Methodologie for evaluation effectiveness and efficiency in management of IT-projects

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***Abstract*—The present paper represents methodological approach for effectiveness and efficiency of IT project management, part of a comprehensive research in Bulgarian high-tech companies. Traditional and Agile methods are explored on the base of different developed indicators establishing wasted time and increased costs for the final product and result, due to the imperfection in IT project management of the companies.**

Keywords—IT project management, management, agile methodologies, scrum project management

I. INTRODUCTION

Different methodologies used for project management in IT sector aim to achieve improvement in effectiveness and efficiency in implemented activities taking into account varied specifics such as: innovativeness, high-technology, different level of unpredictability of results, short life-cycle of product, serious lost profits caused by the delay in project implementation etc. This is the reason that different methods are focused on achievement effective decisions in different conditions and business environment. We can define two basic philosophies for management projects in IT sector – "traditional" methodologies – such as waterfall model, spiral model, V-model etc. They rely on the irreversibility of the client`s requirements and project phases during development of software products. On the opposite side of this understanding is agile movement and agile methodologies – Scrum, Kanban, Dynamic Systems Development Method etc. These methods consider IT project management as a dynamic and flexible system, when long-term planning is not appropriate and reflects to the limit effectiveness.

From historical point of view, traditional methodologies, as the name suggests, are the first explored models for the management of software development. Common characteristics of these models can be considered as fundamental for their strengths, such as:

- Clear dephasing of the development process, which reflects to client's comfortability and understanding;
- Requires strong management control on each phase, which provides security to the development process;
- Quality focused methodologies (where achieving high level of quality of the developed product is more important than time and costs).

Basically their implementation is appropriate for the IT projects, where client`s requirements are stable and clear from the beginning at the moment of contracting.

Some of the basic weaknesses of traditional methodologies we can conclude as:

- Low level of flexibility, e.g. redesign of products;
- Developed team should to be consist of large number of experts with different IT profile and specializations;
- Lack or minimum of interaction between client and developed team – only at the end of each phase or directly to final presentation of the project results.

Agile methodologies come as a response to the challenges of the modern dynamic business environment where "change" and "flexible" are synonyms of competitiveness and success and as a totally new approach for the IT development process. Their main advantages we can summarize in the following way:

- Adaptive to the clients requirements – change can be executed practically on every stage of the development process;
- Efficient in terms of costs and time;
- Involves client in the development process.

Methods under Agile methodology are appropriate for small and medium (in regard to budget), in situation with medium or high level of uncertainty when client doesn't know exactly what he wants from the developed IT product. Still we can underline some main disadvantages of Agile methodologies:

- Low level of management control – Agile rely on the self-control teams – for instance Scrum method has a key role of "Scrum-master" who is rather facilitator and mediator than controlling person.

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- Development process is built on the multi-functionality of each team member and thus results directly to the right criteria of expert selection.
- In situation when customer requirements are not clear, there is a possibility of improper budgeting and deadline settings for development of IT product.

This paper presents methodology developed for research of awareness and implementation of different methods in project management in Bulgarian IT companies.

II. Methodology for research project management in IT companies

Traditional methodology includes well-known models in software development and project management such as: Waterfall model; Spiral model; V-model. Agile methodology includes new understanding about management software project. Numerous new methods and tools are developed under this philosophy, including: Scrum; Kanban; Dynamic System Development Method.

To establish effective and efficient implementation of different methods for management project in IT companies, we use variety indicators, the most important are:

- Percentage of unsuccessful and partly unsuccessful implemented projects (as a numbers and budget);
- Percentage of projects with delays in their implementation (as a number and budget);
- Level of customer satisfaction about project`s product;
- Level of flexibility in cases of needed changes in specification of product during the project implementation;
- Costs for project implementation;
- Duration of project; Effectiveness of costs project management;
- Effectiveness of time project management;
- Risk of financial loss.

In order to achieve comparability of results survey, we divide software projects into five level of complexity regarding their innovativeness:

First level - Standard project with low level of new developed elements;

Second level - Standard project with improvements and upgrades;

Third level - Projects for totally new product, based on known principles;

Forth level - Innovative projects in traditional innovative sectors (with high level of risk and rapid changes);

Fifth level - Project with high level of innovation (cutting edge in the field).

Bulgarian companies implement mainly projects in the first four levels therefore the developed methodology reflects this fact.

A. *Indicator Effectiveness of costs project management (ECPM)*

$$ECPM = \frac{\sum_{i}^{I} C_i}{\sum_{i}^{I} C_i + \sum_{j}^{J} DC_j + R}, \; 0 < ECPM \leq 1 \quad (1)$$

rel. units.

Where : C_i - costs for i – component of the project according initial financial forecasts, in currency; $i = 1,2,...,I$ - project`s components; $DC_j$ – costs for j re-implementations until the full achievement of the component`s desire results, in currency; $j = 1,2,...,J$ - re-implemented projects components; R – other costs due to the poor quality level of implemented project components in currency.

B. *Effectiveness of time project management (ETPM)*

$$ETPM = \frac{\sum_{i}^{I} T_i}{\sum_{i}^{I} T_i + \sum_{j}^{J} DT_j + L}, \; 0 < ETPM \leq 1 \quad (2)$$

, rel. units

where T_i - time for implementation of an i component of the project according initial time-table, in hours; $i = 1,2,...,I$ - project`s components; DT_j – time for j –re-implementation of projects components, in hours; $j = 1,2,...,J$ - $j = 1,2,...,J$ - re-implemented projects components; L –other costs due to the poor quality level of implemented project components, in hours.

C. *Indicator for Risk Management (R_i)*

Measuring the risk of losing financial resources in cases of failed or partly failed project implementation: risk is defined as probability of occurrence of an unfavorable event ($\mathbf{P_i}$) and adverse outcomes (project delay, financial loss, lost profits etc.) in currency.

$$R_i = P_i . (\sum_{i}^{I} C_i + \sum_{j}^{J} DC_j + R), \quad (3)$$

D. *Stages in methodology implementation*

First stage – Identifying respondents – IT companies. In order to achieve representativeness of survey data they are defined at random principle in compliance with the

requirements of company`s size, implemented projects on the innovativeness level, proportion of Bulgarian and foreign companies operating in Bulgaria. The last requirement is needed to define the level of influence of foreign management on the IT business in Bulgaria.

Our initial research shows that IT companies in Bulgarian industry can be divided and classified into two main groups according to the capital and the number of full-time employees in the enterprise:

- Companies with foreign capital – usually these enterprises are large and medium-sized with offices in Bulgaria. Depending on the specifics of their main objects, the number of employees in it can range in big scale - from 10 to more than 100.
- Companies with Bulgarian owners, respectively with Bulgarian capital – usually these enterprises are micro (up to 10 employees) and small (50 employees). There are only few cases in IT Bulgarian Industry, where companies with Bulgarian capital can be defined as medium and big-sized.

Second stage – The execution of real survey on the ground, according to the standardized questionnaire, indicated the level of innovativeness in the implemented projects. The basic data for forming indicators are determined using collected information from the questions, such as:

- Total number of IT projects, developed and implemented in the last 3 years;
- Number successful IT projects, developed and implemented in the last 3 years;
- Number of unsuccessful IT projects in the last 3 years;
- Number of project by level of innovativeness;
- Брой на проекти по степен на новост;
- Costs for different components of the project according initial financial forecasts;
- Costs for re-implementations of different stages up to the full achievement of the component`s desire results;
- Other costs due to the poor quality level of implemented project components in currency;
- Causes for the failure of the development of IT project – lack of time, budget (costs), expertise, staff, inappropriate project management, unclear customer requirements and expectation etc.;
- Methodology, used in project development (traditional or agile);
- Number of successful projects regarding the five level of innovativeness, implemented in different methodologies;
- Flexibility of developers for changing during the phases of project implementation etc.

Third stage – Determination of indicators and statistical processing of the collected data with SPSS. Establishing initial conclusions for effectiveness and efficiency in project management of companies in different methodologies: traditional and agile.

Fourth stage – Analysis, based on the results of indicators, made by different statistical section and combination between sections– in terms of size of the enterprise, capital (national or foreign), level of innovativeness etc.

Fifth stage – Additional survey for clarifying (in case of necessity). Making the final conclusions from survey.

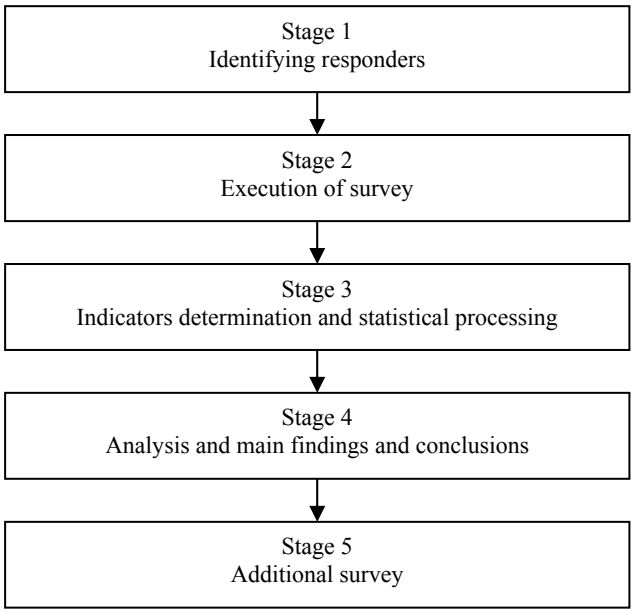

Fig. 1. Block scheme on the stages in methodology implementation.

As a result of implementation of this developed methodology the project management of the Bulgarian IT companies was the object of an empirical research. The data show that Bulgarian IT companies implement both methods – traditional and agile, according to the specific circumstances of the software project (fig. 2).

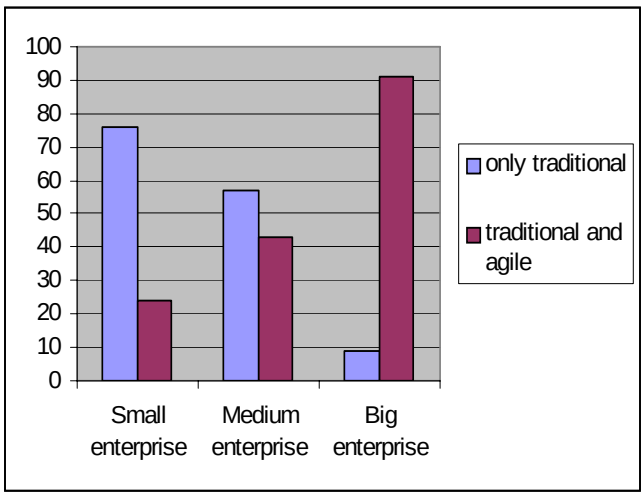

Fig. 2. Methodologies implemented for software engineering.

Most used method from agile methodology is Scrum technique which is appropriate in high level of uncertainty in business environment and client`s requirements, reflecting to the flexibility and changeability on specifications of the developed software product (fig. 3). Scrum is well known and implemented by almost all companies that used agile methodology. Results from the empirical research are subject of another scientific article.

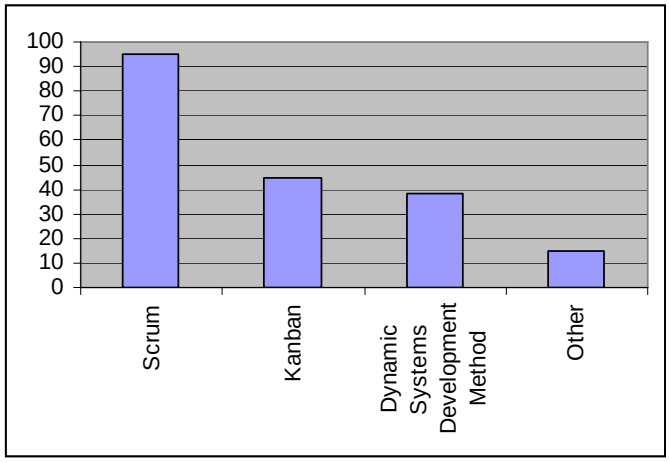

Fig. 3. Agile methods implemented in software engineering.

CONCLUSION

Special methodology for research level of implementation of different management practices in IT projects in Bulgarian companies is developed, based on the indicators and project selection criteria due to the innovation. As a result was established the usability of different methods for project implementation in Bulgarian IT companies.

REFERENCES

[1] A. Aitken, V. Ilango, A Comparative Analysis of Traditional Software Engineering and Agile Software Development, 46th Hawaii International Conference on System Sciences, Conference proceedings, 2013, pp. 4751-4760.

[2] Alexander Poth, Ali Sunyaev, "Effective Quality Management: Value- and Risk-Based Software Quality Management", *IEEE Software*, vol.31, no. 6, pp. 79-85, Nov.-Dec. 2014, doi:10.1109/MS.2013.138

[3] Bernhard Peischl, Mihai Nica, Markus Zanker, Wolfgang Schmid, "Recommending Effort Estimation Methods for Software Project Management", *WI-IAT*, 2009, Web Intelligence and Intelligent Agent Technology, IEEE/WIC/ACM International Conference on, Web Intelligence and Intelligent Agent Technology, IEEE/WIC/ACM International Conference on 2009, pp. 77-80, doi:10.1109/WI-IAT.2009.235.

[4] C. Ebert, P. Abrahamsson and N. Oza. Lean Software Development. IEEE Software 2012, 22-25.

[5] Diane Rover, Curtis Ullerich, Ryan Scheel, Julie Wegter, Cameron Whipple, "Advantages of agile methodologies for software and product development in a capstone design project", *FIE*, 2014, 2014 IEEE Frontiers in Education Conference (FIE), 2014 IEEE Frontiers in Education Conference (FIE) 2014, pp. 1-9, doi:10.1109/FIE.2014.7044380.

[6] Eva del Nuevo, Mario Piattini, Francisco J. Pino, "Scrum-based Methodology for Distributed Software Development", *ICGSE*, 2011, 2012 IEEE Seventh International Conference on Global Software Engineering, 2012 IEEE Seventh International Conference on Global Software Engineering 2011, pp. 66-74, doi:10.1109/ICGSE.2011.23.

[7] Granville G. Miller, "The Characteristics of Agile Software Processes", TOOLS, 2001, Technology of Object-Oriented Languages, International Conference on, Technology of Object-Oriented Languages, International Conference on 2001, pp. 0385, doi:10.1109/TOOLS.2001.10035.

[8] June M. Verner, William M. Evanco, "In-House Software Development: What Project Management Practices Lead to Success?", IEEE Software, vol.22, no. 1, pp. 86-93, January/February 2005, doi:10.1109/MS.2005.12.

[9] K. Anguelov and L. Bacali. Gestion des projets, Université technique de Sofia, 2008.

[10] K. Pries and J. Quigley. Scrum Project management. CRC press, 2011.

[11] Kevin Vlaanderen, Sjaak Brinkkemper, Slinger Jansen, Erik Jaspers, "The Agile Requirements Refinery: Applying SCRUM Principles to Software Product Management", *IWSPM*, 2009, International Workshop on Software Product Management, International Workshop on Software Product Management 2009, pp. 1-10, doi:10.1109/IWSPM.2009.7

[12] Kieran Conboy, Sharon Coyle, Xiaofeng Wang, Minna Pikkarainen, "People over Process: Key Challenges in Agile Development", *IEEE Software*, vol.28, no. 4, pp. 48-57, July/August 2011, doi:10.1109/MS.2010.132.

[13] Leo Vijayasarathy, Charles Butler, "Choice of Software Development Methodologies - Do Project, Team and Organizational Characteristics Matter?", IEEE Software, no. 1, pp. 1, PrePrints PrePrints, doi:10.1109/MS.2015.26.

[14] M. Awad, A comparison between agile and traditional Software Development Technologies. The University of Western Australia, 2005.

[15] M. Cohn. Succeeding with Agile, Software development using Scrum. Pearson Education, January 2010.

[16] M Alexandrova, Dimensions of the national cultural environment: Bulgarian evidence, KSI Transactions on Knowledge Society, Vol. 8, Issue 1, March 2015, pp. 41-48.

[17] M Alexandrova, IT outsourcing partnerships in Bulgaria: Strategic orientation, Scientific Annals of the" Alexandru Ioan Cuza" University of Iasi, Economic Sciences Section, Vol. 57, 2011, pp. 555-569.

[18] Michael Coram, Shawn Bohner, "The Impact of Agile Methods on Software Project Management", *ECBS*, 2005, Proceedings. 12th IEEE International Conference and Workshops on the Engineering of Computer-Based Systems, Proceedings. 12th IEEE International Conference and Workshops on the Engineering of Computer-Based Systems 2005, pp. 363-370, doi:10.1109/ECBS.2005.68.

[19] Pedro Silva, Ana M. Moreno, Lawrence Peters, "Software Project Management: Learning from Our Mistakes [Voice of Evidence]", *IEEE Software*, vol.32, no. 3, pp. 40-43, May-June 2015, doi:10.1109/MS.2015.71.

[20] Phil Laplante, "Remember the Human Element in IT Project Management", *IT Professional*, vol.5, no. 1, pp. 46-50, January/February 2003, doi:10.1109/MITP.2003.1176490

[21] Rashina Hoda, James Noble, Stuart Marshall, "Self-Organizing Roles on Agile Software Development Teams", *IEEE Transactions on Software Engineering*, vol.39, no. 3, pp. 422-444, March 2013, doi:10.1109/TSE.2012.30.

[22] Shvetha Soundararajan, James D. Arthur, Osman Balci, "A Methodology for Assessing Agile Software Development Methods", *AGILE*, 2012, 2012 Agile Conference, 2012 Agile Conference 2012, pp. 51-54, doi:10.1109/Agile.2012.24.

[23] Simon Liu, Rick Kuhn, Hart Rossman, "Surviving Insecure IT: Effective Patch Management", *IT Professional*, vol.11, no. 2, pp. 49-51, March/April 2009, doi:10.1109/MITP.2009.38.