Analyzing knowledge transfer in software maintenance organizations using an agent- and goal-oriented analysis technique – an experience report

Maria Carmela Annosi[1], Antonino De Pascale[1,] Daniel Gross[2,] Eric Yu[2]

[1] Ericsson Marconi Spa- via Madonna di Fatima 2,
84016 Pagani (SA)- Italy.
{MariaCarmela.Annosi, Antonino.DePascale}@ericsson.com
[2] Faculty of Information Studies, University of Toronto
{daniel.gross, eric.yu}@utoronto.ca

Abstract: Software maintenance is a knowledge intensive activity. Implementing effective knowledge management policies and structures during maintenance is therefore a key factor to improving software quality and maintenance productivity. This paper presents a novel agent and goal-oriented analysis technique that was used at Ericsson Marconi Spa to analyze the successful adoption of organizational structures and policies which greatly facilitated knowledge transfer. Utilizing this analysis technique helped to systematically represent, capture and analyze the strategic organizational relationships relevant to knowledge transfer. By capturing and analyzing such strategic relationships, it was possible to make visible the reasons why newly adopted policies and structures improved knowledge transfer, and thus helped the maintenance team to achieve significant improvements in their maintenance processes, and successfully achieve their software maintenance goals.

Keywords: Knowledge transfer, agent- and goal-orientation, maintenance

1 Introduction

In 2003 Ericsson Marconi Spa developed a set of organizational policies and structures geared towards improving the management and transfer of knowledge in its development organization. Since then the policies and structures were implemented with outstanding results during corrective maintenance activities.

To better understand why organizational maintenance goals were better achieved, an agent- and goal-oriented knowledge representation and analysis technique was applied. This paper reports on the insights gained, the benefits observed, and the lessons learned.

2 Objectives of the research

The objective of this research was to gain insights into the successful adoption of organizational polices and structures during corrective maintenance activities. Based on the assumption that the organizational structure and processes were key enablers of

success, the i* modeling framework [1] was chosen to analyze how these structures and processes contributed to the successful achievement of the organizations maintenance goals. Another objective was to identify the utility of the i* modeling framework as a modeling and analysis technique, and, in particular, its use to document, communicate and explain among stakeholders the positive effects of the instituted organizational policies and structures.

3 Scientific Contributions

This paper includes two main contributions: a) the presentation of several organizational policies and structures that contributed at Ericsson Marconi Spa to significantly improved knowledge transfer and acquisition during software maintenance tasks, which in turn contributed to tasks' success, and b) the illustration of i*, as a modeling and analysis technique, that supports representing, capturing and analyzing these policies and structures, and explain how these contributed to success.

A key purpose of organizational policies and structures introduces was to create a knowledge environment which facilitates knowledge sharing and creation amongst individuals, and fosters the development of tacit knowledge.

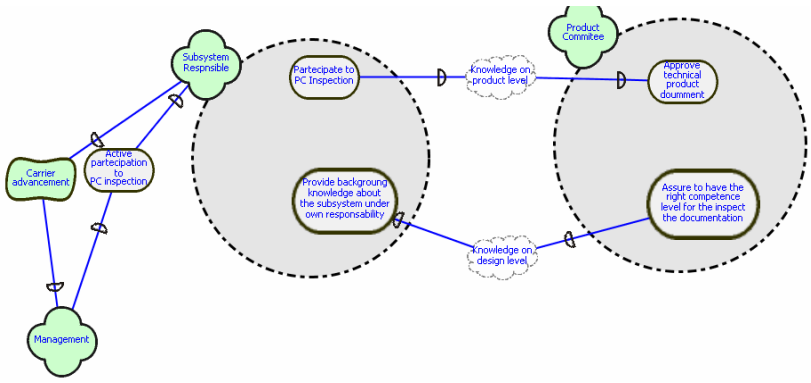

Figure 1: Knowledge transfer from Product Committee members to maintenance core team members responsible for a subsystem and vice versa

At Ericsson Marconi Spa several organizational decisions were made to facilitating the correlation and integration of the experience of individuals each working in different parts of the development organization.

First, four core members of the maintenance team (made up of nine people) where asked to take on responsibilities that went beyond maintaining selected subsystems, and included membership in the product development team and the product committee, the latter responsible for product and process quality. The effect of these multiple role assignments was that these members had to mingle and interact with individuals from other parts of the organization, not only learning first hand the particular challenges and issues others had to deal with, but also be part of the team that proposed solutions.

Maintainers therefore effectively gained hands-on experience with problems raised by customers in the field, participated in developing new product requirements, participated in proposing solutions to problems and faults, which then resulted in subsequent maintenance activities.

It is worthwhile to note that since same persons were assigned multiple responsibilities, the synergy between the diverse activities they performed increased the quality of the experiences they gained. On the other hand, also others in the development organization benefited from these "multitasking" members.

Members of the Product Committee took advantage of having colleagues with direct experience from the field, from product requirements specification, design and development, as well as maintenance activities. This raised the level of competence and assurance within the product committee product committee during inspections, and facilitated the knowledge transfer from various functional areas of the organization to product committee members.

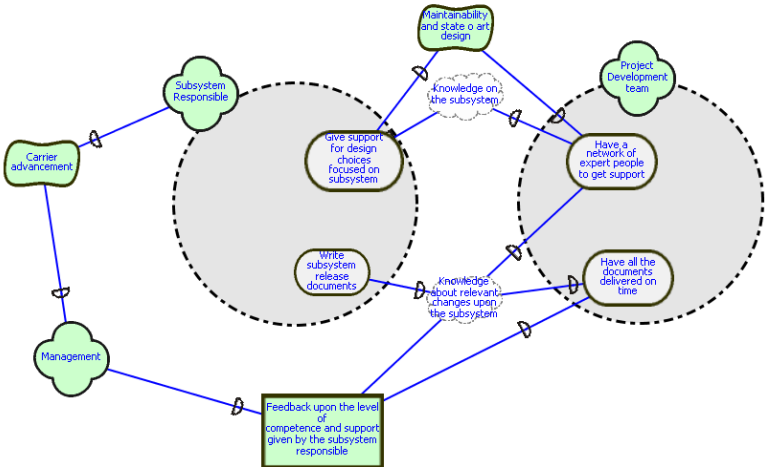

Fig. 2: Knowledge Transfer at design level from the Project Development team towards the Subsystem Responsible.

To encourage the participation in product committee meetings, an additional organizational policy was introduced requiring core members to attend a minimum number of meetings.

Another organizational policy required core members to update subsystem release documents. Writing and updating these documents was another way to acquaint maintainers with the product evolution from a product design perspective.

Another important synergist effect was that core team members often made suggestions during the design stages, as to how maintainability of subsystems under their responsibility could be improved. Suggestions often involved state-of-art design principles and approaches, which in turn improved the quality and maintainability of the products developed.

Figure 1 illustrates how the approval of technical documents by the product committee was made, as per organizational policy, dependent on the participation of an individual responsible for the maintenance of a subsystem, and in particular the latter's contribution of product knowledge. Figure 2 illustrates how management

motivates participation. Management is not only in charge of advancement management also obtains feedback from the development team as to the degree of participation.

Given these motivations maintainers share knowledge with project team members, as well as write subsystem release documentation for them. Figure 2 further illustrates that maintainers responsible for subsystems depend on project development team to implement maintainability measures, which in turn increases the maintainer's productivity. This strategic relationship provides additional motivation for maintainers to share their knowledge so that development teams are motivated to include maintainability suggestions into the product.

4 Conclusions

Modeling organizational policies and structures that encouraged knowledge transfer has proven not only practical but of great value. The models obtained effectively captured how new organizational policies and structures enabled and successfully facilitated knowledge transfer amongst organizational stakeholders.

One limitation observed was the issue of readability and understandability of produced diagrams, which, when diagrams size increased, became more difficult to achieve. This is very important since lack of readability and understandability runs the risk of loosing the knowledge captured in diagrams. In this project, many simple diagrams were produced, rather than cluttering a smaller number of diagrams with too much detail.

The expressiveness of i* helped illustrate that the maintenance organization was well designed and managed, and helped mobilize tacit knowledge held by individuals by an effective combination of instituted organizational roles and positions.

5 Ongoing and future work

Given the successful use of i* as a graphical modeling technique in helping stakeholders understand why policies and structures introduced helped create a successful maintenance organization, future work will focus on disseminating this knowledge to other Ericsson Marconi Spa organizations. Future work will also focus on easing the learning curve of the i* modeling technique so that knowledge transfer mechanisms can become more readily understandable.

References

[1] E. Yu.:"Modeling strategic relationships for process reengineering", PhD dissertation, Department Of Computer Science, University of Toronto.