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IDENTIFICATION OF CRITERIA AND METRICS FOR SOFTWARE PROJECTS PERFORMANCE: AN OUTCOME OF INTERVIEWS

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ABSTRACT

Ample of research has been carried out on the topic software metrics. Lots of metrics have been projected and validated in the field of software engineering especially for software development. However, metrics that related to software project management are still need to explore more especially from the industrial or practitioners. Identification of metrics for software project management may guide the project managers to manage and control the software projects. This is indirectly may reduce the software project failures in the industrial. This paper presents the processes and activities that used to identifying the performance criteria and the related metrics that can be used to monitor the performance of software projects. The aim of this paper is to identify the performance criteria and related metrics from the perspectives of practitioners. We carried out structured interview sessions among project managers from Malaysian Public Sector to accomplish this task. The results of this study are a set of performance criteria and metrics that can be a guideline to manage and control the software projects development towards to its success.

Keywords: performance criteria, metrics, software project.

INTRODUCTION

Software projects have a high rate of failure. In fact, organizations have tried to reduce the rate through many ways [1]. There is still software projects are delay in delivery, overrun cost, insufficient quality, do not meet user requirements and less customer satisfaction [2]. Software projects need to be monitor frequently in order to success. Metrics are vital to determining the software projects success. A software product or a software-development process attributes are measured in detail by using software metrics. In other words, they are measures of success [4]. Generally, software metrics can deliver the necessary information for managerial understanding in managing and controlling the software projects development for its enhancement [3]. Current works on software metrics merely focused on object oriented metrics for the software developments [6]. Largely, most of the metrics are identified in the perspectives of software developments only.

Consequently, the current software metrics does not widely address the performance criteria and related metrics for software project management. Accordingly, most of existing works on software metrics for project management are extensively explored for cost and schedule criteria only. Eventually, a method such as Earned Value (EV) was introduced for monitoring software projects duration and cost [7]. Besides cost and schedule, other elements that influenced software project developments are needed to explore more in detail. Thus, one of the ways to explore this is by discovering performance criteria and metrics that influence the software projects development.

Therefore, monitoring and controlling the performance of software projects could be done by establishing metrics for each and every elements that involved in software projects development [5]. In relation to this, this study focusses on the need to increase an in-depth understanding on the range of performance criteria and related metrics that used by the project managers to manage and monitor the software projects development. A depth understanding of these performance criteria and metrics will ensure the development of software projects to achieve its success.

This paper is organized as follows. Section 2 discusses the methodology of this study. Section 3 presents the result of this study. We discuss the analysis of findings in the Section 4. Finally, we concluded our work in the Section 5.

METHODOLOGY

This study used a qualitative method to gather data. There are four important activities involved in this study. We start our work by collecting data, followed by data transcribes and data analysis and form the findings as described in the Figure-1.

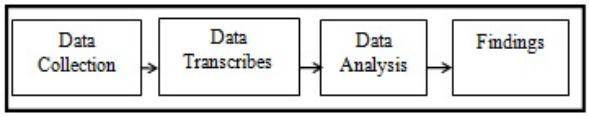

Figure-1. Involved activities.

We used Goal Question Metrics (GQM) Model for deriving the performance criteria and related metrics. GQM model consists of three important phases which are determining the goal, identifying the questions and deriving metrics. The determined goal in this study is to monitor software project performance. This study very carefully generated a set of questions by defining the identified goal. There are 14 questions derived that supports the identified goal in this study. The most important question is the first question which is getting the criteria to monitor the performance of the software

projects development. We collected data for our model by conducting series of structured interviews at the various IT departments at Malaysian Public Sector.

A total number of 37 project managers were involved in this data gathering. Initially, we have identified one experienced project manager who has been dealing outsource software projects from each ministry in Malaysian Public Sector. But during the interview conduction, there are many more project managers willing to take part in this study thus we have included those project managers based on the determined criteria. This is to ensure that our data are high in reliability and can represent the entire Public Sector of Malaysia. These 37 project managers came from different outsource project environment either large scale, medium scale or small scale software projects. In fact, some of the respondents has been dealing high impact outsource software projects. Different project environment with different types of projects and project managers promises the 'richness' of interview data in covering different perspectives. For the purpose of data confidentially and ethics we could not reveal project managers and ministries details in this study.

Data collection

We have conducted our interview sessions at two different rounds. The first round of data collection was conducted from December 2013 to January 2014 at three different IT departments at Malaysian Public Sector whereas the second round was conducted during June 2014 to September 2014 at different IT departments with different project managers. A number of seven project managers were involved in the first round of data collection and a number of 30 project managers were involved in the second round of data collection. We went through these two rounds of interview sessions in order to triangulate our data.

Data transcribes

Data Transcribes process was conducted for each and every respondent. All the 37 raw data were transcribed in a form of documents using word application. We repeatedly listen more than 30 times of each recorded raw data in order to run the transcribe process. Besides this we also referred our written notes that were taken during the interview sessions. These notes helped us to produce better transcribed documents. We took almost 3 months to transcribe these raw data. In addition to this, we also tested the reliability of our transcribed data by performing peers review on the transcribe data. Three post graduate students were chosen to listen the recorded interview sessions and read the transcribed data by randomly. There are no additional changes in the transcribed data after the reviewed. In fact, those three reviewers agreed for the accuracy of transcribed data. This process ensured the accuracy of transcribed data based on the raw data. Below is the example of data transcribes snapshots. Figure-2 illustrates an example of transcribed data.

Data analysis using NVIVO 10

Collected data are analysed using NVIVO 10. There are many important components in NVIVO such as sources, nodes, classification, collection, queries and reports. We import all transcribed data into NVIVO software to perform the data analysis. Below are the examples of NVIVO snapshots of our data analysis. Figure-3 shows the main page of NVIVO.

***2. Do the software projects use the estimated cost effectively?**

First we set the estimated cost for the projects. We always the plan the costs are derived according to activities. Before we estimate cost we do market research on cost. We also set cost based on each activity. We monitor the actual cost and the changes on this estimate and actual cost also.

***3. Do the software projects are delivered on-time?**

We plan the project schedule by looking at the project scope and number of modules and activities that involved in modules. We need to make sure the project is delivered according to plan activities. We also monitor the changes in estimation time and actual time. We will make sure the projects delivered according to planned schedule. Most of the cases change requests make the changes in planning.

***4. How to decide and choose the Project Managers particular software project?**

Project manager should have skills such as negotiation skills, good leaderships; technical skills project management skills, communication skills. He/she should be knowledgeable person. Project manager must have commitments when there is a problem, they must solve problems in fast and they spend more time spend for the project in day. We should have experience also. We must work more systematic and discipline. We must spend more time in project in a day. To choose the project manager, we must see credibility of the project

Figure-2. Example of transcribed data.

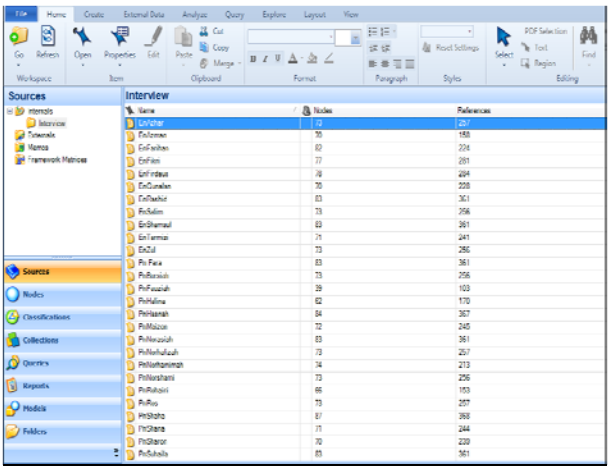

Figure-3. Data are imported into NVIVO.

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All 37 respondents' transcribed data are imported into NVIVO for the further analysis. We analysis the transcribed data by analysing the themes and the text before set the nodes.

RESULTS

In this section, we describe the findings of our study. First, the results of the entire data set are described. Then, we discuss results of the analysis performed. We also perform word frequency query to set the nodes. Figure 4 shows word frequency query result. For example based on the word frequency query we set the nodes such as Project, Project Manager, Team Members, Top Management, Vendor, User, Cost, Schedule, Organization, Documentation, Resources, Training and Communication. We also set the nodes by analysing the transcribed data as shown as Figure-5.

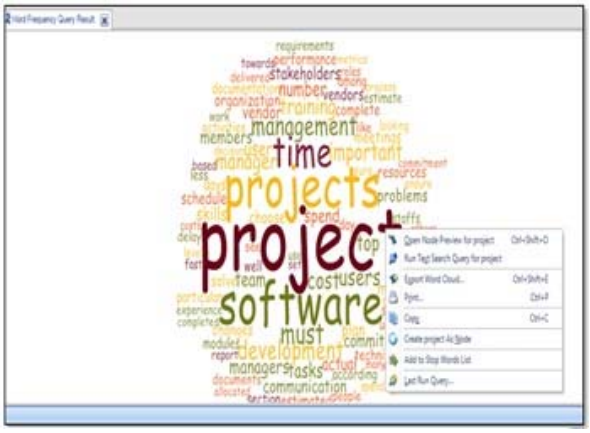

Figure-4. The Word Frequency Query result using Word Cloud features.

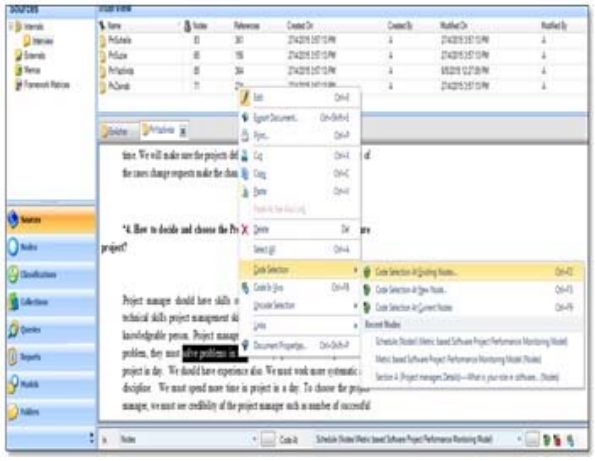

Figure-5. Setting nodes using transcribed data.

A total of 13 nodes were identified in this analysis process. Figure-6 shows all the identified nodes. We also identified sub nodes under each identified nodes. For example, User node are analysed into sub nodes such as number of completed tasks, number of meetings, total number of tasks, total response time and total time spend as shown in the Figure-7.

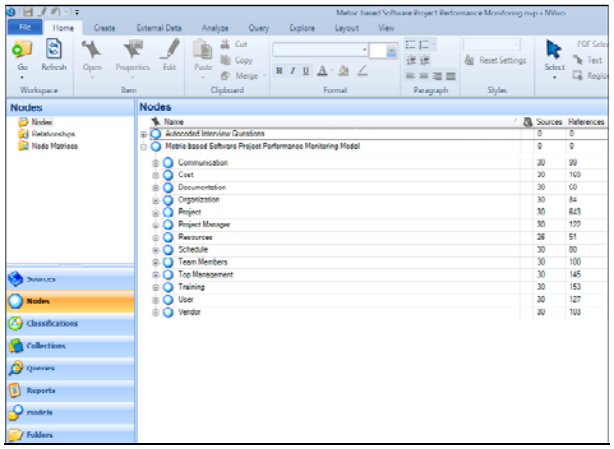

Figure-6. Identified nodes.

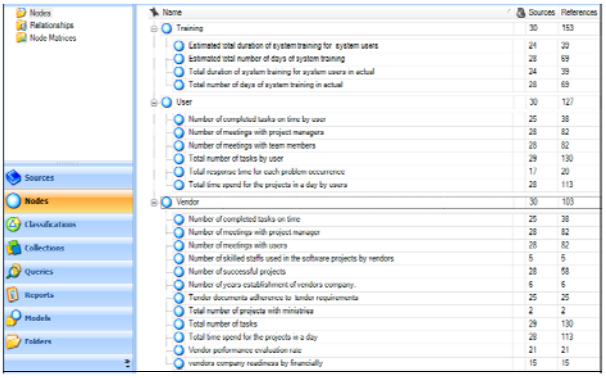

Figure-7. Identified sub nodes.

In line to this identification of nodes and sub nodes, we also did coding on the transcribed data as described in the Figure-8 and 9. For example, the vendors node are further analysed into sub nodes such as experience, financial readiness, staff expertise or skills, number of meetings, tender criteria, successful projects and number of tasks.

Respondent Data
Researcher: How vendors are chosen to deal with the software projects?
Respondent 6:
Experience *on government projects,* ***financial readiness,*** *technical* ***staff expertise*** *or skills(number of people), vendor performance evaluation,* ***number of tasks, number of meetings*** *with project managers and other stakeholders, vendor selection criteria (****tender*** *process),* ***successful projects*** *with government and private sector.*

Figure-8. Example of setting sub nodes from the vendor nodes using transcribed data.

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Respondent Data
Researcher: Why training is important in a software projects?
Respondent 2:
*Train users, **trainers for the actual system** by estimate **training days** and the **duration**.*

Figure-9. Examples of setting sub nodes from the training nodes using transcribed data.

Figure-10 shows Organization node as performance criteria and sub nodes such as project contributes to organization ICT Strategic Plan, adherence of project organization policies, project contributes to organization mission and vision and change management plan are identified as metrics.

DISCUSSIONS

The objective in this study is identifying and performance criteria and the related metrics in practitioner's perspectives. As we discussed earlier, our practitioners are project managers from IT Departments at each ministry in Malaysian Public Sector. This study answered the determined objective successfully by identified 13 performance criteria and 86 related metrics that being applied in monitoring software project at Malaysian Public Sector.

This study provides comprehensive details on performance criteria and metrics which relates to software projects performance monitoring from the real practitioners. Performance criteria such as Cost, Schedule, Project Manager, Team Members, Top Management, Vendor, User, Training, Resources, Project, Organization, Resources and Documentation are the identified criteria that highly contributing to software project performance in Malaysian Public Sector basically. Each performance criteria are analysed in detail for deriving the metrics as shown in the Table-1.

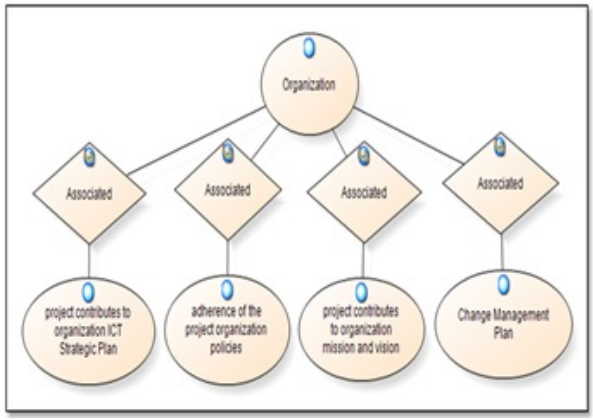

Figure-10. Organization node as a performance criteria and sub nodes as metrics.

Table-1. List of performance criteria and related metrics that identified from structured interviews.

Number	Metric ID	Metric Name
		SCHEDULE
1	S1	project delivered on-time (estimated)
2	S2	project delivered on-time (actual)
3	S3	project delivered according to each planned activities
4	S4	changes in estimated time
5	S5	changes in actual time
6	S6	changes in estimated time and actual time (variance schedule)
7	S7	Changes project delivered according to each planned activities
		COST
8	C1	Usage Cost per activities
9	C2	Changes in cost per activities
10	C3	Usage the detailed Cost
11	C4	Changes in detailed cost
12	C5	Changes in estimated cost and actual cost (variance cost)
		PROJECT MANAGER
13	PM1	Type of skill or expertise
14	PM2	Number of skills or expertise
15	PM3	Number of meetings with users
16	PM4	Number of stakeholders meetings
17	PM5	Number of meetings with vendor
18	PM6	Total number of software projects
19	PM7	Total number of successful software projects
20	PM8	Total number of unsuccessful software projects
21	PM9	Time taken to solve the problem
22	PM10	Total time taken to complete each task
23	PM11	Total time spend for the projects in a day
24	PM12	Total number of tasks
25	PM13	Number of completed tasks on time
26	PM14	Number of project plans

These identified metrics classified into two categories which are human related performance criteria and metrics and non-human performance criteria and related metrics. Table-2 illustrates the detail of this classification.

Table-2. Classified performance criteria.

Human related performance criteria and metrics	Non-Human performance criteria and metrics	
Project Manager Vendors Users Top Management Team Members	Cost Organization Documentation Communication	Schedule Resources Training Project

Out of these 13 performance criteria, human related performance criteria and metrics are highly contributing to a software project success. If performance of these criteria and metrics are good then the higher the chance for software project success. Figure-11 describes that project manager is a very important element for software project success.

Respondent Data
Researcher: In your opinion which factor do you think that highly contributing to software project success?

Respondent 1:
I think ***Project manager*** *very important factor that make the project success.*

Figure-11. Examples of setting sub nodes from the training nodes using transcribed data.

If we analysed in detail, we identified that performance criteria such as project manager, vendors, users, top management and team members which we categorized as a human related performance criteria and metrics that contributing the high percentage for software project success. Thus, project team can focus more on these human related performance criteria and metrics while managing and monitoring the software projects development.

When we look at the respondent's demography, all 37 respondents are appointed as software projects development project managers in their ministries. These project managers are experience project managers. Their years of experiences are ranged from three to 20 years. Hence, the collected data are highly reliable and very meaningful for this study.

CONCLUSIONS

This work describes a study that carried out on identifying performance criteria and metrics for monitoring software project performance. We analysed data from 37 project managers from various IT departments at different ministries in Malaysian Public Sector. Data are collected through structured interview sessions. The GQM Model is used as the basis in this study in order to pursue the data collection process. These collected data were transcribed in a document form before further analysis with NVIVO 10. The Metrics based Software Project Performance Monitoring Model was derived using the NVIVO tool.

As a conclusion, we have identified 13 performance criteria and 86 metrics that have been practiced by project managers at various ministries in a Malaysian Public Sector. These identified performance criteria and metrics are very beneficial and significant to formulate the Software Project Performance Monitoring Model. We managed to answer one of our research objectives which are identifying and performance criteria and the related metrics in practitioner's perspectives.

Next, we are going to integrate these performance criteria and related metrics with our SLR findings which consists of performance criteria and metrics as well. This integration is one of the important activities in a Software Project Performance Monitoring Model formulation. We will use the Constant Comparison Method of Grounded Theory to integrate these findings. Currently, works on metrics descriptions, metrics categorization, and metrics threshold are being carried out with this identified performance criteria and metrics in order to formulate the proposed model. In future, this proposed model will be validated using case study evaluation at Malaysian Pubic Sector. In this case study evaluation, few types of software projects will be selected to test this proposed model. This model will be empirically tested in the next stage in order to assess the usefulness and significance of this proposed model in the perspectives of practitioners.

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