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T···

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Test Process Improvement using TMMi

by Erik van Veenendaal, Rob Hendriks, Jurian van de Laar and Bart Bouwers

Introduction

More and more organisations make efforts to improve their software development processes. The reference model that is most often used is the Capability Maturity Model Integration (CMMI). In this model practices that are related to verification and validation activities are described, but the level of detail is too limited from the viewpoint of the test professional. To fill this gap, the Test Maturity Model Integration (TMMi) has been developed by the TMMi Foundation [www.tmmifoundation.org], using the TMM framework as developed by the Illinois Institute of Technology as one of its major sources. The TMMi provides a structured approach for test process improvement. Testing as defined in the TMMi is applied in its broadest sense to encompass all software quality-related activities. Within Europe the number of companies using the TMMi is increasing.

Practical experiences are positive and show that the TMMi and its predecessor TMM support the process of establishing a more effective and efficient test process. Testing becomes a profession and a fully integrated part of the software development life cycle. Applying the TMMi maturity criteria will improve the testing process and has a positive impact on product quality, test engineering productivity, and test execution lead-time.

In this paper we give our recommendations on how to organize and execute a successful test improvement project, using the TMMi as a reference. We've gathered the practical do's, don'ts and examples that we consider to be the most important success factors, based on our own experience. For a complete description of the TMMi and its guidelines we refer to the web pages of the TMMi Foundation.

Overview of the TMMi maturity levels

Just like the CMMI staged representation, the TMMi has a staged architecture for process improvement. It contains levels that an organisation passes through as its testing process evolves from one with an ad-hoc and unmanaged nature to a mature and controlled process with defect prevention as its main objective. Achieving each level ensures that adequate improvements have been made as a foundation for the next stage. The internal structure of the TMMi contains testing practices that can be learned and applied systematically to support quality improvement in incremental steps. There are five levels in the TMMi that define a maturity hierarchy and an evolutionary path to test process improvement.

Each maturity level contains a comprehensible set of process areas. The process areas for maturity level 2 are shown in figure 1. Experience has shown that organisations are most successful when they focus their test process improvement efforts on a manageable number of process areas at a time. Because each maturity level forms a necessary foundation for the next level, the decision to skip a maturity level is usually counterproductive. On the other hand, test process improvement efforts should focus on the needs of the organisation in the context of its business environment.

(5) Optimisation
(process optimisation, defect prevention and control)

(4) Management and Measurement
(measuring, evaluation and advanced reviews)

(3) Integration
(organisation, training, life cycle, non-functional testing, peer reviews and life cycle)

(2) Managed
Test Policy and Strategy
Test Planning
Test Monitoring and Control
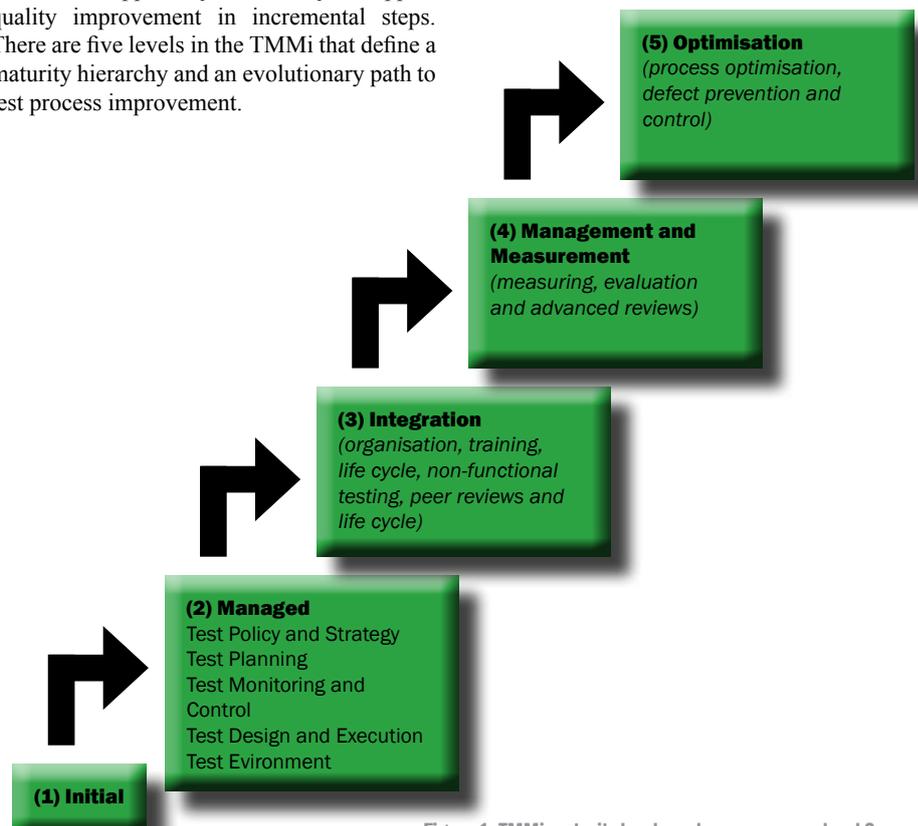Test Design and Execution
Test Evironment

(1) Initial

Figure 1: TMMi maturity levels and process areas level 2

It is possible that a process area at a higher maturity level may address the current needs of an organisation or project.

The TMMi improvement project

The TMMi is not just a theoretical model but a well-defined set of process areas and goals based on practical case studies. Although the model is quite easy to understand, implementing it in an organisation and thereby improving the test process is not always a straightforward task. On average it takes approximately two years to achieve TMM(i) level 2. To support organisations doing test process improvement, a number of recommendations are provided, based on our practical experiences. They have been major contributors towards success in a test process improvement project. A typical TMMi improvement project has the following phases:

- Initiation (determine goal and scope)
- Planning (define the project in terms of structure, resources, ownership)
- Implementation (developing the deliverables, like procedures and templates)
- Deployment (publication and roll-out of deliverables, institutionalisation)

INITIATION PHASE

Determine the current status

"If you don't know where you are, a map won't help." (Watts Humphrey). Before starting an improvement project it is necessary to know which maturity level the existing test processes have. Therefore the current situation has to be assessed. A formal assessment may not be required to determine the current status; a quick-scan is usually sufficient. A small group of people in the organisation is interviewed and the current set of documentation is collected and checked. The result is a report containing a current *maturity profile* (see figure 2 for an example) and *recommendations* for improvement. The report is presented to management and this is usually the basis for a TMMi improvement project.

Process Area	Score	Conclusion
Test policy & strategy	3.9	Not satisfied
Test planning	4.6	Not satisfied
Test monitoring	4.2	Not satisfied
Test design & execution	5.4	Partly satisfied
Test environment	6.6	Partly satisfied

Figure 2: TMMi Maturity Profile

Determine the goal

It is desirable to clearly define the goals of the improvement project. These goals should be directly related to the organisational business goals to enable management commitment. If you want to get people involved and committed, you will have to explain to them where the improvement efforts should lead. Adherence to the TMMi is not a goal in itself. The model can provide guidance and practices in achieving a higher maturity in testing. In the end, a mature testing process should contribute to the business goals of the organisation. Predictability, higher productivity, efficiency and effectiveness are examples of goals that an organisation may want to achieve with test improvement. The organisation itself will have to determine exactly which goals to strive for. For one of our customers we have developed a 'vision document' in which we described the envisioned future as an end goal of the improvement initiative. Creating such a document is important to reach a common understanding about the 'why' of the improvement project, to get commitment and to guide the improvement project along its way.

PLANNING PHASE

Organising the project team

A common problem is that improvement initiatives get insufficient attention and resources to really make a difference. We have seen very positive results when the project is organized around the quick scan's recommendations. Each recommendation is assigned to a *Recommendation Workgroup*. The workgroup implements the improvements and deploys them. Since the changes are to be deployed in test projects, each workgroup consists of representatives from all test projects. Each workgroup reports to the test improvement project manager, who in turn reports to the steering group. It is crucial that the steering group has members that will support the improvements and benefit from them. If no sufficient capacity is allocated to staff the improvement project team, and the team members are not enabled to spend time on improvement activities, then all resources will soon be occupied with their other daily operations instead of improving the process.

Communication

One of the most important parts of the improvement project is communication. Improving means introducing change. People will only change if they really understand why change is necessary, so inform them, continuously. People see their colleagues participating in the improvement project and want to know what is going on. They, as well as management, must be informed on a regular basis. Publishing periodic newsletters showing the progress and having regular department meetings are ways to do this. Another best practice is to involve these persons in reviews of the project's deliverables. In other words: share what you are doing to create a buy-in. You can document your approach in a communication plan, e.g. with a mind map.

Process ownership

With their knowledge and experience, external consultants can make a valuable contribution to an improvement testing project. Especially if they are allocated to the improvement project on a fulltime basis, they can really be the stimulators of process improvement in terms of effort and progress. In one project we experienced the difficulties of combining the responsibility for an improvement project with the role of test manager, especially when operational issues constantly demand attention. We also experienced the benefits of working in pairs: the external consultant teaming with the internal test manager. We discovered that with a good balance between process and project, the improvements were immediately embedded in the organisation. Inevitably the external consultant leaves, and then the organisation must be able to continue the improvements on its own. Therefore we recommend that the ownership of the improvement project and the test process is given to the internal staff, not to the consultant. A common pitfall of consultants 'driving' the improvement project is that they fail to adapt to the maturity level of their customer. Some organisations want to use their own strengths to achieve improvements: to what extent do they accept the involvement of an external consultant? It is difficult to achieve real commitment when the changes are (perceived to be) 'forced' from the outside. Make clear agreements on responsibilities, also for a consultant it is important to know what he is accountable for and what the scope of his involvement is.

Create stakeholders involvement

Not all stakeholders may be obvious at first sight. Therefore we recommend a stakeholder analysis at the beginning of the improvement project. The people whose participation or contributions we need are stakeholders, but also the people who should have a certain interest in our results. Management, or more specifically the sponsor or champion who supports the improvement project, evidently needs to be informed and involved. Also think about quality assurance, the owner of the quality system and those responsible for the test infrastructure. Other disciplines may be involved or affected as well, such as a tailored test training for developers.

The maturity of the development processes

It is important to not only look at test processes but also at the processes which testing is highly dependent on. Without mature supporting processes it will be very difficult or even impossible to improve the test process. Make sure that project management, configuration management, requirements management and risk management get enough attention in the organisation that you are improving. Lack of project management will cause test management to fail. If the organisation is not used to working on projects, it will be difficult to embed the testing activities in a structured way. When applying test design techniques it is recommended to have a set of requirements. Also changes in the requirements should be well managed and the test team should be notified. Finally, not having a configuration management system often results in defects that cannot be reproduced and defects reoccurring that were supposed to be solved. These types of problems can't be solved within the test process itself. Consider starting a separate improvement project for these supporting processes, or just don't start a test process im-

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provement project at all if the organisation is not ready for it.

Alignment with other improvement initiatives

Within organisations other improvement initiatives can be on-going, e.g. software process improvement based on the CMMI. Beware of the 'yet another initiative' syndrome! A department can only handle a certain amount of change at a time. This highly determines the change velocity. To prevent that duplicate activities are executed it is recommended to map how the test improvement activities contribute to other improvement activities and vice versa. This mapping should aid project managers in working with improved processes in their projects.

IMPLEMENTATION PHASE

During this phase all planned changes, typically based on the recommendations from a quick scan, are implemented. When possible, use existing processes and best practices as much as possible. Sometimes a thorough process is already common practice in the organisation; it just needs to be documented.

Although in practice probably all process areas of the applicable maturity level will have to be addressed, this paper will only focus on the process areas that are essential for making a good start. At maturity level 2 the test strategy and policy are the first and most important subjects that give direction to the entire improvement project. This is one of the strengths of the TMMi: its top-down approach that starts with the organisation's view on testing, and using this as the basis for further improvements. Metrics are important to measure the effect of the changes and drive further improvements.

Test policy

Within the TMMi the process area 'Test policy and strategy' requires that an organisation defines a test policy that states the organisation's view on testing. It answers questions like 'Why do we test?'; 'How important is quality?'; 'Are we time-driven or quality-driven?'. Typically the answers to these questions are related to the business goals or strategy of the organisation. The test policy is an important basis for (management) commitment to all the activities in the organisation related to quality and testing. In one of our improvement projects, for example, we derived the test policy directly from the so-called "One Page Development Strategy" that was already available and deployed at a higher organisational level. However, keep in mind that a test policy should be clear and concise. The business language that is typically used in mission statements and business strategies is often too abstract to clearly explain what testing is about. It is better to use testing terminology, e.g. by summarizing the main themes that have focus in the organisation, like 'risk based testing', 'test training' or specific (non-)functional quality characteristics, like reliability and usability.

Test strategy

A test policy is implemented in the organisation by a test strategy. The TMMi requires the definition of a test strategy for each programme in the organisation. This strategy provides clear insight into how the products are tested throughout their life cycle. It has to fit into the organisation's development process (e.g. RUP, RAD, V-model, DSDM). The strategy contains a definition of test levels and the organisational groups that execute them, the approach to regression testing, entry and exit criteria, and more. A sample strategy is shown in figure 3. Make sure that you create a strategy that is easy to explain to stakeholders, mainly your testers. The strategy must be aligned with the organisation's test policy.

	Unit testing	Integration testing	System testing	User acceptance testing
Objective	Unit meets its design. Ensure low level quality. Unit tests run automated for each build (regression test)	System is ready for system test: quick functional check. Integrated units meet interface specifications/global design/architecture.	System meets specification (FD). System does not show regression.	System meets specification (FD). System meets business requirements and expectations. System is "fit for use" in its business context. System does not show regression.
Responsible	Development	Development	System test team	Acceptance testers in business units
Entry criteria	Developers are challenged to write unit tests by TLs and Seniors, following a unit test strategy.	All unit tests pass.	FDs approved. All unit tests pass. No open defects with severity major or higher.	Requirements system tested. No open defects with severity major or higher.
Exit criteria	All unit tests pass (build does not fail).	All unit tests pass. Planned code reviews executed and rework done. No open defects with severity major or higher.	100% Test cases executed. No open defects with severity major or higher.	System meets acceptance criteria. No regression. Business approval for production deployment.
Techniques	Ad hoc testing.	Ad hoc testing / error guessing	Black box techniques. Error guessing.	Error guessing. Some black box techniques.
Tools	JUnit	Jira	HP Quality Center (Test Director + QTP) Jira	Jira

Figure 3: Sample test strategy for a V-model process.

Metrics

Measuring the progress and quality of testing as well as establishing performance indicators for the test process are important to monitor the status and to show the benefits of the improvement process. Think about metrics in the area of efficiency, effectiveness and deployment. A common pitfall is that a (too) large number of metrics is defined. As a result the collection of measurement data requires a lot of effort and we often see that the collected data is not used or analysed. Goal-Question-Metric (GQM) is a good method to define a useful set of measurements. With this method every metric is derived from a specific goal and implements a specific question from a stakeholder related to that goal. Thus a metric is only defined if there is a clearly related need for it. Keep metrics as simple as possible!

Documentation structure

In an early phase of the improvement project a document overview should be established. In one TMMi project the documents were initially delivered separately by different teams for their particular improvement action. When all individual documents came together it was obvious that an overall document, tying all parts together into one total procedure from the start to the end of the test process, was missing. Once this overall procedure had been developed, it became the starting point of a structure or hierarchy for all the other documents in

the quality system. By thinking about a solid structure for your documents at the beginning of your project, you can save a lot of time on reworking and restructuring later.

DEPLOYMENT PHASE

Accessibility of deliverables

Make sure that all documents, both procedures and templates, are easily accessible for all testers and other stakeholders. An intranet page is a very effective way to provide a clear, preferably graphical structure, allowing users to easily access and download the documents they need. In one project we depicted the documentation structure as a graphical presentation of a 'pyramid', with the overall process at the top, and all related and supporting documents, such as work instructions and templates in the basis. This test framework became a familiar artefact in the quality system and soon everybody recognized and used 'The Pyramid' on the intranet as the starting point in their search for a document or template.

The change process

Deployment is the most difficult and time consuming part of the improvement project. You can publish a procedure or template, but that doesn't mean that it will be immediately used by everyone. Often the problem in improvement projects is not the availability of documentation but the lack of adherence to the described way of working. To achieve a maturity level, at least 80% of the people in the organisation should work according the documented process. If existing procedures are not followed, try to solve the root cause first. Only when it's clear why current processes are not being followed is it worthwhile to change and enforce them.

The throughput time of the change process does not only depend on the amount of changes, but also on the organisation, its culture and the running development project(s). It may be wise to look for a suitable pilot project to see if the changes have the intended effects and if the procedures are really feasible in day-to-day practice. But such a pilot candidate must be available – preferably in one of its early stages – and willing to participate. Also in an ad-hoc culture, where local heroes have a large influence, changes leading to a more structured and disciplined way of working may not be directly embraced. When applying changes, be prepared for resistance. Don't change more than necessary, take small steps and communicate the changes as often as needed and in any way you can think of. An improvement project is not successful until it has been deployed by people motivated to improve.

We thank Richard Grooff for his contributions to the initial versions of this paper.

Biography

Erik van Veenendaal is the founder and director of Improve Quality Services BV. He is an internationally recognized testing expert with over 20 years of practical experience. He is the author of numerous papers and a number of books, including the best-sellers 'The Testing Practitioner', 'ISTQB Foundation' and 'Testing according to TMap'. Currently Erik is the vice-president of the ISTQB and the vice-chair for the TMMi Foundation. For his contribution to the testing profession he received the "European Testing Excellence Award" in December 2007.

Rob Hendriks has more than 12 years of experience in software quality, with great emphasis on software testing. The last few years he has been active as a senior consultant in projects for consumer electronics, professional technical systems and administrative systems. He regularly runs courses in the area of inspections and testing (ISEB Foundation and ISEB Practitioner accredited), and is specialised in the field of test design techniques. Currently he fulfils the role of operational manager within Improve Quality Services Ltd.

Jurian van de Laar has more than 13 years of experience in software engineering. As a senior consultant at Improve Quality Services, he is involved in several TMM/TMMI and CMMI improvement programs. He had a leading role in achieving TMM Level 2 at Philips Healthcare in 2007. Jurian is an accredited teacher of the ISTQB Foundation and ISEB Practitioner training. He is member of the Syllabus working party of the Belgium and Netherlands Testing Qualifications board.

Bart Bouwers is a Senior Test Consultant at Improve Quality Services. He has over 13 years of experience in software development and software testing, in several positions, in both technical automation and information systems domains. Bart is a certified ISEB Practitioner. Currently he is running a TMM Level 2 improvement project at a Dutch bank.