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Research paper



Features of Business Administration at different stages of Enterprise Life Cycle

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Abstract

The purpose of the study is to formulate an approach to business administration based on the definition of the appropriate stage of enterprise life cycle. The proposed approach complements the existing methods by combining both the evaluation based on the analysis of characteristics of the internal components of the enterprise and the evaluation of the level of competitiveness of the enterprise and the level of financial and economic activity. The analysis of literature in the field of the theory of the enterprise life cycle has allowed to form a generalized five-stage model of ELC, which includes the stages of formation, development, maturity, diversification and decline. It has been substantiated that the machine-building enterprises in Ukraine, depending on the internal contextual variables, came to such stages of the life cycle as development, maturity, and diversification. At the first stage of development, the company has a simple structure, small size and low level of formalization. At the second stage, companies are barely older and bigger, use more complex types of organizational structures and more formalized. At the third stage, enterprises are even larger and older, have a higher level of formalization and a complex structure, which periodically varies. Indicators determining the level of financial and economic activity and competitiveness of the enterprise considerably increase the accuracy of the definition of the stage of the enterprise life cycle. According to the indicators, it is possible to draw a conclusion about the degree of efficiency of the enterprise at different stages of the life cycle. Therefore, in order to choose the appropriate direction of activity, strategy for the development of an industrial enterprise, or the method of decision-making, it is necessary to monitor various financial and economic indicators and indicators of competitiveness that will determine the stage of the enterprise life cycle.

Keywords: *enterprise life cycle, internal contextual variables, financial and economic activity, competitiveness, business administration*

1. Introduction

The concept of enterprise life cycle (ELC) is established and developed in management theory in order to explain changes in enterprise through the years. However some scholars argue about the validity of the concept, its applicability has been repeatedly confirmed by empirical studies. It has to be accepted that, at different stages of enterprise life cycle, there is the difference in characteristics of enterprises and methods of evaluation and management. For instance, the concentration of power contributes to success of the enterprise at the early stages of the enterprise life cycle, but prevents it at the later stages. Some studies have found that different models of enterprise efficiency are for enterprises at different stages. Despite the growing interest in this issue and the increase in the number of empirical studies in the theory of the enterprise life cycle, there are significant differences between models. The works of domestic researchers are descriptive, or based on one model and its scrutiny.

2. The study of approaches to define stages of enterprise life cycle.

In modern literature, the five-stage model of ELC is most often used. The ELC stage refers to "the unique configuration of the variables associated with the organizational context and structure" [1-3].

G. Lippitt and U. Schmidt [4] developed one of the first models of commercial enterprise life cycles. They assumed that companies pass through three stages of development: birth - the creation of the operating system and achieving viability; youth - the development of stability and reputation and maturity - the achievement of uniqueness and adaptability along with the expansion of the field of activity. The model identifies six main managerial tasks that change when a company moves from stage to stage. At the stage of birth, the critical tasks of development - the creation of a system and the achievement of survival rate. At the stage of youth, the main tasks are stability and building a reputation. At the stage of maturity, the uniqueness and ability to respond to a variety of social needs is achieved.

The next researcher, B.Scott [5-6], founded the ELC model on A. Chandler's work. The model identifies three different types of enterprises which are based on historical development.

Stage 1 is characterized by a small or informal structure, the presence of a single product, personal control and the paternalistic remuneration system.

Stage 2 - functional specialization, institutional study and objective remuneration system.

Enterprises at stage 3 have many product lines, diversified product markets, research and development orientation, growth and adaptation. Scott's model suggests that firms move from informal

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enterprises to a formalized bureaucracy and then to diversified conglomerates.

One of the most popular ELC models is L. Greiner's model [1]. In this model, it is assumed that the organization goes through five consecutive stages, each of which is a "revolution", or a transitional phase, resulting from the main problem or the crisis of the enterprise. The organization successfully moves to a more mature stage only by overcoming this crisis or solving the problem inherent in each stage of development. According to this model, enterprises move from the entrepreneurial stage and the stage of creativity, overcoming the crisis of leadership, which is a consequence of the need to rationalize organizational actions. Movement through the second stage - growth through leadership or rationalized leadership - is carried out by overcoming the crisis of autonomy. This crisis is the result of the need to decentralize decision-making. The third stage - growth through delegation - faces a control crisis when unintegrated targets appear in autonomous entities. The organization overcomes this crisis, moving to the fourth stage - growth through coordination (e.g. restructuring, formal planning, project teams) – up to the formalization crisis, which prompts the organization to move to the next stage of growth through cooperation. Collaboration in L. Greiner's model implies the use of matrix organizational structures and leads to spontaneity of management and increased flexibility of the enterprise. The main crisis of the fifth stage is information overload and psychological saturation, but L. Greiner does not distinguish this crisis in the model, he speaks of it in later commentaries to his work. Thus, L. Greiner's model considers the stages of enterprise development from the stages based on creativity and entrepreneurship, to formalization and then to adaptability and flexibility.

W. Torbert offered a model of development, based on the individual mentality of enterprise members. According to this model, the organization develops as its members become more experienced in understanding the factors, causes and driving forces of development and develop skills which are necessary to enhance personal and interpersonal efficiency [7]. W. Torbert's model describes the natural sequence of stages through which the organization can pass, and specifies the mentalities that determines each of them. It describes the movement from the early stage of individuality and informality to group community and the feeling of collectivism. Introducing his model, W. Torbert emphasizes, firstly, that the subsystems of the company operate with different mentalities and different abilities in relation to the assessment of the benefits of their own activities; and, secondly, the transition to a later stage of integration requires knowledge of the basic concepts and dynamics of actions that apply to all previous stages. W. Torbert does not define the process by which enterprises move from one stage to another; rather, he determines the success of higher levels of business operating that they can achieve.

Researchers D. Katz, R. Kahn suggest a model of ELC [8], in which the main variable characteristic of the enterprise is its structure. They consider the organization as an open system, one of its options may be a cycle of events. In their opinion, the structure is a dynamic interaction of events. In the enterprise life cycle D. Katz and R. Kahn distinguish three main stages. The first is the stage of a primitive system, in which the elementary principles of the production system are based on joint efforts of enterprise members. At the second stage - a stable enterprise - the main efforts of management are aimed at coordination and control. Systems of authority and provision arise in order to regulate activities of the enterprise. The third and final stage is the perfection of the structure on the basis of the development of adaptation mechanisms for interaction with the environment, the constant need for support from the outside environment and subsystems that develop within the enterprise, institutionalize the relationships with the external environment and guarantee such support.

The stages of the enterprise life cycle in the model presented by I. Adizes [3] are divided into two groups: growth and aging. Growth begins with birth and culminates in prosperity, after which aging occurs, which goes from stabilization to the death of the enterprise. According to the model of I. Adizes , the development of enterprises occurs through certain stages, at which the priorities of the four activities change - the achievement of results; entrepreneurial activity; management through formal rules and procedures; integration of individuals into enterprises. Formalization of activities and integration is given special significance as soon as maturity is achieved. Organizational decline is due to excessive focus on stability, rules and procedures. I.Adizes considers the process of organizational decay as consistent and predictable.

The model of enterprise development, presented in the work of J. Kimberly [9], is based on a long study of the creation and development of a medical college. J. Kimberly supposes that the first opportunity to identify the stage of enterprise development exists even before the organization really formed. The first stage involves streamlining resources and forming an ideology. All this inevitably leads to the second stage, when there is a choice of "original driving force", hiring employees and obtaining support from strategic clients; ordinary discrete solutions are taken here. The third stage involves the formation of organizational identity, sense of community and involvement; here high emotional and psychological activity of the members of the company is necessary for the passage of the mission or ideology of the enterprise [10]. The fourth stage - institutionalization - arises when policies and rules become rigid, formalization of the structure takes place, the organization becomes more conservative and predictable in its responses to external influences.

The model of the enterprise life cycle, proposed by D. Miller and P. Friesen [11], contains five key stages. In the phase of birth, firms are trying to develop a viable commodity-market strategy. This is achieved mainly through trial and error, as a result of the efforts made to create and develop the product. The firm at this stage is relatively small and has a simple centralized management structure. At the growth stage, the firm is increasing in size, expanding its niche in the market and developing a more formal organizational structure. Companies at the stage of maturity are more conservative and less innovative, take very small attempts to diversify or absorb and do not make significant changes in goods and services. At the stage of revival, there are significant changes in the product strategy and the innovation of the company generally increases. Because firms become more diversified, they enter new markets, increase in size, expand their assortment.

Firms in the phase of decline become inert, they try to preserve depleted resources and refrain from innovations, because their production lines are outdated.

The Flamholtz model [10] contains seven stages of enterprise development, each of stages has specific critical issues. The author focuses on so-called developmental diseases associated with the transition from entrepreneurial management to professional management. According to E. Flamholtz, the first stage - the creation of a new enterprise - is a period during which the organization goes through the phase which starts with a complete lack of sales and ends when the amount of 1 million dollars is reached. At this stage, the organization must accomplish all the critical tasks needed to succeed, but the focus is made on the two tasks: market definition and product development. At the second stage- expansion- the organization begins to develop its operating systems for everyday functioning. For most manufacturing companies, the second stage begins with a sales volume of $ 1 million and continues up to $ 10 million. At the third stage - professionalization - the company's leader begins to understand (or must understand) the need of a qualitative change in business management. The company must make the transition from entrepreneurship to professional management and reach a new level of development. The emphasis at this stage should be on the development of management systems which the firm needs to

move to the next stage of growth. Managing corporate culture - its values, customs and norms - is the main task of the fourth stage - the stage of consolidation. At the fifth stage - diversification - there is the expansion of its range of products and services, and at the sixth stage- integration - there is a need to combine different business units by creating an appropriate management infrastructure. The main challenge faced by the company at the last, seventh stage - the stage of decline and recovery - the creation of a new level of entrepreneurial activity and rebirth of the company.

One of the most recent ELC models was developed by D. Lester, J. Parnell, A. Carraher [12-15]. This model contains five stages of the enterprise life cycle: existence, survival, success, rebirth and decline. Enterprises at the stage of existence, as a rule, have a simple structure, power is concentrated in the hands of the founder. The focus is on the viability of the enterprise, the identification of customers and markets. At the stage of survival firms grow in size and develop more formal organizational structure. The goals at this stage are usually formulated, and the most important goal is to have enough profit to survive and finance growth. The stage of success corresponds to the stage of maturity of other author's ELC models.

At this stage, the formalization of management and control takes place. Job descriptions, procedures and internal-organizational relations become much more formalized. The stage of revival is characterized by the desire of management to return to a simpler management style, when cooperation and interaction contribute to the emergence of innovation and creativity growth. Creativity can be achieved through the introduction of matrix organizational structure and decentralization of decision-making. The decay stage completes the enterprise life cycle, although the organization may disappear at each of the previous stages. This stage is highly politicized, the power is concentrated in the hands of several people who are more interested in achieving their goals, and not the goals of the enterprise.

Despite the fact that all of these models are based on different contextual variables of the enterprise (for example, in structure, individual mentality, functional problems), it is noticeable that all of them offer development through similar stages of the life cycle. A comparative analysis of different models makes it possible to use a five-stage model (Table 1.2.).

Table 1: Stages of the Enterprise Life Cycle (industrial enterprise)

Establishment	Growth	Maturity	Diversification	Decline
Early innovations, niche formation, creativity	High unity, commitment	Stability and institutionalization	Expansion of markets and decentralization	Reconstruction

Each model contains the stage of formation (early innovations, niche formation, creativity), the stage of accumulation, or collectivity (high unity, commitment), the stage of maturity, or formalization and control (stability and institutionalization), and the stage of diversification, or the development of structure and adaptation (expansion of markets and decentralization); some models contain a stage of decline that can be transformed into a recovery stage. Some authors divide the first stages into many substages; some authors do not include in their models the latest stages of diversification and decline (it can be seen that almost all models developed until the 1980's do not contain a stage of decline, from this point of view the "pioneer" was the article by Adizes, in which he introduced the first model that includes the entire four stages of the enterprise's life, which correspond to the decline and lead to the death of the enterprise).

Thus, four models – I. Adsizes ; D. Miller and P. Friesen ; E. Flamholtz E ; D. Lester., J. Parnell and A. Carraher - include organizational decay and death, but most models only consider the stages of growth and development. This may be due to the fact that in mature enterprises (after the maturity stage), organizational practices are no longer as predictable as at the growth stages. Stages from the birth of the company to its maturity are much easier to analyze and therefore more predictable, therefore most researchs in the field of ELC is devoted precisely to this period of life of the enterprise.

Also, it should be emphasized that neither of the mentioned authors indicates the time interval during which enterprises remain at a certain stage of development. Consequently, we can conclude that this criterion is individual and even for each enterprise of the same industry it will be separate. Therefore, there is an important issue in determining the characteristics which allow the manager to determine the stage of the enterprise life cycle.

The exception is the model of Lester, Parnell, and Carragher, in which the authors suggest assumptions about the time interval of the enterprise's stay at the first stage - the existence - for 10 years. At the same time, in studies by Crimberley, Mileas, it is demonstrated that enterprises can move through stages of ELC at different speeds. In the work of Lippitt, Schmidt, the authors even argue that the age of the enterprise and the stage of its life cycle are weakly related to each other.

Empirical studies have shown that, despite the fact that the ELC stages of contextual characteristics are very different one from another, they are in no case connected with each other in a deterministic sequence. For instance, the stage of maturity may precede decline, regeneration, or even growth, and, on the contrary, a decline or even death may occur after the growth stage. These studies refute most of the previously developed models, based on the assumption of the existence of causal relationships between the various stages of enterprise development.

Modeling the development process of an industrial enterprise through the theory of life cycles inevitably involves the simplification of the object of research and can't describe it in its complexity. The basic value of simulation is the ease of the use for both cognitive and practical purposes. Description of the stages of enterprise development helps to bring management learning closer to reality, to demonstrate differences in the implementation of management functions depending on the stage of enterprise development.

It should also be emphasized that there are certain limitations on the use of ELC models, created on the basis of research of enterprises in countries with different levels of economic development. For instance, Ukrainian industrial enterprises are developing according to a such model of life cycle, which differs from the models of development in countries with a more stable economy.

3. Establishing the stage the enterprise life cycle on the basis of certain characteristics of its internal environment

Industrial enterprise in its development goes through several stages, each of which has certain characteristics of its internal environment. This should help to separate one stage of ELC from another. These characteristics of the internal environment usually include: the type of organizational structure, the complexity of the process of information processing, the number of levels of the hierarchy and the type of selected strategy. The conducted researches have shown, that the period of stay of the enterprise at the initial stages of formation and growth in the modern Ukrainian conditions is less prolonged and compared with the situation in high-tech industries in the countries with developed economies.

The main purpose of the empirical study was to study characteristics of the respective stages of the life cycle of Ukrainian industrial enterprises. Data collection for the empirical study of the peculiarities of life cycles of Ukrainian industrial enterprises was carried out during the period of 2010-2013. The basis of the sample was 18 large machine-building enterprises of the eastern Ukraine. The survey was conducted by questioning managers of the middle level of the machine-building enterprises of Ukraine. The survey used two groups of questions that allowed to obtain information about characteristics of the stages of enterprise life cycle and its internal environment. The first group of characteristics was the basis for the breakdown of the range of enterprises to clusters, and analysis of the characteristics of the

second group allowed to explore the peculiarities of the internal environment of enterprises at different stages of development.

The characteristics of the enterprise that determines the stage of its development by the scale of the life cycle were the age of the enterprise (the number of full years of existence at the time of the survey), the size (the number of staff at the time of the survey) and the degree of formalization of management.

The degree of formalization of enterprise management was determined on the basis of a rating assessment of respondents' consent with a number of assertions regarding the degree of formalization of their enterprise. The poll offered seven assertions, each of which was evaluated on a five-point scale (1- strongly disagree, 2-rather disagree, 3-rather agree, 4- agree, 5- completely agree). The total result was calculated as the sum of estimates for all seven statements. Higher values of this indicator show a higher level of formalization of management in the investigated enterprise.

The type of organizational structure, the complexity of the process of information processing, the number of levels of the management hierarchy, the characteristics of the development strategy are characteristics of internal environment of the enterprise in the research.

The structure of the enterprise was reported by the respondents on the basis of proposed descriptions of the linear, functional, divisional and matrix-design organizational structure. The strategy and complexity of the information processing were determined according to the same principle as the level of formalization (five statements were formulated for each indicator, which required an assessment of the degree of respendent's agreement). The number of levels of the hierarchy in the enterprise was determined by the respondents' answers to the question of the maximum number of management links in the line between the manager of the enterprise and the lower level executives. In Table 2 statements used during the survey and average results of the degree of agreement with them by respondents are summarized.

In the course of the survey the data from 18 machine-building enterprises were collected through the survey. Enterprises included in the sample were created as a result of privatization. The average age of enterprises in the sample is 70 years. The size of the surveyed enterprises by the number of personnel is ,on average, about 5-9 thousand people. The average number of levels of management at enterprises is 4; Maximum observed value is 10. Only 18% have 6 or more hierarchical levels, 82% of them are from 2 to 5 (Fig. 1).

The number of activities is from 1 to 15, but most enterprises concentrate on one direction of activity (this situation is observed in 36% of enterprises). Only 9 enterprises (5% of the sample) have more than 5 types of activities.

At the choice of organizational structure, Enterprises were distributed acoording to organizational structure in the following way (Figure 2): the absolute majority of enterprises use the functional structure (over 50%), the second most popular is the divisional structure (19.1%), then the project-matrix (15.8 %), and the least-used is a simple structure.

The study assumes that each stage of ELC is determined by the unique configuration of the variables associated with the organizational context and structure.

Table 2: Determination of the level of formalization and management features of the companies

№	Statement	Average rating	Average square deviation
	Formalization		
1	Formal policies and procedures governing most decisions	3,02	1,11
2	Important communications between departments documented by office notes	3,20	1,35
3	Formal job descriptions approved from each position	3,29	1,39
4	The team of top managers consists	3,70	1,14
	specialists in each functional area		
5	The lines of subordination and authority are formally defined	3,80	1,03
6	There are objective criteria in the reward system	3,61	1,12
7	There is systematic planning (in writing)	3,62	1,21
	Strategy		
1	The company follows the strategy of frequent product / service restoration	2,99	1,2
2	The enterprise prefers a strategy to follow a competitor	2,09	1,03
3	The company follows the diversification strategy (increasing the number of businesses) and the expansion of the product line	3,08	1,25
4	The company uses a niche strategy to occupy the relevant market niche	1,63	7,35
5	The enterprise uses the strategy of geographical expansion - entering new regional markets	3,17	4,50
	Data processing		
1	The information processing is simple and carried out mainly orally	2,39	1,23
2	The information processing is made as monitoring of results and providing communications between departments	3,26	1,03
3	The information processing is complex and necessary for efficient production and obtaining adequate income	2,83	1,24
4	The information processing is complex and used to coordinate a variety of actions for to best service of markets	3,30	1,28
5	Complex information systems are used to process information	3,35	1,45

If enterprises develop through a certain sequence of stages, then these stages will be expressed by clusters of enterprises that have the general characteristics of the described contextual variables.

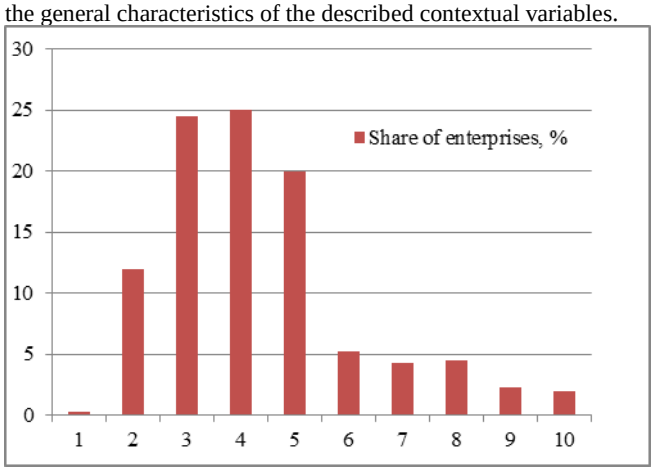


Fig. 1: Distribution of enterprises by the number of hierarchy levels, %

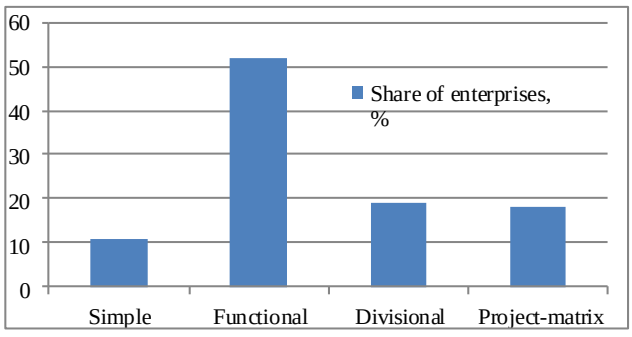


Fig. 2: Distribution of enterprises by the type of organizational structure, %

In order to select clusters of enterprises, the hierarchical agglomeration cluster analysis with the Ward's algorithm was

used in the study, which leads to the formation of the most comparable cluster sizes. The classification was based on the characteristics discussed above, namely: age, size and level of formalization of the enterprise. The choice of the number of clusters is based on the criterion of "pseudo-T2", which reaches the minimum value at the level of three clusters.

Thus, the result of the cluster analysis was the allocation of three groups of enterprises, which differ in the values of the three main variables: the age of the enterprise, the size of the enterprise and the level of formalization. Next it was calculated values of indicators for each cluster that characterize the features of management: the strategy required by the company, the structure, the level of complexity of the process of information processing in the enterprise and the number of levels of the hierarchy. In Table 3 the results of the variance analysis of the named variables, indicating the presence of statistically significant differences in the mean values of the selected indicators of the four selected clusters, are presented.

Table 3: Results of the dispersion analysis

Variables	Determination coefficient	Adjusted determination coefficient	F-Fisher's criterion	Prob>F
Information processing	0,2204	0,1531	3,27	0,0003
Levels of the hierarchy	0,1408	0,0708	2,01	0,0318
Strategy	0,1489	0,0672	1,82	0,0513
Structure	0,0834	0,0648	4,49	0,0048

Cluster A - combines enterprises with an average age of about 60 years; they are the smallest companies in the whole sample (the average value of the indicator is "size" = 3.4), and they are characterized by the lowest level of formalization (formalization = 16 , 46). In addition, the organizational structure of enterprises in cluster A is simplest (structure = 1.92), i.e. they are characterized by the use of either linear or functional structure with the simplest process of information processing (information = 2.27). As for the indicator of the strategy used by the company, it speaks of the most frequent use of monoprocessing strategies and strategies for geographical expansion. The number of hierarchy levels in companies in cluster A does not exceed 3 (equal to 3.1). These companies prefer to use the restructuring strategy as a model associated with a radical change in organizational structures and enterprise management structures. The restructuring of the company in order to transform it into a vertically integrated structure (holding company) and the introduction of a divisional management structure instead of a functional model that was previously ineffective requires a predominantly formalized action.

The cluster B includes enterprises with an average age of just over 80 years (average age = 10.4), much larger than the enterprises of the first cluster (size = 4.74), and with a significantly higher level of formalization (formalization = 25, 66). The process of processing information in this cluster is noticeably complicated and increases to 3.99 (information = 3.99), as well as the organizational structure (structure = 2.44), i.e. companies practically do not use simple structures, preferring functional, divisional and matrix structures. As for the strategy, the absolute majority of enterprises use geographic expansion strategies, approximately enterprises are divided evenly according to the choice of diversification strategy or use mono-product strategies, and a large share of enterprises that use strategies of frequent product / service restoration. Companies in cluster B rarely use strategies of following a competitor. The strategy of reengineering as a change is connected not as much with external manifestations as with internal rebuilding and formation of new business processes. Reengineering of business processes, one of the most popular areas of transformation, involves rethinking and transforming the key business processes of an enterprise with a view to implementing active coordination of its functional parts and increasing flexibility and adaptability to the external environment. Reengineering involves abandoning old approaches to performing production tasks (functions), reorganizing existing information systems, expanding the range of users, and increasing the openness of the enterprise. The number of levels of hierarchy in the companies of cluster B significantly increases compared to the companies of cluster A and is on average 4.5.

The cluster C is examined below in greater detail. The average age of such enterprises significantly exceeds the age of enterprises of the first two clusters and is 116 years. They are also significantly larger by size.(size = 5.9). As for the level of formalization, it is quite high, but does not exceed the formalization of enterprises of cluster B (formalization = 24,9). The same can be said in relation to the processing information and levels of the hierarchy. Here they are 3.67 and 4.5 respectively. But the index of structure is significantly higher (structure = 2.75), which suggests the use of more divisive structures. With regard to the strategies, the clear answer to the question about the most often used strategies of the enterprise of this cluster cannot be given. Strategies of reengineering and regeneration can be identified. Regeneration is a process of complete restructuring of an enterprise, which covers all aspects of its functioning. Regeneration involves the maximum amount of action both in the direction of formalized actions and in the field of motivation, while reengineering has in both areas intermediate positions. Regeneration is also a leader in increasing the ability to set certain goals to create value and achieve the desired efficiency. Renewal is maintained at approximately the same level. The efficiency of reengineering is negligible.

The conducted research allowed to receive answers to a number of significant issues in the theory of ELC. In order to test the basic hypotheses, namely, the assertions concerning the existence of ELC models, the methodology proposed by Hanks and co-authors was used, which made it possible to prove the validity of the assumptions about the existence of separate stages in the development of an industrial enterprise. In the process of cluster analysis 3 clusters were obtained. The analysis of existing models of ELC demonstrates the tendency to summarize them in the five-stage model of industrial enterprise development. It can be assumed that most of the machine-building enterprises are in the 2nd, 3rd and 4th stages of the life cycle, which corresponds to the stages of formation, maturity and diversification.

It can be noticed that one of the notable characteristics of ELC is the level of formalization, the type of organizational structure and the process of information processing, but it was appropriate to add to these characteristics also indicators that would reflect the financial and economic side of the enterprise. As above, it was assumed that there is no precise binding of the company's age to the stage of its life cycle, indicators that determine the stage of the enterprise life cycle are considered further below.

4. The stage of the enterprise life cycle on the basis of determining the level of financial and economic activity of the enterprise and the state of competitiveness.

Consideration of the results of activities of the 18 investigated machine-building enterprises in Ukraine for the period 2010-2013 allows us to notice a higher degree of their progress by the level of actual efficiency. In our investigation, the actual efficiency of the enterprise is characterized by such components as a competitive position and the level of financial and economic activity of the enterprise. The competitive position is determined by the market share and its growth rate. The level of financial and economic activity determine the indicators of business activity, solvency, profitability, financial stability. Therefore, it is proposed to carry out a generalized assessment of machine-building enterprises from the point of view of their competitive position in the market and the level of financial and economic activity using the enterprise life cycle matrix, which can become an effective tool for industry analysis and selection of various methods and approaches to business administration at different stages of enterprise life cycle. Matrix based on the characteristics of the studied features, in which enterprises are systematized into fourteen groups, was constructed (Table 4). According to "the level of financial and

economic activity of the enterprise" , there are enterprises with a high , sufficient, moderate and low level of activity , and according to the "competitive position"-market leaders, enterprises with a strong market position, enterprises with a weak market position and market outsiders.

Table 4: Matrix of the definition of the stage of the enterprise life cycle

Level of financial and economic activity	Competitive position of the enterprise			
	Market leaders	Strong competitive position	Weak competitive Position	Market outsiders
High level	1	3	5	9
Sufficient level	2	4	6	10
Moderate level	7	8	11	13
Low level	15	16	12	14

The matrix makes it possible to identify five stages of the enterprise life cycle, which are characterized by appropriate level of financial and economic activity and competitive position of the enterprise. Thus, the enterprises including in squares 1-4 represent the stage of maturity. Such enterprises are market leaders and have a large market share, have a high and sufficient level of financial and economic activity;

The stage of development includes the square of 5. This includes enterprises with a weak competitive position, which have a high and sufficient level of financial and economic activity due to which it will be possible to increase the market share;

The stage of accumulation (squares 6-8) includes enterprises with a moderate level of financial and economic activity according to their financial and economic activities, but they have sufficient market potential;

The stage of diversification (squares 9-11) is presented by market outsiders according to rates of market share, but they are quite attractive by financial, economic and technical characteristics that allows their further growth on condition they have skillful management;

The stage of decline (square 12-14) is represented by enterprises with a moderate and low level of financial and economic activity and with a lower than average market share, they have neither obvious competitive advantages, nor a high probability of their occurrence.

In practice, such matrix for the definition of the stage of the enterprise life cycle and for selection the appropriate method and approach of management could be created in several ways;

traditionally using the method of even-interval grouping of aggregate values, with the use of which similar matrices and maps are usually constructed, or using a wide statistical apparatus, that allows to identify the characteristics of vibrations of certain characteristics more fully and group their values in unequal size intervals.

The matrix with using traditional methods and statistical tools will be constructed to demonstrate the difference between the results of calculations in using these approaches.

If it is used the method of building the matrix by the equilibrium method , the value of the interval (h) will be calculated by the formula h=(X_max-X_min)/k, where X max and X min are respectively the maximum and minimum values of the parameter, K - the number of groups. The resulting intervals will be as follows:

1) for the parameter "the Level of financial and economic activity", the interval size will be h_{FEA} =0,1513, thus, the boundaries of classification groups; [0,0757; 0,227); [0,227; 0,3783); [0,3783; 0,5296); [0,5296; 0,681];

2) for the parameter"competitive position of the enterprise" the value of the interval will be HQ =5,567, and the boundaries of the classification groups, respectively, [0,028; 5,595); [5,595; 11,162); [11,162,0; 16,729); [16,729; 22,296].

Then, by building a map of the level of financial and economic activity of machine-building enterprises of Ukraine, we get the following cross-section of the situation in the industry (Table. 5):

Table 5: Matrix of the definition of the stage of the enterprise life cycle, built according to the generally accepted method

Level of financial and economic activity	Competitive position of the enterprise			
	Market leaders [22,296; 16,729]	Strong position [16,729;11,162)	Weak position [11,162; 5,595)	Market outsiders [5,595; 0,028)
High level [0,5296; 0,681]	Novokramatorsky machine-building factory	Kryuk carriage building factory		
Sufficient level [0,3783; 0,5296)	Kramatorsk plant of heavy machine-building	Starokramatorsky machine-building factory	Kharkiv Tractor Plant	
Moderate level [0,227; 0,3783)				Dnepropetrovsk Combine Plant Krivoy Rog plant of mining machinery Dneprovagonmash
Low level [0,0757; 0,227)				Kaliniv Machine-Building Plant Yuzhmash them Makarov Novograd-Volyn Plant of Agricultural Machinery Poltavmash Nizhynsilmash plant Plant name. VO Malyshev Drohobychinsky factory of automobile cranes Kharkiv Turboatom Electrotyazhmash

Thus, the most (namely 12) machine – building enterprises of Ukraine are outsiders of the market, and the basis of the industry consists four enterprises-Novokramatorsky machine-building plant, Starokramatorsky machine-building plant, Kryukov railway car-building plant, Kramatorsk heavy machine-building plant. Companies with a small market share and low level of financial and economic activity have little perspective and fall into decline.

Statistical tools that allow to consider degree of uniformity of data, their variation, features of distribution, are used for more adequate display of results of the analysis of machine-building enterprises of Ukraine on the indicators chosen for the analysis

The dynamics of the level of financial and economic activity and the average market share of machine-building enterprises shows a significant spread of individual values of these indicators. Thus, it is necessary to conduct their statistical analysis for the future qualitative work with them in order to determine the degree of homogeneity of the aggregates of characteristics and their suitability for further use. To do this, we use the factor of variation (formula 1):

$$V_{ar} = \frac{\sigma}{\bar{X}} * 100\%$$

here σ - square deviation; ¯X is the value of the changing attribute.

The factor of variation allows us to judge the homogeneity: if Var <17%, then the sample is absolutely homogeneous; if 17% <Var <33% - sufficiently homogeneous; if 35% <Var <40% - insufficiently homogeneous; if 40% <Var <60% - this indicates a large difference of aggregate values [13].

Calculations of the statistical indicators of the average aggregate value, the standard deviation and the coefficient of variation based on two grounds are given in Table 6:

Table 6: Test of homogeneity of a set of values of the financial and economic activity level and market shares of the machine- building enterprises in Ukraine

Statistical Index	Statistical Estimates	
	Level of financial and economic activity	Market share of enterprises
1. Average aggregate value, ($\overline{X}$)	0,28	5,56%
2. Standard deviation, (σ)	0,171	7,08%
3. Coefficient of variation, (Var)	60,24%	126%

The calculations show that the variation of the selected indicators in the case of the level of financial and economic activity is high, and in the case of market share-excessive, which indicates the impossibility of adequate application of the methodology for further analysis and comparison of the values of these parameters without a certain ordering.

Thus, the set of indicators of eighteen machine-building enterprises has been divided into two sectors in order to exclude the influence of very large and very small indicators : the first allocates enterprises with an indicator of the level of financial and economic activity and market share above the average, and the other - below this value (Table 7).

After the distribution of the parameter values into two sectors , the variation indicators improved significantly: for the market share in the first sector Var1 = 37%, in the second sector Var2 = 83% (the lower value is not possible due to the very high relative variation of the extreme values of the trait around the average - the oscillation coefficient is 277%); according to the level of financial and economic activity of enterprises in the first sector Var1 = 20%, in the second sector Var2 = 40%.

In forming the matrix of the enterprise life cycle, an important issue is to determine the boundaries of the intervals of the proposed classification groups. Usually, for solving this problem, practice managers use structured grouping for a given number of groups at even intervals..

The width of the interval is calculated by dividing the difference between the maximum and minimum values of the attribute by the number of groups. However, this approach somewhat distorts the real situation with the classification of certain objects according to the selected characteristics because most often their variation is heterogeneous and there is an unjustified shift of individual values of the characteristic in the group with better or worse characteristics.

Since the set of characteristics of the investigated phenomena is not normally but rather approximately to normal distributed (there are considerable asymmetries), it is offered to minimize distortions of grouping of values of indicators by use of the rule of "three Sigma" . This is lawful to apply ,if the hypothesis of normality of distribution of the General population is carried out but approximately to normal (there are considerable asymmetries). It is offered to minimize distortions of grouping of values of indicators by use of the rule of "three Sigma" ,which is lawful to apply if the hypothesis of normality of distribution of the General population is carried out. It is the rule of "three Sigma" that says that with a probability of 0.9973 the random variable is in the interval ± 3σ (σ is the standard deviation) [14]. The use of this method will allow to determine the boundaries of the intervals, in which the results of research will be highly accurate. Due to the fact that the use of the "three Sigma" method is subject to the condition of normality of the distribution of values, this hypothesis with respect to the market share and the level of financial and economic activity of the studied machine-building enterprises is checked.

Table 7: Sectoral distribution of indicators of market share and level of financial and economic activity of the machine-building enterprises

Name of the enterprise	Level of financial and economic activity, coefficient		Average market share, %	
	1 sector	2 sector	1 sector	2 sector
Novograd-Volyn Plant of Agricultural Machinery				
Poltavmash	-	0,129	-	0,86
Dneprovagonmash	-	0,271	-	1,21
Kaliniv Machine-Building Plant	-	0,215	-	3,52
Starokramatorsky machine-building factory	0,376	-	12,55	-
Kharkiv Tractor Plant	0,473	-	-	5,46
Kryuk carriage building factory	0,563	-	13,03	-
Azovzagalmash	0,496	-	8,71	-
Novokramatorsky machine-building factory	0,681	-	22,42	-
Krivoy Rog plant of mining machinery	-	0,265	-	2,05
Electrotyazhmash	-	0,156	-	1,19
Nizhynsilmash plant	-	0,112	-	0,35
Plant name. VO Malyshev "	-	0,104	-	0,25
Kharkiv Turboatom	-	0,101		
Yuzhmash them Makarov		0,199	-	3,10
Dnepropetrovsk Combine Plant		0,234		2,70
Kramatorsk plant of heavy machine-building	0,482	-	20,29	-
Drohobychinsky factory of automobile cranes		0,076		0,16
Average value	0,512	0,169	15,4	1,91
TOTAL	-	-	77,00	33,00

As a basis the Shapiro-Wilk criterion is used [14], because it allows to check the distribution for compliance with the normal one with a sufficiently small sample (n >3). The criterion is recommended to be applied in the absence of a priori information about the type of possible deviation from the normality and when one can choose a hypothesis of the following form: approximately symmetric distribution (AS <1/2 and ex <3) or asymmetric distribution (AS > 1/2). AS is the parameter of asymmetry of the distribution, and Ex is the parameter of excess. The validity of using the Shapiro-Wilk criterion in the case of our indicators is checked (Table 8.)

Since the results presented in Table 8 allows to use the Shapiro-Wilk criterion, necessary calculations will be made and the degree of normal distribution of the values of the parameters studied will be determined. The algorithm for hypothesis testing, the Shapiro-Wilk test [14]:

1. Make null hypothesis: “the General population is normally distributed". As a confidence probability, use p = 0.99 and assume that the value of the market share of machine-building enterprises and their investment attractiveness are normally distributed.

2. The parameter S (standard deviation of Lloyd) is calculated by the formula

$$S = \sum_{i=1}^{n/2} a_{n-i+1}\left[x_{(n-i+1)} - x_i\right]$$

where i-the index, which varies from 1 to n / 2 when paired n; a_{n-i+1} -the parameter is determined by the corresponding tables.

For a sample of 18 engineering enterprises i = 1;9. The parameters of a_{n-i+1} are 0,4886; 0,3253; 0,2553; 0,2027; 0,1587; 0,1197; 0,0837; 0,0496; 0,0173 [15].

Define S for the market share and the level of financial and economic activity of machine-building enterprises: SPH= 14,36; SPEA = 0,42.

Table 8: Characteristics of distribution of market share and investment attractiveness of sea ports by indicators of asymmetry and excess (calculated by the author by [15])

The statistical indicator	Estimates of market share distribution	Estimates of the distribution of the level of financial and economic activity
1.Asymmetry of distribution: at As > 0 right asymmetry ; at As <0 left asymmetry; As <0,25 - weak asymmetry; As = 0,25-0,5- moderate asymmetry; As > 0,5 - extremely asymmetric distribution	As = 1,25 , i.e. right extremely asymmetric distribution	As = 0,03, i.e. right weak asymmetric distribution
2. Coefficient of excess (degree of sharpness of distribution): at Ex = 0 distribution is normal ; at Ex > 0 distribution is peaked; at Ex <0 distribution is flat-top	Ex = 0,2, i.e. the distribution is a little peaky	Ex = 0,15, i.e. the distribution is a little peaky
Conclusion: application of Shapiro-Wilka criterion is justified		

3. Determine the observed value of the Shapiro-Wilk criterion:

$$W = \frac{S^2}{\sum_{i=1}^{n}(x_i - \bar{x})2}$$

For the indicator of the market share W_{ms} = 4.45, for the indicator of the level of financial and economic activity of machine-building enterprises Wfea = 12.26.

At the selected value of the confidence probability p, we determine the critical value of the $W_{табл}$ criterion from the table [14] for the known sample size n.

For our case Wtable, = 0.858.

The hypothesis of the normality of the sampling distribution law is accepted for a given confidence probability p if W > Wtable.

Since WFH> 0.858 and WFEA> 0.858, thus, the hypothesis that both parameters are normally distributed is accepted and the use of the "three sigma" method is possible to determine the limits of the groups selected for classification.

Determination of the boundaries of the intervals by "three Sigma" is carried out in accordance with the method described in the source [15].

However, previously, two sets were divided into sectors, i.e. a second sample from a normally distributed general population was considered, thus, for the calculation of the standard deviation for the first and second sectors, the formula for determining intervals of intervals using the "three sigma" method was modified. The results of the calculations are given in the table.

As a result, a matrix was built to determine the stage of the enterprise life cycle to select and implement appropriate enterprise life cycle management methods and approaches.

According to this matrix, vertically located indicators of the level of financial and economic activity, and horizontally - a competitive position in the market (Table 10).

Table 9: Calculation of the boundaries of groups for indicators of market share and level of financial and economic activity of machine-building enterprises

Indexes	Estimates of the distribution of the level of financial and economic activity		Estimates for the distribution of the market share	
	1 sector	2 sector	1 sector	2 sector
1. Average by sectors ($\bar{x}$)	0,512	0,169	15,4%	1,91%
2. Standard deviation (σ)	0,101	0,067	5,737%	1,585%
3. Adjusted standard deviation (s)	0,096	0,063	5,419%	1,497%
4. Average aggregate value ($\bar{X}$)	0,283		5,56	
5. Boundaries of intervals	0,58	0,124	19,34	0,825
6. Boundaries of classification groups	[0,0757; 0,124); [0,124; 0,283); [0,283; 0,58); [0,58; 0,6806]		[0,028; 0,825); [0,825; 5,56); [5,56; 19,34);]19,34; 22,24]	

Table 10: Matrix of the definition of the stage of the enterprise life cycle

Level of financial and economic activity	Competitive position of machine-building enterprise			
	Market leaders [22,24; 19,34]	Strong position [19,34; 5,56)	Weak position [5,56; 0,825)	Market outsiders [0,825; 0,028)
High level [0,58; 0,6806]	Novokramatorsky machine-building factory			
Sufficient level [0,283; 0,58)	Kramatorsk plant of heavy machine-building	Kryuk carriage building factory Starokramatorsky machine-building factory Azovzagalmash	Kharkiv Tractor Plant	
Moderate level [0,124; 0,283)			Kaliniv Machine-Building Plant Yuzhmash them Makarov Dnepropetrovsk Combine Plant Novograd-Volyn Plant of Agricultural Machinery Krivoy Rog plant of mining machinery Electrotyazh-mash	Nizhynsilmash plant
Low level [0,0757; 0,124)			Dneprovagon-mash Poltava	Plant name. VO Malyshev Drohobychinsky factory of automobile cranes Kharkiv Turboatom

Comparison of the results of the assessment of enterprises presented in the matrix of determining the stages of the life cycle with the previous results of the analysis based on the use of context variables, suggests that there is a connection in the results obtained from these approaches.

2. Conclusions

Thus, it can be concluded that in the conducted research necessity of establishment of a stage of enterprise life cycle was proved and five such stages on the basis of generalization of theoretical approaches of scientists are defined. According to analysis of empirical data concerning the activity of mechanical engineering enterprises on the relevant indicators characterizing their internal environment allowed to supplement the existing methods. At the level of contextual indicators such as the age of the enterprise, the organizational structure, the number of diversification directions of the activity, it was proposed to use indicators of the level of financial and economic activity and competitive positions of the enterprise. This decision allows to obtain more accurate results for the establishment of the stage of the enterprise life cycle. The proposed indicators can be expanded and refined, but the main thing is that they should necessarily complement the procedure for determining the stage of the enterprise life cycle. The accuracy of such calculations will allow to make an informed management decision concerning the methods of enterprise management and the option of the appropriate direction of development, which will satisfy the possibilities and needs of the investigated enterprise.

The practical application of the assessment of the level of financial and economic activity of the enterprise and its competitive position allows not only to analyze the state of the industry as a whole, but also to find as well as possible better sides each of the studied enterprises according to the proposed criteria. In addition, two important characteristics - the level of financial and economic activity and the competitive position-can be considered as complementary. Creating a matrix for determining the stage of the enterprise life cycle programmatically (using MS Excel tools or other similar programs), it's possible to observe the change in the position of the enterprise depending on the achieved quantitative value of the indicator which put into the appraisal model, as well as the transformation of the situation in the market as a whole.

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