Benchmarking of Tools for Distributed Software Development and Project Management Support

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***Abstract*— Distributed software development as trend raises many issues. Some of these issues could be categorized as the need for proper software tools support, particularly in the area of distributed software development and project management. It is of a high importance to integrate software development (as data source) and project management (that uses such data for decision making). This paper presents results of benchmarking of most frequently used tools that support both distributed software development and project management.**

I. INTRODUCTION

Importance of project management and values that brings to the quality and success of projects and business processes in organizations has been explored within the Project Management Institute research, conducted with 418 projects, 60 reports, 447 interviews with project managers from 65 business organizations from all around the world [1]. Key results are described as elements that influence importance and value of project management:

1. Context – Economy status, Human factor, Culture, Project type and context, Organization characteristics, Strategic directions

2. Context influences implementation via: Training, Tools, People, Motivation and Organization

3. Implementation influences values: Satisfaction, Goals Alignment, Application Consistency, Process Results, Business Results and Implemented Advantages.

Obviously, it is of high importance to consider tools as important implementation factor.

Distributed software development (DSD) projects are very specific. Many research efforts have been made in systematization of issues of this specific type of projects, such as [2] and [3]. DSD issues could be categorized to the area of software engineering and project management. These two dimensions are used to systematize review papers results using specific SE-PM matrix [4] based on SWEBOK (Software Engineering Body of Knowledge) [5] and PMBOK (Project Management Body of Knowledge) as standards.

Integration of tools that support distributed software development and project management improve project management efficiency. Aim of this paper is to present part of results from Ljubica Kazi's PhD thesis [7] that is related to benchmarking model for evaluation of software tools that support distributed software development and project management. Applicability of the proposed model is illustrated with software tools that are extracted as most used in practice, as per previously conducted survey.

II. THEORETICAL BACKGROUND

Benchmarking could be defined in the context of quality management in organizations, as per International Benchmarking Clearinghouse [8] as "systematic and continual process of measurement and comparison of organizational business processes in accordance to business processes of leaders in the same field in the world, in aim to get information that could help organization to take activities of its own performances improvements." According to [9], benchmarking could be defined as "test or set of tests that are used to compare performances of alternative tools and techniques". In [9], three important components of benchmarking are described:

- Motivated comparison – motivation for research and technical description of characteristics that are compared among tools and techniques that are compared
- Relevant set of tests – tests present part of tasks that tools/techniques should perform or solve in practice. It is important to choose relevant tasks.
- Performance measures – performance is link between technology and the way it is used, i.e. purpose. Measuring performance exšresses level of alignment with purpose.

According to [9], good benchmarking model should have characteristics such as: accessibility, applicability, economical sustainability, relevance, portability, scalability.

III. RELATED WORK

Even benchmarking is primarily focused on business excellence, it could be used in evaluation of tools and techniques. In [10], research on criteria for evaluation of IT project success is based on benchmarking within different business organizations, using surveys.

In [9], using benchmarking as a tool for research in software engineering area is examined. In [11], benchmarking is used to explore good practice elements application in the field of software project management from European countries.

Particular role of stakeholders in selection of project and portfolio management tools is examined in paper [12]. In this paper it has been proposed the approach of analytical hierarchical process. According to survey applied at National Documenting Center of Greece, criteria for evaluation and selection of project management tools are defined.

IV. THE PROPOSED BENCHMARKING MODEL

The key element of benchmarking is selection of characteristics that will be measured and compared. Selection of characteristics depends on the type of tools and its purpose, as well on the goals of the analysis.

In [7], key areas for selection of relevant characteristics are aligned with standards in software engineering (according to SWEBOK [5]), project management (according to PMBOK [6]) and strategic management methodology Balanced Scorecard (BSC) (introduced for the first time in [13]). The proposed benchmarking model is presented at Table I, as a three column table. First column represents standard source, second represents area within the standard source and third represents questions to be asked within the appropriate area.

TABLE I. THE PROPOSED BENCHMARKING MODEL

SOURCE	AREA	QUESTION (Yes, No answer) – does the tool support…?
PMBOK	Integration	Interoperability with other tools, especially development environments and different file formats? Data Export?
	Scope	Display of defined scope of software functions? Changes in scope of software functions? Display of implemented scope of needed software functions?
	Time	Estimation and planning of implementation time? Display of time characteristics of implementation flow?
	Quality	Measurement of human resources (project participants) quality? Team quality measurement within the project participation? Measurement of results quality? Measurement of results flow within the implementation process?
	Human resources	Project participants' records? Records on work finished? Personalization of functions for different user profiles according to different roles in project?
	Communications	File exchange among participants? Communication – exchange of messages, ideas, questions?
	Risks	Risk records? Risk measurement? Risk display?
	Procurement	Improvement of existing solution with additional modules?
	Stakeholders	Communication with stakeholders?
SWEBOK	Requirements	Requirements records? Requirements change records? Follow-up and display of requirements changes? Records on the level of alignment of solution with requirements?
	Design	Integration with tools for system design?
	Construction	Integration with tools for software development?
	Testing	Integration with tools for software testing?
	Maintenance	Not covered
	Configuration Management	Not covered
	Engineering Management	Covered with other questions
	Engineering Process	Display of implementation process flow? Measurement of phase success or success of implementation flow?
	Engineering models and methods	Application of different approaches and methodologies of project management? Application of different approaches and methodologies of software development?
	Quality	Results quality measurement? Measurement of quality of process results flow?
	Engineering economy	Financial indicators of phase or process success? Financial indicators of product success?
Balanced Scorecard	Finance	Financial indicators of phase or process success? Financial indicators of product success?
	Users	Communication with users? Creating reports? User satisfaction measurement? Records on needs and requirements from users?
	Internal Processes	Display of process flow? Planning of process flow? Measurement of process flow success?
	Learning and Growth	Records and display of experiences? Records and display on problems and answers?

The proposed benchmarking model is applied in analysis of selected software tools that support both distributed software development and project management. Selection of tools for analysis is explained in section V.

V. METHODOLOGY

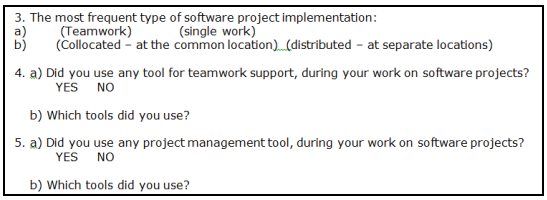
A. Selection of data sample

The source of data for performing benchmarking analysis represent software tools that are practically tested for characteristics defined in the proposed benchmarking model.

Names of software tools for performing analysis are extracted from survey results, implemented among experienced software development employees as well among software project managers.

B. Survey participants characteristics

Prior to benchmarking, survey (Figure 1) has been conducted in aim to explore attitudes of experienced software development employees and software project managers regarding different aspects of distributed software development and project management, including software tools that they use in everyday practice.


3. The most frequent type of software project implementation:
a) (Teamwork) (single work)
b) (Collocated – at the common location) (distributed – at separate locations)

4. a) Did you use any tool for teamwork support, during your work on software projects?
YES NO

b) Which tools did you use?

5. a) Did you use any project management tool, during your work on software projects?
YES NO

b) Which tools did you use?

Figure 1. Part of survey questionnaire related to IT project conduction and tools usage [7]

Survey is conducted with questionnaire that was filled by 165 participants, where 32% are employed in foreign countries and 68% are employed in Serbia. Some of demographic data are represented as follows:

- 92 participants finished Bachelor level of studies, while 44 finished Master level and 16 are PhD.
- 72 participants are employed in IT companies, 36 in educational institution, 29 in business organization and 21 in government agency or institution.

It is important to emphasize examined experience of survey participants regarding teamwork, distributed work and using appropriate software tools:

- 112 participants had experiences in teamwork, while 26 mostly had experiences in single work engagements
- 51 participants worked collocated, 62 participants worked in distributed environment, while 6 participants worked equally in collocated and distributed work environments
- 87 participants used software tools for teamwork, while 61 participant never used teamwork supporting software tools
- 71 participants used project management software tools, while 73 participants never used project management tool.

VI. RESULTS

A. Survey results – tools selection

According to previously presented questionnaire (question 3,4 and 5), survey participants entered answers related to their previous experiences in distributed teamwork, as well as their experiences with appropriate software tools that support teamwork and software tools that support project management. This way, two sets of software tools are extracted: software tools for software development teamwork support and software tools for project management support. By intersection of these two sets, the final set included names of software tools that are used for both purposes. These tools are then sorted by the number of occurrence in survey answers.

Most frequently tools from the intersection set were extracted and they are: Active Collab [14], Jira [20], Basecamp [15], RedMine [22] [23], dotProject [16], Microsoft Team Foundation Server [24] [25] [26], gForge [17] [18] [19], TeamViewer [26].

Analysis of each tool's description from appropriate tool's website led to the conclusion that Team Viewer could not be considered as project management tool, but as file sharing tool in distributed software development. Therefore, final selection of software tools for further analysis within benchmarking included:

- Active Collab
- Jira
- Basecamp
- RedMine
- dotProject
- Microsoft Team Foundation Server
- gForge

B. Benchmarking results – tools ranking

More detailed analysis of characteristics of each tool's website led to conclusion that these tools could be categorized as:

- General tools for teamwork and project management support: ActiveCollab, Basecamp, dotProject
- Tools for software development teamwork support and software project management support: GForge, JIRA, Redmine, Microsoft Team Foundation Server / Visual Studio Online.

In benchmarking analysis, each tool was analyzed for appropriate characteristic, according to previously presented benchmarking model, by answering appropriate question with Yes/No. Number of "Yes" answers was summarized and percentage is calculated, related to the maximum of possible "Yes" answers for each characteristics category.

In this paper, only tools from the second group (particularly related to software project management) are presented with summary results from benchmarking analysis (Table II).

TABLE II. BENCHMARKING ANALYSIS – SUMMARY RESULTS

Category standard / Percent	GForge	Jira	RedMine	Microsoft Team Foundation Server
PMBOK	52	62	95	81
SWEBOK	62	69	77	92
BSC	40	50	90	70
TOTAL	52	61	89	82

According to results of benchmarking analysis, the most appropriate software tool that supports both teamwork in software development and software project management is RedMine. In the area of PMBOK characteristics this tool support is 95%, in SWEBOK 77%, BSC 90%.

VII. CONCLUSION

Distributed software development brings many challenges, where the most important are related to teamwork in software development, as well as related to software project management.

This paper presents a benchmarking model that could be used for analysis and evaluation of software tools that could support software development in both teamwork and project management dimension. The proposed benchmarking model is based on PMBOK, SWEBOK and BSC.

Applicability of the proposed model is illustrated with particular software tools, that are selected from the survey where participants were experienced software developers and software project managers.

Benchmarking analysis is performed upon the selected tools that support teamwork and project management for the particular area of software development: GForge, JIRA, Redmine, Microsoft Team Foundation Server / Visual Studio Online. Results of benchmarking analysis show that the most appropriate tool is RedMine, with 89% of needed characteristics, that are defined within the proposed benchmarking model.

Future research in this field could include research in the field of different areas of interest for defining relevant characteristics for benchmarking and extending number and quality of questions within the proposed model. Another direction for research could lead to new approaches and solutions for automated benchmarking of software tools.

VIII. ACKNOWLEDGMENT

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