

**ФОРМАЛИЗАЦІЯ ПРОЦЕСА СТРАТЕГІЧЕСЬКОЇ АДАПТАЦІЇ
ПРОИЗВОДСТВЕННОГО ПРІДПРИЯТТЯ К ІНТЕГРАЦІЇ В ЦЕПЬ
СКОЗАННЯ СЛОЖНО-ТЕХНІЧЕСЬКИХ СИСТЕМ**

Идентифіковані мотиви інтеграції виробничого підприємства в ланку поставок складно-технічних систем з використанням інструментів стратегічного аналізу. Исследовано вплив інтеграційної стратегії ланки створення складно-технічних систем на бізнес-стратегію виробничого підприємства. Формалізовано процес стратегічної адаптації виробничого підприємства до інтеграції в ланку поставок створення складно-технічних систем ринку безпеки України.

Ключевые слова: ланку поставок складно-технічних систем, інтеграційна стратегія, SCOC-аналіз, проєктний підхід.

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RESEARCH OF THE ASPECTS OF MODELING OF THE PROJECT MANAGEMENT OF RISK OF IMPLEMENTATION SYSTEM INFORMATION SUPPORT

Проведено аналіз сучасного стану ринку програмного забезпечення управління підприємствами. Досліджено проблеми впровадження систем інформаційного забезпечення управління підприємством. Визначено основні підходи до управління ризиками впровадження проєктів в області інформаційних технологій. Проведено огляд теоретичних аспектів та визначено етапи моделювання процесу управління ризиками проєкту впровадження системи інформаційного забезпечення.

Ключові слова: моделювання управління ризиками, проєкти інформаційних технологій, впровадження системи інформаційного забезпечення.

1. Introduction

In modern economic conditions, the use of the information support system (ISS) is a key resource for increasing the efficiency of any enterprise. At the same time, investments in the processing systems of relevant information and the implementation of modern information technologies make it possible to automate the activities of enterprises, but directly contribute to increasing their profitability. Operational control of production activities, analysis of the current production situation, management decisions – all these functions are reduced, ultimately, to the processing of information. And from the fact that this information is operational, reliable and complete, the success of the whole enterprise depends.

Reliable and timely information about the state of the enterprise is needed at all levels of management. It should be noted that profitability of production, reduction of costs, increase in labor productivity are primarily ensured by timely management decisions based on prompt and reliable information. In this case, it is necessary to implement a qualitative implementation of the system for supporting such decisions by developing and implementing modern information technologies.

When implementing the ISS project, there are some difficulties and problems associated with the impact of various kinds of risks. It is possible to increase business

efficiency by controlling the risk management of the project for implementing automated information systems. Thus, the study and modeling of the management process of any risk management project of the ISS implementation project is an urgent problem and requires further solutions.

2. The object of research and its technological audit

The object of research is the risk management of the ISS implementation project.

ISS does not just keep data on what is going on in the enterprise, but also includes modules for planning and optimizing all types of resources (financial, material, human, time, etc.). Most of the functions implemented in the system are aimed at maintaining the functioning of these modules. The process hinders the aggregate of components associated with the ISS design, its implementation in the enterprise, as well as the impact of risks on the implementation project. The process of risk management should not be viewed as a separate problem that needs to be addressed, but as part of the overall corporate management system.

So, one of the most problematic areas is the study of the modeling aspects of a rather complex process of risk management in the ISS implementation at the enterprise, economic efficiency, taking into account the specifics of

management in the enterprise. The problem can be attributed to little-known, which, in turn, provides a large field of activity for further research.

3. The aim and objectives of research

The aim of research is studying approaches and determination of the stages of modeling the risk management of projects in the field of information technology.

To achieve this aim, the following tasks are defined:

1. To conduct an analysis of the current state of the software market for enterprise management.
2. To identify the stages of modeling the risk management process of the ISS implementation project.

4. Research of existing solutions of the problem

The work of many scientists is devoted to the research of theoretical and methodological aspects of automation of management, the formation of information-analytical systems and ISS in business planning. In these works, automated information processing systems [1] are described, the stages of the software life cycle in the form of information systems in the subject domain of the economy, approaches to software design [2] are investigated.

In [3] it is proved that companies need lightweight project management techniques. Methods should be less structured for micro and small enterprises and more – for medium-sized enterprises [4].

Special attention is also paid to the need to implement a project approach in enterprises. The most convincing proofs of this kind are given in [5, 6]. The results of these studies show that project management positively affects the increase in productivity, profitability and sales volume in the surveyed enterprises along with other necessary business skills.

In [7, 8] the authors summarized the ways of implementing the project management system at the enterprise into two groups. The «top-down» approach provides for the adaptation of modern methods and standards for project management to the specifics of enterprises. The «bottom-up» approach assumes, on the contrary, the creation of its own project management methodology for each enterprise from scratch. The authors believe that the second approach will more fully meet the needs of enterprises.

But since all projects of implementation, as a rule, are unique in connection with the specifics of the organization of the company, its structure and existing business processes, there are always some moments that are not fully suitable for a particular enterprise [9].

Many authors who consider the issues of the effectiveness of project management at enterprises in their works highlight a number of problems that make it difficult to implement or operate the project management system. The author of [10] singles out yet another problem related to the organizational culture of the enterprise: psychological resistance of employees to changes, rejection of bureaucratization and an increase in workflow. As a rule, any innovation is negatively perceived by employees, and the implementation of a project management system inevitably leads to an increase in the workflow.

There are many methods that offer different options and methods for managing project risks. If we talk about

corporate risks, then as a problem for the implementation of the project management system, the lack of a long-term strategy of enterprise management. According to the authors of [11], the employees of the company performing operational activities do not often think about the long-term goals of the enterprise they work for. This is due to the fact that their own goals rarely coincide with the goals of the company itself. In this case, the owner, who has a monopoly on information, has his own strategy for the development of the enterprise and prefers to implement it with the help of authoritarian management tools.

So, the basic researches on the project management at the enterprises of small and medium business are considered, the basic theoretical models that adapt the methodology of project management to industry specific features of enterprises, as well as the ways of implementing the standards in such companies are determined. In addition, the main characteristics of the projects are considered and the main problems arising in the project management process are identified. But many applied issues related to the modeling of the risk management process in the ISS implementation at the enterprise, the cost-effectiveness of managing the risks of ISS implementation, taking into account the specifics of management at enterprises, still require a constructive denouement. They acquire special acuity in the context of the increasing importance of information support in the management of the enterprise and the impact of risk management on the competitiveness of the enterprise.

5. Methods of research

During the execution of the work general scientific and special research methods are applied:

- analysis and synthesis – for the preliminary analysis with the formation of the problem, the definition of goals, the definition of assumptions and risks; planning the ISS development and operation with the definition of stages and their sequence; for the study of features, analysis of the current state of the market for enterprise management software, the conditions for the implementation of various types of information systems;
- analogies and comparative comparison – to determine the characteristics of implementation, the ratio of costs and cost estimates of existing corporate enterprise management systems;
- decomposition method – for ISS development decomposition, which includes marketing research, database design, software development, ISS advance planning; detailing the stages of modeling the risk management process of the ISS implementation project.

6. Research results

In addition, it should be noted once again that the efficiency of production, increasing labor productivity, reducing costs are primarily ensured by timely management decisions.

Only that decision can be justified, which is made on the basis of reliable, systematized and scientifically processed information, is achieved using scientific methods of developing and optimizing solutions. To fulfill these tasks, it is necessary to ensure the high-quality ISS implementation at the enterprise by developing and implementing information systems for making managerial decisions in the enterprise's operations [12].

The main task in designing information systems for making managerial decisions is recording and managing the production and economic processes of the enterprise on the basis of methods for processing and analyzing information on the actual state of its production and financial activities. ISS must be able to complete the task. These include automation of the main tasks of accounting and the preparation of standardized reporting. To solve the tasks of financial management; to automate work with orders and purchases. To improve certain problems of warehouse accounting and various production tasks. To carry out planning of personal relationships with customers and suppliers.

An important component of information support of the enterprise's activities are technologies that represent a combination of methods and means of collecting, registering, processing, meeting and bringing to the user the necessary data through the system of organizational management of computer facilities. In this process, an important role is assigned to the means of telecommunications with the use of Internet technologies, as well as information technologies for decision support and expert systems. Today, such tools are widely used based on information processing technologies. Examples of such can be, in particular, MS Access, OracleParadox, Clipper, SQL2; management: «1C: Enterprise», «Parus», «Galactika». Also, office automation technologies, in particular, MS Word, MS Excel, Outlook, PowerPoint, Socrat, FineReader, Internet Explorer. Also teleconferences and decision support technologies, in particular, Project Expert, ArcviewMarketingAnalytic, Tier, SAP R/3 (SAP ERP).

For example, for five years of observations in the European software market, SAP is the largest vendor on the ERP systems market, with a 22 % share, followed by Oracle with 15 %, and Microsoft Dynamics with 10 %. Vendors of the Tier II group (including Infor and Epicor) occupy another 16 % of the market, vendors of the Tier III group – 37 %. In the Ukrainian market: SAP – 43.4 %, «Information Technology» – 15.7 %, 1C – 13.9 %, Oracle – 11.7 %, Microsoft – 6.1 % [13].

In the practice of the selection process or the technology of developing the necessary software, considerable attention is paid. First, the enterprise needs to determine the expected results from the potential ISS: what functions to perform, what stages of production should include, which to use the software platform, prepare reports. Secondly, an enterprise must have requirements for a computer system

in which all indicators and characteristics of the new system are formalized and presented in accordance with priorities. To define objective criteria for comparing systems according to predetermined parameters. Modern problems associated with the solution of automation and control tasks in industrial systems, encourage the development of new methods of modeling and criteria for the application of information technology.

Today, a large number of various software for collecting, storing and processing information for solving applied problems is operating at various industrial enterprises. Among them it is possible to distinguish corporate systems, problem-oriented systems and software packages. All of them have certain properties, which under various conditions can be considered as advantages and disadvantages. The effectiveness of the application of particular software is determined by its functionality, cost and ratio: license – implementation – equipment. It should be noted that industrial facilities are characterized by a complex structure of flows, for example, a multitude of technological stages, the availability of a variety of equipment, a variety of products, etc.

The current state of the computer systems market in Ukraine is due, first of all, to the historical development of domestic and post-Soviet systems, as well as the emergence of Western developers on the Ukrainian market. Simultaneously, there is a process of integration of post-Soviet and Western systems that create competitive software products, are implemented at enterprises of Ukraine to automate their management [14]. Along with production management systems, there appeared control systems for individual processes. Since these processes are interrelated, the vast majority of management systems are part of corporate information systems designed for medium-term, short-term planning and operational management of production. For large enterprise systems, R/3 (SAP AG), BAAN (BAAN), BPCS (ITS/SSA), Oracle Applications (Oracle) are often used [15]. Such systems have great functionality, which determine their considerable cost. Representatives of medium and small corporate systems in European countries, the United States and individual enterprises of Ukraine are: Mfg-pro (QAD/BMS), JD Edwards (Robertson & Blums), Platinum 14 (Platinum Software Corporation), MAX (ISL), BOS («IT»), Scala (Scala CIS), Galactika («Galactika-Parus»), CA-PRMS (Acacia Technologies), etc. [16]. Table 1 presents the results of statistical studies at the stage of implementation of corporate enterprise management systems [17].

Table 1

Implementation characteristics, cost ratio and cost estimates of existing corporate enterprise management systems

Types of systems	Available software products	Implementation characteristics	Functional completeness	Value for money: licensing/implementation of equipment	Estimated cost
Small systems	JD Edwards (Robertson & Blums). Mfg-pro (QAD/BMS), MAX (ISL), Platinum 14 (Platinum Software Corporation).	Phased (or boxed version)	More than 4 months. Comprehensive accounting and financial management	1/1	50–300 thousand USD
Medium Systems	Scala (Scala CIS), BOS («IT»), Galactika («Galactika-Parus»), CA-PRMS (Acacia Technologies)	Only phased	More than 6–9 months. Integrated management: accounting, management, production	1/2	200–500 thousand USD
Large systems	R/3 (SAP AG), BAAN (BAAN), BPCS (ITS/SSA), Oracle Applications (Oracle)	Phased, complex	More than 9–12 months.	1/1–5	500 thousand, more than 1 million USD

Note: developed on the basis of data [17].

It should be noted that large and medium-sized corporate systems have a relatively high relative cost, and their implementation and adaptation in production is a complex and time-consuming procedure due to the possibility of forming alternative circuits of software modules. Systems, developed by foreign firms, often do not take into account the organizational specifics of existing Ukrainian enterprises, in particular, their industry. Usually, they have to develop additional software add-ons, compensate for this discrepancy. Small systems are mostly limited functionally and solve only the tasks of integrated accounting and financial management, and, as a rule, they are not actually applied in production.

In connection with these shortcomings of corporate systems, enterprises often use problem-oriented packages of application programs designed to solve specific production tasks. Currently, there is a class of programs for various developers, for example, Factory Suite, TRIM-QM, 1C, etc. Of course, problem-oriented application packages are developed by the principle of integrating components into a single system based on network client-server architecture or distributed database architecture with the ability to work within local, corporate or global computer networks [9]. Therefore, when performing production tasks, enterprises often have to give preference to integrated systems and mathematical packages of application programs for processing and computing data that are not tied to production. For example, among the available packages are Statistic (Statsoft), SAS (SAS Institute), SPSS (SPSS), Statgraphics (Statistical Grafes). But the production personnel who do not have a special mathematical preparation, when working with such packages objectively experience certain difficulties, moreover, this software tool does not take into account the specifics of production and does not realize the function of optimization of risk management of implementation.

Most integrators on the market provide their services in the implementation and maintenance of information systems, build their solutions on the basis of boxed products (SAP R/3, BAAN, Oracle EBS, Parus, 1C), adapting the systems to the needs of the client. This imposes certain restrictions on the final product – sometimes it is impossible to change the logic of the program, so it is necessary to use workarounds or adapt to the logic of the software. However, using a boxed product reduces the time to implement the system, allows to predict the timing of the completion of the project and provides a certain level of guarantees from the developer.

Analysis of approaches to the use of information technology development technologies allowed create ISS, the purpose of which is implementation of rational management in enterprises and is based on a comprehensive study of relevant dynamic processes during the life time of the project using modern IT tools. The software implementation of ISS is performed in the Java environment using the Spring MVC web technology. The developed system is a web resource, which includes a set of object-oriented program modules and provides transactions with the database.

As it is noted, the implementation of the ISS project is accompanied by the impact of various kinds of risks. The groups of factors interfering with the ISS implementation project at the enterprise.

1. Economic. These include a lack of funds and inadequate measures to conduct research, implement information technology, invest in information projects.

2. Technological, in particular, insufficient material, scientific and technical base and obsolete technologies; obstacles from patent and license provision and the like.

3. Organizational and management. Organizationally inflexible structures; the dominance of vertical information flow; orientation to short-term payback; difficulties in agreeing the goals of the project participants; prevalence of the interests of current production.

The risk management process takes place at each stage of the ISS implementation project and includes the main stages of identification, identification of the assumed risks and their minimization (Fig. 1) [9, 11].

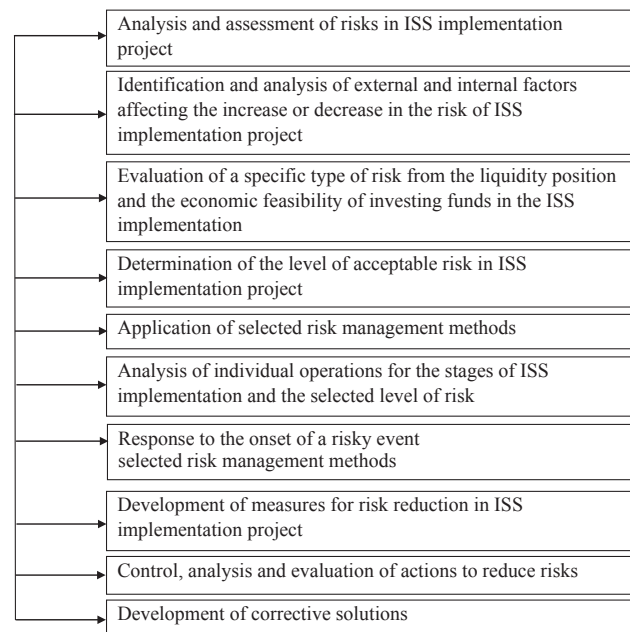


Fig. 1. The structure of the risk management process in the implementation of the project for the implementation of the information support system

At the initial stages of ISS creation, it is necessary to understand how the organization that is going to automate works. The manager is well aware of the work as a whole, but is not able to delve into the details of the work of each ordinary employee. An ordinary employee is well aware of what is happening in his workplace, but may not know how colleagues work. Therefore, to describe the work of the enterprise it is necessary to build a model that will be adequate to the subject area and will include the knowledge of all participants in the business processes of the organization. Modeling of business processes, as a rule, is carried out with the help of case-tools. One option for using this tool is BPwin [18].

This process also includes a risk management procedure for the ISS implementation project. The purpose of this procedure is identification and analysis of risks, and development of a methodology for responding to risks in order to minimize their impact on the project. Implementation of the procedure for risk management of the ISS implementation project includes the main stages:

1. Identification and evaluation of project risks.
2. Analysis of key risks and opportunities.
3. Determination of the strategies and methods for responding to risks.

4. Development and implementation of action plans to minimize risks.

5. Measurement, monitoring and reporting of risk management activities.

6. Results/iteration with the process of making managerial decisions.

Each of these subfunctions is decomposed into component parts by implementing the procedures of the next, lower level. So the stage of identifying and assessing the risks of the project contains the following procedures:

- development of methods for identifying risks;
- development of appropriate procedures;
- documentation of the initial list of risks and coordination with management.

The second stage «Analysis of key risks and existing opportunities» is carried out on the basis of the components:

- analysis and development of risk assessment methods;
- analysis of existing opportunities of the company;
- documentation and structuring of the findings.

The third stage of defining a strategy and methods for responding to risks contains:

- analysis of existing methods of impact on risk;
- development of new methods;
- decision-making on the implementation or refusal of actions.

The next stage is development and implementation of action plans to minimize risks, which is implemented on the basis of the following procedures:

- making decisions on the nomenclature of risks;
- analysis of methods for influencing risks and making decisions on the impact method;
- carrying out activities to minimize project risks.

The stage «Measuring, monitoring and reporting of risk management activities» consists of sub-tasks:

- risk monitoring;
- risk identification;
- implementation of the project risk management plan;
- evaluation of the effectiveness of actions to minimize risks.

The last stage of modeling the process of risk management of the ISS implementation project, namely «Results/iteration with the process of making managerial decisions» contains the components:

- correction of databases on risks;
- analysis of the effectiveness of the used methods and decisions about the need to change the method;
- adherence to the implementation technology.

To model the risk management process of the ISS implementation project, a standard BPwin program procedure is proposed. This program provides an analytical tool for evaluating the model – value analysis (ABC). Functional ABC analysis is a technology for detecting and investigating the cost of performing a particular function (action) [18]. Typically, ABC is used to understand the origin of output costs and to facilitate the selection of the desired model of work in the reorganization of the business (Business Process Reengineering, BPR). With the help of cost analysis, it is possible to solve such tasks as determining the actual cost of producing a product. It is also possible to calculate the actual cost of customer support, identification of the most expensive works. It means those that need to be improved in the first place. This includes also providing managers with the financial degree of the proposed changes, etc. [18].

To set the cost of work (for each work on the decomposition diagram), the frequency of this work within the overall process and duration is indicated. Then amounts are assigned for each type of expenditure. That is, the cost of each work is assigned for each item of expenditure. Total cost of work is calculated as the sum of all cost centers. When calculating the labor costs of the higher level (the parent), first the amount of expenses of the child's work is calculated for the frequency of work (the number of times that work is performed as part of the parental work), then the results are added. Based on the results of the ABC analysis, the final cost of risk management of the ISS implementation project can be found.

7. SWOT analysis of research results

Strengths. Strengths of research and application of modeling of the risk management process of the ISS implementation project is that these measures improve the final result of implementation. Compared with other approaches to the implementation of ISS enterprise management, this can be done by ensuring the predictability of the risks to which this process is exposed. So, the proposed methods allow developing effective methods for minimizing losses associated with the use of other projects in the field of information technology. Compared with analogues, the proposed study allows to predict possible risks and losses, thus eliminating the surprise factor.

Weaknesses. The analysis of the ISS implementation process has shown that one of the key groups that has high dynamism and heterogeneity is the risk factor associated with the implementation of the project. So, the risks of the ISS project implementation include the following risk groups: economic, technological and organizational and managerial. Analysis of the implementation of automated enterprise management systems makes it possible to identify its shortcomings, in particular, the weakness of the proposed approach is the complexity and duration of the ISS implementation. In addition, it is necessary to take into account the rather high cost of this process.

Opportunities. It should be noted that in the future the risk management process of the ISS implementation project can be added by the modules of problem-oriented software packages, which are typically based on mathematical apparatus. Such software can be upgraded, including elements of the adaptive algorithms and mobile use it to solve a wide range of tasks associated with a flexible risk management information technology implementation projects.

Threats. Risk management threats of ISS implementation is the fact that even the proposed approach is not a technology that allows to avoid losses at all because of the influence of different kinds of risks. In particular, for the negative impact of the external environment factors on the object of research. The situation is complicated by the fact that not all threats can be pre-identified and minimized.

8. Conclusions

1. The analysis of the current state of the enterprise management software market is carried out. The main characteristics of the implementation, cost ratio and cost estimates of information systems of enterprise management are determined. The implementation of the ISS project

at the enterprise is complicated by the impact of implementation risks and is a complex and lengthy procedure.

2. Stages of modeling the process of risk management of the ISS implementation project are determined. They include the identification and assessment of project risks, an analysis of key risks and opportunities, the definition of strategies and methods for responding to risks. As well as the development and implementation of action plans to minimize risks, measure, monitor and report on risk management activities with an analysis of the results of management decisions. This makes it possible to reduce production costs at each stage of the ISS implementation.

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ИССЛЕДОВАНИЕ АСПЕКТОВ МОДЕЛИРОВАНИЯ ПРОЦЕССА УПРАВЛЕНИЯ РИСКАМИ ПРОЕКТА ВНЕДРЕНИЯ СИСТЕМЫ ИНФОРМАЦИОННОГО ОБЕСПЕЧЕНИЯ

Проведен анализ современного состояния рынка программного обеспечения управления предприятиями. Исследованы проблемы внедрения систем информационного обеспечения управления предприятием. Определены основные подходы к управлению рисками реализации проектов в области информационных технологий. Проведен обзор теоретических аспектов и определены этапы моделирования процесса управления рисками проекта внедрения системы информационного обеспечения.

Ключевые слова: моделирование управления рисками, проекты информационных технологий, внедрение системы информационного обеспечения.

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