Mariana S. Shkoda
Kyiv National University of Technologies and Design, Ukraine

MANAGEMENT MODEL OF BUSINESS DEVELOPMENT BASED ON CLUSTER CONSTRAINS

The main goal of this work is to investigate the management model of business development based on cluster constrains. The article uses general scientific research methods, in particular, empirical methods to describe the basic approaches to modeling business development management in cluster conditions, theoretical methods, in particular, the classification of the concept of business development management on the basis of cluster partnership, etc. The article explores approaches to modeling business development management based on cluster partnerships. Four basic approaches are distinguished: structural modeling, game approach, neural network approach and statistical approach. It is emphasized that the activation of business development based on cluster partnership increases the competitiveness of all economic agents of the network. Since it is practically impossible to make optimal decisions due to the diversity of partner participants, a partnership method is proposed as an alternative, which allows reaching local compromises and making "quasi-optimal management decisions". It is emphasized that in the process of making optimal decisions on business management based on cluster partnership, it is advisable to use holistic management based on the perception of cluster partnership as a whole. It is noted that in order to holistically, holistically consider business management based on cluster partnership, it is necessary to take into account intercorrelated aspects such as four sectors (individual internal, individual external, collective internal and collective external), development lines (vertical and horizontal, growth and decline, internal and external); levels of business development based on cluster partnerships that meet the previous aspects; choice of management activities depending on the situation, experience and knowledge; definition of management for each of the participants in the cluster partnership.

Keywords: *management decisions; interacting business entities; structural modeling; models of competitive and cooperative interactions of business structures; neural network approach; holistic management concept; network management; cluster partnership.*

Мар'яна С. Шкода
Київський національний університет технологій та дизайну, Україна

МОДЕЛЬ УПРАВЛІННЯ РОЗВИТКОМ БІЗНЕСУ НА КЛАСТЕРНИХ УМОВАХ

Основною метою даної статті є дослідження моделі управління розвитком бізнесу на основі кластерних обмежень. У статті використано загальнонаукові методи дослідження, зокрема, емпіричні методи для опису основних підходів до моделювання управління розвитком бізнесу в кластерних умовах, теоретичні методи, зокрема, класифікацію концепції управління розвитком бізнесу на основі кластерного партнерства тощо. У статті досліджено підходи щодо моделювання управління розвитком бізнесу на кластерних умовах. Виділено чотири базових підходи: структурне моделювання, ігровий підхід, нейромережевий підхід та статистичний підхід. Підкреслено, що активізація розвитку бізнесу на кластерних умовах підвищує конкурентоспроможність всіх економічних агентів мережі. Оскільки прийняття оптимальних рішень в силу різноманіття учасників-партнерів є практично неможливим, як альтернатива запропоновано метод партнерства, що дозволяє досягати локальних компромісів і приймати «квазіоптимальні управлінські рішення». Акцентовано, що в процесі прийняття оптимальних рішень щодо управління бізнесом на засадах кластерного партнерства доцільним є застосування холістичного

управління, що спирається на сприйняття кластерного партнерства як єдиного цілого. Наголошено, щоб цілісно, холістично розглянути управління бізнесом на засадах кластерного партнерства, необхідно врахувати взаємокорелюючі аспекти такі як, чотири сектори (індивідуальний внутрішній, індивідуальний зовнішній, колективний внутрішній і колективний зовнішній), лінії розвитку (вертикальна і горизонтальна, зростання і спад, внутрішня і зовнішня); рівні розвитку бізнесу на засадах кластерного партнерства, що відповідають попереднім аспектам; вибір управлінської діяльності в залежності від ситуації, наявного досвіду і знань; визначення управління для кожного з учасників кластерного партнерства.

Ключові слова: управлінські рішення; взаємодіючі суб'єкти бізнесу; структурне моделювання; моделі конкурентних і коопераційних взаємодій бізнес-структур; нейромережевий підхід; холістична концепція управління; мережеве управління; кластерне партнерство.

Марьяна С. Шкода
Киевский национальный университет технологий и дизайна, Украина
МОДЕЛЬ УПРАВЛЕНИЯ РАЗВИТИЕМ БИЗНЕСА НА КЛАСТЕРНЫХ УСЛОВИЯХ

Основной целью данной статьи является исследование модели управления развитием бизнеса на основе кластерных ограничений. В статье использованы общенаучные методы исследования, в частности эмпирические методы для описания основных подходов к моделированию управления развитием бизнеса в кластерных условиях, теоретические методы, в частности, классификацию концепции управления развитием бизнеса на основе кластерного партнерства и т.д. В статье исследованы подходы к моделированию управления развитием бизнеса на кластерных условиях. Выделены четыре базовых подхода: структурное моделирование, игровой подход, нейросетевой подход и статистический подход. Подчеркнуто, что активизация развития бизнеса на кластерных условиях увеличивает конкурентоспособность всех экономических агентов сети. Поскольку принятие оптимальных решений в силу разнообразия участников-партнеров практически невозможно, как альтернатива предложен метод партнерства, позволяющий достигать локальных компромиссов и принимать «квазиоптимальные управленческие решения». Акцентировано, что в процессе принятия оптимальных решений по управлению бизнесом на основе кластерного партнерства целесообразно применение холистического управления, опирающегося на восприятие кластерного партнерства как единого целого. Отмечено, чтобы целостно, холистически рассмотреть управление бизнесом на основе кластерного партнерства, необходимо учесть взаимокоррелирующие аспекты такие как четыре сектора (индивидуальный внутренний, индивидуальный внешний, коллективный внутренний и коллективный внешний), линии развития (вертикальная и горизонтальная, рост и спад, внутренняя и внешняя); уровни развития бизнеса на основе кластерного партнерства, отвечающие предыдущим аспектам; выбор управленческой деятельности в зависимости от ситуации, имеющегося опыта и знаний; определение управления для каждого из участников кластерного партнерства.

Ключевые слова: управленческие решения; взаимодействующие субъекты бизнеса; структурное моделирование; модели конкурентных и кооперационных взаимодействий бизнес-структур; нейросетевой подход; холистическая концепция управления; сетевое управление; кластерное партнерство.

Formulation of the problem. Today, the government, business and all citizens of Ukraine face an urgent need to increase the level of competitiveness of the national economy as the main

factor in ensuring an adequate standard of living for the population. The problem of raising the national economy to an appropriate level can be solved through the introduction of a cluster approach. Clustering processes can activate the development of the state economy, especially if they are consistent with a strategy developed with the role of state, local authorities and scientific institutions and society. Therefore, the scientific community continues to search for new theoretical and methodological aspects of the formation of business development models on a cluster basis, which will solve problems on the path to reforming and effectively developing the national economy in the current turbulent conditions.

Analysis of recent research and publications. Scientific approaches to the study of effective business development management models on a cluster basis indicate a growing relationship between clusters, where the resources and competencies of clusters are combined, access to target markets and know-how becomes open, information and experience are exchanged between clusters, networks are created using special technology it becomes possible to use sources of knowledge from all over the world, as well as the development of a new branch of knowledge. According to M. Porter, the founder of cluster theory, business management on a cluster basis contributes to the establishment and expansion of business contacts, the use of common infrastructure elements, and the lobbying of professional and commercial interests [7]. The increase in the importance of the knowledge economy has led to a change in approaches to the formation of the composition of the cluster members since the importance of the system of interactions between industrial enterprises and innovation infrastructure enterprises has significantly increased. It should be noted that the "triple helix" model proposed by Professor of Stanford University G. Itkowitz and Professor of the University of Amsterdam L. Leidesdorff assumes active involvement of state structures in business management on a cluster basis [9]. The relevance of business development in this way is determined by the fact that a new method is proposed to achieve the coordination of interests and goals of elements of complex network socio-economic systems, which is especially important for the functioning of business on a cluster basis in the context of a transition to a full-fledged partnership between interacting participants in the processes of production and commercialization of innovations. Among the scientists who proposed the statement that business management on a cluster basis should develop global connections or global partnerships, one should single out professors of business economics H. Batelt, P. Maskel and A. Malmberg [1] and the scientific works of scientists from Cornell University (USA) by M. Gertler and J. Levitt [3]. In these studies, scientists note that these partnerships can provide businesses with significant benefits, but they are not without problems, especially in the formation, development, and management. Therefore, to date, the business development management model based on cluster partnership has not been fully studied by scientists, there are debatable questions regarding approaches to modeling and making optimal decisions on business development based on cluster partnership.

The purpose of the article to management model of business development based on cluster partnership.

Statement of the main material. The analysis of the works of domestic authors devoted to the issues of modeling business development based on cluster partnerships made it possible to identify four basic approaches.

Firstly, structural modeling, when, consisting of some structural elements, a certain pattern is superimposed on the proposed integrated structure to determine the direction of its development. So, for example, in [4], the authors proposed a universal structural model, using which it is possible to build an information model of cluster partnership through a certain database structure with information about the partner cluster, their relationships with external partners.

Secondly, a game approach that allows obtaining models of competitive and cooperative interactions of business structures in a cluster partnership, as well as evaluating the advantages of

the strategies of individual partner clusters. Lobova S.V. et al. [5] proposes a multi-agent model in which the cluster members seek to maximize their interests, and the connections between them are represented as a game M(NK(t)) + 1 person:

$$\Gamma(t) = \langle NK(t), \{Xn(t), Yn(t), z0(t)\} | n \in NK(t), zk1(t)\rangle, t = 1, \dots, T. \quad (1)$$

The analysis of the works of domestic authors devoted to the issues of modeling business development based on cluster partnerships made it possible to identify four basic approaches.

Firstly, structural modeling, when, consisting of some structural elements, a certain pattern is superimposed on the proposed integrated structure to determine the direction of its development. So, for example, in [4], the authors proposed a universal structural model, using which it is possible to build an information model of cluster partnership through a certain database structure with information about the partner cluster, their relationships with external partners.

The analysis of the works of domestic authors devoted to the issues of modeling business development based on cluster partnerships made it possible to identify four basic approaches.

Firstly, structural modeling, when, consisting of some structural elements, a certain pattern is superimposed on the proposed integrated structure to determine the direction of its development. So, for example, in [4], the authors proposed a universal structural model, using which it is possible to build an information model of cluster partnership through a certain database structure with information about the partner cluster, their relationships with external partners.

At the same time, $z0(t)$ is the goal of company n ($n \in NK$ (t)) included in the cluster structure that characterizes the efficiency of its operation at time t (for example, the goal can be profit maximization):

- $xn(t)$ is the vector of managerial actions of company n included in the cluster structure;
- (t) is the intensity matrix of using internal cluster links of company n;
- (t) is the vector of environmental factors affecting the performance of company n;
- $(t-1)$ is the result of the company's operation at the previous time;
- $z(t-1)$ is a vector that reflects the totality of advantages received by the company due to joining the cluster structure and its development;
- NK (t) is the set of companies included in the cluster partnership.

In addition, in the conditions of the company entering the cluster structure through changes in managerial influences aimed at developing the cluster as a whole, some properties of the cluster $zk1$ (t) are subject to optimization:

$$zk1(t) = F1(xA(t), z(t), w(t), zk(t-1)) \rightarrow e\_xtr \quad (2)$$
$$(t) \in \Pi n \in NK(t) \, XAn(t)$$

where $z(t)$ is the vector of performance results of enterprises included in the cluster $z(t) = (z1(t), \dots, zM(NK(t))(t))$.

However, the application of game theory in modeling business management on a cluster basis is hampered by a significant number of interacting participants, which entails difficulties in finding solutions numerically. Accordingly, the basic premise of simulation models built on the basis of game theory is, as a rule, the interaction of only two firms, which undoubtedly limits the practical application of such models.

And, thirdly, a neural network approach that allows solving complex and difficult to formalize tasks that arise while managing business development on a cluster basis [4]. The use of neural networks for modeling cluster structures is convenient because they do not need to build a model but build it only based on the information provided. Artificial neural networks will turn incoming data into the optimal vector of management decisions and are capable of self-learning. Thus, in [6], neural network predictive models were built that take into account the impact of

clustering processes on the state of meso- and micro-objects: at the meso-level in the short term, it allows calculating the expected GDP per capita; at the micro level, the neural network model makes it possible to determine the dependence of the profits of the enterprises of the cluster core on the indicator of the cluster development of the region.

However, the use of neural networks in modeling cluster structures is not easy. Complex models quite often fail on the set as well and setting up learning algorithms on a specific data set requires laborious experiments and therefore a lot of time. Contradictions between learning algorithms and the objective function of the cluster reduce the reliability of artificial neural networks. The main mechanisms of operation of several neural network methods of neuro-control and the distinctive features of their implementation are presented in [8, 11].

Algorithms of artificial neural networks solve the problems of developing algorithms for finding an analytical description of the patterns of functioning of economic objects (enterprises, industries, regions). These methods are used to predict some "initial" characteristics of objects. The use of neural network control makes it possible to solve the problems of economic and statistical modeling of the development of cluster partnership systems, to increase the adequacy of mathematical models, to bring them closer to economic reality [3]. Since the economic, financial and social systems in a cluster partnership are very complex, creating a complete mathematical model, taking into account all possible actions and reactions, is a very difficult task. In systems of such complexity, it is natural and most effective to use models that directly imitate the behavior of society and the economy. Specifically, this is what the methodology of neural networks can offer.

Fourthly, the statistical data is the most informative from our point of view. As a result of this stagnation, significant links between factorial changes are revealed, indicators of successful business activity in cluster ambush are identified, and structurization of all structures is carried out to enter a partnership. In [2], using statistical methods of data analysis, the authors managed to identify the key factors for the "success" of business structures operating on a cluster basis and to determine stable statistical indicators that determine them, to identify the relationship between the participation of an enterprise in a cluster and its innovative activity.

However, statistical data – is, first for everything, a tool for the primary processing of information about the cluster, and structurization and revealed already significant interrelationships.

It is necessary to indicate that the activation of business development at the ambush of cluster partnerships promotes the competitiveness of all economic agents in the region. Irrespective of those that are still not affected by management from the center, pro-regional entities with their actions influence the development of cluster partnerships. Management decisions that are accepted in their minds are often dysfunctional, that they do not push the system to reach the set goals, the shards do not protect the interests of all participants-partners. Some dysfunctions, revealed at this stage of regulation, may require a negligible leveling for the identification of potential important traces. Since accepted optimal decisions due to the difference between the participants-partners is practically impossible, as an alternative, the method of partnership is promoted, which allows reaching local compromises and accepting "quasi-optimal managerial decisions". In the process of adopting optimal solutions, there is a need for holistic management, which is based on the adoption of cluster partnership as a single whole.

Diffusion of holism into the theory of management should be brought to the point about those that will be directly included in the development of the current paradigm of management to the warehouse of the conceptual positions of the upcoming priority positions (Table 1).
It should be noted that the holistic paradigm is closely related to the systematic approach to business development based on cluster partnerships. Consequently, a new organizational and managerial, "cluster-network" paradigm of business development based on cluster partnerships is emerging, within which sectoral regional economic systems are moving to a cluster organization and a

network method of partnership interactions. Networks allow economic partner-participants to integrate into the economic space (Fig. 1).

Table 1

Fundamentals of the old, new world and holistic
business development management concepts based on cluster partnership

Traditional concept	New world concept	Holistic management concept
1. Cluster partnership is a "closed" system.	1. Cluster partnership is a "closed" system.	1. A cluster partnership is a living organism, relatively isolated (having its own experience, history, resources), but having close ties with the external environment.
2. The main factor of success and competitiveness is the growth in the scale of production of products and services.	2. The main factor of success and competitiveness is the growth in the scale of production of products and services.	2. An important task of management is a vision of the future based on the existing relationships of phenomena and processes.
3. The main task of management is the rational organization of production, the efficient use of all types of resources and the increase in labor productivity.	3. The main task of management is the rational organization of production, the efficient use of all types of resources and the increase in labor productivity.	3. An important factor for success and competitiveness integration and synergy.
4. The main source of surplus value is labor productivity.	4. The main source of surplus value is labor productivity.	4. An important source of surplus value is people who integrate new knowledge based on understanding the relationship between phenomena and processes in the economy.
5. A management system built on the control of all types of activities, the functional distribution of work, norms, standards, and rules for implementation.	5. A management system built on the control of all types of activities, the functional distribution of work, norms, standards and rules for implementation.	5. The management system is built on the interaction and mutual understanding of people, multilateral and interacting communications.

Source: author's development.
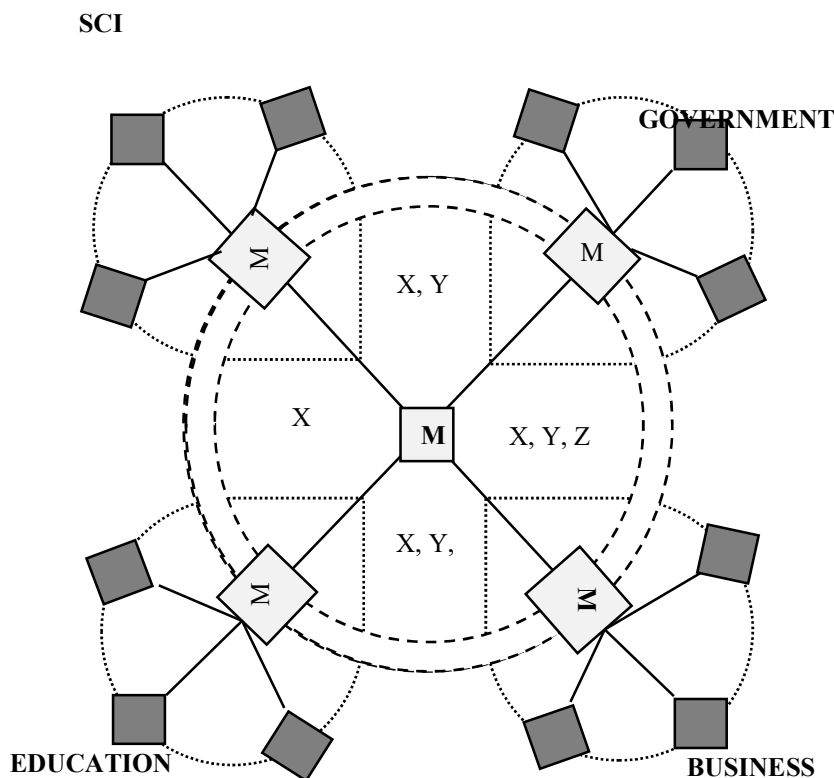
Source: author's development.
Fig. 1. **Network business management model based on cluster partnership**

Conclusions. Therefore, we can conclude that, according to the "all-sector" model, to holistically, holistically consider business management based on cluster partnerships, it is necessary to take into account the following mutually correlated aspects:

- 4 quadrants (or sectors) – individual internal, individual external, collective internal and collective external;

- lines of development (vertical and horizontal, growth and decline, internal and external);

- levels of business development based on cluster partnerships that meet the previous aspects;

- choice of management activities depending on the situation, experience and knowledge;

- definition of management for each of the participants in the cluster partnership.

References	Література
1. Bathelt, H., Malmberg, A., Maskell, P. (2004). Clusters and knowledge: local buzz, global pipelines and the process of knowledge creation. *Progress in Human Geography*, 28(1), 31–56. https://doi.org/10.1191/0309132504ph469oa.	1. Bathelt H., Malmberg A., Maskell P. Clusters and knowledge: local buzz, global pipelines and the process of knowledge creation. *Progress in Human Geography*. 2004. 28(1). 31–56. https://doi.org/10.1191/0309132504ph469oa.
2. Da Rocha, A., Kury, B., Monteiro, J. (2009). The diffusion of exporting in Brazilian industrial clusters. Entrepreneurship and Regional Development.	2. Da Rocha A., Kury B., Monteiro J. The diffusion of exporting in Brazilian industrial clusters. Entrepreneurship and Regional Development, 2009.
3. Gertler, M. S., Levitte, Y. M. (2005). Local Nodes in Global Networks: The Geography of Knowledge Flows in Biotechnology Innovation. *Industry and Innovation*, 12(4), 487–507. http://dx.doi.org/10.1080/13662710500361981.	3. Gertler M. S., Levitte Y. M. Local Nodes in Global Networks: The Geography of Knowledge Flows in Biotechnology Innovation. *Industry and Innovation*. 2005. 12(4). 487–507. http://dx.doi.org/10.1080/13662710500361981.
4. Keller, M., Reingruber, I., Dermastia, M., Bersier, J., Meierzu Koecker, G. (2018). Smart Specialization Strategies (S3) and Clusters–An Innovation Model for Transformative Activities, Working Paper, University for Applied Physics Lausanne.	4. Keller M., Reingruber I., Dermastia M., Bersier J., Meierzu Koecker G. Smart Specialization Strategies (S3) and Clusters–An Innovation Model for Transformative Activities, Working Paper, University for Applied Physics Lausanne, 2018.
5. Lobova, S. V., Ponkina, E. V. (2012). Teoreticheskie aspekty funkczionirovaniya mezhregionalnykh klasterov [Theoretical aspects of the functioning of interregional clusters]. *Ekonomicheskij analiz: teoriya i praktika = Economic Analysis: Theory and Practice*, No. 17 [in Russian].	5. Лобова С. В., Понкина Э. В. Теоретические аспекты функционирования межрегиональных кластеров. *Экономический анализ: теория и практика*. 2012. No. 17.
6. Mikhalev, D. A. (2015). O vozmozhnykh problemakh vnutrennej organizaczii klasterov [About possible problems of classers' internal organization]. *Sovremennye naukoemkie tekhnologii. Regionalnoe prilozhenie = Modern science technologies. Regional application*, No. 3 (43).	6. Михалев Д. А. О возможных проблемах внутриорганизации классеров. *Современные наукотехнологии. Региональное приложение*. 2015. No 3 (43).
7. Porter, M. E. (2005). Clusters of Innovation Initiative: Regional Foundations of U.S. Competitiveness. Washington, DC: Council on Competitiveness.	7. Porter M. E. Clusters of Innovation Initiative: Regional Foundations of U.S. Competitiveness. Washington, DC: Council on Competitiveness, 2005.

8. Prim, A. L., Amal, M., Carvalho, L. (2016). Regional cluster, innovation and ex-port performance: An empirical study. *BAR – Brazilian Administration Review*.

9. Frangsmir, T. (ed.) (1989). Science in Sweden. USA.

10. Solow, R. M. (1991). Growth Theory. Companion to Contemporary Economic Thought. London. P. 393–415.

11. Webser, J. (1995). Networks of Collaboration or Conflict? Electronic Data Interchange and Power in the Supply Chain. *The Journal of Strategic Information Systems*. Vol. 4. No. 1. P. 31–42.

8. Prim A. L., Amal M., Carvalho L. Regional cluster, innovation and ex-port performance: An empirical study. *BAR – Brazilian Administration Review*. 2016.

9. Science in Sweden. Ed. T. Frangsmir. USA, 1989.

10. Solow R. M. Growth Theory. *Companion to Contemporary Economic Thought*. London, 1991. P. 393–415.

11. Webser J. Networks of Collaboration or Conflict? Electronic Data Interchange and Power in the Supply Chain. *The Journal of Strategic Information Systems*. 1995. Vol. 4. No. 1. P. 31–42.