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Innovative Tools for Management the Lifecycle of Strategic Objectives of the Enterprise-Stakeholder in Construction

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ABSTRACT

The article is devoted to innovative and application tools of the new stakeholder in the construction and commercial real estate market called as surveying company or real estate management company (REMC). The scientific novelty of the paper is determined by the introduction of methodology and scientific and analytical principles of regulating the operational activities of the stakeholder of construction and real estate markets, which administers investment and construction projects (individual objects and commercial buildings).) as a developer of a new type in a single surveying cycle regulates the interaction of institutional participants and stakeholder enterprises (performers), ensuring compliance with economic, budgetary and administrative characteristics of the real estate servicing cycle as an object construction / integral investment, commodity-property complex and its subsequent profitable operation. Theoretical-methodological and scientific-applied results are integrated into a set of applied software products for administration of surveying companies and stakeholders in construction. As a part of practical recommendations concerning support of REMC the technique and algorithmic procedures of calculation of the REMC tariff for a complex of surveying services are substantiated.

Keywords: surveying, construction stakeholders, real estate management company (REMC), surveying cycle, enterprise-stakeholder in construction, dynamic programming tools.

1. INTRODUCTION

The development of innovative activity of enterprises in the construction industry in Ukraine is at a relatively low level. Organizations engaged in innovative activities make up no more than 10% of their number, at the time when in developed countries this indicator tends to 60%, in Eastern European countries this indicator is 20%.

Innovative development with the subsequent technological renewal of the construction industry is necessary for the formation of competitiveness in a strategic perspective due to increased global competition in the construction services market, the acceleration of innovation and technological development and the reindustrialization of the world economy [1].

Traditional works in this area [2-4] are devoted to the development of the transition of the industrial and civil construction industry to a higher level of competitiveness in many countries of the world is associated with the creation of full-fledged BIM models.

According to the BIM model proposed by authors in papers [5, 6], the level of maturity of information modeling is assessed based on the ability to operate and exchange information in the process of design and construction production.

The dynamics and high degree of uncertainty of the external environment negatively affects the efficiency of construction companies, forcing modern organizations to become increasingly complex systems.

The question of defining the essence and classification of business models of the organization is covered in the works[7, 8].The articles [9] and [10] are devoted to problems of adaptation of enterprises to the conditions of unstable market environment.

Authors of [11] examine traditional organizational and functional structures of enterprise management systems.

In works [12, 13], there are questions of defining the essence and classification of business models of the organization.

The authors of the works [14-16] describe the mechanisms of resource and product flows running and distribution on the given enterprise business process network using special analytical tools. That made it possible to ensure a high level of formalization of corresponding information channels. The result is an integral model of resource distribution and consumption in the process network of industrial enterprise.

The solution of problems of improvement of structural and process construction of the enterprise is considered in modern researches of authors in articles[17-19].

Surveying as a system of scientific knowledge about the laws, forms and methods of management of projects and objects of construction at all stages of the life cycle of real estate is one of the new scientific directions of modern construction development[20-22].

The basis of competition between construction companies is the ability to apply innovative management technologies using the best world experience.

2. MODELSAND METHODS

The purpose of the article is to develop innovative tools for modeling the lifecycle of strategic objectives of the models and methods of the enterprise-stakeholder in construction.

The full lifecycle of strategic objectives of the enterprise-stakeholder in construction consists of five stages, which are presented on Figure 1:

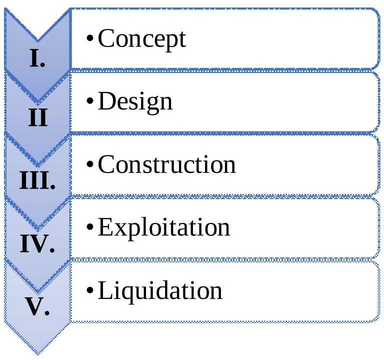

Figure 1: Stages of strategic objectives of the enterprise-stakeholder in construction

A thorough study of the scientific works of the authors [1-6] allowed us to conclude that in order to ensure the balanced development of the enterprise it is necessary to maintain a balance between two strategically important areas of enterprise development:

1) creating value for consumers;
2) increasing the value of the enterprise.

These areas, embodied in specific tasks, must be intelligently intertwined, initiated in parallel and implemented in real projects. In particular, to create value for consumers, it is necessary to coordinate a range of such strategic project objectives as ensuring the appropriate level of quality of goods (services); prices of goods (services) and customer service. In turn, to increase the value of the enterprise it is necessary to coordinate its range of project tasks, namely: focus on maximum efficiency; focus on maximum performance; the need to form a positive image and the image of a socially responsible enterprise.

The set strategic tasks can be reduced to solving the task of managing the "portfolio of tasks" of the business model of the enterprise. Its purpose is to achieve internal and external competitive advantages in the presence of different areas of organization of activities by coordinating the order and timing of life cycles of strategic objectives.

The model of combining the lifecycles of project strategic objectives of the innovative model of the enterprise is shown in Figure 2.

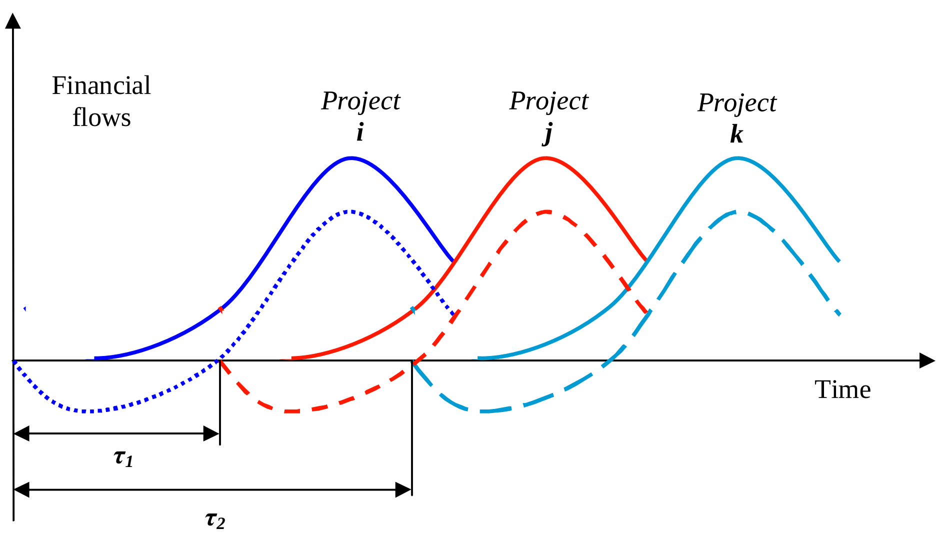

Figure 2: Model of combination of lifecycles of project strategic tasks of innovative model of enterprise
Notation: *i, j, k*are ordinal numbers of executed projects;
----,----,----arecurves of executed projects "portfolio of tasks" of the innovative model

The efficiency of the innovative model is enhanced by complementarily, synergy, which provides additional benefits that cannot be achieved when the "portfolio of tasks" is a simple sum of individual projects. Synergy is achieved through mutual support and accumulation of results of various ongoing projects. The "portfolio of tasks" to create value for consumers and increase the value of the enterprise can be presented in the form of sequential and parallel implementation. Therefore, there is a need for effective planning and organization of the lifecycle of the task in order to make timely management decisions, which will reduce the impact of possible disturbances. Unlike most matrix models used for "portfolio" analysis and planning, it is recommended to use the method of dynamic programming in the management of the "portfolio" of the innovative model.

An applied innovation of the study is an algorithmic complex for calculating the tariff of a real estate management company (REMC) for a set of surveying services, which is given by the function **Q (τ)**:

$$\mathbf{Q(\tau) = Trf(\Delta\tau)*(Tsz/\Delta\tau) + \acute{\eta}*100*(\tau^{actual}_{IM} - \tau^{dir}_{IM})/\tau^{dir}_{IM} + \xi*100*[Ł^{actual}(\tau) - Ł\tau^{BV}(\tau)]/Ł\tau^{BV}(\tau)} \quad (1)$$

τ is current coordinate of the "surveying cycle";

Tsz is duration of the surveying cycle;

(Δτ) is duration of time intervals, according to which intermediate milestones of controlling the course of the servicing cycle are determined for all stakeholders, according to which intermediate results of its implementation are determined (months or quarters);

Trf (Δτ) is current tariff for services in the administration of the project of construction and operation of a commercial real estate object, calculated regardless of the financial results of the surveying cycle;

ή is percentage specific tariff of additional remuneration of REMC for early operation of the project facilities (UAH million /%);

$\boldsymbol{\tau^{actual}_{IM}} - \boldsymbol{\tau^{dir}_{IM}}$ is respectively the actual and directive terms of commissioning of the project (commercial real estate), months;

$\mathbf{100*(\tau^{actual}_{IM} - \tau^{dir}_{IM})/\tau^{dir}_{IM}}$ is percentage reduction in the duration of commissioning of the project capacity (%);

ξ is percentage specific tariff of additional remuneration of KUN for the increase of the target cost of the project at a certain current coordinate of the surveying cycle (UAH million /%);

$\mathbf{Ł\tau^{BV}(\tau)}$ is the book value of the project assets (CREO – commercial real estate object), estimated at the current moment of the cycle **τ** ^;

$\mathbf{Ł^{actual}(\tau)}$ is expertly estimated value of all project assets for the studied time coordinate of the cycle τ;

$\mathbf{100*[Ł^{actual}(\tau) - Ł\tau^{BV}(\tau)]/Ł\tau^{BV}(\tau)}$ is the percentage increase in project cost from the beginning of the surveying cycle to the control coordinate τ (%).

Figure 3 presents the lifecycle model of a surveying company (REMC) in a single integrated "surveying cycle" (investment-preparation-construction-operation-liquidation) with the formation of the target cost of the project according to the tariff calculation complex ***Q (τ)***.

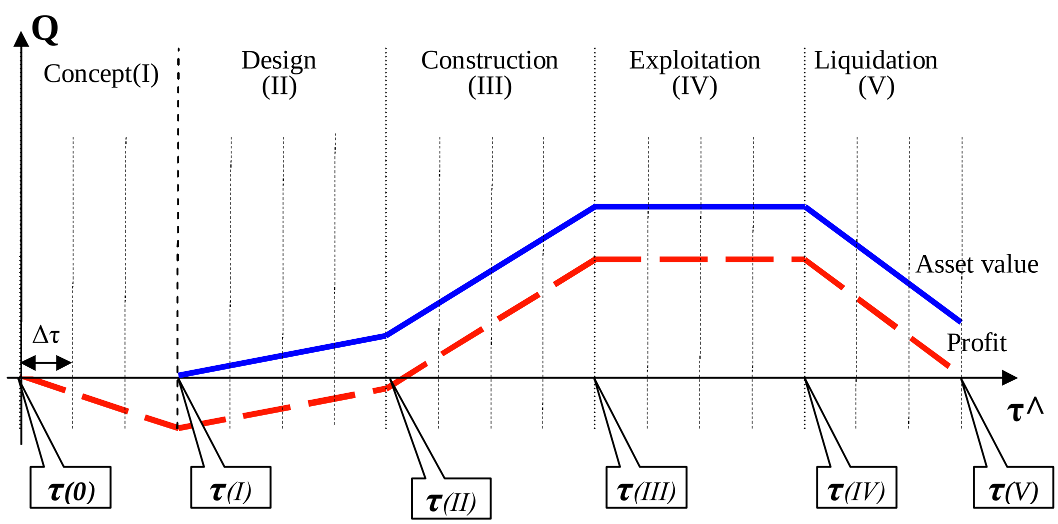

Figure 3: Model of the surveying company's lifecycle in a single integrated "surveying cycle"

The task of managing the "portfolio of tasks" of the innovative model is to determine the optimal start dates for operational tasks both in the field of creating value for consumers and in the field of increasing the value of REMC.

The objective function is presented as follows:

$$V = \sum_{i=1}^{K}\left(\begin{matrix}\lambda \cdot \sum_{j=1}^{n}\left(\frac{S_j\left(\tau_j^{(S)},\tau_i\right)\cdot f_{j,i}(\tau_i)}{(1+q)^i}\right) + \\ \mu \cdot \sum_{j=1}^{n}\left(\frac{P_j\left(\tau_j^{(P)},t_i\right)\cdot g_{j,i}(\tau_i)}{(1+q)^i}\right)\end{matrix}\right) \rightarrow \boldsymbol{max} \quad (2)$$

where ***V*** is the value of the total profit of surveying company; $\boldsymbol{\tau_j^{(S)}}$ is time of the beginning of the *j*-th project of creation of value for consumers, required size, months; $\boldsymbol{\tau\wedge_j^{(P)}}$ is time of the beginning of the *j*-th project of increasing the value of surveying company, the required value, months; $\boldsymbol{S_j\left(\tau_j^{(S)},\tau_i\right)}$ is the amount of profit of the *j*-th project task to create value for the consumer, UAH; $\boldsymbol{P_j\left(t_j^{(P)},t_i\right)}$ is the amount of profit of the *j*-th project task to increase the value of surveying company; $\boldsymbol{f_{j,i}(\tau_i)}$ is the value of the efficiency function in the case of combining the time of implementation of various project tasks to create value for consumers; $\boldsymbol{g_{j,i}(\tau_i)}$ is the value of the efficiency function in the case of combining the time of implementation of various project tasks to increase the cost of surveying company; $\boldsymbol{\tau}\hat{}_i$ is current project implementation time; months; n isnumber of time intervals allocated for project implementation, units; q is discount rate, %; **K** is the number of projects considered in each area in the areas of creating value for consumers or increasing the value of REMC.

Units $\boldsymbol{\lambda}$, $\boldsymbol{\mu}$ are weights that show the relative weight of the value of the selected industry for surveying company, such that satisfy the condition:

$$\lambda + \mu = 1, \quad 0 \le \lambda + \mu \le 1. \qquad (3)$$

To solve the problem of dynamic programming, additional restrictions are set on:

• ensuring a certain level of REMC profit during the specified period of implementation of the "portfolio of tasks":

$$S_j\left(\boldsymbol{\tau}_j^{(S)}, \boldsymbol{\tau}_i\right) + P_j\left(\boldsymbol{\tau}_j^{(P)}, \boldsymbol{\tau}_i\right) \ge \Pi^{const}, \; i^{(1)} \le i \le i^{(2)} \quad (4)$$

•project implementation duration:

$$n \le N. \qquad (5)$$

It is proposed to use the following algorithm to solve the problem of dynamic programming.

At the first stage, during the solution of the problem there is a selection of two strategically related areas of enterprise development:

• value creation for consumers, described by the function *S (t)*;

• increase in the value of surveying company, described by the function *P (t)*.

In the second stage, it is sufficient to determine the sequence of operational tasks. To do this, sequentially list *k!*possible options for consistent implementation of project activities in each area is creating value for the consumer or increasing the value of REMC. As a result, the order of execution of operational tasks is selected for each direction, which provides the maximum of the expected result.

In the third stage, the problem is reduced to the problem of linear programming with the ability to search for unknown quantities $\tau_j^{(S)}$, $\tau_j^{(P)}$, which in their content determine the timing of the combination of operational tasks, maintaining the order of their implementation.

3. RESULTS

Thus, the developed concept of lifecycle of strategic tasks of the innovative model of surveying company describes with the help of dynamic programming tools the process of balancing the "task portfolio", in which the lifecycles of strategic tasks are balanced by the stages of the "cycle of serving" and expected profits.

The use of such a model will help to achieve a balance between the tasks and will facilitate the process of strategic decision-making in the management of REMC.

Figure 4 presents a visualization of the implemented set of application programs – a subsystem of application of target indicators of quality of operational activity of REMC for the choice of the final alternative of the annual program of activity in the market of surveying services.

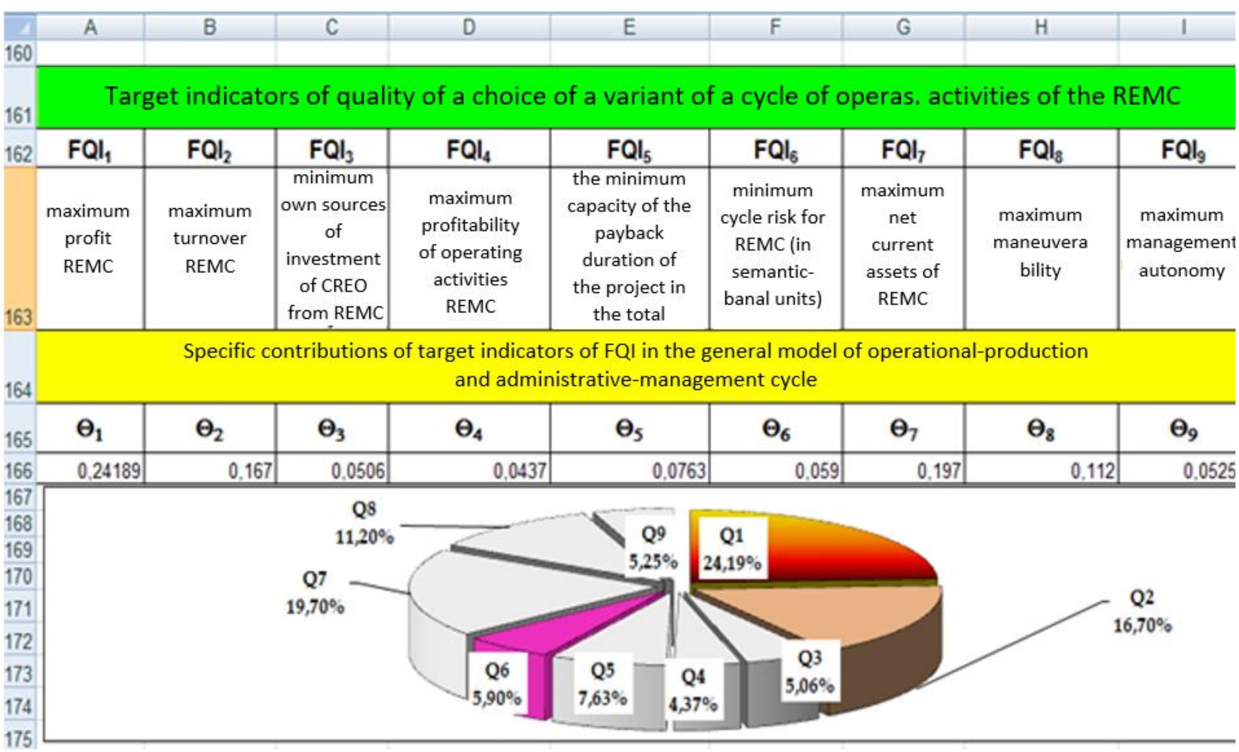

Figure 4: Complex of application programs: application of target indicators of quality of operational activity of REMC for a choice of final alternative of the annual program of activity in the market of surveyingservices

It is proposed to consider the practical and cost-effective implementation of innovative tools by example.

Let's consider a task to confirm the research results.The problem condition isreduction of time at the decision of problems in the course of operation. Calculations of calculations for objects:

– area of two buildings: S = 27 900 $м^2$;

– service staff: 3 mechanical engineers and one call centre manager;

– 100 units of repair work per month, including unscheduled, using iPad / BIM / cmms;

– 70 units of preventive maintenance tasks without the use of iPad / BIM / CMMS (iPad / BIM / CMMS is not used at this stage at the discretion of the customer, there are no technological restrictions on use).

The followingtree aspectsare implemented:

1. Save time when using iPad by engineers to handle tasks compared to the classic approach using paper drawings and text messages: during maintenance work it was possible to completely abandon paper media and reduce by two levels the phasing of information transfer, which in total allowed saving 10 minutes for each task, or 16 hours. per month, or 192 hoursfor a year.

2. Saving time when searching for information on the project: it was possible to eliminate catalogues of information on physical media (paper, disks) and the need to use a mechanical room, where these catalogues are stored, each time a task occurs;in addition, the need to search for information in these unstructured directories has disappeared. Each time this task of searching for information took from 20 to 40 minutes, this need arose about 10 times a month, or 120 times a year, ietime savings were 36-72 hours per year.

3. Identification of the position of hidden systems in the building: it was possible to eliminate the need to read paper and electronic 2D-drawings and the need to use the drawing room each time, where they are stored.

This saved about 1-2 hours. In the event of such a situation, this occurs approximately twice a month, or 24 times a year, ietime savings of 48-96 hours per year.

Total: savings: 284-368 hours per year.

Table 1 shows the results of the effectiveness of the introduction of innovative tools for capital construction.

Figure 5 presents a diagram of results of the effectivenessof the implementation of innovative tools from table 1.

Table 1: The results of the effectiveness of the implementation of innovative tools

The effect of use	Expected cost reduction,%
Reduction of energy consumption. Optimization of utilities. *By identifying and analyzing the most expensive consumers, cases of wasteful use of energy*	2–10
Reduction of energy consumption costs. Use of utilities through peak load management. *Management of energy-consuming consumers to avoid unnecessary peak loads*	5–20
Confirmation, documentation of energy consumption. *Minimize the cost of creating consumption reports through the use of data on objects and meters from the system*	50–90
Reduce documentation costs. *Thanks to fast systematization of information, use of templates, direct access of reports to actual data*	30–70
Reducing the cost of searching, improving the quality of information. *Reducing the cost of finding and providing up-to-date and correct information, reducing problems with insufficient and erroneous information*	30–70
Equipment availability. *Reducing the number of failures of equipment and structures due to automated control of service life*	1–10
Scheduled maintenance. *Reduce the cost of scheduled maintenance and repairs through effective planning and preparation*	10–30
Distribution of outfits / tasks. *Reduction of service costs due to consolidated centralized accounting and distribution of correct orders / tasks (eg maintenance, cleaning)*	10–30
Registration of applications. *Reduction of accounting costs, scheduling of applications / tasks*	40–80
Processing of applications / tasks. *Reduction of administrative, managerial costs for scheduling tasks. Execution control, minimization errors in the interpretation of applications / tasks*	40–80

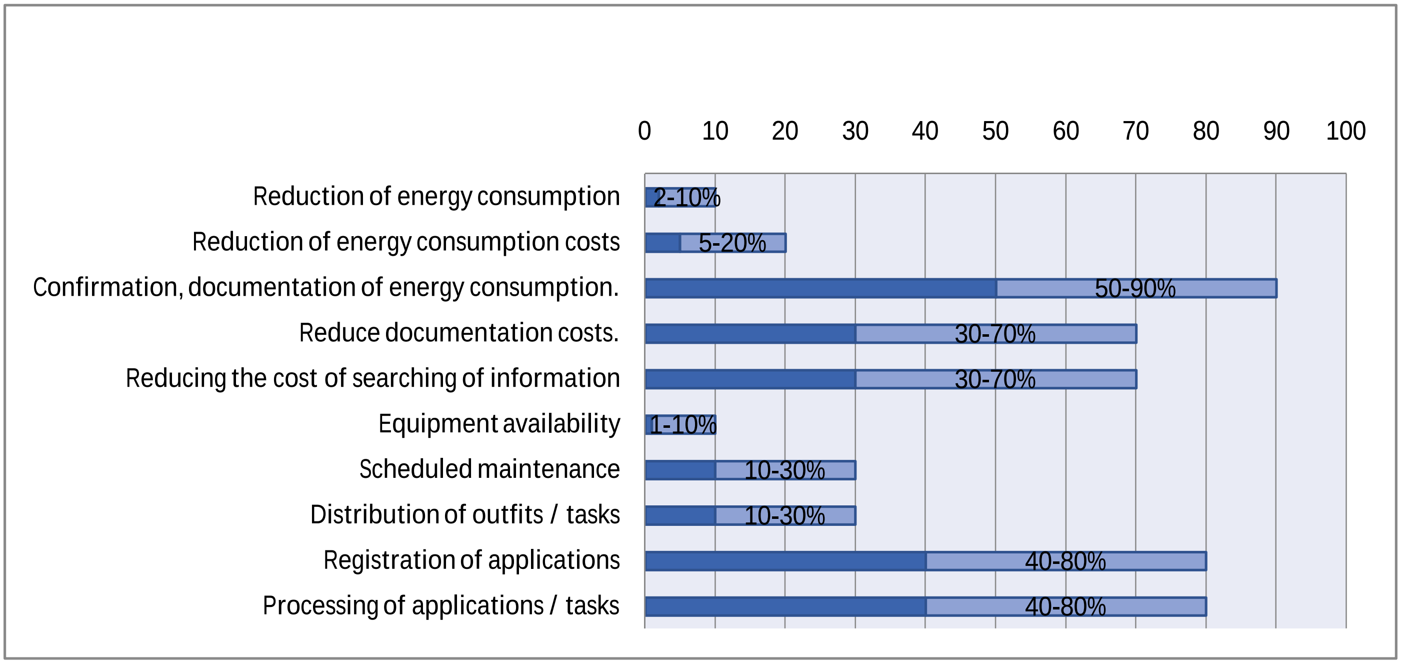

Figure 5: Diagram of results of the effectivenessof the implementation of innovative tools form table 1

4. CONCLUSION

The scientific novelty of the study is to develop the concept of the life cycle of the business model of enterprises using the tools of dynamic programming. This approach describes the process of balancing the "portfolio of tasks" of the business model, in which the "life cycles" of strategic tasks are agreed on the timing of the stages and the amount of expected profit. The use of such a model by managers of senior and middle management will help to achieve a balance between two strategically determined areas of enterprise development to create value for consumers and increase the value of the enterprise. Theoretical-methodological and scientific-applied results are integrated into a set of applied software products for administration of surveying companies and stakeholders in construction. As a part of practical recommendations concerning support of REMC the technique and algorithmic procedures of calculation of the REMC tariff for a complex of surveying services are substantiated**.**

REFERENCES

1. H. Elbardan, A. Othman, R. Kholeif. **Enterprise Resource Planning, Corporate Governance and Internal Auditing. An Institutional Perspective**, Cham: Palgrave Macmillan, 2017. 446 p. doi: http://doi.org/10.1007/978-3-319-54990-3
2. R. J.DeFillippi, M/ Arthur, V. Lindsay. **Knowledgeatwork : creativecollaborationintheglobaleconomy**. Boston: BlackwellPublishing, 2006. 297 p.
3. H. Elbardan, A. Othman, R. Kholeif. ***Enterprise Resource Planning, Corporate Governance and Internal Auditing. An Institutional Perspective***, Cham: Palgrave Macmillan, 2017. 446 p. doi: http://doi.org/10.1007/978-3-319-54990-3
4. K. Hausman. ***Sustainable Enterprise Architecture***, New York: CRC Press, 2011. 291 p. doi: http://doi.org/10.1201/b10793
5. S.Kortmann. **The Relationship between Organizational Structure and Organizational Ambidexterity. A Comparison between Manufacturing and Service Firm**, Springer Gabler, 2012. 183 p. doi: http://doi.org/10.1007/978-3-8349-3630-1
6. A. Osterwalder, Y.Pigneur. ***Business Model Generation***, New Jersey: John Wiley & Sons, Inc., 2010. 288 p.
7. M.McClellan. Collaborative manufacturing: using real-time information to support the supply chain, London: CRC Press, 2000, 264 p.
8. T.Janssen. ***Enterprise Engineering. Sustained Improvement of Organizations***. Cham: Springer, 2016,148 p. doi: http://doi.org/10.1007/978-3-319-24172-2
9. T. Marchuk, D Ryzhakov, G. Ryzhakova, S. Stetsenko. **Identification of the basic elements of the innovation-analytical platform for energy efficiency in project financing**, *Investment Management and Financial Innovations*, Volume 14, Issue 4, 2017, pp. 12-20, http://dx.doi.org/10.21511/imfi.14(4).2017.02
10. Miller R., Strombom D., Iammarino M., Black B. **The commercial real estate revolution: nine transforming keys to lowering costs, cutting waste, and driving change in a broken industry**, *John Wiley & Sons*, 2009. 352 p.
11. V. Mihaylenko, T. Honcharenko, K. Chupryna, Yu. Andrashko, S. Budnik. **Modeling of Spatial Data on the Construction Site Based on Multidimensional**

Information Objects in '*International Journal of Engineering and Advanced Technology (IJEAT)*', ISSN: 2249-8958 (Online), Volume-8 Issue-6, August 2019, Page No. 3934-3940. URL: https://www.ijeat.org/wp-content/uploads/papers/v8i6/F9057088619.pdf

12. O.Terentyev, S. Tsiutsiura, T. Honcharenko, T. Lyashchenko.**Multidimensional Space Structure for AdaptableData Model** in '*International Journal of Recent Technology and Engineering (IJRTE)*', ISSN: 2277-3878 (Online), Volume-8 Issue-3, September 2019, Page No. 7753-7758. URL: https://www.ijrte.org/wp-content/uploads/papers/v8i3/C6318098319.pdf
13. A. Kuchansky, Y. Andrashko, A. Biloshchytskyi, O. Danchenko, O. Ilarionov, I. Vatskel, T. Honcharenko. **The method for evaluation of educational environment subjects' performance based on the calculation of volumes of M-simplexes**in *Eastern-European Journal of Enterprise Technologies*, 2 (4-92), pp. 15-25, http://journals.uran.ua/eejet/article/download/126287/125235
14. A. Gorodetsky, M.Barabash, V. Sudak. **Integrated design and construction management systems using the full-featured building information model (BIM)**, *Foreign and Domestic Experience, Perspectives of Development // Problems of Urban Environment Development: Scientific and Technical Collection*, 2014, (2), p. 499.
15. Y.Riabchun, T.Honcharenko, V. Honta, K.Chupryna, O.Fedusenko. **Methods and means of evaluation and development for prospective students' spatial awareness**in *International Journal of Innovative Technology and Exploring Engineering,* Volume 8, Issue 11, September 2019, Pages 4050-4058, https://www.ijitee.org/wp-content/uploads/papers/v8i11/K15320981119.pdf
16. F. Heidari, P. Loucopoulos. **Quality evaluation framework (QEF): Modeling and evaluating quality of business processes** in *International Journal of Accounting Information Systems,* 15 (3), 2014, pp.193-223.
17. Y. Chupryna, D. Ryzhakov, O. Malykhina, **The identification of alternatives and changes in scenarios for the development of regional build clusters** in *International Journal of Engineering & Technology*, UAE: Science Publishing Corporation, 2018, Vol 10, No 3.2: Special Issue 2, pp. 484-486.
18. I. Ulbieva, K.Uzhakhov, A.Tsechoeva, A.Dzangieva, M.Uzhakhov.**The Construction Technology of Preschool Institutions: Eco-Friendly and Fire-Resistant Materials***in*InternationalJournal on Emerging Trends in Engineering Research, 8(4), April 2020, Pages 1227–1231, https://doi.org/10.30534/ijeter/2020/46842020
19. O. O. Gorshkova.**Construction of Long-Distance Oil Pipelines***in*InternationalJournal on Emerging Trends in Engineering Research, 8(1), January 2020, Pages 60-66, https://doi.org/10.30534/ijeter/2020/11812020
20. M.T. Gómez-López, R.M. Gasca, J.M. Pérez-Álvarez. **Compliance validation and diagnosis of business data constraints in business processes at runtime**" in *Information Systems*, 48, 2015, pp. 26-43.
21. I. Kulikov, K. Karpukhin.**Studying Energy Efficiency of Thermal Management Systems Designed for Electric Vehicles with In-Wheel Motors***in*InternationalJournal on Emerging Trends in Engineering Research, 8(6), June 2020, Pages 2654-2662, https://doi.org/10.30534/ijeter/2020/71862020
22. S. Appel, P. Kleber, S. Frischbier, T. Freudenreich, A. Buchmann, "Modeling and execution of event stream processing in business processes" in *Information Systems*, 46, 2014, pp. 140-156.