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Program and System Engineering PSE

Quality Management

Siegfried Zopf, Siemens PSE QM

Quality Management

- **Quality assurance in projects**
  - Quality assurance manager
  - Quality assurance plan
  - QA measures
  - Review
- **Concepts of quality management**
  - Quality management in a software development organization
- **Quality models**
  - ISO 9000, CMMI, EFQM

Quality assurance in projects

Overview

Tasks of the QA manager

Error prevention in general

Validation and verification

see stdSEM

QA managers in the project (QAMs)

Support project manager and/or project team in reaching the required/agreed quality (as “deputy” of project manager)

Plan QA measures in the project (draw up QA plan)

Check compliance with development method and other process instructions (together with project manager)

Implement QA measures as specified in QA plan

Coordinate reviews, moderate review meetings and keep minutes, where necessary

Evaluate Q data: analyze systematic errors (occurring multiple times)

Report in the case of Q problems

Initiate and **track** corrective measures in the project

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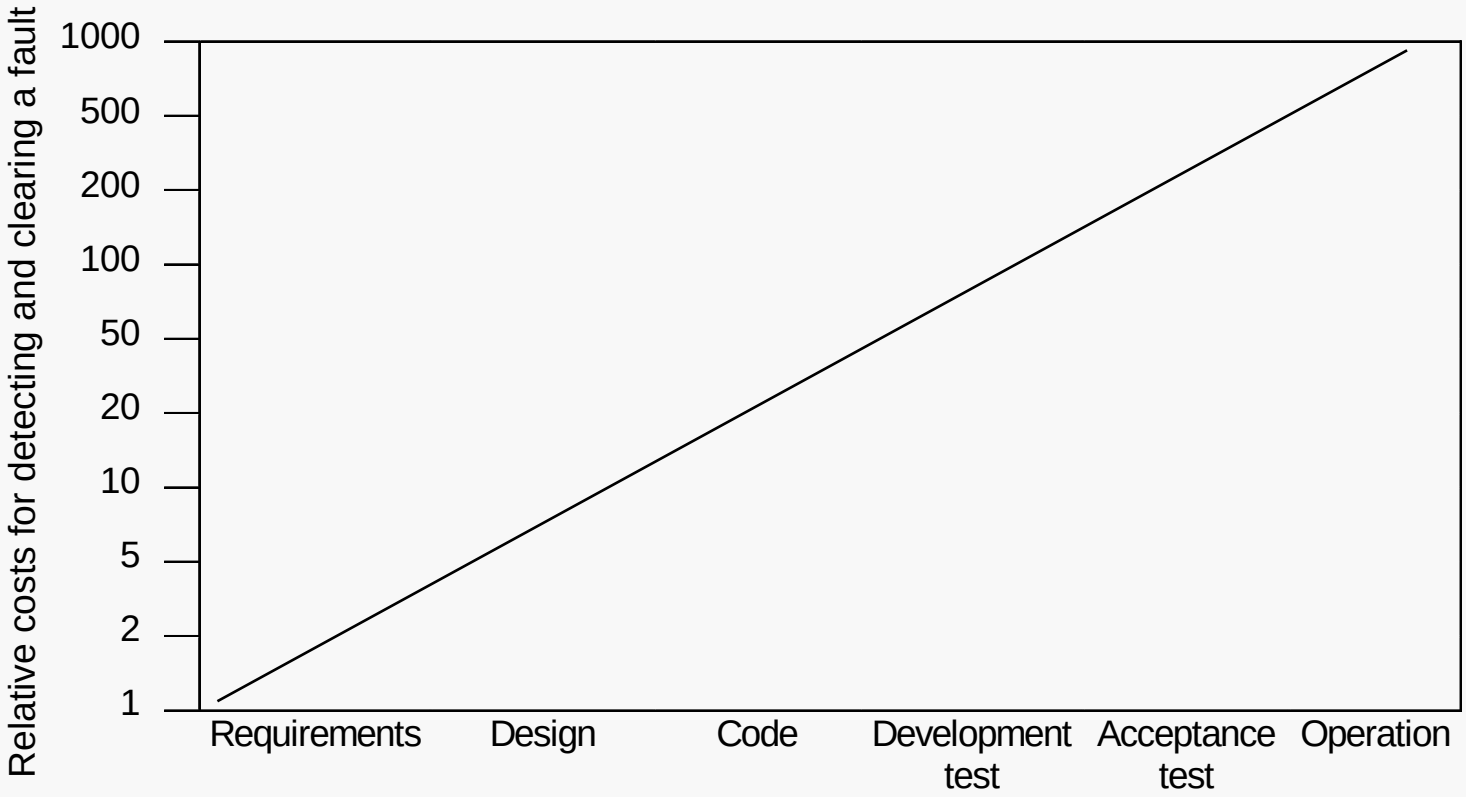
Reviews

Costs of delayed detection of faults (B. Boehm, 1976)



Cost of delayed error detection

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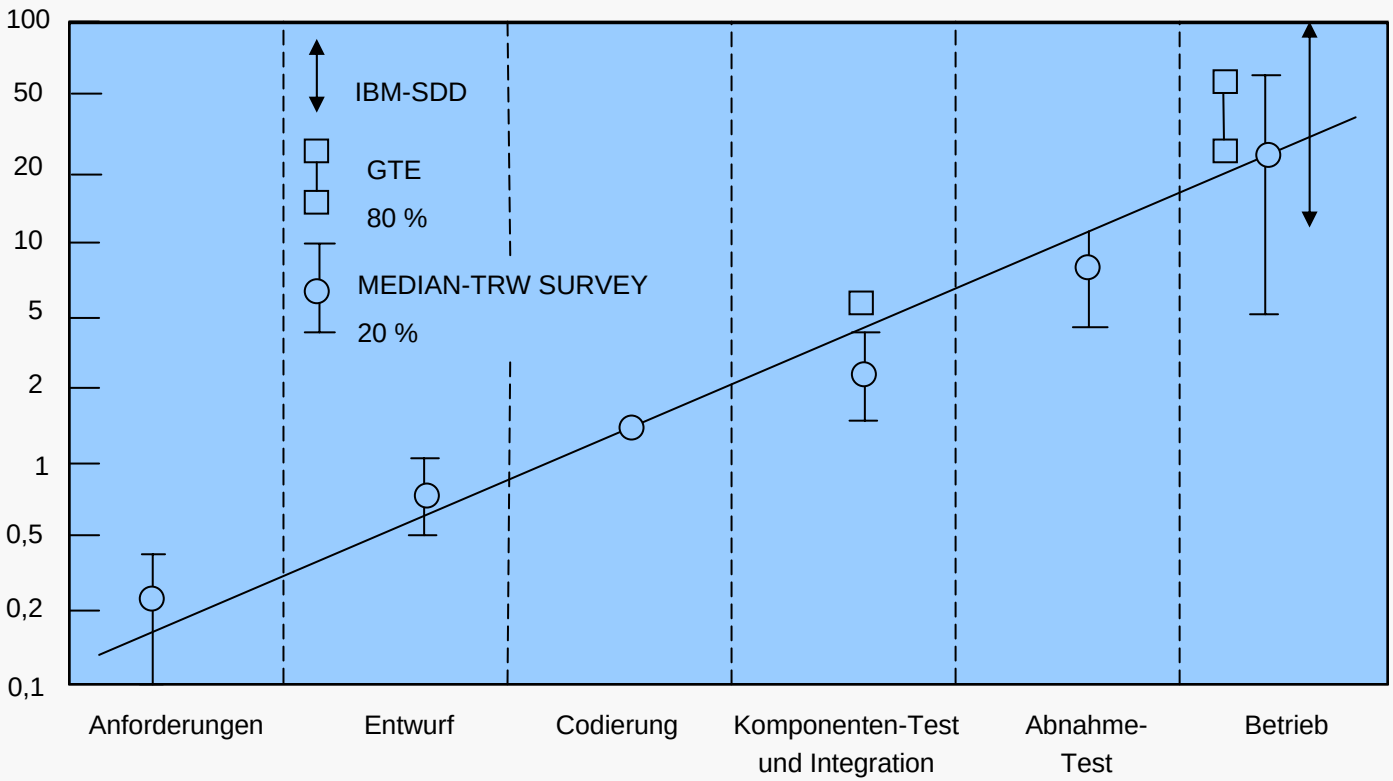
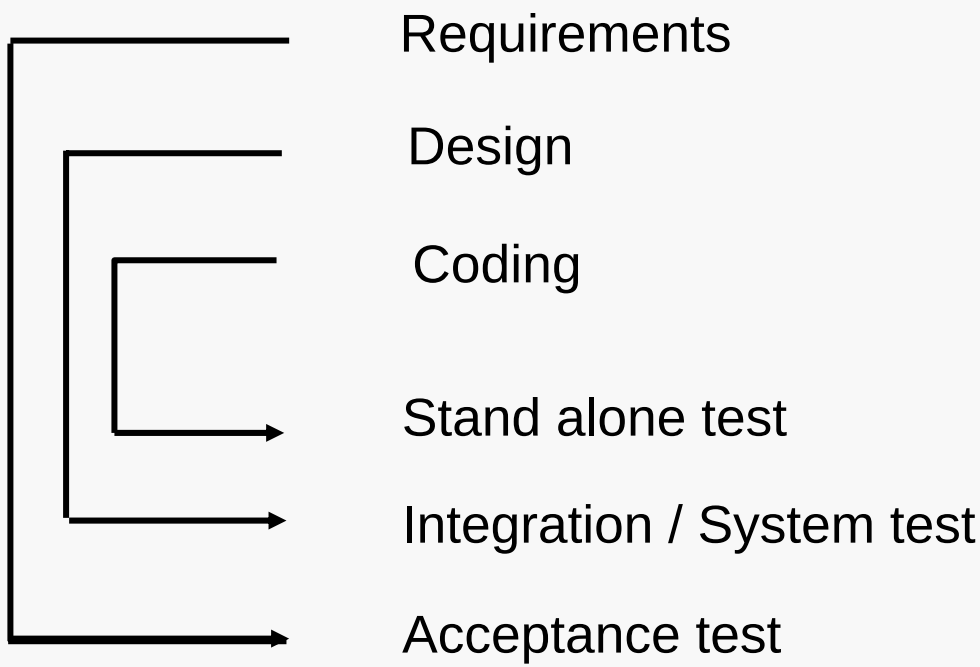


Kosten einer verzögerten Fehlerentdeckung nach/Boehm 76 /

TRAINING center

Early errors are detected late



Reviews

Goal

To **detect** errors in a subresult **at an early stage**, thus increasing productivity and product quality

Approach

A review is a **formalized, critical** check of work results by **more than one** reviewer

Reviews

- Reviews are mandatory (provided the respective documents are required for the project) for:

User Requirements Spec.	Architectural design spec.
Tender	Detailed design spec.
SW Requirements Spec.	Adaptations specification
Feasibility study	Test plan
Project plan	Product documentation
QA plan	

- Reviews for the other documents and code are useful and therefore recommended
- The review scope of a project is defined in the QA plan
- All other documents need to be submitted **at least** to an informal type of check

Review techniques

Reviews in comment technique

Reviews in session technique

- General reviews in session technique
- Intensive inspection

Project-specific specification of methods in the QA plan

Intensive inspection Characteristics

Based on M. Fagan

Roles
- Facilitator
- Author
- Reader
- Tester

Special checklists

Time required
- Preparation: 100 LOC/h, document max. 10 pages/h
- Inspection : 125 LOC/h, document max. 10 pages/h

Errors
- in the product
- in the process (e.g. SEM)

Intensive inspection
How it works

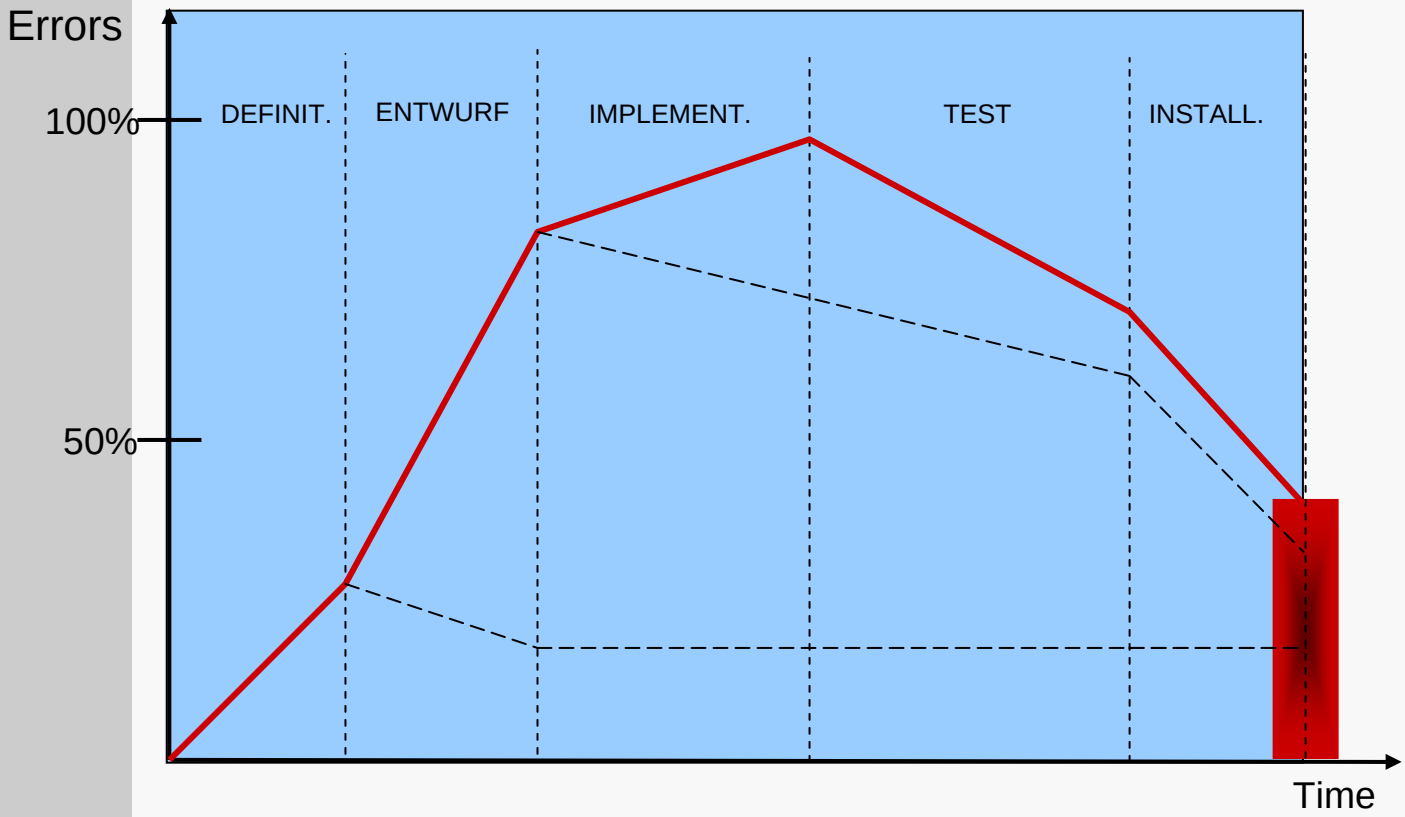
Planning	Documents, participants, location, roles, date
Overview	Introductory information for the team (10 min.)
Preparation	Individual preparation for the role
Inspection	Detecting errors (max. 2 hours)
Analysis	For process and systematic errors
Fault clearance	Clear all faults
Verification	Have all faults been cleared?

} session

Not like this !

Accumulated Errors (I)

without reviews



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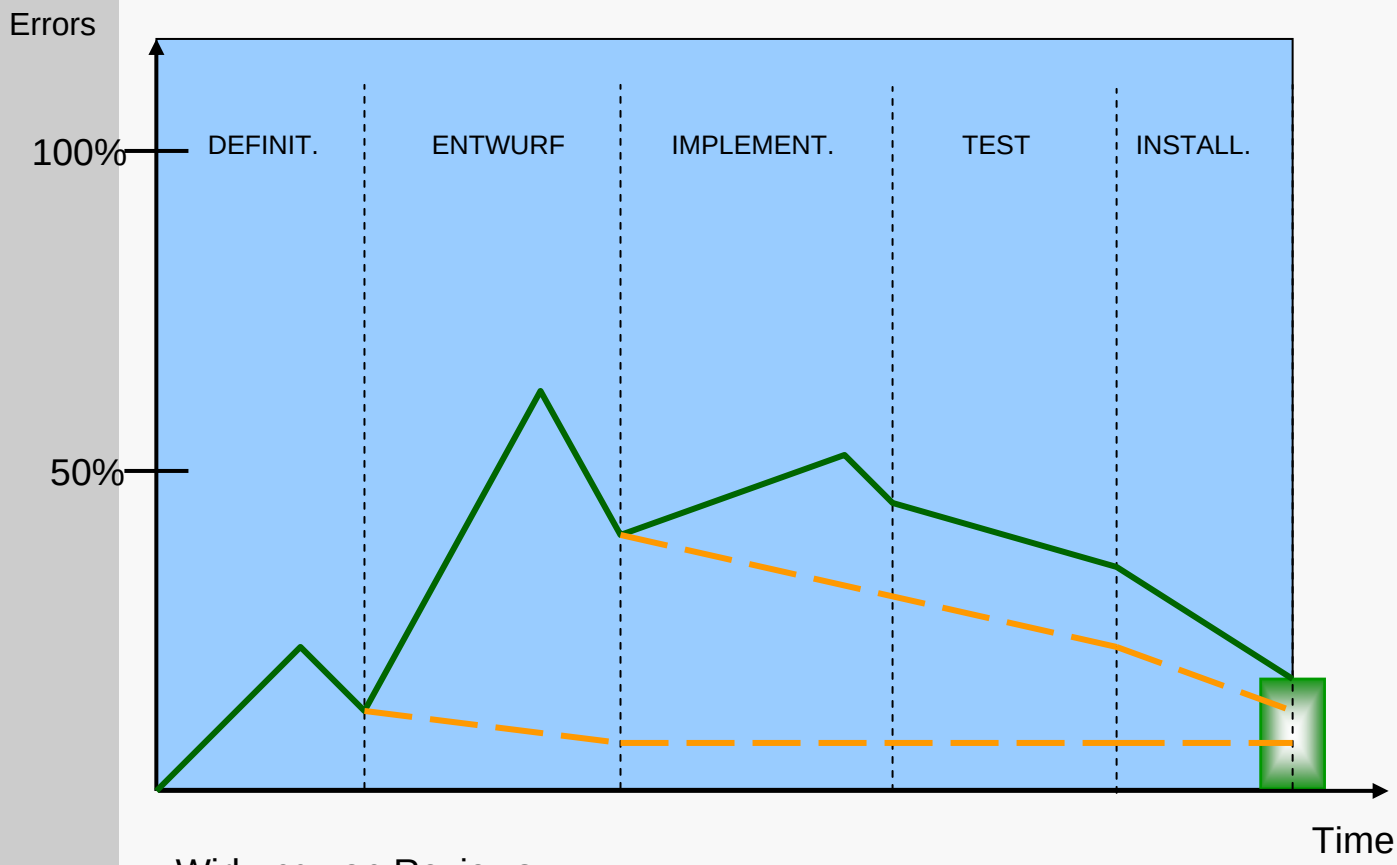
Accumulated errors (II)

with reviews



Wirkung von Reviews

Review Metriks

Error detection rate	[Errors / 100 pages]
Intensity	[h / 100 pages]
Efficiency	[h / errors]
Effectivity	[errors detected / total errors]

Error detection rate (Fehlerfindungsrate FFR)

$$FFR = \frac{\text{errors detected}}{\text{Reviewed pages}} \; 100$$

FFR = 17 ???

FFR-Diagramm

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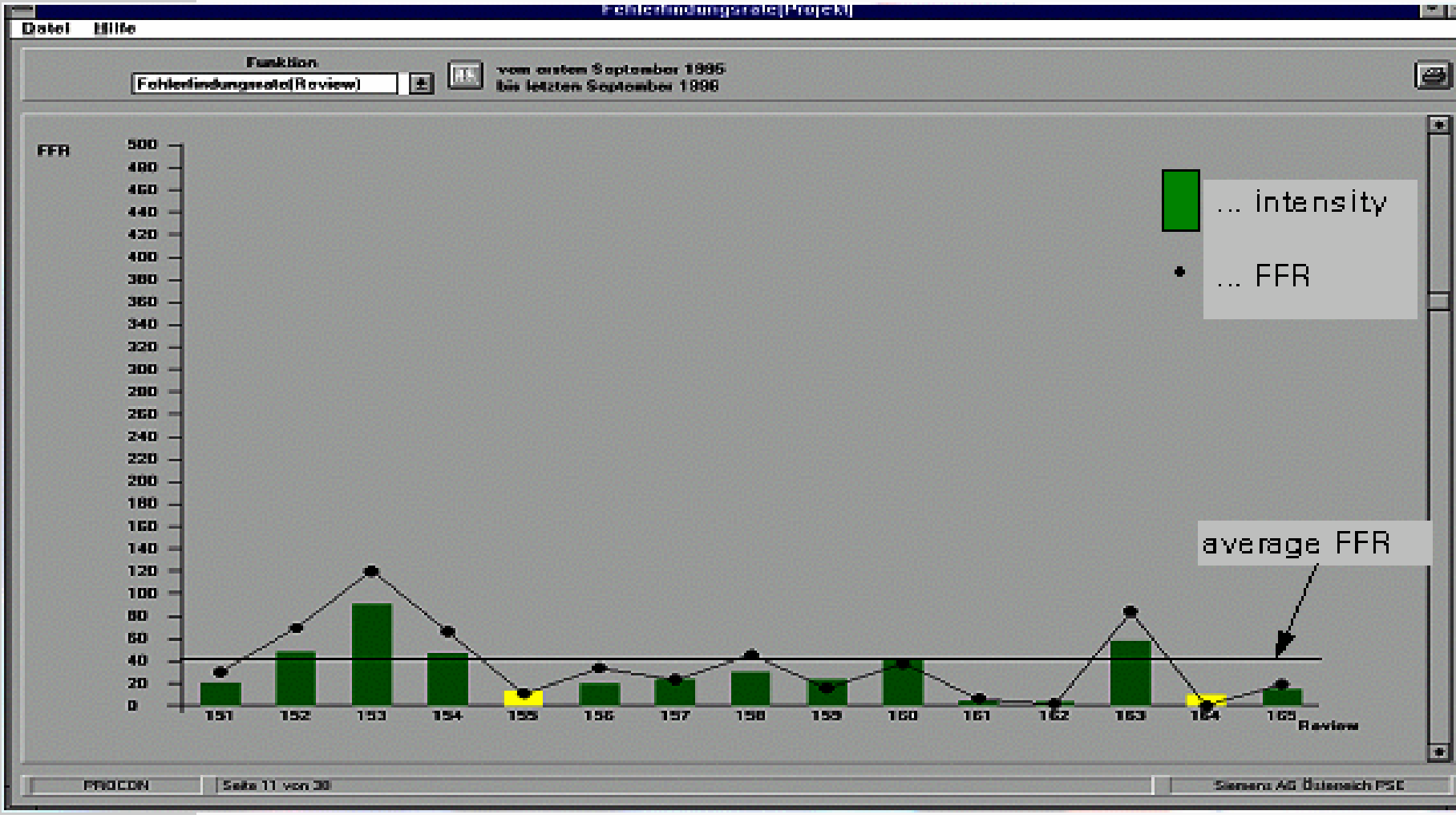


Early Findings

General observations

Average FFR is independent from
- development platform and
- application domain

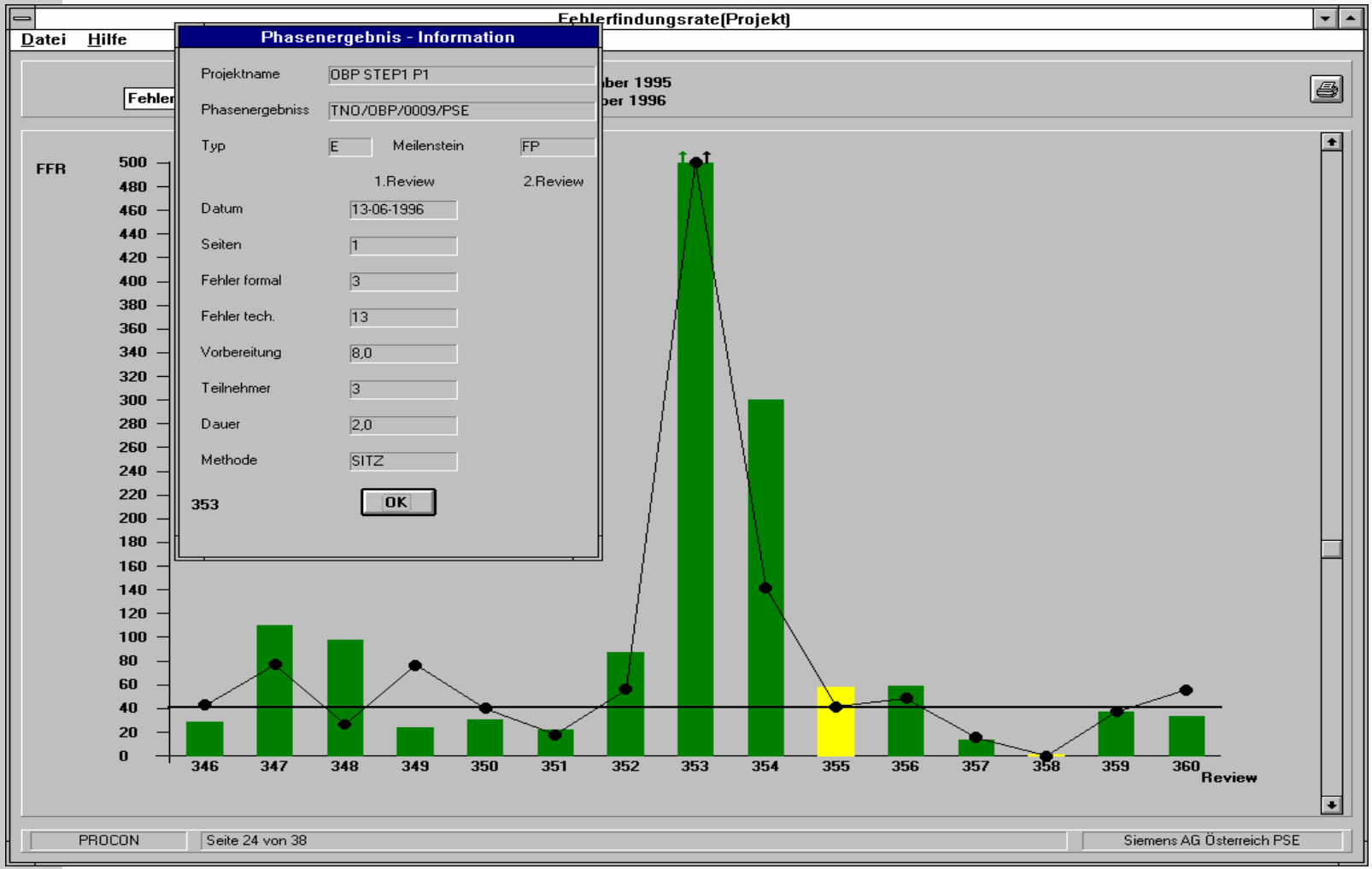
FFR and intensity is high for small documents (<4 pages)

Strong correlation between intensity and FFR

Efficiency is about one hour per defect

Variation is large

Error detection rate



Benefits of Reviews

1993/94
FFR~20

Quality Goal

+ 50 %

1994/95
FFR~40

Many defects found in test

low intensity

Fagan Inspections yielded four times as much defects

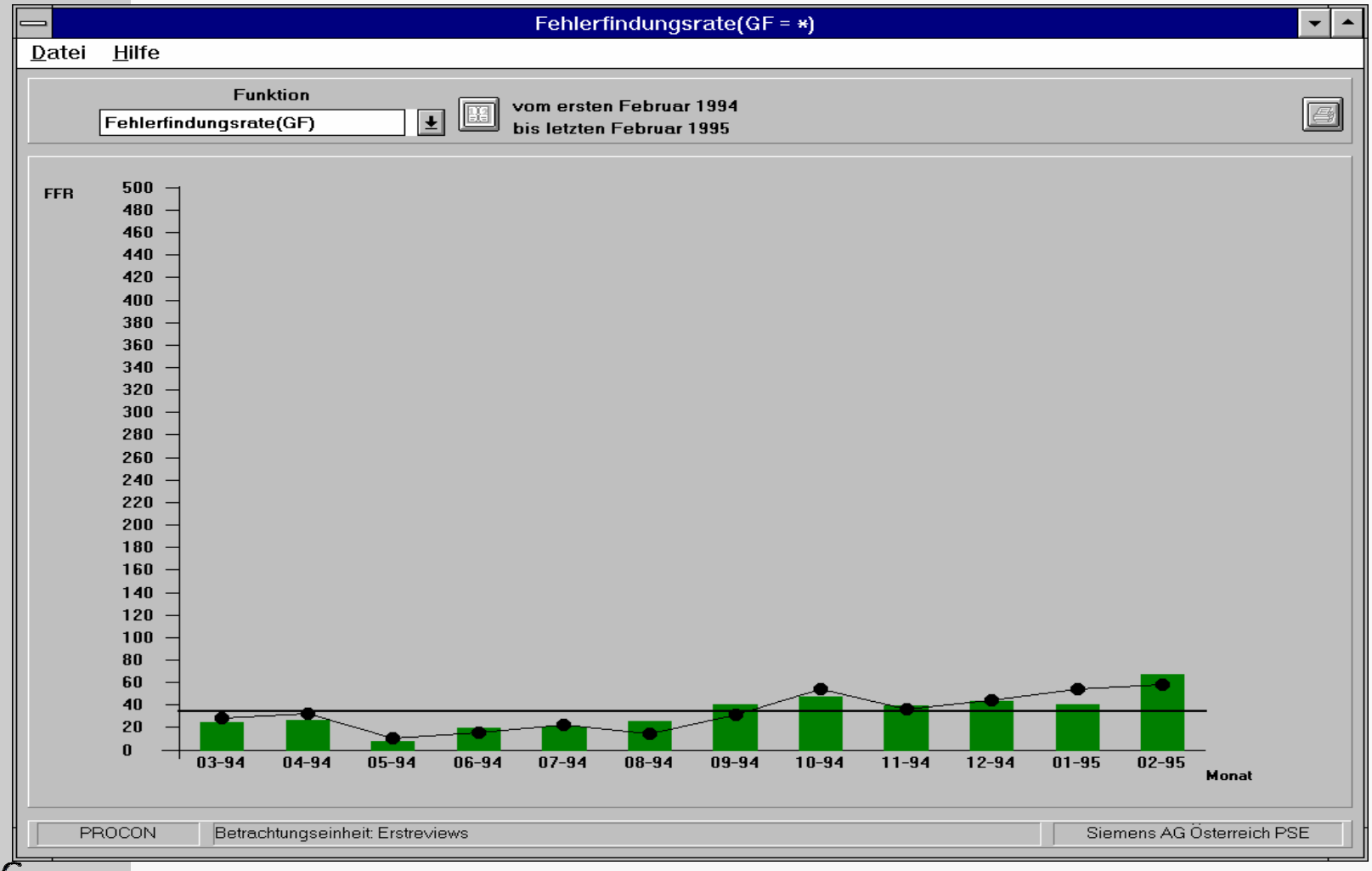
Guideline Training

monthly observation and report

3000 defects more detected in reviews

0,7 million Euro saved

Error detection rate (Organization)



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Concepts of quality management

What is quality management

- QM is a management philosophy
- It originated in Japan around 1950 Deming /Juran
- Key ideas:
  - Market success based on customer satisfaction
  - Product improvement based on process improvement
  - Productivity gains based on error prevention
  - Continuous improvement process
  - Statistical methods

Management philosophies

R.Zultner

Quality management	**Management by objectives**
Process orientation	Results orientation
Systematic approach	Achievement of objectives
Methods	Coincidence, personality
Correct root causes	Correct errors
Quality first	Profit first

Quality ⇒ Customer satisfaction

Customer satisfaction ⇒ Market success

Market success ⇒ **Profit**

Processes

R.Zultner

- Which level of quality will we achieve?
- A process will deliver only what it is capable of delivering, not more and not less
- We only know the capability (what can be achieved) of stable processes
- Forecasts are possible only if the capability is known
- Never set objectives without knowing the capability

Definition of terms

ISO 9000:2000

- **Process**

  A a set of interrelated or interacting activities which transforms inputs into outputs

Statistical methods

- Managing by figures
- Measuring processing
- Monitoring changes from a quantity angle
- Distinguishing natural dispersion from special influences

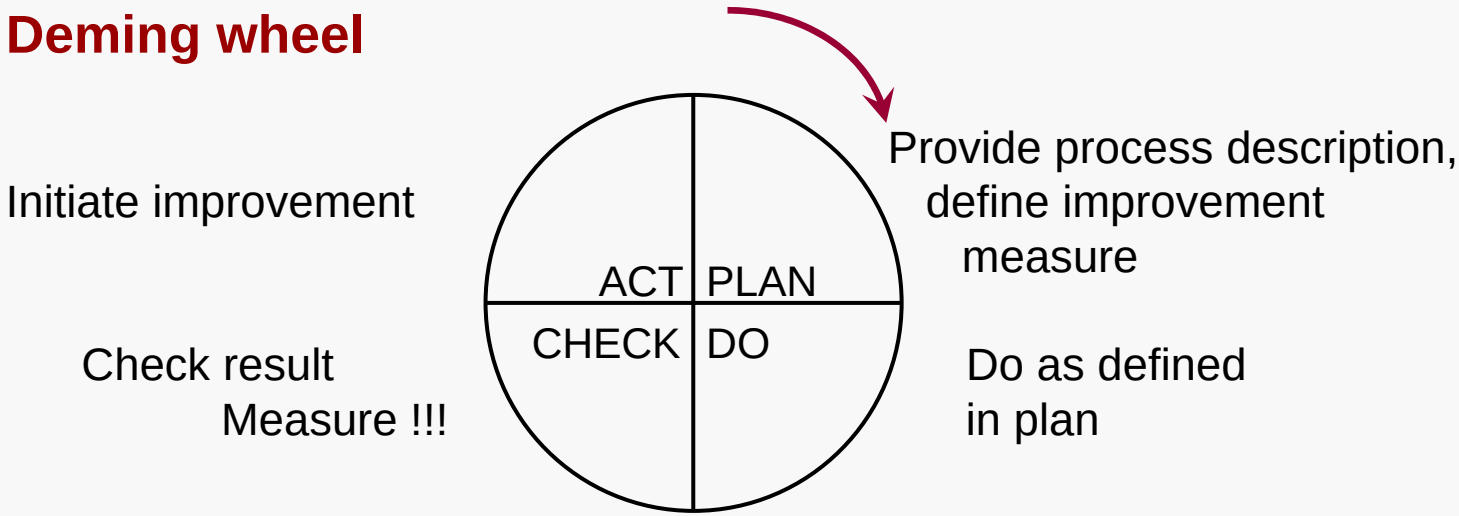
Statistical Process Control (SPC) is not common yet in the SW industry (control charts can be used for stable processes)

Continuous improvement (Kaizen)

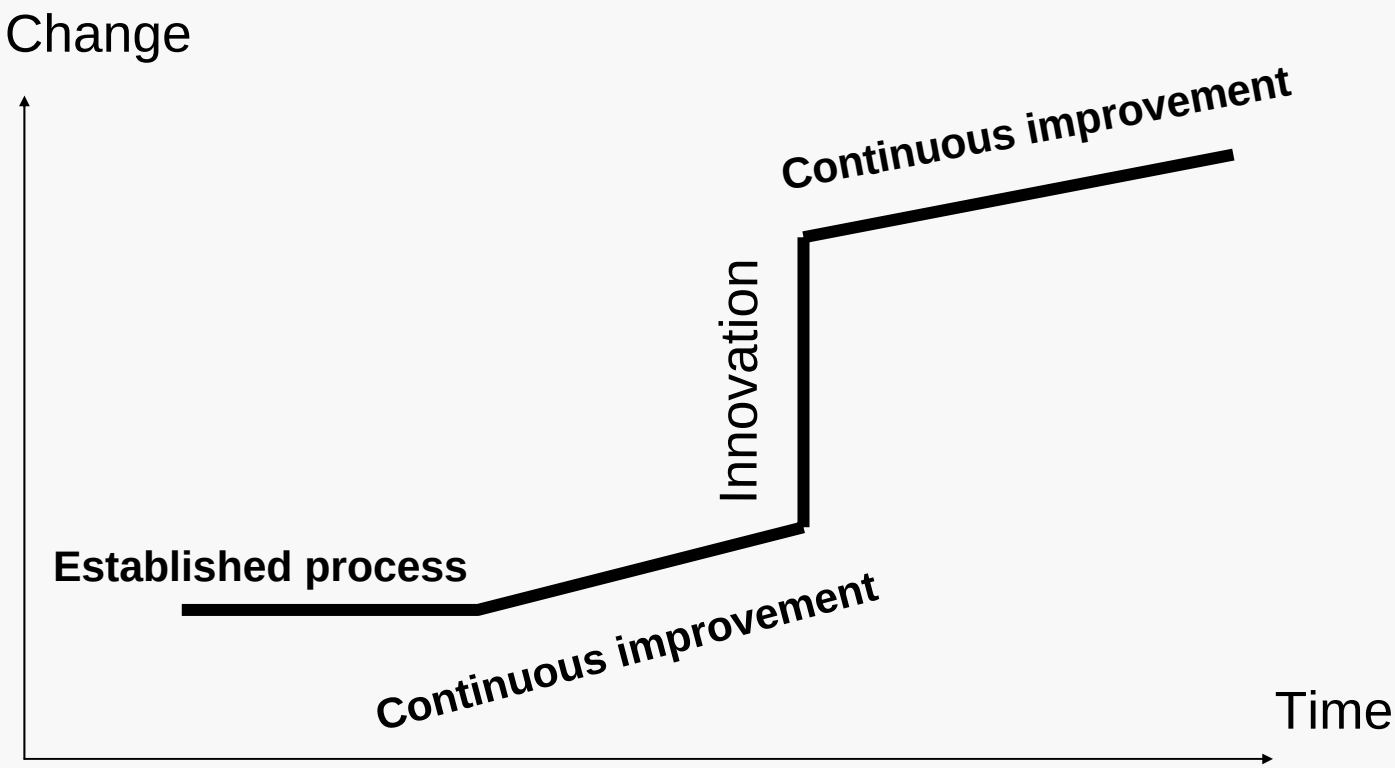
Prerequisite:

- Finding causes, and not scapegoats
  - **To err is human**
    (an error may occur once, but it's bad if it occurs a second time)

Deming wheel

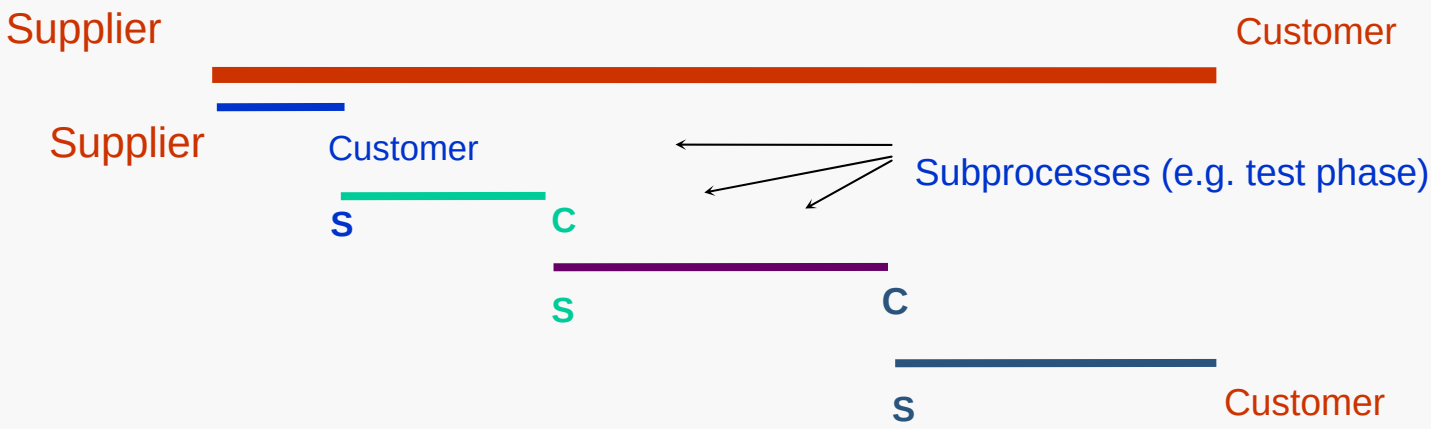


Continuous improvement: innovation



Market success based on customer satisfaction

Thinking in processes (established today?)



Customer-supplier relationship in all (sub) processes
Customers decide what is good! (what they need)

Customer wishes / requirements

Explicit requirements + **implicit requirements**

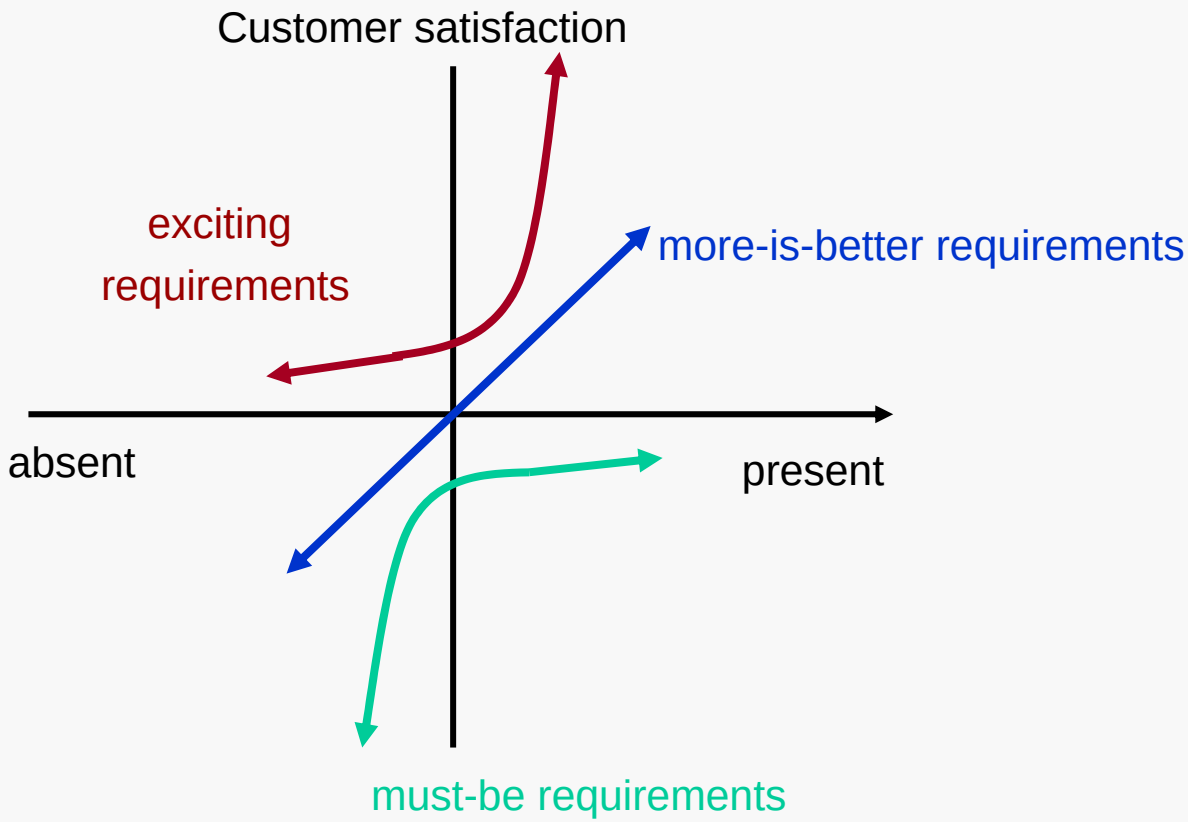
What the customer says ⇔ **What the customer really needs**

Systematic collection of all requirements

Requirements are the benchmark during all stages of development

Method: **Quality Function Deployment**

3 types of requirements (Kano)



What is quality?

ISO 9000:2000

Quality

Degree to which a set of inherent characteristics fulfils requirements

Characteristic

Distinguishing feature

Requirement

Need or expectation that is

stated,

generally implied or

obligatory

What is software quality?

ISO 9126

Software quality attributes

ISO 9126 Software Engineering – Product Quality

Part 1	Quality Model
Part 2	External Metrics
Part 3	Internal Metrics

Software engineering – Product quality

ISO 9126

Part 1: Quality Model

Quality model for external and internal quality

- **Functionality**
- **Reliability**
- **Usability**
- **Efficiency**
- **Maintainability**
- **Portability**

Quality model for quality in use

- **Effectiveness**
- **Productivity**
- **Safety**
- **Satisfaction**

Definition of terms (1)

ISO 9000:2000

- Quality management

  Coordinated activities to direct and control an organization with regard to quality

- Quality assurance

  Part of quality management , focused on providing confidence that quality requirements will be fulfilled

Definition of terms (2)

ISO 9000:2000

- Quality management system

  Management system to direct and control an organization with regard to quality

- Management system

  System to establish policy and objectives and to achieve those objectives

Organizations

- JUSE (Japanese Union of Scientists and Engineers)
- EOQ (European Organization for Quality)
- EFQM (European Foundation for Quality Management)
- AFQM (Austrian Foundation for Quality Management)
- ÖVQ (Austrian Association for Quality Assurance)
- ÖQS (Austrian Association for the Certification of Quality and Management Systems)

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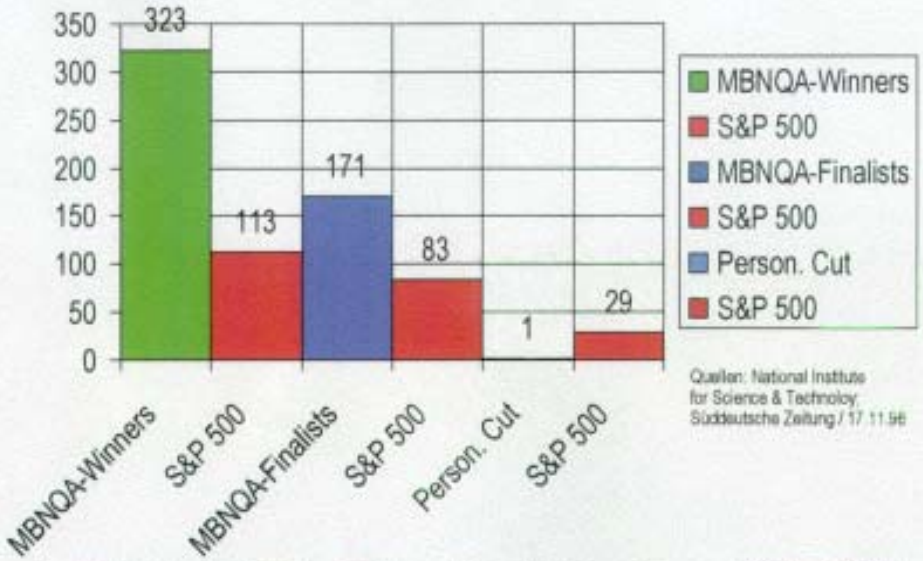
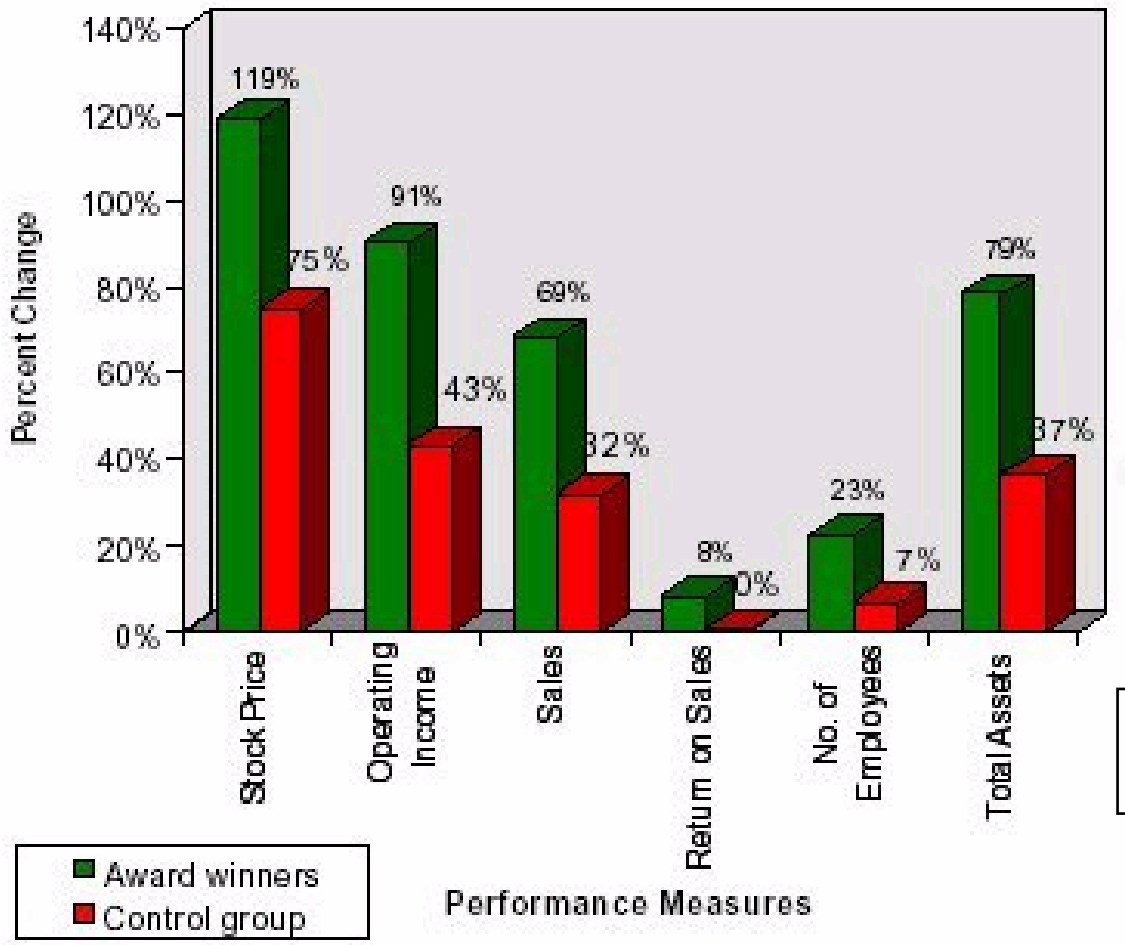
Gewinn durch Qualität



Die 16 *Gewinner* des Malcolm Baldridge National Quality Awards von 1995 - 98 übertrafen beim Return on Investment die Ergebnisse der anderen, im *Standard & Poor´s 500* gelisteten Unternehmen um Faktor drei.
Die 48 *Finalisten* des MBNQA übertrafen den Mittelwert der S&P 500 noch um Faktor zwei.
Unternehmen mit *radikalem Personalabbau* zeigten praktisch keinen Zuwachs des Aktienwertes im Gegensatz zum S&P 500 - Wachstum von 29% im gleichen Zeitraum.

TQM-Intranet / Elemente der Modelle / Martina Lutterbeither / 07.07.1999 Folie 19



Hendricks, Singhal, 2000

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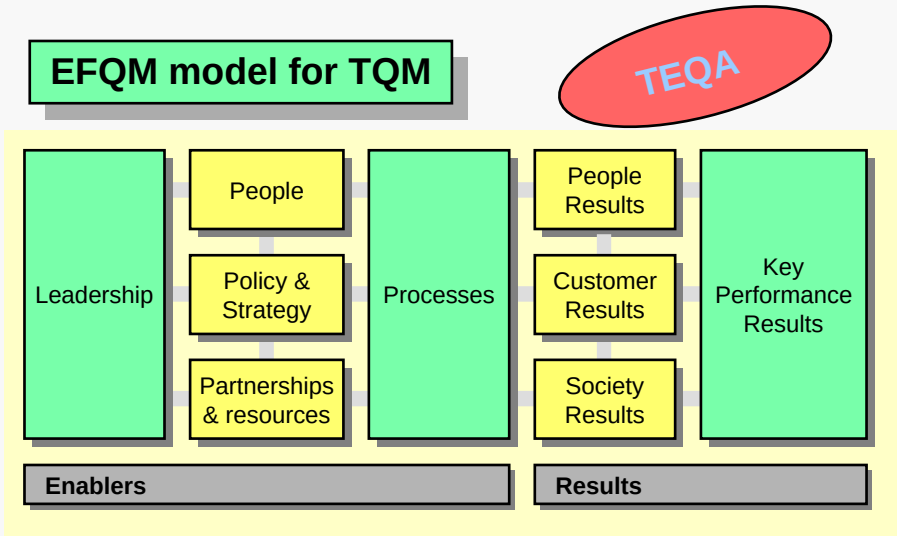
Quality management models

Quality management models



CMMI

CMMI Level

5-level model

Focuses on **processes** and"enablers" relating to **SW development**

Assessments:
SIEMENS: SPA
SEI: Scampi

ISO 9001

ISO certification

Requirements for a quality management system

ISO 9000:2000 series of standards for Quality management systems

ISO 9000:2000 Fundamentals and Vocabulary

ISO 9001:2000 Requirements

ISO 9004:2000 Guidelines for Performance Improvement

ISO 90003 Software engineering – Guidelines to the application of ISO 9001:2000 to computer software

Certification is to inspire confidence in the customer regarding the supplier's capability for quality

Often, certification exists even though requirements are only formally met

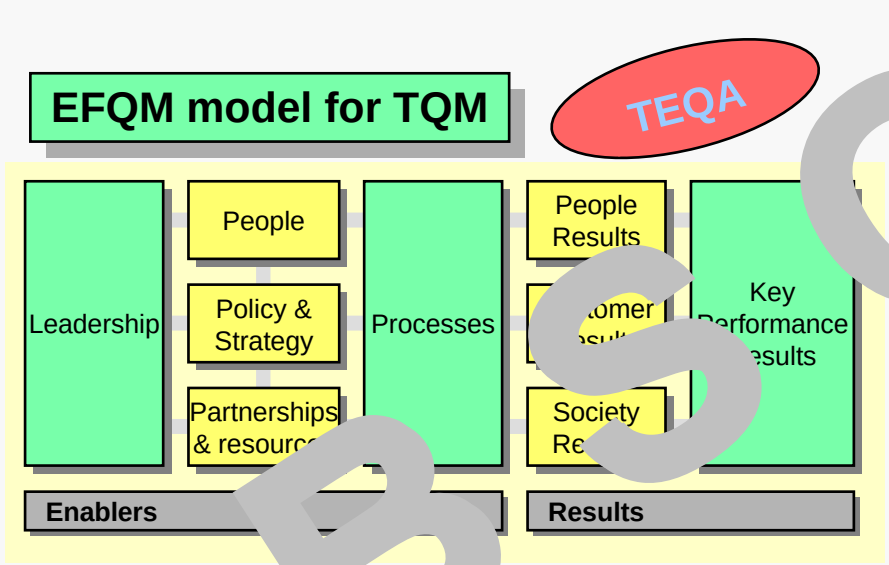
Therefore, the value of certification is frequently being questioned today

Value of a "living" QM system is undisputed

ISO 9000 Quality management principals	
Customer focus	
Leadership	
System approach to management	
Process approach	
Factual approach to decision making	
Involvement of people	
Continual improvement	
Mutually beneficial supplier relationship	

ISO 9000 Quality management principals	EFQM Fundamental concepts of excellence
	Results orientation
Customer focus	**Customer focus**
Leadership	**Leadership & constancy of purpose**
System approach to management	
Process approach	**Management by processes and facts**
Factual approach to decision making	
Involvement of people	**People development & involvement**
Continual improvement	**Continuos learning, innovation & improvement**
Mutually beneficial supplier relationship	**Partnership development**
	Public responsibility

Quality management models



CMMI

CMMI Level

5-[illegible]vel model

Focuses on **processes** and"enablers" relating to **SW development**

Assessments:
SIEMENS:SPA
SEI: Scampi

ISO 9001

ISO certification

Requirements for a quality management system

Balanced scorecard (BSC)

Kaplan and Norton, Harvard Business School, 1992:

- Managing based on balance sheets (i.e. outcomes, post facto) is too inert
- It is necessary to address the factors that lead to outcomes:
  - Identify impacting factors (drivers)
  - Strategically define objectives
  - Monitor achievement (metrics)
- Not just keep an eye on finances, but also on
  - Customers/market
  - People / innovation
  - Internal processes
- The focus is on business strategy

Balanced Scorecard (BSC) at PSE

- ***Joint definition*** of strategic goals, related objectives and their interrelations (strategy map) by the management
  - Overall BSC at the PSE level
  - Business-specific BSCs in the subdivisions and business units
- ***Ongoing monitoring*** of a limited number of quantities at all levels
  - "BSC cockpit" with traffic light representation, early warning indicators, need for action

PSE's strategy map