Introduction to Quality Management

1st Workshop on „QA Issues in Silicon Detectors"
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Curriculum Vitae

• Born 1955, married, two children.
• University education in Mechanical Engineering with emphasis on Production Management.
• Graduated from the University of Dortmund in 1980 with a masters degree in Mechanical Engineering (Dipl.-Ing.).
• Received a PhD (Dr.-Ing.) in 1985 based on the work at the Institute for Industrial Engineering in Dortmund.
• The following 11 years head of the departments of Industrial Engineering and Quality within two german locations of the Philips Company.
• Since 1997 back to applied research as the vice director of the Chair of Quality (Prof. Dr.-Ing. H.-A. Crostack) at the University of Dortmund.
Chair of Quality

• Located at the University of Dortmund, Faculty of Mechanical Engineering.
• Headed by Prof. Dr.-Ing. H.-A. Crostack.
• More than 15 years of research and education in all aspects of Quality Engineering and Management.
• Scope of activities:
  - destructive and non-destructive testing
  - quality management
  - information systems related to quality engineering/management
• Collaboration with the RIF e.V. in education and research (regulated by a co-operation agreement).

(RIF e.V. is a registered non-profit society, founded in 1990 with the aim of enforcing applied research and future development in the field of Computer Integration and Automation at the various stages of a product’s life cycle)
Quality - What?!?
This presentation will show you

- a brief survey of the history of Quality Management
- the backgrounds of „modern“ Quality Management
- some of Quality Management Terminology
- the contents of different Quality Functions
- the correlations between Product Life Cycle Models and Quality Management
- examples of Quality Methods and Tools and where to apply
- how to plan complex Development Projects by means of Project Management and Milestone Planning
Quality Management is ....

... to prevent you from things happening like this 😊

Non-official Definition of Quality Management
History of Quality Management

1950
- final inspection and test
- quality improvement by decreasing tolerances
- focused on product

1960
- quality assurance in design and development
- quality improvement by preventive actions
- beginning of process orientation

1970
- quality assurance in design and development
- quality improvement by preventive actions
- beginning of process orientation

1980
- systematization of quality related activities
- documentation of structure and procedures
- registration of quality systems to demonstrate the ability to provide products that fulfil customer requirements
- management approach centered on quality
- customer driven activities
- examination of all business processes
- special role of the top management

1990
- TQM
- QA/QM-Systems
- QS 9000
- Environmental Mgmt

Inspection

Quality Assurance
Lehrstuhl für Qualitätswesen

Product Life Cycle Phases

Where 75% of defects are originated

Where 80% of defects are corrected

Origination of Defects

Correction of Defects

[Source: Jahn]

„Jahn Graph“
Costs per Failure

Product Life - Cycle Phases

Definition | Development | Operations Planning | Production | Inspection | Use

Rule of Ten

[Source: Daimler Benz]
Quality Loop Model (ISO 9004:1994)
“Product” means any of the following: Products, Services, Offers, Platforms

[Source: AT&T, 1996]
Continual Improvement of the Quality Management System

Customer

Requirements

Input

value-adding activities

Product

Realization

Product

Resource Management

Measurement Analysis and Improvement

Management Responsibility

Output

Satisfaction

[Source: ISO 9000:2000]

Model of a process-based Quality Management System

Lehrstuhl für Qualitätswesen
Quality Management

„Coordinated activities to direct and control an organization with regard to quality.“

- Quality Planning
  - Part of quality management focused on setting quality objectives and specifying necessary operative processes and related resources to fulfil the quality objectives

- Quality Control
  - Part of quality management focused on fulfilling quality requirements

- Quality Assurance
  - Part of quality management focused on providing confidence that quality requirements will be fulfilled

- Quality Improvement
  - Part of quality management focused on increasing the ability to fulfil quality requirements
Quality Management Functions

**Quality Planning**
- define quality objectives for all relevant functions and levels within the organization
- plan the quality management system
- determine quality objectives and requirements for the product
- establish quality plans
- identify and prioritize quality characteristics
- define tolerances

use quantitative methods, i.e.
- QFD
- FMEA
- DoE

**Quality Control**
- perform quality surveillance
- carry out inspections
- take corrective actions

examples:
- management reviews
- internal audits
- quality evaluation
- measuring, examining, testing or gauging one or more characteristics of an entity
- monitoring and measurement of processes

**Quality Assurance**
- establish the quality management system documentation

examples:
- quality manual
- documented procedures
- quality records

**Quality Improvement**
continually improve the effectiveness of the quality management system

examples:
- establish quality circles
- training of the personnel
- motivation of the personnel
- take actions to eliminate the causes of nonconformities
- eliminate the causes of potential nonconformities
Document specifying which procedures and associated resources shall be applied by whom and when to a specific process, product, project or contract.
## Use of Quality Management Methods

### Quality Control / (-Assurance)

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<th>SPC</th>
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**Audits**

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### Quality Planning

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<th>FMEA</th>
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### Marketing and Market Research

<table>
<thead>
<tr>
<th>Product Design and Development</th>
<th>Process Planning and Development</th>
<th>Purchasing</th>
<th>Production</th>
<th>Verification</th>
<th>Packaging and Storage</th>
<th>Sales and Distribution</th>
<th>Installation and Commissioning</th>
<th>Technical Assistance and Servicing</th>
<th>Disposal or Recycling</th>
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<td>DFMA</td>
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<td>Failure Mode and Effects Analysis</td>
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Quality Function Deployment (QFD) is a customer-oriented approach to product innovation.

- puts the focus on the customer
- helps to manage the process of product creation
- reduces the time-to-market
- leads to lower costs
- promotes cooperation and communication between functions
- supports organizational learning

House of Quality

Quality Function Deployment
The translation of customer needs into manufacturing requirements is supported by a sequence of four „Houses of Quality“:

1. Customer requirements are translated into product specifications
2. Product specifications are translated into component characteristics
3. Component characteristics are translated into production process characteristics
4. Process characteristics are translated into manufacturing specifications

QFD-Sequence according to ASI
Use Project Management Principles taking into account following Fundamentals:

1. Define the Scope
   - customer requirements
   - technical solution (or proposal)
   - time line
   - costs
   - constraints

2. Select and Organize the Team
   - invite all disciplines involved
   - select the team leader
   - define roles and responsibilities
   - describe ways of communication and documentation method to be used
   - identify customers and suppliers involved (external / internal)

3. Train the Team Members
   - common understanding of requirements
   - skills needed in project

4. Use Simultaneous Engineering
   - avoid sequential phases
   - early involve different disciplines

5. Define Milestones
   - number and timing of milestones
   - contents of milestone reviews
   - members of milestone reviews
   - how to resolve concerns

Quality Planning for comprehensive Projects
### Example: Responsibility Matrix

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<td>incorporate Business Case into Business Plan of AT</td>
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<td>Define position of new product within MTN Product Platform</td>
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<td>Describe consequences of market introduction for existing products</td>
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<td>Adapt concerned Business Plans</td>
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<td>inform respective departments in case of yes</td>
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<td>Prepare Advance Product Information</td>
<td>API Announcement</td>
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(V: responsible; M: collaboration; I: information)
Gate 4: „From Development to Deployment“

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<th>Project Name:</th>
<th>Review Date:</th>
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<td>Project Leader:</td>
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<td>Project Type:</td>
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**Required Gate Review Inputs**

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<th>YES</th>
<th>NO</th>
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<tr>
<td>4.1</td>
<td>Updated Business Case and comparison to Gates 2 &amp; 3 Business Cases</td>
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<td>4.2</td>
<td>Updated Project Support Plans</td>
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<td>4.3</td>
<td>FOA Completion Notice or Applicable Field Test Results</td>
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<td>4.4</td>
<td>Statement of project costs to reach Gate 5</td>
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**Gate Review Decision Criteria**

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<td>4.5</td>
<td>Is the project still aligned with the objectives of the original Business Case?</td>
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<td>4.6</td>
<td>Can the product be manufactured within target cost?</td>
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<td>4.7</td>
<td>Is there a plan for asset management?</td>
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<td>4.8</td>
<td>Is implementation of the project support plans on schedule?</td>
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<td>4.9</td>
<td>Is the customer documentation complete?</td>
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<td>4.10</td>
<td>Is customer training available?</td>
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<td>4.11</td>
<td>Are the documentation, tools, and training to support Sales, Engineering, Ordering, Technical Support, Installation, and Training staff available?</td>
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<td>4.12</td>
<td>Is the manufacturing ramp-up schedule and inventory plan baselined?</td>
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<td>4.13</td>
<td>Has a design review shown the Project to be supportable?</td>
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<td>4.14</td>
<td>Has a design review shown the Project to be manufacturable, serviceable, and maintainable?</td>
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<td>4.15</td>
<td>Are relevant BCPs being planned for the next phase?</td>
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<td>4.16</td>
<td>Does the Project meet customer requirements? (This must be shown in an integrated system test or other appropriate setting.)</td>
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[Source: AT&T, 1996]
Product Quality Planning Timing Chart

[Source: QS 9000, APQP]
Phase 1: Plan and Define Program

Outputs:
- Design Goals
- Reliability and Quality Goals
- Preliminary Bill of Material
- Preliminary Process Flow Chart
- Product Assurance Plan
- Management Support
Phase 2: Product Design and Development

Outputs by Design Responsible:
• Design FMEA
• Design for Manufacturing and Assembly
• Design Verification
• Design Reviews
• Prototype Build
• Engineering Drawings
• Engineering Specifications
• Material Specifications
• Drawing and Specification Changes

Outputs by Q-Planning Team:
• New Equipment, Tooling and Facility Requirements
• Special Product and Process Characteristics
• Prototype Control Plan
• Gages/Testing Equipment Requirements
• Team Feasibility Commitment & Management Support

Outputs Phase 2
Phase 3: Process Design and Development

Outputs:
- Packaging Standards
- Product / Process Quality System Review
- Process Flow Chart
- Floor Plan Layout
- Characteristics Matrix
- Process FMEA
- Pre-Launch Control Plan
- Process Instructions
- Measurement Systems Analysis Plan
- Preliminary Process Capability Study Plan
- Packaging Specifications
- Management Support
Phase 4: Product and Process Validation

Outputs:

- Production Trial Run
- Measurement Systems Evaluation
- Preliminary Process Capability Study
- Production Part Approval
- Production Validation Testing
- Packaging Evaluation
- Production Control Plan
- Quality Planning Sign-Off and Management Support
Phase 5: Feedback, Assessment and Corrective Action

Outputs:
- Reduced Variation
- Customer Satisfaction
- Delivery and Service
Voice of the Customer