SELECTION CRITERIA FOR SOFTWARE DEVELOPMENT TOOLS FOR SMES

SMEs and Cooperatives in Venezuela

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Keywords: Software development, methodology, SME, tools, selection.

Abstract: Software engineering tools have regained interests in recent years due to different changes affecting software developing organizations. These organizations carry out activities that might be undertaken in a plan driven and agile manner with the support of such tools. A proper balance between both approaches and the effective tool adoption will help organizations to meet their objectives and evolve. Small and medium enterprises and Cooperatives (S&C) share common characteristics throughout Latin America. Small and medium enterprises (SMEs) lack of formality in their roles and relationships among interacting individuals, whereas Cooperatives are usually small companies with weaknesses as to management techniques and technological equipment. In fact, both have difficulties when finding the right personnel and tools that best suit their needs. Considering Venezuela as our study subject, we have herein proposed some criteria to assist S&C in the tools selection that support their development processes while fostering the balance required between agility and discipline. Such criteria were formulated based on the characterization of five factors aimed at determining this balance. These contributions will help subsequently identifying methodological and technical aspects to provide guidance to S&C in the improvement of their development processes.

1 INTRODUCTION

Small and medium enterprises and Cooperatives (S&C) are increasingly consolidating their presence in the countries' economies. In Venezuela, there are 83.68% of local software developing organizations (Rivero et al., 2007). However, S&C have characteristics that might affect their competitiveness. Such characteristics influence the organizations' software developing activities and determine their particular needs, as to the support required from software engineering tools. Boehm & Turner (2004) proposed five factors to determine the balance between agility and discipline for software development projects. Our main goal is, from the analysis of such factors (size, criticality, dynamism, personnel, and culture) within the S&C particular context, to propose a set of criteria for tool selection at Venezuelan S&C.

2 RELATED WORK

An adequate agility-discipline balance may signifi-

cantly support compliance with the objectives of a software development organization (Boehm & Turner, 2004). Parada et al. (2008) proposed a decision network aimed at determining the organizations' necessity of applying either an agile or a plan-driven methodology. If it is located in the center of the network, an agile methodology is recommended for the organization, but if pointing towards the outer edge, a plan-driven methodology seems to be a suitable decision (see Figure 1).From this network, we infer that S&C require agility, but when they undertake critical, complex or medium-sized projects, they might require a higher discipline level in order to improve their probability of success. Likewise, if they want become more competitive, they should apply more disciplined methodologies. The perfect balance lies in obtaining a degree of discipline that does not make them lose their essence of S&C, with little-specialized highly-proactive resources. Based on this categorization, we identified functional and non-functional characteristics for those software engineering tools, which focus on the development processes undertaken at S&C to gather a set of criteria that facilitate their selection.
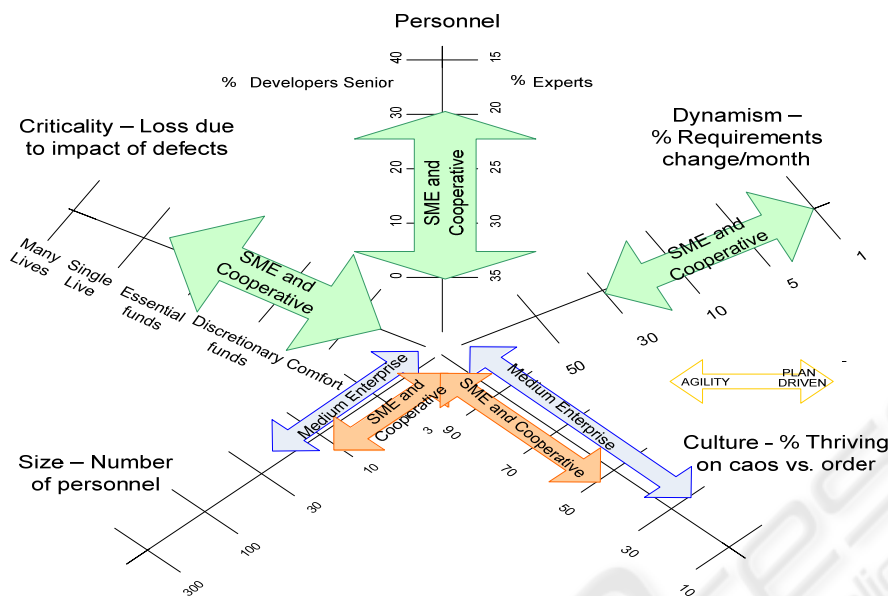
Figure 1: Decision network of Venezuelan software developing SMEs and Cooperatives (Parada et al., 2008).

3 S&C CHARACTERISTICS

In SMEs, complete functions are concentrated on few individuals. Flexibility in the roles performed by the personnel is a common pattern to most SMEs. This pattern is evidenced in the lack of formality of relations among individuals and their roles. This is also observed in the organizations' flat structure as well as in the flexible workflow driven by the needs of a specific moment (Erard, 2005). SMEs' main difficulty is finding the right personnel and necessary tools to perform their work.

Cooperatives show fluid communication and work. A group of people integrate an ad-hoc team any time a need arises. The composition of that team will not probably be influenced by the personnel's degree or work position within the organization, but it will be driven by the current work needs and skills of the available personnel (Molina & García, 2005). Cooperatives usually are small organizations. They are mostly managed by volunteers, who have little managerial skills and remarkable technological deficiencies in their productive and service processes (Muller, 2001).

S&C have characteristics that allow for approaching the degree of agility and discipline they should have to succeed; all this in order to adopt or adapt their methodologies for achieving this purpose. The initial effort for implementing processes aimed at improving product and service quality at Latin American (LA) software systems development

(SSD) organizations is high and complex. This is mainly due to the fact that most organizations are small- or medium-sized, lack any monthly budget and plans, and have no control on the productivity and processes involved in SSD (Herrera, 2003). Only a small fraction of LA organizations has been awarded official CMM or ISO 9000 certifications from international entities (Herrera, 2003).

These organizations account for a significant percentage of SSD companies in LA. In Venezuela, the Software National Industry (SNI) is mostly comprised by SMEs with less than 51 employees (approximately 83.68%), the main layer being organizations with 21 and 51 employees (42.68%) (Rivero et al., 2007). Most companies of SNI do not use mature models and methods for their productive processes. Now, only a little percentage of the surveyed organizations could be qualified at CMMI level 2, which is a relevant and high-priority factor for reaching international competitiveness (Rivero et al., 2007).

For LA S&C, and particularly in Venezuela, the question is: In accordance to the factors proposed by Boehm, which parameters determine the level of agility and discipline of a methodology to make these organizations competitive in the global market? Consequently, which implications should software developing S&C consider when deciding on the tools required to support their development processes? Next, we present the Boehm's factors analysis according to S&C context in Venezuela.

Size. *This factor's determines the application of a methodology with a high agility level that allows*

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for distributing team's work.

Culture. *This factor determines the application of a methodology that leads to flexibility in decision-making processes and problem resolution within a formal framework, so as to achieve agility without risking team work planning.*

Personnel. *This factor determines the application of an agile methodology that allows experts to solve immediate problems with a sufficient level of discipline aimed at work management for the rest of the group.*

Criticality. *This factor determines the application of a plan-driven methodology.*

Dynamism. *This factor determines the application of a plan-driven methodology.*

4 TOOLS SELECTION CRITERIA

Although software engineering supporting tools were developed to support the stakeholders' tasks and processes throughout the information system life cycle (Lundell & Lings, 2004), they share multiple scopes and are subjected to constant changes derived from the advances in the software engineering knowledge field. For S&C, the decision of acquiring a tool may have significant implications in terms of costs and implementation. Hence, the need for making well-grounded decisions regarding technology-adoption processes.

For this reason, we intend proposing a set of criteria for tools selection in S&C. These criteria establish a framework for decision making processes and serve as referential parameters for the evaluation and selection of tools, so to offer advantages for achieving the necessary agility-discipline balance throughout the software development processes at S&C. Such criteria have been established based on the S&C characteristics analyzed herein and the factors affecting the required balance (see Figure 2).

Flexible Project Management. S&C have time, people and financial restrictions, i.e., S&C need an efficient management of their resources. This poses some expectations regarding support to flexible project management, which are related to the tool functional characteristics, are: (a) Organizational management: objectives, time, tasks -per individuals and groups- goals, events, unplanned actions, and corrective actions; (b) Metrics management and generation of reports on metrics related to the project follow-up: percentage of completion, planned/executed progress, percentage of participation.

Flexible Process Management. High competitive environment, and productivity pressures, de-

mands to S&C to be prepared for handle changes that arise during the project development. Then, considerations about personnel skills and distribution of software development activities among experts and senior developers are very important. Balance of agility and discipline is required to solve problems and manage work, respectively. Criteria proposed include (a) methodology customization support; key device generation in accordance with time, objectives and available personnel; selection or omission of activities according to the context; (b) strengths in analysis activities; UML support, use case-oriented analysis; iterative development support*; (c) prototypes' design; (d) role management support: role selection, fluent communication among roles

Coordination, Communication, and Cooperation. The process requires mechanisms to facilitate for efficient interaction among the team members, since development teams are usually diverse, shared and distributed. Therefore, it is necessary to evaluate tools with features such as: (a) portability, thus facilitating users' handling in different time-zones and locations; (b) allow for efficient information exchange: notification mechanisms; support at repositories and virtual or distributed environments.

Scalable Repository Management. The tool's ability to facilitate coordination, communication and cooperation, demands integrated data management and safeguarding. It is relevant to count on tools capable of (a) interoperations, by being compatible with other data storage tools, protocols, standards, shared databases; (b) providing access security and appropriate role and team restrictions; (c) offering accurate results by being consistent in the integrated exchange of data recorded in the repository.

Support to the Methods and Approaches. In order to support planning required by S&C, we expect the satisfaction of the following criteria: (a) support to the methods, models, and notation of analysis and designs used by the organization, (b) adherence to standards (c) availability of documentation on the methods used, (d) support to the development approach used by S&C.

Quality Assurance. Normally S&C accept challenges of increasingly *critical* projects; therefore, we have conceived this criterion as support to activities mainly related to software internal features, such as availability of resources for (a) Audit and inspection checklists; (b) Code standard analyzability; (c) *Testability*: black-and- white box tests, (d) model verification (logic checks, error messages, ease of debugging, trace files step, dynamic display of elements and display of the workflow path).

Figure 2: Proposed criteria for tool selection in S&C.

User-friendly and Self-learnable. S&C have difficulties for acquiring specialized people. People are few. Then, S&C could need tools that provide ease of learning, so that people can getting benefits in short time. Hence, the relevance of considering criteria related to tool usability: (a) user-friendly management of appealing interfaces, reducing change resistance; (b) model representativity and functionality; (c) tutorials and on-line documentation to encourage effectiveness and efficiency of the learning process (d) availability of libraries support-ing modeling efficiency.

5 CONCLUSIONS AND FUTURE WORK

In this work, we have established a set of criteria for the selection of software engineering tools that best suit S&C' reality. Criteria pursuing a higher level of agility are essential for proper management of soft-ware development activities within time, resources, and personnel restrictions, which are common to these organizations. Criteria pursuing a higher level of discipline are key to ensure a higher control over the team, tasks and objectives, thus reducing the possibility of chaos and supporting efforts' integra-tion.

Next step in this research is identifying which elements should be included in the agile methodolo-gies to achieve these goals, i.e. a proper disciplined balance and refined tool selection criteria susceptible of being evaluated and instantiated.

ACKNOWLEDGEMENTS

REFERENCES

Boehm, B. & Turner, R., 2004. *Balancing Agility and Discipline: A Guide for the Perplexed.* Addison-Wesley Professional.

Erard, P. ¿Como vencer los obstáculos al desarrollo de la pyme? El aporte de Fundes. *Debates Iesa*, 5, 9-19, Ca-racas, Venezuela.

Herrera, E. 2003. A methodology for self - diagnosis for software quality assurance in small medium-sized in-dustries in Latin America, In *Americas Conference on Information Systems.*

Lundell, B. and Lings, B. (2004), Changing perceptions of case technology, *J SYST SOFT*, *7*(2), 271-280**.**

Molina, C. & García, A., 2005. *Cooperativa ¿qué es y cómo funciona?,* PANAPO: Caracas, Venezuela.

Muller, A., 2001. Acerca de la Reforma de la Ley de Co-operativas de Venezuela. *Revista Venezolana de Eco-nomía Social,* 1*,* 1-19. Mérida, Venezuela.

Parada, D, Di Paula, G., Mendoza, L., Pérez, M., 2008. Disciplina y agilidad en el proceso de desarrollo de software para SMEs y cooperativas en Latinoamérica. In *VII Jornadas iberoamericanas de ing. de software e ing. de conocimiento*. Guayaquil, Ecuador.

Rivero, D., Montilva, J., Granados, J., Barrios, J. Besem-bel, I., Sandia, B., 2007, La Industria de Software en Venezuela: Una Caracterización de su Recurso Huma-no. In *Encuentro Venezolano sobre Tec. de la Inf. e Ing. del Software,* Margarita, Venezuela.