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The Role of Knowledge Management in IT Projects

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Abstract. Project Management is a field of management dealing with using available knowledge, skills, tools and technology to fill needs and expectations of projects principles. The main goal of this article is to show how knowledge management powered by AI can be used in projects, why it is so important nowadays and how it can impact on the projects effectiveness in a positive way. In the first part of the paper the author focuses on definition and division of knowledge. The second part relates to project management basics. The last one focuses on role of knowledge management in projects.

Keywords: Knowledge, Knowledge Management, Knowledge Modeling, Project, Project Management, IT Project

1 Introduction

Project management is used in almost every field of human activity, ranging from military and space projects, through the wide range of typical design areas such as IT business, consulting, architecture, government programs and projects to new areas of PM such as pharmaceutical industry and health care.

This area especially derive from knowledge management to improve effectiveness of implemented projects. It is caused by increasing environment turbulence (law changes, new technologies development) and by the fact that unique knowledge which creates new products and services is an important source of the competitive advantage. This pressure has forced the organizations to bring innovation processes on improving performance and, by this way, to begin continuous learning and improving organizational processes.

According to the much research and surveys conducted by institutions of European Union which are responsible for supporting projects and programs, the crucial problem of realizing projects is inappropriate way of project knowledge managing, especially loss of organizational memory because of an insufficient ability to collect the project knowledge. It causes low effectiveness, poor results quality, dissatisfaction of commissioners and ineffective way of financial sources managing. Low level of learning and using experience, leads to aversion to implementation

of new projects and loosing, as a consequence, opportunities from business point of view.

As a solution, more and more scientists and managers head towards the knowledge management. Knowledge management is a source of methodology and tools helpful to recognize, to get, to use and to collect knowledge which is necessary to realize complicated projects in better and more efficient way. Knowledge gathered during previous projects ensure better start for next ones. Managers can easily extract basic information about similar projects, predict possible problems, plan solutions to avoid them before begging of a project and make more reliable decisions based on previous experiences in the middle of a project which makes whole process more effective and less time-consuming. As a result, project knowledge management, the new area of science has been appearing before our eyes.

This field of knowledge, utilizes the existing, very rich heritage of knowledge management in the area of organizational management – the management of repetitive activities, based on permanent organizational structures and transfer it into the field of realization of complex, unique and time-limited projects.

2 Definition of knowledge. Knowledge management and modeling

The knowledge that accompanies us in many situations and what has already been shown, is an indispensable part of the business. The first thing which should be explained is the definition of knowledge.

The term is traditionally considered as a triangle data-information-knowledge and it is illustrated as a pyramid.

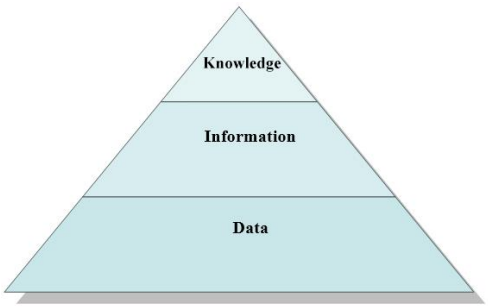

Fig. 1. Hierarchy of knowledge. Traditional approach.
Source: Own work based on Kowalczyk A., Nogalski B. (2007), p. 22. Diffin, Warszawa

In spite of alternative shots, this model is accepted as the most appropriate in knowledge management. Attempts to create superior concepts in relation to knowledge, such as wisdom, have not been recognized as they meaning for philosophy rather than scientific and practical management challenges [1].

Misunderstanding of the differences between data, information and knowledge concepts can lead to inappropriate understanding of tools or misleading expectations e.g. misleading knowledge planning with information-planning systems.

The term of data can be understood as one sign or group of signs, arranged in accordance with the rules of a given syntax [2]. From technical point of view data can be recognized as set of cold facts and numbers without any context what prevents the use of data in its pure form [3].

Information is a narrower concept than data because it includes facts and figures that are presented in a comprehensible form to the recipient and do not duplicate the resources of current knowledge. Information can be defined as interpreted data, placed in a certain context [4]. It is necessary to point out that significant meaning from organizational point of view has only information which is helpful in whole management process and it is called as business information.

The term of knowledge is the most difficult to explain. Knowledge refers to the practical use of the information we have already acquired for a specific purpose. In many definitions we can find out that this term is used in relation to the problem solving.

The most popular classification of knowledge mark out explicite and tacit knowledge. The first one can be easily encoded or written in form of text and exchanged [5]. The essence of tacit knowledge can be easily illustrated by the example: We know someone's face and we are able to recognize it in the crowd, between thousands or billions other faces, but we cannot explain how we can do that. To be more specific – it cannot be expressed by words. This type of knowledge based on intuition, feelings, faith, life experiences and organizational culture. Explicite knowledge is important because of ability of collecting, sending and even selling. Tacit knowledge is especially important for the organization. It has the biggest impact on tasks implementation and efficiency of functional structure in the organization. What is more, it has also fundamental meaning as a competition advantage.

Tacit knowledge can be kept in our mind, the explicit one can be stored in written form (also electronic such as databases). Thereby, it acquires the nature of the available good and it is the type of knowledge which can be multiplied by subsequent processes of recording or copying [6].

Nonaka emphasizes that new knowledge come out from individual and then it is transferred to the next three levels: group, organization, multi-organization. The essence can be explained as a knowledge which follows the employee and it can be risky when someone leaves the company. In case of big projects individual knowledge is not enough and success depends on combining knowledge of the group (synergy effect). Organizational knowledge is interpreted as a total knowledge resources held by the organization. On the highest multi-organizational level occurs knowledge exchange [7].

Organizational learning is based on an organizational culture that promotes free communication and knowledge sharing between members of the organization. The basis for the smooth functioning of the learning organization is a strong and coherent vision of the organization, which must be communicated to all employees and implemented by them to promote strategic thinking as well as a strategy which is not

only impassive, but also unequivocal [8]. An organization can be called learning if it can draw conclusions from its own past and build on it the routine practices that underpin its behavior [9].

Knowledge management is a relatively new interdisciplinary business model that covers the fields of economic sciences, management, information technology, telematics, sociology, linguistics, and psychology. It combines strategies, tools and techniques that are often known and used for many years [10]. Almost all of the definitions have a few common points that identify knowledge management in the most precise way [11]:

- using of external sources,
- collecting knowledge resources in business processes, products and services,
- representing knowledge in databases and documents,
- promoting the growth of knowledge resources through the development of organizational culture and motivation,
- transferring and sharing knowledge across the organization,
- regular assessment of the value and impact of knowledge assets.

Based on knowledge diversification proposed by Polanyi, we can identify knowledge management as a set of processes that transform the knowledge of the workers and tacit knowledge from the organizational environment into the valuable resources of the knowledge that makes it possible to gain competitive advantage.

Knowledge management as a complex process that depends on the character of the organization, requires a well-thought out strategy and assumes certain priorities. Two most popular strategies developed by M.T. Hansen and T. Tierney are [12]:

- codification strategy, based on explicit knowledge that involves collecting and sharing knowledge in the computer databases,
- personalization strategy, based on tacit knowledge that giving opportunity for sharing knowledge between employees, computer systems are not as useful as they are in the codification strategy.

As it was mentioned above, knowledge can take a shape hard to describe and codify. Surprisingly, there are tools which can be helpful in resolving this problem. Knowledge modeling is a cross disciplinary approach to capture and model knowledge into a reusable format for purpose of preserving, improving, sharing, substituting, aggregating and reapplying it. In the computer world it is used to simulate intelligence. Innovation, progress and prosperity, all depends heavily on making the right decisions. The good news is that making right decisions is not hard. For a rational agent there is no way of making wrong decisions, given “all” the facts and a “clear” objective. The only reason for making wrong decisions is by neglecting the facts or misinterpreting the goal. That is why knowledge modeling is such a critical element of cognitive discipline and a prerequisite for reaching true Artificial Intelligence. knowledge modeling offers a shift from local proprietary solutions to produce and disseminate embedded Knowledge Models into larger computational solutions in effort to generate “applied knowledge.” It contributes to scores of intellectual activities, from continuous improvement to automated decision-making or problem-solving, and hence increases “Intellectual Capital” for generations

of humankind to come. The fundamental goal of knowledge modeling is to bring methodologies and technologies together in an implementation neutral framework as a practical solution for maximizing the leverage of knowledge. The core difference between working with information and knowledge is that - in addition to facts - a knowledge model includes enactment and has the ability to support intuition as well as the subjectivity of experts and/or users. In everyday situations, people make a variety of decisions to act upon. In turn, these decisions vary based on one's preferences, objectives and habits. The following example, Figure 2 – Situational Effects, highlights how gender and age play a role in the decision-making process.

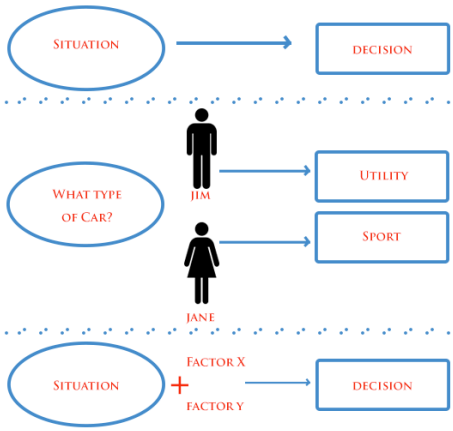

Fig. 2. Situational Effects
Source: Own work based on Makhfi Pejman,
Introduction to Knowledge Modeling, www.makhfi.com/KCM_intro.htm [31.07.2017]

As such, many models, like the example of Jim and Jane, can only be executed after having a profile assigned. A profile is defined as the personnel interpretation of inputs to a model. knowledge modeling incorporate the quantitative and qualitative use of information, and processes tangible and intangible attributes that contribute to end result, such as Jim's decision of buy a sport's car. The bridging together of quantitative and qualitative methods enables knowledge modeling to incorporate subjectivity, which is the main differentiator between information and knowledge. Knowledge models help us to learn from past decisions, to assess present activities and, just as important, to preserve domain expertise. Knowledge saves time and overhead costs, and reduces the mistakes from overlooks. Knowledge models are very valuable and often outlive a particular implementation and/or project. Accordingly, the challenge of knowledge modeling is that this process must be designed not only as an abstract idea, but as an implementable process with the ability to aggregate and disseminate applied knowledge for the purpose of creating intellectual capital for generations of humankind to come. As a best practice approach knowledge models should stay implementation neutral and provide experts with flexibility of picking the appropriate technology for each specific implementation. In general the technology

solutions can be categorized into case-based systems and knowledge-based systems. Case-based approach focuses on solving new problems by adapting previously successful solutions to similar problems and focuses on gathering knowledge from case histories. To solve a current problem: the problem is matched against similar historical cases and adjusted accordingly to specific attributes of new case. As such they don't require an explicit knowledge elicitation from experts. Expert or knowledge-based systems (KBS) on the other hand focuses on direct knowledge elicitation from experts. There are a variety of methods and technologies that can be utilized in knowledge modeling, including some practices with overlapping features. The most commonly used methods are highlighted below [13]:

Decision tree & AHP	Graph of options and their possible consequences used to create a plan in order to reach a common goal. This approach provides designers with a structured model for capturing and modeling knowledge appropriate to a concrete-type application. Closely related to a decision tree, AHP (Analytic Hierarchy Process) developed by Dr. Thomas Saaty bestows a powerful approach to Knowledge Modeling by incorporating both qualitative and quantitative analysis.
Bayesian networks & ANP	Influence-based systems such as Bayesian Network (Belief Network) or ANP (Analytic Network Process) provide an intuitive way to identify and embody the essential elements, such as decisions, uncertainties, and objectives in effort to better understand how each one influence the other.
Artificial neural network	An Artificial Neural Network (ANN) is a non-linear mathematical or computational model for information processing. In most cases, ANN is an adaptive system that changes its structure based on external or internal information that flows through the network. It also addresses issues by adapting previously successful solutions to similar problems.
Genetic & evolutionary algorithms	Inspired by biological evolution, including inheritance, mutation, natural selection, and recombination (or crossover), genetic and evolutionary algorithms are used to discover approximate solutions that involve optimization and problem searching in explorative models (refer to model types).
Expert systems	Expert systems are the forefathers of capturing and reusing experts' knowledge, and they typically consist of a set of rules that analyze information about a specific case. Expert systems also provide an analysis of the problem(s). Depending upon its design, this type of system will produce a result, such as recommending

	a course of action for the user to implement the necessary corrections.
Statistical models	Statistical models are mathematical models developed through the use of empirical data. Included within this group are 1) simple and/or multiple linear regression, 2) variance-covariance analysis, and 3) mixed models.
Rule engines	Another effective tool for knowledge modeling is a rule engine, which is categorized as an inference rule engine or a reactive rule engines. The inference rule engines is used to answer complex questions in order to infer possible answers. For example, a Mortgage Company would ask – "Should this customer be allowed a loan to buy a house?" Reactive rule engines are used to detect and react to interesting patterns of events occurring and reacting.
Workflow systems	A Workflow System manages the operational aspect of a work procedure, analyzing 1) how tasks are structured, 2) who performs them, 3) what their relative order is, 4) how they are synchronized, 5) how information flows to support the tasks, and 6) how tasks are being tracked. Workflow problems can be modeled and analyzed using graph-based formalisms like Petri nets.

Tabel 1. Knowledge modeling methods

Source: Own work based on Makhfi Pejman, Introduction to Knowledge Modeling, www.makhfi.com/KCM_intro.htm [31.07.2017]

As we can see in the table above, there are a lot of possible solutions to use knowledge management methods powered by artificial intelligence. There are also plenty of benefits which should encourage to use them. All of them enable to reduce decision-making process in time, improve the productivity of process and staff, reduce costs, automate our actions, reduce risk of making mistakes. These are only examples of tangible benefits. It is worth to point out a few intangible advantages such as: positive influence on organizational transparency and reliability, accurateness and faster access to data for timely decisions, saving enormous time and effort in data entry, facilitates strategic planning etc..

Interpretation of knowledge and knowledge management is not a simple task. It depends on many aspects and point of view. Researchers and business practitioners try to define it as precisely as possible but it seems to be unenforceable because of dynamic changes in the environment. We can only approximate general characteristics. Artificial intelligence tools give us opportunity to improve decision making process and find solutions very quickly which is desirable in managing projects. In the next part of the paper the author will present how areas of knowledge management and projects interpermeate each other.

3 Knowledge management in projects

Due to the rapidly growing popularity of projects in recent years, acknowledged by someone as even the fashion of management, it is necessary to clearly delineate their conceptual boundaries.

Project Management Institute, the biggest organization gathering project managers, treats projects as "A temporary action undertaken to create a unique product or service" [14]. As a temporality we should understand time constraint of project "life" (defined time of project beginning and end) and it do not need to be recognized absolutely as a short time of realization. According to PMI definition, the aim of the project can be understood as delivering specific, unique result, product or service. Specific because of requirements, scope, circumstances, suppliers and other characteristics.

Why project management is so popular today? Companies are increasingly implementing their operations at the operational and strategic level in the form of projects. Projects are helpful in reconstructing and rebuilding agency assets by raising the value of the organization for its stakeholders [15]. Project management is used in almost all fields of business, starting with space and military projects through popular areas such as IT, consulting and architecture to new areas of music business, movies, health care and pharmaceutical business [16].

We can consider three main parameters (constraints):

- result quality and fulfill requirements,
- time and deadline,
- costs.

Parameters mentioned above are classified as elements conditioning project success. A lot of scientist treat as an insufficient and create additional ones e.g. client satisfaction, keeping current organizational culture etc. [17].

The specificity of knowledge management in projects and the uniqueness of the issues within this scope is directly rooted in the definition and characteristics of projects [18]. We can divide organizations activity according to repeatability and complexity criteria into four groups: routine activities (high repeatability and low complexity), functions (high repeatability and complexity), improvised activities (low repeatability and rather low complexity) and projects (low repeatability and rather high or high complexity) [19].

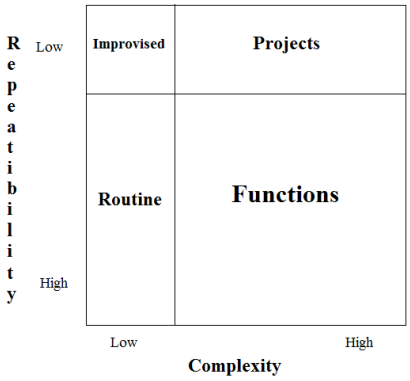

Fig. 3. Kind of activities in organizations.
Source:Own work based on 19. Trocki M., Grucza B., Ogonek K. (2003), p.14. Zarządzanie Wiedzą, PWE.

Typical and traditional area of interest for knowledge management are functions - complex and traditional action/processes. Because of its complexity, realization is strongly connected with collecting and processing of significant knowledge sources. Their repeatability let relatively easy record. What is more, repeatability make the new sets of knowledge easy to obtain and update according to the Deming cycle. Projects are complex and require (similar to functions) big sources of knowledge. In contrast to functions, projects are not repeatable and, as a consequence, projects are unaffiliated to stiff regulations. Due to this fact, they are very often compared to the art of project management [20].

The project uniqueness causes a lot of questions about the knowledge uniqueness used in projects. Can knowledge used in one project, be useful in the other projects? Can we consider knowledge from previous projects (lessons learned) as a valuable source of the knowledge for the organization? We can bring it to the level of project knowledge specificity and to the level of mobility. The crucial aspect of creating an individual knowledge management system in the organization is to keep balance between general sources of knowledge and specific project experiences connected to the project in a particular environment.

Another challenge for knowledge management in projects is to deliver appropriate knowledge in appropriate time. It is related to two appearances. First of all, people who start working in the project, should have sufficient knowledge at the beginning. In the other case, the knowledge should be delivered as soon as possible and according to all needs. For example, project manager who has been chosen from the team without any experience in management and procedure awareness in the organization, should be involved in intense training. Secondly, every step in the project is related with specific problems and specific set of knowledge which is needed to solve them. Especially important from knowledge management point of view is closing the project because it is connected with dissolution of a project team. Ignoring the stage of project closure in knowledge management processes can cause distraction

and even significant loss of project knowledge. The main challenge at this stage is to keep the knowledge after project and let it be used in the next projects [21].

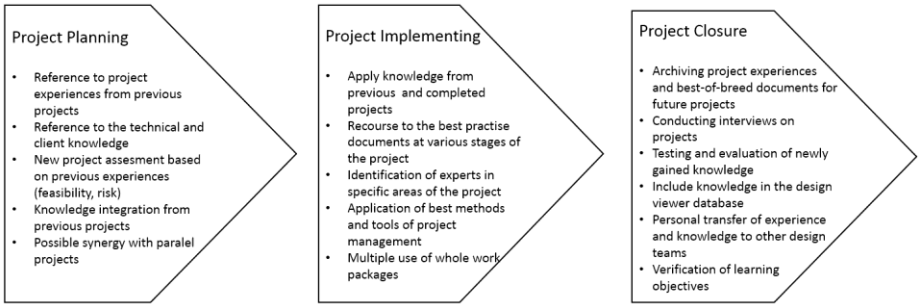

Fig. 4. Knowledge Management in project environment

Source: Own work based on Hanisch B., Lindner F., Mueller A., Wald A., Knowledge management in project environments. Journal of Knowledge Management, 2009, 13 (4), p. 150.

More examples of knowledge management through project management stages are presented at the diagram above.

The teamwork nature of the project strongly influences on the specificity of knowledge management. At first, knowledge and specialized skills should be treated as a main criteria of selecting staff for the project team. As it was mentioned before, we should not loss time and resources for trainings and other methods of learning at the beginning of the project. There is a strong need for employee information and their qualifications in the early phases of the project. This information should be collected and stored independently of ongoing projects, to let managers use it in every moment during the project. Another challenge is to ensure high level of communication between team members because of their functional and knowledge diversification. Hermetic language, specified vocabulary, conviction about the superiority of own expertise knowledge inhibit the knowledge management processes and also cooperation. The third aspect of teamwork nature is project teams autonomy. Autonomy very often stunts learning process in organization [22]. Inadequate control and project coordination can lead to knowledge retention in individual projects, unwillingness to share it outside the team, loss of knowledge, and even the use of individual practices and tools that are not in line with organizational standards and policies [23].

By analyzing internal environment we cannot forget about tacit knowledge. According to the studies, people are almost five times more eager to look for information in their closest environment. They prefer to ask friends rather than search for the answer in the database or documents. The most common way to reach knowledge will be through informal activities, based on friends networks, such us sending e-mail , short informal calls or meetings. The knowledge gathered by each employee will be determine by the position in the company or role in the project. It causes the risk of reluctance to share it with the others. In the reference to personalization strategy is better to lead moderate expenses on IT and let put

people in contact with colleauges [24]. It is the phenomenon strictly corresponding with the process of knowledge externalization. Gathering knowledge derived directly from individuals is possible only on the condition that they want to share it with the others. It is a difficult task for managers to create friendly atmosphere and organizational culture conducive to knowledge share but it is also one of the keys to projects succeed [7].

4 Summary

The specific features of the projects detailed and discussed in this paper have a very strong influence on the specificity and priorities of knowledge management in projects. Summarizing, let introduce the following conclusions:

- project implementation requires advanced interdisciplinary knowledge (with a view to the complexity of project innovation),
- project knowledge is dispersed (due to the task and temporary character of the project team),
- this knowledge must be described at an appropriate level of detail to ensure its transferability between projects,
- the basic object of the project management knowledge management process should be the project team,
- technical (object-oriented) knowledge is an essential element of project knowledge.

The use of knowledge management methods in project implementation is an object of interest for researchers from knowledge management and professionals dealing with complex and unique projects. They focus especially on impact of KM according to three main project success parameters, pointed out in the third paragraph of the section "Knowledge management in projects" because it give us the answer on the question how it is used in projects nowadays and what we can do to develop its usability in the future. The author tries to refine them by describing specific benefits in the Table 2.

Advantages	Specific benefits for project teams
Cost reduction	- Study on own mistakes and mistakes committed in other projects - Quick and easy training of employees - Use good practices and existing solutions - Avoid duplication of work
Time saving	- Sharing experience and team communication without conflicts - Avoid duplication of work and wasting time - Use of ideas from other design teams
Quality improving	- Improving the quality of results through a good design concept - Competent partnerships

	- Good local coordination with the other project participants - Experience-based learning with a business partner - Common direction of the teams

Tabel 2. Overall and specific benefits cause of knowledge management in projects Source: own work based on Schwaab J., Knowledge management for project managers and other decision-makers – Learning from experience. Deutsche Gesellschaft fur Technische Zusammenarbeit, Eschborn, 2009, p. 2

Particular interest is given to the benefits that the project can achieve in the case of adequate management of knowledge resources.

Introduction to knowledge management solutions in the area of project management can significantly improve the efficiency and effectiveness of process execution. However, these solutions should be based on justified grounds.

References

1. Jashapara A. (2004). Knowledge Management, FT Prentice Hall, Harlow, 34-35.
2. Probst G., Raub S., Romhardt K. (2004). Zarządzanie wiedzą w organizacji, Oficyna Ekonomiczna, Cracow, 21.
3. Jashapara A. (2004). Knowledge Management, FT Prentice Hall, Harlow, 32.
4. Floridi L. (2005), Is Information Meaningful Data?. Philosophy and Phenomenological Research, 70 (2), 351-370.
5. Tiwana A. (2002). The Knowledge Management Toolkit: Orchestrating IT, Strategy and Knowledge Platform, Prentice Hall PTR, Harlow, 57-59.
6. Polanyi M. foreword by Sen A. (2009). The Tacit Dimension, The University of Chicago Press, Chicago, 50.
7. Nonaka I. (1994). A Dynamic Theory of Organizational Knowledge Creation. Organization Science, 5 (1), 14-37.
8. Armstrong M., Taylor S. (2014). Armstrong's Handbook of Human Resources Management Practice. Thirteenth edition, 284-287.
9. Garwin D.A. (1993). Building Learning Organization, Business Harvard Review, July-August 1993.
10. Dalkir K. (2005). Knowledge Management in Theory and Practice, Elsevier Butterworth–Heinemann, 21-24.
11. Awad E.M., Ghaziri H.M. (2004). Knowledge Management, Pearson Education, New Jersey, 26-27.
12. Hansen M.T., Nohira N., Tierney T. (1999). What's Your Strategy for Managing Knowledge?. Harvard Business Review, 77(2), 106-116.
13. http://www.makhfi.com/KCM_intro.htm [31.07.2017]
14. PMI (2008). Guide to Project Management Body of Knowledge, 4th Edition, Project Management Institute Inc., 5-6.
15. Nokes S., Kelly S. (2007). The Definitive Guide to Project Management, Prentice Hall, 89.
16. Semadeni M., Anderson B. (2010). The follower's dilemma: Innovation and imitation in the professional services industry, Academy of Management Journal, 53 (5), 1175–1193.
17. Kerzer H. (2003). Project Management, A systems approach to planning, scheduling and controlling. 8th edition. John Wiley & Sons, 6.
18. Canonico P., Soderlund J., De Nito E., Mangia G. (2013). Special Issue on organizational mechanism for effective knowledge creation in projects: Guest editorial. International Journal of Managing Projects in Business 6 (2), 223-235.
19. Trocki M., Grucza B., Ogonek K. (2003), Zarządzanie Wiedzą, PWE, Warszawa, 14.
20. Berkun S. (2005). The Art of Project Management. O'Reilly Media Inc.
21. Brady T., Davies A. (2004). Building project capabilities: from exploratory to exploitative learning. Organization Studies, 25 (9), 1601-1621.
22. Hobday M. (2000). The project-based organization: an ideal form for managing complex products and systems?. Research Policy, 29 (7-8), 871-893.
23. Scarbrough H., Swan J., Laurent S., Bresen M. (2004). Project-based learning and the role of learning boundaries. Organization Studies 25 (9), 1579-1600.
24. Allen T. (1977). Managing the Flow of Technology. MA: MIT Press, Cambridge.