# Aligning Requirements and Testing - Working Together Towards the Same Goal!

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**THE TESTERS** ought to be a requirements engineer's closest ally. The tester is the one that verifies the product and ensures that it fulfills the requirements.  As such, the tester often instinctively reacts to unclear and unverifiable requirements, and can be an asset in the requirements work. Even so, these two tasks are mostly performed in isolation from each other. And, the people in these two roles are often unknown to each other especially in larger development projects.

Aligning requirements and testing (RET) is a significant challenge for many companies. Unfortunately, the effects of weak RET alignment are many, including late discovery of customer issues, need for re-work at a late stage in development, project delays and the potential loss of customers and market shares (Bjarnason EMSE).

A skilled requirements engineer might manage to capture the customer and end-user requirements through solid requirements engineering practices. But these intentions are often distorted as the requirements trickle downstream to development and test engineers. Similar to the Chinese whisper game, requirements are often misinterpreted and understood differently from what was originally intended.

Operating in a domain with fast changing requirements and short delivery cycles is another factor that exacerbates the difficulties of keeping RET aligned. One common approach to tackle these challenges is the agile practice of Test-Driven Development (TDD) - helping developers understand the requirements by writing early unit tests. While TDD certainly can be a good start to align RET, its developer-oriented approach is not the complete solution – TDD is also known to be difficult to implement for large systems (Causevic 2011).

Frequent communication is required to ensure that a project works towards the same goal and requirements. The development-near roles need to be connected to the business and requirements side of an organisation to ensure a continuous requirements communication. Simply "throwing requirements over the wall" is not sufficient to ensure a good end result and happy customers (see figure). Instead the requirements and testing activities need to be aligned throughout the development cycle for a smoother ride and to ensure that the product meets the customer's expectations.

Developers

Testers

Customer
requirements

Requirements
specfication

Happy
customer?
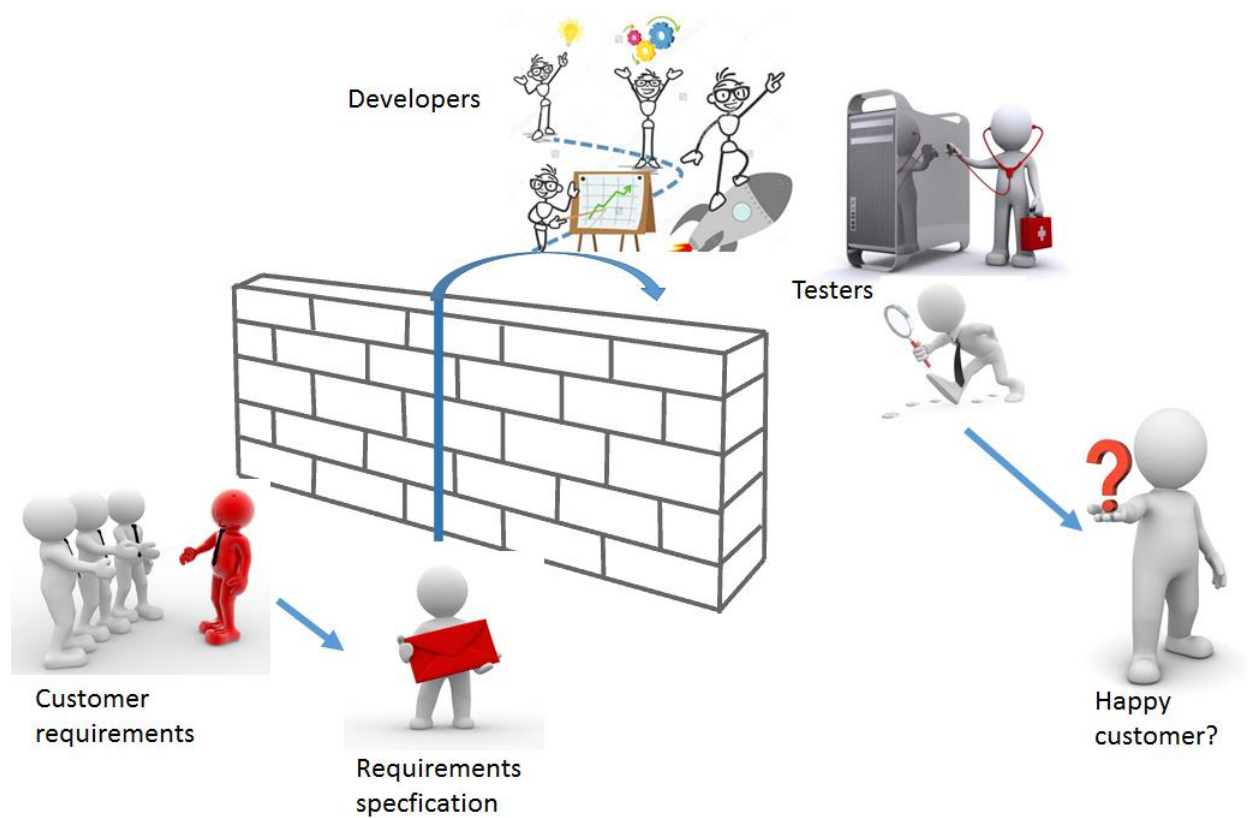
# RET Alignment

RET (Requirements Engineering and Testing) is a new research area that focuses on this problem of aligning requirements and test. The main aim is to support project coordination by improving the connection between requirements and testing activities. It is important to ensure that the project members have a uniform understanding of the requirements that flow through the loop of Customer-Requirements-Implementation-Testing activities. But, there is no one-fits-all solution! Each development organisation is different and requires a solution tailored to their specific needs and characteristics.

Size and development model are two major variation points that affect which practices to apply in order to align requirements and testing activities. The organisational side of a project also has a large impact on how to handle RET. For example, geographically distributed projects require more extensive artefact-oriented practices than small-scale and co-located ones. Finally, the regulations around safety-critical systems affect the return-of-investment into tracing and documentation for such projects, and thus also the motivation to implement alignment practices (Bjarnason EMSE).

We now illustrate these variations in project context by presenting three possible RET solutions that we have encountered in research or practice: using test cases as requirements, using actionable traces, and reducing distances. We outline an example scenario for each solution, and describe the RET-related challenges that these address.

# Test Cases as Requirements

The use of test cases as requirements is a common practice within agile development (Bjarnason IST). Agile projects often say: "we have no requirements", meaning that they do not use traditional requirements specifications. Instead requirements are invented during development and often documented as test cases - reducing the overhead of maintaining a separate requirements specification. The use of an active artefact in the shape of test cases as an executable specification helps keep the documentation up to date. However, in order to ensure that the right product is developed this practice relies heavily on good and continuous communication between customers and business roles, and the development-near roles including testers.

This kind of active customer involvement is a known challenge within agile development. The development-near roles often complain about lack of access to the customer and insufficient requirements information. Also the communication between business and development roles is challenged due to variations in perspectives and technical knowledge. The differences in terminology and "language" cause frustration and misunderstanding of the customer requirements and expectations on the product.

The use of a pre-defined structure and tool for expressing requirements closer to development artefacts can help to support the communication between customer and development. This approach enables evolving the customer-agreed requirements into test cases with a much reduced risk of distortion. Within behaviour-driven development, this is achieved by expressing goals as user stories and defining acceptance criteria that must be fulfilled for the customer to sign off on the implemented functionality. In this way, alignment is achieved through close and continuous collaboration between customer and development-near roles supported by a lean documentation process closely coupled to this collaboration and to the testing activities.

# Harvest the Trace Links

Another alignment solution is to use requirements-test trace information to support RET. In safety-critical projects, such traces must be maintained to provide evidence for safe operation - and safety certification. However, trace links should not simply rot in documents after the safety audits. They are hard currency in RET, formalizing how requirements and test cases go together. As such, they can be used as input to tools supporting test planning when requirements change, or to support change impact analysis - for artifacts on both sides of the RET perspective (Borg 2014).

Large projects traditionally involve much documentation, and managing a large document space is a common RET challenge (Bjarnason EMSE). Although the agile movement reflexively questions documents, for some projects the information overload remains an ever-present threat - without documentation there will be no certification. Furthermore, if the safety standards require an independent testing organization, then direct communication cannot be the key to RET alignment. In such a project context, artefact-oriented practices are needed.

Traceability is fundamental to safety-critical development. But the work is tedious and it might be hard for the developers to appreciate the effort. In a "tracing-heavy" organization it is important that the engineers perceive this task as beneficial - otherwise tracing will just be a tax to pay without any perceived benefits. By using the documented trace links to build accurate tool support, developers receive a direct value of the tracing effort. The increased cost-benefit balance of the tracing might motivate them to really keep the trace links up-to-date.

# Reducing Distances

The communication within the "whisper game" of requirements can be improved by shortening the distances between key players . For example, by bringing people physically closer together but also by bridging temporal and socio-cultural gaps.  This applies in particular to global software development (GSD) but also affects co-located development (Bjarnason REJ). Within GSD, frequent face-to-face meetings are recommended between distributed roles and teams preferably early in the projects to maximize the gain of the travel costs (Grechanik 2010). This establishes trust and "teamness" that facilitate both face-to-face and indirect communication via, e.g. video conferencing, e-mail. The communication with an offsite testing team can also be strengthened by assigning one team member as an information broker, and having this person stay at the main site for a period of time.

When direct communication is limited, the quality of the requirements specification and solid requirements engineering practices are very important. A clear and accurate requirements specification is vital when communicating with offshore testers. Another important aspect of aligning requirements and testing over distances is facilitating the findability of project information. Tools that support distributed work can be used for this. It is also important to define a strategy for knowledge management. What information is produced and used by whom and when, and where can it be found. Quick and concise access to documentation and project updates is essential - even more so when engineers don't meet at the coffee machine!

To conclude, coordinating requirements with an offshored (and distant) testing team is challenging. There is no cross-site luxury of rich interactions, real-time collaboration, and face-to-face meetings. Instead, there is a host of distances which make communication, coordination and control difficult. The geographical distances between requirements engineers and offshore testers is one major challenge. But, there are also other types of distances that affect this communication. For example, cognitive differences in knowledge, reasoning and priorities.

**T**esting is the activity that verifies that the final product meets the requirements. But how can we ensure that the testers verify against the right requirements? Achieving good alignment between requirements and testing is a balance between connecting people and connecting artefacts, and ensuring good coordination of these. The ideal balance between these communication channels varies and depends on the specifics of the development organisation and the product domain in which they operate. An awareness and consideration of the interplay between requirements and testing is vital in managing a successful project and in designing the

necessary communication channels between requirements engineers and testers. Our vision for the future includes an empirically-based body of knowledge within RET that can guide industry practice and support projects in achieving good alignment between requirements and testing.

# References

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