Three-Dimensional Modeling of Innovative Socio-Economic Entities

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Abstract— **The article considers the procedure of modeling processes of launching innovative products of the social sphere based on the elements of the integral-matrix analysis in three-dimensional space. The objective of the procedure is selection of perspective lines of energy-saving product development in view of the market characteristics and technological capabilities. Three-dimensional display of the common innovation improvement direction vector allows to study product development in the "product-market-technologies" space in a complex way in view of their interconnections. Application of the approved techniques of the integral-matrix analysis based on expert point assessments of the connections between the influencing factors (strategic objectives) and objective functions (operative tasks) in the offered procedure allows to base on their quantitative estimates in the course of the research. The authors offer an algorithm for selection of the most marketable product considering the influence of the said interconnections. The formalized algorithm allows to automate selection of implementation of the basic product characteristics, which increases project development efficiency.**

Index Terms— **Three-dimensional modeling of economic entities, investment activity management, method of integral-matrix analysis**

I. Introduction

IN the task of selecting ways to launch energy-saving products of the social sphere the strongest tool is the system approach based on consideration of non-linear connections between entities forming the space of the considered process [2, 3]. The works demonstrate the qualitative influence of the loops of direct and reverse links on achievement of the set objectives. However, the quantitative assessment of the links and their influence is still an intractable problem in terms of analytics considering their probabilistic and non-linear nature. The method of two-dimensional integration-matrix analysis previously developed by the authors of this article helps to solve several problems [5].

Nevertheless, as it is shown in [3], sustainability of the models is considerably increased in view of all the three aspects defining the business, namely, the space of the product, the market and the technologies. Such three-dimensional structure considers the said aspects as interdependent and proposes to manage their interactions through the influencing factors and the objective functions, which are interconnected via the influence coefficients (or interconnection coefficients).

The two-dimensional integral-matrix analysis (IMA) is based on establishment of an interconnection between the customer requirements (CR) and their supporting characteristics (SC) considering the internal correlation links between separate SC [5].

In the three-dimensional analysis the influencing factors or CR to a product can be defined as strategic objectives, which are applicable both to the market, the technologies and the product. Operative tasks can be defined as functions of the market (technology, product), which depend on the strategic objectives.

The research objective is elaboration of a method to select a priority of development projects based on the point-rating expert assessment of the offered lines of product engineering (design) in view of the market requirements and the technological level. At the same time, it considers interconnections between the requirements to the product, market and technological level.

This research is aimed at development of tools for management of the innovation commercialization process allowing to cut the companies' market research costs and to mitigate the new product development and launch risks.

II. Selection and Justification of Evaluative Parameter Coordinates

If we outline strategic objectives and operative tasks in the three-dimensional business architecture, the said architecture can be presented as shown in Fig. 1.

Zones in Fig. 1:

- "Ms – To": connection of the strategic objectives (requirements) of the market (argument) and the operative tasks of the technology (function);
- "Ts – Po": connection of the technology development strategy (argument) and the short-term operative product requirements (function);

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• "Ps – Mo": long-term connection of the strategic product requirements (argument) and the short-term operative market requirements (functions).

Thus, Thus, we set the strategy of market, technology and product development (as an argument in each plane) and via the coefficients of the IMA method define the operative tasks to be solved in each plane (as functions). Each indicator (market, technology, product) acts as an argument in one plane (procedure of the stated CR) and as a function in another plane (procedure of the estimated SC).

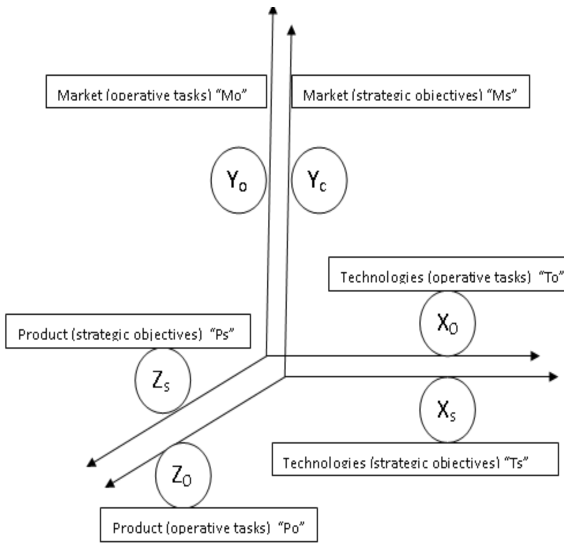

Fig. 1. Symmetrical three-dimensional analysis of the strategic objectives and the operative tasks of product development by the methods of integral-matrix and vector analyses

Justification of axes symmetry: strategic objective (market) => operative support of the objective (technology solutions):

1. "Ms – To". The strategic market requirements are supported by operative (short-term) technology solutions.

2. "Ts – Po". The technology development strategy for this product is supported by operative (short-term) product requirements.

3. "Ps – Mo". The strategic product requirements are supported by short-term market characteristics.

Considering the axes symmetry, we have developed an algorithm [1] of vector displaying of the interconnected development efficiency indicators in three-dimensional space (Fig. 2).

III. Implementation of the Algorithm

Implementation of the three-dimensional analysis can be exemplified by energy-saving housing.

Components of the multidimensional structure (shorthand notation)

1. Market (M):

Strategic market objectives: market operability (marketability not only in terms of personalization); product safety; level of operating costs; quality/price ratio – position on this product market.

Operative market tasks: statutory government regulation (prices of electric and heat supply); financial stimulation tools (discounts, interest-free loans, testing and finding the best, assignment of the resource-saving brand, etc.); educational market stimulation methods ("green", environmental offers of the manufacturers, energy-saving logos); market position; manufacturer's brand.

2. Technologies (T):

Strategic technological objectives: complex composition of the supply systems at autonomous energy-saving modules and autonomous sources; "friendly" – control interfaces on a mobile platform; diverse scenarios: "switch off everything", "left for a long period – economy mode", etc.; availability of an engineering and service center; competence level of the maintenance personnel.

Operative technological tasks: automatic control and metering of energy resources; individual air temperature and quality control in a separate premise; unification of supply systems and climatic parameters; individualization of supply systems and climatic parameters.

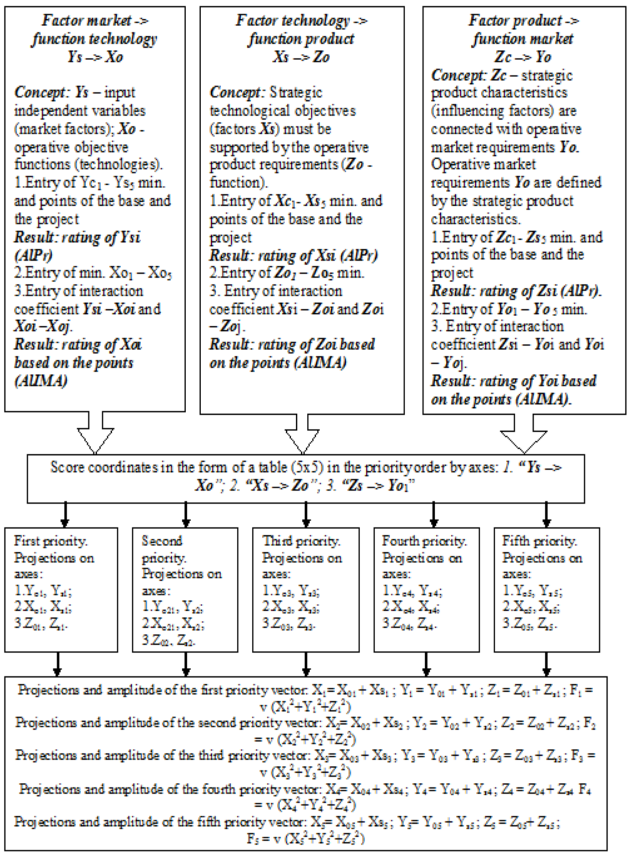

Fig. 2. Algorithm of vector displaying of the interconnected indicators in axes "market-technologies-product" in three-dimensional space

3. Product (P):

Strategic product objectives: positioning of the product "imprint" on the price-quality matrix; number of useful product functions; failure-free operation; easy setting control (training); high service level.

Operative product tasks: characteristics of heat-insulating structures (walls, windows, floors, roofs, etc.); parameters of autonomous energy-saving devices (generators, turbine towers, heat pumps, solar batteries, etc.); parameters of filter and ventilation plants (conditioning and ventilation; control panels (functions, level of self-containment, etc.); level of reliability (failure-free operation, durability, serviceability) of unit parts and components.

IV. Basic Calculation Results

The developed algorithm is used for calculations [4] to determine the multidimensional priority of solving the operative tasks and achievement of the strategic objectives in the sphere of energy-saving housing. The calculations were made by the method of point-rating expert assessments in view of the above objectives and tasks.

Thus, we set a strategy of energy-saving technology market development in the social sphere as an argument in each coordinate axes plane (Fig. 1) and define operative tasks as functions to be solved in each plane.

Strategic objective => operative objective support:

1. “Market – Technologies” in axes “Ys – Xo”. The strategic market requirements in the part of market operability of an energy-efficient technology must be supported by availability of engineering and service centers as an operative development task.
2. “Technologies – Product” in axes “Xs – Zo” The strategy of development of unified systems of supervisory control, automation and safety of energy supply and climatic parameters of the technology in the social sphere must be supported by the parameters of filter and ventilation plants.
3. “Product – Market”: in axes “Zs – Yo”. The strategic requirements to products being energy-saving plants in the part of control panel design and simplicity of settings must be supported by the educational market stimulation methods with regard to energy-saving technologies.

Scaling of the axes in view of the rating of the objectives and tasks indicators allows to obtain a display of the obtained calculation results as shown in Fig. 3.

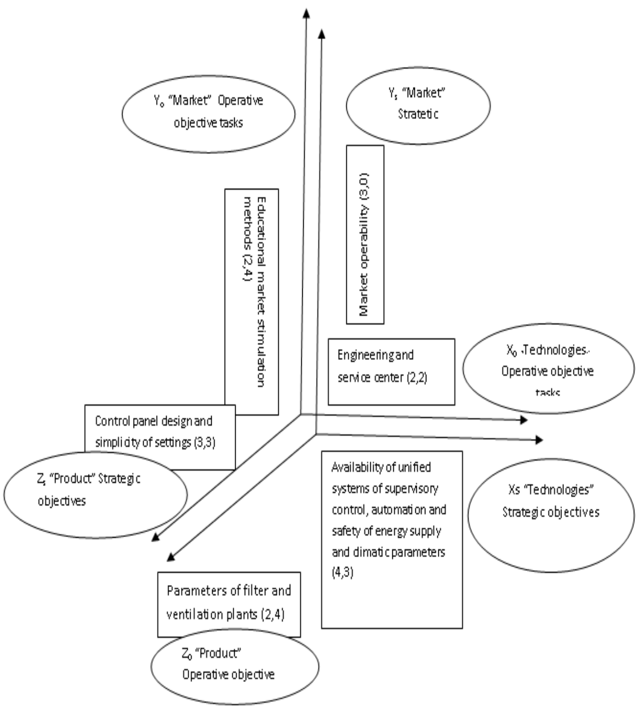

Fig. 3. Scaled three-dimensional analysis of the priority strategic objectives and operative tasks solved at implementation of energy-saving technologies in the social sphere

V. Conclusion

The analysis of the results of the first energy-saving technology development priority allows making the following conclusions:

1. The strategic objective of technological development: availability and improvement of the unified systems of supervisory control, automation and safety of energy supply and climatic parameters got the maximum score (4,3 points). At the same time, the main operative task of technological development supporting the strategic market objectives lies in improvement of engineering and service centers. The said task obtained 2,2 points and considerably lags behind the strategic objectives of technological development.
2. The strategy of development of energy-saving technologies with regard to their application market lies in market operability (3 points) supported on the market by solution of the operative tasks in the part of the educational market stimulation methods (2,4 points). A comparative analysis points at an insignificant divergence of the strategic objectives and the operative tasks solved at marketing of the energy-saving technologies.
3. The strategic objectives of development of energy-saving systems with regard to them as a market product lie in improvement of the control panel design and simplification of the system settings (3,3 points). It is accompanied by solution of the operative tasks in the part of improvement of the filter and ventilation plant parameters (2,4 points).
4. A summary expert analysis of the energy-saving system development in the social sphere has shown that improvement of specialized engineering and service centers of population support needs maximum attention and support. It concerns the priority solution in the part of the system development technology.
5. The overall score of the complex analysis shows that the first priority of the solvable tasks in view of the strategic objectives comprises 10,2 points with a prevailing deviation of the complex vector towards the energy-saving system development technologies.

The priority of solving operative and strategic tasks in the conditions of the presented multidimensional analysis is defined on the basis of a divergence between the points of the strategic objectives and operative tasks, as well as on the basis of the absolute value of their score.

As for market positions of the considered energy-saving systems, we can conclude that their market operability almost fully corresponds to the tasks of the educational market stimulation methods.

In general, the performed multidimensional analysis allows to ensure a balance of the strategic market objectives and the company’s tasks to be solved already in the first priority of implementation of the energy-saving technologies in the sphere of housing construction. Consideration of further priorities of the decisions taken depends on the level of the supplier’s capabilities and its adequate assessment of the market response.

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