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BUSINESS TECHNOLOGIES AND PROCESSES OF IT-PROJECT MANAGEMENT ON THE PLATFORM OF SIMULATION

Abstract. *In the modern world of information technologies and projects, simulation modeling is experiencing a new birth. Interest in this kind of computer modeling has been revived in connection with the significant technological development of programs, projects and simulation systems, which today are a powerful analytical tool that has absorbed the entire arsenal of the latest information technologies, including advanced graphical shells for the purposes of projects and model design and interpretation of output results modeling, project-oriented programming. Due to their attractiveness and accessibility, these simulation technologies are still being mastered by IT-specialists in business projects. It should be noted that the success of innovative projects depends on a clear definition of goal setting of motivational activities of the project team, providing control functions on the results of the IT-project, development of the concept of interaction of stakeholders within the project-oriented knowledge-based organization. The project managers of the enterprise are to make management (capital, human resources, and projects) economically more efficient, which, as a rule, requires the introduction of a number of innovations at the enterprise.*

Keywords: innovation; IT-project; processes management; business organization; simulation modeling

Introduction

Successful development of organizations, regions and entire countries is possible by using modern concepts of innovation project management.

Today, the promising top management begins to show increasing interest in non-traditional methodologies and approaches, situational analysis of decision-making, the ability to predict non-trivial behavior of business processes at the very first, pre-investment phases of IT-projects development [1].

Top-managers are interested in the development of the whole business, how to understand its functioning on the basis of the corresponding models of business processes, and put forward proposals for their improvement. It is necessary to understand the nature of business situations, the arising problems require studying the interactions, studying the degree of their impact on the effectiveness of business processes and the fruitfulness of the procedures for making strategic decisions. Business processes always exist in the context of market relations.

The business process of managing IT-projects can be described in terms of moving resources, the analysis of interacting stock flows. The model identifies the most important aspects of the behavior of the business process model: Personnel management, financial management, customer service, quality management.

When organizing business processes, the object of attention is increasingly the human, synergetic factors, when the increase in efficiency is due to the interaction of activities involved in integrated business processes such as the business process of developing a new product and bringing it to the market, the business process of marketing and supply, business process of customer service, etc. The concept of system dynamics allows you to model dynamic processes at a high level of aggregation, it is based on the idea of the functioning of a dynamic system as a set of flows (money, products, people, etc.).

It is important to pay attention to innovative startup projects - both goals of the enterprise must have novelty, uniqueness, clear sense, the results obtained in achieving of the goal must be measurable, and set limits (on time, on budget, allocated resources and the quality of the results) implementation. Product for innovation project is a set of tools, activities and educational materials necessary for a successful, cost-effective integration of test automation processes in project at any stage of its life cycle. With the help of simulation modeling, the tasks of the broadest range of problems are effectively solved - in the field of strategic planning, business modeling and

reengineering, management and management of projects, supply chains.

For example, simulation modeling includes conceptual modeling (in the early stages of the simulation model), logical-mathematical (including artificial intelligence methods) - for the purpose of describing individual subsystems of the model, as well as in the procedures for processing and analyzing the results of computational experiment and decision-making .

Simulation modeling involves the creation of a model of a complex technical system. In simulation modeling, the logical structure of the simulated system is adequately displayed in the model, and the processes of its functioning, the dynamics of interaction of its elements are reproduced (simulated) on the model.

The simulation model is able to show a holistic picture of the development of the situation in time, to demonstrate or reveal hidden trends, to provide an opportunity to quickly analyze the consequences of decisions, to assess the impact of various random factors and the price of risk, to perform extended ABC analysis. Therefore, the construction of the simulation model includes structural analysis of the simulated system and the development of a functional model that reflects the dynamic portraits of the modeled system. Another important specific feature of simulation modeling as a kind of simulation is that the method of computer model research is a directed computer experiment whose content is determined by the conducted analytical studies and corresponding computational procedures implemented both at the strategic planning stage of the experiment and at the processing stage, interpretation of its results.

Business processes, like complex organizational structures, are characterized not by individual elements, but by relations between them, not by static existence, but by constant development.

Today, system dynamics and tools with a comfortable ideographic interface (iThink, Powersim) are used to solve various tasks of engineering and business process reengineering. The approach is especially important in large-scale IT projects, evaluating non-trivial management situations at the early stages of project implementation. [2; 3].

Analysis of the main achievements and literature

According to the latest reviews [3] published on the Internet, where information is provided by simulation software companies, today there are about 300 analytical software products oriented to simulation modeling on the information technology market. Many scientists: Cremeans J. E., Bekey G.A., Gelrough G.L., De Sola Pool I., and other [5-7]. This article focuses more on the technological aspect. The authors of this article studied the technological and functional capabilities of these modeling systems, which made it possible to draw a general picture of the situation in the information technology market, to identify the main trends in the field of modern simulation systems, the most significant of which will be considered below. Innovative process associated with the creation, development and dissemination of innovations.

System dynamics declares that it is interactions that reveal behavioral complexity and determine the non-trivial behavior of organizational structures that are amenable to targeted project management. System dynamics focuses on interactions arising in schemes of reflexive feedback loops, and interaction management suggests interpreting effects by triggering appropriate decision-making procedures that transform the resource potential of organizations.

Research aim and task

The purpose of this article is to compare the effectiveness of business technologies and the management of IT-projects in organizations, the processes of the functioning of the software system systems simulation modeling on the basis of methodological foundations of project-oriented organizations is the task of the article.

Materials of research

According to modern concepts for innovation there are equally important three properties: the innovative IT-project is a project that includes technical, economic, legal and organizational ultimate justification of innovative activity [4]. Simulation models are always dynamic - this allows to study the behavior of the simulated business process as a developing process along a certain trajectory during a certain period of model time, which allows predicting future states, development trends taking into account their interaction and the influence of environmental factors, under uncertainty.

The system dynamics technology offers semi-conceptual design of business processes, allows to create dynamic variants of management situations "AS-IS" and "TO-BE" in the early stages of implementing reengineering projects [8].

General problems of simulation include a some of aspects:

– methodological, connected with the creation of new concepts for formalizing and structuring the simulated systems, improving the methodological foundations of system modeling, developing approaches to creating stratified descriptions of simulated systems, building decision-making systems in the field of complex modeling projects, etc.;

– mathematical, associated with extensive use in simulation simulation in general, and in the procedures of computational experiment in particular, statistical methods for a variety of purposes, mathematical methods

of optimization and decision making, methods of artificial intelligence;

– technological aspect. The technological capabilities of modern modeling systems are characterized by: the versatility and flexibility of the basic and alternative to the basic concepts of structuring and formalization of simulated dynamic processes embedded in the modeling system.

– That is, the specific content innovations make changes, the main function of innovative activity is a function of the change. Implementing of innovative project - the process for creating and bringing to market an innovative product. As the dominant basic concepts of formalization and structuring in modern modeling systems, the following are used:

– for discrete modeling – process description systems: process-oriented block-type modeling systems - (Extend, Arena, ProModel, Witness, Taylor, Gpss / H-Proof, etc.);

– systems based on network concepts (network paradigms). Network paradigms (Petri nets and their extensions) are used to structure causal relationships and simulate systems with parallel processes that serve to stratify and algorithmize the dynamics of discrete and discrete-continuous systems;

– networks of piecewise linear aggregates, automatic circuits modeling discrete and continuous-discrete systems;

– for systems oriented to continuous modeling - models and methods of system dynamics, - (Powersim, Vensim, Dynamo, Stella, Ithink, etc.).

– Dynamic systems (MATLAB), agent modeling (AnyLogic 7) and others.

The purpose of the innovation project – creating new or modifying existing systems – technical, technological, informational, social, economic, organizational and achievement by reducing resource costs (production, financial, human) radical improvement of the quality of products, services and high commercial effect [1; 9].

Controlling for manager is what allows workers to keep certain limits. But this is not the case. Control is a process to ensure that the organization achieves its goal. Process control consists of setting of standards, measuring actual progress and adjustment in the case where the results achieved differ significantly from established standards. Control function is the ability to identify of management problems and accordingly adjust the organization to how these problems develop into a crisis.

Table – ***Overview of the characteristics of simulation systems***

№	Software	Input Distribution Fitting (Specify)	Support analysis output information	Batch input and development experiment
1	**Arena**	**-**	Output Analyzer (deviation from middle, Anova, histograms, graphics)	**-**
2	**AutoMod**	Using ExpertFit	The AutoStat module provides increased statistical analysis throughout the phase experimenting on a simulated object	Batch input when used AutoStat; AutoMod allows plan an experiment
3	**eM-Plant**	Included Standard tool analysis of data (DataFit)	Standard included DataFit Data Analysis Tool (Confidence interval, average, etc.)	Control system experiment, support batch mode of operation, calculation confidence intervals, neural networks
4	**Extend Industry**	**-**	Confidence Intervals	Automatic execution different scenarios, supported by the system
5	**ProModel**	Certain user distribution, 15 predefined distributions, a plus allocation of supplied with Stat:Fit (included software security)	A complete analysis of the output data, use of diagrams; also export to Excel and Access for subsequent analysis	Unlimited scenarios can be predefined to experiment on parameters
6	**QUEST**	**-**	Carries out a combined analysis, stochastic analysis joint probabilities of all of events	**-**
7	**Witness**	Contains about 10 mathematical distributions. Besides perhaps programming own allocation	**-**	**-**
8	**AnyLogic 7.0**	Stat: Fit supports the more than 40 mathematical distributions	Data collection and statistical processing (deviation from the mean, probability distributions and etc.), presentation (graphics Gant, histograms, etc.)	Supported types experiment: simulation, optimization, Monte Carlo, sensitivity analysis, custom algorithms

The concept of a process related functions synthesized school principles of scientific management, administrative areas and behaviorist schools into a single model.

Interested parties may be at different levels within the organization and have different levels of authority or may be external to the organization performing the project.

Section 13.1.2.1 (PMBOK 5th ed.) examined different types of project stakeholders [10]. In brief the definition - the party concerned, interested party (stakeholder) – individual or legal person that can positively or negatively affect on the progress of the project. Recently in modern theory and practice of project management interaction project team (project manager) with stakeholders given increased attention. Even the first time the existence of the most common international standard on issues of project management PMBOK (Guide for management of projects from Project Management Institute) the PMBOK 5-th ed. changed the structure raids rectification knowledge (component) project management [4; 11]. Existing components added nine tenth - Project Stakeholder Management (Management of stakeholders / parties project). This component of the project management is divided into four processes:

- definition of stakeholders;
- stakeholders' planning management
- stakeholders' expectations management;
- stakeholders' expectations monitoring.

These processes belong to different groups of project management processes: the processes of initiation, planning, execution and control, respectively.

The resulting model can be "lost" in time and get statistics of the ongoing processes as it would be in reality. In the simulation model, process and data changes are associated with events [12]. "Playing" the model consists in a sequential transition from one event to another. Technological or organizational links between arbitrarily chosen moments can be specified using the inequality; where *ξij* can take both positive and negative values. The value *ξij* determines the distribution of the time dependence between the events i and j for the arc-bonds *(i, j).* A positively distributed quantity *ξij* corresponds to a "no earlier" relationship, and a negatively distributed quantity *ξij* defines a "no later" relationship. Thus, a generalization of technological links is obtained. It is taken into account that they can have a non-discrete, but a probabilistic nature.

It should be added that the amount of work durations determines the timing of the events. For a sufficiently large number of such works, the distribution of the random variable *Ti* tends to a normal (with the expectation *MTi* and the variance *DTi)* between events.

As a parameter of the arc *ξij,* we can also consider any characteristic parameter that has additively in the arcs of any path (for example, the cost of work), while using the equivalent GERT-transformation [13] we obtain the mathematical expectation and variance of the cost of a fragment of the network or the project as a whole. The assignment of explicit and implicit, external and internal goals in the form of absolute restrictions is carried out through inequalities of the form: for certain events i that are determinants for the above purposes. The relations presented are a generalization of the corresponding inequalities in the description of generalized network models, where the parameter *ξij* and the adjacency matrix A are deterministic.

Absolute restrictions on the timing of events reflect the relevant directive, organizational and technological restrictions on the timing of the work or parts thereof, given in the "absolute" (real or conditional) time scale. Absolute restrictions are also characterized by the type "not earlier" or "no later than" and takes the form. The introduction of a stochastic adjacency matrix A in combination with generalized connections provides additional possibilities for describing the process of creating a complex project.

If the events i and j are connected in several ways, then an equivalent GERT-transformation of the given fragment of the network in accordance with is performed, the generating function *ξij (s)* of the transformed fragment is calculated, and the probability of event j, provided that event i occurred *P (j / i) = ξij (0).* The mathematical expectation *M (j / i)* and the variance *2 (j / i)* of the time of event j with respect to the time of event i are determined by the corresponding formulas. The length of the path *L (i, j)* is a random variable whose mathematical expectation *ML (i, j)* is the sum of the mathematical expectations of the lengths of all arcs making up the given path, and the variance *DL (i, j)* is equal to the sum of the variances [14].

Under these conditions, the path length (contour) can take negative values, which is interpreted as follows: if *L (i, j) <0* and the arc *(j, i)* has a negatively distributed parameter *ξji,* then event j must occur no later than *-ξji* days after the occurrence of the event *i.* The parameter *ξji* is of a probabilistic nature, which allows more flexible description of the logical-temporal relationships between the events.

$$T_j - T_i \geq \xi_{ij},$$

$$T_i \geq l_i, \text{ or } T_i \leq L_i$$

$$T_i - T_0 \geq l_i, \text{ or } T_0 - T_i \geq -L_i$$

The results of the run contain the following data:

– optimal terms for the performance of individual elementary operations;

– the workload of each member of the IT-project team as a ratio of the time worked by him during the project implementation to the workman's time fund;

– shortage of personnel for the types of IT-project, as a function of the number of personnel;

– professional capacity of each member of the IT-project team during and at the end of the assignment;

– tension in the work of individual functional groups of personnel;

– the total duration of the implementation of the IT- project;

– coefficients of loading of certain types of equipment;

– the quality of the IT-project implementation as a percentage of operations performed satisfactorily from the first time, without reworking;

– distribution of costs for individual types of resources and total costs for the IT-project;

– the degree of achievement of each of the objectives of the IT-project.

It is also possible to plan and simulate the use of a variety of equipment, increase or decrease the time required to complete assignments, and use different numbers of personnel for a particular specialty [15]. Each run is completed by printing new data that the system analyst can use to compare alternative systems, select the composition and size of the IT-project team, and compare job options to optimize the planned activity, taking into account the limitations imposed by the doctrine, finances and technical capabilities.

The statistics obtained in the course of a number of experiments on the model makes it possible to construct histograms of the distribution of the following values: early and late timing of the events, the duration of the process, and the loading of human resources. Such information in turn allows to estimate within the limits of a certain confidential interval existing time reserves and risks of failure of the planned terms of completion of works.

Let's imagine some results obtained using the simulation model as a result of 900 runs. In Fig. 1. is a histogram of the time distribution of the completion of the repair of the technical system. The area under the curve determines the likelihood of completion of work on the project at a given time. Thus, the proposed method allows you to determine the likelihood of project implementation by the planned date, or to calculate the end date of the project, which can be achieved with a given probability. In Fig. 2. Reflects the distribution of the amount of labor.

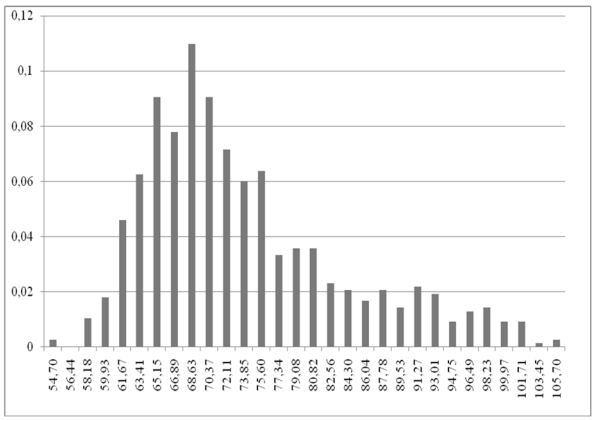

Fig. 1. – The histogram of time distribution in the selection of business projects

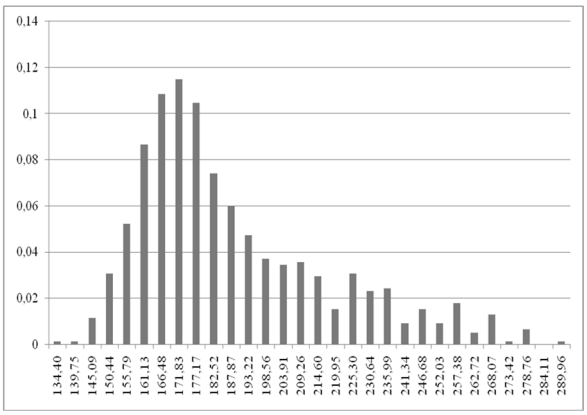

Fig. 2. – The histogram of the allocation of the labor costs of IT-projects, taking into account the returns and the parallel work performance

By building similar dependencies for each IT-project resource, you can plan the optimal composition of the IT-project team [16].

Conclusions

In the business world, organizations, simulation is becoming more common and is used as a backbone and the most valuable link in the decision-making process, therefore it is used in conjunction with other software in decision-making processes in business information systems for various purposes. This method is especially effective when used in projects, whose work is not defined in advance, for example, in business IT-projects. Models of system dynamics are used in conjunction with differential equations of the balance type, as well as in conjunction with the principles and methods of logistics, based on optimization, project management, integration of flows in complex socio-systems.

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БІЗНЕС-ТЕХНОЛОГІЇ ТА ПРОЦЕСИ УПРАВЛІННЯ ІТ-ПРОЕКТАМИ НА ПЛАТФОРМІ ІМІТАЦІЙНОГО МОДЕЛЮВАННЯ

Анотація. *У сучасному світі інформаційних технологій і проектів імітаційне моделювання переживає нове народження. Інтерес до цього виду комп'ютерного моделювання був відроджений у зв'язку зі значним технологічним розвитком програм, проектів та імітаційних систем, які сьогодні є потужним аналітичним інструментом, що поглинув весь арсенал інноваційних інформаційних технологій, включаючи передові графічні оболонки для цілей проекту і моделювання та інтерпретацію результатів моделювання, проектно-орієнтованого програмування. Авторами запропоновано систему імітаційного моделювання до формування та реалізації безнес-процесів в організаціях. Завдяки своїй привабливості і доступності ці технології моделювання все ще освоюються ІТ-фахівцями в бізнес-проектах. Слід зазначити, що успіх інноваційних проектів залежить від чіткого визначення постановки цілей мотиваційної діяльності проектної групи, надання контрольних функцій за результатами ІТ-проекту, розробки концепції взаємодії зацікавлених сторін в рамках проектно-орієнтованих знань на основі організації. Керівники проекту повинні зробити економічно більш ефективними управління (капітальні, людські ресурси і проекти), що, як правило, вимагає впровадження на підприємстві ряду бізнес-інновацій.*

Ключові слова: інновації; ІТ-проект; управління процесами; організація бізнесу; імітаційне моделювання

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БИЗНЕС-ТЕХНОЛОГИИ И ПРОЦЕССЫ УПРАВЛЕНИЯ IT-ПРОЕКТАМИ НА ПЛАТФОРМЕ ИМИТАЦИОННОГО МОДЕЛИРОВАНИЯ

Аннотация. *В современном мире информационных технологий и проектов имитационное моделирование переживает новое рождение. Интерес к этому виду компьютерного моделирования был возрожден в связи со значительным технологическим развитием программ, проектов и имитационных систем, которые сегодня являются мощным аналитическим инструментом, поглотившим весь арсенал инновационных информационных технологий, включая передовые графические оболочки для целей проекта, и моделирование и интерпретацию результатов моделирования, проектно-ориентированное программирование. Авторами предложена система имитационного моделирования к формированию и реализации безнес-процессов в организациях. Благодаря своей привлекательности и доступности эти технологии моделирования все еще осваиваются IT-специалистами в бизнес-проектах. Следует отметить, что успех инновационных проектов зависит от четкого определения постановки целей мотивационной деятельности проектной группы, предоставления контрольных функций по результатам IT-проекта, разработки концепции взаимодействия заинтересованных сторон в рамках проектно-ориентированных знаний на основе организации. Руководители проекта должны сделать экономически более эффективным управление (капитальные, людские ресурсы и проекты), что, как правило, требует внедрения на предприятии ряда бизнес-инноваций.*

Ключевые слова: инновации; IT-проект; управление процессами; организация бизнеса; имитационное моделирование

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