8. *Петкова Л.О.* Інтеграція України до світового фінансового простору в міжнародних співставленнях та макроекономічній динаміці / Л. О. Петкова // Фінансовий простір. — 2013. — № 1 (9). — С. 15-22.
9. *Шпенюк О.Є.* Вплив фінансової глобалізації на розвиток національної економіки / О. Є. Шпенюк // Економіка і прогнозування. — 2014. — № 1. — С. 145-159.
10. 2013 KOF Index of Globalization [Електронний ресурс]. — Режим доступу : <http://globalization.kof.ethz.ch.

УДК 330.46 : 519.866

Ткаченко М. А., магістр,
аспірант кафедри інформаційного менеджменту
КНЕУ імені Вадима Гетьмана

KNOWLEDGE MANAGEMENT AS A COMPONENT OF IT PROJECT RISK MANAGEMENT

АНОТАЦІЯ. У статті розглянуто шляхи розв'язання проблеми ефективного управління ризиками проектів у сфері інформаційних технологій. Проаналізовано сучасні напрями удосконалення процесів управління ризиками проектів у сфері інформаційних технологій і запропоновано підхід, заснований на практиках управління знаннями проекту.

АННОТАЦИЯ. В статье рассмотрены пути решения проблемы эффективного управления рисками проектов в сфере информационных технологий. Проанализированы современные направления усовершенствования процессов управления рисками проектов в сфере информационных технологий и предложен подход, основанный на практиках управления знаниями в проекте.

ANNOTATION. In the article, the ways of solving the problem of effective IT project risk management are considered. Modern directions of improving IT project risk management processes are analyzed and the approach based on project knowledge management techniques is proposed.

Problem statement. IT projects tend to be the most complex and costly. According to different estimates, only 30-40 per cent of IT projects are delivered on time and within the budget frames [1]. Constant changes of users' needs, new tools and new technologies stipulate corresponding changes within the course of the project and force the project team to make decisions under conditions of uncertainty, which, in its turn, generates a large number of risks. Subsequent to the aforementioned, effective IT project management, including risk management, becomes a key factor in the success of the project.

Risk is immanent to any project, since it is impossible to foresee all actions necessary for reaching its aims. Moreover, it is also impossible to anticipate all events, which may have negative impact on the project accomplishment process. Herewith, such repetition does not change the unique characteristics of project activities, though repeatable elements may be present in the project.

Due to the definition of Project management 'Institute, "a project is a temporary endeavor designed to produce a unique product, service or result" [2]. Due to this, each project has its own requirements, management, users, organizational culture, knowledge and skills of the personnel. In addition, a unique product requires unconventional solutions and measures, which in its turn raises the level of uncertainty concerning the result and causes a large number of alterations within the project accomplishment process. These changes may be connected with both the project environment and the very aims of the project as well as qualitative and quantitative characteristics of its results. This is relevant for IT projects where customers' needs and technologies used change most dynamically.

At the current stage, the most pertinent IT project risk management issues include project risks classification, risk identification and estimation methods, risk monitoring and forecasting, risk reduction technologies. Particularly pertinent are development and improvement of IT project risk management methods and models, which allows to reduce the level of uncertainty, to adequately estimate risks related to the project's realization and design efficient measures to minimize them.

Publications analysis. IT project risk management issues are a subject to many scientific publications, which propose measures to improve its efficiency for reaching the project's aims. At the same time, there exists a large number of definitions concerning success and failure of the project. Delivering a project on time, within the budget frames and with acceptable level of quality refer to the most common criteria. In particular, the Standish Group company uses these criteria to identify the success of the project [1].

Therewith, there are also different factors. Thus, sometimes a project, which outstrips the budget frames and schedule, is able to satisfy consumers' needs in case it reaches the result [3]. On the contrary, a project that was delivered on time and within budget frames, may turn out to be unsuccessful. *Turner* [4] notes that different stakeholders, for instance, sponsors, users and project managers assess success in different ways. That is why it is important that a balance between different criteria should be reached and needs

of all stakeholders should be satisfied. Turner singles out three groups of project success criteria:

(1) Strategic aims — "The project increases the shareholder value of the parent organization, generates profit and provides the desired performance improvement".

(2) The expected result of the project — "the new asset works as expected, produces a product or provides a service that consumers want to buy and is easy to operate".

(3) The complete project works — "the project is finished on time, to budget, and with the desired quality. The project team has a satisfactory experience and contractors made a profit".

Thus, the success of a project is a many-sided phenomenon that includes a broad range of criteria and relevant scientific tasks. The success of the project is predetermined by a large number of internal and external factors, which, however, are confined to several main ones. Due to this, the author will consider the success of the project from the viewpoint of its accordance with the most common criteria, taking into account the volume of this article, correspondingly delivering the project on time and within the budget frames.

The analysis of publications [5-8] dedicated to the issues of IT projects shows that the general problems of IT projects are outstripping the frames of the budget as well as failing to meet the project deadlines. At the same time, some researchers [9] refer to the classical problem of IT projects as the development of new technologies during their execution.

IT projects are the most sensitive as compared with other types of projects in connection with using rapidly changing technologies, their long terms of accomplishment and the volatility of consumers' expectations concerning the result of the project. Since IT projects generally include all aforementioned characteristics, they tend to failure and cost and schedule outstrips [10].

According to the pointed issues, the following risk sources are identified in the scientific literature. *Demarco* and *Lister* [11] give the list of five most important risk sources of any software development project: scheduling drawbacks, staff turnover, inflating requirements, violation of deliverables and low performance. A famous scientist in the field of program engineering *Barry Boehm* [12] identifies unreal terms and budget as well as the difference-gap in the knowledge of the specialists having different 'background, as the most widespread risks while executing IT projects

In the one of the surveys [13] dedicated to IT project risks, project managers ranged 27 kinds of risks by their possibility and interaction

to identify the most important ones. Top-5 risks included lack of personnel, unreal terms and budget, unrealistic expectations concerning project results, failure to meet the requirements and shortfalls of opportunities due to product delivery delays.

Thus, it is necessary to identify scheduling and budgeting drawbacks among main risks that may cause problems while executing the project. Herewith, risks may be connected with activities at both planning and executing stages. This stipulates the necessity to develop and introduce effective measures concerning elimination or minimization of these risks, or rather, risk management measures.

Understanding of the necessity to manage risks is reflected in many scientific works and international standards [2, 14-17]. The idea that project risk management presupposes reaching the project's aims by maximizing potentially positive consequences (opportunities) and minimizing potentially negative ones (threats) is conventional within the confines of project management. Such maximization should be attained by correct risk identification, estimation and control.

Kathy Schwalbe defines project risk management as "the art and science of identifying, analyzing, and responding to risk throughout the life of a project and in the best interests of meeting project objectives" [14]. Risk in a project is an indeterminate that may either impact a project positively or negatively. Due to *Schwalbe*, the goal of project risk management is to "minimize potential negative risks and maximize potential positive risks."

The American Project management Institute (PMI) that designs and publishes standards in the field of project management pays much attention to chapters regulating risk management. In the new version of the PMBOK Guide [2] six procedures of risk project management are described: risk management planning, risk identification, risk assessment, risk estimation, risk response planning, risk monitoring and control.

The ISO/DIS 21500 Standard [15] (project management guide), the risk subject group includes processes maximizing the possibility of reaching the project's aims by actively managing threats (risks that may have negative impact on project) and opportunities (risks that may have positive impact on project). The standard emphasizes risk identification and estimation as well as responding to a risk and and controlling it.

If we consider project risks in the scheduling and budgeting context, it will be evident that the most effective measure to minimize corresponding risks is correct planning of the project's resources

including time. Estimating the duration of activities is a rather difficult task, especially while executing projects in the field of IT. That is why the concept of time turnover, that includes the project team performance and different interruptions, is quite important. Whitten and Bentley [16] note that interruptions may take 10-50 per cent of the employee's work time.

In this regard, ISO/DIS 21500 recommends creating emergency reserves that may be used to manage preliminarily identified risks while planning and budgeting the project. The accurate forming of the 'project time reserves may be critically important for achieving success and may be considered as one of the methods of risk management.

The idea of managing risks by forming reserves is crucial in the critical chain method, which, together with decision trees and Monte-Carlo methods, has received wide support among specialists. For the first time the method was described in 1997 by *Eliyahu M. Goldratt* [17] as a supplement to the traditional Project Evaluation and Review Technique (PERT). The critical chain method widely uses buffers for project risks reduction and ensuring the stability of the schedule set.

While planning the project any task contains a certain reserve, which exceeds the expected time of the activity completion. In the traditional approach to project management employees try to start and finish the task exactly on time, which is designated by the plan and imposes certain obligations on the executors. Such approach, by *Goldratt*, does not use possible positive consequences in the project since completion of some task ahead of schedule does not hasten the date of the project's completion. Executors, who should start carrying out the addicted tasks, are unable to do so since they are busy with different activities and do not expect to begin their tasks earlier than planned. Thus, finishing tasks ahead of schedule cannot accelerate executing the addicted tasks and have positive impact on the project's success.

Regarding this, the critical chain method presupposes dividing resources into two categories: resources executing critical tasks and resources of non-critical tasks. If the resources for tasks that pass simultaneously for a certain resource over its accessibility are limited, extra resource connections are created. Then, the "critical chain", that is, a critical path designated taking into account resource connections (a succession of tasks that do not have time reserves and breaking their deadlines causes breaching the deadline of the whole project), is identified.

When a task on the critical chain is finished, the resources for carrying out the next critical task must be ready and accessible. For

fulfilling this, it is necessary to collect information from the resources: by which time they should be warned of interruption of their current activity and switch over to more important tasks of the critical chain. Having such information, project manager can track when the remaining time estimate of the current critical chain task gets lower than so-called buffer of warning the addicted task executor and inform him or her that he or she must be ready to start the task.

Thus, within the confines of the method "Parkinson's first law in project management" is used, according to which any task occupies all assigned time. It is suggested to consider that tasks have inward «"buffers of subinsurance»" on 50 % to their duration, which corresponds an approximately 50 % probability of completion of task on time, provided the reserve is withdrawn from it. Goldratt proposed to collect task reserves on the critical chain into the "project buffer" and to concentrate non-critical task's reserves near it.

Risk realization is visualized by "buffer penetration trends" diagram, which allows the manager to understand where risks trigger and to effectively react on the depletion of buffers. Calculation algorithms of the method are quite simple and effective in terms of performance. Buffers' calculation is also simple and analogous to the method of calculation of tasks duration in some modifications of PERT and responds to the common practice in many organizations.

*Unsettled questions of the general problem***.** Though the efforts of scientists and standardization organizations directed at improvement of project risk management methods are reflected in developing and implementing the appropriate measures and instruments, they provide only general recommendations. At the same time, as it has been noted, each project is unique and requires individual solutions.

Despite the fact that a large number of potential risk factors for IT projects has already been identified and formal procedures for managing these risks have been provided for, little is known about the manner in which project managers estimate each of these risks in practice and what kinds of actions they take in their projects.

Moreover, though being simple to implement, the critical chain method as one of the newest project risk management methods has a substantial drawback — the assumption of withdrawing 50 per cent of the task's duration, which accounts 50 per cent of probability of finishing the task on time, does not allow to consider real deviations of operations [18]. In this regard, the level of incertitude concerning the probability of finishing the task on time when the reserve is withdrawn is high, which in turn reduces the probability of reaching the project's aims.

Formulation of aims. Because of a row of unsolved parts of general issue, being described above, the author sets a task to define directions of subsequent improvement of methods of management of IT-projects risks with the use of mathematical models. For this purpose, it is necessary to solve a problem, related to forming of time backlogs based on 'the first law of Parkinson within the framework of method of critical chain. The solution of this problem, in 'author's opinion, lies in the plane of understanding of "»risk"» and "»uncertainty"» concepts.

The main material. A famous economist, the founder of Chicago school [18], distinguished risk from uncertainty, associating risk with quantitative component of measurement, a "countable uncertainty", and opposing it to uncertainty itself, which is uncountable. Such interpretation is often met in the modern project management literature. In particular, some authors [19] note that risk is connected with the "identified event that will have negative consequences" while uncertainty concerns risk sources. Uncertainty is the situation that generates risk: "the context for risks in the form of events that have negative impact or opportunities that affect the project positively" [20].

Among the theoretical achievements concerning the interpretation of risk notion in the economic sphere in the domestic science, the definition by *V. V. Vitlinsky* should be marked. According to *Vitlinsky*, risk is "the economic category that reflects the features of perception of objectively existing uncertainty and conflicts, immanent processes of targeting, management, decision-making and estimation, which are exacerbated with possible threats and unused opportunities, by economic subjects" [21].

The international risk management standard ISO 31000 [22] that is also used in project management, provides the following definition of risk: "risk is the influence of uncertainty on the aims". The influence is defined as deviation from the expected — with positive or negative consequences. Uncertainty is the state of absence of the information that concerns understanding or knowledge of the event, its consequences or probability.

Summarizing the noted above, risk in the context of project management may be defined as quantitative and qualitative measurement of events that may have both positive and negative impact on reaching the project's aims and that are connected with uncertainty (the state, which is characterized by lack of information for making the decisions that provide absolute probability of achieving the objectives stated).

At the same time, it should be noted that, according to ISO 31000, the input for the risk management process are based on such information resources as historical data, experience, stakeholders' feedback, observations, forecasts and expert opinion. Thus, the level of uncertainty depends directly on the information and knowledge that are available to the project team. Due to this, such direction as project risk management with the use of knowledge management practices becomes prospective.

Knowledge (the form of existence and systematization of human cognitive activity results) in the context of project management can be defined as the totality of systematized data about the domain and management process that are represented in storage media and the experience of the project team and stakeholders. In accordance with such distribution of knowledge, two basic types of knowledge are distinguished by many researchers [23; 24]. Those are tacit and explicit types of knowledge.

At the same time, in *Reich's* [25] opinion, most fields of knowledge referenced by PMBOK are explicit by their nature. The same, however, cannot be said about knowledge used in the context of a project team. In projects, professionals use actively tacit knowledge that gives an answer to the question why projects recruit certain employees — the have experience and understanding to perform their duties out of so-called "by-the-book" approach that is used by new team members.

Many scientists underline the importance of knowledge management in project management. *Cope et al*. [26] affirm that knowledge management is the practice that makes sense for improving project management. They state that if knowledge (both explicit and tacit forms) may be captured and distributed within the project management team, and organizations only benefit from it.

Owen [27] notes that knowledge, which is being created, spread, captured and reused within the project, facilitate the improvement of project management performance. By her words, knowledge are developed on the level of tasks executed and embedded in the toolkit of the project, which, in its turn, increases the organization's potential. At the same time, Owen assumes that knowledge are embedded in the toolkit of the project during the whole project's lifecycle at both explicit and tacit levels.

In *Liernie's and Ribiere's* [28] opinion, there are reasonable grounds to believe that project managers perceive the use of knowledge management practices as a positive impact on project management. Among the most effective knowledge management

practices, the researchers identify shared repository of project artifacts; lessons learned and best practices repositories; and document and content management systems.

The use of knowledge management practices in project management reflects in integrating several directions of this kind of activity. In the field of risk management, such integration resulted in knowledge risk management (KRM), which is the field that develops intensively and proposes the ways to solve the problems connected with traditional risk management methods.

KRM-related research has two main themes. First, the researchers examine how to reduce risk using knowledge. For instance, *de Zoysa* and *Russel* [29] investigated in which way knowledge can help to identify, calculate and react to risks. Secondly, scientists seek to know how knowledge management processes can improve risk management. Thus, *Marshall et al*. [30] provide a series of knowledge management leverages including transition of knowledge to decision makers, increasing the accessibility of knowledge etc. Some researchers seek to explain the commonality between knowledge management and risk management, for example, the necessity of understanding an employee and value of lessons learned, and conclude that risk management is knowledge management.

At the same time, the effective use of knowledge often depends on its organization. This requires a certain knowledge management method and, more important, a form or manner, in which it will be organized. By *Tesh et al*. [32], the effective use of project management tools including risk management is important but not crucial. It is the ability to constantly support the knowledge base, which lies in the basis of the project that is critical to the success of the project.

Karlsen and *Gottschalk* [33] identified a substantial correlation between different kinds of knowledge transition and the project's success. Moreover, due to *Kasten* [34], a typical project with tight schedule, limited budget and, sometimes, unstable environment increases its chances to succeed when it involves knowledge bases (repositories). It should be noted that PMBOK 5 underlines the importance of creating a corporate knowledge base to store and retrieve data including historical data (project records and documents, information concerning previous projects, decision-making and risk management activities) and documentation from previous projects (schedules, budget, performance indicators, risk registers etc).

Thus, effective knowledge risk management necessitates the creation of a knowledge base, since, in spite of unicity of each project,

the role of experience of executing previous analogous projects including both common points and experience of individual members is significant.

Conclusions and prospects for further research. In the context of the tasks of the present article, namely the improvement of risk management methods within the critical chain method, a knowledge base, provided it is effectively organized, may be used to compute possible deviations while calculating tasks reserves. This in turn opens up significant opportunities to create mathematical models estimating IT project risks based on the experience accumulated.

The development of this direction, by the author's opinion, requires considerable effort connected with the organization of a knowledge base (format, scheme and structure of data, filling the base with knowledge, its retrieval) ant its formalization to use it as an input for mathematical models that calculate time reserves. However, it is quite prospective and improving the effectiveness of measures concerning IT project risk management.

Due to the aforementioned, among prospects for further research, the investigation of knowledge management practices to identify the most effective ones and their use to organize the knowledge base should be mentioned. At the same time, the main task is to ensure completeness and homogeneity of the information used to fill the knowledge base. This in turn must ensure the usability of such base among different categories of project participants.

For introduction of incoming data from the base into risk management forming time reserves, it is necessary to design a mechanism of transforming records within the base into input variables of the mathematical model. The model, in its turn, must be developed on the basis of the identified sustainable relations between events taking place in project management and having impact on reaching its objectives.

Literature

1. The Standish Group. CHAOS Summary 2009 // Kinzz official site [Electronic resource]. — Mode of access: URL: http://kinzz.com/resources/articles/91-project-failures-rise-study-shows.

2. A Guide to the Project Management Body of Knowledge (PMBOK-Guide). Fifth Edition. An American National Standard (BSR/PMI 99-001-2013). — Project Management Institute, Inc. — 2013. — 616 p.

3. *Tschinkel B*. Information Technology Project Risk Management: How Risk Management Impacts the IT Project. — Pace University, 2011. — 10 p.

4. *Turner J. R.* The Handbook of Project-Based Management. — London: Mc-Graw Hill, 2009. — 264 p.

5. *Boehm, B. W.* Software risk management: Principles and practices / *Boehm, B. W.* // IEEE Software. — 1991. — January. — P. 32–41.

6. *Drummond H.* The politics of risk: trials and tribulations of the Taurus project / *Drummond H.* // Journal of Information Technology. — 1996. — №11. — P. 347–357.

7. *Keil M.* Pulling the plug: Software project management and the problem of project escalation / *Keil M.* // MIS Quarterly. — 1995. — December. — P. 421-447.

8. *McFarlan, F. W.* Portfolio approach to information systems / *McFarlan, F. W.* // Harvard Business Review. — 1981. — №59 (5). — P. 142–150.

9. *Havenstein H.* IT execs seek new ways to justify Web 2.0 / *H. Havenstein*. // Computerworld. — 2007. — №33. — P. 14–15.

10. *Lane G., Bruton S., Schneider C.* Monitoring risk in information/ *Lane G., Bruton S., Schneider C.* // International Journal of Digital Information and Wireless Communications. — 2009. — №1. — P. 63–67.

11. *Demarco T.*, *Lister T.* Waltzing with Bears: Managing Risk on Software Projects. — Dorset House, 2003. — 106 p.

12. *Boehm B.* A Prioritized Top-Ten List of Software Risk Items / *Barry Boehm* // IEEE Computer Society. — 1998. — May. — p. 70.

13. *Salm D., Love G., Baccarini D.* Management of risks in information technology projects / *D. Salm, G. Love, D. Baccarini* // Industrial Management & Data Systems. — 2004. — №4. — P. 286–295.

14. *Schwalbe K.* Information technology project management. Revised, Sixth edition. — Augsburg College, 2011. — 422 p.

15. International standard. ISO/DIS 21500. Guidance on project management. International Organization for Standardization, 2011.

16. *Whitten, J. L., & Bentley, L. D.* Systems Analysis and Design Methods (7th ed.). — New York: McGraw-Hill/Irwin, 2007. — 705 p.

17. *Goldratt Eliyahu M.* Critical Chain. — Great Barrington: The North river press-publishing corporation, 1997.

18. H. Knight. Risk, Uncertainty and Profit, 1921. [Electronic resource]. — Mode of access: URL: www.econlib.org/library/Knight/knRUP.html.

19. *Sicotte H. & Bourgault M.* Dimensions of uncertainty and their moderating effect on new product development project performance / *Sicotte H. & Bourgault M.* // R&D Management. — 2008. — №5. — P. 468–479.

20. *Perrott B. E.* A strategic risk approach to knowledge management / *B. E. Perrott* // Business Horizons. — 2007. — №6. — P. 523–533.

21. *Vitlinsky V. V.* Riskology in the economy and entrepreneurship: [monography] / Vitlinsky V. V. — Kyiiv: KNEU, 2004. — 480 p.

22. International standard. ISO 31000. Risk management — Principles and guidelines. International Organization for Standardization, 2009.

23. *Taylor H.* Risk management and tacit knowledge in IT projects. – Queensland university of technology, 2003.

24. *Rodriguez E.* Before and After Modeling: Risk Knowledge Management is required. — IN: 6th Annual Premier Global Event on ERM 2008 ER Management Symposium. Chicago, 14.04.08 — 16.04.08.

25. *Reich Blaize Horner & Wee Siew Yong*. Searching for knowledge in the PMBOK Guide / *Reich Blaize Horner & Wee Siew Yong* // Project Management Journal. — 2006. — №37 (2). — P. 11–27.

26. *Cope III, R.F., Cope, R.F. & Hotard, D.G*. Enhancing project management with knowledge Management principles. — Allied Academies International Conference 2006, New Orleans, LA.

27. *Owen, J*. Integrating knowledge management with programme management / *Jennex, M.E*. (ed.) // Current Issues in Knowledge Management, IGI Global. — New York. — 2008. — P. 132–148.

28. *Lierni, P. C. & Ribiere, V. M*. The relationship between improving the management of projects and the use of KM / *Lierni, P. C. & Ribiere, V. M* // The Journal of Information and Knowledge Management Systems. — 2008. — №1. — P. 133–146.

29. *De Zoysa, S., Russell, A. D*. Knowledge-based risk identification in infrastructure projects / *De Zoysa, S., Russell, A. D.* // Canadian Journal of Civil Engineering. — 2003. — №3. — P. 511–522.

30. *Marshall C., Prusak L., Shpilberg D*. Financial risk and the need for superior knowledge management / *Marshall C., Prusak L., Shpilberg D* // California Management Review. — 1996. — №3. — P. 77-102.

31. *Neef D*. Managing corporate risk through better knowledge management / *Neef D* // The Learning Organization. — 2005. — №2. — P. 112-124.

32. *D. Tesch, T. J. Kloppenborg, M. N. Erolick*. IT project risk factors: the project management professional perspective / *D. Tesch, T. J. Kloppenborg, M. N. Erolick* // Journal of Computer Information Systems. — 2007. — Summer.

33. *Karlsen J.T. & Gottschalk P*. An Empirical Investigation of Knowledge Transfer Mechanisms for IT Projects / *Karlsen J.T. & Gottschalk P.* // Journal of Computer Information Systems. — 2003. — Fall. — P. 112-119.

34. *Kasten, Joseph*. Knowledge Organization and the Project Management Process / Eds. Srikantaiah T. Kanti, Koenig Michael E.D., Hawemdeh Suliman // Convergence of Knowledge Management and Project Management. — Lanham: Scarecrow Press, 2010. — P. 174-183.