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People matter, results count.

Software-Engineering in industrial practice

Quality management & quality assurance

Lecture TU Darmstadt
Dr. Gunter Grieser

Darmstadt, 20.11.2015

AGENDA

- **Software quality**
- Important terms related to quality
- Norms and standards
- Quality management inside the company
- Quality management in the project
- Case study "Replacement of a web portal"
- Risk management in the project

Software systems are extremely complex entities

Reasons for the Complexity

- Software consists of many components (in the end the programming instructions) that interact in extremely diverse ways. Unlike other technical systems, smallest changes in the software can have a major impact.
- Software systems are invisible, they are abstract artifacts whose structure is not clearly present. This makes it enormously difficult to understand the (co-) interaction of its components.

- **What constitutes the quality of software?**
- **How to achieve high quality of software?**

What is quality?

We have defined for us:

Quality is the fulfillment of requirements

From the perspective of software development projects, we have the following three objectives:

- We want to build the right software system.
- We want to build the software system correctly.
- We want to make it right from the start.

Quality model - who defines the requirements regarding quality?

ISO 9126

Functionality
- Suitability
- Accuracy
- Interoperability
- Security
- Compliance

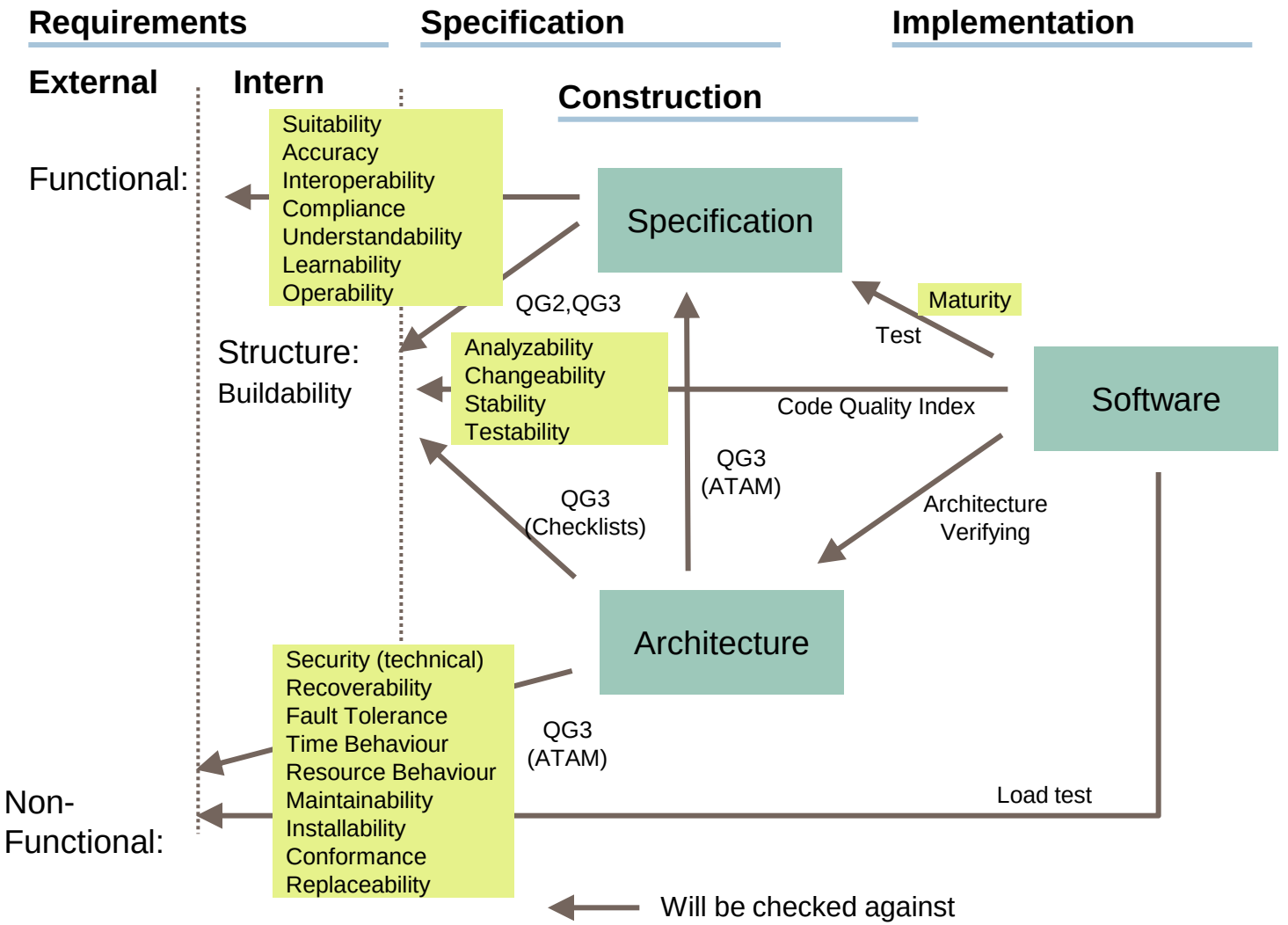
Reliability
- Maturity
- Fault Tolerance
- Recoverability

Usability
- Understandability
- Learnability
- Operability

Efficiency
- Time Behaviour
- Resource Behaviour

Maintainability
- Analyzability
- Changeability
- Stability
- Testability

Portability
- Adaptability
- Installability
- Conformance
- Replaceability



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ISO 9000: Definition of „Quality“
ISO 9000: Definition of „Quality Management“

Term	Definition
Quality	• „The degree to which a set of inherent characteristics fulfills requirements“
Quality Management	• „Coordinated activities to guide and lead an organization“ • Guidance and leading concerning quality typically include defining the **quality policy** and **quality objectives**, **quality planning**, **quality control**, **quality assurance** and **quality improvement**.

Quality planning

Term	Definition
Quality planning according to ISO 9000	• „Part of quality management, which is aimed at defining the quality objectives and the necessary execution processes and related resources to fulfill the quality objectives“
Quality planning at Capgemini CSD	• This is about creation, implementation, maintenance and continual improvement of a quality management system. • Such a system should be incorporated into all company levels: – across projects – specific to a project – specific to a project phase

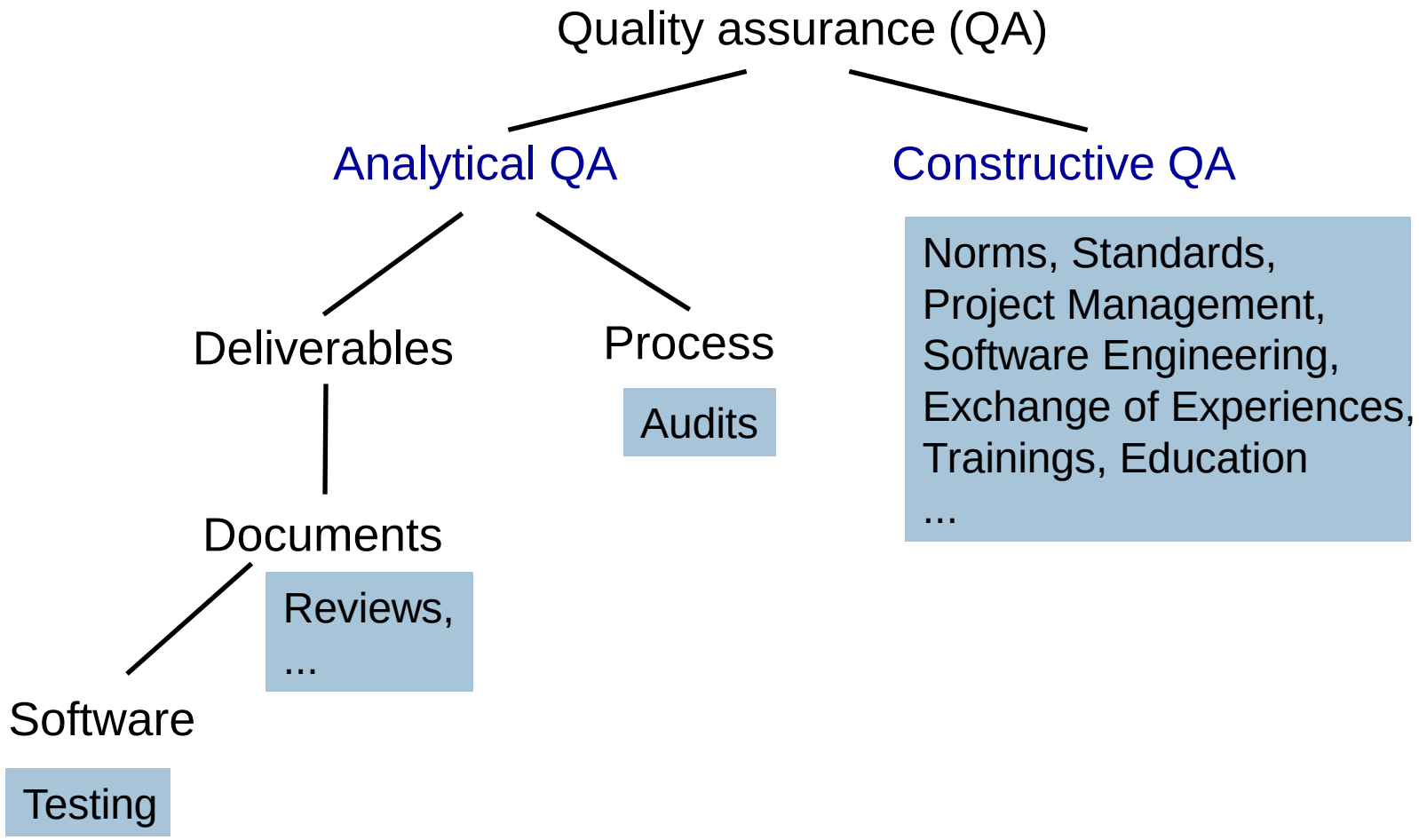
Quality Control

Term	Definition
Quality Control according to ISO 9000	„Part of quality management, which is aimed at the fulfillment of quality requirements.“
Quality Control at Capgemini CSD	As possible, the quality should be designed into software from the start. The quality control (often referred to as **constructive QA**) is primarily preventive, it should prevent errors and quality issues from the outset. This can for example be achieved by defining the principles, methods, tools and formalisms. Also the fault corrections belong to this class.

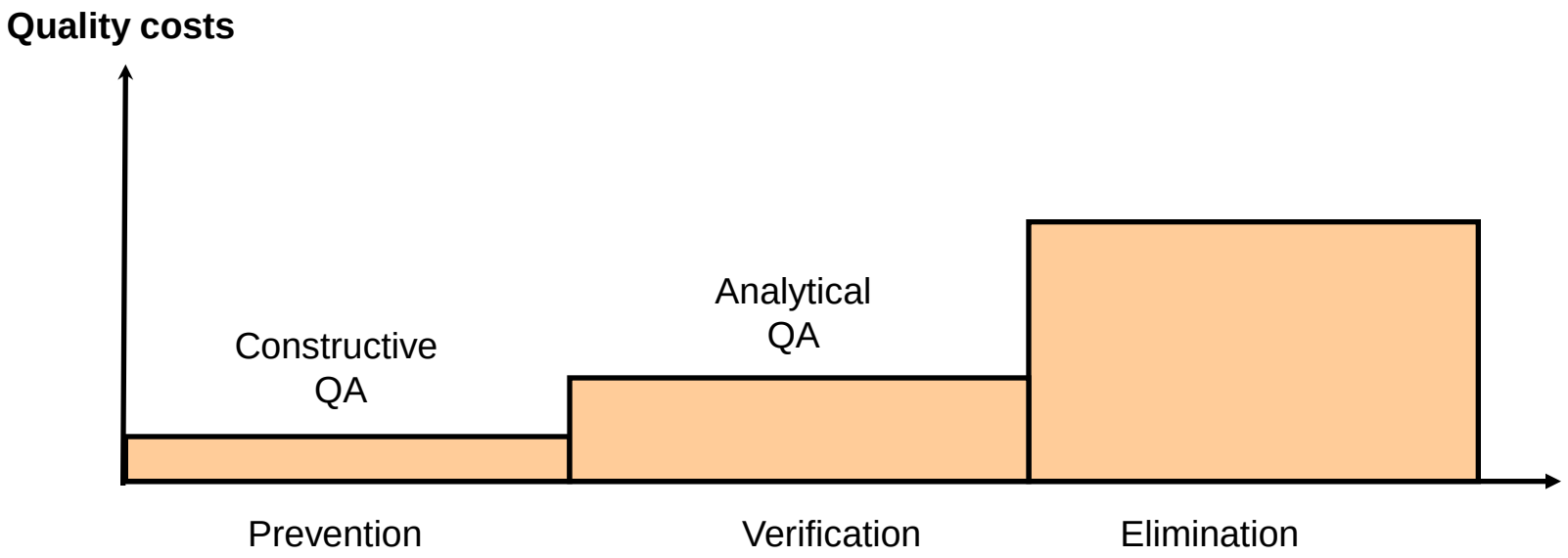
Quality Assurance

Term	Definition
Quality Assurance according to ISO 9000	„Part of quality management, which is aimed at creating confidence that quality requirements are fulfilled.“
Quality Assurance at Capgemini CSD	It must be determined, evaluated and documented whether planning and constructing quality have been successful. This is achieved by measures which in the broadest sense can detect and locate faults and defects. Quality assurance is therefore often referred to as **analytical QA**.

Analytical vs. constructive quality assurance

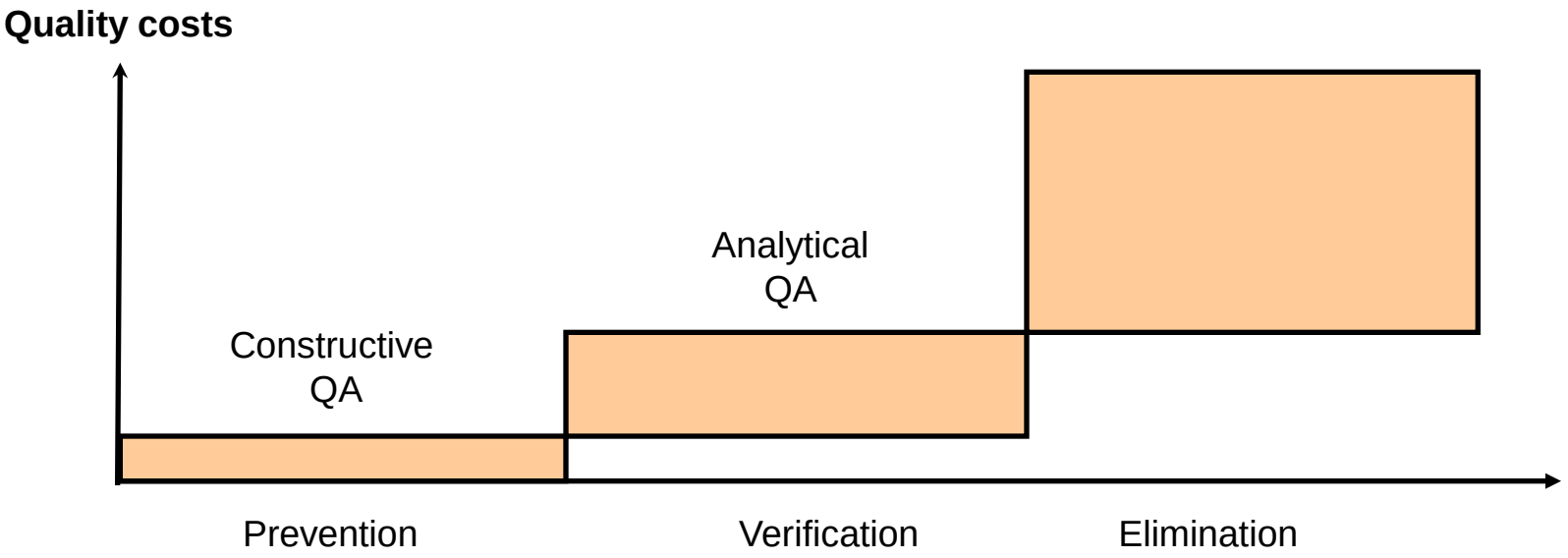


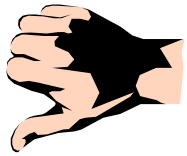
Quality costs: the total height of quality costs depends on the time of their investment

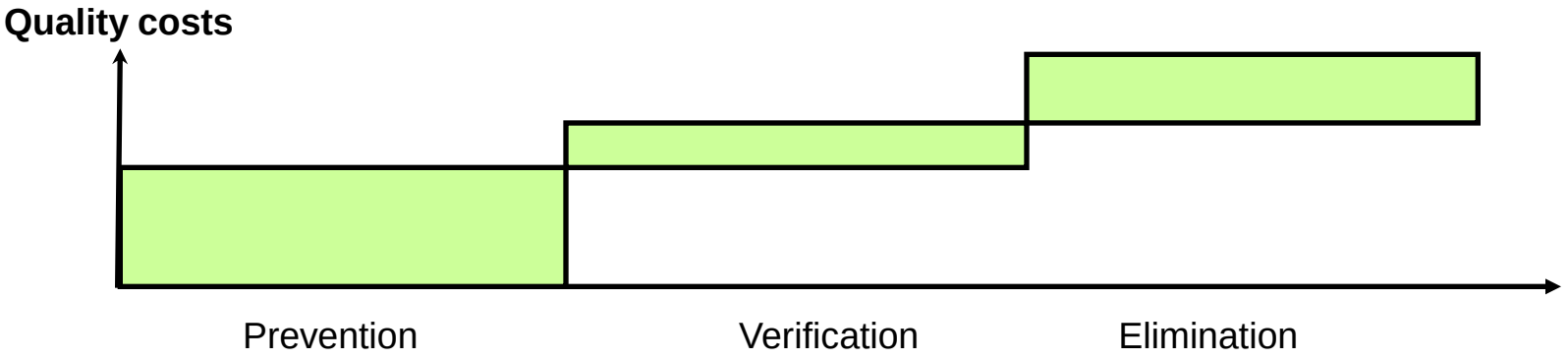


- What can we do to reduce the quality costs concerning
  - prevention
  - verification and
  - elimination?

Quality costs: the total height of quality costs depends on the time of their investment







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Norms and standards for the introduction and improvement of quality management systems

Coverage (rough estimate)	**ISO9001** ISO9001:2000	**CMMI-DEV** V1.2	**PMI** ANSI/PMI 99-001-2004	**V-Modell XT** V1.3
Application area	Quality management systems (in general)	Systems and Software Engineering	Project management (in general)	Mandatory development standard for federal IT systems (D)
Process orientation	☑	☑	☑	☑
High level process	☐	☑	☑	☑
Concrete Requirements at QMS	☑	☑	☐	☐
Process to improve customer satisfaction	☑	☐	☐	☐
Degree of maturity modell	☐	☑	☐	☐
Tool support	☐	☐	☐	☑
Number of pages >=	66	573	394	624

ISO 9001:2000
„Quality management system requirements“

ISO 9001:2000

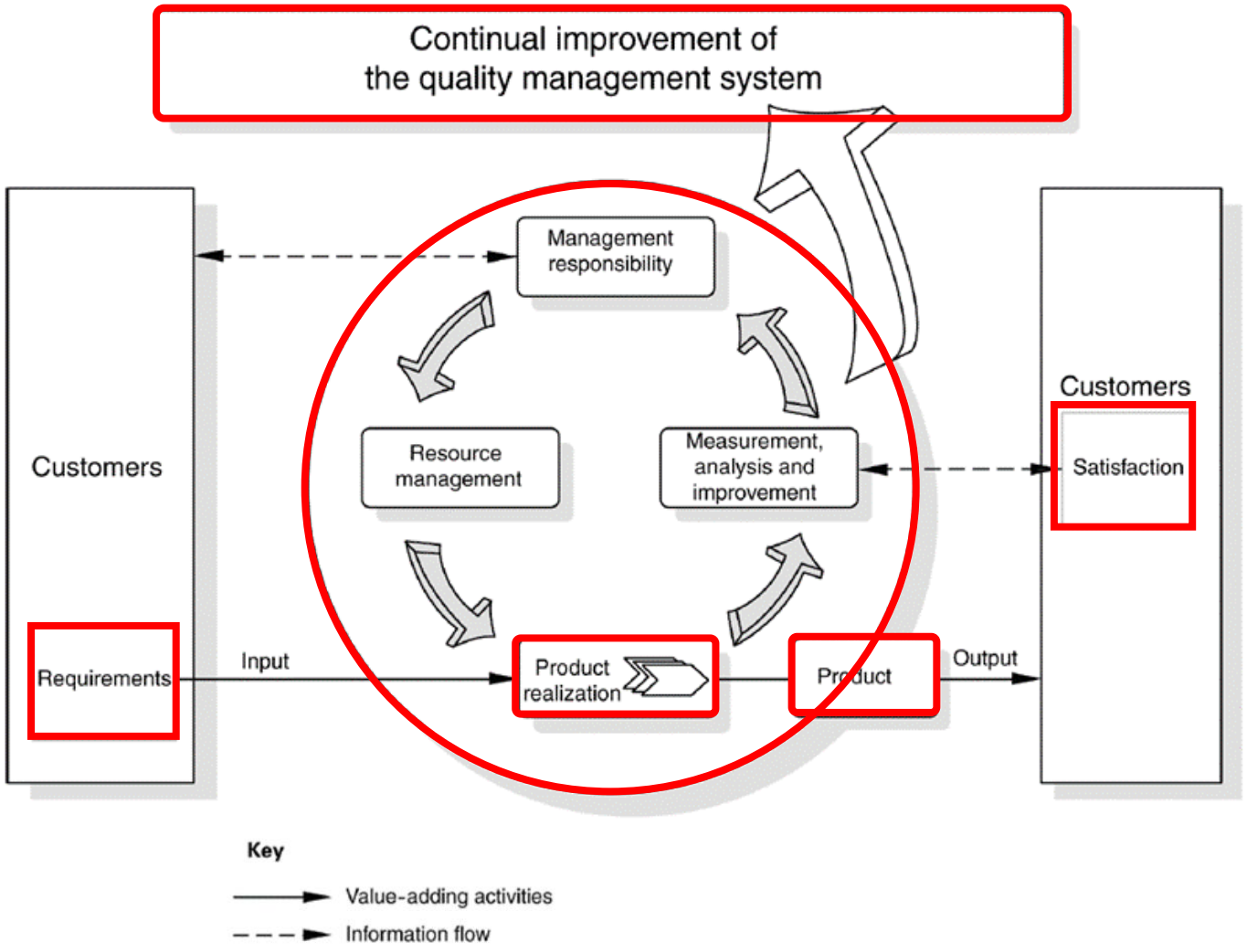
- ISO 9001:2000 is an **international standard** (http://www.iso.org).
- It describes the **requirements for a quality management system**.
- The standard focuses on a) the **quality assurance** of products or services and on b) increasing **customer satisfaction**.
- Compliance with the standard means that an organization is able to fullfill the **requirements of customers**.
- The standard **does not** prescribe **how** a quality management system must be structured or documented.
- The standard promotes a **process-oriented approach** for developing, implementing and improving the effectiveness of a quality management system.
- It is often a **prerequisite for the award of contracts** to a service provider.

Content of ISO 9001:2000 standard

The Content of the standard is:

- Terminology
- Requirements to a quality management system
- Management responsibility
- Management of resources
- Product realization
- Measurement, analysis and improvement

Model of a process oriented quality management system according to ISO9001:2000



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The QMS documentation provides a solid basis for the Quality Management at Capgemini CSD

The **Quality Management Manual** describes the principles, organization and model of the QMS at Capgemini CSD.

The **procedures manual** contains a detailed description of the processes.

Document samples, Checklists and **Best Practices** supplement the documentation.

ZERTIFIKAT ◆ CERTIFICATE ◆ 認證證書 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT

TÜV SÜD Management Service

ZERTIFIKAT

Die Zertifizierungsstelle
der TÜV SÜD Management Service GmbH
bescheinigt, dass das Unternehmen

Capgemini
CONSULTING.TECHNOLOGY.OUTSOURCING

Capgemini sd&m AG
Carl-Wery-Straße 42, D-81739 München
einschließlich der Standorte gemäß Anlage

für den Geltungsbereich

Entwicklung und Integration
maßgeschneiderter Softwarelösungen
für unternehmenskritische Prozesse
sowie IT-Beratung mit Umsetzungskompetenz

ein Qualitätsmanagementsystem
eingeführt hat und anwendet.

Durch ein Audit, Bericht-Nr. 70010782
wurde der Nachweis erbracht, dass die Forderungen der

ISO 9001:2008

erfüllt sind. Dieses Zertifikat ist gültig bis 2011-07-07
Zertifikat-Registrier-Nr. 12 100 14749 TMS

München, 2010-11-18

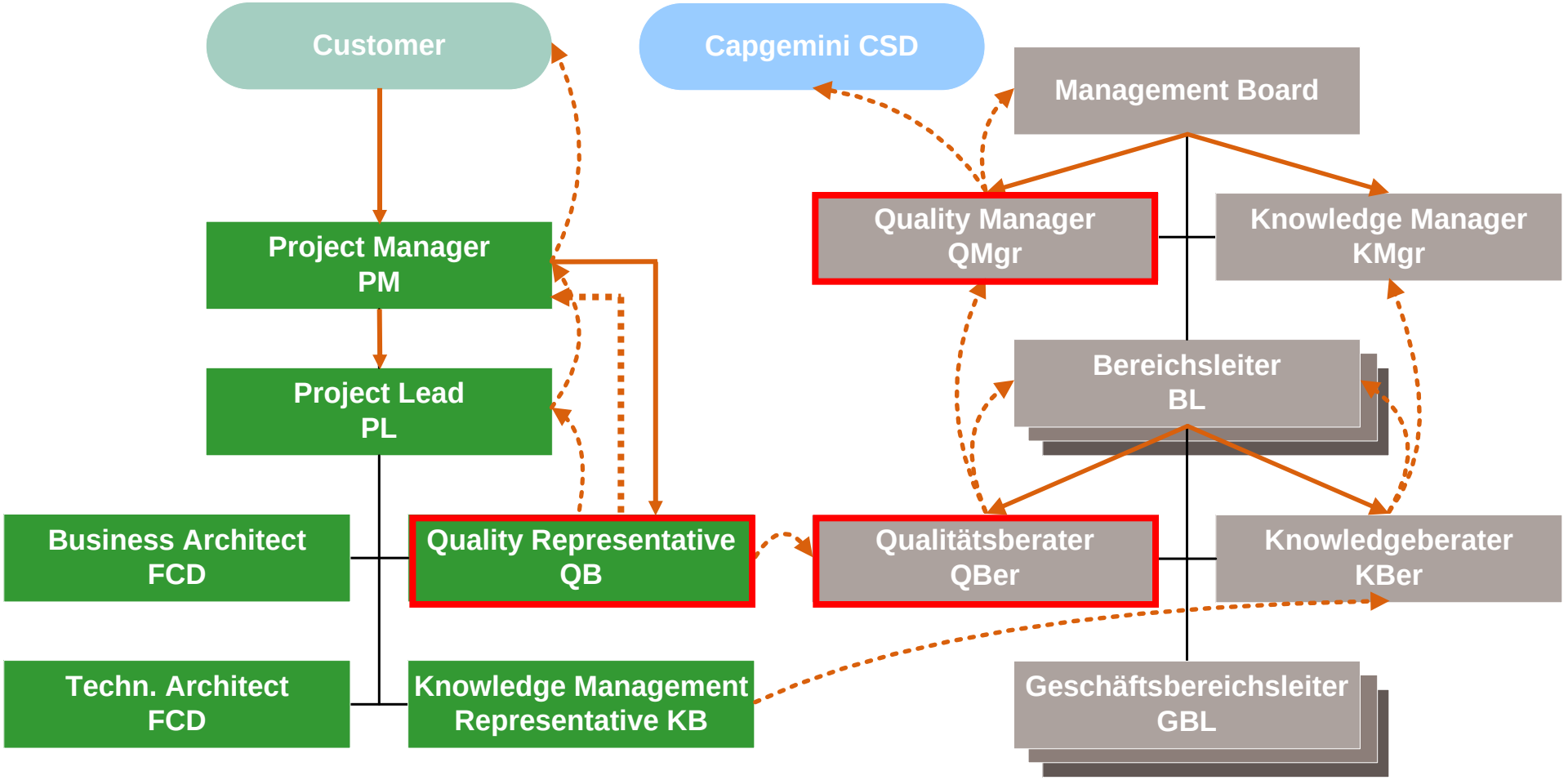
Seite 1 von 2

GMS-TGA-ZM-07-02

TÜV SÜD Management Service GmbH • Zertifizierungsstelle • Ridlerstraße 65 • 80339 München • Germany

Principles of the (software-)quality management at Capgemini CSD

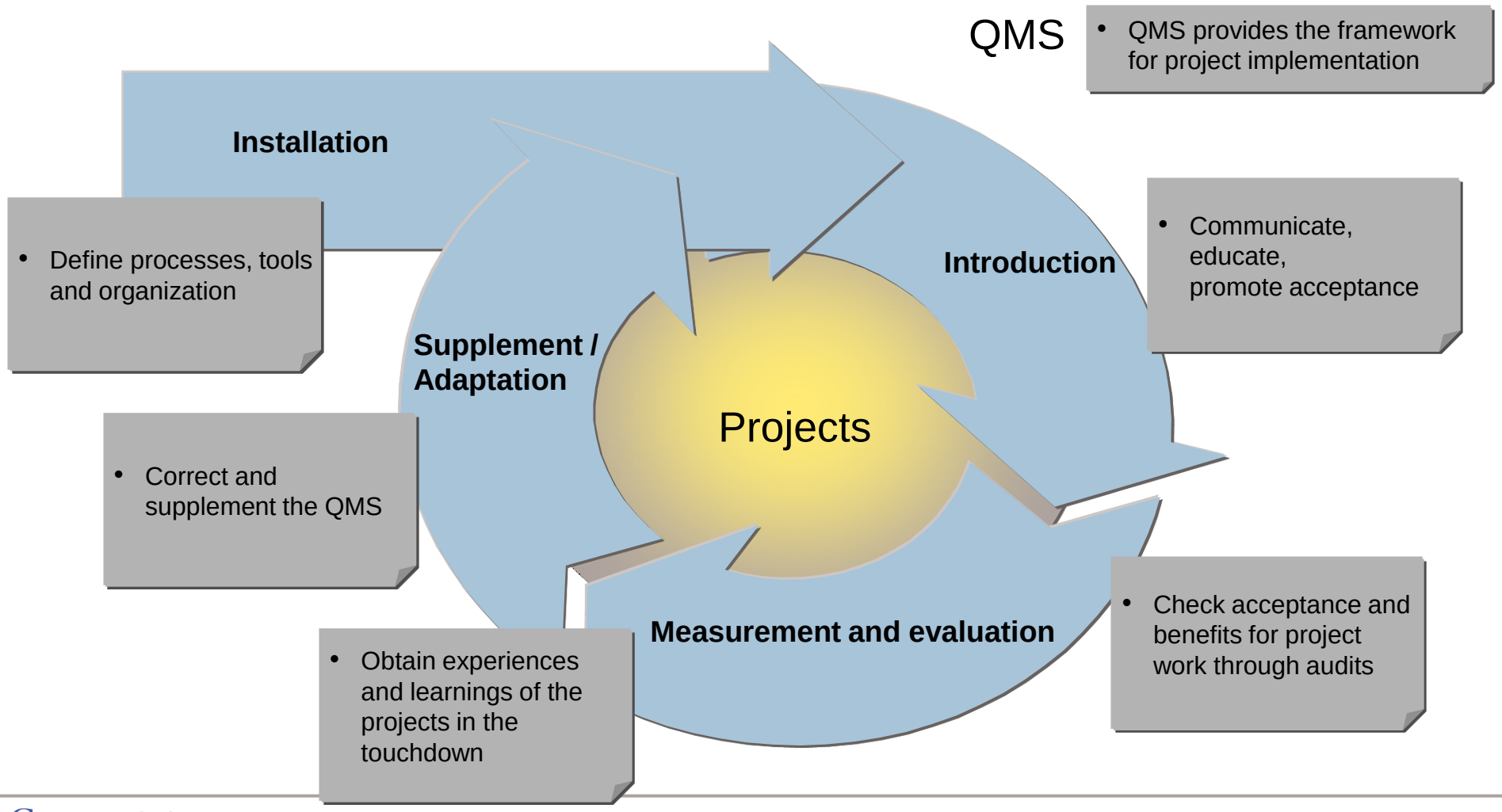
The quality management is reflected in the organization – both in the project and in the line



The key for successful projects is the acceptance from the employees…

Problems w.r.t. QM introduction	Our suggestion
QMS can lead to bureaucracy	• Establish QMS in the minds rather than on paper
Reservations against regulations	• All employees are involved in the QMS and all are responsible for quality
QM staff members are not accepted	• Recruit experienced people as Quality managers • Quality manager is a job on limited time, they come from the regular project work
Quality management is perceived as overhead	• Introduce detailed regulations only there where problems are the most critical • Limit written traceability to the necessary
Quality is delegated to the QMS	• Emphasize the responsibility of each employee for the quality of their results

Integration of projects within our QMS



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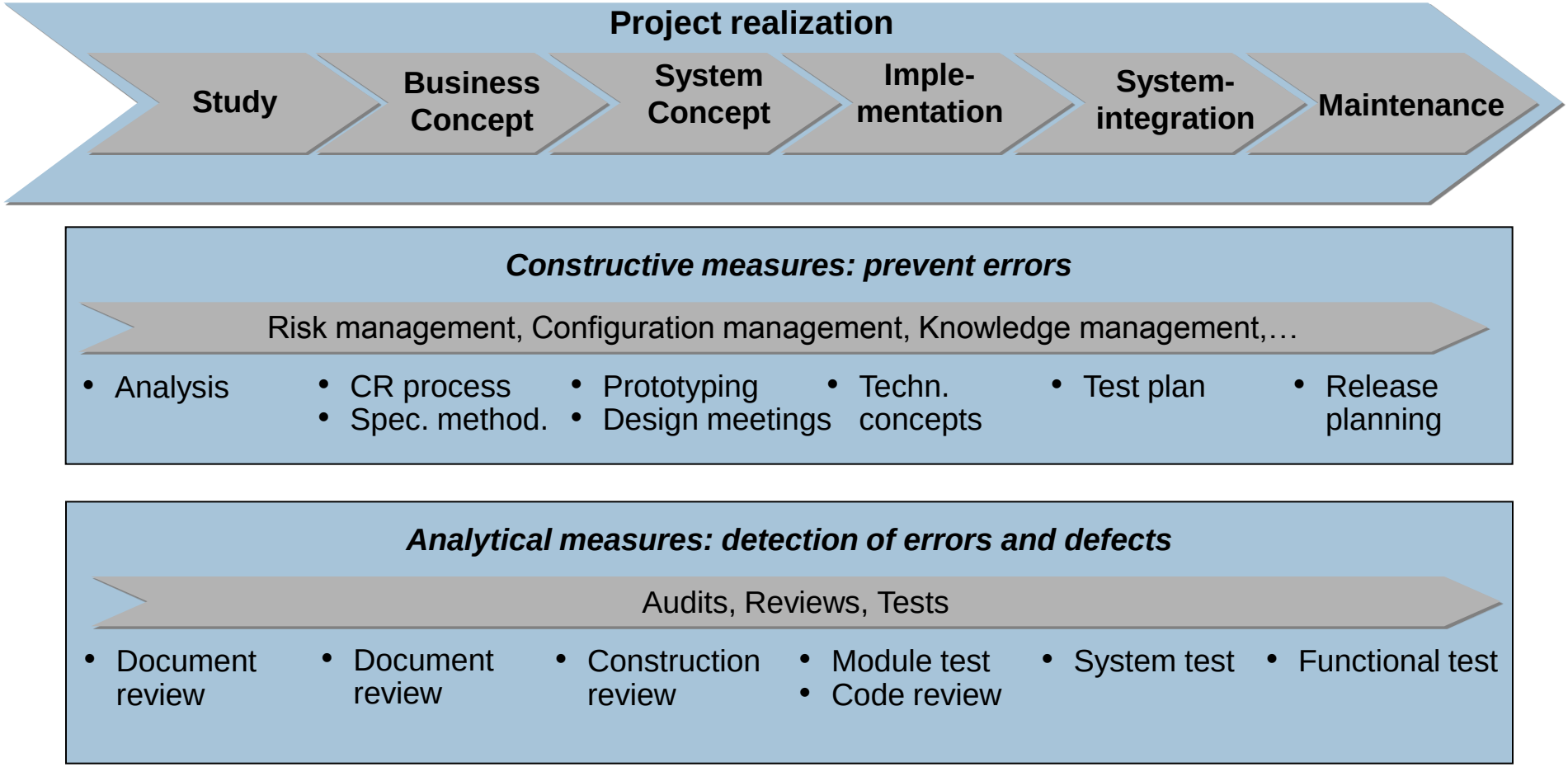
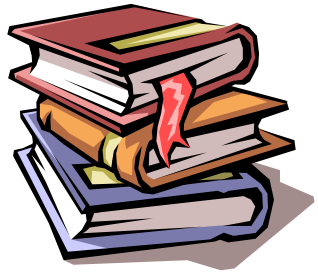
There are number of actions whose realization can increase the quality of the results



The implementation of quality management is performed in an appropriate manner by the projects



An appropriate project documentation supports project transparency:

- Project manual: Starting point in the project
  - Project structure (Subject, Organization,..)
  - Methods
- QM Plan: detailed quality planning
  - Quality objectives / quality criteria
  - Quality measures to be implemented
  - Project planning:
  - Milestones
  - Resource assignment
  - Time context
- Project status:
  - current status of the project (time, quality, budget)
- QA Documentation:
  - Documentation of planned / implemented QS measures
- Risk List:
  - Documentation of risk management in the project
- Test Plan:
  - Analytical procedure for quality assurance of the created software including the testing strategy

What is all in the QM plan?

Content classification

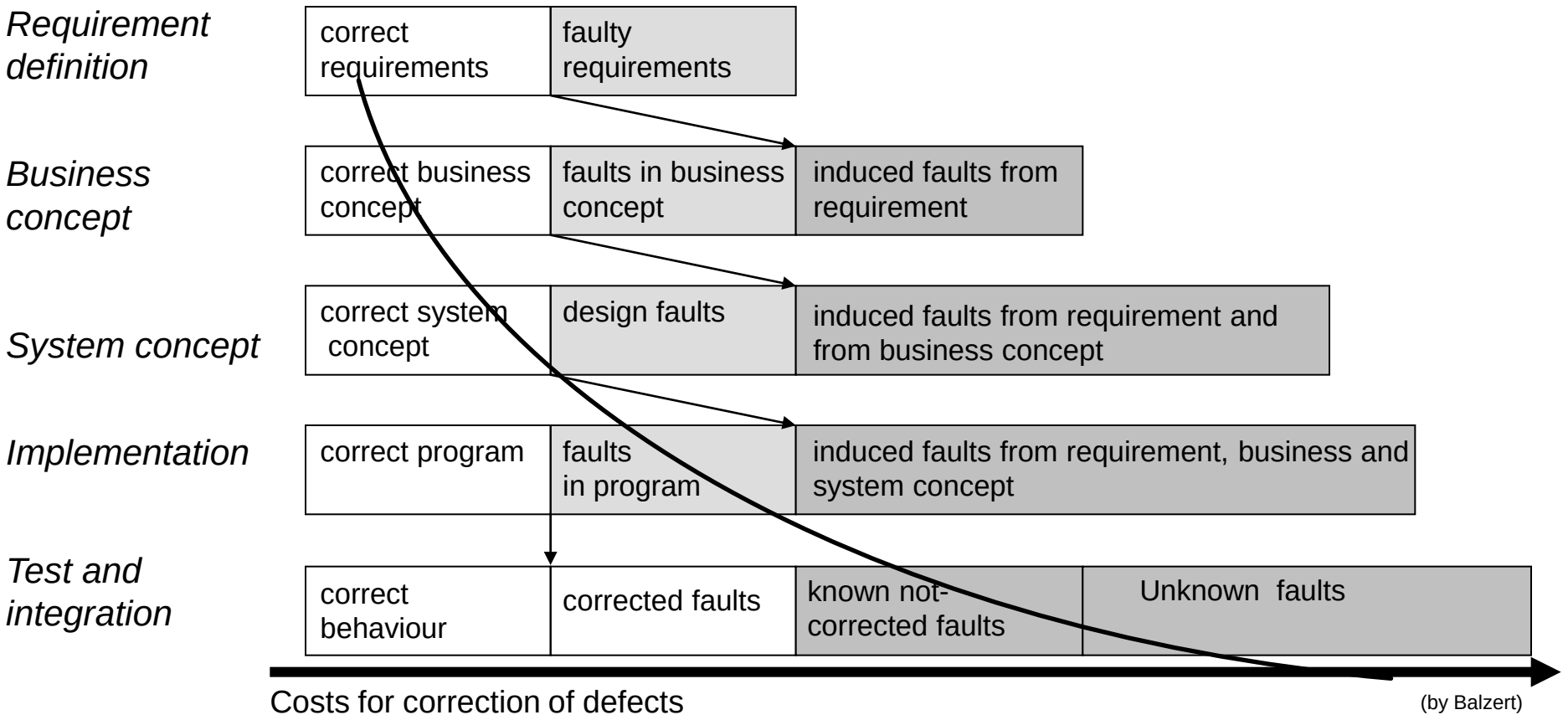
- Introduction
  - Identification, a brief description of the project, reference to other plans, editorial
- Quality objectives and criteria
- Criticality of the individual delivery items / components
- Measures:
  - Constructive and analytical QA activities, QA planning and documentation
- Organization from the perspective of the QMS
  - Structures
  - Resources: Equipment, involvement of customers, team members, other resources
  - Supplies
  - Schedule, test schedule, test plan, security
- Applicable documents, reference list, list of abbreviations, glossary

What is all in the test plan?

Content classification

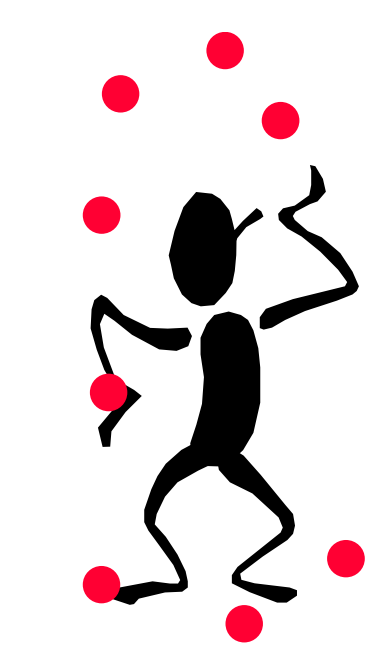
- Introduction
  - Identification, a brief description of the project, reference to other plans, editorial
- Overview of the test objects
- Features to be tested and not to be tested
- Test strategy
  - Definition of test objectives, if possible based on a risk analysis
  - Selection of test methods to be used
- Acceptance criteria, criteria for test abortion and test continuation
- Test documentation, test tasks, test infrastructure
- Responsibilities / competences, staff, training, education
- Time / work schedule
- Planning risks and miscellaneous, authorization / approval

Quality generates costs: The sooner the less!



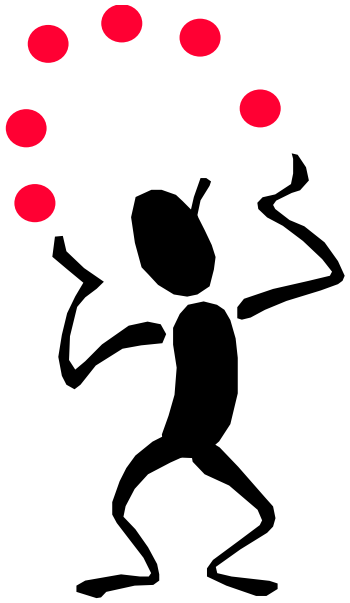
The sooner an error is discovered, the more cost-efficient it can be solved

Conclusion: A good quality management system ensures a controlled project execution and allows to learn from the mistakes of others!



"work hard"

QMS



"work smart"

**The project creates the quality,
the QMS provides the guidelines.**

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Initial situation for the web project

Case study

- Replacement of a web portal for a media customer
- Main goals in the overall project:
  - Introduction of a new Content Management System (CMS) based on a standard product
  - Integration of existing legacy and newly built internal systems to the CMS
  - Migration of the old data to the new platform
- Criticality: Medium
  - Misbehavior can lead to significant loss of acceptance
  - But we do not expect any risk to people or property.

Index of contents of the QM plan

Quality objectives and quality criteria from the QM plan

Quality objectives with the highest priority

Quality criteria (measurable requirements)

Explanation

- Assuring the delivery dead-line
- Good usability of the new system in terms of simplicity and speed
- Reliability / System availability
- Performance and Scalability

- Delivery dead-line is fixed and (unfortunately) can not be shifted
- Typical editors can work with the system. However, due to the delivery dead-line: adjustment of the CMS standard product only through its configuration, extensive programming adjustments are to be avoided.
- Certain failure scenarios (web server, database, etc.) are covered
- Non-functional requirements are covered, such as 90% of all queries are processed in <1 second, an editor waits max. 10 seconds for the processing of his GUI action, in 90% of cases less than 2s.

Constructive quality measures for quality objectives with the highest priority

- Constructive quality measures:
  - Use an agile development process so that after each sprint a running system exists and the customer can assess the usability early
  - For each sprint let the customer make proposals for the configuration of each user interface in the editorial editor of the standard product
  - Create templates / checklists for the design, implementation and testing
  - Discuss the developers work packages / user stories at the kickoff with the architect
  - Plan load tests early during development

Analytical quality measures for quality objectives with the highest priority

- Analytical QA measures:
  - Review of completed user stories and critical bug fixes through the front-end or back-end architects
  - Establish nightly build of the software, including execution of the JUnit tests
  - Specify for each sprint acceptance tests and execute them accordingly
  - Establish automated regression testing at the HTML level
  - Intensive non-functional tests, i.e. load and performance tests

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Terms: We distinguish between risks and problems…

A **problem** ...

- ... is a circumstance which handicaps or prevents the successful implementation of a project

A **risk** ...

- ... is a problem that can **occur with a certain probability**
- ... is a potential problem or obstacle, with a corresponding **amount of damage**
- … changes during the project: the **risk trend** indicates how
  - potential damage and / or
  - probability of occurrence

  changes compared to the last observation status.

Risk management …

- … is **systematic dealing with risks**:
  - Early detection of risks (before admission)
  - Explicit planning (= writing down), rating, conscious deciding & tracking
  - Risks can be accepted, or reduced by **measures** or contained or transfered
- … is the responsibility of the **project lead** and the **management level**
  - With the support of the team
  - Often, supported by the customer

Amount of damage, probability of occurrence and the risk trend characterize risks (1/2)

Amount of damage	Characterization	
low	Customer: hardly affected Deadline: without/problem-free postponement Acceptance: not endangered	Investment: optionally low budget overrun Team: slightly affected Schedule: unproblematic adjustments
middle	Customer: must change their own planning Deadline: problematic postponement Acceptance: not sure	Investment: significant budget overrun Team: spirit decreases Schedule: strong changes/overtime
high	Customer: lost for Capgemini CSD Deadline: unacceptable postponement Acceptance: quite unlikely	Investment: high loss budget Team: disaster atmosphere Schedule: unusable

Amount of damage, probability of occurrence and the risk trend characterize risks (2/2)

Probability of occurrence	Characterization
low	One cannot entirely exclude the possibility that the risk will become a problem.
middle	It is more likely that the risk will become a problem than it will not become a problem.
high	Unless something decisive happens, the risk becomes a problem.
entered	The risk has already become a problem.

Risik trend	Characterization
falling	Compared with the previous risk assessment the damage or probability of occurrence is less.
constant	No change since the last risk assessment.
increasing	Compared with the previous risk assessment the damage or probability of occurrence is higher.

Recommended Reading

- Frederik P. Brookes: *The Mythical Man-Month,*
  Addison-Wesley 1995
- *A Guide to the Project Management Body of Knowledge,*
  Project Management Institute 2004

- ***additional german literature:***
- Karol Frühauf, Jochen Ludewig, Helmut Sandmayr:
  Software-Projektmanagement und –Qualitätssicherung
  vdf Hochschulverlag 2002
- Friedrich Graf-Götz, Hans Glatz: *Organisation gestalten*
  Beltz Verlag 2001
- Georg Erwin Thaller: *ISO 9001 – Software-Entwicklung in der Praxis*
  Verlag Heinz Heise GmbH 2000
- Ralf Kneuper: *CMMI*
  dpunkt.verlag GmbH 2003
- Helmut Balzert: Lehrbuch der Software-Technik: Software-Management, Software-Qualitätssicherung, Unternehmensmodellierung, Band 2, Spektrum, Akad. Verlag 1998

Norms and standards concerning quality management

- ISO9000 bzw. ISO9001:2000
  - International Organization for Standardization
  - http://www.iso.org/
- CMMI
  - Software Engineering Institute, Carnegie Mellon University Pittsburgh
  - http://www.sei.cmu.edu/cmmi/
- PMI (ANSI/PMI 99-001-2000)
  - Project Management Institute, PA, USA
  - http://www.pmi.org/
- V-Modell XT
  - Der Beauftragte der Bundesregierung für die Informationstechnik
  - http://www.cio.bund.de/DE/Architekturen-und-Standards/V-Modell-XT-Bund/vmodellxt_bund_node.html

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Research and science live on the exchange of ideas, the clear arrangements are thereby useful:

If you have any questions, please contact:

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