Bruk av modenhetsmodeller under programvareutvikling, er det nøkkelen til suskess?

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Malte Foegen worked for IBM Germany for several years. There he participated in the development of the IBM Method for IT projects and he was project manager of the international project for the deployment of this software life-cycle model in IBM projects.

Today Malte is member of the board of directors of wibas GmbH in Germany and responsible for the software process improvement division.

He is a member of the ISO 15504 working group and frequently leads both SPICE and CMMI assessments for our customers.

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Jürgen Richter worked for more than 14 years for IBM Germany in the division of SW quality assurance and test. He gained in-depth experience as a test manager in numerous customer projects.

As a core member of the „IBM Quality and Test Competence Center“ he played a significant role in the standardization of SW testing in IBMs customer projects.

In spring of 2003 Jürgen moved to Oslo with his Norwegian wife and since then he has been supporting customers in their CMMI software process improvement projects.
<table>
<thead>
<tr>
<th></th>
<th>Quality Models</th>
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<tbody>
<tr>
<td>2</td>
<td>SW-CMM</td>
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<td>3</td>
<td>ISO 15504:2004 / SPICE</td>
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<td>5</td>
<td>SPI in Practice</td>
</tr>
<tr>
<td>6</td>
<td>Summary</td>
</tr>
</tbody>
</table>
Quality models support the acquisition, the development and the marketing of software.

For the acquisition of external development services:
- Objectively evaluate the current and future capability of your suppliers

For software engineering:
- Objectively evaluate your own current and possible software development capabilities
- Identify and prioritize the activities in order to improve your software development
- Checklist / 'roadmap' for the execution of software process improvement activities

For marketing of your development services:
- Presentation of your capabilities
- Competitive advantage

Evaluation and Certification of the software development based on standardized and objective criteria.
Develop own vs. Use best practices

Overview

Quality Models
CMM, ISO...

Methods
RUP, XP, ...

Project

“The common cause of all troubled projects is, that these teams don’t use the existing best practices.”

IBM Quality Assurance, Analysis of troubled projects

Reduction of project risks

Reduction of project costs
Use best practices – and change the organization

- Quality Models
  - CMM, ISO...

- Culture
- Organization
- Skills & Abilities

- Method
- Technology
- Measurements

- Project
- Reduction of project risks

- Project

- Project
- Reduction of project costs

- Exchangeable people and work products

- Understanding of management, QA, etc.
ISO 15504 and CMMI set the scope for the software development within a ISO 9001 scope

In order to be ISO 9001 compliant in the IT department, either ISO 15504 or CMMI Level 3 must be fulfilled.

‘BASEL II’ makes the risks of development projects relevant for equity.
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</table>
SW-CMM was developed by the Software Engineering Institute (SEI) of the Carnegie Mellon University.

SW-CMM defines a set of proven practices which are typically found in mature software organizations. They are a Checklist for „Where are we?“ and „What should we improve?“

SW-CMM was initiated by the Department of Defense, with the goal to obtain control of the quality of their software suppliers.

SW-CMM defines 5 maturity levels. These indicate how structured the software development is being performed.

SW-CMM supports the organization in improving the quality and the success of projects.
The benefit of CMM: Improvement of processes, improvement of estimations, reduction of costs.

<table>
<thead>
<tr>
<th>Level</th>
<th>Structure of project</th>
<th>Benefit</th>
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<tbody>
<tr>
<td>5</td>
<td><img src="image1" alt="Diagram" /></td>
<td><img src="image2" alt="Graph" /></td>
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<td>4</td>
<td><img src="image3" alt="Diagram" /></td>
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<td>1</td>
<td><img src="image9" alt="Diagram" /></td>
<td><img src="image10" alt="Graph" /></td>
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</table>
A project on level 1 is ad hoc and chaotic

1 Initial

On level 1 the software process is a “black box”. The software development is chaotic. There are no standards for planning and controlling of projects. Success in these organizations depends on the competence, motivation and heroics of the people in the organization and not on the use of proven processes.
A project on level 2 is **repeatable** and uses **milestones**

Projects in **level 2** organizations have **installed basic project management controls**, like planning, monitoring and control of time, costs, functionality and quality. The software process consists of a series of „black boxes“ with defined milestones (checkpoints).
A project on level 3 is defined.

3 Defined software process

On level 3 a standard software process is documented and implemented across the organization. The internal structure of the „boxes“ are now visible. Managers and team members understand their roles and responsibilities within the processes.
An organization on level 4 manages the software development.

4. managed software process

On level 4 the organization sets quantitative quality goals for both software products and processes. The software process is predictable because the process is measured and operates within measurable limits. With this management has an objective basis for decisions.
An organization on level 5 continuously improves its software process.

5 Software process is optimized

On level 5 an organization has the means to identify weaknesses and strengthen the process proactively. They are continuously striving to improve the range of their process capability, thereby improving the process performance of their projects.
By implementing software process improvement based on CMM, organizations have achieved a „Return on Investment“ of 1:5.

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>Productivity growth (per year)</td>
<td>35 %</td>
</tr>
<tr>
<td>Increase of early defect detection (per year)</td>
<td>22 %</td>
</tr>
<tr>
<td>Reduction of time-to-market of a product</td>
<td>19 %</td>
</tr>
<tr>
<td>Reduction of field defects (per year)</td>
<td>39 %</td>
</tr>
<tr>
<td><strong>Return on Investment</strong></td>
<td><strong>5.0</strong></td>
</tr>
</tbody>
</table>

From: “Benefits of CMM-Based Software Process Improvement”, Software Engineering Institute
Average of 13 organizations, using SW-CMM
The transition from one level to the next takes on average about 2 years.

A significant reduction of that time can be achieved by using existing experience and assets.

Average time used to reach the next maturity level in organizations, that have started their software process improvement in 1992 or later.

From: Software Engineering Institute, Process Maturity Profile of the SW Community, August 2002
CMM Integration – CMMI – was released as the new CMM version.

SW-CMM development will not be continued.

SW-CMM „Sun setting“

- „SEI will not develop and release any enhancements to the SW-CMM model or to any SW-CMM training."

- „The new assessment model SCAMPI$^\text{SM}$ V1.1 was released by the SEI to replace CBA IPI and SCE$^\text{SM}$ as standard for assessments or evaluations. The SEI will not release any enhancements to CBA IPI and SCE methods."

- „Data of SEI-authorized assessments, based on the SW-CMM, will still be accepted."

From the SEI website http://www.sei.cmu.edu/cmmi/adoption/sunset.html
<table>
<thead>
<tr>
<th></th>
<th>Quality Models</th>
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<tr>
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<tr>
<td>6</td>
<td>Summary</td>
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</tbody>
</table>
ISO 15504 / SPICE: the international standard for process reference models and assessments

- In June of 1993 a project with a mandate by the Joint Technical Committee JTC1 of ISO and IEC was started.
- The first draft of the standard was published in 1998 as a technical report.
- The final publication of the standard is expected in 2004. The standard differs significantly from the first draft (technical report). Information given will refer to the new standard 15504:2004.
- ISO 15504:2004 contains the methodology and structure to perform assessments of system development processes.
The main innovations of ISO 15504 in comparison to CMM: Capability level of single processes and not maturity levels of the whole organization.

The elements:

- A set of processes (e.g. ISO/IEC 12207 for software development)
- An evaluation of the capability level of each process, independent of other processes.

List of processes

<table>
<thead>
<tr>
<th>Process (examples)</th>
<th>Capability levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENG.1 (Requirements)</td>
<td>0 1 2 3 4 5</td>
</tr>
<tr>
<td>CUS.1 (Acquisition Prep.)</td>
<td></td>
</tr>
<tr>
<td>SUP.1 (Documentation)</td>
<td></td>
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<tr>
<td>SUP.7 (Audit)</td>
<td></td>
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<tr>
<td>etc.</td>
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</tbody>
</table>

For each process the level of implementation in the software organization will be assessed.
The processes of SPICE (ISO 15504 Part 5)

(in reference to ISO 12207 AMD 1)

<table>
<thead>
<tr>
<th>PRIMARY Life Cycle Processes</th>
<th>ORGANIZATIONAL Life Cycle Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Acquisition Group</td>
<td>1. Management Group</td>
</tr>
<tr>
<td>1.1 Acquisition preparation</td>
<td>1.1 Organizational alignment</td>
</tr>
<tr>
<td>1.2 Supplier selection</td>
<td>1.2 Organization management</td>
</tr>
<tr>
<td>1.3 Supplier monitoring</td>
<td>1.3 Project management</td>
</tr>
<tr>
<td>1.4 Customer acceptance</td>
<td>1.4 Quality Management</td>
</tr>
<tr>
<td>2. Supply Group</td>
<td>1.5 Risk Management</td>
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<tr>
<td>2.1 Supplier tendering</td>
<td>1.6 Measurement</td>
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<tr>
<td>2.2 Contract agreement</td>
<td></td>
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<tr>
<td>2.3 Software release</td>
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<tr>
<td>2.4 Software acceptance</td>
<td></td>
</tr>
<tr>
<td>3.1 Requirement elicitation</td>
<td>3.1 Process establishment</td>
</tr>
<tr>
<td>3.2 System requirement analysis</td>
<td></td>
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<tr>
<td>3.3 System architectural design</td>
<td></td>
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<tr>
<td>3.4 Software requirement analysis</td>
<td></td>
</tr>
<tr>
<td>3.5 Software design</td>
<td>3.2 Process assessment</td>
</tr>
<tr>
<td>3.6 Software construction</td>
<td>3.3 Process improvement</td>
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<tr>
<td>3.7 Software integration</td>
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<tr>
<td>3.8 Software testing</td>
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<tr>
<td>3.9 Software installation</td>
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<tr>
<td>3.10 System integration</td>
<td></td>
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<tr>
<td>3.11 System testing</td>
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<tr>
<td>3.12 System &amp; software maintenance</td>
<td></td>
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<tr>
<td>4.1 Operational use</td>
<td>3.1 Human resource management</td>
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<tr>
<td>4.2 Customer support</td>
<td>3.2 Training</td>
</tr>
<tr>
<td>1. Configuration control Group</td>
<td></td>
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<tr>
<td>1.1 Documentation Mgt.</td>
<td>3.3 Knowledge management</td>
</tr>
<tr>
<td>1.2 Configuration Management (adj.)</td>
<td></td>
</tr>
<tr>
<td>1.3 Problem Mgt. (adj.)</td>
<td>3.4 Infrastructure</td>
</tr>
<tr>
<td>1.4 Change Request Mgt. (Adj.)</td>
<td></td>
</tr>
<tr>
<td>2 Quality Assurance Group</td>
<td>4. Reuse Group</td>
</tr>
<tr>
<td>2.1 Quality assurance</td>
<td>4.1 Asset management</td>
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<tr>
<td>2.2 Verification</td>
<td>4.2 Reuse program management</td>
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<tr>
<td>2.3 Validation</td>
<td>4.3 Domain engineering</td>
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<tr>
<td>3 Product Quality Group</td>
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<tr>
<td>3.1 Usability</td>
<td></td>
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<tr>
<td>3.2 Product Evaluation</td>
<td></td>
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</tbody>
</table>

SPICE

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The evaluation of the capability level of a process based on compliancy to 9 attributes.

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Achievement of the attribute</th>
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</thead>
<tbody>
<tr>
<td>Execution of processes</td>
<td>1</td>
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<tr>
<td>Management of processes</td>
<td>2</td>
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<tr>
<td>Management of products</td>
<td></td>
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<tr>
<td>Definition of processes</td>
<td>3</td>
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<tr>
<td>Distribution of processes</td>
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<tr>
<td>Measurements of processes</td>
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<tr>
<td>Control of processes</td>
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<tr>
<td>Process-Innovations</td>
<td>5</td>
</tr>
<tr>
<td>Optimization of processes</td>
<td>5</td>
</tr>
</tbody>
</table>

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The parts of ISO 15504 – and referenced Standards

ISO 15504:2004

Part 1 (normative)
Concepts and Vocabulary

Part 2 (normative)
Performing an assessment

Part 4
Guidance on use of process improvement and process capability determination

Part 3
Guide on performing an assessment

Part 5
An exemplary assessment model (SPICE)

ISO 12207 AMD 1
Software Engineering – Software life cycle processes

ISO 12288:2002
System Engineering – System life cycle processes

ISO 9001:2000
Quality Management Systems

ISO 9000:2000
Quality Management Systems - Vocabulary

Possible process definitions

Mandatory for SW development

Similar basic understanding
Dependency of Standards

- ISO 9000:2000
- ISO 9001:2000
  - ISO 9000:2000-1 Vocabulary
  - ISO 9000:2000-3 Interpretation for IT

Guidelines and Instructions for execution of assessments

- ISO 15504:2004
- SPICE 15504-5
- or SCAMPI

Possible assessment model for

Processes of 12207 mean implementation of 9001 in IT

Uses vocabulary

ISO 12207 AMD 1
- or CMMI

Model for IT-Life-cycle processes

Used processes

Copyright © 2003 wibas GmbH IT Maturity Services
1. Quality Models
2. SW-CMM
3. ISO 15504:2004 / SPICE
4. CMMI
5. SPI in Practice
6. Summary
CMM Integration (CMMI) is the new version of SW-CMM.

- The different CMM Models such as „System CMM“ and Software CMM were integrated.
- In addition to the staged model (5 maturity levels), CMMI now also defines a continuous model (as in ISO 15504 (SPICE)), where single processes can be evaluated.
- CMMI contains more detailed guidelines for implementing the process areas. CMMI contains therefore more information, but not necessarily more requirements than SW-CMM.
- In CMMI the process areas of the 5 maturity levels were rearranged.
- CMMI fulfills ISO 15504.
With CMMI the evaluation of the maturity level of an organization is based on the evaluation of the capability levels of single processes.

<table>
<thead>
<tr>
<th>Process Area</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<td>Risk Management MAN</td>
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<td>Integrated Supplier Management MAN</td>
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Process Capability

Organization Maturity
CMMI Process Model Components (staged representation)
A project on level 1 („Initial“) has **no defined processes**

1. No Process Areas on level *Initial*
A project on level 2 („Managed“) has the **basic project management processes** in place.

The Process Areas of level **Managed**:

- Project Planning **MAN**
- Project Monitoring and Control **MAN**
- Supplier Agreement Management **MAN**
- Requirements Management **ENG**
- Configuration Management **SUP**
- Measurement and Analysis **SUP**
- Process and Product Quality Assurance **SUP**
An organization on level 3 ("Defined") has **defined** processes and all projects are using them.

The Process Areas of level **Defined**

- Organization Process Definition **PRO**
- Organization Process Focus **PRO**
- Organizational Training **PRO**
- Integrated Project Management **MAN**
- Risk Management **MAN**
- Decision Analysis and Resolution **SUP**
- Product Integration **ENG**
- Requirements Development **ENG**
- Technical Solutions **ENG**
- Validation **ENG**
- Verification **ENG**
- Integrated Supplier Management **MAN**
- Integrated Teaming **MAN**
- Organizational Environment for Integration **SUP**
An organization on level 4 („Quantitatively Managed“) has quantitative measurements in place and projects are controlled based on the analyzed data.

**The Process Areas of level Quantitatively Managed**

Organizational Process Performance PRO
Quantitative Project Management MAN
An organization on level 5 ("Optimizing") has established processes to improve its defined processes ("Continuous Improvement")

The Process Areas on level Optimizing

Organizational Innovation and Deployment PRO
Causal Analysis Resolution SUP
CMMI is ISO 15504 compliant
Assessments can be performed according to CMMI and ISO 15504

ISO 15504:2004
Requirements for assessments and process reference models

CMMI fulfills
SCAMPI fulfills
ISO 12207 AMD 1 fulfills
SPICE

CMMI is not yet 100% ISO 15504 compliant. Which means that some additional effort has to be spend if a certification according to CMMI and ISO 15504 is planned.
| 1 | Quality Models |
| 2 | SW-CMM |
| 3 | ISO 15504:2004 / SPICE |
| 4 | CMMI |
| 5 | SPI in Practice |
| 6 | Summary |
Software process improvement (SPI) addresses method, skills, projects, culture, organization and technology.

- **Methods**
  - Definition of a common understanding of conducting software engineering projects

- **Technology**
  - Education of the employees based upon a method as a common language

- **Projects**
  - Usage of the methods, project support and measurements

- **Skills**
- **Culture**
- **Organization**
Software process improvement is organizational change – and a project

Organizational Change

- is the *realization of new processes or technologies* in order to adapt an organization to new business requirements or to open up new possibilities

Project

- is a *temporary endeavor* undertaken to create a *unique product* or service

(Definition of „project“ by the Project Management Institute)
Key success factors for a software process improvement project

- Top Management Support & Involvement
  - Clear Direction
  - Measurable Goals

- Focus

- Broad Support
  - Profit for Practitioners
  - In Depth SE Knowledge of Change Teams

- Communication

- Project-Management

Compelling Need
SPI cannot be mandated by a SPI project. Rather management must require SPI from the organization, which in turn turns to the SPI project for support.
Typical actions of a CMMI software process improvement project

Single Actions

Create processes and tools
Create education

Establish usage of processes in the organization

Deliver education
Establish education process
Establish CMMI-Exponent-Team (Godfather-Team)
CMMI-Exponent-Team (Godfather-Team)

Establish continuous maintenance process
Establish continuous education process
Establish CMMI-Exponent-Team (Godfather-Team)
Continuous measurement process

Establish continuous maintenance process
Establish education process
Establish CMMI-Exponent-Team (Godfather-Team)
Continuous measurement process

Deliver education
Initialize usage in projects
Change organization
Communicate
Measure Profit

Initialize usage in projects
Change organization
Communicate
Measure Profit

Establish last usage
Iterative method is the key for success. The iterations base on prioritized process areas and the sequence of chosen projects.

Business Goals

Initial Assessment (Class B / ca. 2 weeks)

SPI Project planning

Project

Release

Build

Implement Process Areas and Measurements

Institutionalization

Intermediate-Assessment (Class C / ca. 2 days)

Official Assessment (Class A / ca. 3 weeks)
The steps and the team of an assessment

**Steps**

- **Interviews**
  - Senior Management
  - Middle Management
  - Project Leaders
  - Practitioners
  - Observations

- **Vision Business Objectives**

- **Policies & Procedures**

- **Project Management**

- **Requirements Design Implementation Test**

- **Observations**

- **Action Plan**
  - Senior Management
  - Middle Management
  - Project Leaders
  - Practitioners
  - Findings & Recommendations

**Team**

- Assessment Team Leader (external, SEI approved)
- Assistant Team Leader (external)
- 2-4 Assessment Team Members (internal, officially trained)

**Projects**

- Representative set of 4-5 projects from organization
A competence team must be responsible for the usage and maintenance of the processes. Team members of the projects are part of the competence team.
Distribution of effort

<table>
<thead>
<tr>
<th>People</th>
<th>Controlling</th>
<th>Development</th>
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<tbody>
<tr>
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<tr>
<td>Establish Usage in Projects</td>
<td>Measurements</td>
<td>Develop Prozesses &amp; Tools</td>
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<tr>
<td>10%</td>
<td>10%</td>
<td>30%</td>
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<tr>
<td>Training</td>
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<tr>
<td>10%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organization Change</td>
<td>Communication</td>
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<tr>
<td>10%</td>
<td>30%</td>
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</table>

Total SPI Effort:
3% - 6% of organization size

Additional: PM, QA Effort
Example-Scenario: e-business company with consultants, designers and developers

**Problem:**

Most of the projects are troubled. Lack of communication and lack of understanding among the different roles in the projects.

1. step: Identification of weaknesses with an assessment, to be able to define specific improvement activities

**Obvious process strengths:**

- Each *individual* engineering discipline
- Project management
- Customer supplier management

**Identified process weaknesses:**

- No common understanding / no common process
- Human resource management
Example-Scenario: e-business company with consultants, designers and developers

2. step: Activities to improve the processes

- Development of a common understanding of the project
- Reorganization of the teams (by projects rather than by disciplines)

Direct benefit:
- No more troubled projects
- Turn around of the company

Further benefit:
- Higher motivation
- Higher corporate identification of the employees

Sustained strengths:
- Outstanding individual performance (several design awards)
- Good customer supplier management
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<tbody>
<tr>
<td>1</td>
<td>Quality Models</td>
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<tr>
<td>2</td>
<td>SW-CMM</td>
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<td>3</td>
<td>ISO 15504:2004 / SPICE</td>
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<td>5</td>
<td>SPI in Practice</td>
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<td>6</td>
<td>Summary</td>
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Summary and Recommendations

SPI

- Software process improvement helps to reduce costs and risks in IT projects - and CMMI/ISO 15504 help you to do this successfully by proven best practices.
- Software process improvement is organizational change – and a project.
- The transition of an organization from one CMMI maturity level to the next takes on average approx. 2 years. Total SPI Effort: 3% - 6% of organization size (per year).
- Iterative method is the key for success.
- The whole organization has to take part in process improvement - the SPI project just supports this. The close interaction between software development projects and the SPI project is necessary.

SW-CMM vs. CMMI

- If you start now: use CMMI instead of SW-CMM. SW-CMM is being shut down.

ISO 15504 vs. CMMI

- CMM(I) is used more often than ISO 15504
- ISO 15504 is not a standard yet - but will be 2004
- CMMI integrates software and system engineering - ISO 15504 does not
- CMMI gives more guidance and best practices for implementation
More Information

CMMI

- Go to the official SEI website:
  www.sei.cmu.edu/cmmi

ISO 15504

- www.isospice.com - but currently the new version is not yet available
- ISO 15504 TR 1998 is available from www.iso.org

More information needed:

- We offer an individually tailored Info Day for CMM(I), ISO 15504:2004 and SPI
- We deliver In-house training - official SEI classes and individually tailored classes
- We conduct assessments
- We support SPI projects
- www.wibas.com

Market leader in IT Maturity Services
# Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>CBA-IPI</td>
<td>CMM-Based Appraisal for Internal Process Improvement</td>
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<td>CMM</td>
<td>Capability Maturity Model</td>
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<tr>
<td>CMMI</td>
<td>Capability Maturity Model Integration</td>
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<td>SCAMPI</td>
<td>Standard CMMI Assessment Method for Process Improvement</td>
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<tr>
<td>SCE</td>
<td>Software Capability Evaluations</td>
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<td>SEI</td>
<td>Software Engineering Institute</td>
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<td>SPI</td>
<td>System/Software Process Improvement</td>
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<tr>
<td>SPICE</td>
<td>Software Process Improvement and Capability Determination</td>
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