Use of Software Metrics to Scope Control in IT Projects Using Paraconsistent Logic

JONAS P. DA SILVA, JAIR M. ABE, LUIZ A. DE LIMA, FELIPE S. DAVID DE OLIVEIRA,
[2]KAZUMI NAKAMATSU,
Graduate Program in Production Engineering
Paulista University
Rua Dr. Bacelar 1212 CEP 04026-002 – São Paulo – SP
BRAZIL
[2]School of Human Science and Environment
University of Hyogo – JAPAN

jonassunip@gmail.com, jairabe@uol.com.br, luiz.lima@wcisp.com.br, feldavol@hotmail.com,
nakamatu@shse.u-hyogo.ac.jp

Abstract: - Information Technology (IT) projects have been highlighted in the organizational environment since the results of these projects impact in organizations' strategy. Good practices of project managements defend high-quality projects to deliver it within scope, on time, and within budget. In this sense, to deliver a project on time and a budget, it is necessary that their scope be well defined. However, the project team is faced with difficulties in understanding business requirements. Consequently, it causes project failures and affects the user's satisfaction. Project software metrics as Function Points (FP) is taking a growing interest in the organization to control the scope of IT projects. Despite the importance of this theme, there are few empirical studies on the practical use of these metrics to IT Projects Scope Control (ITPSC). Considering this gap, the objective of this research is twofold: 1. identify the use of software metrics to ITPSC, and 2. provide a proposal of software metrics use based on FP to ITPSC. This is an exploratory qualitative study based on literature review and paracon-sistent logic. The literature review is based on academic papers published in the last 10 years. This paper contributes to academy area by offering an overview of how software metrics are being used by organizations to control the ITPSC and present a proposal of how they can be used to control the ITPSC.

Keywords: Software Metrics; Scope Control; IT Project; Paraconsistent Logic.

1 Introduction

Since Information Technology (IT) projects have contributed to the organization's strategy, the adoption of solutions that better control these projects is essential. Despite the importance of IT projects in business, the project team is faced with difficulties in understanding business requirements, which cause failure in projects and, consequently, affect the user satisfaction (Ullah & Lai, 2011).

A survey conducted by Standish Group in 2011, involving data from 400 organizations, pointed out that only 29% of software development projects were finalized successfully (Levinson, 2009). Analyzing the causes of failure, it was concluded that the vague requirements and the management of inefficient scope are significant contributing factors (Levinson, 2008).

The use of metrics can be justified because of their ability to identify problems early, which allows decision making (Kerzner, 2011). Some authors propose software metrics as FP to ITPSC (Richardson & Butler, 2006). Function Points are "an internationally standardized unit of measure used to represent software size. The IFPUG functional size measurement method (referred to as IFPUG 4.3.1) quantifies software functionality provided to the user based on its logical design and functional requirements" (IFPUG, 2010).

The objective of this research is to present the findings of the use of software metrics to ITPSC through a literature review. Furthermore, the authors present a proposal to ITPSC using software metrics based on FP.

This paper is organized as follows. The next section describes the research design; it reports the steps followed to carry out a literature review and how the proposal to ITPSC was developed. Next, it presents the findings of the use of software metrics based on the papers selected for literature, and the proposal of software metrics use to ITPSC. Finally,

the paper ends with a discussion, limitations of the research and suggestion to forwards studies.

2 Methodology

This paper describes an exploratory, prescriptive qualitative study. Literature review methodology is used for achieving a better understanding of a knowledge domain for a specific problem (Rowe, 2014). Furthermore, this paper presents a proposal for soft-ware metric use to ITPSC. This study has a prescriptive characteristic because solving a practical problem. According to Patton (2015), a prescriptive analysis involves showing the results of data analysis and making a recommendation.

The literature review is scanning a range of academic references from google scholar from 2007 to 2017. The sources matched the keywords "IT project" + "metrics" + "scope control." Based on this search, 77 references were found. From these references, 10 were selected for further analysis. Books and book chapters were discarded. Based on researcher's personal experience it was considered the use of metric software to ITPSC. Next section shows the results of this research.

2.1 Results

2.1.1 Literature Review

The literature review aimed to identify how organizations control the scope of IT projects. Different solutions have been identified. However, a few studies presented a solution for effective use of software metrics to ITPSC. The most relevant study identified was a thesis by McQuighan (2013) that claim the use of FP as a metric to ITPSC. His studies point out that the use of software metrics represent state of the art regarding ITPSC. The scope control ensures that changes in the project scope are controlled. Project performance metrics must be used to maintain the control of time and cost of the project (Nechaeva, 2016).

Scope Control is the process of monitoring the progress of the project scope and the scope of the project (PMI, 2013). Projects connected to a program by scope-related are decisive to achieve success regarding client satisfaction (Görög, 2016). According to this author, the criteria of success of projects might be evaluated considering the level maturity of the organization. He also recommends the use of a metric system to help assessment time and cost of the project. Unrealistic expectations caused by poor estimation of scope and size of IT project creates a mess, and the realistic goals are lost (Frimpon, 2012). Project managers need to convert estimates using parametric models (Bower, 2007).

Regarding SOA implementation, the process of scope control is considered a Critical Success Factor. To generate a standard definition of SOA projects, it is essential the implementation be detailed in the technical perspective (Lee, Shim & Kim, 2010). In the same line, Hemingway and Peppard (2007) also related project scope with project risk. Also, lack of defined scope is one of the challenges of the PMO implementation of implementing a PMO (Kutsch, Ward, Hall & Algar, 2015).

Furthermore, Ash (2007) relates that in projects management there are five main aspects which constrain the achievement of an objective: a) scope, b) delivery times, c) resources, d) bid price, and e) customer satisfaction. In this context, he recommends the PMBOK guide (PMI, 2013).

Because of the lack of academic references about the use of software metrics to ITPSC, the proposal of metric software use based on FP to ITPSC was supported by McQuighan (2013) thesis, and the researchers experience in the software metrics area. Next subsection presents this proposal.

3 3.2 Proposal of Software Metrics Use to ITPSC using Paraconsistent Logic

The IT project life cycle consists of four phases (Westland, 2007):

Project Initiation - This is the first phase of a project. In this step, it is identified a business problem or opportunity, and solution options are defined. Terms of reference are completed outlining the objectives, scope, and structure of the new project;

Project Planning - Once the scope of the project has been defined, the project enters the detailed planning phase. This phase involves creating a project plan outlining the activities, tasks, dependencies, and timeframes;

Project Execution - This phase involves implementing the plans created during the project planning phase. While each plan is being executed, a series of management processes are undertaken to monitor and control the deliverables being output by the project. The project is considered ready for closure if all the deliverables have been produced, and the customer has accepted the final solution.

Project closure - Project closure is comprised of the release of the final results to the client, plus the delivery of project documentation to the business, as

well as the termination of contracts with suppliers, the release of project resources and finally the communication of the final plan to all team involved.

The final step is to undertake a post-implementation review to quantify the level of project success and identify any further improvements for future projects. The variation of project size during the phases of software development lifecycle may be impacted by Scope Creep. This phenomenon is considered normal when it comes from the deepening of the requirements. However, in some cases, it may represent project scope problems. For example, when a user requests five functionalities during the project definition phase and fifteen functionalities are implemented, it may indicate that there was a failure to specify the requirements. One solution to ITPSC is tracking the project size.

The software metric most used by the organizations is FP. FP represents a measure of the functional size of a software project that allows comparison during the development phases of a project. We propose to use this measure to monitor the evolution of the IT projects scope. Figure 1 represents the measure points proposed during the development phases of an IT project. The idea is to establish three measure points, the first in early Project Planning phase, the second at the beginning of the Project Execution and the last one during the Project Closure.

Given the size of the three counting points, a comparison between phases can be executed. If the % of size deviation is higher than the reference considered normal for that type of project, it means that the project may have scope problems. In this case, this indicator allows defining actions to recover the ITPSC. To calibrate this references, it is crucial to maintaining a historical base of projects.

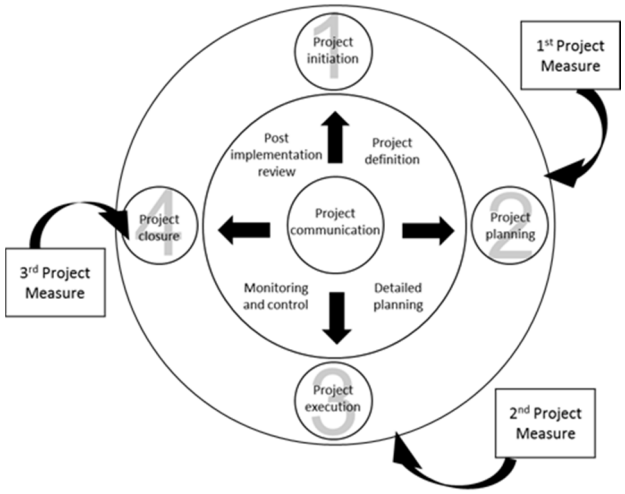

Figure 1 – Points of project measure based on phases of the project lifecycle

Source – Adapted from Westland (2007, p. 4)

Table 1 presents the degree of favorable evidence and contrary evidence based on Paraconsistent Logic Annotated Evidential to analyze the following proposition: "The IT project is within the scope."

Table 1 - % of deviation between points of measure and the corresponding degree of evidence

The deviation between 2nd and 1st measure (%)	The deviation between 3nd and 1st measure (%)	Favorable evidence degree (μ)	Contrary evidence degree (λ)
0 to 4	20,1 to 22	0	1
4,1 to 8	22,1 to 24	0,25	0,75
8,1 to 12	24,1 to 26	0,5	0,5
12,1 to 16	26,1 to 28	0,75	0,25
16,1 to 20	28,1 to 30	1	0

Note – The values of deviation represent hypothetical numbers

Figure 2 shows the degrees of favorable evidence (μ) and contrary evidence (λ). The degree evidence must be checked from % deviation described in Table 1. For example, suppose the size of Project A was 100 FP in the first point of measure and 110 FP in the second point of measure. Comparing both project size, the deviation between second and first measure is 10%. Consulting the first column of Table 1, we concluded that $\mu = 0,5$ and $\lambda = 0,5$.

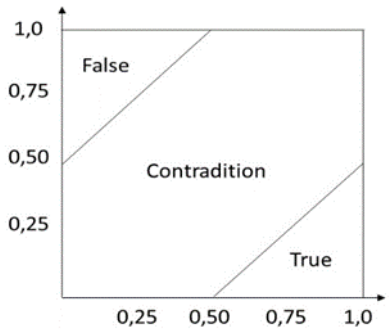

Figure 2 - Degree of favorable evidence (μ) and contrary evidence (λ)

4 Discussion

Although academic studies point out that the use of software metrics represent state of the art in scope control, the effectiveness of the metrics depends on the quality of the requirements documents available for counting. However, according to reports from experienced IT project managers, the most of IT projects do not have adequate documentation to allow assertive project measurement. Therefore, low quality in the requirements specification represents a risk in the generation of scope control indicators. Moreover, lack of knowledge about measurement software techniques can be a barrier to use a quantitative measure to scope control of the projects. FP can be used to measure the size of IT projects at any stage of the project life cycle, even in the early stages. However, it depends on sufficiently detailed requirements definitions, which are not always available. In this way, many organizations have difficulties in measuring their projects due to the poor quality of the requirements documentation.

This paper presented the results of a literature review of the use of software metrics to ITPSC. Furthermore, a proposal of their use is presented. The main contributions of this paper were a) demonstrate the potential use of software metrics to scope control of IT projects and b) present a proposal to guide project managers on the adoption of software metrics to ITPSC. The limitations of the paper are the literature review considered only one cycle analysis involving publication of google scholar based on the last 10 years. We suggest that the research is extended with more iterations considering "IT project" + "function points" + "scope control" like a new set of search parameters. Since the use of software metric to ITPSC is an emergence theme, there are few empirical studies in the literature. Therefore, we also recommend empirical studies about the effective use of software metrics to ITPSC.

The Paraconsistent Logic Annotated Evidential was used to support the establishment of favorable or contrary evidence according to the degree of deviations in size raised during IT projects measure process. This non-classical logical presents alternatives to propositions, whose conclusion may have values beyond true and false - such as indeterminate and inconsistent (Abe, Akama & Nakamatsu, 2015). For this reason, the use of this logic to assessment metrics to ITPSC makes much sense.

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