Benchmarking as a Foundation of the Future Economy

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SYMBOLS AND ABBREVIATIONS

AMF - Action Message Format

EBITDA - Earnings Before Interest, Taxes, Depreciation and Amortization

GUI - Graphical User Interface

EJB - Enterprise JavaBeans

HQL - Hibernate Query Language

JPA - Java Persistence API

J2EE - Java Enterprise Edition

JMS - Java Message Service

OLAP - Online Analytical Processing

OLTP - On-Line Transaction Processing

ORM - Object-Relational Mapping

UML - Unified Modeling Language

XML - eXtensible Markup Language

AISU - Automated Information Management System

DB – Database

KB - Knowledge base

SSDMC - Support System Decision-Making and Competitiveness

DM - Decision makers

DF - Decision former

IAD - Data Mining

IAS - Information and Analytical System

MIS - Management Information System

CIS - Corporate Information System

INTRODUCTION

The problem of managing the competitiveness of enterprises in various fields of activity has recently acquired national significance. To date, no company can give up its competitive positioning and use tools for analyzing and managing competitiveness. At the same time, companies are trying to develop a unique development strategy in order to apply competitive advantages to achieve high economic performance.

One of the mechanisms for managing the production and economic activities of enterprises is comparative research, modeling and forecasting based on the benchmarking principle. Benchmarking refers to the process of identifying and adapting examples of effective functioning of competitors in order to improve the company's own performance. Models and decision-making methods for managing competitiveness in the benchmarking process allow to explore the advantages and disadvantages of competitors in order to develop and implement an effective strategy for enterprise development.

Unfortunately, today, the problems of competitiveness are often considered only from the production point of view, without affecting other areas. Modern ideas assume that the main role in ensuring competitiveness is played by intangible assets and intellectual capital [1]. However, this statement is not entirely consistent with the Russian reality on the market: the information link between companies is still too weak, the introduction of innovations is weak, and the legal framework is not yet fully prepared [2]. On the other hand, the increasing pressure of various factors, especially crisis phenomena, on Russian companies leads to an aggravation of the competition for market share between them. At the same time, most companies pay little attention and do not conduct research in the field of decision-making to develop a strategy for their competitive development. One of the effective mechanisms for managing aspects of production and economic activity of enterprises in various sectors of the economy is a comparative study, modeling of determining, understanding and adapting existing examples of effective functioning of the nearest competitive company in order to improve their own performance [3]. Models and methods of decision-making for managing the competitiveness of your own

company in the process of comparative research allow exploring the competitive advantages and disadvantages of your nearest competitors in the market, developing and implementing your competitive strategy and manage it quickly, depending on the changing situation.

Competitiveness is a property of socio-economic systems [4], as well as the closest sphere to it - competition. The complexity of managing competitiveness is that the decision-making process cannot be based only on one or more factors that affect competitiveness. It should take them into account in total and separately, determining the significance of each of them by means of intellectual analysis or expert method, taking into account the requirement of updating data [5], since time and situational trends influence factors. Another problem of managing competitiveness is the need for forecasting, and the existing forecast models are not fully adequate and cannot guarantee the correctness of the chosen management strategy. This is because many competing companies react to the same market situations in different ways, which should be taken into account when making decisions. Therefore, when creating a methodology for supporting decision-making in this area, it is advisable to use scenario analysis methods [6]. These problems lead to the fact that the administration of enterprises makes mistakes in planning and implementing measures to improve the efficiency of competitiveness management processes. In this regard, the task of developing and implementing decision support methods for managing competitiveness using benchmarking principles is an urgent research task in modern market economic conditions.

The analysis showed that most researchers are working on general theoretical approaches to modeling the competitiveness management process and developing recommendations for the production of competitive products. At the same time, little attention is paid to the creation of software tools for automated decision support in this area of enterprise management. It is also worth noting the problems: the lack of adequate mathematical models for assessing and predicting competitiveness, the lack of consideration of hidden patterns of the competition process in existing models, the complexity of automation and the lack of efficiency in decision-making for managing competitiveness.

This confirms the relevance of research in the field of systematization of decision-making technologies and the development of new models and methods for automating benchmarking processes and managing competitiveness based on modern information, computing and telecommunications technologies. The book is aimed at describing models,

methods and software tools for analyzing and managing competitiveness based on the benchmarking principle in order to make decisions on optimizing the company's development strategy in market conditions and crisis phenomena.

CHAPTER 1

THEORETICAL ASPECTS OF ENTERPRISE MANAGEMENT TO IMPROVE ITS COMPETITIVENESS

1.1 The concept of enterprise competitiveness

Such a concept as competitiveness comes first in the management of production and economic activities of any enterprise in the market conditions. For all levels of management, it is relevant and affects each of its levels. The problem of effective management of enterprises in order to increase its competitiveness in dynamically changing market conditions requires an analytical study of existing different points of view of scientists and specialists in order to form a strategic approach to the effective solution of the tasks set in the book. Now, experts do not clearly define the concept of competitiveness, since there are different scientific approaches and ambiguity in relation to what the concept of competitiveness is applied to (in relation to an enterprise, group of companies, industry, region, sector, etc.).

First, we note a number of definitions of competitiveness from the position of well-known scientists. For example, specialists consider the characteristic of competitiveness Bernard I. and Collier J. K. through the concept of competition. Competition, by their definition, is a state when there is a complete, reliable and free relationship between economic entities, in terms of supply and demand for goods and services [7]. Competitiveness is the result of these relationships. Statistical analysis based on a comparison of market actors is very important. The disadvantages of this judgment include the fact that it does not describe how to improve the competitiveness of an individual firm.

Another point of view considers the competitiveness of a product or service as a multi-level concept that is formed at the level of an individual enterprise or company, and then flows to the level of the industry, region, or country. These levels are not identical, but closely related, and sometimes it is

difficult to determine what affects what. According to Andrianov [8], the company's competitiveness is determined primarily by the country's competitiveness. That is, from top to bottom, first comes the country's competitiveness, then goes regional, industry competitiveness, which rests on the product and the producer.

The modern economic dictionary reveals the concept of a country's competitiveness in this way: a country's competitiveness is the ability of the country's economy and the state to participate in international trade, retain and expand certain segments on world markets, and produce products that meet world standards. It depends on the technical and economic development of production in the country, the level of production costs, the quality of products produced, the development of infrastructure, and the presence of relative and absolute advantages [9].

Consideration of the competitiveness of a country, region, industry, and, in particular, a separate company in the domestic and foreign literature is given much attention. Some authors argue that there can be no single definition for such a complex concept as competitiveness. There are only various definitions that depend on the subject or subject to which they relate [10].

The European Management Forum (EMF), an international organization, suggested that the company's competitiveness should be considered as "its real and potential ability to design, manufacture and sell products that are more attractive to the consumer in terms of «price and non-price characteristics than those of competitors»" [11]. Another approach is based on determining competitiveness through the qualitative characteristics of its activities (market share, functional efficiency, managerial efficiency, etc.). In benchmarking concept, the company's advantages (organizational, economic, and technical) in comparison with its competitors are highlighted as key indicators of competitiveness. These advantages are used to reduce costs, increase product quality, upgrade opportunities, extensive production growth, maintain market share, and, as a result, increase profits.

Competitiveness is the main reason for the growth of profits and sales for any company, regardless of its size. The company's competitiveness is expressed through the potential and real ability of the company, taking into account its existing capabilities, to design, produce and sell products in specific conditions that are more attractive to consumers in terms of consumer and cost characteristics than the products of competing companies. Competitiveness can be defined through comparative and competitive advantages. Competitive advantages are scientific, technical and educational

potential, new technologies and innovations at all stages of production and product promotion [12]. For example, you can focus on competitive advantages in the scientific and technical field, which will determine the competitiveness of the entire country, and therefore the competitiveness of all its enterprises. The company's current and long-term competitive advantages are related to the market environment, which reflects and generates incentives, influences market factors, and interacts with social institutions that the company interacts with. Incentives are the signals emanating from the market external environment, for example, competitive pressures, rapid changes, redistribution of the market, etc. Each country and individual enterprise has its own set of incentives. For example, Russian companies have recently been influenced by such concepts as transaction costs, corporate responsibility, and mergers and acquisitions. In addition, competitiveness is influenced by factors of foreign and domestic policy, as well as the factor of globalization of the world economy [13], the processes of international division of labor, dependence on the international financial system, etc. [14]. It is generally recognized that only an innovative way of development can ensure the competitiveness of an enterprise. A characteristic feature is the transition to the era of post-industrial development, where information and the generation of ideas will play a key role. Thus, competitiveness can be determined through social factors, such as the availability of highly qualified employees, their ability to apply their experience in practice, the ability to self-study, etc. The use of new knowledge, skills and abilities will not only reduce the working cycle of the enterprise, labor, labor costs, resource saving, etc., but also, ultimately, will increase competitiveness. Thus, an important factor here is the availability of intangible information resources, which include knowledge, experience, new technologies, computer modeling [15], etc. At the same time, without having a huge capitalization and staff, a modern small enterprise is able to compete with large enterprises of the old model, and that emphasizes the great influence on the competitiveness the factor of innovation. Innovation is the introduction of new technologies in the manufacture of products or services. Innovations can be of an evolutionary nature (more useful product qualities, cheaper component parts of the product) or revolutionary (a new type of product, new characteristics, etc.). Innovations can also include new ways of management, warehousing, planning, logistics, etc. Incentives for innovation are the need to increase the market share of the enterprise, improve the competitive advantages of the product, improve forecasting, etc. It should be noted that competitiveness through innovation can be achieved where enterprises operate legally without the possibility of using corruption schemes, which is proved by the Coase theorem [16]. In addition,

the innovative approach is characterized by goodwill towards competitors [17] or the strategy of «friendly» competition, which is studied in game theory [18].

Often, authors approach the problem of competitiveness through achieving goals in a competitive environment, and the main criterion of competitiveness is understood as the «balance of power» between the company and its main market competitors. It is considered that competition should not be aggressive. In fact, this is the benchmarking strategy that is devoted to. The first step of the strategy is to partner with your competitors. For example, Russian economist Ilyin emphasizes that: «Modern competition of manufacturers is not the destruction of a partner, not the suppression of an opponent in any way. This is highly motivated cooperation and competition in using the best examples of experience and achievements of entrepreneurs» [19].

The transition from Soviet planning systems to market relations led to the emergence of competition and the concept of competitiveness for Russian enterprises. In market conditions, each company needs its own competitive strategy and action plan. It is impossible to create such a plan without evaluating the competitiveness of your company in relation to your nearest competitors and other industry players. Here it is necessary to use the concepts of benchmarking [3], strategic planning [13] and an instrumental model of scenario planning. These tools can provide an accurate forecast for the future for companies that want to compete not only within the borders of a country or region, but also around the world. The introduction of a benchmarking strategy in the process of managing competitiveness allows to combine the process of interaction between competing companies with the processes of modeling, forecasting and decision support to develop an effective mechanism for improving competitiveness. Thus, demonstrating the synthesis of mathematical and algorithmic descriptions of the competitiveness management mechanism with the implementation of the benchmarking strategy and its implementation as a decision-making support system represents the goal of the book.

1.2 System-synergetic approach to the analysis of complex socio-economic systems in the organizational field

Modeling of any processes, structures and communities refers to both universal and specific methods of scientific knowledge that apply objective laws of research in the framework of a system-synergetic approach.

Currently, research in the field of organizational theory is based on the analysis of the form and structure of companies, which, in turn, are considered as open systems. A complex system must have a multi-level and multi-element structure with nonlinear feedback. Corporations and banks that are clearly socio-economic systems have the same set of characteristics as any other open systems. To complex open systems can be attributed the state, the city, any civil and military institutions, unions and association. According to Jay Forrester [20], complex systems have ambiguous responses to external influences. From the point of view of synergetics, small impacts can lead the system to significant results and change the trajectory of its evolution.

Complex systems have specific properties. It should be noted that there is an interconnected structure of feedback circuits that determine the system's response to decision-making. Management decisions represent a sequence of actions that change the state of the system. At the same time, they create new information that must be analyzed to assess the consequences and justify new decisions. The multi-level management process is typical for all types of decisions: public, individual, conscious, unconscious, etc.

The next property is that complex systems have a hierarchical structure of a large order. The order of a complex system is determined by the number of equations that are necessary to describe its states at different levels of the hierarchy. For example, bank organizational structure on several hierarchical levels is represented by staff or employees, bank balance, customer service, banking system, banking operations, equipment, reputation of the bank, the system of relations with the bank, loan portfolio, system of relations with natural and juridical persons, etc.

Complex open systems are nonlinear, so the functions describing them must also be nonlinear. On the one hand, non-linearity ensures that a particular feedback loop dominates for some time. On the other hand, it may happen that the dominant is in a different part of the phase space, where the behavior of the system is so different from the first case that the two regions of the phase space may seem at first look unrelated to each other. In the aspect of synergy, even small changes in the system parameters lead to a considerable change in the system as a whole, which is due to the nonlinear nature of the relationship between the system elements. However, the same non-linearity can provide a system with conservative resistance to management decisions that are applied to change its behavior. In our case, non-linearity allows to model organizational systems with real dynamic characteristics. The interaction of complex systems with each other should be considered in the

organizational field, where the behavior of each individual system is very different from the behavior of simple systems, modeling and analysis of which are quite trivial procedures. The organizational field is a set of organizations that make up the sphere of institutional life [21]. Organizations that exist in the same organizational field, in the process of evolutionary development, become more homogeneous and unified due to their close information interaction with each other. Researchers explain the decrease in organizational diversity by the impact of the external environment (instructions, regulations, legislation), as well as the impact of the internal environment, in particular, from employees who require standardization of wages, labor, and career growth. Unified effective organization models are distributed by consulting services to other enterprises. An organization always has internal factors that stimulate its growth and development, regardless of external factors. Internal factors include the professional qualities of managers, the company's regulated production and business processes and accounting procedures, which allow the company to spread its experience and organizational structure to new regions and markets. However, in the process of evolutionary development of enterprises, the risks of loss of control and loss of feedback increase. This is because organizational structures, being complex systems, do not have time to adapt to dynamically changing market conditions.

The organizational field, like all complex socio–economic systems, includes many factors. In the process of modeling and analyzing the states and dynamics of the behavior of such a system, a comprehensive account of the social, economic, technical and information interactions of its components (enterprises) is required within the framework of the system-synergetic approach. All types of interactions can be considered as a broad aspect of different types of information interactions. At the same time, the possible synergy of types of information interactions, which causes an emergent effect when factors are combined, is often more important than the influence of each of them separately. Therefore, in the process of analysis and modeling, it is unacceptable to consider factors separately from each other, since in this case it is impossible to describe the dynamics of interaction of banking structures in the organizational field with sufficient completeness and reliability.

The system-synergetic nature of the evolution of a complex system means a high sensitivity to changes in only a small number of certain parameters of the order [20], as well as to some changes in the internal structure. Complex open systems are characterized by different internal structures and can have the following organization models: hard deterministic, stochastic,

nonlinear, and self-organizing. In a multidimensional phase space, the system is represented by a point and a coordinate vector of states. The behavior of a point is determined by moving along the phase path. To change the phase trajectory, control actions are used on the parameters of the system, to change which its behavior is particularly sensitive-order parameters. In the phase space, there are also special points of unstable equilibrium, in which even a minor administrative impact of an informational nature puts pressure on the entire system so that its behavior can change in any direction. The purpose of functioning of the socio-economic system is to achieve and maintain its sustainable state. Stability in this aspect means that the system retains its basic structure and the main functions performed for a certain time and under various external influences and internal disturbances.

The order parameters to which the system is sensitive, and the coordinates of special unstable equilibrium points where the system is sensitive, are usually not obvious. For example, in economic terms, there are two groups of indicators that are often used in solving strategic forecasting problems. Indicators from the first group include: dynamics of the company's market share, current market share, current sales volume, sales dynamics, and others that indirectly indicate customer satisfaction with the company's products. Indicators of the second group include labor productivity, profit margin, profit dynamics, operating costs, etc. and reflect the efficiency of the enterprise. To determine and select order parameters, you need to develop a model of the behavior of a particular system, perform modeling, and analyze the dynamics of the system to detect order parameters and special points. As an example, we note the Adizes model [22], which is based on the fundamental law that underlies the functioning of all organizations that go through similar stages of the life cycle and demonstrate predictable and repetitive behaviors. At each stage of its development, any organization is faced with a unique set of tasks that need to be solved. The success of an organization is determined by the ability of managers to manage the transition between these stages. At the same time, Adizes offers not to solve the organization's problems, but to teach the organization to solve its own problems. Then the process of managing an enterprise is the process of achieving results in the short and long term.

Developing Greiner's ideas, Ichak Adizes suggested that the dynamics of organizational development, like the functioning of most physical, biological and social systems, is cyclical. He based this idea on the theory of the organization's life cycles, which is characterized by two components: explaining and predicting. The first contributes to the formation of a sense

of trust, both in the theory itself and in the consultant who uses it. The second one makes you pay attention to issues that are not usually considered by the company's management as key ones. Thus, the theory of Adizes allows to analyze both possible scenarios for the development of the organization, and the prospects for attracting effective managers. We purpose to investigate the dynamics of the organization's behavior through changes in the phase trajectories of development in the phase space, where they can be described in the form of related nonlinear differential equations. This allows to study the dynamics of the enterprise structure, behavior over time, and find the most sensitive of the parameters. To model a complex system, the author proposes a mathematical model that includes a system of equations and inequalities to describe financial and economic processes and phenomena, in order to study and then manage competitiveness by changing the order parameters at special points in the phase space.

1.3 Analysis of methods for assessing and managing competitiveness

In the scientific community, there are different approaches to determining the factors that affect the competitiveness of the enterprise. One approach was suggested by Arthur Thompson and George Strickland [23]. To assess the competitiveness of the company, they proposed such factors as product quality, image (reputation), production capacity, use of technologies, innovative opportunities, financial resources, distribution opportunities (dealer network), customer service. Based on the analysis of the performance of individual enterprises, they also suggested using the relative market share occupied by the company, the ability to exert pressure on suppliers and consumers as criteria for competitiveness. In fact, it was stated that the size of the market share determines the competitive position of the enterprise. Other indicators proposed by David Krevens include competitive advantages, multifunctionality (competitive advantage in different situations), and complexity of duplication [24]. All factors Krevens smashed by three processes: first, the factors related to the internal process, the second to the outer third to two-way. Internal process factors must satisfy consumers, external ones form feedback and are related to the external environment. Two-way process factors provide a link between consumers and the external environment. This approach proves that the market is a complex system with multidirectional high-order processes. However, the absence of a minimum set of functions that describe these factors reduces the value of the model in terms of predicting changes in the company's competitiveness in the future. However, David Krevens also

noted [24] that the company's market share indicates not only its competitive position in the market, but also acts as an indicator of the forecast of future sales.

Jean–Jacques Lambert [26] gives the following indicators of competitiveness: market share, product properties, image, sales methodology, level of technology use.

A comparative analysis of other works on the subject allowed to conclude that competitiveness is mainly evaluated based on two criteria: consumer utility and price. [25]. It is also common to use a comprehensive assessment of product quality and, with some restrictions, the market share occupied by the product, which is functionally dependent on the profit received for the product and the quality of the product. Many authors consider the market share occupied by a product and / or organization and related indicators to be the main criterion for competitiveness [25, 26, 27].

Let's consider the main methods used by the authors to calculate a comprehensive assessment of the competitiveness of the enterprise and products:

1. In the first method, a comprehensive assessment of competitiveness (K) is represented by the sum of: $K = \sum_{i=1}^{N} K_i$

   (1.1),

where K_i is a single indicator of the competitiveness of the enterprise (product) with a total number of N.

As noted by Arthur A. Thompson and A. J. Strickland [25], the company's management should make up a set of key factors and competitive advantages or disadvantages of the company. Then an expert assessment of each indicator is carried out on a scale from 1 to 10 points, the points are added together, and a comprehensive assessment of competitiveness is obtained. A similar calculation is made for the company's strong competitors, which corresponds to the benchmarking strategy. Comparison of complex estimates of your own and competing enterprises can show the advantage or lag of your own enterprise. Next, we consider the criteria by which the company operates successfully, and by which it lags behind its competitors. Relative values that were obtained by dividing the current values of the company's indicators by the possible maximum values, or by the values of this indicator for the most successful competitor, can be used as competitiveness parameters. Then the complex indicator according to

formula (1.1) will illustrate the value of the level of competitiveness in comparison with competitors (benchmarking). The method is quite simple, but it can distort the idea of competitiveness, since the values of indicators may vary, have different effects on competitiveness depending on the time, players, and other indicators.

2. The following approach makes it possible to determine a more accurate complex indicator of competitiveness based on the weighted average of the arithmetic mean: $K = \sum_{i=1}^{N} W_i K_i$

(1.2)

where K_i - is a single indicator of competitiveness with a total number N; W_i is the weight of the i-th indicator of competitiveness.

In practice, the normalized values of the weights of competitiveness indicators are used, and their sum should be equal to one. Then the complex indicator will be measured on the same scale as the individual indicators of competitiveness. This approach is used by scientists Arthur A. Thompson, A. J. Strickland [25].

The method proposed in the works of A. A. Thompson and A. D. Strickland [25] and D. Krevens [24] considers the market share and its dynamic change as indicators of competitiveness. This approach is confirmed by research in the framework of a project of the Cambridge Institute of strategic planning, which showed the relationship between market share and sales volume and the company's profit volume [25]. At the same time, market share can serve as a measure of the accuracy of the above methods for determining complex indicators of competitiveness. Therefore, to assess competitiveness, it is proposed to study the dynamics of the market over time.

Analytical studies of existing approaches to assessing competitiveness allowed to draw the following conclusions. All evaluation methods have a common functional drawback, which is that they determine only individual points of the trajectory of changes in competitiveness in the phase space and do not allow to see the whole picture of the dynamics of changes in competitiveness over time, and therefore do not allow you to make forecasts for the future. The methods do not allow to synthesize and study the dynamic model of competitiveness for a particular enterprise in comparison with the dynamics of competitors ' competitiveness in the framework of the benchmarking process, which does not allow to find out the hidden reasons that affect competitiveness and trends of change under their influence.

1.4 Methods of enterprise management in terms of increasing its competitiveness

Entrepreneurs and owners are mainly interested in the long-term sustainable position of the company, determined by the potential competitiveness of goods and services. Competitiveness depends on the stage of the product's life cycle, i.e. the entrepreneur needs to know the function of changing competitiveness over time. Therefore, graphs of changes in sales or profits for managers are more informative than the numerical values of these indicators for the same period. Let us consider methods of managing competitiveness. In Fagerberg's research method of managing competitiveness [16], the investment mechanism was considered, namely: direct investment in r&d; indirect investment in r&d obtained through the purchase of innovative products and services from local and foreign suppliers; investment in production capital. Research has shown that direct investment is doubly effective in high-tech industries, while indirect investment and investment in production capital are crucial in low-tech industries. It is also found that the competitiveness of large countries is more dependent on internal innovation, while small countries are more dependent on external innovation. At the same time, investing in r&d is more effective than investing in production capital, and the size of the country and the technological level of the industry do not matter. We will call this method of management investment. It should be noted that at present, the interest in this method of management on the part of large corporations is somewhat reduced, since they reduce the intensity of innovative developments. The national science Foundation of the United States has shown that for every dollar invested in innovative development, small firms generate four times more revenue than medium-sized companies, and 24 times more than large firms [29].

Another method of managing competitiveness is the development and implementation of competitive strategies to oust foreign companies from the market and capture their market segments. There is an opinion that competitiveness depends, to a greater extent, on the new market niches that the company occupies. Competition for a small business in a narrow niche can be more effective than chasing the leaders of existing large market niches. This method is defined as niche marketing. One of the strategies of this approach is to bring new products to the market, literally, the next day after the patent protection period for competitive analogues ends. According to Sam Hill's calculations, 32,025 products are offered annually in the United States, 93.3 % of which are an absolute copy of what is already on

the shelves [28]. Although niche marketing is primarily of interest to small and medium-sized businesses, large corporations use their financial, technological, and manufacturing potential to oust weak competitors from promising market niches.

1.5 Benchmarking process as an enterprise management mechanism

In General, benchmarking is a process of identifying, studying and adapting the best practices and experience of other organizations to improve the performance of their own organization in terms of improving its competitiveness [30] (organizations with similar processes in their industry, regardless of industry affiliation, in their own country or abroad). The concept of benchmarking first appeared in the United States in 1972. PIMS, a research and consulting organization, found that in order to find an effective competitive solution, it is necessary to adopt the best practices of other companies that are successful in similar conditions. According to the American consulting company Bain&Co, in recent years, benchmarking is one of the three most common methods of business management in large corporations, along with strategic planning and mission of companies. However, simply identifying differences between your own business and your competitors does not explain how to overcome these differences and achieve a competitive advantage. In this regard, the need for benchmarking should be justified, and the goals of benchmarking should coincide with the strategic goals of the organization [48]. The American company Ernst & Young and The American Quality Foundation conducted a study that showed that benchmarking is effective for companies that are national and world-class leaders, but ineffective for weak companies.

It is natural that any enterprise should first implement a program to improve its activities in terms of reducing costs, increasing sales, gaining new markets, developing new products and services, creating new sales channels, improving efficiency and productivity, etc. before chasing the leader.

However, in order to implement this program, the company must know which areas and functions require changes and improvements. In addition, benchmarking serves for this purpose. Business processes in your own company are compared with the existing best methods of the competing company within the framework of benchmarking. The comparison identifies possible shortcomings that need to be addressed. After identifying

the shortcomings, the task is to develop ideas and find solutions that are adapted to the requirements of your own company so that, thanks to your own developments, you can surpass the best indicators of your competitors. In the future, you should constantly double-check the results of benchmarking in order to maintain and strengthen your superiority. The founder of the production management method, Robert Kemp, defines the benchmarking process [31]:

1. Identification of the benchmarking item.
2. Identification of the benchmarking partner.
3. Defining the method for collecting information and collecting data.
4. Identify discrepancies that are important for competitiveness.
5. Planning future performance indicators.
6. Communicating the results of benchmarking to interested parties and getting help in applying them in practice.
7. Setting specific goals and objectives for improving the company's performance.
8. Development of action plans for their achievement and solution.
9. Conducting planned events and tracking results.
10. Re-checking of benchmarking control points.

The algorithm for conducting benchmarking does not have strict regulations - usually each company develops and adapts the stages of strategy implementation to its needs and often offers its own method of benchmarking project.

The use of benchmarking has many directions. For example: benchmarking in logistics allows to quickly and cost-effectively identify problematic situations in logistics systems. Benchmarking is used in the working out of development strategies and management functions and is considered as a way to evaluate performance strategies in comparison with leading companies to ensure long-term presence in the market. Analysis of the content of the benchmarking process shows that it can be considered as a direction of marketing research. The advantage of benchmarking is that production and marketing functions become more manageable when the best methods and technologies of other enterprises or industries are researched and implemented in your company. Thus, today benchmarking becomes a management mechanism in any socio-economic systems, as it allows you to discover what others are doing better by studying, comparing, improving and applying their methods of work. The goal of benchmarking is to provide a high probability of success of the socio-economic system based on the research. Benchmarking is carried out within the framework of

competitive analysis and is a detailed and ordered function of managing the competitiveness of an enterprise.

According to the concept of benchmarking, any business process must be marked, i.e. it must have several recognizable points by which it is possible, first, to determine how successfully the business process is proceeding, and, accordingly, how successfully the company is working at a given time, and, secondly, to plan the implementation of changes that can track the company's achievements in the field of business processes.

The technology for collecting information for the benchmarking process is often insider activity and industrial espionage. In our case, industrial espionage should be considered as a form of unfair competition, in which the illegal receipt, use or disclosure of confidential information constituting a commercial, official or other secret protected by law is carried out in order to obtain competitive advantages or to obtain material benefits. There is another area of information gathering called competitive intelligence. The main difference between industrial espionage and competitive intelligence is in criminal methods of obtaining information, while competitive intelligence operates within the law. Businesses are more likely to opt for competitive intelligence.

Summing up, we can conclude that benchmarking is actually an exchange of experience between companies. Competitive benchmarking can be considered a driving force in business [31]. Many companies work on the basis of benchmarking, applying the experience of colleagues and considering it as a tool for improving business and achieving competitive advantages.

Well-known mathematical methods are often used to support the process of benchmarking enterprises. Note the method of pairwise comparisons developed by T. L. Saati [32], which belongs to the field of game theory. Game theory is one of the sections of optimization and is used in solving a wide range of problems that lie in the field of economics, sociology, technology, etc. The theory includes a set of mathematical methods for analyzing and evaluating the behavior in a conflict situation in order to ensure the maximum possible gain for one of the parties. The method of pairwise comparisons, as an element of game theory, makes it possible to rank enterprises. In the framework of the method for each factor, establish relevant evaluation. At the next stage, experts evaluate the significance of situations by pairwise comparison. The comparison technique consists of simultaneously presenting two situations to the expert, who must choose the

most significant one among them in terms of its impact on the final results of the activity. Pairs are compared with each other in every situation of every unit. The comparison results are used to calculate the significance coefficients for individual situations.

The law of competition dictates, at least, a pair (interconnected) consideration of economic entities when modeling the competitiveness of enterprises, since the consideration of the model of development of a single enterprise makes sense of the problem of analyzing competitiveness in its dynamic aspect. One of the first paired models of competition is the Bertrand model of price competition in the oligopolistic market [17]. The model describes the behavior of companies in the oligopolistic market by changing the prices of their products. The main conclusion is that the price of the product will be equal to the cost. The result of Bertrand's research is two models of market behavior:

- cooperative model, which implies an agreement in which companies charge a monopoly price and serve their part of consumers;
- competitive model in which firms do not act co-operatively and set the price at the level of their costs. However, in an asymmetric case where one of the firms has lower marginal costs, it can set the price below the competitor's costs and get the entire market.

It should be noted that the Bertrand model is one of the models of «paired» consideration of competing companies of firms and is a prototype of the benchmarking strategy. The disadvantage of the model is its static nature, since the decision-making process is considered at certain points in time.

1.6. Systematic approach to describing the interaction of competing enterprises in the benchmarking process

Organizational field [20], in which there is interaction between companies in the process of benchmarking allows to describe the enterprise as a complex dynamic system with the help of coupled differential equations. All systems are characterized by different internal organization and are divided into hard-deterministic, stochastic, nonlinear, self-organizing. For all systems, stability is an important property, i.e. the system maintains the basic structure and basic functions for a certain time, under external influences and internal disturbances. Stability is an internal property of systems. The mathematical model of a complex dynamic system includes a system of equations and inequalities for describing processes and phenomena that include a set of variables and parameters for the purpose of

its research and management [33, 34]. Norbert Wiener proposed to consider complex dynamic systems in Cybernetics as a set of interacting nonlinear oscillators [35]. Since companies in the organizational field are in constant evolutionary development, it is also possible to apply a similar approach to describing the dynamics of changes (fluctuations) in the technical and economic indicators of competing enterprises [36, 37, 38]

It should be noted that fluctuations in economic indicators are complex due to the large number of interacting factors in real market relations, as well as the presence of subjective factors such as archetypal features of owners and top managers. Despite this, there are certain prospects for using mathematical models to describe real fluctuations and model the dynamics of benchmarking processes [39].

Let's consider a block diagram of competitive interactions to assess the competitiveness of a product produced and sold by a leading company and its competitor in the process of their interaction in the market for the study of the benchmarking process [39] (Fig. 1.1).

For this scheme, assume that any company has the properties of an open self-supporting system. In particular, during the production or purchase of goods at wholesale prices, the product is accumulated for sale, and then the product is transformed into monetary form as a result of its sale. At the end of the cycle, because of feedback, money is transformed into production or product acquisition. As can be seen from the figure, the dynamics of competition depends on external and internal parameters. For example, the company is subject to external influences (investments, costs), as well as random market fluctuations. Fluctuations in economic indicators in the markets are subject to changes that are both regular and chaotic. The study of the nature of fluctuations is necessary for their use in order to predict the main trends in the company's economic activity, as well as to analyze the dynamics of indicators of individual enterprises. For a self-sustaining system model, it is possible to evaluate the dynamics of changes in competitiveness through the functions of influencing the model parameters. We formulate the tasks of enterprise management to improve its competitiveness in the process of benchmarking:

1. Forecasting the dynamics of changes in competitiveness.
2. Evaluation of the dependence of competitiveness on the volume of confidential and ordinary information about competitors received.
3. Increasing the company's competitiveness with the correct organization of the cost strategy.

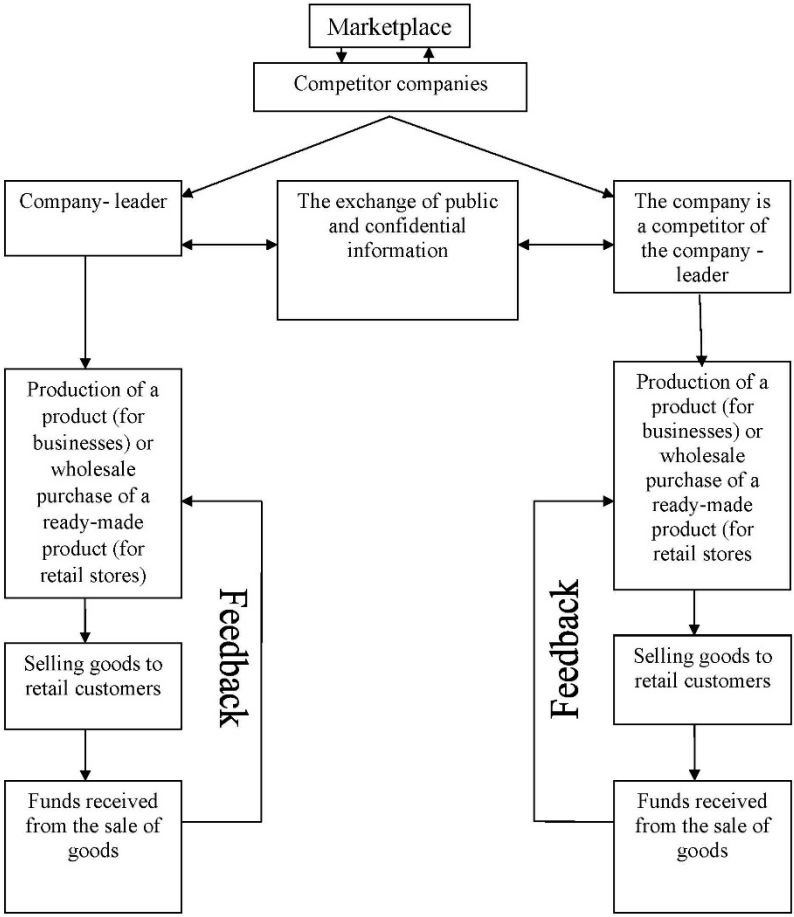

Figure.1.1. - Block diagram of competitive interactions

4. Determining the impact of the size and frequency of investments to improve the competitiveness of the enterprise.
5. Modeling and research of the impact of crisis events on competitiveness in order to develop procedures for improving it.
6. Managing competitiveness depending on market conditions and enterprise development strategies.

Any company that produces and sells products is part of the market, which is a socio-economic system that also has the properties of complex open