Lecture Quality Management

01 Introduction

Prof. Dr.-Ing. Robert Schmitt
Dates of lectures

The lectures in Quality Management take place every Wednesday from 1:00 pm to 2:30 pm in Room 38 A 1 of the ITMC (Worringer Weg 1).

14.10.09  1. Introduction
21.10.09  2. Normative Quality Management Systems
28.10.09  3. Strategic Quality Programs
04.11.09  4. Quality and Economics
18.11.09  5. Quality during Field Operation
25.11.09  6. Quality Management in the Production
02.12.09  Case Study: KAIZEN Lecturer Dr. Starke
13.01.10  9. Quality Management in the Early Phases – Focus Faults and Defects
20.01.10  10. Quality Management in the Procurement
27.01.10  11. Quality and Information
03.02.10  12. Quality Management in Service Industries

see also www.wzl.rwth-aachen.de
### Dates of Exercises

The Exercises in Quality Management take place every Thursday from 4:00 pm to 5:30 pm in **Room 38 A 3 of the ITMC Worringer Weg 1).**

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
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<tbody>
<tr>
<td>15.10.09</td>
<td>1. Quality Management Tools</td>
</tr>
<tr>
<td>22.10.09</td>
<td>2. Basics of Statistics</td>
</tr>
<tr>
<td>29.10.09</td>
<td>3. Implementation of a Quality Management System</td>
</tr>
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<td>05.11.09</td>
<td>4. Quality and Costs</td>
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<td>19.11.09</td>
<td>5. Evaluation of Test and Field Data</td>
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<td>26.11.09</td>
<td>6. Statistical Process Control (SPC)</td>
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<td>10.12.09</td>
<td>7. Quality Function Deployment (QFD)</td>
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<td>17.12.09</td>
<td>8. Design of Experiments (DoE)</td>
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<td>14.01.10</td>
<td>9. Failure Modes and Effects Analysis (FMEA)</td>
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<td>21.01.10</td>
<td>10. Assessment of Suppliers</td>
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<td>28.01.10</td>
<td>11. Practical Computer Training</td>
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<td>(ADITEC Room 102/103; 4:00 - 5:30pm)</td>
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<tr>
<td>04.02.10</td>
<td>12. Quality Management in Service Industries</td>
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</tbody>
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see also [www.wzl.rwth-aachen.de](http://www.wzl.rwth-aachen.de)
Information Concerning the Examination „Quality Management“

Examination in „Quality Management“

– It will be an examination of 120 minutes which consists of 6 exercises.

– Relevant for the examination are the lectures as well as the exercises.

– Not relevant for the examination, but nevertheless very interesting is the “CAQ-Workshop” and the case study.

– The exam will take place
  11. February 2010; 14:00-16:00h
  Kármán-Auditorium, Fo4

see also www.wzl.rwth-aachen.de
Offers During the Lecture „Quality Management“

- Lectures with participation of lecturers from the industry
- Exercises and practical work with industrial examples of use
- The practical computer training is limited to 2x20 participants
  The registration can be done in during the first lecture.
- Time for questions during and after the lectures and exercises
- 2 consultation-hours with the assistants before the exam
- Extensive lecture notes (see slide with lecture notes sale)
- Exams of the last 5 terms with sample solutions (see slide with lecture notes sale)

see also www.wzl.rwth-aachen.de
Lecture Notes Sale

Sale of the lecture notes „Quality Management“

When? Tuesday and Thursday
      From 1:00 to 2:00 pm

Where? WZL
       Room 009, 53B
       Steinbachstrasse 53B

Costs: € 20,-

For exam preparation the tasks and sample solutions of exams of the last 5 semesters can be bought at the WZL.

see also www.wzl.rwth-aachen.de
Further Literature

T. Pfeifer:
Qualitätsmanagement
Strategien-Methoden-Techniken

T. Pfeifer:
Qualitätsmanagement Praxishandbuch

T. Pfeifer:
Quality Management
Strategies-Methods-Techniques
Your person of contact concerning the lecture „Quality Management“

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E-Mail: H.Lieb@wzl.rwth-aachen.de
Steinbachstraße 25
Aditec Room 112
52074 Aachen

see also www.wzl.rwth-aachen.de
Contents

- Understanding of Quality and Quality Management
- Consequences of Bad Quality
  - Economical
  - Image
  - Judicial
- Importance of Quality Management
- Ensuring High Quality – But How?

Literature
Understanding of Quality

Colloquial, often referring to products:
- Free from defects
- Lasting
- Of higher value

Definition of quality

„Quality is the overlap rate of explicit as well as implicit customer demands with the supplied product characteristics.“

„Target“ = Demands
„Actual“ = Characteristics

Quality

...according to this, quality is customer satisfaction.

The colloquial understanding of quality often refers to product quality regarding characteristics like no defects, long-lasting and high value. The modern, corporate understanding of quality exceeds the colloquial one and is seen as the overlap rate of „target“ and „actual“. The term „target“ holds explicit expressions by a customer as well as those which remain unspoken and are just implicit wishes. Those can be technical characteristics but also subjective issues, delivery time and price of a product (exact: of a set of characteristics). The understanding of quality will be examined in detail in chapter 2.
Measures of Quality Management

The Quality Management has the responsibility to take measures in order to guarantee the quality in the entire company. A clear development of Quality Management is to be observed.

Shaped by the Tayloristic approach of “division of labour”, the activities of quality assurance were first limited with the final inspection whereby the principle of “failure detection with objective” dominated the sorting out of incorrect parts.

In the 30's the focus was directed from the product towards the manufacturing process. Although the basics for the development of statistical activities for process control and monitoring were already compiled during this time, the application took place many years afterwards.

Since the beginning of the 80's the activities of quality assurance were focused on production planning stages (off-LINE). With the use of the preventive quality assurance methods the aim is to detect failures at the planning stages before production starts and prevent the occurrence by suitable measures.
Quality Management is the sum of structures and activities (processes) that aim at generating maximum corporate quality. In fact, this definition affects many different fields of a company. For example, the project management, the organisational structure, etc. This means, that Quality Management can not be separated from the companies’ day-to-day business.

But how can the Quality Management be specified if it can’t be seen separated from management, development, production, planning etc.? Quality Management helps to understand everything that is going on in the company, to identify coherences and to modify the control levers for success pointedly and systematically (corporate quality). On the one hand, this means the conservation of quality within the company, on the other hand the continuous improvement; Starting microscopic e.g. with the task and process of a worker (terms of ergonomics), this leads to macroscopic fields (e.g. company strategy).
Structuring the Control Levers in Companies and in the Lecture

Quality Management Systems and Models structure the control levers of success in a company (see lecture 2 and 3). Starting from the customer different fields of Quality Management also occur along the product lifecycle.

Lecture 2: Standardised Quality Management Systems, terms etc.
Lecture 3: Strategic Quality Programs, company modelling/ focusing
Lecture 4: Economical point-of-view

Frame of action

9: Preventive error avoidance
7: Development, directed Innovation
6: Production
5: Product use and field data

10: Purchase
11: Networking, Information und IT-Support
12: Translation of contents to the service and hybrid sector

According to the widespread definition of Quality Management, the lecture shows the whole company. Lecture 2 and 3 open up the frame of action and highlight how companies can be modelled (pictured). Goal of Quality Management Systems and Quality Programs is not only to give a simplified picture of the company, but to be more specific: The transparency, delivered by the visualisation, shows weaknesses, allows comparisons of companies and enables the definition of minimum requirements for the organisation of a company (e.g. certification).

Lecture 4 widens the view for company-wide coherence of quality and economics before individual divisions of the company are considered.

Lecture 5 focuses on the end of the product lifecycle, where the paying customers decide about good or bad quality. In this stage a company can learn a lot - the lecture shows how.

Backtracking the product creation process, the production (lecture 6) and the development with a directed innovation represent important milestones on the way to generating external customer satisfaction. Lecture 8 shows how business processes - also in development and production - can be optimised systematically. After that lecture 9 concentrates on a preventive layout of product- and process.

The purchase (lecture 10) represents another pre-stage in the product creation process. Lecture 11 connects the prior contents with the IT-branch and points out the important benefits that can be derived.

Finally lecture 12 translates the content of the former lectures to the industrial service sector.
Consequences of Bad Quality - At a Glance

"90% of customers, which are dissatisfied with the product quality, avoid the product in the future."

"Each customer will communicate his dissatisfaction to at least 9, sometimes 20, people."

"Only 4% of the dissatisfied customers complain about the bad quality."

"Each failure above the acceptable average of market leaders causes a decrease of the selling volume by 3-4%.

<table>
<thead>
<tr>
<th>Failures/Unit</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected failure rate (%)</td>
<td>90</td>
<td>80</td>
<td>70</td>
<td>60</td>
<td>50</td>
</tr>
<tr>
<td>Expected selling volume (%)</td>
<td>100</td>
<td>90</td>
<td>80</td>
<td>70</td>
<td>60</td>
</tr>
</tbody>
</table>

Source: Study about Investment goods sector

1 Mio. € Warranty costs
1 Mio. € Costs for elimination of defects
5 Mio. € Missed sales and corresponding profits

Quality is the crucial requirement for a “good reputation”. Those who have it, will find all doors open, but those who have lost it, frequently perish or have to struggle desperately to have their names associated with that magic word “Quality” again.

A customer, who is dissatisfied with the product or the performances of the company and shares this idea with other people, has a great importance for the company. He represents only the tip of the iceberg.

About 24 further customers are dissatisfied with the product but do not express this to the company.

Not only the company suffers from dissatisfaction, but also other people. In some cases this is even more than 20 people.

Failures lead to the fact that buyers avoid the product in the future and this leads to sales and market share losses.
### Consequences of Bad Quality – At a Glance

<table>
<thead>
<tr>
<th>Consequences of bad quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Customer dissatisfaction</td>
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<tr>
<td>- Image damage</td>
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<tr>
<td>- Reduction of market value</td>
</tr>
<tr>
<td>- Complaints</td>
</tr>
<tr>
<td>- Product recalls</td>
</tr>
<tr>
<td>- High financial effort</td>
</tr>
<tr>
<td>- ...</td>
</tr>
<tr>
<td><strong>Product quality</strong></td>
</tr>
<tr>
<td>- Waste</td>
</tr>
<tr>
<td>- Deficiency of efficiency and eventually even effectiveness</td>
</tr>
<tr>
<td>- Internal customer dissatisfaction</td>
</tr>
<tr>
<td>- Demotivation</td>
</tr>
<tr>
<td>- ...</td>
</tr>
<tr>
<td><strong>Process quality</strong></td>
</tr>
<tr>
<td>- Bad differentiation from competition</td>
</tr>
<tr>
<td>- Demotivating company culture</td>
</tr>
<tr>
<td>- Disorientation caused by imprecise responsibilities</td>
</tr>
<tr>
<td>- Demotivation by lack of attraction</td>
</tr>
<tr>
<td>- Fear caused by lack of competence</td>
</tr>
<tr>
<td>- ...</td>
</tr>
<tr>
<td><strong>System quality</strong></td>
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The classic understanding of quality differs between product, process and system quality. The consequences of bad quality can be differed accordingly.
An Example From the Past: The „Ford - Pinto Desaster“

**Situation:**
- High competition, especially in the compact car segment
- Short development period demanded
- High cost pressure

**Product specifications („Green Book“):**
- „Low Cost of Ownership“
- Purchase price below 2000 $
- Weight below 2000 pounds.
- Big trunk
- „Safety doesn´t sell“
Risks Have to Be Analysed in a Holistic Way

(Pre-) Start of production:
- Crashtest showed a high fire risk in case of rear impact, even at low speed
- Technical solution (11$ additional expenses per car vs. 180 expected dead people at a „price“ of 200,000$)

Actual consequences:
- Conservative approximation 500 dead people
- Recall of 1,2 Mio Pinto not until 5 years after SoP
- Absolute additional costs of more than 300 Mio $
### Spectacular Product Recalls

<table>
<thead>
<tr>
<th>Product Recall</th>
<th>Cause</th>
<th>Recall Amount</th>
<th>Paid Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Damaged Tires</td>
<td>In the year 2000 tires of the Japanese company were responsible for the overbalancing of Ford Explorer all-terrain vehicles. This problem ended in the biggest callback worldwide.</td>
<td>14.4 million tires</td>
<td></td>
</tr>
<tr>
<td>Poison in Cans</td>
<td>In 1999 the beverage company had to callback Coke-cans in Belgium and Luxembourg. While transportation on wood pallets the cans were contaminated by timber preservatives before bottling.</td>
<td>800 million US-Dollar</td>
<td></td>
</tr>
<tr>
<td>Dangerous side effects</td>
<td>The cholesterol-downer Lipobay was taken out of worldwide commerce by the pharmaceutical company. In case of combination with another substance serious side effects occurred.</td>
<td>52 deaths</td>
<td></td>
</tr>
<tr>
<td>Fire in the engine compartment</td>
<td>In September 2001 the automotive company started a callback for the brands Chrysler and Jeep. Causes: Risk of fire in the engine compartment, problems with the automatic and defective welding seams at the gear box.</td>
<td>3.1 million cars</td>
<td></td>
</tr>
<tr>
<td>Oily protheses</td>
<td>In the year 2000 the Swiss medical technology-company had to callback artificial knee- and hip-joints. The protheses were polluted by mineral oil.</td>
<td>1 billion US-Dollar</td>
<td></td>
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</tbody>
</table>

The list of spectacular product recalls shows, that not only automotive companies are affected but also companies of other branches.
Quality Management increases effectiveness, efficiency and leads to motivated, qualified and informed employees. Company success is based on these three columns.
The connection between an increase of quality and the success of a company has already been identified long ago. Professor Deming, an American scientist who had great success in introducing and realising Quality Management in Japan and who is one of most well known scientists in the fields of quality, visualised this coherence in the “Deming-Chain”.

This chain gives a causal relationship between advance in quality and company success. Of course the relationships in the chain just give a simplified picture of the actual very complex coherences, but they show the main relations and thereby create an awareness for the importance of quality.
Importance of Quality Management

Quality Management focuses all factors for company success. The lectures show how to modify them systematically and pointedly by understanding the company coherences.

The key factors for company success have a direct cause-and-effect-relationship.
Success is Based on Several Columns

Like the previous slide showed, the factors for success provide coherences in form of direct cause-and-effect relationships.

With this column based visualisation the diversity of perspectives and the amount of coherences becomes even more obvious. Quality Management claims to check each perspective and to learn from this regarding corporate quality.
Determining the Time for Improvement Is Important

Failure prevention in the early phases does not only save time and money, but increases the customer satisfaction.

Not Only Modifying the Control Lever Is Important, But Also Determining the Time
The earlier the control lever for corporate quality is moved into the right direction the stronger is its impact.

Necessity of Quality Planning
The economical importance of Quality Planning cannot be measure, assuming that during the development and construction of a product already almost 70% of the later production costs are determined.

At the same time, today 70-80% of all product failures have their origin in planning and designing steps before SoP. In contrast to this, measures for the elimination of failures start way to late – often in end-of-line tests or already at the customer.

So the aim is, to reduce the amount of failures and their causes and to move their detection to the early phases of the product creation. With a widespread failure prevention and a strict process organisation, less failure should occur and more failures can be eliminated at an early stage.

According to this, less failures are made and follow-up costs can be reduced (see picture on the right: 10-times rule for follow-up costs of failures). So time and money can be saved and consequentially due to higher quality the customer satisfaction is increased.
Deming Circle, Pareto Principle
As a first example for the „How“ a proceeding-model, a recommended action for a good determination of goals and a visualisation of coherences will be explained:

The Deming circle describes a systematical approach towards continuous improvement. The goals which are identified in the step “plan” should fulfil the SMART-requirements. The Pareto principle shows that (e.g. by recurrences of the PDCA circle) the progress towards perfection decreases. Thus, different further proceedings can be derived if necessary (see further lectures).

Those three different examples/methods indicate, that Quality Management is scalable – from generic to specific – and that the bigger picture has to be kept in mind.

Details for Continuous Improvement
Often right from the beginning the focus lies on perfect solutions. To identify and realise such solutions, usually a lot of time and personnel is necessary. In addition, the danger that a solution, which has been developed with high effort turns out to be improper or adverse during the realisation, exists. Therefore, it often makes more sense not to concentrate on perfect solutions exclusively, but also to consider solutions, which are quickly realisable.

After the introduction, there comes a phase of continuous improvement. Within this phase the focus should be on testing and verifying the implemented methods and measures, as well as challenging the processes and structures to enhance further improvements. Therefore, the Quality Management System should be designed to enhance and support continuous improvement. The system should be build open, transparent and developable and should not only allow but also encourage intensive communication.

Increasing effectiveness, efficiency, and ability for quality and to be competitive is not a temporary project which ends with the introduction of a Quality Management System. In fact, it is more important not to be satisfied with the achieved improvements, but to permanently learn and continuously improve.
Lecture Quality Management

Quality Management holds more than just implementing standards and methods. In fact, Quality Management consists of cross functional tasks and the understanding of the importance and challenge of high quality in a company. The lecture Quality Management aims at picking up on this extended understanding of quality and conveying it.
... The Turnaround Starts With the First Stroke
„Without quality everything is nothing.“

Thank you very much for your attention!