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ScienceDirect

Procedia Computer Science 154 (2019) 347–353

Procedia Computer Science

www.elsevier.com/locate/procedia

8th International Congress of Information and Communication Technology, ICICT 2019

The Productivity Gains Achieved In Applicability of The Prototype AITOD with Paraconsistent Logic in Support in Decision-Making in Project Remeasurement.

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Abstract

This paper addresses the subject of software measurement, namely, the method of Function Point Analysis, which consists in functionally sizing the software. The sizing activity held between customer specialists and suppliers causes disagreements because it involves multiple vague factors that are difficult to quantify. This paper aims to develop the AITOD- Intelligent Decision-making Support system, based on Paraconsistent Annotated Evidential Logic Eτ. This system aims to contribute to the decision-making process of managers. Such methodology has as a precept the materialization of artefacts derived from concepts. The AITOD product has achieved significant improvements in the process of mitigating project recounts. Through the AITOD system, it was verified that 46 projects would result in approval of 28.57% of the projects, 50 projects would result in approval of 64.10% of the projects. With these results, companies would avoid unnecessary expenses and rework. In the scope of the innovative project, the results achieved on the reduction of values spent on project recounting stands out, being proved the viability of the AITOD product.

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1877-0509
10.1016/j.procs.2019.06.050

Keywords: Software Measurement; Function Point Analysis; Paraconsistent Annotated Evidential Logic Eτ; Parametric Algorithm; Paraconsistent Decision Method

1. Motivation to use Function Points (FP)

In general, timely, budget-oriented, error-free projects are not often found between orders delivered by software factory suppliers because they are primarily underestimated and inaccurate in initial estimates. Thus, in response to the losses, it is proposed to analyze point-of-function [16][18][19][24][26][27] counting samples, contained and stored in historical consulting bases, during the two-year life cycle of the project.

Therefore, it is motivated to define as general purpose the analysis of software building tools, making it possible to apply web technologies in a programming language in the development and implementation [9] of the AITOD (Intelligent Decision-Making Support) product based on requirements elicitation [28]. Projects can be identified in three categories: project application, project development and, finally, project improvement. In the type of application project, we only have to count in a system that exists, and that must be installed in computational environments. The innovation generates the need to follow concepts applied in the type of development project [9], which is characterized by the absence of a built system. One should even have the definition of which computer technology park should be installed since it is a new project. This type has another strong characteristic because we cannot measure something that does not exist, leaving only the possibility of estimating the function point [16][18][19][24]. The improvement project addresses the need for changes made in application projects since only something that exists can be altered.

Every formal process recognized as best market practices aim to add quality to the product and services in the market segments. In order to contribute to the fulfillment of the demands of software projects, software engineering was used as one of the pillars in this study. In particular, the measurement of the proposed software and project management was used [8][10][12][25]. Therefore, the counting process in function point analysis offers the measurement of software as a standardized way between national and international companies. The international acceptance is because there are groups that guarantee the normalization of the rules and keep it updated in the manual of practices.

2. Paraconsistent Logic

Paraconsistent Logic is part of the non-classical logical calls [1], because it contains provisions contrary to some of the basic principles of Aristotelian Logic, as the principle of contradiction. This new logic emerged with the recognition of the Polish logician Jan Łukasiewicz Lvov, born in 1878, and the Russian philosopher Nicolai Alexandrovich Vasilév, born in 1910, considered to be predecessors of the Paraconsistent Logic, also known as the Imaginary Logic. In mid-1948, the Polish logician S. Jaśkowski published studies on paraconsistent propositional calculus. In the mid-1950s, Jaśkowski and the Brazilian logician N.C.A. da Costa proposed the contradiction in the logical structure and became known as the founders of Paraconsistent Logic. Newton Carneiro Affonso da Costa proposed, in 1954, predicates, logics of higher order (set theory). In the contemporary world, it is increasingly necessary to maintain the constant use in applications with Classical Logic embedded in computational equipment that allow us to obtain only two results in a binary form (0 or 1), or even qualitatively, good or bad. However, there are other logics known as non-classical that allow treating several results, such as: possible, probable and remote. This is the opposite of Classical Logic, which allows only two results. This Logic can be seen in [3][5] since it is formalized and synthesized by a paraconsistent decision method. Faced with the search for success, we find the path of non-classical Logic, applied in decision-making, proposed by ABE [1] in eight stages.

Advanced scientific studies [2] contribute significantly to the construction of proposals to treat information that is discarded to a certain extent in the final decision-making. The underlying logic applied to formal systems known as

Paraconsistent Logic [3] is born. This proposal focuses on the treatment of situations encountered in the decision-making process.

Given the knowledge explored by the Paraconsistent Annotated Evidential Logic Eτ, and with the paraconsistent decision method (MPD) proposed in the studies [3], a scenario is framed with possibilities to support decision-making in particular, in this work of assisting managers in deciding the recount of the project in the function point [16][18][19][26][27] technique. Also, it ensures the possibility of mitigating many defenses between customers and suppliers.

In the understanding of the Paraconsistent Annotated Evidential Logic Eτ, we apply computational techniques with the use of the Para-Analyzer Algorithm. In studies done by researchers, the computational technique known as the Para-Analyzer Algorithm was applied [3], which aims to support the analysis of propositions. However, it has been realized that, in order to accurately analyze such a proposition, limit values must be taken into account both for control of certainty and control over contradiction, which are not bound to logical principles. These values are known as the upper control value of certainty, lower value of control of certainty, the upper value of control contradiction, and lower value of control of contradiction. The Para-Analyzer algorithm translates the paraconsistent analysis by examining the values of the degrees of favorable evidence, contrary evidence, resulting in possible calculations of values using degrees of Contradiction and Certainty [3]. The expert system developed is based on the Para-Analyzer tool, which performs information processing of projects counted in function points. In this way, it is possible to aid decision-making in choosing which projects should have defenses (recount), using function point analysis [16][18][19][24][26][27].

3. Real Data for Analysis

The first stage of the research is in the analysis of data provided by the visit to the company WINFORMA consulting, and this phase contains projects counted by numerous specialists in function point. Significant benefits are expected for companies and suppliers (software factory) in the acquisition/construction of new systems. Thus, it is interesting to use the repository of counts made in the banking niche, where it resulted in many defenses that could be avoided, thereby reducing project costs. In the second stage, the research is developed using technologies in software development [9], web environment, database management system, angular [15][17][21] programming languages [11], Java [6][20] and Artificial Intelligence with Paraconsistent Annotated Evidential Logic Eτ [4].

Lastly, in the last step, we seek to design [29] a solution that will support managers in decision-making in defining whether there will be a project recount or approve and continue in the development of the project. In order to proceed with the AITOD solution, the MPV technique was applied [13]. The following applicable criteria.

4. Innovation in Decision-Making

The data collected during the work reflected information from the banking segment of (new) projects measured at function point [16] and resulted in the database containing new projects that generated the need for numerous defenses between the period from 2015 to the first half of 2018.

In front of the database formatted with data necessary to foment tests, information without confidential data was used, since they only contain values of function point counts [14]. The following data were initially defined, which only concern the count in function point analysis [16]:

- Project code: project identifier.
- Functionality: functional requirements identified by the CFPS.
- Type of data: taking into account the use of the APF technique (ALI, IEA).
- Type of transaction: considering the use of APF technique (EE, CE, SE).
- TPF: Total value of function points not adjusted by the project.
- MC: Maximum value in function points counted by CFPS.
- CFPS: identifier of the specialist professional.

The records found in the databases reflect, in their entirety, defenses (recounting) of projects, since it is assumed that all projects must be recounted.

One way to allow a better understanding of the system to be measured is to use project management [12] and software engineering [10][25] management methodologies [10][25] in order to elicit, with the client, information of all types of requirements to formalize in systems modeling using the Unified Modeling Language - UML technique [10].

The MVC (Model-View-Controller) architecture [7] reinforced the AITOD system's three-layered implementation:

• Model: Layer of communication with the MySQL database, by the CRUD commands (insert, search, update, delete).

• View: Presentation layer (user interface) responsible for displaying information.

• Controller: a Business layer for system control based on logic and business rules.

Any business scenario contemplated in the AITOD system should be observed in the following functionalities (as in Figure 1) presented in the AITOD system use case diagram. The logical model of the AITOD expert system should be a theoretical representation in the concept of "Design Thinking" [29] in a unified modeling language, represented by the use case diagram [3].

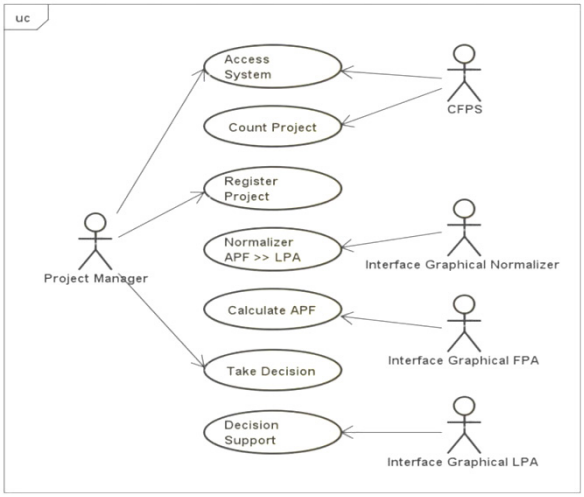

Fig 1. AITOD System Use Case Diagram

In constructing the presentation layer in the AITOD project, we chose to use object-oriented MVC technologies and responsive technologies (display the screen appropriately to the situation), such as best practices with bootstrap [4], type criptangularjs .ts [15][21]), hypertext markup language (.html), and style (.css). As can be seen below:

• CFPS: List of function point specialists.

• Counting: Allows the counting of the CFPS count and counts in function point by complexity.

• Filter-search: Query projects.

• Manager: List of Managers for decision-making.

• Login: Allows access to the system.

• Project: Allow project registration and add CFPS that will count the project.

• Decision-making: Allows approval or disapproval of the project. It includes functionality (button AI) for consistency in decision support.

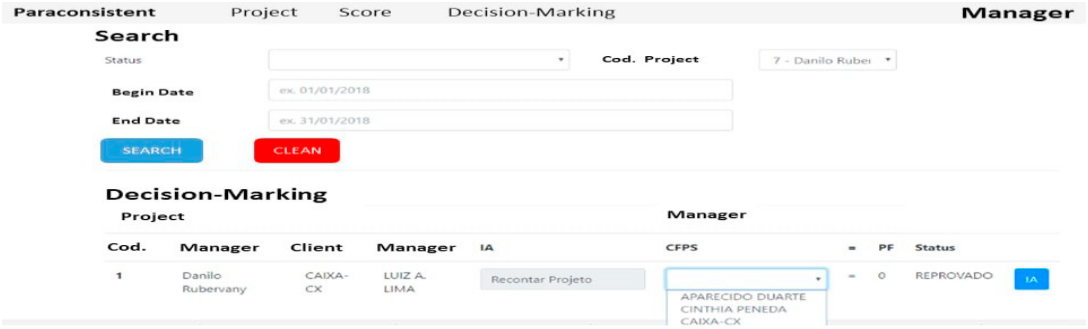

Fig 2 AI Botton Layout in AITOD System.

According to the initial presentation layer requests, we defined the modeling to meet the database layer in the AITOD project, we chose to use MVC technology as a model layer to support the database management system tool (DBMS) with easy manipulation in the web environment and, at the same time, with scalability and performance for future implementations in artificial intelligence techniques [22].

5. Results And Discussion

In line with the desired goal of the work and relentless efforts to formalize a product, the AITOD system is analyzed in a punctual way (according to Figure 6) by means of a first historical series of the database (2015-2018) containing 161 projects ("CLIENT-1", Historical basis analysis: Recount projects.). These projects required a recount in function point analysis by at least three suppliers with CFPS involved. It was verified that 46 projects by the AITOD system would result in approval of 28.57% of the projects. With this, companies would avoid unnecessary expenses and rework.

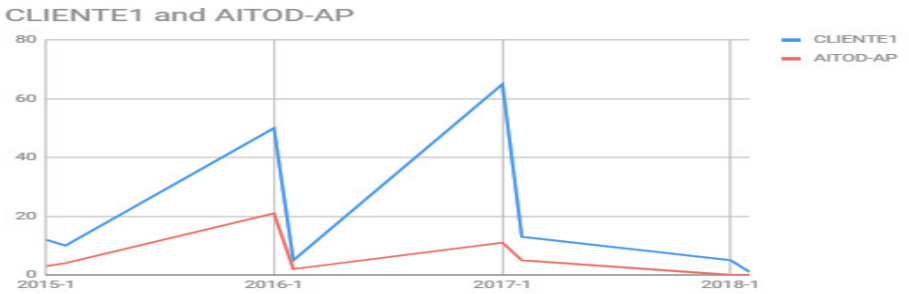

Fig3 Historical base analysis: projects (Customer 1) recounted

A punctual view of the graph shows that in 2015 the client had 12 projects recounted in the first semester and ended in the second half with ten projects recounted. By the simulation, using the AITOD system, only three projects out of 12 would be approved while in the second half four projects out of 10 would be approved. Likewise, the analysis was continued in the years 2016 to the first half of 2018. With regard to the amount, it could be stated that, for every $ 1 million (dollars) in recounting, there would be a reduction to $ 714,285.71.

The AITOD system was analyzed in a punctual way for a first historical series of the database (2015-2018) containing 78 "CLIENT-2" projects, Historical base analysis: recount projects.) That required recounting in function point analysis by at least three CFPS suppliers involved. It was verified that 50 projects by the AITOD system would result (according to Figure 6) in approval of 64.10% of the projects. With this, companies would avoid unnecessary expenses and rework.

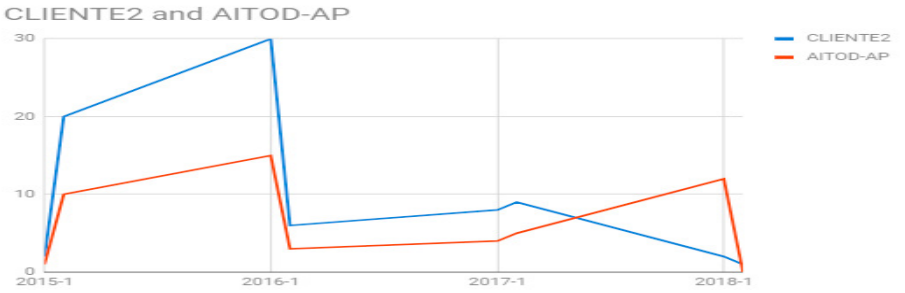

Fig 4 Historical base analysis: projects (Customer 2) recounted

An accurate view of the graph shows that the client, in 2015, had two projects recounted in the first semester and finished in the second semester with 20 projects recounted. By the simulation, using the AITOD system, only one project of 2 would be approved respectively. Already in the second half, 10 of the 20 projects would be approved. In the same way, the analysis continued in the years 2016 to the first half of 2018. About the amount, it would be possible to affirm that, for every $ 1 million spent on recounting, there would be a reduction to $ 641,025.64.

6. Acknowledgment

Our thanks to PPGEP (Graduate Program in Production Engineering) e a company WINFORMA for allowing us to apply all knowledge acquired to its database provided.

7. Conclusion

The proposed AITOD system can be used by client companies and suppliers to increase new business and continually mitigate rework and unnecessary spending by both companies. Other issues that the proposed system can be useful is project managers who seek productivity and increase new demands, dammed or reduced due to a discrepancy between counts by CFPS.

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