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Digitalization of Biocluster Management on Basis of Balanced Scorecard

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Abstract

The article is devoted to the digitalization of biocluster management on the basis of a balanced scorecard. It is proved that a biocluster, as a local model of business concentration that integrates environmentally oriented enterprises, through a combination of traditional and new technologies, resource saving and diversification of the range of environmental products, is able to satisfy various customer requests in one place and time, to ensure competitive

advantages and integration into the world economic space. The concept of applying a balanced scorecard in the strategic biocluster management was formed. The technology of formation and mechanism of implementation of the balanced scorecard and digital data processing technologies into the management information system of strategic biocluster management was proposed. The digital outline of the strategic program for transferring the mission and strategy of the biocluster to the mode of effective use, capacity building and development was formed. The scorecard for strategic management of the biocluster was developed, the study of the dynamics of which allows to determine the strengths and weaknesses of the biocluster, to identify tolerance and resilience to changes in the business environment, to identify ways to achieve the set development goals.

Keywords: Bioeconomy; Digitalization; Biocluster; Strategic Management; Balanced Scorecard; Forecasting

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Introduction

In the face of today's global challenges, the bioeconomy is becoming a priority area of socio-ecological and economic development. The concept of the bioeconomy is based on the reality of economic life and covers a specific processing network and value creation, in which products from major biomass production sectors move through processing enterprises, trade and distribution networks to the end consumer - in the form of food, biomaterials for further production as well as industrial bioproducts and consumption (Birch and Tyfield, 2013).

In fact, this is a fundamentally new approach to the renewal and rational use of resources by enterprises. Under these circumstances, a necessary but not sufficient requirement to ensure their effective operation along the entire value chain is the formation of sectoral integration and partnership associations - "clusters" operating on the basis of bioeconomic development. An equally important prerequisite is the quality of management of these associations. The dynamism and imbalance in the external environment, intensified by the processes of digital business transformation, determine the search for new approaches to biocluster management. Softer, more flexible, adaptive approaches to management are becoming increasingly important, rather than rigidly determined ones.

It is a reflective management that includes not only a response to the situation but also directs staff to use resources in a balanced manner and achieve external balance in business

relations, teaches managers to be ready to act in unpredictable situations, focuses on forecasting, evaluation, and the ability to choose the least risky solutions in advance from the field of events in the context of digitalization and global uncertainty. As part of this approach, a balanced scorecard is one of the most effective management models that allows for clear formulation of plans, including strategic ones, and their implementation, it also provides feedback between internal business processes and external indicators to improve strategic efficiency and achieve the desired results.

Literature Review

Digitalization changes all aspects of society and creates new opportunities to stimulate economic activity and business development, allows for innovation, and the creation and development of socially and environmentally responsible businesses. It broadcasts events and processes in the economy through the prism of biology. Bioeconomy is a field that combines two sciences - economics and biology. In 1997, Jean Henrique Cabot and Rodrigo Martinez defined the bioeconomy as "the part of the economy that uses new biological knowledge for commercial and industrial purposes to improve human well-being" (Bugge et al., 2016). I. Mateescu defines bioeconomy as an optimal and efficient socio-economic activity when biological systems are used rationally and efficiently, without affecting the ability to regenerate, i.e. sustainability (Mateescu et al., 2011; Malyarets et al., 2017; Malyarets). The bioeconomy is also known as a new model of industry and economy that includes the use of renewable biological resources for the production of food, energy and industrial goods (Viaggi et al., 2012).

According to L. Staffas and M. Gustavson, bioeconomy is the study of the mutual influences of human and nature in the process of resource consumption and economic activity (Staffas et al., 2013). The use of renewable energy, biotechnology and bioprocesses creates all the conditions for the development and production of innovative bio-based products, while improving the social component of the economic system (by creating additional workplaces). The growing impact of the technological revolution on global society made significant adjustments to the structure of many types of production (Derbentsev et al., 2021; Malyarets et al., 2017; Mavlutova et al., 2021). The latest discoveries in biotechnology contributed to significant shifts in all research areas, which ensured a powerful diffusion of innovations in many sectors of national economies (Kuznetsov et al., 2019; Krasnobaev et al., 2019). Such fundamental changes resulted in the formation of high-tech clusters that allowed for the fastest possible optimization of business entities' activities and directing their efforts to achieve numerous industrial effects. Thus, the cluster concept first appeared in the works of Alfred Marshall in 1890, which identified a tendency among grouped specialized enterprises that leads to geographical concentration of their experience and business activities (Marshall, 1890). American scientist M. Porter, a specialist in the field of clusters, introduced the classic definition of a cluster in his book The Competitive Advantage of Nations (1990): "A cluster is

a geographically concentrated group of interrelated companies, specialized suppliers, service providers, firms in the respective industries, as well as related institutions (in certain areas (regions)) that compete with each other, but at the same time work together and cooperate" (Porter, 1990). P. Krugman, while studying economic geography and international trade, noted in his work that clusters should not be considered as basic flows of goods and services, but rather as dynamic mechanisms based on knowledge generation, income generation and innovation in the broadest sense of the word (Krugman, 1991).

According to this view, clusters should be considered as a form of entrepreneurial organization with intensive exchange of technological experience and focus on the importance of innovation as a tool that tries to explain the emergence and sustainability of agglomerations. Considering the above, the term "biocluster" should be understood as a local model of concentration of business in the processing industry sector based on a combination of traditional and modern technologies, the complementary and synergistic effect of which is to increase knowledge intensity, significant resource savings, wider opportunities to gain a foothold in global markets by diversifying the range of environmental products that can ensure the international competitive position of innovative companies of different taxonomic levels operating in the global economy (Kaganovska et al., 2022). A biotechnology cluster is formed within a specific geographical region, where, due to the high concentration of intellectual, infrastructural, technological, organizational, and research potentials, a systematic development of a certain type of environmental products is carried out for their further commercialization, introduction, and distribution, through synergy, consolidated decision-making, and high transfer innovativeness (McCormick and Kautto, 2013).

Clusters in the bioeconomy can be formed on the basis of self-organization as a result of natural integration and cooperation in the production of ecological goods or through strategic planning carried out by regional or sectoral governments. For the formation and effective operation of bioclusters, appropriate conditions must be created, primarily of an organizational, economic, and methodological nature (Fig. 1).

Therefore, qualitative technological and innovative changes against the background of digital transformation of the economy encourage deepening research on the formation of high-tech innovative bioclusters and substantiation of methodological approaches to the implementation of integrated management strategies for their development.

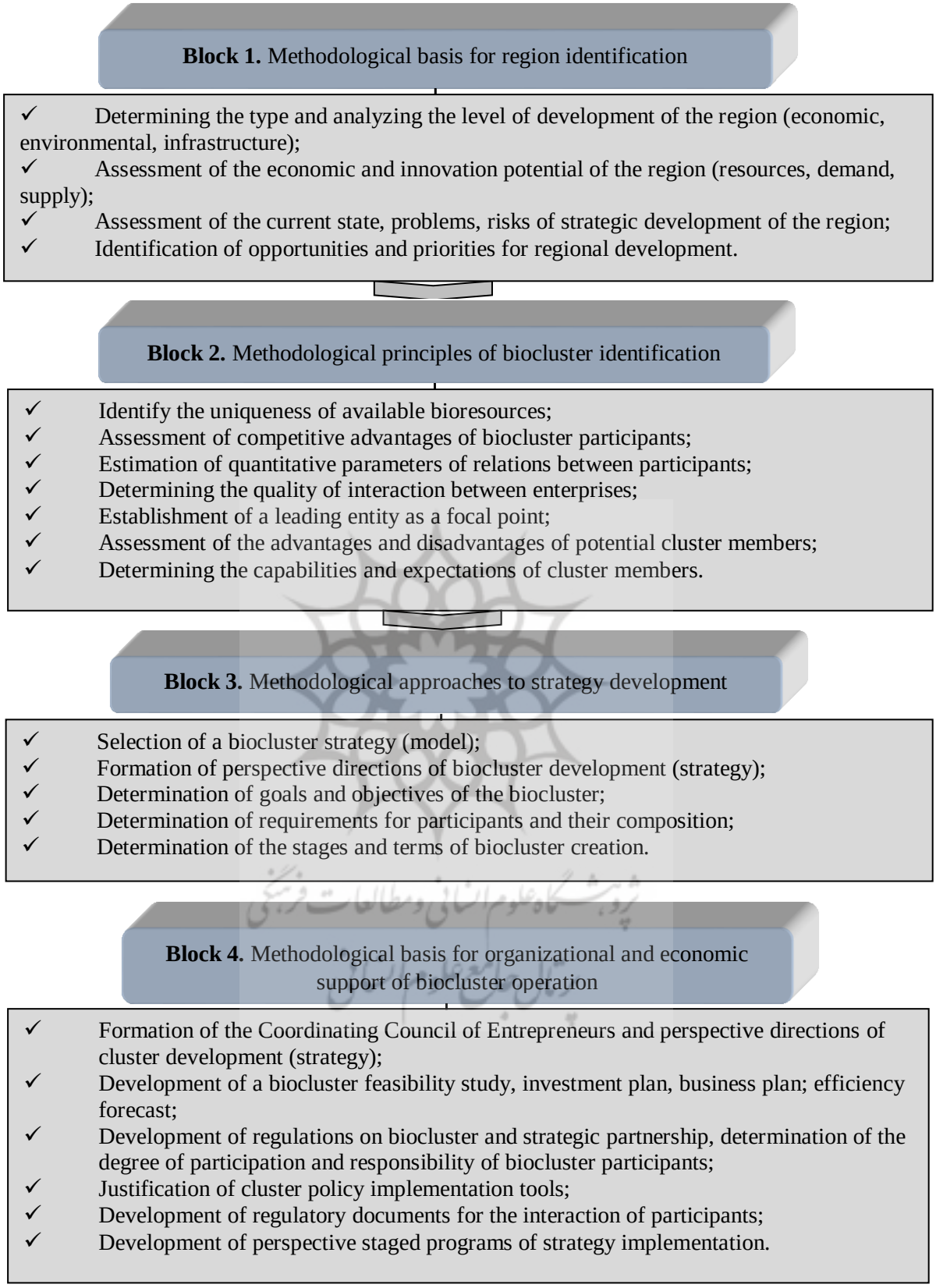

Figure 1. Organizational and Methodological Model for the Formation of Innovative Bioclusters

Source: (Sölvell, 2009; Menzel and Fornahl, 2007; Vicente, 2010).

Methodology

The main objectives of creating a biocluster, the use of technology to regulate the synergistic interaction of enterprises within it, and management digitalization are: the focus on the process approach and development management strategy in the face of digital change and uncertainty of the business environment; developing a balanced scorecard system; developing innovation policy objectives of an innovative biocluster; preparing for the development of synergistic management tools; developing standards for service management framework and quality of eco-friendly goods.

Strategic management is based on a long-term development strategy that allows businesses to adapt to market realities in a shorter period of time and respond in a timely manner to changes in both the internal and external environment (Kashchena et al., 2019). In the context of the study, its formation is subordinated to the mission and strategic goals of the biocluster, and requires the development of areas of activity, assessment of development potential and identification of real problems, as well as determination of optimal ways to eliminate them. As a tool for ensuring the optimization of biocluster activities, it is advisable to use a synergistic approach and a balanced scorecard (BSC). This system is based on four main components: finance, customers, internal business processes, training and growth (Viaggi et al., 2012). The balance of the management system is based on a comprehensive approach to the assessment and efficient use of both tangible and intangible assets.

The balanced scorecard, in our opinion, should be considered as an element of the economic mechanism of strategic management that fulfills its functions within the complex interrelationships of the biocluster with the external environment. These relationships are synergistic and are formed with the following aims: implementation of the market ideology, where the principle of competitive relations dominates; integration ideology with the priority of unifying trends in cluster, network, and associative models, where partnership relations dominate; innovation and investment ideology with the aim of restoring the mechanism of capital investment (intellectual, financial, labor); social orientation of the cluster, where the target guidelines determine the necessity of constant response to the needs of service users and subordinate the decision-making system to the conditions and norms of the social environment (Pfau et al., 2014). Thus, the BSC is an analytical, strategic, and management system that transforms the mission and strategy of a biocluster into a mode of efficient use and capacity building. One of the most important tools of the BSC methodology is to assess and track the "movement" of growth indicators (indices) and the degree of their stability in the pre-forecast and forecast periods (Daneci-Patrau and Coca, 2017). This allows not only to identify the strengths and weaknesses of the association, but also to show tolerance and resilience to changes in the parameters of the external and internal environment, as well as to establish ways to achieve the set goals of biocluster development. As key criteria, it is advisable to use relatively independent parameters of the biocluster's activity, since it is their

combination that is most likely to describe the system as a whole. We propose to base the formation of criteria system on the following principles: applying a systematic approach to the formation of criteria and focusing on synergistic interactions; covering processes at all stages of the cluster's life cycle; planning for the perspective based on various methods of analyzing the biocluster's activities (retrospective analysis, scenario analysis, hierarchy method, etc.) (Nazarova et al., 2022).

Results

The implementation of a comprehensive approach to the new model of the optimization process requires consideration of various criteria that reflect the political, social, environmental, and technical characteristics of the biocluster, on the one hand. On the other hand, they are based on forecasts of economic development of the consumer, market, and country. The set design and quantitative parameters of the system should be based on various calculations to determine the degree of risk and stability of financial activity, with the involvement of sufficient and qualitative information characterizing the technical, organizational, environmental, economic, and social aspects of the biocluster (Olszewska, 2019).

Considering these factors and their dominant influence on a biocluster, economic analysis, development strategy, and control mechanism are reflected in a balanced scorecard (BSC), which includes three main components necessary for understanding and implementing the concept of ensuring economic integrity and proportionality of development, namely: creating a scorecard (selecting, clustering, assessing the relationships between indicators); setting the BSC state modes; system balancing (using optimization calculations, deviation management, setting "corridors", benchmarking, etc.) (Fig. 2).

In order to ensure the effectiveness of the defined concept, the factors of the external and internal environment of biocluster member enterprises that influence the expansion of practical usage of the balanced scorecard in the strategic management of its development are divided into two groups by the nature of their influence: factors that facilitate the BSC expansion and factors that impede it. The first group includes the dynamic development of the agricultural sector, which leads to consumption growth (supply and demand); protectionist state policy towards this sector of the economy; increased planning horizons; transition from short-term to strategic planning; and the desire of biocluster managers to improve strategic management.

The second one includes increased investment risks; shortage of highly qualified management personnel; low level of digitalization; lack of experience in implementing the BSC and corporate culture of agricultural enterprises; staff resistance to innovations. In view of the foregoing, there is a need to refine the tools for implementing the balanced scorecard,

taking into account the minimization of negative factors and the possibilities of using digital data processing technologies.

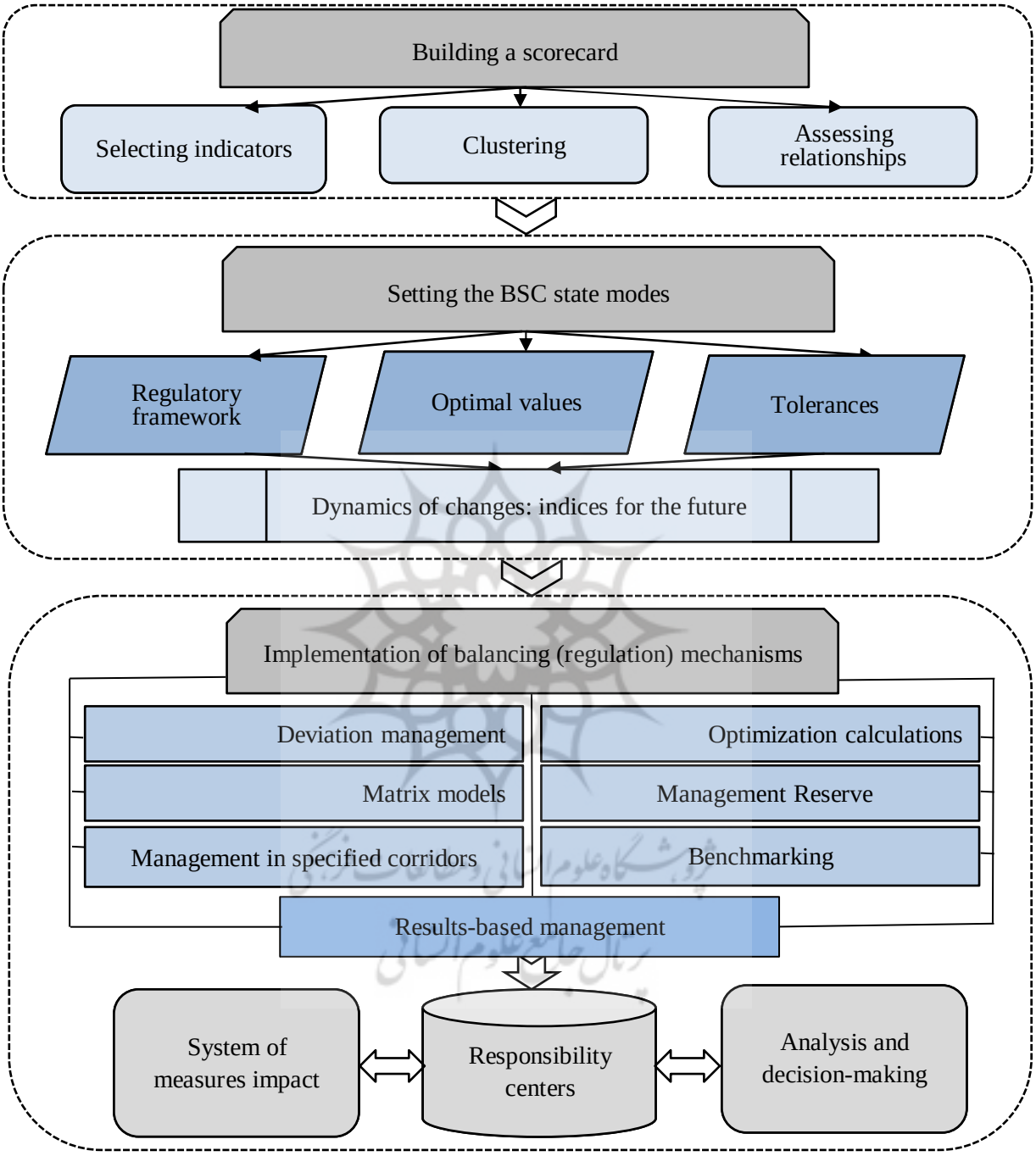

Figure 2. The concept of applying a balanced scorecard in the biocluster strategic management

Source: compiled by the authors

The proposed technology for the formation and mechanism for the implementation of a balanced scorecard in the biocluster's activities with the use of digitalization capabilities is shown in Fig. 3.

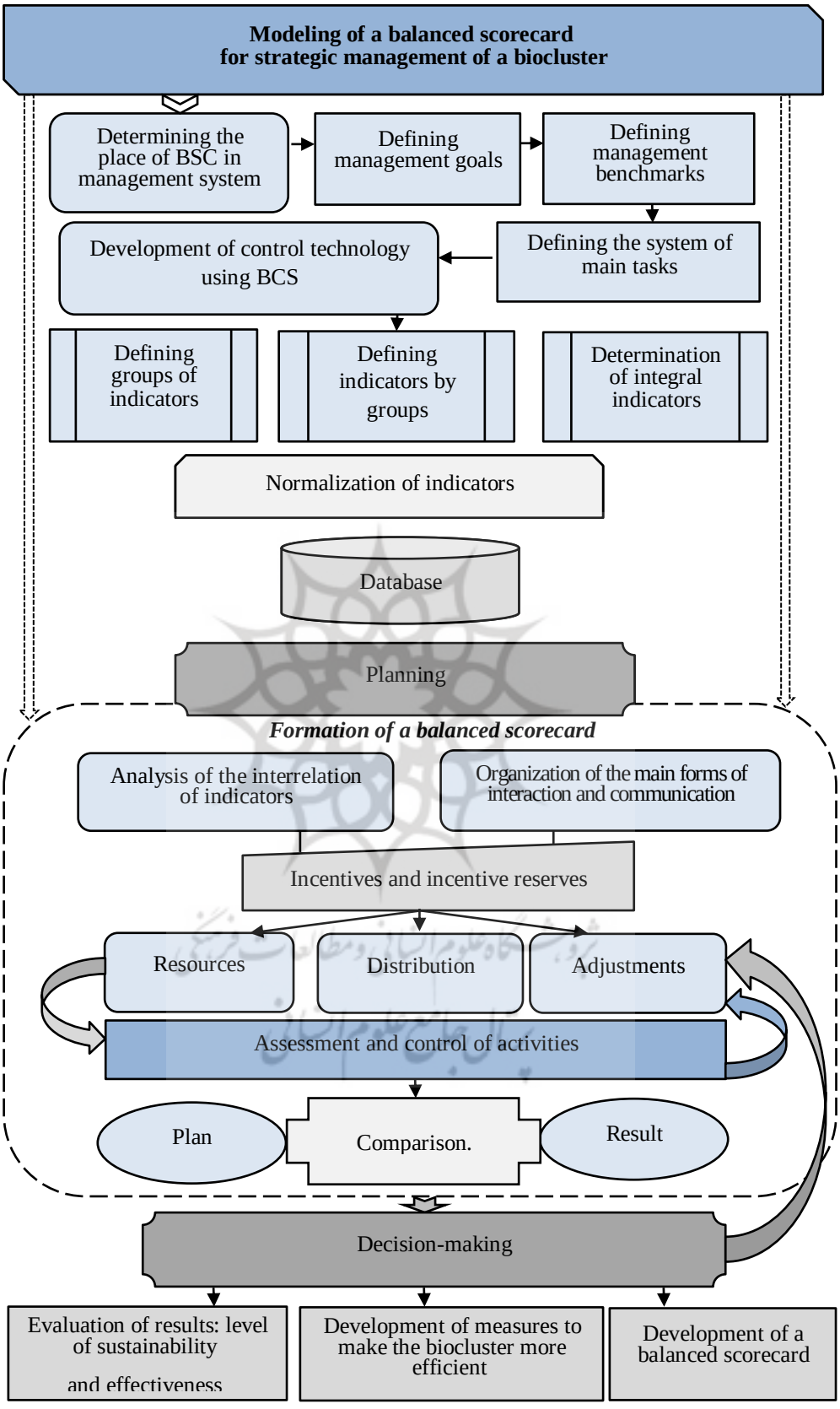

Figure 3. Organizational model for application of the BCS in the strategic management of a biocluster
Source: compiled by the authors.

The presented model provides for the continuous improvement of decision-making technology and the development of the BCS itself. After defining strategic goals, indicators, and the relationships between them, a generalized model of a biocluster strategic plan is drawn up, on the basis of which strategic plans for each type of activity are developed (Vasilyeva et al., 2023).

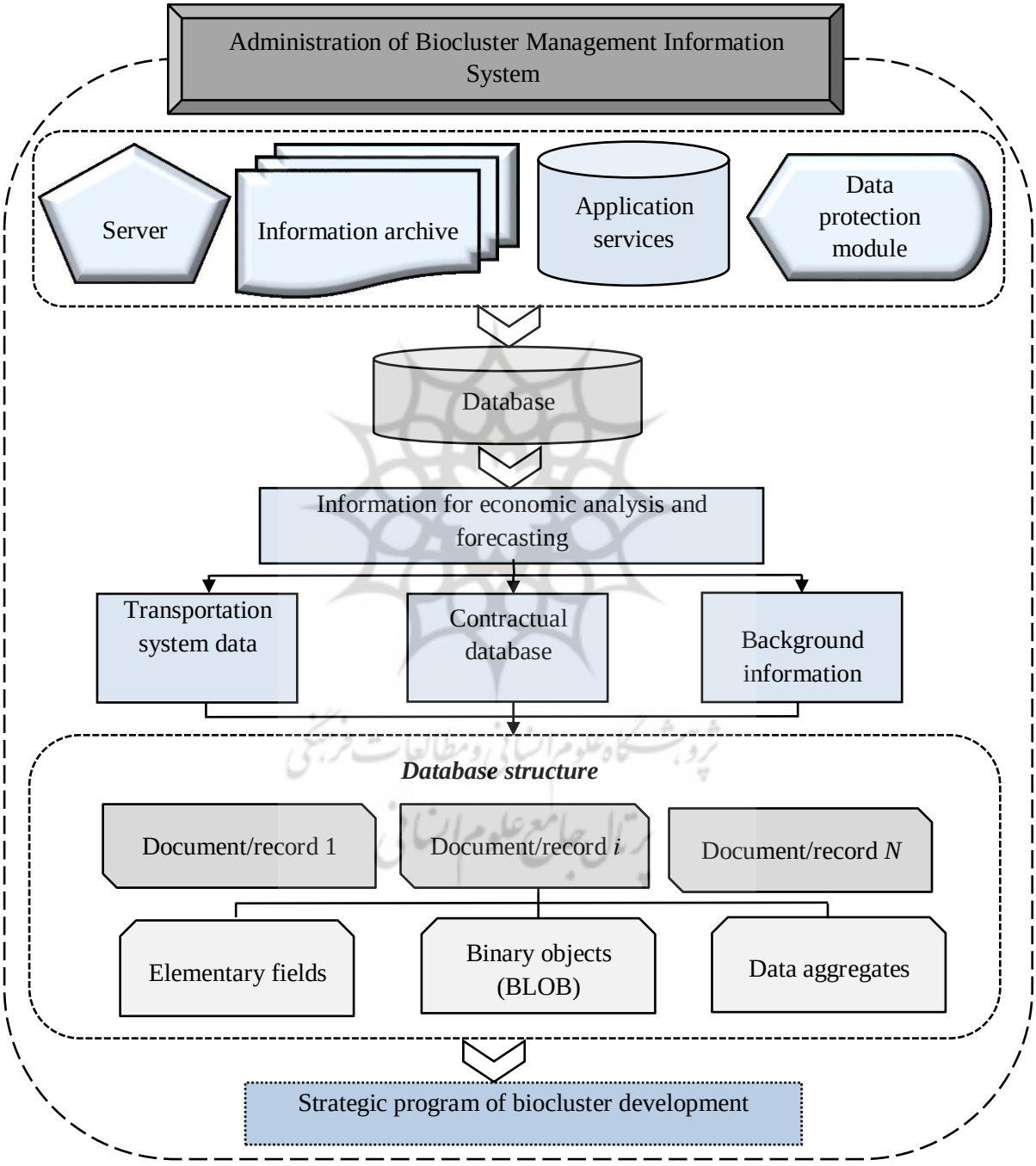

Figure 4. Digital outline of the strategic program of biocluster development

Source: compiled by the authors.

These tasks of strategic biocluster management should be reflected both in the regulatory framework and in the information support of enterprises, and form a digital information service loop similar to the "associative model" (Fig. 4).

The proposed model identifies the component of data preparation for economic analysis and forecasting, which should perform information, control, evaluative and analytical functions within the subsystem of information support for decision-making, which operates in a single digital circuit of the biocluster strategic management system.

An analysis of the works of researchers (Banker et al., 2018; Kovalevska et al., 2022; Rocha et al., 2019; Matsuoka et al., 2018) on the application of the Performance Indicators and Bioclaster Management System proves that: the selection of indicators and their calculation are carried out in accordance with the goals and objectives of the analysis; biocluster performance indicators are not clearly formed into independent groups, but clearly reflect the logic of the main processes - economic activity, quality improvement, competition policy, innovative development, customer satisfaction, etc. Therefore, the processes of strategic management of biocluster activities should be the main factor in the study.

The use of the BSC concept affects a number of processes within the biocluster organization, but the degree and nature of changes in this process remain unexplored (Savytska et al., 2022). In this context, we propose to apply a modified model of strategic biocluster management based on the BSC, which combines different approaches to the use of the BSC in the management process, taking into account the expansion of the boundaries of its use compared to traditional approaches. This model provides for the use of a balanced scorecard not only as a tool for monitoring the implementation of the strategy, but also as a tool for communication, analysis, formation, planning and achievement of strategic goals.

All four key processes of strategic management are subject to adjustment under the influence of the BCS: comprehensive analysis, strategic choice, formation of a management mechanism, and strategy implementation (Bencsik, 2020; Karpenko et al., 2019).

The central task of processing the indicators is to form certain classes and groups from them, as well as to balance the scorecard and find new tasks for their application in the practice of biocluster management. For this purpose, it is important to consider the scorecard in terms of integration of biocluster member enterprises, institutional restructuring of relations and transition to cluster forms of organization (Table 1).

The main task in this model, as in the traditional model of the strategic management process, is to achieve strategic goals.

Table 1. Biocluster Strategic Management Scorecard

Group	Indicators
Group 1. Biocluster potential	Production and general structure of biocluster. Material and technical equipment. Integral coefficient of competitiveness. Human resources and service potential.
Group 2. Personnel. Quality of service	Number of personnel. Level of special training. Product range and range of services. Customer satisfaction with quality. Level of labor productivity.
Group 3. Biocluster customers	Customer structure. Stable (permanent) contingent. Degree of focus on consumer needs.
Group 4. Additional services	Scope and characteristics of additional services. Costs of additional services. Revenue from additional services.
Group 5. Level of internal organization	Order, security, comfort. Production and maintenance management. Development management. Quality of information and service support. Participation in cluster organization models.
Group No. 6. Financial and economic indicators	Market value of biocluster. Profitability. Pricing policy. Cost and cost management, energy saving.
Group 7. Innovative changes	Innovative product (specific gravity, characteristics). Costs of innovation. Innovations in service culture.
Group 8. Biocluster development	Dynamics of economic indicators. Innovation activity. Quality and level of development strategy implementation. Growth of competitiveness. Development of new participants.

Source: compiled by the authors

The study of formation and development of biotechnology clusters and tools for their support proves that the innovative way of development of business enterprises should be focused on the use of clustering approaches to solve economic problems (Zechendorf, 2011; Gardiner and Stenning, 2014). When optimizing the biocluster management, it is advisable to expand the scope of analysis of the factors influencing the economic state of the biocluster, the balance of which will lead to an improvement in the system of its technical and economic indicators and the level of demand for environmental products and services. At the same time, the optimization model of a biocluster should include a system of rules and regulations as well as economic mechanisms that express the strategy of biocluster development while coordinating the interests of its participants.

At the same time, the optimization model of a biocluster should include a system of rules and regulations as well as economic mechanisms that express the strategy of biocluster development while coordinating the interests of its participants.

The organizational sequence of the formation and use of the biocluster's BSC has the following logic: selection of indicators in the strategic management system, standardization of indicators and creation of a data bank, analysis of the relationships between indicators, allocation of resources in accordance with management requirements, evaluation and control of activities using the latest information systems and technologies. Indicators for each aspect of the activity should characterize both the economic state of the biocluster at a certain point in time and its changes. In this case, it is advisable to use relative indicators that allow for their comparison (Lysak, 2022).

In order to determine the indicators of strategic management of bioclusters, it is appropriate to use strategic maps of their development based on an integration approach. Thus, when selecting indicators, it is necessary to analyze and establish the nature of the causal relationships between strategic goals for each of the four aspects of activity (supply and demand, price and quality) as well as indicators that allow characterizing the state of the biocluster at a certain point in time.

The goal of strategic biocluster management is more effective if different optimization tools are used for a strictly deterministic system (e.g., a separate agricultural holding, etc.) and for flexible complexes where the elements have more freedom. As a tool for ensuring the optimization of the activities of biocluster participants, it is proposed to use a synergistic approach and a balanced scorecard involving information systems and technologies. To this end, the procedure for implementing the BSC should meet the following requirements: simplicity, adaptability to the specifics of the enterprise, the possibility of combining the processes of implementing the BSC and improving the level of corporate culture, creating conditions and incentives to overcome staff resistance.

The analysis of reasons for the BSC limited practice shows that the implementation methodologies ignore a number of recommendations related to the passage of three stages: mobilization, plan and its development, and implementation. In the context of digitalization, the passage of these stages ensures that the biocluster is prepared to implement the BSC concept in the strategic management of its activities.

Conclusion

Modern business requires innovative ideas that can withstand modern challenges of humanity (digitalization; globalization; climate change; environmental pollution; exhaustion of valuable natural resources; ecosystem degradation, etc.), the latest management methods and tools to gain prestige and public trust, as well as to increase environmental and social responsibility. This can be achieved through the use of clustering approaches to address socio-ecological and economic development challenges, namely through the creation and effective management of bioclusters. The goal of strategic biocluster management is more efficiently achieved by using different optimization tools for a strictly deterministic system and for flexible complexes

where elements have more freedom. As a tool for ensuring the optimization of the activities of biocluster participants, it is proposed to use a synergistic approach and a balanced scorecard involving information systems and technologies. Synergistic biocluster management based on a balanced scorecard with the use of information technology for data processing allows you to organize work on the analysis of the cause-and-effect relationships between strategic goals and actual indicators of their achievement on a systematic basis. The digitalization-based model of such a systematic organization of analysis focuses management on the priorities of customer relations, attention to internal business processes, work with staff, and monitoring the situation in the market environment. In general, an innovative biocluster, as a universal complex that can satisfy various customer requests in one place and time, can develop an ecological product more efficiently, while solving strategic management tasks based on digitalization and a balanced scorecard makes it possible to gain competitive advantages and ensure a proper transition to the global economic community.

Conflict of interest

The authors declare no potential conflict of interest regarding the publication of this work. In addition, the ethical issues including plagiarism, informed consent, misconduct, data fabrication and, or falsification, double publication and, or submission, and redundancy have been completely witnessed by the authors.

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