**SOLUTIONS**

**Improved Tool Chain**

**Requirements Management and Traceability**

Key elements of a successful project are requirements and their proper management and traceability. The goal is to ensure that the needs and expectations of the project stakeholders are correctly captured, documented, implemented, verified and validated.

**Complete Solution View**

Standard development is a long process that can take many years. This process is constantly evolving and challenged with the emergence of new technologies and the needs of the different actors working on it. Moreover, in the standard development process, requirements come from different sources: each stakeholder has needs to meet using this standard. During the development process, requirements can change according to the evolution of the stakeholders’ needs and new requirements can also be created from feedback on the implemented features for example. Consequently, requirements traceability should be integrated into this process to document the full lifecycle of each requirement, from its origin to its implementation. Thereby, each stakeholder can track the source of each requirement, the changes made to these requirements and link them to the features through which they are satisfied. Tracking requirements allows the stakeholders to know whether a requirement has been successfully implemented or if it needs to be reworked. Moreover, requirements management makes it easier to identify the person (or group of people) who issued a requirement, to get more information about it, but also offers a real-time overview of all the requirements to prioritize them.

The development of STEP began several decades ago and since that time, the stakeholders’ requirements have evolved because of the change of the business needs and the evolution of technologies for instance. Moreover, in the STEP development process, requirements are listed in ISO documents, without any information about the requirement source or what was the objective behind each requirement. Thus, once the features are implemented, it is almost impossible to get back to the concerned stakeholder to validate his requirement because of the lack of information. Besides, in STEP, there are two different types of requirements: technical requirements, which are the requirements about the implementation of the standard, and domain requirements, which are the requirements about the environment in which the standard will be operated, for example, PMI, Mechanical and Electrical wire harness.

Additionally, the development of international standards includes many actors, from different countries and organizations. This diversity of stakeholders necessitates efficient tools to make it possible for all of the different actors to work together. Indeed, the stakeholders need to be able to understand the role and the activities of everyone on the project for a good collaboration. In the same way, it can be useful for all members of the WG to know who is working on what and what tasks still need to be done.

Requirements traceability is a roadmap that defines where in the standard development process each requirement was implemented. Traceability can also be used to assess the impact of requirements change and expose dependencies between the requirements. Indeed, on complex projects with multiple parts and different teams working on it like standard development, it can be pretty long and difficult to manually determine what part and who is affected by the change.

**Current Tool availability**

Requirements were traditionally captured in spreadsheets, but the growing importance of requirements management led to the development of dedicated requirements management and traceability tools.

Jira is very popular software in Agile projects. Jira is a tool specialized in bug tracking, issue tracking, and project management, including requirements management. However, tracking requirements will be really difficult with Jira, once they are completed. Indeed, Jira is a task management tool, it is not originally designed to manage requirements. When requirements are completed, they are taken off the backlog, so tracking the completed requirements can easily become a full-time job.

Modern Requirements is a solution that provides a collaborative requirements management platform. This software also offers requirements traceability and impact analysis. Besides, it can be easily integrated with bug issues tools like JIRA and backlog tools like Microsoft TFS.

ReqView is a requirements management tool that allows to capture structured requirements and trace these requirements between requirements elicitation, design, and tests.

**Future Research Needed**

As previously mentioned, SAFe provides methods to help teams in implementing Agile in their projects, including Backlog management and Agile Release Trains. SAFe also offers methods and processes for requirements management such as the SAFe Requirements Model and, Continuously Verify and Validate processes. The SAFe Requirements Model “provides a scalable model that demonstrates a way to express systems behaviors” (Scaled Agile Framework), like features, stories, and non-functional requirements. The Continuously Verify and Validate processes ensure “that the system works as designed and it meets the needs of the user” (Scaled Agile Framework), and these processes are supported by the Requirements Model. However, these are only conceptual model and processes, which means that you need tools to implement them.

Moreover, while SAFe provides guidelines to implement Agile principles and requirements management, there are still some practises that are missing and need to be integrated such as meetings’ minutes. In international standard development, the different actors are generally geographical dispersed, in different timezones, and working in different teams in parallel, making it challenging for the different actors to keep track of all ongoing activities and decisions made. By definition, meeting minutes record relevant, important, and critical topics and decisions discussed and agreed upon during the meetings. These notes, archived and distributed amongst the community, helps to ensure that every member of the development process knows what was discussed, decided, and agreed upon. These notes are a key communication and traceability tool in a distributed and collaborative environment, in order to keep people informed and integrated into the development process. The STEP development process is led by several international meetings such as the ISO TC184/SC4 or PDES workshops during which the different stakeholders meet face-to-face to discuss past, current, and future developments. These meetings are both held twice a year and STEP experts don’t necessarily attend all the international meetings. Due to the lack of minutes, a lot of information is repeated, and a lot of decisions are discussed again, which is a loss of time and resources for all the attendees. Taking minutes during these meetings and make them available to all the STEP community will create a better integration of the different attendees’ communities.

Furthermore, integrating Agile principles, requirements and even, minutes management into the standard development process require the use of multiples tools and technologies. Also, there are many different tools used to develop, implement, and maintain a standard. Working with all of these different tools and technologies means that the development team needs to ensure that these tools and technologies will all be able to work together. Indeed, there is no formal integration model to ensure perfect interoperability and integration between all of these technologies and tools. In the case of STEP, the tools integration situation is even more complex because STEP began to be developed decades ago and its range has expanded a lot over the past few years. With the continuous emergence of new technologies, the tools used for STEP development have changed since its creation. There are two types of integration to implement for STEP: on one hand, the integration between the old and the current technologies; on the other hand, the integration between the tools used to implement STEP and the Agile management tools. Regarding the first integration, some legacies data need to be migrated in the technologies currently used, and for the second, the tools chosen to implement the Agile method in the STEP development should be able to easily collaborate with the tools currently used.

Finally, the standard development process is not the same as usual IT projects process. Indeed, the development of a standard relies on the voluntary contribution of the members of the WG. The people and resources available vary, which makes the development process irregular. Besides, standard experts are geographically dispersed and with the time difference, everybody is working according to their time zones, which can make it difficult to adopt some of the Agile practices. Without a full-time development team, the Agile sprint can’t be as regular and intense as normal Agile projects sprints, which means that in the case of the standards development, there are challenges that we still need to work on to ensure that the Agile method can meet all their needs and constraints.