***This study focuses on the process of strategic change management at a high-tech enterprise. The task addressed relates to the lack of a unified pedagogical method for managing the strategy of changes, which would combine situation analysis, diagnostics of the structure of enterprise functions, and economic-mathematical prediction of the effectiveness of transformation decisions.***

***The main results are as follows. It has been proven that the success of transformations does not depend on individual management decisions but on a set of organizational resilience factors that help the enterprise adapt innovative processes to changes in the external environment. In the process of studying, a conceptual model of change management was built, which allows for the coordination of environment monitoring, situational diagnostics of structural inconsistencies, and the design of organizational shifts in a single management circuit.***

***The economic-mathematical assessment was performed on the basis of data on the activities of TOV "Flight Control" in 2015–2024 using regression-correlation analysis. A statistically significant impact of internal functional subsystems on the integrated performance indicator, the overall profitability of the enterprise, which increased from 9.3% in 2015 to 13.6% in 2024, was revealed.***

***The modeling results showed that the greatest positive impact on profitability is exerted by controlling and risk management ($\beta = 39.55$), innovation and R&D ($\beta = 26.53$), marketing and foreign contracts ($\beta = 25.99$), while financing of innovation projects without proper administrative support is characterized by a negative impact ($\beta = -28.74$). Correlation analysis ($r = 0.86–0.98$) confirmed the systemic relationship of management factors, which justifies the appropriateness of a comprehensive, rather than a separate, approach to strategic changes.***

***The results could be used by enterprises in the high-tech sector to carry out structural and organizational changes, devise reorganization programs, optimize production and business processes, as well as to increase the level of innovative development***

***Keywords: high-tech business, organizational changes, situational analysis, economic-mathematical modeling, management efficiency***

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# CONSTRUCTION OF A STRATEGIC CHANGE MANAGEMENT MODEL TO ENABLE THE EVOLUTION OF A HIGH-TECH ENTERPRISE

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## 1. Introduction

The current stage of evolutionary changes in the world economy is characterized by a dynamic activation of technological transformations, the transition to digitized production structures, and the growth of the importance of intellectual capital as the main strategic resource. Advanced enterprises occupy a key position in these changes, because they lay the foundation for innovative activity, contribute to the formation of industrial groups, and manufacturer goods with a higher degree of added value. Under such conditions, existing and established models of development management are unable to guarantee the appropriate speed of response to threats caused by technological changes, a decrease in the duration of product life cycles, and the complication of production systems. It is the strategic management of organizational transformations that will attract attention, acting as the main way to ensure the future progress of a high-tech enterprise. This very toolkit makes it possible to introduce innovations into all levels of organizational architecture, allows for the combination of management decisions with the dynamics of the external environment, creates a flexible structural configuration and supports the integrity of technical modernization [1]. At the same time, modern transformation processes

for high-tech enterprises are characterized by considerable complexity, as they integrate technical, organizational, economic, and social dimensions.

There is considerable interest in the scientific community in the issues of organizational change management, but most of the existing concepts focus on individual components of the process: organizational culture, communication principles, leadership influence, or technological innovation. They do not provide comprehensive coverage of all aspects of such transformation [2]. The absence of a single integrated conceptual model that would be able to combine strategic diagnostics, forecasting mechanisms, econometric tools, and technological toolkit to support management decisions creates a scientific space that hinders the development of the practice of effective organizational changes.

For these reasons, our study is related to the construction of models for improving strategic change management for the growth of high-tech firms, as it correlates with the main difficulties of the modern economic system and the needs of the real sector of the economy. That is why advancements for improving the fundamental change management policy to ensure the long-term development of high-tech enterprises are timely.

## 2. Literature review and problem statement

Important principles regarding the evolution of change management in the context of digitalization are formulated in study [3], in which the emphasis is on the need to form new approaches to transformations. However, the limits of the analytical model remain too general since it is not revealed how the tools of strategic administration could be integrated into the technical and technological cycles of high-tech industries. Despite the fact that the authors substantiate the need for a qualitatively new type of managerial sensitivity, the mechanism of coordination of organizational changes with the life cycle of innovative products remains out of focus, which creates a theoretical failure in the formation of complex models of strategic influence.

In work [4], the authors described the level structures of organizational change options in relation to enterprise development programs. They emphasized the options for the interaction of individual, group, and system transformations, but omitted the issue of instrumental support for technologically complex systems remains open. The reason for the authors' limitations is the complexity of the empirical basis when searching for consistency between the levels of changes in the market environment. A logical way to overcome this shortcoming is to integrate the method of situational analysis with predictive modeling methods.

A factor of strategic management effect on the effectiveness of the activities of enterprises in the industrial sector under the conditions of digital management was substantiated in [5]. However, the methods devised are overly focused on the statistical validation of dependences and do not reveal the architecture of the process of strategic transformations as such. This is due to the fact that digital administration in the production environment is a multidimensional phenomenon that requires means of structural integration, and the lack of such means makes it impossible to implement the drawn conclusions to high-tech companies.

Work [6] deepens the understanding of the role of entrepreneurial abilities and organizational resilience in strategic changes, but its limitation is the fact that the main focus is shifted to the behavioral and psychological components of adaptation, which does not make it possible to synthesize an effective mechanism of interaction between the technological complexity of production and management decisions in the field of transformations. This gap can be overcome by building hybrid models that combine behavioral and quantitative indicators. A significant array of conceptual provisions is reported in [7], in which change management is considered as the basis of enterprise adaptability, but the authors focus mostly on the general principles of building an adaptive system, without detailing the mechanisms that confirm the effectiveness of the implemented changes.

A comprehensive study of process optimization is reported in [8], but even with a broad sectoral analysis, the question of how enterprises can integrate the results of technological audits into the system of strategic changes is not sufficiently addressed. Presumably, because such processes require not only technological but also organizational and cultural shifts, which are much more difficult to formalize. Paper [9] provides strong evidence that strategic consensus is a key factor in the innovative performance of high-tech enterprises, but it does not disclose how this consensus is ensured in conditions of high market dynamics and rapid technological renewal.

The materials from study [10] indicate that to a large extent, the effectiveness of change management depends on the consistency of organizational decisions and the formation of the levers for overseeing the implementation of transformations. Special emphasis is on the development of productivity factors and organizational performance. At the same time, the work does not address aspects related to the coordination of performance assessment systems with real technological steps of high-tech enterprises, which complicates the construction of a holistic model of strategic management. The reason is the great variability of the structure of high-tech systems and the limited availability of empirical data that would make it possible to build a comprehensive metric architecture of the efficiency of transformations. This forms a basis for further studies aimed at devising complex assessment models that would take into account the intellectual and innovative components of enterprise activity.

Work [11] focuses on the influence of the technological capability of the enterprise and strategic flexibility on the implementation of industrial innovations. This gives grounds to consider the relevant parameters as the main vectors of the success of organizational transformations. However, the study only outlines the general dependencies between these factors, leaving out of consideration the measuring apparatus that would make it possible to form quantitative models for assessing the level of technological flexibility.

The high complexity of the described production systems and the significant heterogeneity of innovative processes make simple formalization impossible, and that is why further scientific work should be aimed at building metrics of strategic flexibility and their integration into transformation forecasting models.

In study [12], we observe that the large-scale implementation of technological innovations involves not only technical modernization but also methodologically verified change management, within the framework of which a multi-level adaptation of the organization to new technological standards is formed. Despite the presented analytics, the problem of interaction between the pace of technological renewal and the organizational ability of the enterprise to maintain the stability of business processes during the period of active

transformations remains unsolved. The limitations are associated with the difficulties of empirically measuring the processes of large-scale technological shifts, which complicates the modeling of the effects of transformations. In view of this, there is a need to form models capable of reproducing the cause-and-effect relationships between technological modernization and the stability of business systems.

As the results of empirical analysis [13] reveal, the strategic flexibility of the enterprise, its inclusion in the business network, and the use of high-tech production systems form a synergistic effect that ensures long-term competitiveness. Despite this, the work does not provide a deep interpretation of how network interactions in real production conditions affect the pace of adaptation of the enterprise to changes in the external environment. This is justified by the difficulties of modeling multilayered relationships between the subjects of network structures and the high costs of collecting detailed information about such interactions. It is quite possible to overcome these limitations by designing hybrid models of network dynamics research that take into account both structural and behavioral characteristics.

Study [14] lists the formats of functional changes but reveals the mechanism of how the digital tools present in the enterprise combine strategic decisions of process restructuring. We identify the lack of change technologies due to the large variation of digital platforms and the speed of their updating, which could be the basis for further research in the area of integration of digital solutions into the strategic model of corporate transformations.

In work [15], a conceptual approach to the analysis of strategic factors of development of international organizations was devised, which demonstrates the importance of strategic coherence at all levels of implementation. However, the study focuses mainly on interorganizational coordination and does not take into account the specificity of high-tech enterprises, for which the balance between innovation dynamics and organizational stability is decisive. Therefore, there is a need to transfer the theoretical provisions of strategic coherence to the context of innovation and technological systems.

Our review of the literature [4, 6, 9, 12, 14, 15] has shown that the change management framework does not sufficiently take into account the specificity of high-tech enterprises, in particular the high variability of innovation processes, dependence on transnational cooperation, the complexity of engineering technologies, and the need for a prompt response to exogenous challenges. Despite numerous scientific advancements, the issue of constructing an integrated model of strategic change management that would synthesize systemic and situational approaches, quantitative assessment methods, as well as forecasting tools, remains unresolved.

## 3. The aim and objectives of the study

The purpose of our study is to construct an integrated model of strategic change management for the development of high-tech enterprises. This will make it possible to assess the level of effectiveness of implementing changes in the functional support of the work of a high-tech enterprise.

To achieve the goal, the following tasks were set:

– to substantiate the theoretical and methodological basis of strategic management of organizational transformations, to determine its functional role in the development processes of high-tech enterprises;

– to propose the structure of a strategic change management model based on situational analysis, diagnostics of structural inconsistencies, and multi-level coordination of organizational transformations;

– to form a multifactor regression model for quantitative assessment of the effectiveness of organizational changes in the environment of high-tech enterprises.

## 4. The study materials and methods

The object of our study is the process of strategic management of changes in the functional support of the work of a high-tech enterprise.

The principal hypothesis assumes that the tangible effectiveness of strategic management of transformations at high-tech enterprises could be achieved by ensuring the consistency of the functioning of internal functional subsystems.

The scientific assumption is based on the statement that high-tech enterprises achieve sustainable development provided that a comprehensive transformation management system is introduced, which integrates multi-level monitoring, timely diagnostics of structural inconsistencies, assessment of influencing factors, and generation of adaptive organizational solutions.

A systemic approach was applied, which made it possible to consider a high-tech enterprise as an open socio-economic system with a multi-level structural organization. In order to study the interaction of the enterprise with the market environment in detail, the methods of situational and comparative analysis were used, as well as the morphological method, which enabled the identification of key structural components of the system and the justification of strategic vectors of transformation. The method of functional-structural analysis was applied to build a conceptual model of strategic change management, demonstrating the interdependence of target benchmarks, operational tasks, tools, and management decisions.

Based on the data on the economic activity at the enterprise TOV “Flight Control” (Ukraine) over the period of 2019–2024, a matrix of management efficiency was constructed with indicators characterizing production, engineering, innovation, financial, and logistics processes. Regression-correlation analysis was used to identify the patterns of influence of these factors on the performance indicator (overall profitability).

## 5. Results of the study on providing strategic change management to enable the growth of high-tech enterprises

### 5. 1. Theoretical and methodological principles of strategic change management in the functioning of high-tech enterprises

Under the current conditions of accelerated technological progress, the implementation of the updated concept of enterprise management involves transformational measures brought to the level of strategic thinking and tactics of market behavior. Traditional approaches, which are formed according to the logic of a planned economy, are unsuitable for high-tech types of business, and they function in a situation of a “buyer’s market”, when supply exceeds demand, and the manufacture of a product in itself does not guarantee its sale.

These components determine the shift in emphasis from a simple increase in production capacity to strategic change management, which will be focused on innovations, digital platforms, flexible business models, and individualization of the value proposition [16].

The "new" concept of strategic change management should be based on a systems approach, according to which a high-tech enterprise is considered as a complex open socio-economic system. It should interact with the external environment by transforming "inputs" (resources, data, knowledge, technologies) into "outputs" in the form of high-tech products, services, and a number of innovative solutions [17] (Table 1).

This leads to a number of key provisions:

– first, the enterprise must constantly maintain compliance with its strategies, processes and competencies with market requirements;

– second, rapid changes in the external environment are uncontrollable for management;

– third, this uncontrollability can be compensated only through the targeted implementation of a system of organizational and technological changes;

– fourth, these changes must adequately reflect the variability of the digital and innovation context, ensuring adaptability, flexibility and proactivity of the strategic development of high-tech enterprises.

The core of ensuring development for high-tech enterprises is the practice of strategic management of the process of organizational changes, which is based on a systemic approach and in-depth situational analysis of the external and internal environment (Fig. 1).

It is proposed to allocate a module of goals (I), focused on achieving long-term market success. For the enterprise, this will be not only a factor in increasing market value but also a basis for maintaining the position of a technological leader in the base market. Achieving such a general goal will involve the implementation of two interrelated sub-goals. First, maximizing the commercialization of innovative products and technological solutions while ensuring the target level of profitability, and second, forming long-term relationships with customers through the creation of added value from production [21].

The module of tasks (II) details the tools for achieving these goals and focuses on ensuring constant compliance of strategies, business models and organizational structures of a high-tech enterprise. This will correspond to the dynamics of scientific and technological development and market trends, which is implemented through the targeted implementation of organizational changes.

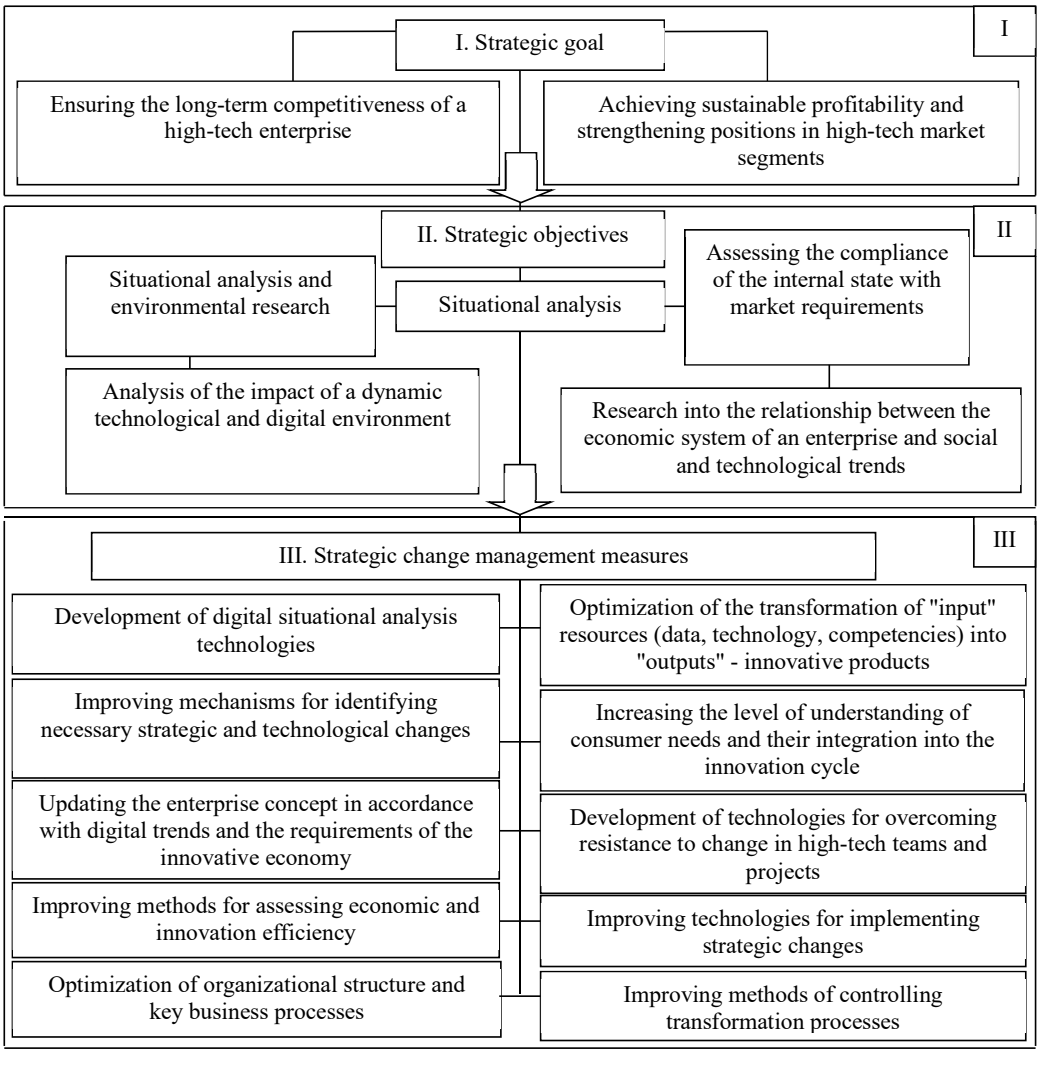


Fig. 1. Conceptual scheme of organizing strategic change management for the development of a high-tech enterprise (devised by Authors)

Table 1

Comparative characteristics of approaches to change management at high-tech enterprises (based on [18–20])

| Component | Traditional approach | A strategically oriented approach for high-tech enterprises |
|---|---|---|
| Digital external environment and technological dynamics | Relatively stable markets, limited technological change, predictable operating conditions | High turbulence, rapid technological innovation, emergence of breakthrough solutions, complex digital ecosystems |
| Environmental impact | External factors are considered as a system of constraints for choosing production tactics | The company actively shapes the terms of interaction, influences market standards and technological trends through innovation |
| Market conditions and competitive environment | Partial undersaturation, dominance of price competition, slow change in demand structure | Saturated global markets, high competition for innovation, knowledge and speed of product launch |
| «Main» on the market | Volume-oriented producer | Consumer and user of digital solutions, customer experience orientation |
| The role of the consumer | Passive recipient of products, limited influence on product policy | Active participant in co-creation of solutions, source of ideas for innovation and change |
| The company's behavior style in the market | Reactive: reacting to events on an event-reaction basis | Proactive: "analysis – forecast – anticipation", scenario planning, portfolio management of transformational projects |
| Enterprise management system | Mostly technocratic, functionally oriented management, fragmented changes | Integrated strategic change management, digital transformation focus, flexible and adaptive structures |
| «Philosophy» of top management | Enterprise management and process control | Strategically managing change and digital transformation to create innovative value |
| Location of key success factors | Mostly within the enterprise: equipment, resources, production facilities | Outside the enterprise: partner networks, technology alliances, access to knowledge, platforms and data |
| Directions for ensuring development and market success | Production rationalization, cost reduction, local process optimization | Situational and strategic analysis, innovation management, development of digital platforms, rapid adaptation to change, building flexible value chains, strategic change management as a continuous process |

On this basis, the last module (III) is already being formed, which covers areas for improving the management of the implementation of changes and determines a system of priority objects of management attention. These include critical business processes, project and risk management tools, and problem areas that require transformation [22]. The module provides a sequence of transformation stages and contains indicators of the effectiveness of changes, which is critical for substantiating strategic decisions and maintaining the pace of development for a high-tech enterprise.

**5. 2. Structure of a strategic change management model for a high-tech enterprise**

The new approach involves a transition from the traditional question for enterprise management "where is the enterprise and in what direction is it moving?". The transition occurs to a more strategic and identification model of the type "what is the enterprise in the existing ecosystem and what does it strive to become in the future" [23]. It is the discrepancy between the current state of organizational development and the desired target configuration that provides technological leadership and innovative capacity that forms both the field and vectors of necessary changes, determines their content and priority.

In fact, the model is based on three interconnected modules. The first module is environmental monitoring; it is the initial basis of the entire methodological complex. Its task is to provide the management of a high-tech enterprise with complete, reliable, and timely information about the internal state of the system and the dynamics of the external digital, market, and institutional environment. The implementation of the tasks of this module involves, firstly, the formation of an integrated information and communication system for collecting, processing, and visualizing data. Secondly, the construction of structured databases according to key areas of internal functional areas and external environmental factors that are critically important for technological renewal and innovative activity (Fig. 2) [24].

The second module, situational analysis, will act as the central link of the model, since it is at this stage that discrepancies between the existing parameters of the enterprise's functioning and the strategically desired characteristics of its development are identified, measured, and interpreted. The assessment is carried out in two main directions:

1) coordination of elements of internal potential with the requirements and capabilities of the external environment;

2) identification of necessary organizational, technological, and managerial changes that should be integrated into the portfolio of strategic initiatives at a high-tech enterprise.

In the context of strategic change management, a comprehensive analysis of the system of transforming "inputs" into "outputs" is gaining importance, which in the structural model of the study is identified with the upper level of the situational space. On this analytical plane, an in-depth study of the key functional areas of the enterprise is carried out using the "gap" matrix.

The specified tool identifies those components of the internal environment that do not meet modern technological, market or regulatory requirements, and sets the benchmarks for the necessary transformations that can provide the enterprise with the opportunity to respond in a timely manner to the dynamics of the external environment [25]. The analysis is carried out at the junction: "enterprise → outputs → external environment" and is identified with the lower plane of the situational model. It is aimed at assessing the extent to which the products, technologies, and services created by the enterprise are competitive from the standpoint of market standards, consumer demands and technological trends. At this stage, an idea is formed about the necessary changes in the parameters of "outputs" – their innovativeness, functionality, technological complexity, and cost. A desirable element

of the above analytical module is the coordination of the socio-economic and technical-technological subsystems of the enterprise. Parallel application of complementary analytical procedures makes it possible to form the topic of "coordinating" organizational changes, which are a necessary prerequisite for the synchronization of strategic, operational and project decisions in the enterprise management system. The next module of the model is aimed at forming a system of organizational changes, which will be structured in the form of relevant plans [26]. The application of the methodological approach, which is the basis of the devised model, requires the clarification of a number of conceptual positions that ensure its effectiveness. First, the model is aimed at implementing changes simultaneously at the strategic, tactical, and operational levels, which is especially important for high-tech enterprises where the high speed of technological changes requires multi-level coordination of decisions in the functional space of the enterprise.

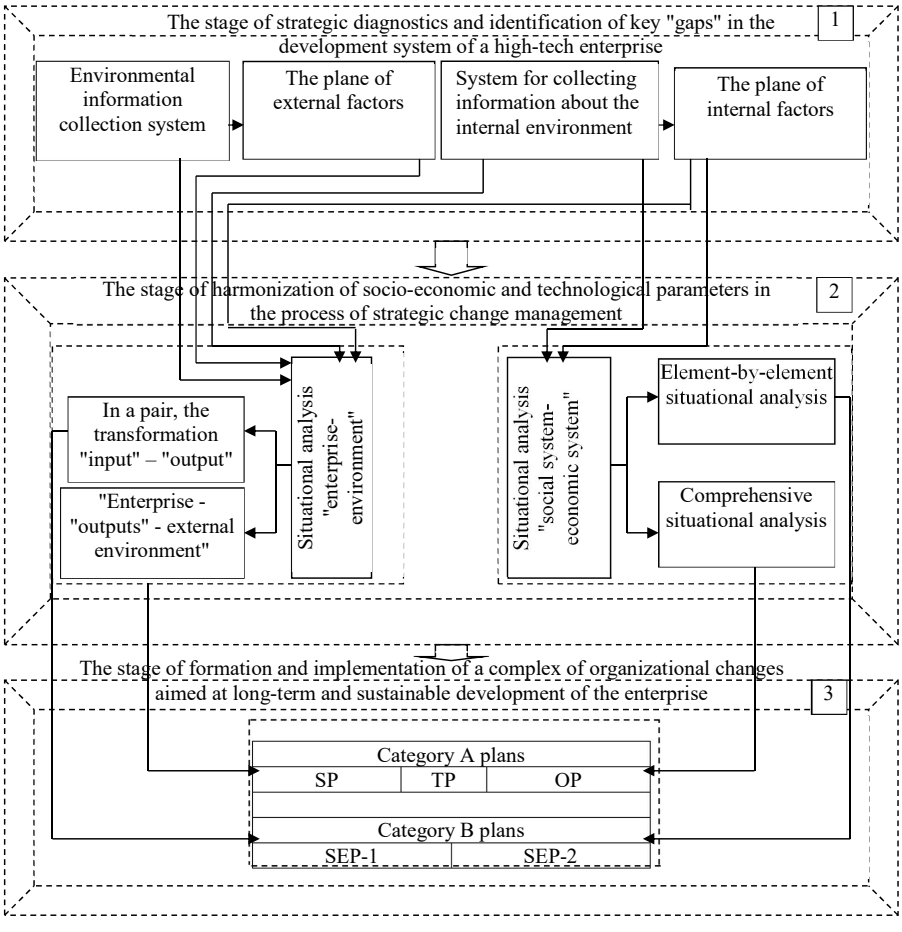


Fig. 2. Level structure of strategic change management at a high-tech enterprise based on situational analysis and elimination of structural "gaps" (SP — strategic level plans; TP — tactical level plans; OP — operational level plans; (SEP-1 — socio-economic plans of the first group; SEP-2 — socio-economic plans of the second group)

Secondly, we must be aware of the difference between the analysis of the system of transformation of "inputs" into "outputs" and the analysis in the format of the interface "outputs – market. The fundamental prerequisite for the successful implementation of organizational changes is the compliance of the organizational structure with the requirements of internal and external development factors [27]. The structure itself acts as an object of change, and its transformation will be coordinated with the level of mobility of the industry, the scale of the enterprise and the complexity of current production and technological processes (Fig. 3). The "enterprise – environment" matrix in the context of the object of research is transformed into a planar model that reflects the variability of organizational structures depending on the combination of key parameters of external dynamics and internal complexity.

The conceptual content is that with the growth of the scale of activity, technological saturation and intensity of changes. At the same time, the final choice of a specific type of structure is also determined by a number of specific factors related to the profile of high-tech activity, strategic priorities and resource constraints [28].

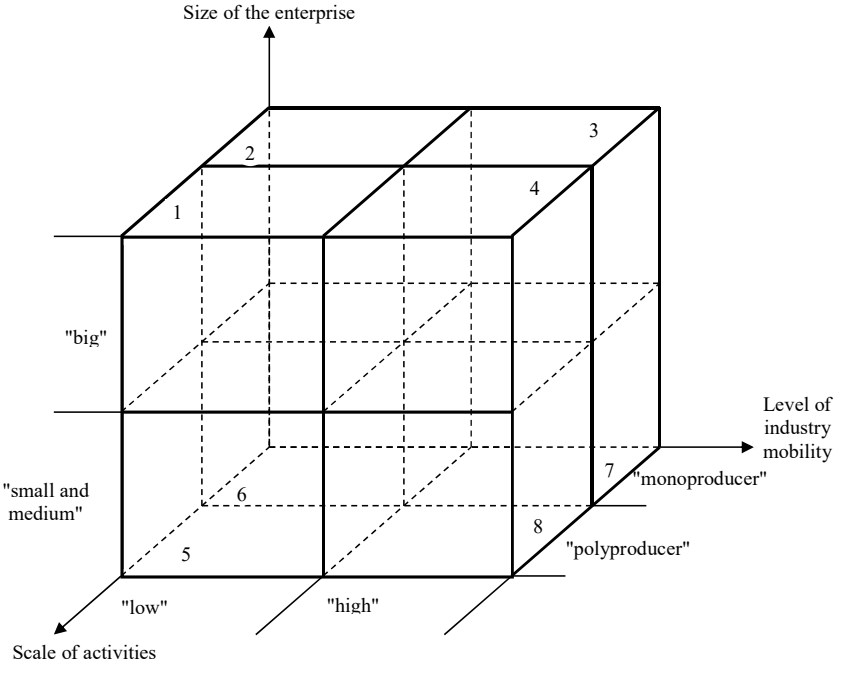


Fig. 3. The "enterprise — environment" matrix for selecting directions of organizational changes in the strategic management system at a high-tech enterprise (devised by Authors)

**5. 3. Economic-mathematical assessment of the effectiveness of strategic change management at a high-tech enterprise (a case of TOV "Flight Control")**

For TOV "Flight Control" (the city of Dnipro), which specializes in the production of components for aviation and space systems, the accuracy of assessing future values of management and technological parameters is a critical condition for maintaining competitiveness and innovation dynamics. Within the framework of the strategic change management model, it has been determined that the key factors that shape the effectiveness of transformation processes at TOV "Flight Control" are related to the state of functional subsystems of the internal environment. Under conditions of high requirements for engineering accuracy, technological safety, and innovative activity, ten groups of indicators have been identified that reflect the enterprise's comprehensive readiness for change. These include:

$X1$ – production processes and engineering management;
$X2$ – quality management system (ISO/AS9100);
$X3$ – organizational structure of technological management;
$X4$ – personnel and scientific and engineering potential;
$X5$ – marketing and international contracts;
$X6$ – innovation and R&D;
$X7$ – supply of materials;
$X8$ – logistics and export sales;
$X9$ – finance and investments in R&D;
$X10$ – controlling and risk management.

The resulting indicator is the overall profitability of the enterprise as an integral characteristic of the efficiency of the functioning of all subsystems. A comprehensive analysis will help compare the actual state of each functional area with the necessary one, which is determined by the requirements of the global aerospace market, and to identify existing "gaps". The results are the basis for devising targeted organizational changes, which will include optimizing production processes, modernizing the technological base, introducing new management structures, and strengthening innovative activity [29, 30]. To systematize data and determine the trajectories of strategic changes, it is advisable to form a management efficiency matrix that reflects the dynamics of a selected number of economic and technical indicators for TOV "Flight Control" during 2019–2024 (Table 2).

Table 2

Factor evaluation matrix of management efficiency of TOV "Flight Control" (2015—2024)

| Year | $X1$ | $X2$ | $X3$ | $X4$ | $X5$ | $X6$ | $X7$ | $X8$ | $X9$ | $X10$ | $Y$ – overall profitability |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2015 | 2.1 | 1.8 | 1.4 | 1.2 | 2.2 | 0.8 | 1.0 | 1.1 | 0.9 | 0.7 | 9.3 |
| 2016 | 2.5 | 2.0 | 1.6 | 1.3 | 2.4 | 1.0 | 1.2 | 1.3 | 1.1 | 0.9 | 9.7 |
| 2017 | 2.9 | 2.3 | 1.8 | 1.5 | 2.6 | 1.2 | 1.4 | 1.5 | 1.3 | 1.1 | 10.2 |
| 2018 | 3.3 | 2.8 | 2.2 | 1.6 | 3.0 | 1.3 | 1.8 | 1.7 | 1.7 | 1.4 | 11.0 |
| 2019 | 3.8 | 3.2 | 2.5 | 1.9 | 3.6 | 1.4 | 2.0 | 2.4 | 2.0 | 1.5 | 12.8 |
| 2020 | 4.4 | 3.7 | 2.9 | 2.5 | 3.9 | 2.1 | 2.7 | 2.8 | 2.4 | 1.9 | 12.5 |
| 2021 | 6.2 | 4.8 | 3.4 | 3.0 | 4.3 | 3.2 | 3.5 | 4.2 | 3.2 | 2.6 | 12.1 |
| 2022 | 6.9 | 5.4 | 4.3 | 3.8 | 4.6 | 3.7 | 4.5 | 5.6 | 3.7 | 3.4 | 12.6 |
| 2023 | 8.7 | 7.1 | 5.5 | 4.7 | 5.9 | 4.3 | 5.1 | 7.2 | 4.6 | 3.8 | 13.1 |
| 2024 | 11.0 | 9.3 | 6.4 | 6.4 | 8.5 | 5.4 | 7.9 | 9.4 | 7.0 | 5.6 | 13.6 |

Within the framework of our study, multiple linear regression describes the dependence of the dependent variable ($Y$ – total profitability) on a number of independent variables ($X1$–$X10$), which characterize the factors of changes at the enterprise TOV "Flight Control". The model will take the following form

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ ... \ + \beta_{10} X_{10} + \varepsilon,$$

where $\beta_0$ – free term; $\beta_i$ – regression coefficient; $\varepsilon$ – random error.

The coefficients are calculated by the least squares method, which will minimize the sum of the squares of the differences between the actual and predicted values for the dependent variable $Y$. The regression equation is constructed as follows

$$Y = -7.89 - 24.69X_1 + 17.36X_2 - 5.84X_3 - \\ -16.36X_4 + 25.99X_5 + 26.53X_6 - 21.96X_7 + \\ +6.68X_8 - 28.74X_9 + 39.55X_{10}.$$

The factor variable $X1$, which represents production processes and engineering management, demonstrates a negative effect on overall profitability with a coefficient of –24.69, which characterizes it as moderate in strength and important for management decisions. The indicator $X2$, associated with the implementation of the quality management system (ISO/AS9100), has a positive effect on profitability with a coefficient of 17.36, which demonstrates moderate significance in the context of management strategies. The variable $X3$, which is responsible for the organizational structure of technological management, gives a weak negative effect with a coefficient of –5.84, but even such a small effect is taken into account in the further development of the overall development strategy of the enterprise. The factor $X4$, which covers the personnel and scientific and engineering potential of the organization, negatively affects profitability with a coefficient of minus 16.36, which indicates its moderation when making management decisions within the framework of the policy of changes at the enterprise. The $X5$ indicator, which relates to marketing activities and international contracts, showed a strong positive effect with a coefficient of 25.99, and therefore we note it as one of the critical factors in the growth of the profitability of the enterprise TOV "Flight Control".

Next, the factor variable $X6$, which is responsible for innovation and R&D, demonstrated a strong positive impact with a coefficient of 26.53. This makes it decisive in improving the future financial performance of the enterprise under study. Factor $X7$, which reflects the processes of material supply, is characterized by a moderate negative impact, and its coefficient is –21.96, emphasizing its importance in the formation of effective management approaches. Indicator $X8$ – logistics and export of products – has a weak positive impact, its coefficient is 6.68, but even its small contribution is considered when building a comprehensive enterprise development strategy. In relation to variable $X9$, which covers financing and investment in R&D projects, the strongest negative impact was found with a coefficient of –28.74, so managing this factor is a critical task in organizational change projects. And at the very end, factor $X10$ – controlling and risk management systems – demonstrated the most powerful positive effect with a coefficient of 39.55. We recognize it as the most critical element of influence on the increase/decrease in the level of overall profitability of the enterprise TOV "Flight Control". We take into account the specificity of the space industry with its increased requirements for accuracy, innovation, technological adaptability, and financial reliability. Under these circumstances, it is justified to involve in the model all ten parameters of the internal environment, which comprehensively characterize the managerial, production, and organizational maturity of the enterprise (Fig. 4).

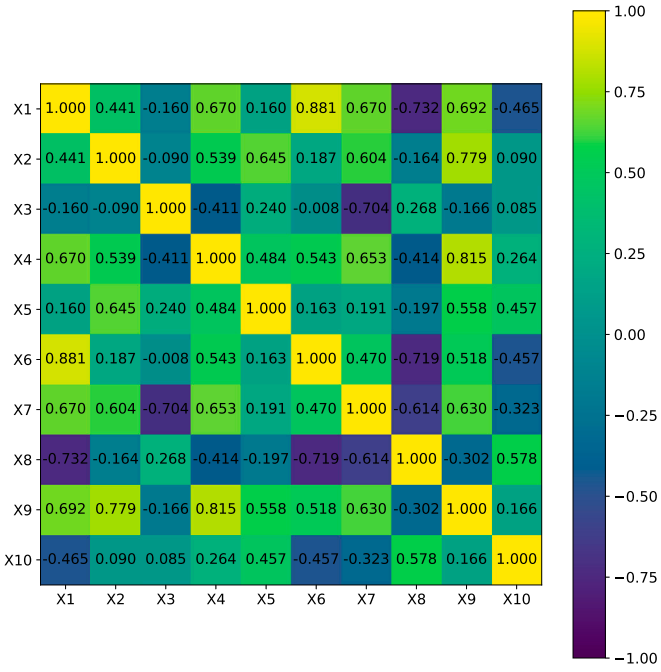


Fig. 4. Correlation matrix of change management effectiveness factors for the enterprise TOV "Flight Control"

The correlation matrix demonstrated the intensity and direction of the relationships between the independent variables involved in the regression model of management effectiveness. Pearson correlation coefficients can take values ranging from –1 (indicating an absolute inverse relationship between the variables) to + 1 (this is an absolute direct relationship), and "0" indicates a complete lack of relationship. All obtained coefficients in the matrix are in the range from 0.86 to 0.98, which proves the presence of significant multicollinearity between the selected factors of evaluation of transformations at the enterprise TOV "Flight Control". The main conclusions regarding the relationships between the management factors:

1. The closest correlations:

1. 1. Indicators $X1$ and $X2$ demonstrate almost perfect consistency ($r = 0.982$), which indicates a deep integration of organizational approaches to product production and quality control standards. There is a high probability that these vectors evolve in parallel and support each other at the enterprise.

1. 2. $X2$ and $X3$ are strongly interconnected ($r = 0.968$), which indicates that technical solutions are formed according to the needs of the quality system, and do not exist separately.

1. 3. A high degree of internal coherence ($r = 0.971$) is revealed in $X9$ and $X10$, which indicates that investments in innovation are accompanied by strict internal supervision and a systemic model for risk management.

2. Less powerful, but still significant relationships:

2. 1. $X1$ and $X6$ ultimately show a lower degree of correlation ($r = 0.848$), which may indicate a certain independence of innovative activity from the operational component. This is a result of the fact that innovative advancements at the enterprise are created separately from the current production chain.

2. 2. So, $X4$ and $X10$, in turn, show a lower degree of correlation ($r = 0.888$), which may be due to the fact that the R&D department and the controlling apparatus at TOV "Flight Control" are functionally weakly intertwined.

Correlation analysis confirms the assumption about the density of the main management processes at TOV "Flight Control".

## 6. Discussion of research results. Construction of a model for improving strategic change management at a high-tech enterprise

Our results have contributed to building a model of strategic change management (Fig. 2). The given model is based on the regularities of the relationship between the efficiency of transformations and the level of organizational flexibility and technological readiness of the firm, defined in Table 3. According to the analytical dependences, the acceleration of the change implementation cycle is consistent with the level of harmonization of internal processes, shown in Fig. 4.

The final result of the scientific search was an integrated three-level model that combined the analysis of the market situation and the planning of the processes of reorganizational changes. This guarantees the systematicity, logic, and scientific validity of management decisions. Unlike fragmentary and mostly reverse (reactive) methods, our model expresses the proactive nature of changes, which aligns the strategic goals of the enterprise with technological and market changes. The scientific achievement of our study was the empirical confirmation of the influence of internal functional subsystems on the overall profitability of the enterprise. The regression-correlation analysis revealed the presence of a stable, statistically significant relationship between the result of the economic activity of the enterprise and the level of its managerial, production, innovative, and financial maturity.

Comparison of the obtained results with previous scientific advancements demonstrates their consistency with a number of works that emphasize the importance of strategic flexibility and innovative development [4, 6, 9, 12]. At the same time, our study goes beyond the traditional analysis, offers a quantitatively measured model that is based on the economic-mathematical apparatus and provides the ability to build forecasts on the basis of actual controlled indicators. These considerations distinguish the model among the approaches that dominate current literature [10, 11]. Empirical research has shown that the growth of the integral factor of the effectiveness of organizational transformations leads to a corresponding increase in the overall profitability of the enterprise. At the same time, the greatest growth in profitability is observed in the interval where the active stage of the implementation of managerial reforms takes place.

The study has a number of limitations that require consideration in future work. First, the model is based on a description of the internal environment of one firm, which narrows the possibility of full universalization of achievements. Further advancements require an expansion of the selection and a comparative review of different types of high-tech industries. Second, the model used is static, while the real transformation processes are dynamic and depend on fluctuations in the market and technological environment. Third, economic-mathematical modeling takes into account a limited number of factors, which in the future will require an increase in the parametric set, in particular macroeconomic, institutional, and intellectual components.

Within the framework of the study, it is appropriate to determine a set of limitations that outline potential vectors for improving the methodology for strategic management of organizational transformations in high-tech firms. First of all, it should be noted that the practical verification of the effectiveness of the proposed model is based on the analytical base of a single business entity, which restrains the ability to spread the consequences and makes it difficult to obtain general results for a wider group of high-tech institutions.

Despite the proven statistical reliability, the economic-mathematical model does not fully take into account the validity of latent determinants, in particular the level of organizational assimilation, the intensity of innovation cycles or structural features of the market climate. Further exploration should be focused on eliminating the obstacles found and corrected through the expansion of the empirical set, the incorporation of time series, the implementation of hybrid predictive models and the integration of additional behavioral parameters into the determination system.

Prospects for further development are associated with the modernization of the methodological apparatus based on the combination of machine learning algorithms, the use of adaptive forecasting models and multi-scenario optimization analysis tools. Increasing the accuracy of assessing the consequences of transformations will contribute to expanding the time horizons of observations, which will be the key to identifying long-term patterns of strategic development for high-tech enterprises.

## 7. Conclusions

1. The feasibility of considering strategic change management for high-tech enterprises, which is represented as a permanent cyclical process, has been considered. It is integrated into the general architecture of corporate management and is focused on ensuring technological dynamics, innovative activity, and market resistance. It was found that traditional, mainly technocratic and functionally determined approaches do not provide an adequate level of adaptability under the conditions of digital turbulence. They neglect the role of network interactions, relational strategies, and customer-centric logic of value generation. It is proved that the essential content of the updated concept of change management is the synthesis of systemic, situational, and innovative approaches. Their combination makes it possible to synchronize strategic goals with the organizational architecture and business model of the enterprise.

2. As a result of the development of the strategic change management model, it was found that its effectiveness is determined by the consistency among three interrelated modules:

1) market monitoring;

2) situational analysis;

3) organizational change design.

It is substantiated that the use of the "gap" matrix and the planar "enterprise – environment" matrix is aimed at identifying critical imbalances between internal potential and exogenous requirements. Given the volume of operational activities, the degree of technological complexity and industry instability, areas of priority intervention have been identified; the desired direction of the planned organizational changes was outlined. The result is formed on the basis that multifaceted consistency of strategic, tactical, and current decisions in combination with adaptation to the variability of the base market becomes a priority in ensuring sustainable technological sustainability of high-tech companies.

3. Based on the results of our economic-mathematical assessment of the effectiveness of strategic transformation management at TOV "Flight Control", the feasibility of using a multifactor regression model as a tool for comprehensive analysis of its internal environment has been substantiated. It is proven that the profitability of activities is formed under the influence of a system of interrelated managerial, production, financial, and innovative factors, among which the most important role is played by controlling with risk management, innovative activities, and research and development, as well as marketing activity and international contracts. The identified high level of multicollinearity between factors confirms the systemic nature of change management in the aerospace industry and justifies the need for comprehensive, rather than fragmentary, management solutions.

## Conflicts of interest

The authors declare that they have no conflicts of interest in relation to the current study, including financial, personal, authorship, or any other, that could affect the study, as well as the results reported in this paper.

## Funding

The study was conducted without financial support.

## Data availability

The manuscript has associated data in the data warehouse.

## Use of artificial intelligence

The authors used the Claude Sonnet 4.5 model to parallel test the accuracy and adequacy of the econometric model reported in the paper.

## Authors' contributions

**Viacheslav Makedon**: Conceptualization; Supervision; Formal analysis; Writing – review & editing; Project administration; **Dmytro Pavlov**: Formal analysis; Methodology; Visualization; Writing – original draft; **Olena Plakhotnik**: Data curation; Resources; Investigation; Writing – review & editing; **Dmytro Nechaev**: Investigation; Validation; Formal analysis; **Oleg Kovnir**: Software; Visualization; Writing – review & editing.

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