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# QUALITY MATTERS

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# ACHIEVING TMMI LEVEL 3 – A CHINESE CASE STUDY

*This paper takes the reader on a journey achieving TMMi level 3. The test center of Rural Credit Cooperatives of Yunnan Province, a company with over 23.000 employees based in China, recently became a TMMi level 3 certified organization. The context, background and business drivers to the test improvement initiative are explained. Subsequently, the priorities set and achievements are discussed. Finally, the major benefits that were identified, after deployment and applying the improvements in over 80 projects during the review and evaluation phase of the test improvement project, are described.*

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## Test Maturity Model integration (TMMi)

The TMMi framework has been developed by the TMMi Foundation as a guideline and reference framework for test process improvement, addressing those issues important to test managers, test engineers, developers and software quality professionals. Testing as defined within TMMi in its broadest sense to encompass all software product quality-related activities. With TMMi, organizations can have their test processes objectively evaluated by certified assessors, improve their test processes, and even have their test processes and organization formally accredited if it complies with the requirements. TMMi has a staged architecture for process improvement. It contains stages or levels through which an organization passes as its testing process evolves from one that is ad hoc and unmanaged to one that is managed, defined, measured, and optimized. Achieving each stage ensures that all goals of that stage have been achieved and the improvements form the foundation for the next stage. There are five levels in TMMi that prescribe the maturity hierarchy and the evolutionary path to test process improvement. The process areas for each maturity level of TMMi are shown in Fig. 1. TMMi is freely available on the web site of the TMMi Foundation ([www.tmmi.org](http://www.tmmi.org)). The model has, among others, been translated into Chinese. TMMi is also available in published book format [1], [2]. Indeed, both books are also available in Chinese.

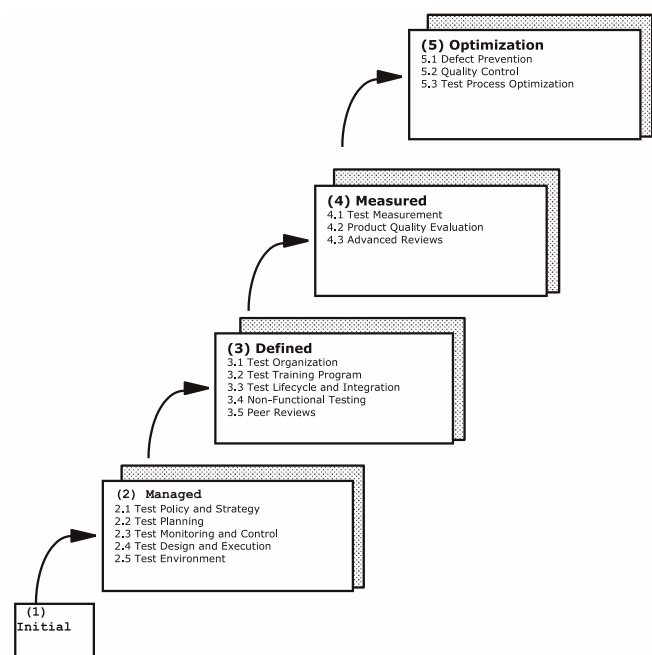
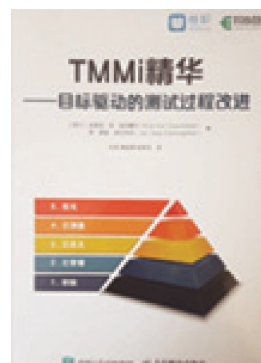


Fig. 1: TMMi maturity levels and process areas

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## Rural Credit Cooperatives of Yunnan Province (YNRCC)

In 2005 Rural Credit Cooperatives of Yunnan Province (hereinafter referred YNRCC) was formally established, which opened a new era of reform and development of rural credit cooperatives of Yunnan province. To support the organization a science and technology center was set up which today also includes an independent software testing department. The test department aims to contribute to the quality of software products throughout the software development life cycle. It is responsible for executing two defined test levels: software integration test and software acceptance test. The major responsibilities of the test center are:

- To define and maintain a test policy and test processes
- To build a professional test team, e.g., via both internal and external training
- To establish and execute test plans, and ensure an on-time completion of the test activities
- Be responsible for the Credit Cooperative testing related activities outside project scope, such as test tool selection and implementation, test platform building and test outsourcing (suppliers' selection and management)
- To provide services to front end business operation people, e.g., maintain acceptance test environment, providing training and coaching

## Background

In the financial industry the core processes of a company are highly dependent on software. Software products of a high level of quality to manage, run, execute and support daily financial processes 24/7 are not optional. In fact software quality is essential and mandatory for companies in the financial sector, e.g., bank and insurance companies. Business success nowadays depends



Fig. 2: Project Mgt. Triangle

largely on the ability to deliver and deploy software quality products. Delivery with high quality and high efficiency has become one of the most important competitive edge for banks. This is also true for the market in which YRNNC operates and indeed was one of the main drivers for the TMMi level 3 project.

Although this seems like a straightforward objective, in practice this is often challenging since not only does the business require software products of high quality, they also need to be delivered and deployed "tomorrow". Time-to-market is another critical driver in highly competitive (international) markets. Product quality and time-to-market are in fact each others' enemy, and trade-offs are necessary. This is the problem all IT and testing departments have been facing for many years, but today this is even more of a problem. In fact this goes back to the project management triangle (Fig. 2), a model of the constraints of project management. It contends that:

- The quality of work is constrained by the project's budget, deadlines and scope (features).
- The project manager can trade between constraints.
- Changes in one constraint necessitate changes in others to compensate or quality will suffer.

To enhance the capability of the organization CMMI was introduced in 2012 at YNRCC. YNRCC achieved CMMI level 3 with positive results and some basic improvements in the area of software quality. However, due to a lack of attention within the CMMI on test practices, a key part of quality control, it was decided that the software test process was not yet at an adequate level to contribute sufficiently to high quality software products. Some of the remaining weaknesses in the organization were:

- Lack of testing guidelines for different types of test projects
- Misunderstanding of the test processes and hard to use templates
- Long test execution phase at the end of the projects on the critical delivery path
- A lot of time needed to setup test environments and low efficiency
- Problems with knowledge transfer and knowledge drain when test personnel left



- Test metrics not systematically gathered and insufficient to support decision making
- Challenge of how to select and manage outsourcing
- Challenge of how to set up a test measurement system
- Test tools, test management tools and project management tools not integrated.

As a result of the above a five-year plan (2017–2021) was developed, in which a vision for test process improvement was defined. The plan provided starting points, policies and clear objectives regarding test organization, test system, test strategy, test method, test assets, test team and test tools.

## Priorities

In any improvement process, do not just follow a model but define a clear and limited set of priorities. Exactly this also took place within YRNCC. Nine priorities, called focus points, were identified derived from the objectives defined in the improvement plan. You can also quite easily observe a cross-reference from these nine focus points to the earlier mentioned weaknesses of YRNCC.

1. **Test Management System** – build a test management system based on TMMi in line with the actual banking environment.
2. **Devops Platform** – Based on virtualization technology, the software and hardware resources of different architectures are to be integrated to build a unified development and test cloud platform.
3. **Professional Test Team** – a professional testing team with echelon structure is built by combining core staff, front-end bank teller and outsourcing staff.
4. **Test Strategy and Method** – Build test strategy and test method based on W model and risk control (risk-based testing).
5. **Test tools and Platform** – Gradually introduce appropriate testing tools and build a unified software testing tool platform through end-to-end integration of various tools.
6. **Test Asset Library** – Gather test assets and best practices to establish an organization-level test asset library.
7. **Quality Measurement System** – Build a software quality measurement system based on software quality models (e.g., SQuaRE [3]).
8. **Comprehensive Test Capabilities** – Integrate resources such as system, team, environment, tools, methods, assets and measurement system to improve comprehensive testing capabilities.
9. **Continuous Improvement Mechanism** Establish a continuously optimized software testing process improvement mechanism using IDEAL [4].

For each of the nine focus points, implementation key points, implementation roadmap and an implementation approach were defined. A three-year plan and schedule was defined with various milestones, with achieving TMMi level 3 as the last milestone in the plan.

## Achievements

With the clear needs, objectives and priorities, the test improvement project was carried out as an iterative incremental project based on the IDEAL model. Through the project Supported by IDEAL model to carry out software quality continuous improvement based project data, deviations were analyzed and improvement opportunities were identified. The manager of the test department was also the lead of the TEPG group and all the test project team members, external test process improvement consultants and other department stakeholders were involved at different stages of the implementation project. This of course had two main advantages, it ensured the improvement project delivered practical and usable results, and also it strengthened the commitment of all those involved. Some of the major achievements are briefly described hereafter.

### Test Management System

Based on the results of the gap analysis, setting up and deploying a test management system was an important improvement area. A test management system needed to be defined to enhance both the efficiency and effectiveness of testing in the organization and to be less people dependent. The test management system needed to support testers in being able to do a better job. When setting up a test management system it's important to start with a process architecture otherwise there will be policies, processes and templates without a clear overall structure and not being coherent. The structure of the TMMi and its process areas were used to provide this process architecture. It also helped that the TMMi model has the same structure as the CMMI, which was already a familiar model for the organization. It total a three layer test process architecture (see Fig. 3) was set-up consisting of 4 test policies, processes, 12 consistent guidelines and 18 easy to use templates were established and/or updated, and subsequently deployed. In total all 13 test process areas of the TMMi, up to and including TMMi level 4, were covered by the test management system.



Fig. 3: Three-layer process architecture

### Secure and Flexible Development and Test Cloud Platform

Based on OpenStack and SDN technology, a centralized and unified hardware management system was implemented with automatic software installation and deployment, automatic environment installation and deployment and application service templates. This led to the following major effects and benefits.

No.	Major Effects	Explanation
1	Shorten development and test resources delivery lead time	The lead-time was cut short from originally 1 week (manually) to 2/3 hours (automated).
2	Enhanced security control throughout the entire processes	Strict management and control of the data and components in the test environment was enforced.
3	Testing as a Service (TaaS)	Supported one-click automatic delivery of test resources based on specified requirements.

Table 1: Benefits of Development and Test Cloud Platform

### Professional Test Team

A professional testing team with echelon structure was built by combining core testing staff, front-end bank teller and outsourcing staff. The organization structure for the test organization was defined, including tasks and responsibilities, and implemented. Test functions were identified, job description developed and test career paths established. As part of this action item employees were trained and certified as appropriately, e.g., Advanced Engineering of Computer Science, TMMi Professional, Devops Matters and ISTQB Foundation in Software Testing.

### Risk based Test Strategy and Test Approach

A risk analysis method was selected and introduced in the organization. It was built around eight software quality characteristics that are considered to be core for YRCNN for which every project had to decide on which ones to test and to what extent. These eight quality characteristics are functionality, availability, installability, usability, efficiency, compatibility, and security. In addition, risk management was integrated into the whole test processes, including test planning, test analysis and design, test implementation and execution, test monitoring and control and test report.

### Test Asset Library

To facilitate easy access and re-use of testware, a cross-organizational test asset library was created, supported by test asset management and usage guidelines. The test assets were classified as either an organizational or project level asset. To enhance the value of the test asset library, a new asset library of best practices was added. This new initiative followed the test improvement manifesto statement "Best Practices over Templates" [6]. Templates are great, but it is even better to provide examples of how they should be used. What provides more support, a test plan template or three test plan best practices? Testers will choose the latter. When doing test process improvement, it's important to also focus on getting a library of best practices set up as soon as possible.

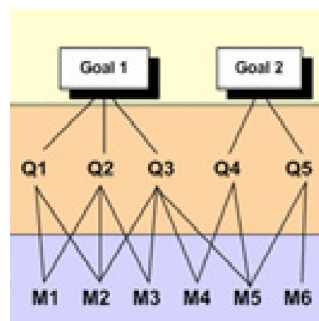


Fig. 4: GQM model

### Software Quality Measurement System

Using the SQuARE (System and Software Quality Requirements and Evaluation) model, which today has evolved into the ISO/IEC 25000 series, a framework for the evaluation of software product quality was created. To ensure metrics were gathered that have added value and to create a focus in the measurement system, the Goal-Question-Metric (GQM) method (see Fig. 4) was used. Using the TMMi level 4-process area Test Measurement to bring it all together, finally 67 quantitative and qualitative metrics were identified, defined, deployed and today used.

### Reviews and Evaluation

The improvements were implemented in more than 80 projects, 28,000 test cases were developed and 3,500 defects were detected. 100% of high severity level defects were found and fixed. A large retrospective meeting was held with both internal and external stakeholders. The following major benefits were identified during a review and evaluation phase:

#### 1. Standardized software test processes throughout the organization

Building the standardized test management system, achieving monitoring and control of the test processes, and ensuring test tasks are being performed coherently has shown to improve the test efficiency.

#### 2. Enhanced software test capabilities

Via internal and external training, deployment of a risk-based test strategy and the corresponding approaches, the capabilities of the test organization and team were improved in many ways.

#### 3. Enhanced software product quality

Via continuous test process improvement and monitoring software quality during the software development lifecycle, the software delivery quality has improved.

#### 4. Increased the customer satisfaction rate

Customer satisfaction rate is increased due to the improved levels of software quality, service efficiency and quality increased in the way of working in general.

#### 5. Enhanced finance service capabilities

Via shortening the delivery time, meeting the business needs and outcomes much better in a continuous development environment, the finance service capabilities were enhanced.

