Overcoming COTS Marketplace Evolvability and Interoperability

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Abstract. Though the importance of COTS components selection is well recognized by the Software Engineering community, the process of searching candidate COTS components is associated with major difficulties related with the diversity, size, evolvability and interoperability of the COTS components as well as the lack of structure and subjectivity of the COTS marketplace information, making the searching process expensive and inefficient. In this paper we report the use of some techniques for dealing with some of these difficulties, providing support not only for a reliable and comprehensive structuring of the COTS marketplace, but also for COTS components reuse.

1. Introduction

Nowadays, the use of COTS (Commercial-Off-The-Shelf) components technology for building information systems is perceived as a crucial need in a wide variety of application areas. However, many challenges must be faced for adapting the traditional software engineering practices in order to exploit its promising benefits [1]. Selection of COTS components is one of the cornerstone activities, defined as the process of [2]: 1) determining system requirements; 2) searching candidate COTS components in the marketplace; and 3) evaluating those candidates with respect to the requirements. Although many proposals with significant results have been achieved for the activities 1 and 3 (see [3] for a recent survey), not much attention has been directed to the problem of searching components in the marketplace, in spite of the fact that it is considered an important open issue [4]. Thus, based on several industrial experiences which have been undertaken under action-research premises [5], as well as literature survey and grounded theory [6], we have designed a prescriptive method called GOThIC (Goal-Oriented Taxonomy and reuse Infrastructure Construction) for structuring the COTS marketplace by means of a goal-oriented taxonomy composed of two types of nodes, market segments and categories [7]. Market segments are the leaves of the taxonomy, whilst categories serve to group related market segments and/or subcategories (e.g., the category of multi-user real time communication systems or messaging tools). Having this kind of taxonomy helps to overcome many obstacles related with the diversity, size, evolvability, interoperability, lack of structure and subjectivity of the COTS marketplace that makes the searching process expensive and inefficient. In this paper we focus on describing our findings in the application of some well-known techniques in order to overcome evolvability and

interoperability, two of the most critical issues for COTS selection success, in the framework of our GOThIC method.

2. **Overcoming the Evolvability and Interoperability Obstacles**

Marketplace evolvability is evidenced by the continuous emergence of new market segments according to innovative technologies, and the rapid release of new products and new versions of existing products not only for improving their features but also for offering new services which were previously considered as belonging to different segments. On the other hand, interoperability is given by the fact that COTS components are not designed to work isolated, but in collaboration with others, which results in many dependencies [8]. In order to overcome these obstacles, we propose the use of goal-oriented approaches for building and providing the rationale to abstract, well-founded and stable taxonomies capable of dealing with the rapid evolution of the COTS marketplace, allowing reliable COTS information reuse.

2.1 Identification, Refinement and Statement of Goals

A goal is an objective that should be achieved and may be formulated at different levels of abstraction, ranging from high-level strategic to low-level technical concerns and implies more stable concepts in respect to changes [9]. Thus, inspired by GBRAM (Goal-Based Requirements Analysis Method) [10] -a widespread method in the requirements engineering discipline- we have stated an iterative process for identifying and refining goals from previously analyzed and suited sources by means of a set of techniques as those related in [11], among which the Inquiry Cycle (consisting of a series of questions and answers designed to pinpoint where and when the information needs to arise), scenario construction and consideration of obstacles play a crucial role. An excerpt of these techniques is shown (Table 1, left).

Table 1 Example of the identification and refinement process (left), and statement of goals (right)

Goals	Goal Obstacles	Scenarios
Real Time Synchronous Communication (RTSC) Established	-RTSC Not Established -There is no infrastructure available -Users Not Connected at the same time	-Users Communicated in Real Time -Session Established
One to One RTSC Established	-There is no compatibility among software clients	-Establishing One to One RTSC
…		
Multiuser RTSC Established	-There is no enough bandwidth available. …	-More than 2 RTSC users connected

Goal:	Multiuser Textual Communication Established
Type	Achievement
Description	Provide RTSC in a Multi-user Text Environment
Agent	Software Client
Stakeholder(s)	Software Client, Software Server, Sender, Receiver
Precondition(s)	Users Communicated in Real Time Session Established Number of users >=2
Post-condition(s)	Multiuser Textual Communication Established
Subgoal(s)	Software Client Provided Software Server Provided

Finally, goals are stated in a systematic way using a pre/post style for denoting which conditions are met when others hold (Table 1, right). Moreover, for avoiding syntactic and semantic discrepancies common in the widespread and unstructured COTS marketplace information, we have proposed the use of the Language Extended Lexicon (LEL) [12] for capturing a glossary of the domain which homogenizes terms of different information sources and helps to detect synonymous or duplicated goals.

2.2 Establishment of Dependencies

We have analyzed the types of dependencies that may exist among COTS components and we have concluded that a COTS component may need another for: *enabling its functionality* (e.g. in order to follow document life-cycles, document management tools need workflow technology to define them); *complementing its functionality with an additional feature, not originally intended to be part of its suitability* (e.g. a web page editing tool can complement a web browser for editing web pages); *enhancing its quality attributes* (e.g. resource utilization can be improved significantly using compression tools). Analyzing the goal information obtained previously, relationships among COTS components are gradually identified and declared as dependencies using goal-oriented models, specifically *i** models [13]. We represent market segments and categories as *i** actors, and establish dependencies that may be of four different types: goal dependencies, when an actor depend on another to attain a goal; task dependencies, when an actor requires another to perform an activity in a given way; resource dependencies, when an actor depends on another for the availability of some data; and soft goal dependency, when an actor depends on another to achieve a certain level of quality of service. Fig. 1 shows an example of this approach, which allows the identification and formal representation of dependency relationships between COTS components, recording and managing COTS interoperability in an optimal way. As far as we know, in the context of COTS selection these dependencies have been dealt on a case-by-case basis, with the only exception of product lines architectures.

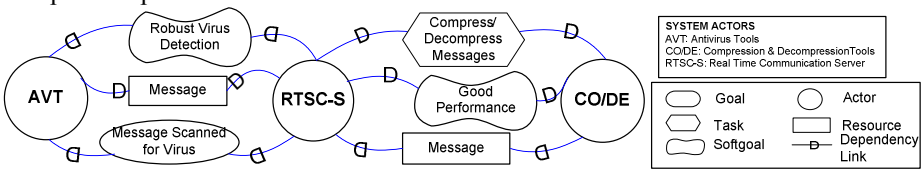


Fig. 1. An example of the establishment of dependencies among COTS components

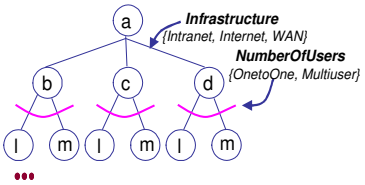
2.3 Taxonomy Structuring

We use the classification in the form of a decision for organizing and characterizing the goals into nodes. Such organization comes from the analysis of pre and postconditions stated for each goal which is operationalized in terms of variables. The variables, in the case of categories, represent classifiers (e.g., number of users of the system, type of data, …). These classifiers may take values (e.g. for infrastructure, values are Intranet, Internet, WAN), and for each possible value, a subcategory or market segment applies. From a semantic point of view, market segments stand for the basic types of COTS components available in the marketplace (e.g., the domain of anti-virus tools or spreadsheet applications), i.e. atomic entities covering a significant group of functionality such as their decomposition would yield to too fine-grained domains. Table 2 shows an excerpt of the assignment of variables to goals, while Fig. 2 shows the subsequent goal organization, stating the appropriate classifiers considering that all the assignments are inherited downwards the hierarchy.

Table 2. A taxonomy structuring example

Node /SubNode		Variable
a. Users Communicated in Real Time		ConnectionType
	b.Intra-organizational Communication Established	Infrastructure
	c. Internet Communication Established	Infrastructure
	d. WAN Communication Established	Infrastructure
…	**l**. One to One Communication Established	NumberOfUsers
	m. Multiuser Communication Established	NumberOfUsers
	…	

Fig.2 Goal organization



3. **Conclusions**

In this paper we discussed our goal-oriented strategy for dealing with the COTS marketplace evolvability and interoperability. It is based on the application of well known techniques for supporting the COTS components search and reuse by means of abstract, well-founded and stable taxonomies and COTS dependency models which semantic provide the rationale for the decisions taken. Diverse actors that range from IT (medium and large) companies to software engineers which usually carry out components selection may benefit from our approach, structuring and reusing their knowledge better being more confident on their own selection processes or offering assessment for business automation; achieving not only a better return on investment but also improving the efficiency and reliability on the software engineering activities involved, especially selection and evaluation activities.

References

1. Brownsword, L., et al. "Developing New Processes for COTS-Based Systems" IEEE Software, Vol. 17, No. 4. July-August 2000 pp. 48-55.
2. Kunda, D., Brooks, L. "Applying Socio-Technical Approach for COTS Selection" Proceedings UK Acad Inform Syst Conference, 7-9 April 1999, University of York.
3. Cechich, A., et al."Trends on COTS Component Identification and Retrieval" Proceedings International Conference on COTS-Based Software Systems 2006. IEEE Society.
4. Réquilé-Romanczuk, et al. "Towards a Knowledge-Based Framework for COTS Components Identification". Proceedings ICSE-MPEC 05, St Louis, Missouri, USA. ACM 2005.
5. Baskerville R., Wood-Harper A.T. "Diversity in Information Systems Action Research Methods". European Journal on Information Systems. Vol. 7 No.2, June 1998.
6. Martin, P., Turner, B. "Grounded Theory and Organizational Research" Journal of Applied Behavioural Science.1986; 22: 141-157.
7. Ayala, C., Franch, X. "A Goal-Oriented Strategy for Supporting Commercial Off-The-Shelf Components Selection" 9th International Conference on Software Reuse (ICSR). June 2006.
8. Franch, X., Maiden, N. "Modelling Component Dependencies to Inform their Selection". Proceedings 2nd International Conference on COTS-Based Software Systems (ICCBSS). LNCS 2580. 2003
9. A. Lamswerdee. "Goal-Oriented Requirements Engineering: A Guided Tour". Proceedings 5th IEEE International Symposium on Requirements Engineering. 2001, pp. 249-263.
10. Antón, A. I. Goal Identification and Refinement in the Specification of Software-Based Information Systems. Ph.D. thesis, Georgia Institute of Technology, June 1997.
11. Regev, G. "Where do Goals Come from: the Underlying Principles of Goal-Oriented Requirements Engineering". 13th IEEE Requirements Engineering Conference 2005.
12. Leite, J.C.S.P. "Application Languages: A Product of Requirements Analysis" Informatics Department PUC-/RJ (1989).
13. Yu, E. Modelling Strategic Relationships for Process Reengineering. PhD Thesis, University of Toronto, 1995.