New Practices to Structure and Elicit Information in Scientific Software Development in Teams.

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Abstract: The purpose of this paper is to introduce a new approach to structure and elicit information about practices that are carried out in the tecnichal-scientific software development, which complement the processing methodology of information that carried the recent years. In structure, prioritization and elicit of practices carried out by development teams, we will apply Card Sorting, Kelly Grid and Multi-Voting.

Keywords: Kelly Grid, Card Sorting, Multi – Voting, Survey, Scientist, Scientific Software.

1. Introduction

In recent years, many scientific software development teams have faced the challenge of improving their product and development process to keep up with faster and shorted funding cycles. Process improvement in particular has followed to main strategies: adopting an industry-based improvement framework, such as CMMI or a focused bottom-up approach, using surveys to assess problems and priorities on development teams. The first approach has little or none success reported, indicating that differences between commercial and scientific development may be so deep, that models cannot be directly transferred without substantial tailoring. Surveys, on the other hand, are a widely used instrument but have as their main drawback the lack of a systemic view and requiring a diagnostic on software engineering to scientific teams, which derives in erratic or minor improvements.

The objective of this paper will be exploring and outlining a new framework to improve the elicitation of problems related to software engineering in scientific software development teams. We will introduce techniques like Repertory Grid (Kelly, 1955), Sorting Card (G. Rugg and P. McGeorge, 1997), and others; that will allow us to identify areas of improvement in maintenance and development in technical-scientific software development teams. The framework uses team consensus and prioritization to identify key areas to be included tackled as process improvement initiatives. This framework will be applied to scientific software development teams of Fuerza Aérea Argentina.

Our study will analyze the results of using an alternative framework to obtain input for process improvement plans in scientific software development teams. We expect that results will reflect the proposed framework outperforms some deficiencies in surveys, keeping requirements and logistics on the study accessible to any organization. The combination of techniques allows a structured staging of divergent generation of items, introspection and prioritization, maintaining candidate's items in the domain knowledge of scientific developers. This study establishes the basis for the use of combination of quality tools to carry out process improvement activities in scientific environments.

2. Context

Surveys are a common Systems Engineering tool to investigate areas of improvement related to Software Engineering in scientific teams. However, the use of surveys as the only tool to derive improvement plans presents a series of drawbacks that have been researched (Jo Erskine Hannay et al., 2009) (Luke Nguyen-Hoan et al., 2010) (Salo O. and Abrahamsson P, 2008) .

First, the sample size always raises doubts about the validity of generalizing results. Surveys are also subjective and qualitative tools, where answers may be influenced by respondents' perceptions of

previous experiences, personal opinions and attitudes toward the study. Additionally, the uneven background of people answering the survey leads to misunderstandings of the questions, invalidating the results.

A deeper problem of surveys is that they reflect the mental model of the team conducting the study, even using vocabulary in the software engineering field. On the other hand, the answers obtained fall short on revealing the actual problems related to scientific teams daily development activities. In fact, a survey with leading questions could also point improvements in the wrong direction, without reaching a true understanding of the problems of the observed teams.

The difficulties in obtaining significant input to structure an improvement plan using surveys motivated the definition of a more comprehensive framework, able to obtain uncontaminated input from scientific teams, and then working on refining their understanding and priorities.

3. Tools and Methodology proposed to structure and elicit the information.

Although limitations of surveys to gather problems are clear, we still need some tools to obtain as much information on pain points from development teams as possible. Since sample size is usually small, we adopted techniques from the design domain that has a good fit on structuring brainstorming to produce a categorized list of items.

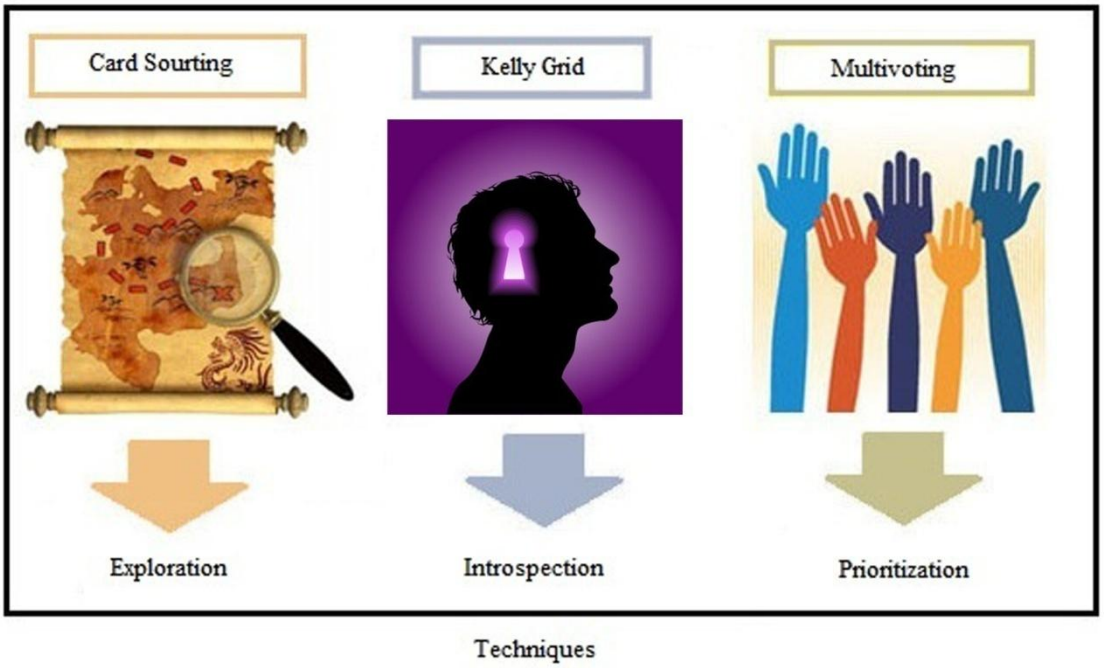

Fig. 1. Techniques applied during the research.

Card Sorting (G. Rugg and P. McGeorge, 1997) is an exploration tool that allows free and divergent generation of items in a first phase, and forces conceptualization through categories in a second. The sorting exercise is very useful in understanding participants' mental models, increasing the chances of a successful adoption of the improvement plan. In the experiment we assigned three sticky notes to each participant where they had to write the three top priority problems in their daily activities. After that, we asked them to decide as a team how to group all the cards in four categories using a whiteboard. Finally they named each category using their own vocabulary.

For the second phase, we used Kelly Grids (Kelly,G, 1955), which allow to make an introspection about the situation, answering the questions how we are today and where do we go. It is an instrument that evaluates structures and dimension of personal meaning that comes from The Theory of Personal Constructs. This technique intends to capture how someone gives meaning to its own experience on its own terms. Kelly Grid is an interview designed to specify and analyses the constructs that someone used to organize its own world.This interview generates a data grid that it is subject to multiple analyses structure. All this, it have the purpose to draw the structure of the cognitive map of the subject from its own semantic. This process has four steps:

1. Select the elements that will be used in this activity.
2. Build the constructs that comes from the selected elements.
3. Evaluates the elements against constructs.
4. Process the recollected data and analyses it.

For the final stage of the study, we applied Multi-voting tool to enable the group to make a quick prioritization of candidate improvements. This input feeds directly into the process improvement plan.

The basic dynamic was to assign 5 voting points to each participant that could be discretionarily distributed in the list of candidate improvements (Dunham Randall, 1998) (Michael Brassard and Diane Ritter, 1994).

4. The Experiment

New techniques such as card sorting were very effective in energizing the group, obtaining input from all participants and allowing them to share opinions and views. The highest level of rapport in the group was more related to the type of function in the teams than to the project or team, indicating a degree of commonality associated to the process and horizontal to the product.

During categorization, participants started a debate on the root causes of some problems, which moderated for the sake of time, led to a very useful exchange of internal concepts that were understood differently by clusters of participants.

Application of Kelly's Grid activity induced scientists to express their constructs, generating some conflict when they had to contrast them and therefore forcing participants to go deeper in the analysis of their understanding of these concepts.

The last activity was executed quickly and with team consensus, establishing a ranking of problems that have to be solved urgently.

5. Expected results

We expect that the combination of techniques will allow a structured staging of divergent generation of items, introspection and prioritization, maintaining candidate's items in the domain knowledge of scientific developers. This study will establish the basis for the use of combination of quality tools to carry out process improvement activities in scientific environments. One of the hypotheses still to be proven is the relationship between prediction of Kelly's Grid and multi-voting results, which we anticipate to have a positive correlation.

The following graphics represents how we expect these activities will impact team's knowledge from idea generation to a prioritized list. A quantitative analysis will be conducted to evaluate and contrast the different techniques.

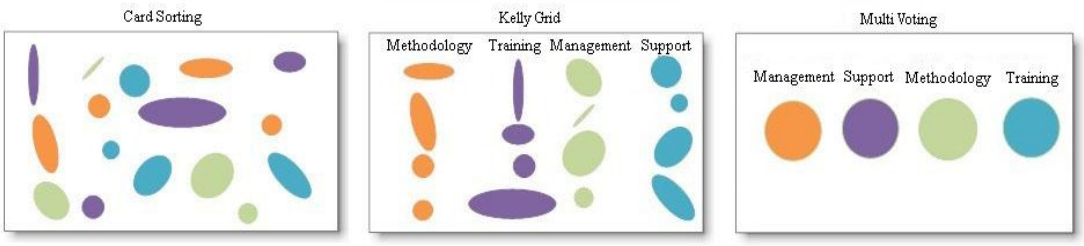

Fig. 2. Results get from techniques.

6. References

Dunham, Randall (1998). Nominal Group Technique: A User's Guide. University of Wisconsin. http://instruction.bus.wisc.edu/obdemo/readings/ngt.ht ml. (last accessed on 15 December 2011)

G. Rugg and P. McGeorge (1997), "The Sorting Techniques: A Tutorial Paper on Card Sorts, Picture Sorts and Item Sorts," Expert Systems

Jo Erskine Hannay, Hans PetterLangtangen, Carolyn MacLeod, DietmarPfahl, Janice Singer, Greg Wilson (2009), How Do Scientists Develop and Use Scientific Software?. In: *SECSE '09 Proceedings of the 2009 ICSE Workshop on Software Engineering for Computational Science and Engineering.*

José L. Zanazzi, Alicia G. Salamon, Gabriela Cabrera, Analía González, BeatrízPedrottí (2011), LA

INVESTIGACIÓN OPERATIVA SOFT EN LA ESTRUCTURACIÓN DE PROBLEMAS VINCULADOS CON LA ORIENTACIÓN VOCACIONAL. XXIV ENDIO - XXII EPIO, Rio IV.

Kelly,G (1955). The psychology of personal constructs. New York. Norton.

Luke Nguyen-Hoan, Shayne Flint, Ramesh Sankaranarayana (2010), A Survey of Scientific Software Development. In: *ESEM '10 Proceedings of the 2010 ACM-IEEE International Symposium on Empirical Software Engineering and Measurement.*

Michael Brassard and Diane Ritter (1994), The Memory Jogger II: A Pocket Guide of Tools for Continuous Improvement and Effective. Planning. Goal/QPC.

Salo O., Abrahamsson P., Agile methods in European embedded software development organisations: a survey on the actual use and usefulness of Extreme Programming and Scrum. *Software, IET* , vol.2, no.1, pp.58-64, February 2008

Upchurch, L.; Rugg, G.; Kitchenham, B. (2001). Using Card Sorts to Elicit Web Page Quality Attributes. IEEE Software, Julio/Agosto 2001.

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