Traceability Usage and Adaptation in Practice

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1 Introduction

Traceability usage within different projects is as manifold as the domains in which traceability is applied. A traceability information model (TIM) describes the traceability for a project. A basic TIM consists of at least two types of artifacts and a traceability relation between these artifacts [3]. One of the open traceability challenges is the traceability adaptation during usage [1]. The TIM should be adaptable to changing contexts and needs. We investigate the usage of traceability, in particular the adaptation of TIMs. Therefore, it is important to study whether TIMs are used explicitly, i.e. a TIM is defined and documented for a project upfront, or TIMs are used implicitly, i.e. project participants know which artifacts are intended to be traced, but a formal documentation of the TIM is missing. Several studies and experience reports reflect the usage of TIMs in practice [4]. However, experience reports describing the adaptation of a TIM during the project are rare. Therefore, we report on the results of two expert interviews regarding the usage and adaptation of TIMs in practice. The interviews show that in two different domains TIMs adapt during the project. In particular, we identified events and roles which caused the need to adapt the TIM and we describe which parts of the TIM are affected by the adaptation.

2 Interviews

We conducted two expert interviews settled in two different domains. For the interview, open questions were used to elicit as much information as possible from the experts minimizing prior bias. However, we developed an interview guideline to ensure that all relevant aspects were covered during the interviews. Each interview was recorded or written down, if a recording was not desired by the interviewee, and the interviews were transcribed for analysis. The following statements are specific to our interviewees, not the domain in general.

2.1 Automotive Domain

We first interviewed a test manager of a logistics software project settled in the automotive domain. At project start, neither an explicit TIM nor an implicit TIM was defined, and also traceability guidelines were not in place. Requirements and test cases were documented within different tools. SAP's solution manager was used to document requirements and HP's Quality Center was used to document test cases. Although at least two artifacts were defined, a relation representing a traceability link between both artifacts (necessary for a TIM) was missing. During the project, the test manager observed that evidence on test coverage of all requirements is missing, but needed. For this, the test manager introduced a naming convention for test cases. The naming convention clarified which test cases test which requirement. The resulting relations between requirements and test cases were documented within Microsoft Excel. The document contained the list of test cases and the list of requirements. Test cases were related to requirements using an unique ID (naming convention). As a consequence, a TIM was formed which comprised requirements, test cases and a traceability link between both artifacts. The TIM was documented using general-purpose tools such as Microsoft Powerpoint and Microsoft Word. During a kick-off meeting, the TIM was made available to all developers explicitly. As part of our interviews, we asked for improvement suggestions regarding traceability. From the test managers point of view, it is essential that traceability between requirements and test cases is fully tool supported. Whenever requirements change, testers want to be notified in order to create new test cases or modify existing ones. This must be supported by tools even if heterogeneous tools are used.

2.2 Medical Domain

The second interview belongs to the domain of devices for dental use, where we interviewed the head of the development unit of a German manufacturer that develops products that range from dental chairs, to digital 3D x-ray systems. Motivated by ISO 13485 [2], a norm for the development of medical products, the company has a need for a regulatory approval, i.e. CE, FDA, etc. of products. This approval is based on a thorough assessment where product-specific documents and an expert group comprising developers, engineers and dentists/physicians are involved. In the past, the company used a TIM according to the waterfall structure of related documentation: product requirements, requirements specification, functional

specification, design and test. However, this structure did not allow the reuse of documentation for unchanged or slightly adapted components in other products. Therefore, a new hierarchical documentation model was established that is structured into five layers, as depicted in figure 1. The *solution layer* targets sales and marketing and comprises a customer demands and a product portfolio with available medical products. The combination of medical products describes which specific medical products should be used by a dentist for diagnostics and treatment, e.g. a dental x-ray device, a medical image viewer for diagnosis and a software tool to plan a special treatment. On the *system level* the requirements of exactly one medical device are documented as a functional specification, including the intended use of the system, e.g. cavity-detection by a dentist. The architecture describes which components are used to realize the given requirements. Details about how requirements are implemented are described in the design document. The documents on the *component level* describe the requirements, design and architecture of each of the system's components. Components could be the x-ray device and the modality software for a x-ray system. The *unit level* contains requirements, architecture and design of major units of which a component consists of. Finally, the *code level* contains the specific software implementation of units, e.g. the code of the firmware of an x-ray device. In each level, except the solution level, a combined test-specification and -plan describes, how the requirements, the design and architecture will be tested on the particular level. A test report, which documents the test execution is also available on each level, except the solution- and code-level. The documentation model forms an explicit TIM, is documented and used in the CASE-tool Polarion and is used for new developments.

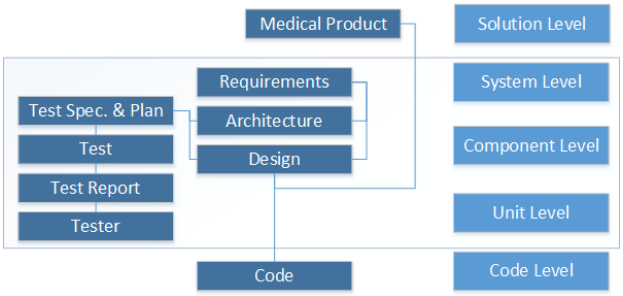

Figure 1: Hierarchical Documentation Model

The interview revealed two more subjects for future improvement of the existing TIM. (i) Regular code reviews should be performed. The regulatory approval requires the documentation of the reviewed artifact, the involved developers and the result of the review, admissible by law. This is currently neither supported in the TIM nor supported in their Polarion implementation. (ii) The results of unit tests are not automatically transferred into Polarion. In cases where this has been forgotten, traceability has limited value.

Criteria	Interview 1	Interview 2
Initial TIM	implicit	explicit
Adapted TIM	Test to requirement	Document model
TIM adaptation benefit	Enabled test coverage analysis	Improved document reuse
Tool support	General-purpose, HP Quality Center, SAP Solution Manager	Polarion

Table 1: Comparison of TIM usage and adaptation

3 Discussion

Table 1 compares the interview results according to the criteria prior TIM definition, adaptation of the TIM and resulting benefit, and related tools of our interviewees. It shows that an explicit TIM definition and documentation is applied prior to the projects of the second interview, but not of the first interview. However, the TIM adapts in both cases during the projects and a benefit from this adaptation is achieved also in both cases. Moreover, both TIMs were explicitly documented after adaptation. The interviews showed a need for future TIM-adaptation. In addition, the interviews confirmed the well-known fact that traceability is much harder in case of heterogeneous tools.

4 Conclusion

In this paper we have reported on the usage and adaptation of TIMs in practice based on two expert interviews. Our results show that TIM definition (either implicit or explicit) and usage varies between the interviewees. However, we have seen that the TIM adapts during the project in both cases and that this adaptation leads to traceability improvement. In future work we will conduct more interviews in order to study traceability usage and adaptation within more domains and projects. From the results, we will be able to develop appropriate tool support assisting practitioners in TIM-adaptation.

References

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