise about the process and the constituent elements of strategic changes in the enterprise. A prerequisite for the implementation of this stage is the study and structuring of internal and external drivers of strategic changes. The result of this stage should be the definition of a list of factors (concepts) characterizing the situation of implementation of strategic changes.

For modeling purposes, the factors should be divided into: target concepts of strategic changes – the factors of change that characterize the processes, the results and/or goals of which need to be achieved; factors that influence the target concepts of strategic changes. They can be characterized as tools, levers of influence on target concepts with the help of which the team of strategic changes can achieve the goals of changes in the conditions of the current set of drivers;

factors-indicators of strategic changes are factors and processes that provide an explanation for the dynamics of the processes of implementation of strategic changes.

● **Table 9.2** Benefits of cognitive modeling for substantiating the behavior of business entities in the process of implementing strategic changes in activities

Benefits	Characteristic	Features of the implementation of strategic changes
Effectiveness in the face of limited information	Set of factors influencing the studied situation is significant, and their influence in the current strategic management system is difficult to measure. This limitation is removed by limiting the number of factors studied	The method allows to assess the factors that form the most powerful drivers of strategic changes that are important for achieving goals, the formation of key competencies and the implementation of external opportunities for change
Structuring a problem-solving model	Ability to assess the entire set of situations of strategic changes and organize monitoring of the selected (desired) scenario of changes	Possibility of introducing any factor into the cognitive model makes it possible to assess the ways of achieving the goals of changes in various variations in the development of resource provision of changes and the level of resistance
Visibility of cognitive maps and models	Presentation of only the basic factors that are most significant for the strategic change management system and the links between them	Allows to additionally take into account the subjective opinions of the change team and the change leader without reducing the quality of the decisions made
Taking into account the multidimensionality and interconnectedness of phenomena and processes	The cognitive map allows to identify indirect links between factors and the reasons for their formation	Expansion of tools for assessing the impact of drivers of strategic changes, their combinations and the consequences of the impact on the enterprise as a platform for changes
Improving the quality of produced managerial decisions	Allows to develop various scenarios for the development of events	Combination of competence-based and scenario approaches allows to cover the entire range of possible strategic changes and ways to achieve their goals
The dynamic nature of the connections between the elements of the cognitive map	A cognitive map is a directed graph that allows to fix the spatio-temporal relationship between factors and situations	Allows to identify variations in the lag of changes and bifurcation points of strategic changes, to provide ways to optimize them
Taking into account the positive and negative relationships between factors	Modeling the positive and negative influence of factors and phenomena increases the potential number of consideration of possible scenarios for the development of the research object (management problem)	In the absence of a clear interpretation of positively and negatively-minded drivers of strategic changes, cognitive modeling allows to cover a wider area of situations of change and adequately take into account the drivers of changes in the course of implementing a certain strategy

Source: compiled from [2]

To implement this stage, heuristic expert methods are used and, in addition to members of the change team, external analysts – change agents, stakeholders, etc., can be involved. This stage is one of the most important and at the same time one of the most difficult because it is weakly amenable to formalization.
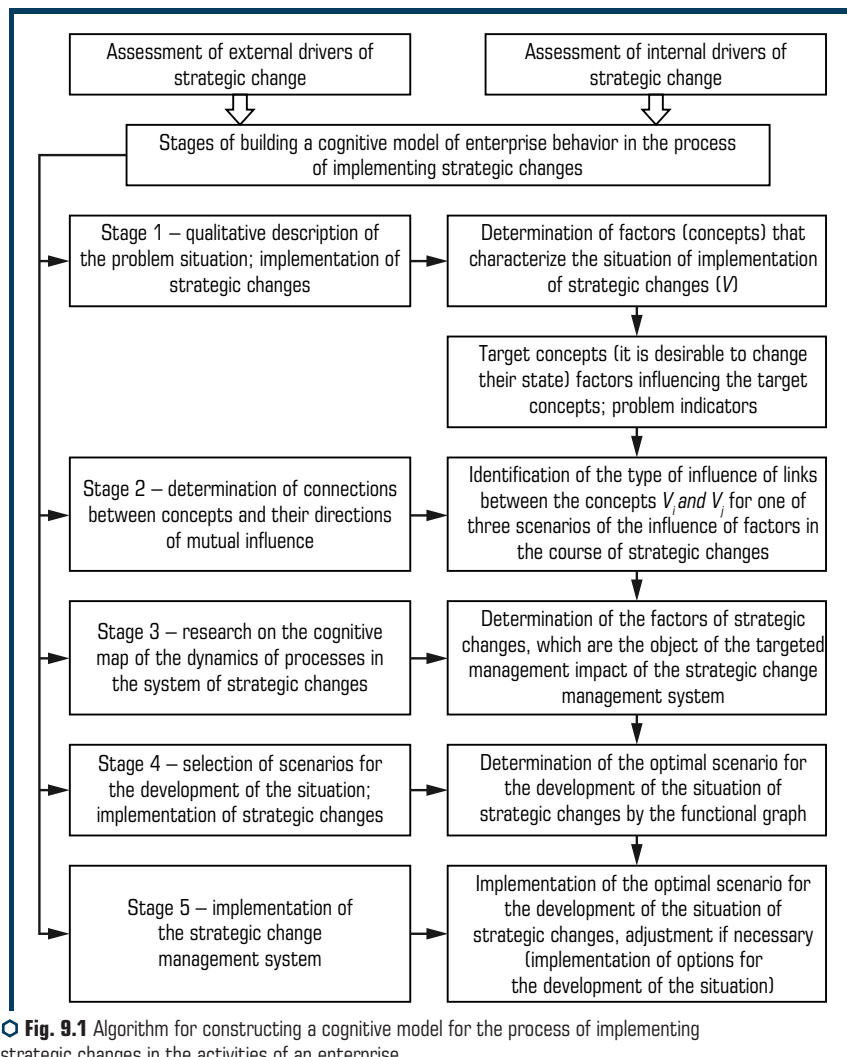
○ **Fig. 9.1** Algorithm for constructing a cognitive model for the process of implementing strategic changes in the activities of an enterprise
Source: compiled by the author based on adaptation [6, 7, 13]

2. Determination of connections between the concepts of strategic changes and the construction of cause-and-effect relationships (chains) with an indication of their polarity: positive, negative or absent. It is at this stage that a cognitive graph (cognitive map) is built that visually visualizes the connections of factors in the process of implementing strategic changes at the enterprise. At this stage, the head of the change team is able to identify pools of homogeneity of the influence of factors on each other, which increases the level of perception of strategic changes as a system of objects of management influence.

3. Research on the constructed cognitive map of the dynamics of processes (variations in the influence of factors and situations of changes) and determination of the range of factors of strategic changes, which are the object of the targeted management impact of the strategic change management system. The purpose of this stage is to determine the areas of influence of the strategic change management system on the change processes in order to optimize the change lag and achieve the set goals.

4. The choice of scenarios for the development of the situation, the introduction of strategic changes as a result of modeling the impulse process of the propagation of disturbances in the system of changes, that is, their transition from one state (scenario) to another either by evolutionary way, or as a result of a set of managerial influences from the management system and the team of strategic changes. The result of the stage is the determination of the optimal scenario for the development of the situation of strategic changes by the functional graph.

5. Implementation of the strategic change management system based on a set of managerial decisions on the implementation of the optimal scenario for the development of the situation of strategic changes.

The above stages are associated with the implementation of strategic change management at the enterprise on the basis of strategic management, but it must be borne in mind that since each situation of change is unique, the sequence of stages of cognitive modeling, their frequency and, in general, their presence, can change.

The set of factors of the cognitive model for the process of implementing strategic changes are shown in **Table 9.3**.

Among the above list of factors (concepts) for the implementation of strategic changes, two factors (concepts) were selected as target – the goals of strategic changes (V_1) and the goals of the implementation of the strategy (V_2), which should correlate with each other, but they cannot always be identified since the goals of strategic changes are in the majority cases provide for corrective actions in relation to the strategy, and therefore to its goals (in most cases – in functional components).

Among the list of factors (V_i), the following are recognized as manageable:

1) target factors (V_1, V_2) (concepts);

2) sufficiency of the potential for strategic changes (V_8). The potential for strategic changes is a set of strategic resources, competencies and internal capabilities that are accumulated and used (or can be used) in the process of implementing strategic changes by a business entity to achieve

strategic goals in a dynamic environment). The sufficiency of the potential for strategic changes is its ability to ensure the achievement of the goals of strategic changes in the specific conditions that have developed.

The controllability of these factors is related to the fact that a person makes a strategic decision, determines goals in accordance with the formed strategic potential (a set of strategic resources) of changes, which means that all three components of the strategic process are subject to its conscious impact (management).

● **Table 9.3** Factors of the cognitive model for the implementation of strategic changes in mining and processing enterprises

Factor (concept) name	Designation (V_j)	Type of factor (concept)	Target
Objectives of strategic change	1	Guided	+
Objectives of the implementation of the enterprise strategy	2	Guided	+
Duration of change lag	3	Observable	
Level of encouragement of the team of changes	4	Observable	
Threshold opportunities for strategic change	5	Uncontrollable	
Unique opportunities for strategic change	6	Uncontrollable	
Medium potential for strategic change	7	Uncontrollable	
Adequacy of potential for strategic change	8	Guided	
Resistance to change	9	Uncontrollable	
Fiduciary corporate culture	10	Observable	

Source: compiled by the author

Uncontrollable factors are defined:

1) possibility of strategic changes in their three manifestations – threshold (V_5) unique (V_6) and average (V_7), which generate, taking into account the capabilities of all participants in the target market (in our case, mining and processing enterprises), and therefore, a priori cannot be subject to any manager impact, since this may violate both the current antimonopoly legislation and the laws of the oligopoly market, which, in fact, is the investigated market for metal ruins of Ukraine;

2) resistance to change (V_9), which is carried by people involved in the strategic process, and which determines the distortions or adjustments of the goals of achieving strategic changes by the actions or inaction of the subjects of changes.

The factors that are observable in the cognitive model include:

1) duration of the change lag (V_3);

2) level of encouragement of the team of strategic changes (V_4);

3) fiduciary corporate culture (V_{10}), which is adopted in a business entity, which is a platform for changes or a basis for making strategic decisions.
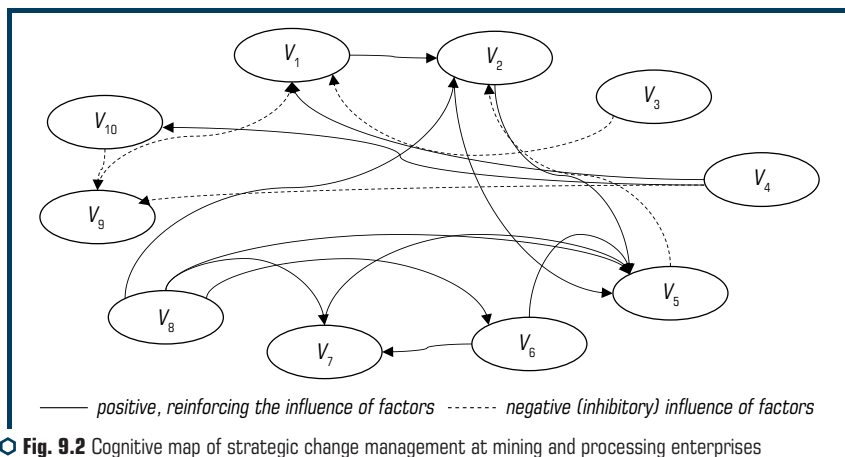
To determine the relationship between factors (concepts) (**Table 9.4**), a dichotomous analysis was used, within which, according to a linguistic approach, the mutual influence of factors is quantitatively assessed using the values «1» for factors that have a positive, reinforcing influence on each other or «1». For factors that have a negative (inhibitory) effect on each other. It is possible to determine the value of influence «0» when there is no mutual influence of factors.

The resulting cognitive model for managing strategic changes at enterprises has the form of a cognitive graph, the vertices of which are the factors of the cognitive model, and the connections between them are defined by lines (**Fig. 9.2**).

● **Table 9.4** Fuzzy cognitive matrix of adjacency of strategic change management factors in the enterprise

Factor	V_1	V_2	V_3	V_4	V_5	V_6	V_7	V_8	V_9	V_{10}
V_1	0	+1	0	0	0	0	0	0	0	0
V_2	0	0	0	0	+1	0	0	0	0	0
V_3	−1	0	0	0	0	0	0	0	0	0
V_4	+1	0	0	0	0	0	0	0	−1	+1
V_5	0	−1	0	0	0	0	0	0	0	0
V_6	0	+1	0	0	+1	0	+1	0	0	0
V_7	0	0	0	0	+1	0	0	0	0	0
V_8	0	+1	0	0	+1	+1	+1	0	0	0
V_9	−1	0	0	0	0	0	0	0	0	0
V_{10}	0	0	0	0	0	0	0	0	−1	0

Source: [21]

— positive, reinforcing the influence of factors ------ negative (inhibitory) influence of factors

○ **Fig. 9.2** Cognitive map of strategic change management at mining and processing enterprises
Source: compiled by the author

The cognitive map for managing strategic changes in business entities shows that a positive influence in the management process can be traced between the factors: the goals of strategic changes and the goals of the strategy; goals of strategic change and support for a threshold level of opportunities for strategic change; to laugh the team of changes and the goals of strategic changes, as well as to laugh the team of changes and the fiduciary nature of corporate culture, proves the feasibility of introducing motivational measures for its formation; unique and threshold level of opportunities for strategic changes, as well as unique and average levels of opportunities for strategic changes, which is explained by their conditionality in the logical sequence of the implementation of the enterprise strategy; average and threshold opportunities for change; the sufficiency of the potential for strategic change and the goals of change, the sufficiency of the potential for strategic change and the threshold, average and unique opportunities for change.

At the same time, a negative (inhibitory) effect is observed between the factors: the duration of the lag of strategic changes and the goals of strategic changes, determines the expediency of an optimal reduction in the duration of the lag of changes in order to minimize the destabilizing effect of the drivers of changes on the process of achieving goals; encouraging the team to change and the level of resistance to change; threshold opportunities for strategic changes and the implementation of the goals of the enterprise strategy, which is associated with the need for additional search for strategic resources in the event of their change; resistance to change and goals of strategic change; fiduciary of corporate culture and level of resistance to change.

In order to move from a cognitive map to building a cognitive management model, each case of interconnections of factors (concepts) will be provided with a linguistic meaning corresponding to the type of connection between them («very high», «high», «above average», «average», «below average», «low» and «very low») and each variant of the linguistic meaning will be assigned a level of influence on the scale [0;1].

The analysis of the stability of the cognitive model of strategic change management at enterprises showed that its level corresponds to the value of 0.37 and characterizes it as medium stable. The assessment of the mutual influence on the factors (concepts) of the cognitive model of strategic change management, carried out using the capabilities of MS Excel, is shown in **Fig. 9.3**.

In the course of calculations, it was assumed that the target impact of the strategic change management system on the factors (concepts) of the model is 10 %. This made it possible to determine, taking into account the directions of the influence of factors on each other, taking into account the consonances of influence, the factors (concepts) of the model that require priority consideration during the implementation of managerial influence:

– duration of the lag of strategic changes (has a inhibitory effect on the achievement of the goals of strategic changes as a result of significant subordination (in the case of a long lag) to the destructive effects of the drivers of changes). Taking into account that the lag of strategic changes is the period of time from the detection by the strategic management system of the factor of occurrence of strategic changes until the end of the process of implementing the changes and receiving an innovation that is the result of strategic changes, then, in order to make an optimal

strategic decision, «dragging out» the processes of strategic transformations will lead to the malicious achievement of the goals of changes, and hence the goals of the strategy, which, corny, may become irrelevant in the external environment, which are stored at a certain point in time. Also, the lag of changes is determined by the research of scientists [22] as one of the options for the reaction to mines in the external and internal environment of a business entity;

VARIABLE FACTOR	TARGET FACTOR	VALUE	CONSONANCE OF INFLUENCE
Targets of strategic change	Enterprise strategy targets	Δ ↑ 9 %	0.5
Enterprise strategy targets	Threshold opportunities for strategic change	Δ ↑ 5 %	0.47
Duration of the strategic change lag	Targets of strategic change	Δ ↓ 6 %	1.0
Change team commitment	Targets of strategic change	Δ ↑ 7.5 %	1.0
	Resistance to change	Δ ↓ 7 %	1.0
	Fiduciary corporate culture	Δ ↑ 7.5 %	1.0
Threshold opportunities for strategic change	Enterprise strategy targets	Δ ↓ 6.5 %	0.5
Unique opportunities for strategic change	Enterprise strategy targets	Δ ↓ 6 %	0.35
	Threshold opportunities for strategic change	Δ ↑ 4.5 %	0.5
	Medium opportunities for strategic change	Δ ↑ 5.5 %	1.0
Medium opportunities for strategic change	Threshold opportunities for strategic change	Δ ↑ 5 %	0.55
Adequacy of potential for strategic change	Enterprise strategy targets	Δ ↑ 8.5 %	0.55
	Threshold opportunities for strategic change	Δ ↑ 8 %	0.5
	Unique opportunities for strategic change	Δ ↑ 6 %	1.0
	Medium opportunities for strategic change	Δ ↑ 6 %	1.0
Resistance to change	Targets of strategic change	Δ ↓ 7 %	0.65
Fiduciary corporate culture	Resistance to change	Δ ↓ 7 %	1.0

Fig. 9.3 Evaluation of the results of modeling the impact of cognitive model indicators on the factors of strategic change management
Source: compiled by the author

– threshold level of opportunities for change (an increase leads to a distortion of the goals of change and requires a change in the focus of management towards supporting competitiveness). The threshold level of opportunities for strategic changes is the level of implementation of strategic resources, accumulated by the external environment, for the potential for strategic changes, which allows an enterprise to achieve the goals of strategic changes that can achieve (maintain) competitiveness in the market. The value and importance of control for the strategic management of this concept lies in its ability to form competitiveness and remain in an attractive strategic economic zone for the company;

– level of encouragement the team of changes (determines the course of the processes of changes and their implementation in conditions of dyspathy and fluctuation, the attitude to changes). This concept combines both resistance to change and the level of fiduciaries of corporate culture, forming an attitude towards the goals of strategic development and the goals of a specific program of strategic change.

9.4 INTERPRETATION OF THE RESULTS OF COGNITIVE MODELING BY THE STRATEGIC MANAGEMENT SYSTEM

Thus, the application of the cognitive modeling methodology for making strategic decisions on the example of the production of strategic changes made it possible to come to the following conclusions:

1. Making optimal managerial decisions in a crisis requires the construction of a structural description of the situation in the form of a frame or cognitive map (graph), which will ensure the quality of analysis of the problem situation and finding a strategy for its transfer from the current state to the target state.

2. The situation of the implementation of strategic changes at the mining and processing enterprises of Ukraine refers to the type of semi-structured areas and actualizes the use of cognitive modeling for the following reasons: there is a socio-humanitarian aspect of making managerial decisions; strategic changes are fully consistent with the uncertainty factor; orientation of changes in the specific conditions for the development of the enterprise's strategy and the specific conditions of activity.

3. The purpose of using cognitive modeling during the implementation of strategic changes in the activities of an enterprise is to generate and test hypotheses regarding the combination of interaction factors for the implementation of strategic changes that can explain the dynamic directions of development (a possible vector of development) of the situation of strategic changes and the achievement of their goals.

4. Based on the results of modeling the influence of the indicators of the cognitive model on the factors of strategic change management, it is recommended to take priority into account in the course of the implementation of the managerial impact of such factors: the duration of the lag of strategic changes; threshold level of opportunities for change; laugh the change teams.

5. The strengths of the cognitive modeling technique for making optimal managerial decisions are its versatility and the ability to take into account subjective models of managerial situations and managerial activity in general, based on the professional (cognitive) experience of the managerial decision maker.

The weak side of this technique is that it does not contain a universal algorithm (formula) for each specific strategic situation, it is a product of the dynamism of the modern environment of business entities and the uniqueness of each strategic decision-making situation.

An opportunity for further research is the application of the results obtained in the construction of neural development of strategic changes.

The threats to the application of the cognitive modeling methodology in making strategic decisions are the low competence of those who make strategic decisions and the uncertainty of the level of controllability of the factors involved in the process of making strategic decisions.

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CONCLUSIONS

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The results allow to assert that the econometric approach to managerial decision-making takes place at all levels, is the basic one when justifying the choice of a decision. But it should be noted that the effectiveness of its implementation depends on the knowledge and understanding of economic and mathematical methods by the decision maker. The main results of the study set out in the monograph are as follows:

– a generalized classification of managerial decisions and concretized the parameters affecting the adoption of managerial decisions at the micro level (organizational structure of the enterprise, qualifications and personal characteristics of personnel; efficiency of channels for obtaining information; provision of means and objects of labor) and at the macro level (competence of employees of public authorities; rationality of the structure and bureaucratic procedures, the level of motivation in decision-making, technical means, information support; the environment for decision-making and implementation; requests from stakeholders; regulatory framework for the functioning of public authorities, the political situation; financial and economic situation) considered the stages of managerial decision-making in the migration European Union policy; identified the main challenges for the migration policy of the European Union as a managerial decision at the macro level (numerous uncontrolled flows of illegal migrants and refugees following the countries of Africa and Asia, the need to ensure effective control over the borders of the EU member states) are formed. The analysis of the migration policy of Ukraine from the point of view of the effectiveness and efficiency of managerial decision-making at the macro level is carried out. It is determined that the main task of the migration policy of Ukraine is to reduce labor emigration. Measures and directions for the implementation of the migration policy of Ukraine in the European migration policy have been developed [link to Section 2];

– a regression model developed with performance indicators, which reflects the dependence of the probability of the onset of the period of «crisis» on a number of economic indicators and carried out its approbation according to the data of economic development of Ukraine: forecast data for 2021–2022. Possible deviation of the Ukrainian economy from the trajectory of sustainable development is indicated; corrective measures of economic policy on the part of macroeconomic regulators in order to stop the inertial development of the forecast situation are outlined [link to Section 3];

– the stages of the process of identification of managerial decisions are highlighted, covering: definition of the problem; classification of the problem; ascertaining the facts, evaluating and analyzing the data concerning the problem; the classification of management problems has been improved by including such features as: focus on the goals of the enterprise, the degree of importance and urgency, the scale of the consequences in cases of making or rejecting decisions

and the number of organizations and individuals affected by these problems, risks associated with solving the problem and the opportunity emergence of new problems on this basis, the degree of structuredness and reflection through qualitative and quantitative indicators, the level of decision-making and risks, types of activities, the level of participation in the study of the problem and discussion on its solution [link to Section 4];

— the author's understanding of the concept of «econometric approach to managerial decisions» as a combination of properties and principles of the system (acceptance and understanding of the hierarchy of variables and their relationships, preservation of the principle of consistency) and situational approaches (taking into account system analysis, analysis of the content and dynamics of each individual situation) with an emphasis on the use of econometric methods and models are proposed; the advantages and disadvantages of the econometric approach to managerial decision-making are identified; the methodological toolkit of the econometric approach to substantiating strategic decisions to ensure economic security is determined, namely: taxonomic and canonical analyzes, the use of which made it possible to prove the statement about the existence of a relationship between the standard of living of the population and the level of innovative development of regions, which made it possible to form strategic solutions to ensure economic security; a matrix «economic security – standard of living – innovative development» is developed to substantiate the decision on the application of strategies to ensure economic security through changes in the level of innovative development and the standard of living of the population of the region (transformation strategy, innovative development strategy, human development strategy and growth strategy);

— the author's approach to understanding the concept of «information and analytical support of managerial decisions» is proposed; the varieties of the decision-making process are determined depending on the type of managerial decisions; types used in the managerial decision-making process; features and advantages of Data-driven decision-making over Highest Paid Person's Opinion; on the basis of cluster analysis, three groups of countries were identified (countries that are leaders in innovative development, countries that are moderate innovators, countries that are modest innovators), which are characterized by similar parameters and results of innovative development; identified and ranked (based on the results of the correlation analysis) the main factors that determine the features of the innovative development of the leading countries of innovative development; on the basis of the method of the main components, it is established that the country's innovative development is more not deterministic, but a controlled process, the main objects of which are the architecture of the innovation infrastructure, the volume of public expenditures on R&D; strategic directions for the development of the innovation infrastructure of Ukraine are determined (development of the institutional environment for the development of the innovation infrastructure, reconfiguration and diversification of the functional components of the innovation infrastructure, increasing the competitiveness of the structural elements of the functional components of the innovation infrastructure); on the basis of correlation-regression analysis, calculation of partial coefficients of elasticity, the potentially

most effective variant of reconfiguration of the functional components of the innovation infrastructure is established;

— the need to take into account spatial polarization as an objective condition for the adoption of managerial decisions to manage the development of local markets of tourist services is substantiated; clustering of regional markets of tourist services in Ukraine is carried out according to the indicators of the functioning of subjects of tourist activity (the number of tour operators and travel agents, the number of travel packages sold by tour operators and travel agents, the cost of travel packages, sold by tour operators and travel agents, the number of tourists served by tour operators and travel agents, the number of collective accommodation facilities, the number of persons in collective accommodation facilities.), as a result of which 6 clusters of local markets of tourist services in Ukraine were identified, formed at a threshold distance of 2, and namely: Cluster 1 – Kyiv city; Cluster 2 – Odesa and Zaporizhzhia regions; Cluster 3 – Lviv, Dnipropetrovsk and Kyiv regions; Cluster 4 – Kharkiv, Kyiv, Mykolaiv, Kherson and Donetsk regions; Cluster 5 – Poltava, Cherkasy, Zakarpatia, Khmelnytskyi and Volyn regions; Cluster 6 – Chernivtsi, Ternopil, Luhansk, Chernihiv, Kirovohrad, Zhytomyr, Sumy, Rivne and Vinnytsia regions; a model of authentic management of the development of the tourist services market in Ukraine is developed, which involves the use of specific mechanisms of authentic management and accounting for the authenticity of the cultural and historical resources of local tourism markets, the asymmetry of the infrastructural and socio-economic development of markets, the spatial polarization of the location of climatic and recreational factors in the development of local tourism markets allows for the formation of competitive advantages through the use of specific tourism determinants of local tourism markets;

— the application of the taxonomy method for diagnosing the development strategy of the hotel and restaurant industry is substantiated, for this it is proposed to use a conceptual descriptive model of taxonomic analysis; identified indicators for diagnosing the development strategy of the hotel and restaurant industry, which are grouped according to the dominant directions: structural, scale of production activities, marketing, personnel, investment attractiveness and financial performance; in accordance with the value of the integral indicator, it is proposed to divide into four states of the industry development, which correspond to certain strategies and managerial decisions for their implementation; proposed managerial solutions for the implementation of the development strategy of the hotel and restaurant industry for the coming period, including events at the national level and at the level of individual business entities;

— a theoretical and methodological approach to assessing the components of the innovative potential of personnel are developed, which are decisive for making optimal decisions based on the «tree of opportunities» and the integral indicator of the innovative potential of personnel, contains complex indicators for assessing the innovative activity of personnel, innovative development of the enterprise, the degree of development of the enterprise; an algorithm for making optimal decisions based on the development of the innovative potential of personnel is developed, namely: determining the problems of enterprise development; search for the reasons for the retardation of the development of the enterprise; determination of the reasons for the retardation of the development of

the enterprise; determination of optimal solutions depending on the formulated problem; development of recommendations for achieving strategic goals, based on building a «tree of opportunities»;

— the advantages of the cognitive modeling methodology for the strategic process are determined on the example of the situation of the production of strategic changes; a cognitive map (graph) of the process of making strategic decisions in the field of making strategic changes at mining and processing enterprises was built, taking into account the influence of such concepts: the goals of strategic changes; the goals of the enterprise strategy implementation; the duration of the change lag; the level of encouragement of the team of changes; threshold opportunities for strategic change; unique opportunities for strategic change; average opportunities for strategic change; sufficiency of the potential for strategic changes; resistance to change; the fiduciary nature of corporate culture, while the target concepts in the model define the goals of strategic changes and the goals of the enterprise strategy, all other concepts of the model are defined as uncontrollable.

The practical significance of those obtained in the monograph lies in the fact that the proposed scientific and practical recommendations and conclusions can be used to form and implement decision-making models for solving such problems.

The theoretical and scientific-applied provisions presented in the monograph will be useful for researchers, teachers, graduate students, applicants for higher education, and is intended for decision-makers in companies, non-profit organizations and government.

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ECONOMETRIC MODELING OF MANAGERIAL DECISIONS AT THE MACRO AND MICRO LEVELS

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