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Guidelines for Testing Maturity

Part 1: The TMM model

Erik van Veenendaal and Ron Swinkels of Improve Quality Services BV in the Netherlands are both involved in test process improvement projects at a number of industrial organizations. For the past year they have been using the Test Maturity Model (TMM) as their reference model. In a series of two papers the authors provide an overview of the model, its background and guidelines for achieving TMM level 2.

For the past decade, the software industry has put substantial effort in improving the quality of its products. This has been a difficult job, since the size and complexity of software increases rapidly while customers and users are becoming more demanding. Despite encouraging results with various quality improvement approaches, the software industry is still far from zero defects. To improve product quality, the software industry has focused on improving their development processes. A guideline that has been widely used to improve the development processes is the Capability Maturity Model. The Capability Maturity Model (CMM) is often regarded as the industry standard for software process improvement. Despite the fact that testing often accounts for 30-40% of the total project costs only limited attention is given to testing in the various SPI models such as the CMM. As an answer, the testing community has created its complementary improvement models. This paper focuses on the Test Maturity Model (TMM). TMM[SM1] is a model for test process improvement and positioned as being complementary to the CMM. The ISEB practitioner syllabus also identifies test process improvement as one of the key areas within the testing profession and identifies TMM as one of the major models.

History and background

The TMM framework has been developed by the Illinois Institute of Technology as a guideline for test process improvement and is positioned as a complementary model to the CMM (Brunstein *et al*, 1996a, 1996b). Just like the CMM, the TMM also uses the concept of maturity levels for process evaluation and improvement. Furthermore process areas, maturity goals and key practices are identified. For defining the maturity levels, the evolutionary testing model (Gelperin and Hetzel, 1988) has served as a starting point. The evolutionary testing model reflects the testing phases that an organisation will go through, from a debugging and detection oriented period to ultimately a prevention-oriented period. Furthermore, various industrial best-practices have contributed to the TMM development providing it with its necessary foundation and the needed level of practicality.

Whereas some models for test process improvement focus only on high-level testing or address only one aspect of structured testing, e.g. test organisation, the TMM addresses static *and* dynamic testing. With respect to dynamic testing both low-level and high-level testing are within the TMM scope. Studying the model more in detail one will learn that the model addresses all four cornerstones for structured testing (life cycle, techniques, infrastructure and organisation).

TMM overview

The structure of the TMM is partly based on the CMM and the staged version of its successor: the Capability Maturity Model-Integrated (CMM-I). This is a major benefit for organisations that are already familiar with the CMM(I). The TMM consists of 5 maturity levels that reflect a degree of

[1] TMM is a servicemark of the Ilinois Institute of Technology

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test process maturity. For each maturity level, a number of process areas are defined. A process area is a cluster of related activities within the test process, e.g. test planning or test training. When these activities are performed adequately, they will contribute to an improved test process. The five levels of the TMM will support an organisation to determine the maturity of its test process and to identify the next improvement steps that are necessary to achieve a higher level of test maturity.

The five maturity levels and related process areas of the TMM are (figure 1):

- Level 1: Initial
  No process areas are identified at this level
- Level 2: Definition
  Process areas: Test Policy and Goals, Test Planning, Test Techniques and Methods and Test Environment
- Level 3: Integration
  Process areas: Test Organisation, Test Training Program, Test Life Cycle and Integration, and Control and Monitor
- Level 4: Management and Measurement
  Process areas: Peer Reviews, Test Measurement and Software Quality Evaluation
- Level 5: Optimisation
  Process areas: Defect Prevention, Quality Control and Test Process Optimisation

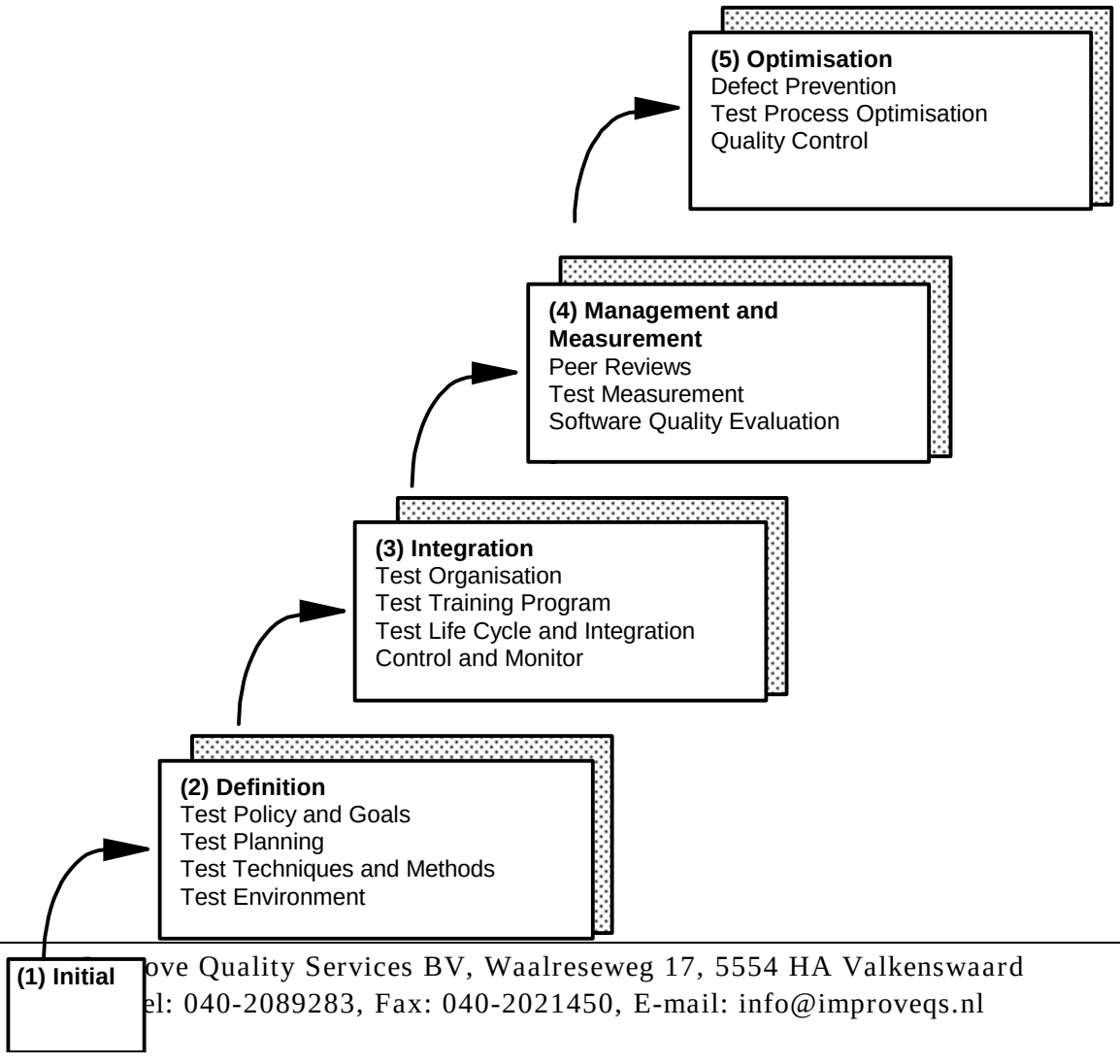

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Figure 1: TMM maturity levels and process areas

Maturity Levels

As can be seen in figure 1, the TMM consists of five maturity levels. In this paragraph, the maturity levels are characterised.

The five maturity levels show an evolution from a chaotic, undefined test process to a controlled and optimised test process and largely reflect the five evolutionary periods that are described by Gelperin and Hetzel. TMM level 1 is related to the "debugging-oriented" period, level 2 to the "demonstration-" and "destruction-oriented" periods, level 3 to the phase "evaluation-oriented" and level 4 and 5 to the "evaluation-" and "prevention-oriented" periods. The five maturity levels are also strongly related to the CMM levels. In fact in many cases, a given TMM level needs specific support from key process areas in its corresponding CMM level and the CMM level beneath it. An overview of support from the CMM level required for the TMM level achievement is shown in table 1 (Suwannasart, 1996).

TMM	CMM	Supporting CMM Key Process Areas
2	2	Requirements Management, Software Project Planning, Software Configuration Management
3	2	Software Project Tracking and Oversight, Software Quality Assurance
3	3	Organisation Process Focus, Organisation Process Definition, Training Program
4	3	Intergroup coordination, Peer Reviews
4	4	Quantitative Process Management, Software Quality Management
5	5	Defect Prevention, Technology Change Management, Process Change Management

Table 1: Support for TMM maturity levels from CMM key process areas

Level 1: Initial

At level 1, testing is a chaotic, undefined process and is considered as a part of debugging. The objective of testing at this level is to show that the software runs without major failures. Software products are released without adequate visibility regarding the quality and risks. In the field, the software does not often fulfil needs, is not stable, or is too slow to work with. Within the test project there is a lack of resources, tools and well-educated testers. There are no process areas at this level.

Level 2: Definition

At level 2, testing is a defined process and is clearly separated from debugging. In the context of structuring the test process, test plans are established containing a test strategy. For deriving and selecting test cases from requirement specifications, formal test design techniques are applied. However, testing still starts relatively late in the development life cycle, e.g. during the design or even during the coding phase. The main objective of testing is to verify that the software satisfies the specified requirements.

Process areas at level 2 are:

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- Test Policy and Goals
- Test Planning
- Test Techniques and Methods
- Test Environment

Level 3: Integration
At level 3, testing is fully integrated in the software life cycle. It is recognised at all levels of the V-model. Test planning is done at an early project stage by means of a master test plan. The test strategy is determined using risk management techniques and is based on documented requirements. A test organisation exists, as well as a test training program and testing is perceived as being a profession. Reviews are carried out, although not consistently and not according to a documented procedure. In addition, to verify that the software satisfies the requirements, testing is very much focused towards invalid testing.

Process areas at level 3 are:
- Test Organisation
- Test Training Program
- Test Life Cycle and Integration
- Control and Monitor

Level 4: Management and Measurement
Testing is a thoroughly defined, well-founded and measurable process. Reviews and inspection are taking place throughout the software life cycle and are considered to be part of testing. Software products are evaluated using quality criteria for quality characteristics such as reliability, usability and maintainability. Test cases are gathered, stored and managed in a central database for re-use and regression testing. A test measurement program provides information and visibility regarding the test process and product quality. Testing is perceived as evaluation; it consists of all life cycle activities concerned with checking software and software-related work products.

Process areas at level 4 are:
- Peer Reviews
- Test Measurement
- Software Quality Evaluation

Level 5: Optimisation
On the basis of all results that have been achieved by fulfilling all the improvement goals of the previous levels, testing is now a completely defined process and one is capable of controlling the costs and the testing effectiveness. At level 5 the methods and techniques are optimised and there is a continuous focus on test process improvement. Amongst others "Defect Prevention" and "Quality Control" are introduced as process areas. The test process is characterised by sampling based quality measurements. A procedure exists for selecting and evaluating test tools. Tools support the test process as much as possible during test design, test execution, regression testing, test case management etc. Testing is a process with the objective to prevent defects.

Process areas at level 5 are:
- Defect Prevention
- Quality Control
- Test Process Optimisation

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Conclusion

Software systems play an increasingly important role in the society, making it necessary to link quality both to the process and the product. TMM is focused on the test process as a complementary model to CMM. It has been developed to support software organisations at evaluating and improving their test process. Within the TMM, testing evolves from a chaotic, ill-defined process with a lack of resources, tools and well-educated testers to a mature and controlled process that has defect prevention as its main objective.

Practical experiences are positive and show that TMM supports the process of getting a more effective and efficient test process. Testing becomes a profession and a fully integrated part of the software development process. The focus will change from defect detection to defect prevention.

Literature

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