Tool-Based Checks of Process Implementation – an Example

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Abstract

Systematical checking for complete process implementation is often a difficult and tedious task. As an example, it is shown in an industrial experience presentation, that with the help of so-called "model searches" in the CASE tool "Enterprise Architect", for the software requirements analysis process, ENG.4, process work task performance checks may be carried out efficiently. It is also shown, that work task performance is directly related to process performance.

1. Introduction

The Enterprise Architect (EA) is a commercial UML CASE tool (see www.sparxsystems.eu) providing, for example, management of requirements, design and test development, and modeling of processes.

At Softing AG, the EA tool is used in all processes of the engineering process group (ENG), mainly in customer projects in the automotive environment, especially in the field of ECU diagnosis applications. The company currently has implemented the SPICE processes in the HIS scope (15 processes).

2. Implementation of the Software requirements analysis process ENG.4

In the Softing AG implementation of the software requirements analysis process, the process is distributed into 12 work tasks, namely

1. Import of stakeholder requirements
2. Complete list of software requirements
3. Requirements analysis (status and risks)
4. Categorization of requirements
5. Priority of requirements
6. Mapping of requirements to releases
7. Definition of verification criteria
8. Management of changes
9. Tracing to customer requirements
10. Architectural overview
11. Release of requirements specification document
12. Customer sign-off

Managing requirements in the EA is achieved by managing the values of the requirement element's attributes (e.g. version, status, author, date, etc.). As the types of attributes of the standard EA requirement element are somehow limited, the user has the option to additionally define her/his own attributes with the help of tagged values [1] (for example at Softing AG, a criticality value or a value of an impact to an environment is defined as a tagged value).

3. Completeness criteria in the work tasks

For each work task in the process, a completeness criterion is defined first, e.g. a constraint on attributes and tagged values, and this criterion is transformed to searches for requirement elements whose attributes or tagged values do not fulfill the constraint. Only when the search lists for a particular process work task are empty, a process work task is

considered as complete, in which case the responsible requirements engineer may proceed to the next task of the process. For example, in work task 3, listed above, one of 2 completeness criteria is that if a requirement element has a criticality value of higher than low, it must also have risks defined that are to be tracked further in risk management. The element search looks for a logical combination of the tagged values "criticality" and "risks" in the requirements package that is to be inspected, and a necessary condition for completeness of work task 3 is that the associated search list is empty.

Combining all searches in the EA with the help of RTF reports then allows managing and tracking the work task completion of requirement elements on a package, or even an individual level. **Figure 1** shows a sample output (for work task 3) of the RTF report generated for all work tasks giving an overview of the completeness of the work tasks as described in **chapter 2**.

In the sample output, by visual inspection, it is immediately seen that a requirement with a criticality value set to "high" exists, however the risk has not been defined yet (the description is empty).

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Package: Requirements

Package: StakeholderRequirements

Package: CustomerRequirements

Name:	**ID-2**	**Criticality:**	**high**	**Risks:**	

Package: ProductManagementRequirements

…

Figure 1. Sample RTF output of search results for work task 3 (requirements analysis): requirement with identification number "ID-2" has a criticality value set to high, but no risk defined.

4. Generalization to other processes

Similar work tasks and searches may easily be defined for other processes as well. At Softing AG, currently the ENG.5 software design process is also completely managed with the help of work tasks and searches. In principal, all ENG processes may be managed in this way, the plan is to complete all ENG processes until mid of 2010.

As the processes of the MAN and SUP category are currently not managed in the EA tool, the method is not used for these processes, however the EA provides planning and resource management facilities as well. For example, estimation of necessary development and test resources may be achieved with the help of use case metrics, and all documentation may as well be generated from contents managed in the EA.

5. Using the method in evaluating process capability

The work tasks and the corresponding searches may be related to the process capability with the help of a relationship matrix (**see Figure 2**). Some work tasks and their corresponding search(es) are directly related to a base practice on level 1 (see e.g. work tasks 4-6 that are directly related to ENG.4.BP4, prioritize and categorize software requirements, or work task 9 that is directly related to ENG.4.BP6, traceability to customer requirements). In those cases, a completeness in the corresponding search signals a very high probability that the associated base practice is also fully achieved (see last row in **Figure 2** giving the coverage of the search with respect to practices).

On the other hand, some practices may not be completely checked with the help of the searches, e.g. ENG.4.BP2, analyze software requirements, as this obviously requires a more careful analysis of the sources of the requirements and their meaning in the project. Nevertheless, also here, the searches will give a level of confidence with respect to the achievement of the practice, indicated by an estimated percentage rating in the last row.

All work products are efficiently managed in the EA including an automatic generation of the documentation. The work tasks are integral part of a general process description where tasks including their goals are assigned to roles (see **Figure 3,** showing part of a process description in the EA, modeled with the help of BPMN - Business Process Modeling Notation diagrams). As a consequence, the management of the **work products** on level 2 may also be efficiently checked (see also [2]) with the help of the searches. Contrary to this, the management of the **performance** on level 2 is only partly checkable with the help of the searches, as currently in the implementation at Softing AG, other tools are used for planning and

resource management (cf. note **3***) in **Figure 2**). The EA may however also be used as a planning tool, in which case the searches may be extended to cover also the GP.2.1.x practices more efficiently.

Searches	**Work Tasks**		**ENG.4.BP.1**: Identify SW requirements	**ENG.4.BP.2**: Analyze SW requirements	**ENG.4.BP3**: Impact on operating environment	**ENG.4.BP4:** Prioritize and categorize SW requirements	**ENG.4.BP5**: Evaluate and update SW requirements ***3)**	**ENG.4.BP6**: Traceability to customer requirements	**ENG.4.BP7**: Traceability of system architecture to SW R.***1)**	**ENG.4.BP8**: Communicate SW Requirements	**GP.2.1.1**: Identify objectives ***2)**	**GP.2.1.2**: Plan and monitor performance of process ***3)**	**GP.2.1.3**: Adjust performance of process ***3)**	**GP.2.1.4**: Define responsibilities and authorities ***2)** , ***3)**	**GP.2.1.5**: Identify and make available resources ***3)**	**GP.2.1.6**: Manage interfaces between involved parties ***2)**, ***3)**	**GP.2.2.1**: Define requirements for work products	**GP.2.2.2**: Define requirements for documentation and control	**GP.2.2.3**: Identify, document, control work products	**GP.2.2.4**: Review and adjust work products
		Description	Level 1: Base practices								L2: Performance						L2: Work products			
	1	Import of stakeholder requirements	X								X			X			X			
X	2	Complete list of software requirements	X								X			X			X			
X	3	Requirements analysis (status / risks)		X	X						X			X			X			
X	4	Categorization				X					X			X			X			
X	5	Priority				X					X			X			X			
X	6	Mapping to releases				X					X			X			X			
X	7	Verification criteria / use cases		X							X			X			X			
X	8	Management of changes					X				X			X			X	X	X	
X	9	Traceability to customer requirements						X			X			X			X			
	10	Architectural overview									X			X			X			
	11	Release of software requirements								X	X			X		X	X	X		X
X	12	Customer sign-off								X	X			X		X	X	X		X
		Search coverage	75	75	75	100	75	100	N/A	100	100	0	0	75	0	75	100	100	75	75

Figure 2. Relationship matrix for work tasks and searches to ENG.4 attributes on level 1 and 2. Notes *1)-*3) have the following meaning:
***1) N/A (at Softing AG., currently only software projects are carried out with the help of the EA)**
***2) cf. process description as BPMN diagram, based on work tasks**
***3) Other tools are used for project planning, e.g. MS-Project and Excel (Project Manual)**

The searches may also be used for checking on level 3, when the process descriptions modeled in the EA are used as a standard including tailoring rules (at Softing AG not yet completely defined). For example, for GP 3.1.5, part of the effectiveness of the standard process may be measured as relative number of requirements with an issue in a work task, or relative time spent in a group of work tasks until completion. More details are explained in the conference presentation.

6. Conclusions and outlook

In conclusion, from experience in customer projects, the EA tool-based check for completion of work tasks and work products in the software requirements analysis process is of valuable assistance to the quality assurance responsible person in the project in evaluating the progress of the project and assessing process performance. The method is generally applicable to all engineering processes, however it will obviously not replace formal assessments, as certain aspects require a more fundamental and detailed analysis.

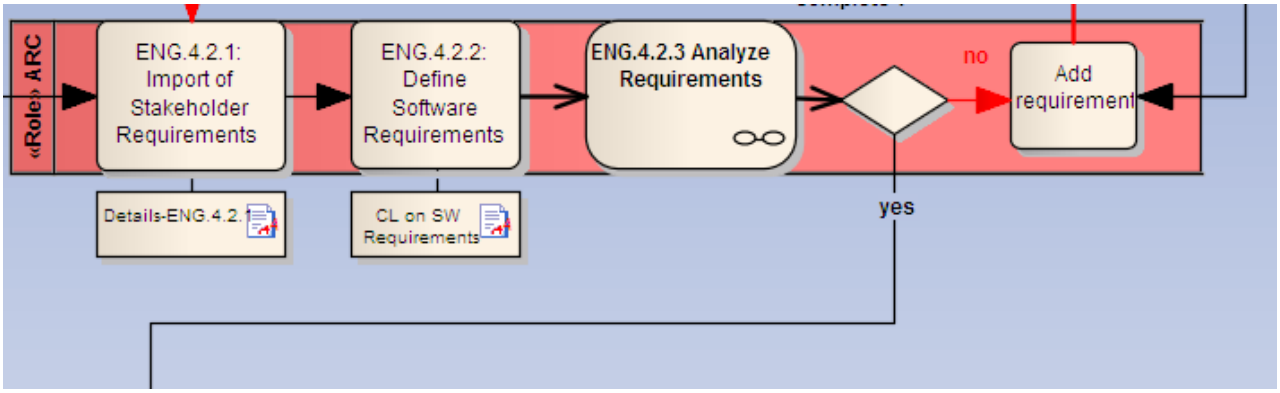

Figure 3. Part of the process description for the ENG.4 software requirements analysis process. Work tasks 1-3 may be found in this part of a BPMN diagram (see chapter 2 and Figure 2).

10. References

[1] Requirements Management with Enterprise Architect, Sparx Systems, 2008, Version 1.2, white paper for download from manufacturer, www.sparxsystems.com
[2] Höhn, Sechser, Dussa-Zieger, Messnarz, Hindel, Software Engineering nach Automotive SPICE, dpunkt.verlag, ISBN 978-3-89864-578-2, Pp. 149