Study of the impact of the life cycle of aircraft engines on the strategy of an engineering enterprise

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Abstract. The article explores the relationship between the life cycles of aircraft engines / engineering plants / aircraft engine industry with various strategies based on organic and material approaches. The analysis of the characteristics of the life cycle stages of aircraft engines that affect the performance of an innovation - active enterprise (a part of the United Engine Corporation (UEC)) is presented. The basic toolkit has been studied, which allows to competently and reasonably form the relationship of the life cycles of an aircraft engine / enterprise / of UEC with strategies to ensure the stable functioning of the organization.

Modern conditions for the functioning of innovation - active enterprises in the aircraft engine industry in a dynamically developing external economic environment dictate the rules for taking into account their relationships with the life cycles (LC) of aircraft engines manufactured. The issues of managing the life cycle of various objects operating in the external environment occupy a special place in the research of domestic and foreign scientists. The study of the cyclical problem of the development of various management objects showed the presence of a fairly close relationship between the product, organization and industry life cycles. Despite this, the author’s study showed the insufficient analysis of these connections’ formation. In theory and practice, there are certain approaches to managing the life cycle of products. Such well-known approaches are organic, which has a contemplative nature, and material, which has an active impact on the external environment to achieve the desired goals of the organization based not only on managing its resources, but also on the life cycle. Studying the concept of life cycles using a material approach made it possible to analyze all the possible interactions and interdependencies of products / organization / industry with various strategies to create a favorable environment for the stable functioning of innovation - active organizations.

Table 1. The study of the characteristics of the stages of the product life cycle.

| No | Stages of the product life cycle | Characteristic features of life cycles that actively influence the results of the activity of an innovation - active organization |
|----|--------------------------------|------------------------------------------------------------------------------------------------------------------|
| 1  | Market entry                   | Characterized by a small sales volume of the organization’s product. It may also be characterized by loss-making activities due to significant initial cost, which also include marketing costs. In addition, this stage is characterized by a small volume of production, and, sometimes, the lack of effective technology. |
No | Stages of the product life cycle | Characteristic features of life cycles that actively influence the results of the activity of an innovation - active organization
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22 | Volume growth | Characterized by a rapid increase in the sales of the organization’s product, which is determined by its active consumption, growth in product profitability due to increased profits and a decrease in the relative share of marketing costs. The functioning of the organization is characterized by stability.
33 | Maturity | Characterized by a slowdown in sales growth due to almost complete satisfaction of consumers’ needs for the product produced by the organization. At this stage, there is an increase in competition, an increase in marketing costs or advertising costs, a possible decrease in market prices, as well as profit margins. With modernization, an increase in the duration of the stage is possible.
44 | Recession | Characterized by a sharp decrease in sales volumes and the amount of profit received. An increase in the time spent by the organization at this stage is possible due to: modernization (as at the maturity stage) of a product produced by the organization, lowering its price, increasing marketing costs, etc. At this stage, profit maximization compared with sales volumes maximization shifts towards the initial stages of the life cycle. This is due to the increase in the organization’s expenses to maintain the sales of its product in the later stages of its life cycle.

The concept of a life cycle applies both to product classes (aircraft), and to the type of product (fighter) or to a specific brand of product (Su-35 aircraft is a Russian multi-purpose, highly maneuverable fighter with a controlled thrust vector of the 4 ++ generation developed by Sukhoi Design Bureau). Of greatest practical interest is the study of the life cycle of the brand of a particular product of the organization: at different stages of the life cycle, various marketing strategies should be used.

The nature of the product life cycle curve, as shown by the study, is related to its specificity (features of demand formation, consumer preferences, etc.) and remains more or less similar for most products. This means that after the appearance of a product on the market, its demand by consumers, its sales volume first grows and then falls. Nevertheless, the time duration and the rate of transition from one stage of the life cycle to another vary greatly and depend on the specifics of the product itself and the market. The transition from stage to stage is not always smooth, therefore it was recommended to organization’s marketing department to carefully monitor the dynamics of sales and profits in order to catch the boundaries of the stages and, if necessary, make adjustments in the marketing program. The life cycle theory is quite popular; however, domestic and foreign experience does not confirm the passage of the four-phase cycle by most products, even taking into account transition moments. Therefore, it is possible to consider various types of life cycle curves, starting with the identification of consumer preferences. The type of life cycle curve can be the result of targeted management without the influence of external factors. Many managers are of the opinion that the product produced by their organization will inevitably have its own life cycle curve, and miss new market opportunities, the possibility of updating technology, etc. As a result, they look for a different business or its other directions.

Today there is a rather extensive toolkit that gives organizations the opportunity to determine the life cycle of their products, taking into account its features, for further updating their development strategy. Some common tools are the BCG (Boston Consulting Group) matrix and the McKinsey Matrix (MKK). These tools are described in detail in the sources of special literature, and there is no need to discuss them in detail. The main recommendations for possible strategies used are presented in the figure.
Organizational and economic characteristics can change at different stages of the product life cycle. It requires different tools for management. During the analysis of the life cycle theory, it was revealed that most researchers approach the concept of life cycle from terms of organizational and economic development. In the process of research in this area, a sufficiently large number of different models of the step-by-step functioning and development of the organization were revealed, significantly different from each other. In the vast majority of studies, a four or five-stage organization life cycle model (OLC) is proposed.

Based on the results of the study, it was concluded that the key to success in managing an organization is the ability to focus on solving problems that are inherent in this stage of its life cycle in order to ensure its successful further development. In the domestic scientific literature, there are only a few works devoted to the theory of OLC. However, these works are either descriptive or analyze in detail any of the well-known models and comments. To identify similar elements that characterize different stages of the organization’s development, the author analyzed thirteen models of the organization’s life cycles, in each of which the content was disclosed, which made it possible to see the frequent ignoring of the stages of early development and decay. This omission makes managers independently look for solutions characterized by a large scatter at these stages of the development of their organizations, spending a significant amount of time and resources on this.

The author revealed that when studying the theory of organization life cycle, the most difficult is to calculate the duration of each of the stages that the organization goes through, since sources of specialized literature do not give recommendations for its determination and forecasting. However, as an essential factor that has a huge impact on the "growing up" of the organization, the fierce competition in the market stands out. The study of specialized literature also showed that many scientists are unanimous in the opinion that each stage of the life cycle contains its own unique structure, systems and leadership style, and transitions from one stage to another do not occur naturally and smoothly, regardless of the desire of top management. Studying the theory of ensuring the development of organizations helps in determining the stage of development of the object of study, which provides an objective reliable forecast and a reasonable choice of directions for current or future changes. If necessary, you can also timely adjust the organization’s strategy to pre-empt uncontrollable changes.

The advantage of another tool – ADL matrix of strategic planning – is the ability to take into account in a comparative analysis the cyclical development of the market in which the organization operates, and to choose one of the proposed strategic decisions. The position of a certain type or line of business is marked on the matrix at the same time as other types or lines of business of the organization. Depending on the position of the type or line of business, the matrix reflects a clearly thought-out pool of strategic decisions. As criteria, one can use the profitability of aircraft engine production or the market share. Information on the stages of the life cycle certainly follows directly from the specifics of the development of the aircraft engine building industry.

Another tool designed to balance the corporate business portfolio is the Hofer – Shendel model, which can also be used to analyze domestic and foreign competitors both at the corporate and business
levels. It is important to note that only four countries of the world - Russia, the USA, Great Britain and France - possess full cycle technologies for creating modern turbojet aircraft engines. The aircraft engine building industry is internationally recognized as one of the most high-tech industries, using the most unique achievements of science, technology, and high-tech at its enterprises. With each year of development of the aircraft engine industry, the requirements for the reliability of aircraft engines, increased resource, operational manufacturability, and impeccable environmental indicators are steadily increasing. The production of aircraft engines at the present stage provides for the coordinated work of many related enterprises and numerous manufacturing divisions. To ensure the coordinated work of all involved in the design, manufacture, sale and operation of products, appropriate information support is used at all stages and stages of the product life cycles.

To identify the stage of the life cycle of the market, the author recommends using the following variables as distinctive parameters-characteristics: changes in the market growth, rates of technological changes in the product, rates of market growth, rates of technological changes in the process, market segmentation and functional value. The last tool investigated in this work to help analyze the LC industry will be a study by M. Porter, which characterizes each stage of the industry from a competition position. A study of the portfolio of aircraft engines produced (which UEC enterprises use for an objective assessment) revealed the lack of a tool that would allow to take into account the cyclical development of the industry / organization / products and link the results of the analysis with the pool of strategies. ADL matrix is the only exception. The strategies proposed by various authors of the special literature are only of a static nature, which does not allow a clear understanding of the further actions of organizations in terms of their development direction, and accordingly adjust this vector depending on the transition to a new stage. This study allowed us to formulate the concept of cyclical strategies, which was reflected in the concept of its life cycle.

The search for effective tools allowed us to put forward the idea of a possible integration of the organization’s current strategy with other close target strategies. However, it should be borne in mind that in theory, the strategies developed and adopted for implementation already have the set of their distinctive elements described by the authors of the special literature, which allows this or that strategy to remain “recognizable”. Therefore, the author of this study developed an original toolkit based on the search and fixing of intersections of traditional (basic) strategies with the current organization development strategy. The concept of the strategy life cycle will be to develop the strategy in the process of its implementation. This provision will contain the following steps:

- Reasonable choice and adoption by the organization the strategy for implementation.
- Adaptation / transformation of the organization to the selected and adopted strategy.
- Movement of the organization towards innovative transformation.
- Search for a new organization development strategy.

At the first stage, the criteria for choosing a development strategy by the organization, its direct selection and acceptance for implementation, are formed.

The second stage involves the disclosure of the potential of the strategy through its characteristics, which will allow managers to substantiate goals and correctly formulate the tasks that are solved within its framework; the strategy is in its prime, the results of the organization's activities within the framework of this strategy are maximum. At this stage, the innovative activity of the organization is maximum.

At the third stage, the current strategy no longer meets the requirements for the stable functioning and development of the organization, which means that its characteristics do not meet the changing external conditions, as it does not ensure the achievement of the desired goals. As the study showed, in this situation it is not advisable to abandon the current strategy, since it can be updated by integrating its elements with stimulating elements of the goals of other strategies that are similar in direction, corresponding to the stage of the life cycle of the control object. For this, it is necessary to conduct a detailed analysis of all available traditional (basic) strategies, decomposing them into relevant basic elements that will characterize a particular development strategy of the organization. When highlighting
the elements corresponding to the strategies, it is also necessary to take into account the orientation of the organization in terms of its innovativeness. These actions will make it possible to transform the strategy by translating it into a new innovative state, which will allow to talk about its innovative transformation. However, such a transformation is possible only if the organization has prepared the "ground" for its change in the direction of innovative activity. The human factor could be the bottleneck. Therefore, it is so important to take into account the stimulating elements of integrated strategies, related to work with the organization’s human resources. In the process of functioning of the organization, an archive of actual performance indicators is being formed. The financial department, based on the information collected, compiles regular reports on the current situation of the organization, and also allows to track the implementation of tactical plans and budgets of the organization, which serves as a factor in assessing the effectiveness of the chosen development strategy. Monitoring and analysis of the organization should be carried out at regular intervals. It was recommended to hold a meeting at the level of financial, business, production, managerial, personnel units of the organization once a quarter, within which the current situation of the organization and its comparison with the indicators for the same time period of the previous period are discussed. After the discussion on progress in the implementation of operational and strategic plans, if necessary, a decision is made to collect additional information and additional control of indicators, decisions are made on the need to adjust the indicators planned values, new strategic initiatives are discussed.

It is also recommended to hold extended annual meeting, during which additional issues such as analysis and comparison of current year indicators with the past, analysis of industry dynamics, discussion of new prospects and opportunities, as well as risks and threats of the organization will be discussed. Also, new strategic goals and objectives of the organization’s development for the next year and ways of their implementation are determined taking into account the life cycle of products/services, the organization itself and the industry in which it operates.

A special place in the process of both selection and implementation of the chosen development strategy is occupied by the issue of staff motivation. It is no secret that in a revolutionary way of development, organizations often face resistance to change from their employees. The proposed evolutionary path of development, consisting in successive, continuous, dynamic change of strategies, has a great advantage. It is recommended to inform not only top managers, but also ordinary employees about changes or adjustments in the direction of the organization’s development. This will help to greatly simplify the appearance of misunderstandings and errors caused by the lack of necessary information. It is recommended to inform staff about the main changes in the functioning and procedures of the organization at special events held as they accumulate important information. If the adjustments made in the organization’s functioning system seem significant, it is recommended to arrange both theoretical and practical training courses. The motivation system is a separate issue of great importance. The organization’s personnel should be interested in the effective implementation of changes and the further maintenance of the organization’s stable functioning. Implementation of the proposed system for choosing an organization’s development strategy is regular and universal for all organizations, regardless of the scope of their functioning.

The fourth stage will be characterized by wide discrepancies between the capabilities of the current strategy and the needs of the functioning and development of the organization in the innovation environment, so that the introduction of stimulating elements will be meaningless. The strategy at this stage becomes ineffective, its reanimation (integration with new stimulating elements) is impractical, and therefore, the organization needs to move on to choosing a new, traditional, situationally suitable strategy.

The study conducted by the author indicates the serious influence of taking into account the life cycle of the control object on the results of its activities, as this allows timely adjustments to the organization’s direction of activity, to slow down or accelerate the transition to the next stage of development, if necessary for sustainable functioning and increase its innovation activity.
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