IT QM Part1 Lecture 7

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Dr. Withalm Mar 3, 2009

IT QM Bratislava

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Lectures at the University of Bratislava/Spring 2008

21.02.2008	**Lecture 1 Impact of Quality-From Quality Control to Quality Assurance**
28.02.2008	**Lecture 2 Organization Theories-Customer satisfaction-Quality Costs**
06.03.2008	**Lecture 3 Leadership-Quality Awards**
13.03.2008	**Lecture 4 Creativity-The long Way to CMMI level 4**
03.04.2008	**Lecture 5 System Engineering Method-Quality Related Procedures**
10.04.2008	**Lecture 6 Quality of SW products**
17.04.2008	**Lecture 7 Quality of SW organization**

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Lectures at the University of Bratislava/Spring 2007

19.02.2007	**Lecture 1 Impact of Quality-From Quality Control to Quality Assurance**
05.03.2007	**Lecture 2 Organization Theories-Customer satisfaction-Quality Costs**
12.03.2007	**Lecture 3 Leadership-Quality Awards**
19.03.2007	**Lecture 4 Creativity-The long Way to CMMI level 4**
02.04.2007	**Lecture 5 System Engineering Method-Quality Related Procedures**
16.04.2007	**Lecture 6 Quality of SW products**
23.04.2007	**Lecture 7 Quality of SW organization**

Vorlesungen am Technikum-Wien Sommer 2007 (5A)

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28.02.2007	**Vorlesung 1 Bedeutung der Qualität, Qualitätsbegriff und Normen**
06.03.2007	**Vorlesung 2 Von der Qualitätsprüfung zur Qualitätssicherung**
14.03.2007	**Vorlesung 3 Meilenstein des Qualitätswesens-Arbeitsorganisation**
21.03.2007	**Vorlesung 4 Qualitätskosten-Führungsverhalten 1**
28.03.2007	**Vorlesung 5 Führungsverhalten 2- Q-Awards**

Vorlesungen am Technikum-Wien Sommer 2007 (5B)

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02.03.2007	**Vorlesung 1 Bedeutung der Qualität, Qualitätsbegriff und Normen**
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23.03.2007	**Vorlesung 4 Qualitätskosten-Führungsverhalten 1**
30.03.2007	**Vorlesung 5 Führungsverhalten 2- Q-Awards**

Vorlesungen am Technikum-Wien Sommer 2008 (5A/5B)

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04.03.2008	**Lecture 1 Impact of Quality-Quality Definition-Standards**
11.03.2008	**Lecture 2 From Quality Control to Quality Assurance**
01.04.2008	**Lecture 3 Organization Theories-Product Liability-Emphasis from Quality Control to Prevention**
08.04.2008	**Lecture 4 Customer Satisfaction-Quality Costs**
15.04.2008	**Lecture 5 Team Work-Leadership Behavior-Deal with Changes-Kind of Influencing Control-Conflict**
22.04.2008	**Lecture 6 Tasks &Responsibility of Leading Personnel-Audits-Quality Awards**
06.05.2008	**Lecture 7 Management Science-Creativity Techniques-Embedded Systems-FMEA**

Today's Agenda

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- Management Science
- Creativity Techniques
- Embedded systems
- FMEA

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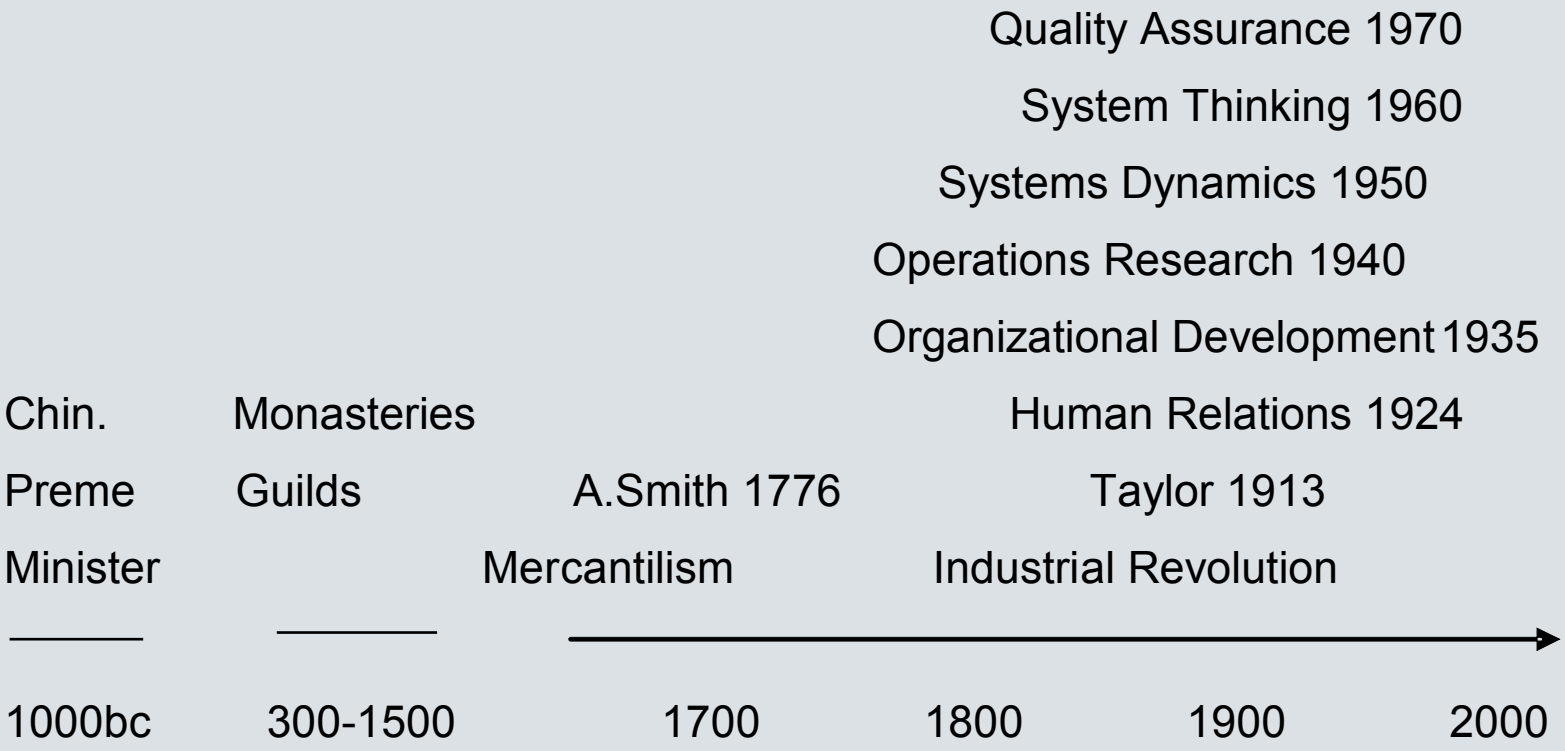
Milestones in the area of Organization Theory



Managementscience/1
Art or Science/1

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After Forrester:

- In the 60's a change in the nature of the management begins.
- In former times management was understood and taught as art. Art develops by empirical experience.
- It comes with the advancement however to saturation features, i.e.
  - the growth rate is reduced, because the knowledge is disorganized.

Managementscience/2
Art or Science/2

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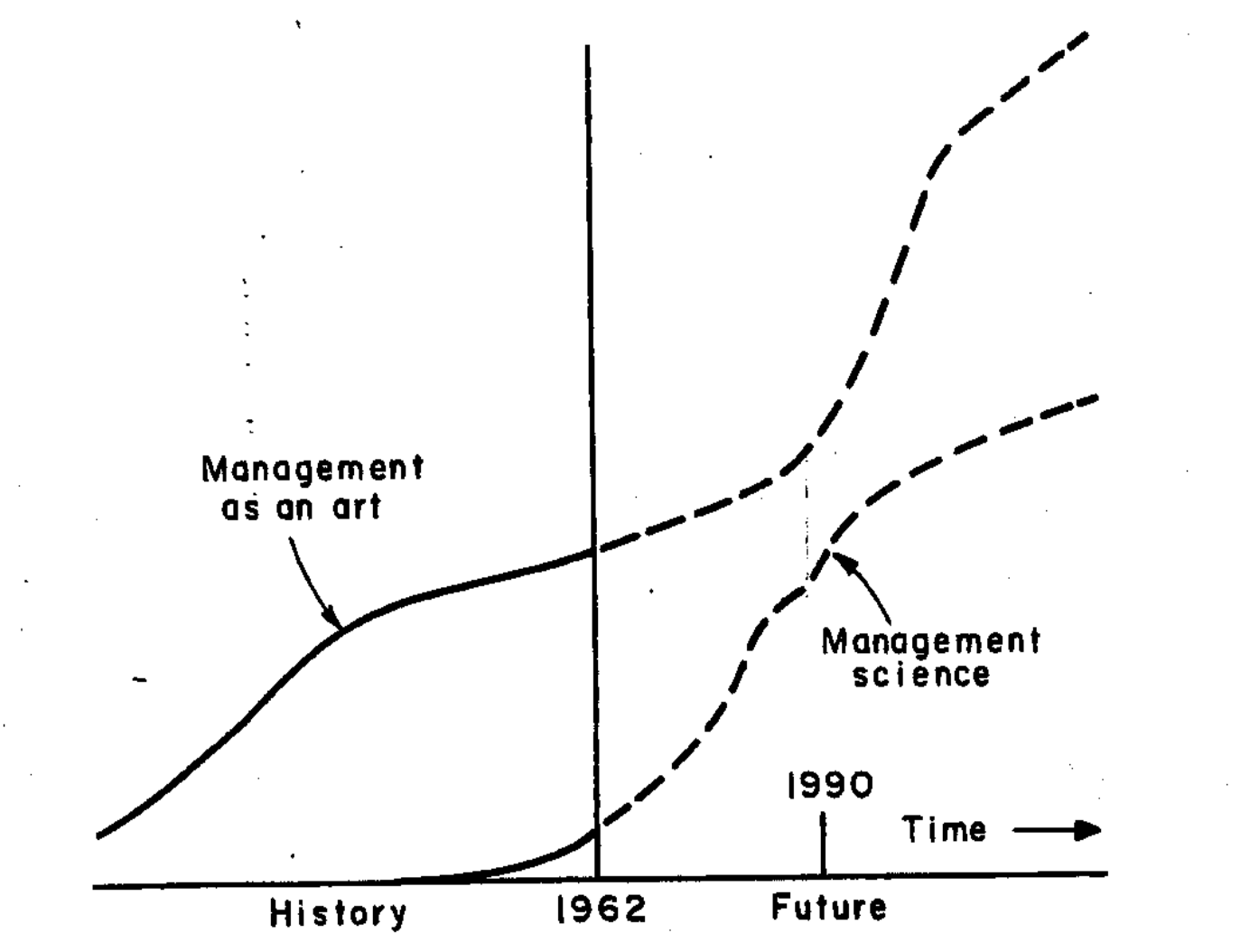

Managementscience/3
Art or Science/3

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Outgoing from the Taylorism:

- Over statistic quality assurance up to Operation Research always only isolated ranges were treated;
- Top management activities were not reached by these beginnings.

Area of conflict:

- Search for the optimal solution led to the mathematical simplification of most complex systems

- How Top managers want to improve the real organization

Managementscience/4
Art or Science/4

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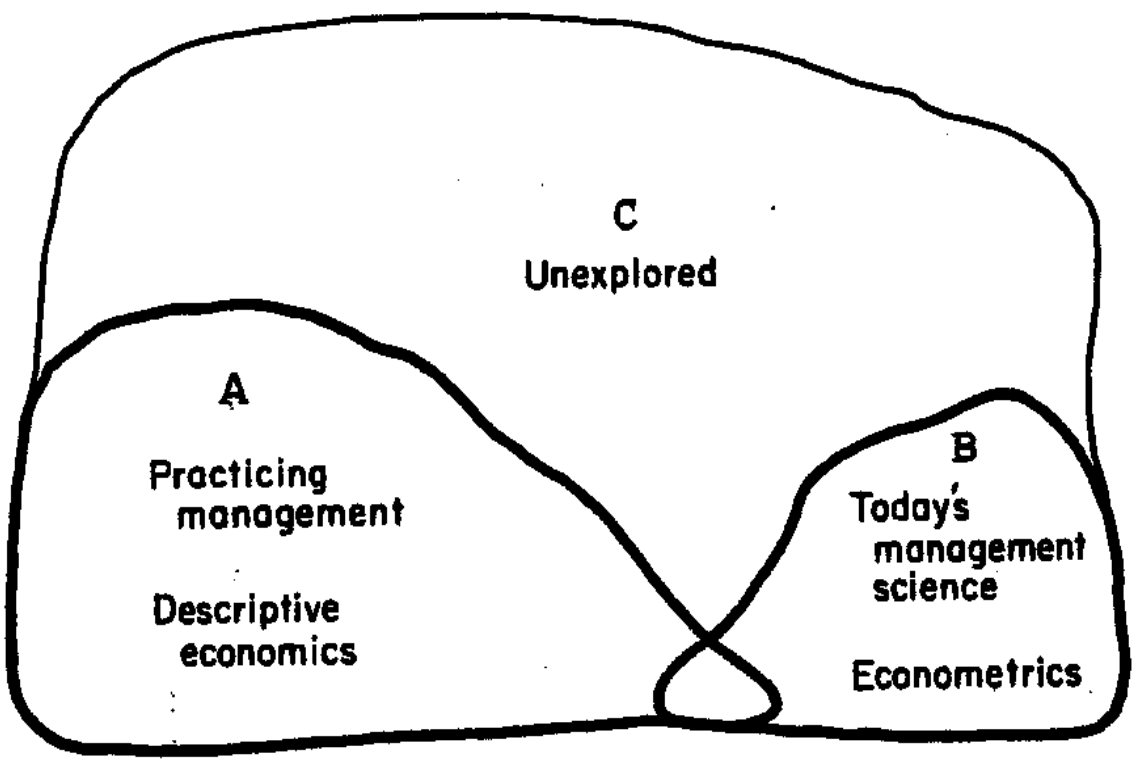

System Dynamics/1

1935 ago:
Engineering= Art
(use of noted procedures and experience)
Starting from 1940:

- Research based on the realizations of the engineering sciences
- formed a substantial component of the assigned technology.
- Similarly to the engineering of the 30's Forrester recognizes the increasing need of management sciences in the 50's and 60's.
- Similarly as in percentages of the turn over the research and the developing costs are measured
- Forrester assumes that the research activities are planned and evaluated by innovations of management.

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System Dynamics

- Forrester understands the investigation
  - how strategies, decisions, structures and delays
    - the growth and the stability of an organization affect.
- "The goal is enterprise design, to create more successful management of policies and organizational structures." [Forrester (1965) S.VII]

Managementscience/6
System Dynamics/3

As basis for the possibility of the research of "system dynamics" four prerequisites are considered, which off approx.. 1940 were invented, developed further and applied:

- Theory of feedback
- Research, how decisions are made
- Beginning of the experimental model tests
- Digital computer

Managementscience/7
System Dynamics/4

- The basis of "system dynamics" represents the integration of the functions/departments by reduction on a common denominator.
- Each action consists of a movement, a flow of:
  - Funds
  - Orders
  - Material
  - Personnel,
  - Capital equipment.
- These five flows are integrated by an information network; the **information flow**
- is thus the sixth flow.

Managementscience/8
System Dynamics/5

- The dynamics of a system/an organization are described by a flow.

- The static component is described by a memory (also level or accumulator mentioned).

- Thus the components for the description of each system are defined by:
  - Flows
  - Memory

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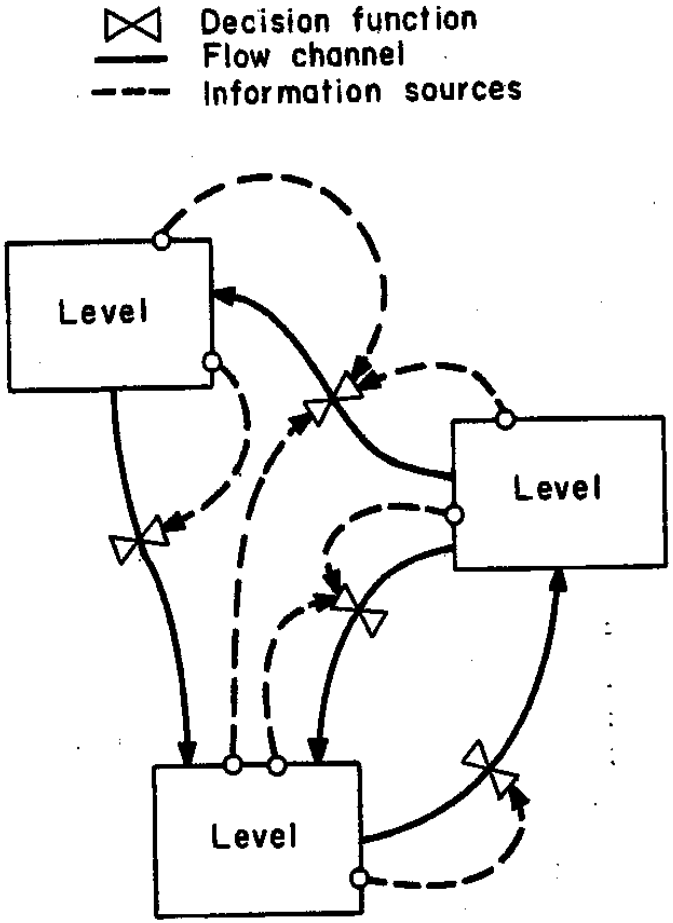
Decision function
Flow channel
Information sources
Level
Level
Level

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Approach to develop a model

- Identify the problem
- Isolate the factors, which interact with the observed symptoms
- Pursue the cause effect chains and the information return flow
- Formulate the rules, which illustrate, how decisions depend on the information flow

Approach to develop a model

- Generate a mathematical model.
- Calculate the behavior during the observation period.
- Compare the result with the available knowledge.
- Correct the model, until it shows sufficiently the real system.
- Modify the sizes in the model, changeable in the real system, in order to recognize improvements in the behavior of the system.
- Improve the real system in the direction, which led in the model test to the improvement

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System Thinking: Elements

- Circulating ,describe reciprocal effects
- Visually, have strong visual components
- accurate, and reduce thereby misunderstandings
- transparency increasing because the conceptions over circumstances are made transparent
- team supporting, because they are used frequently in group works.

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Assumption:

A guidance crew compiled 5 substantial factors:

- Guidance,
- Coworker steering element,
- Processes
- Customer satisfaction

Question:

How can this guidance crew use the realizations of Forrester?

Managementscience/14
Consideration of a simple TQM oriented model/2

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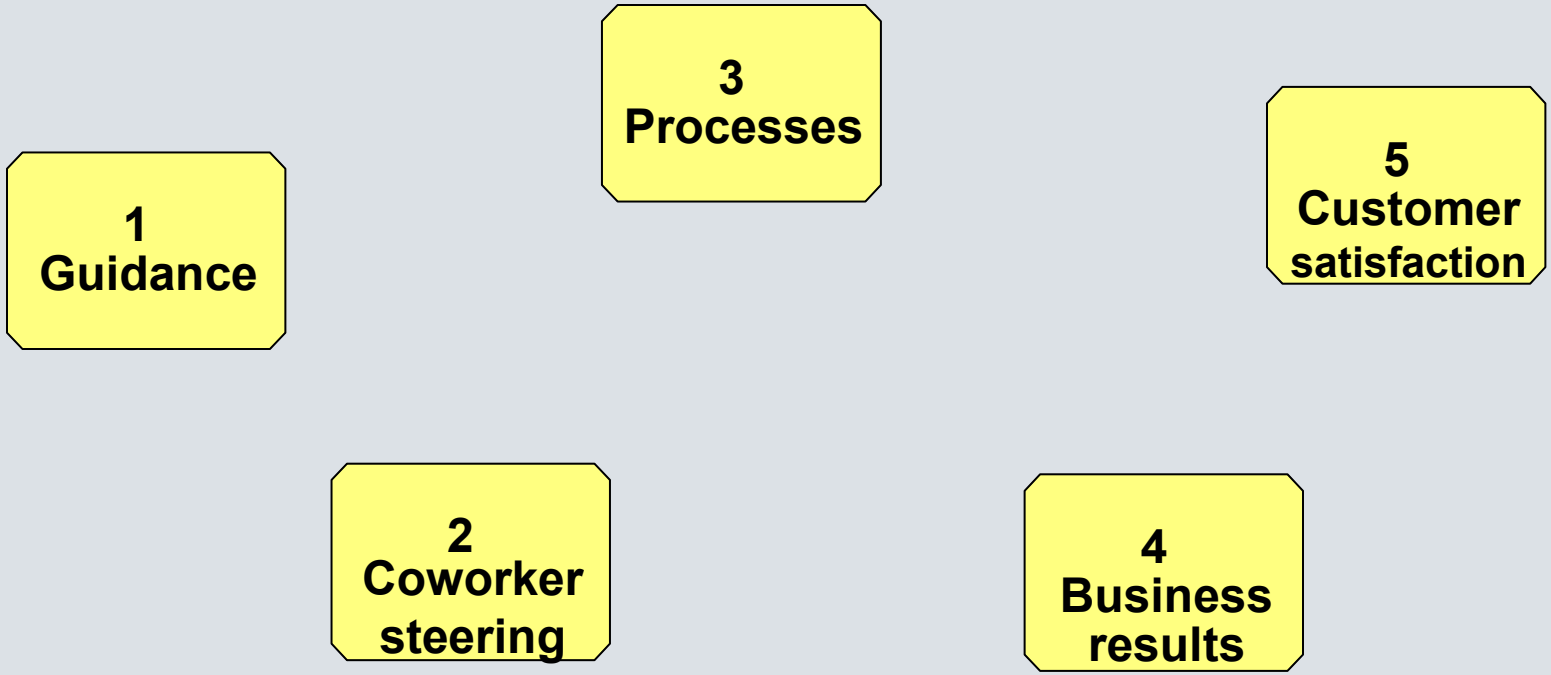

Managementscience/15
Consideration of a simple TQM oriented model/3

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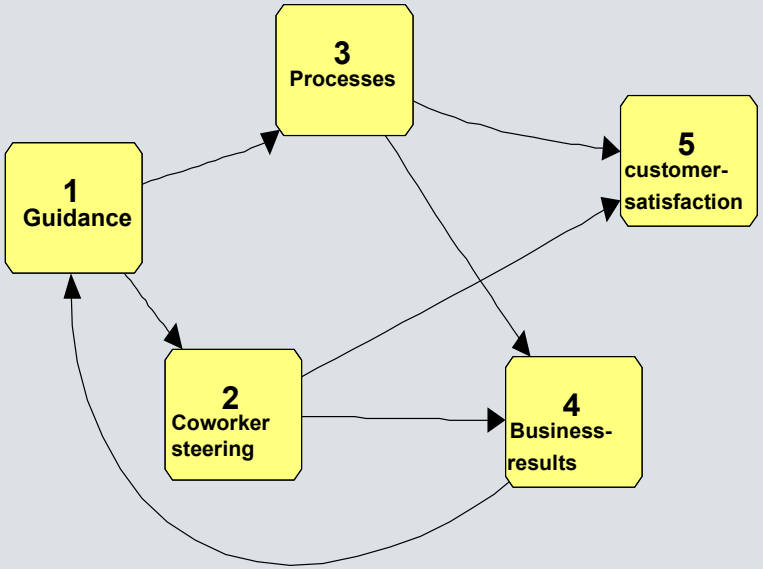

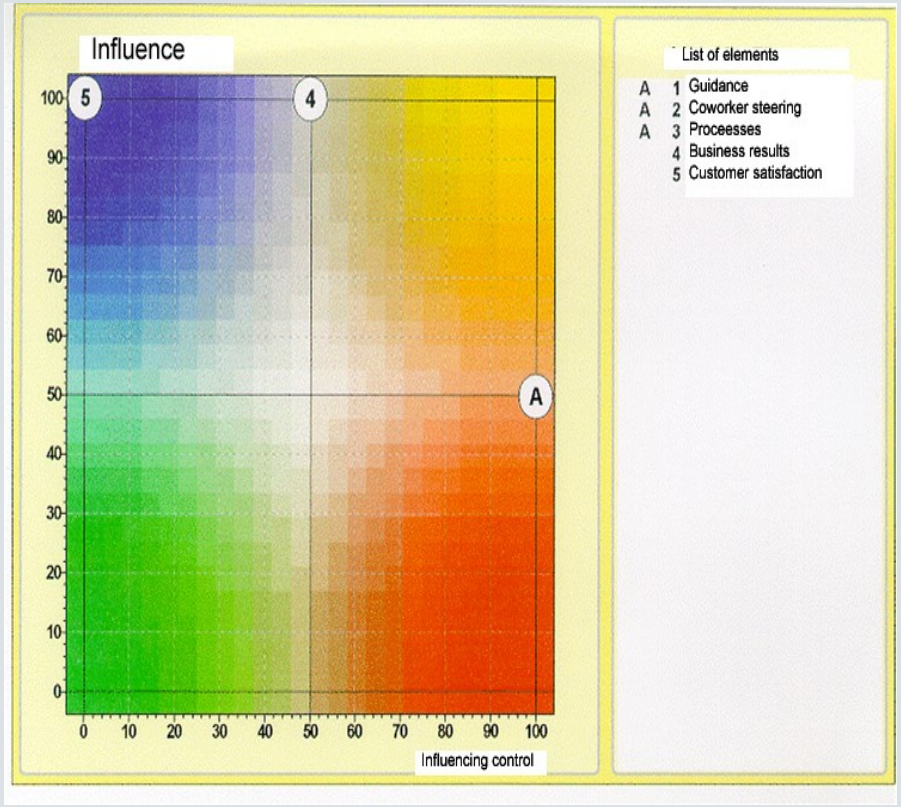

Creativity Techniques/1

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Definition :Creativity

- Ability to think productively and the results of this thinking,
  - above all originally new processing of existing information applying for instance
    - in form of an invention
    - or a work of art.
- Creative humans are characterized by large independence and world openness,
  - in the same way by mental flexibility
  - and unorthodox style of thinking
  - and high frustration tolerance.

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Creativity Techniques/2
Phases of creativity

- Seek out from
  - Problems
  - Lacks
  - Gaps
  - and discrepancies
- Define appropriate formulation of a problem and of a question
- Formulation of hypotheses
- Search for solutions - including examination on correctness
- Communicate new realizations and penetration in relation to established conceptions

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In the sociology:

- Innovation, planned and controlled change of a system of function relations
  - before not practiced possibilities are to be realized in applying new ideas and techniques.
  - A goal is here an optimization of the existing system in individual aspects or its overcoming by a new system.

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In the economy:

- The realization of a new solution for a certain problem
  - in particular the introduction of a new product
  - or the application of a new procedure.
- Innovations are commercial utilizations of inventions and discoveries
  - important is thus the readiness for the market

Creativity Techniques/4
Data-information-knowledge

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- Data +Structure = Information
- Information (Usefulness, temporal relevance, accuracy)+Context = Knowledge

Creativity Techniques/5
Complexity of tasks

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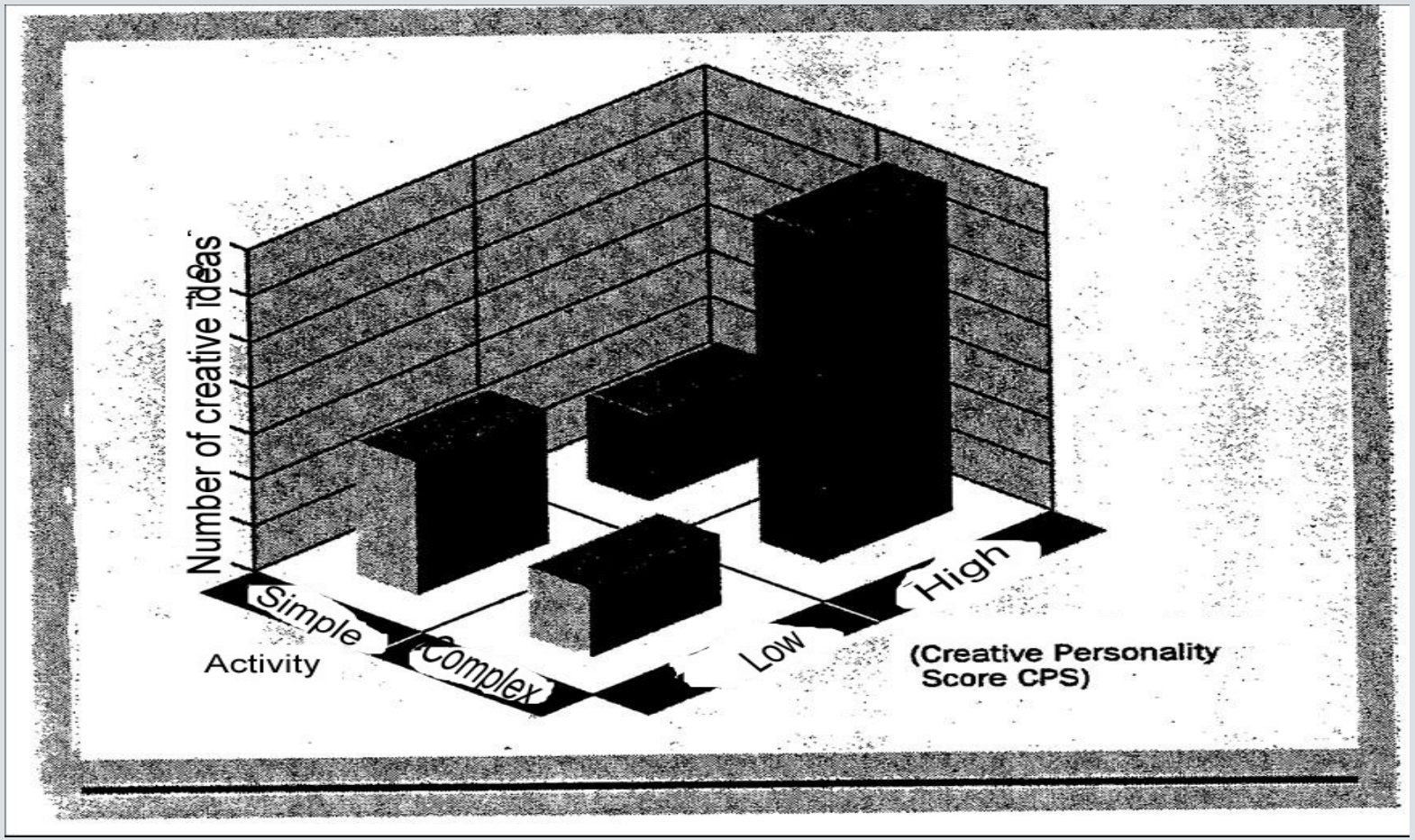

Creativity Techniques/6
Complexity of tasks +impact of leadership

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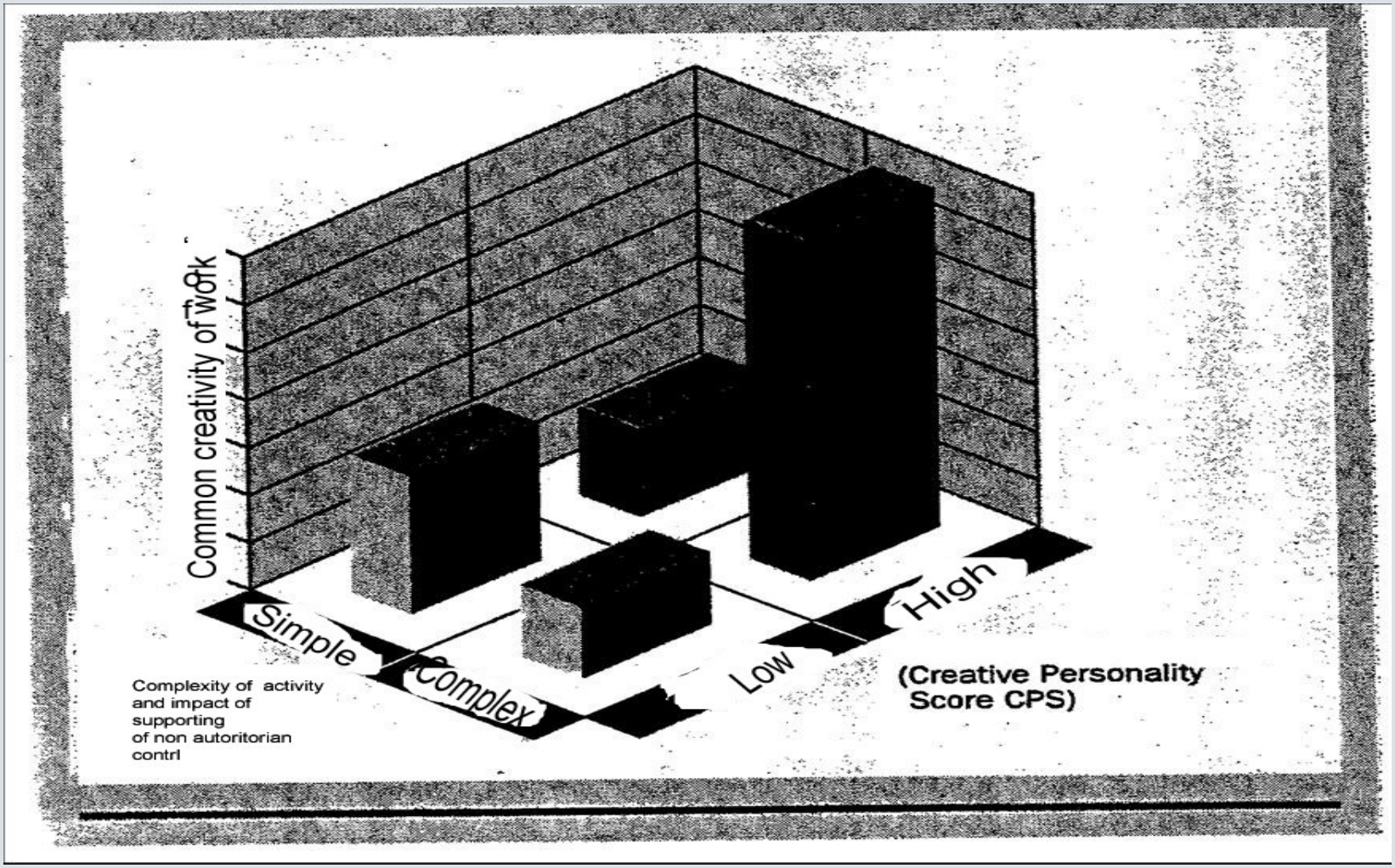

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Why?

•To the structuring and visualization of complex problems.

Proceeding (individually or group work)

•Identification of the problem/topic = the center

•From the center run the main branches away

- •which develop the problem/topic in individual ranges/topic fields.

•As many as desired branches are assigned to these main branches;

- •each branch stands thereby for a concrete idea
  - •this is written as keyword on the branch.

• With complex Mind maps different colors can facilitate the structuring

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- In order to facilitate the work shifting Meta plan walls or EDV Tools can be used;
  - on the Flip Chart - leaving loops.
- Pictograms, which are well-known in the problem field and the working group, increase the compression effect.
- The evaluation can take place e.g. with questioning issues, whereby the topics are prioritized, which should worked out first

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Indicator for the balance of the Mind map:

- Main branches with approximate equal many branches and sprigs
- 1 - 2 main branches substantially more thinly overgrown
- or a main branch particularly closely overgrown
    - subject is not optimally compiled by this group with a Mind map.

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Which it causes?

- Mind Mapping creates a connection between
  - the left - logically thinking
  - and the right - graphically thinking brain half.
    - Thus spontaneously ideas become lively.
- Further by visualization complex reciprocal effects are becoming recognizably
  - and by visualization new realizations

Creativity Techniques/11
Mind-Mapping/5

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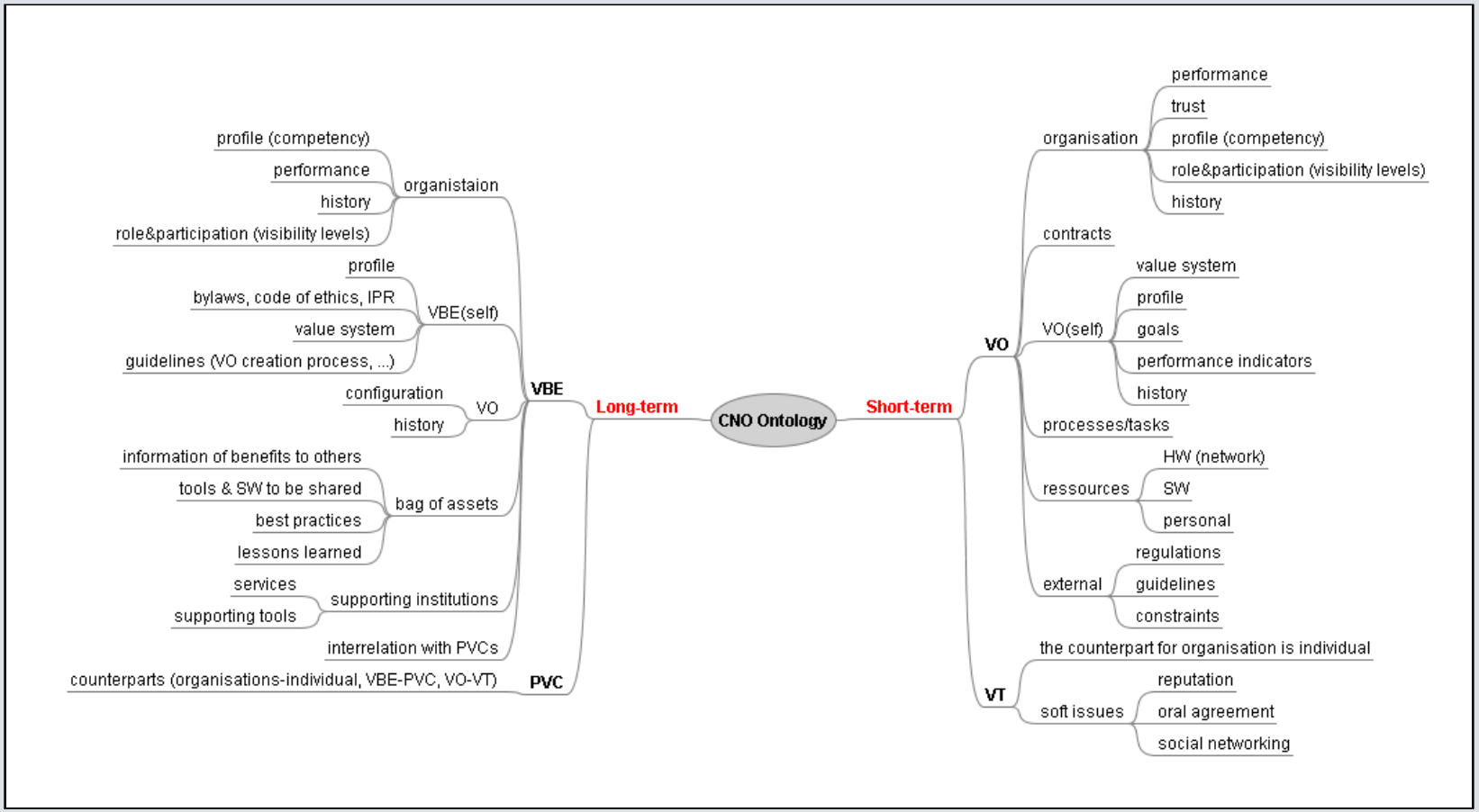

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Why?

- To recognize the accurate, causal problems

Proceed (group work)

- Start to formulate the problem
- Short brainstorming, in order to compile first solutions
- Criticism phase:
  - criticize the found solutions
    - what could be better done
    - in order to sensitize to the profound causes

Creativity Techniques/13
Progressive abstraction/2

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- What' s really essential?“
  - first problem abstraction leads to a new problem definition.
  - The new problem definition has a deeper and broader sphere of influence.
- Short brainstorming, in order to compile solutions for the abstracted new problem definition.
- Criticism phase: criticize the found solutions
  - what could be better done,
    - in order to sensitize in the further profound causes

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- These steps (definition - solution - criticism - abstraction) are repeated whenever
  - until a penetration of the problem satisfying the group is reached.
- Termination condition:
  - if the solutions are outside of the sphere of influence of the group.

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Which it causes?

- It leads to the final cause of a problem
- and lists at the same time all symptoms
  - which appeared as result.
- At the same time it serves as basis of recognition
- to which cause who has access
  - in order to obtain lasting improvement._

What happens,

- if between a cause and symptom one does not differentiate?

Creativity Techniques/16
Morphological box/1

Why?

- the solution of a problem is reached by dismantling into single aspects.

Proceed (group work)

- problem definition
- Recognize the parameter (= 1th dimension of the morphologic box)
- if characteristics, which occur with all solutions in different development, are held as parameters and form the first column of the morphologic box.
- characteristics must be:
  - logically independently
  - generally valid
  - relevantly

Creativity Techniques/17
Morphological box/2

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- Recognize possible shaping of the characteristic
  - next dimension of the box
- Structure of the combinations:
  - each combination represents a solution of the problem
  - in such a way many solutions result
- Alternative evaluation:
  - only now the individual alternative are evaluated.

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Which it causes

- straight persons within the technical range
  - who are experienced in handling analytic methods
  - appreciate this method
    - since from dismantling of the problem in sub-problems and variation of these ranges
    - many new potential solution methods result.
- The systematic prevents that individual solutions are too fast favored.

Method 635/1

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Why:

- Idea identification similarly brainstorming
  - here however brainwriting,
    - so that load or rhetorically superior group members can develop no dominance

Proceed (group work)

- define problem
- **6** persons write on a sheet
- pro person **3** ideas should be formulated
- **5** minutes are available

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- Afterwards the sheet is passed on in the clockwise direction
- and the participants continue working with the ideas of the predecessor
- after 6 rounds all members have brought in new ideas
  - both spontaneously
  - and stimulated by the remaining participants.
- Evaluation: now the most promising ideas are determined
  - e.g. by a point scaling system

Which it causes:

- with this method all participants are activated
  - The presence of a moderator is not necessary.

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Why?

- Trust things that are alien and alienate things that are trusted
  - This encourages on the one hand, fundamental problem analysis
  - And on the other hand, the alienation of the original problem
    - Through the creation of analogies.

Proceed:

- Preparatory phase
- Step 1 Analysis of problems and explanation of the proceeding
- Step 2 raise spontaneous solutions
  - e.g.: by brainstorming to enter the synectics process
- Step 3 new formulation of the problem:
  - Secures same problem understanding of all group members

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Incubation phase

- Step 4 creation of direct analogies concerning the problem
  - e.g. by brainstorming
- Step 5 creation of personal analogies concerning the problem
  - strong identification is to be achieved
    - by feeling-stressed transformation.
- Step 6 creation of symbolic analogies concerning the problem:
- further alienation by paradoxes analogy
- Step 7 direct analogy: Linkage of the symbolic analogy with a further topic field
- Step 8 analysis of the direct analogy

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Illumination phase
- Step 9. Application to the problem:
  - Transmission of the solution established at step 8
  - to the problem formulated under step 3

Verification phase
- Step10.development of possible solutions

Which it causes:

- The alienation prevents prepossession
  - not invented here syndrome
  - requires however excellent moderators.

Creativity Techniques/24
Buzzword Analysis

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Why:

- Promotion of the intuition

Proceed:

- Problem definition
- Finding problem-strange buzzwords
- Analyze Buzzwords,
    - According fixed
        - Principles
        - Characteristics
        - Structures
        - Shaping of arrangements
- Establish relationships with the problem and find solutions

Which it causes: Solutions by structure transmission

Bionic

Why:

•Activate solution approaches

Proceed:

•The study of structures, forms, processes and systems in nature as well as the use of these by assumption of the principle of solution

Which it causes: source for new ideas

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- All hats must be used
  - as coverage of the comprehensive treatment of the topic
- The moderator selects the order
  - as methodical control element

Which it causes:

- by colors the creativity will be stimulated
- and by adoption of symbols e.g. hats disciplined
  - without blocking thereby creativity.

Awards for creativity/1

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Categories:_

Knowledge and discovering

- Integration of the European culture into the digital world
- Support of SME's in the e-Business at the market
- More democracy and better participation of citizen improved by Multimedia
- First steps and new social nets by Multimedia in the service of multilingual and multi-cultural Europe
    - for the mobile society

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Criteria for evaluation:

- Content and its novelty
- Attractiveness of the product
- Operability
  - Suitability of the product for the user

Embedded Systems (ES)/1
Terms and definitions/1

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Computerbased systems being embedded in reallife processes.

Embedded Systems (ES)/2
Terms and definitions/2

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1. ES is embedded into an external process which exhibits
   - interfaces to physical systems
   - interfaces to humans.

   Each physical system possesses its own dynamics

Realtime requirement

2. Coupling ES ⟷ external process
- Takes place by sensors and actuators

Input and output data can exhibit different type.

3. Sensors and actuators can be spatially distributed.

Embedded Systems (ES)/4
Terms and definitions/4

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4. must fulfill strict reliability requirements

   - different functions ⟶ different requirements

5. ES can be inhomogeneous.

6. ES can consist of HW and SW modules.

7. Some ES must be expandable during the operation.

Embedded Systems (ES)/5
Terms and definitions/5

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8. Are mostly subject of extreme environmental influences

- temperature, humidity, vibration, shock...

  and ES badly need requirements as

- size, weight, energy consumption...

9. Some requirements of ES require extremely high

   processor achievement

- ... rapid generation of prototype is helpful

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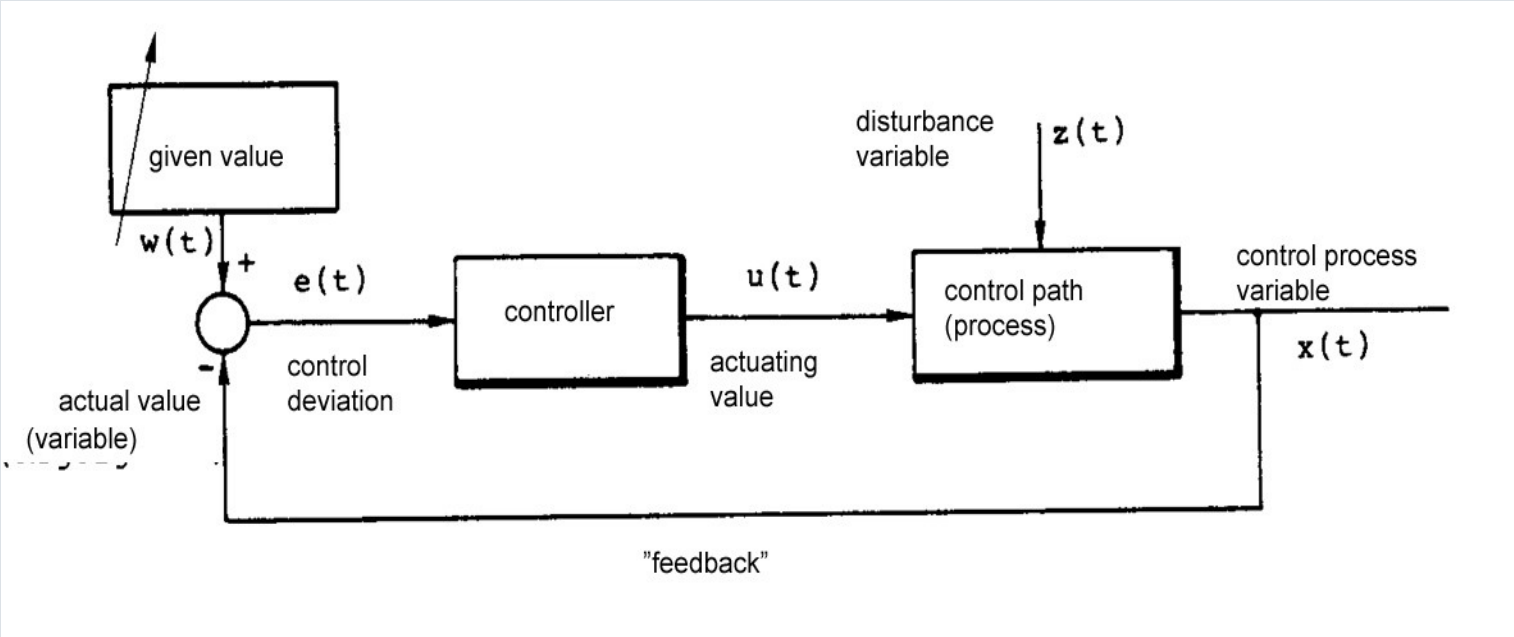
- **Closed loop control, control circuit**
  - **The automatic provision of suitable steering effects on the process are provided by the controller by means of the actuator.**



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- Open loop control
  - The functional chain without feedback is called

    continuous control

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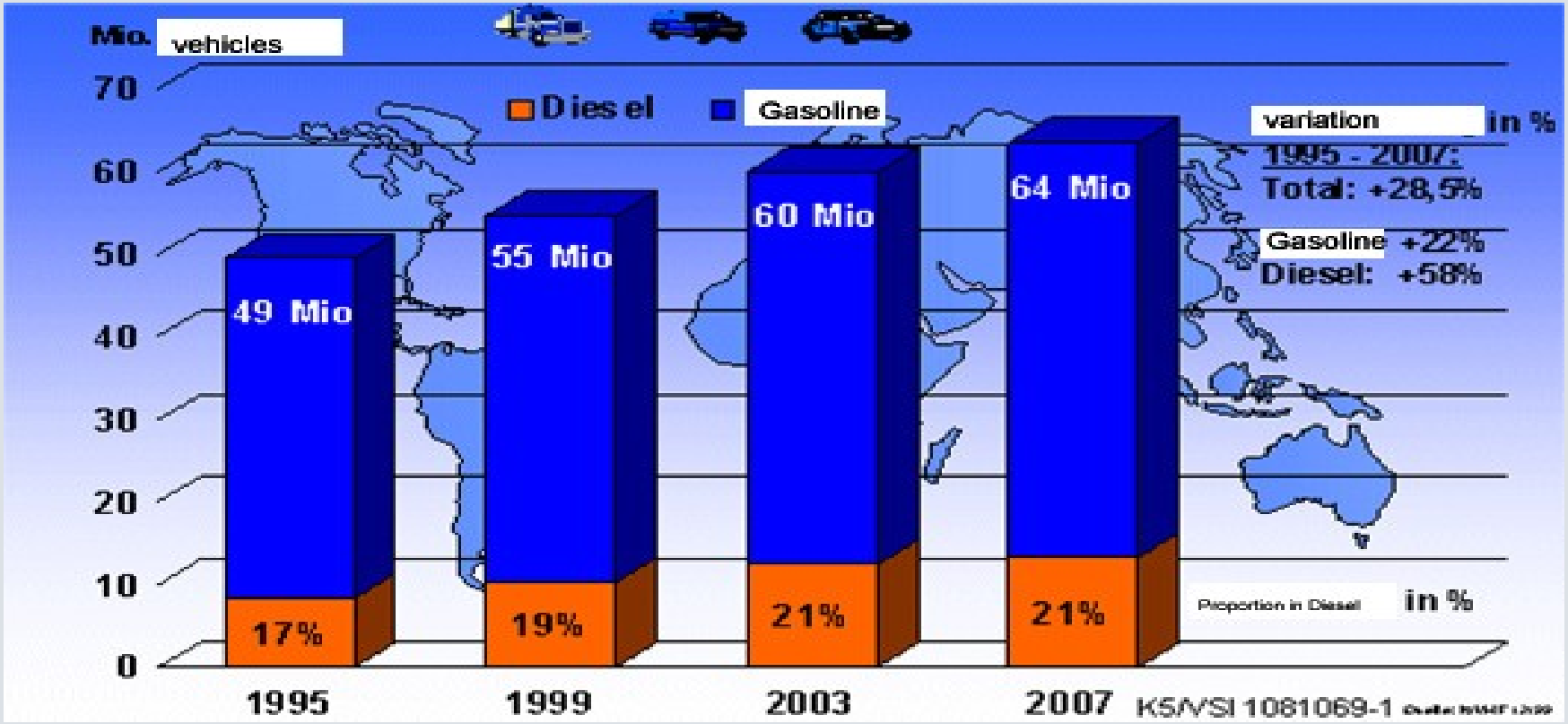
Market/customer base: Diesel market



Embedded Systems (ES)/9
Example: Cartronic – Impact of structure/architecture/1

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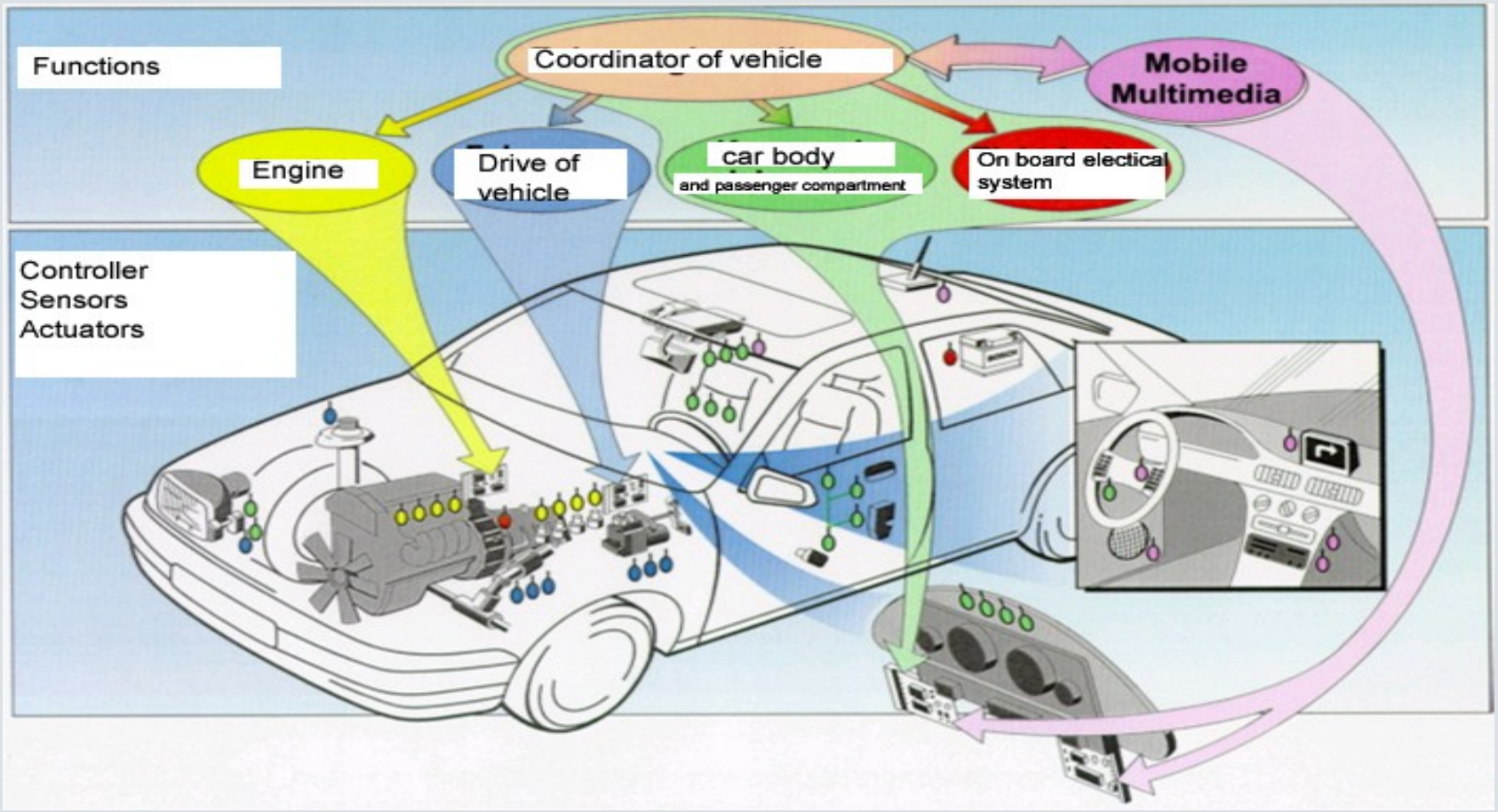

Embedded Systems (ES)/10
Example: Cartronic – Impact of structure/architecture/2

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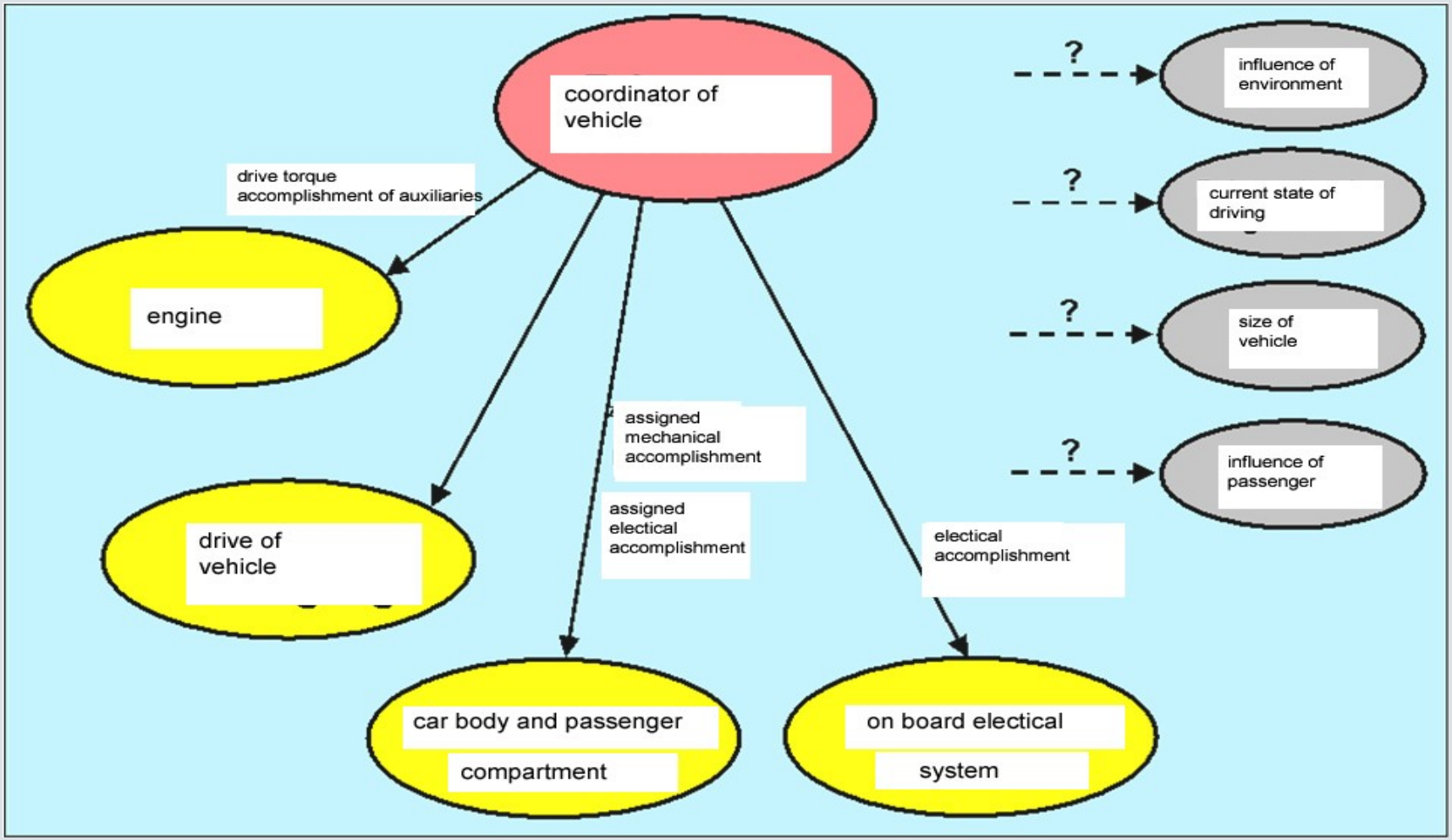

Fundamentals/Goals of FMEA/1

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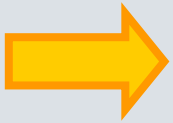
The failure mode and Effects analysis (FMEA) is an analytic method of the preventive quality assurance.

Find potential weak points
Recognize the meaning +assess it suitable measures:
Introduce Avoidance + discovery in time



Minimizing the risk
Reduction of the error costs
Improved reliability

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Fundamentals/Goals of FMEA/2
Basics/History/1

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- Center of the sixties: in the USA (Apollo project) developed

- Air and space travel

- Nuclear technology
- automobile industry + other ranges.

- FMEA is today a component of quality management systems

Fundamentals/Goals of FMEA/3
Possibilities and delimitations/1

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- The FMEA is a tool, in order to analyze risks by individual defects.
- The individual risks are weighted against each other, in order to recognize emphasis.
- The FMEA does not supply a statement about the absolute height of an error risk.
- For the view of error combinations a fault tree - analysis is better suitable.

Fundamentals/Goals of FMEA/4
Possibilities and delimitations/2

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- The advantages of the FMEA show
  - that the expenditure is justified
    - for the avoidance of errors
      - at beginning of the product development process
    - since it eliminates the substantially higher subsequent costs at a later time.
- Advantages are e.g.:
  - Avoidance of errors in construction and development
  - Less additional changes of product implies cost reduction
  - Avoidance of repeating errors.

Fundamentals/Goals of FMEA/5
Possibilities and delimitations/3

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- The high expenditure is often stated as argument against the employment of a FMEA.
- The following issues play thereby a role:
  - Complexity of the product
  - view level/kind of the FMEA
  - experience in FMEA method of moderator/team
  - quality of the preparation
  - setting of tasks/range of the investigation

Fundamentals/Goals of FMEA/6
Potential for rationalization/1

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- The range of the investigations can be reduced after agreeing upon with the client and the working group.
- Approaches for rationalization are:
  - Prioritization and selection of the view ranges
  - A decision analysis (critical components)
  - The use of existing FMEA (similar products/processes)
  - The use of a "basis FMEA”

Fundamentals/Goals of FMEA/7
Potential for rationalization/2

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Expenditure of the FMEA is easily determinable.
Savings usually not directly measurably

FMEA is necessary:

- New developments
- Changes at the product
- Changes at the procedure
- Products with safety-relevant requirements
- Demand of the customer

Fundamentals/Goals of FMEA/8
Positive Impact

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- all project-stake holders meet promptly on a table
- better system understanding for the involved ones
- early uncovering of deficiencies
- consistent pursuit of the measures up to the conversion

Fundamentals/Goals of FMEA/8
Optimal benefit

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- Accompanying the development/production planning
  - as early as possible
- results flow in time into the product developing process
  - in order to avoid unnecessary recursions

Fundamentals/Goals of FMEA/8
Different kinds of FMEA's/1

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System FMEA

Construction FMEA

Process FMEA

Fundamentals/Goals of FMEA/9
Different kinds of FMEA's/2

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- System FMEA
  - functional cooperating of the system components and its connections
    - system development
- Construction FMEA
  - the requirement specifications compatible organization and interpretation of the product/components
    - product/component development
- Process FMEA
  - the process planning and execution due to drawing of the products/components
    - production planning

Fundamentals/Goals of FMEA/10
Time of Establishment/1

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- The FMEA is established within the team at the earliest possible time.
- The knowledge and experience of specialists of different ranges are considered
  - which cooperate in the regarded topics.
- The FMEA analyzes the project status
  - Is to be reestablished/updated
    - when changes arise.

Fundamentals/Goals of FMEA/11
Time of Establishment/2

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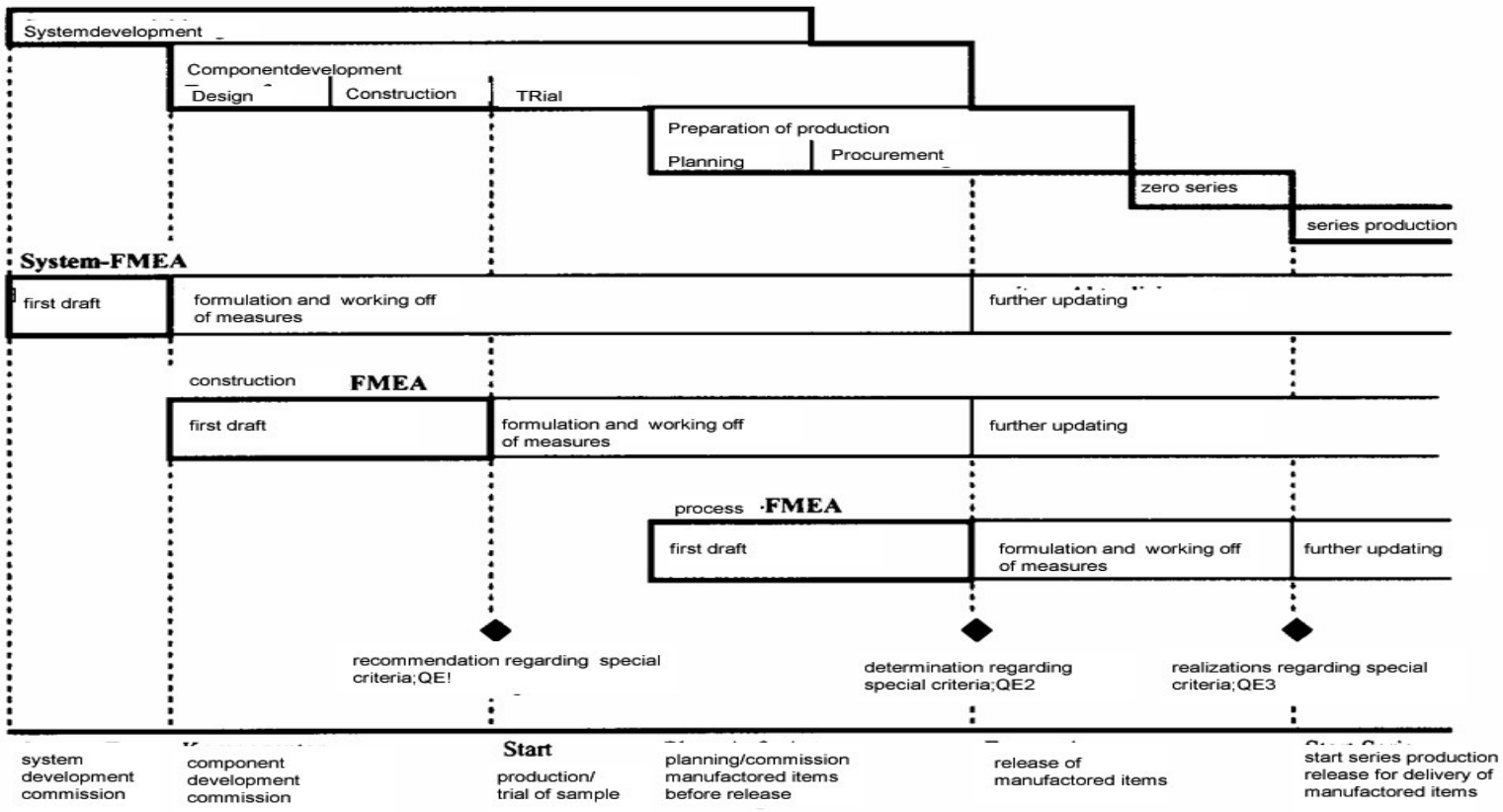

Fundamentals/Goals of FMEA/12
FMEA-Team/1

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- FMEA is accomplished by a team of specialists.
- Goals of the teamwork are:
  - as soon as possible working in parallel instead of serial work
  - use larger knowledge and experience potential
  - open handling with available information
  - increase creativity
  - faster coordinated decisions
  - consent finding and increased acceptance of results
  - Promote department-spreading co-operation .

Fundamentals/Goals of FMEA/13
FMEA-Team/2

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- For an efficient FMEA execution master teams (approx. 3 to 5 participants) are educated.
- If necessary further experts are included.
  - Master team
    - system development
    - application
    - moderator
  - occasional participation
    - component development
    - sales
    - central offices
    - procurement

Fundamentals/Goals of FMEA/14
FMEA-agenda/1

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- Preparation &Planning
  - Assignment of tasks, delimitations, goals
  - Working group, Schedule
  - Documents for working group
  - Description of occupation
- Structure
  - Summary
  - Components/Work packages
- Analysis of functionality
  - Functions/Characteristics
- Error Analysis
  - Potential kinds of errors
  - Consequence and cause of errors

Fundamentals/Goals of FMEA/15
FMEA-agenda/2

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- Risk evaluation
  - Error avoidance and error discovery
  - Impact of the error consequence (B)
  - Probability of occurrence (A)
  - Probability of discovery (E)
  - **R**isk **P**riority **N**umber **RPN** = B x A x E
- Optimization/quality improvement
  - Form order of rank of the risks
    - Analyze B, A, E and RPN
  - Establishment of improvement measures
    - with assignment of R (Responsibility): and D (Date):
  - Introduce the improvement measures
  - Evaluating of the improved conditions (A, E)

Fundamentals/Goals of FMEA/16
Systematic preparation

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- Specify setting of tasks
  - kind of the FMEA
- Specify objective
- Determine team members
- Determine need for training courses
  - if necessary provide training.
- Make available overviews and diagrams
- Plan topics which can be worked out
- Accomplish expenditure estimation
- Take organizational preparations

Fundamentals/Goals of FMEA/17
Important impacts on the outcome of a FMEA

SIEMENS

- Execution time/punctual beginning
- Composition of the working group
- Team ability of the coworkers
- Knowledge of the FMEA method
- Executing process FMEA:
  - Knowledge about the translation into action
- Measures of coworkers in the manufacturing

Fundamentals/Goals of FMEA/18
FMEA- Documents

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- First page with general information and a summary
- Description of the regarded area
  - designs, sketches...
- List of the used documents
  - Used table of valuations...
- FMEA forms
- Evaluations
  - time schedule, FMEA summary...

Fundamentals/Goals of FMEA/19
Example of a System-FMEA/1

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BOSCH Qualitätssicherung			System-FMEA Erzeugnis: Sachnummer:						Seite: Abteilung: FMEA-Nummer: Datum:				
Nr.	Komponente Prozeß	Funktion	Fehler-art	Fehler-folge	K	Fehler-ursache	Fehler-vermeidung	Fehler-entdeckung	B	A	E	RPZ	Maßnahmen V:/T:
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)

- Structuring

Nr.	Komponente Prozeß												
(1)	(2)												

- Functional analysis

Nr.	Komponente Prozeß	Funktion											
		(3)											

The FMEA extent is specified in the context of the functional analysis.

Fundamentals/Goals of FMEA/20
Example of a System-FMEA/2

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- Error analysis

Nr.	Komponente Prozeß	Funktion	Fehler-art	Fehler-folge	K	Fehler-ursache							
			(4)	(5)	(6)	(7)							

- Risk evaluation

Nr.	Komponente Prozeß	Funktion	Fehler-art	Fehler folge	K	Fehler-ursache	Fehler-vermeidung	Fehler-entdeckung					
							(8)	(9)					

Nr.	Komponente Prozeß	Funktion	Fehler-art	Fehler-folge	K	Fehler-ursache	Fehler-vermeidung	Fehler-entdeckung	B	A	E	RPZ	
									(10)	(11)	(12)	(13)	

Fundamentals/Goals of FMEA/21
Example of a System-FMEA/3

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B impact of error consequences	assessment
extremely serious error, which the security impaired and/or which hurts adherence to laws, without warning	10
extremely serious error, which possibly the security impaired and/or which adherence to laws hurt with warning or to tow a car, which stops	9
heavy error loss of main functions e.g. not roadworthy vehicle	8
heavy error operability of the vehicle strongly reduced, immediate workshop stay compellingly necessarily	7
moderately severe error loss of more importantly serve and comfort systems, immediate workshop stay not necessarily	6
moderately severe error function impairment of more important serve and comfort systems	5
moderately severe error small function impairment of serve and comfort systems, from each driver perceptible	4
the error is insignificant. the customer is only slightly troubled and probably only a small impairment is noticed, by the average driver l perceptible	3
it is improbable that the error has any perceptible effect on the performance of the vehicle ;only from the technical personnel or practice/experienced driver perceptible	2
no effect	1

Fundamentals/Goals of FMEA/22
Example of a System-FMEA/4

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System-FMEA A - , Possibility of occurence	possible error detection rate '	ppm*	assessment
very high it is almost sure that the error/cause arises very frequently.	1/10 1/20	100.000 50.000	10 9
high the error/cause appears repeated on a problematic matured system	1/50 1/100	20.000 10.000	8 7
mean the error appears occasionally on in the maturity level advanced system.	1/200 1/1.000 1/2.000	5.000 1.000 500	6 5 4
small arising of the error/cause is small, proven system design	1/15.000 1/150.000	67 6,7	3 2
improbable arising of the error/cause is improbable.	<1/1.500.000	<0,67	1

* per LD (LD = Life duration of product)

Fundamentals/Goals of FMEA/23
Example of a System-FMEA/5

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E Probability of detection

improbable. it is impossible or improbable that the kind/cause of error is detected by test/validation measures during development phase	10
very small.the probability is very small that the kind/cause of error is detected by test/validation measures during development phase	9 8
small. the probability is small that the kind/cause of error is detected by test/validation measures during development phase	7 6
mean.the probability is mean that the kind/cause of error is detected by test/validation measures during development phase	5 4
high.the probability is high that the kind/cause of error is detected by test/validation measures during development phase	3 2
very high.the probability is very high that the kind/cause of error is detected by test/validation measures during development phase	1

Assessment criteria "area"	Assessment
It is impossible or improbable that the error is detected at all or on time	10
error can be detected,i.e.: read of data from diagnosis store,no substitution measures are undertaken changed side functionalities or other symptoms (i.e.:striking noise, smell)	9 8 7
Diagnosis and substitution of system activated warnings are switched on.	6
Clearly recognizable side effects (i.e.loadly noises) or developing impairment of functions	5
Diagnosis and warnings activated. lamps must not switched on.	4 3 2
It's certain to detect the error and an appropriate reaction of the system is initialized which leads to be master of situation during driving.	1

Fundamentals/Goals of FMEA/23
Risk priority number (RPN)/1

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- The risk priority number is the product of B, A and E. It is a yardstick of rank of the existing risks

RPN = B x A x E

Fundamentals/Goals of FMEA/24
Risk priority number (RPN)/2

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- RPN and B, A and E clarify system risks.
- High RPN or high individual values require improvement measures!
- If B>= 9 Measures are required,
  - which reduce the meaning of the error sequence.
  - Usually these are changes of the system
    - if not possible then A should be reduced so far
    - that residual risk is justifiable
- Further limit values for B, A, E, and RPN are to be specified by the team
  - quality goals fulfilled at start of series production.
- Within some departments the following is applied:
  - Border for the introduction of quality improvements with a RPN between 60 and 300.

Konstruktions-FMEA

Datei: Druckdatum:

BOSCH QUALITÄTSSICHERUNG	KONSTRUKTIONS - FMEA ERZEUGNIS: SACH-NR.:	SEITE: ABT: FMEA-NR.: DATUM:

NR.	KOMPONENTE PROZESS	FUNKTION	FEHLER-ART	FEHLER-FOLGE	FEHLER-URSACHE	FEHLER-VERMEIDUNG	FEHLER-ENTDECKUNG	B	A	E	RPZ	MASSNAHMEN V:/T:

Conclusion of Part 1/1

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- Impact of Quality
  - Quality wins
  - Quality deficiencies
- Standards
  - Quality definition
- Evolution from quality control to TQM
  - Shewhart, Deming, Juran, Feigenbaum, Nolan, Crosby, Ishikawa
- Evolution of organization theory
  - i.e. Taylorism, System Dynamics, System Thinking, Quality Assurance
- Product liability
- Customer satisfaction
  - Criteria, two-dimension queries, inquiry methods

Conclusion of Part 1/2

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- Quality costs
  - Failure prevention, appraisal, failure, conformity, quality related losses, barriers
- Leadership
  - Behavior, deal with changes, kinds of influencing control, conflict resolution, syndromes to overcome when introducing changes
- Audits
- Quality awards
- Creativity techniques
  - Mind Mapping, Progressive Abstraction, Morphological Box, Method 635, Synectics, Buzzword Analysis, Bionic, De Bono
- Embedded Systems
- FMEA-Failure Mode Effect Analysis

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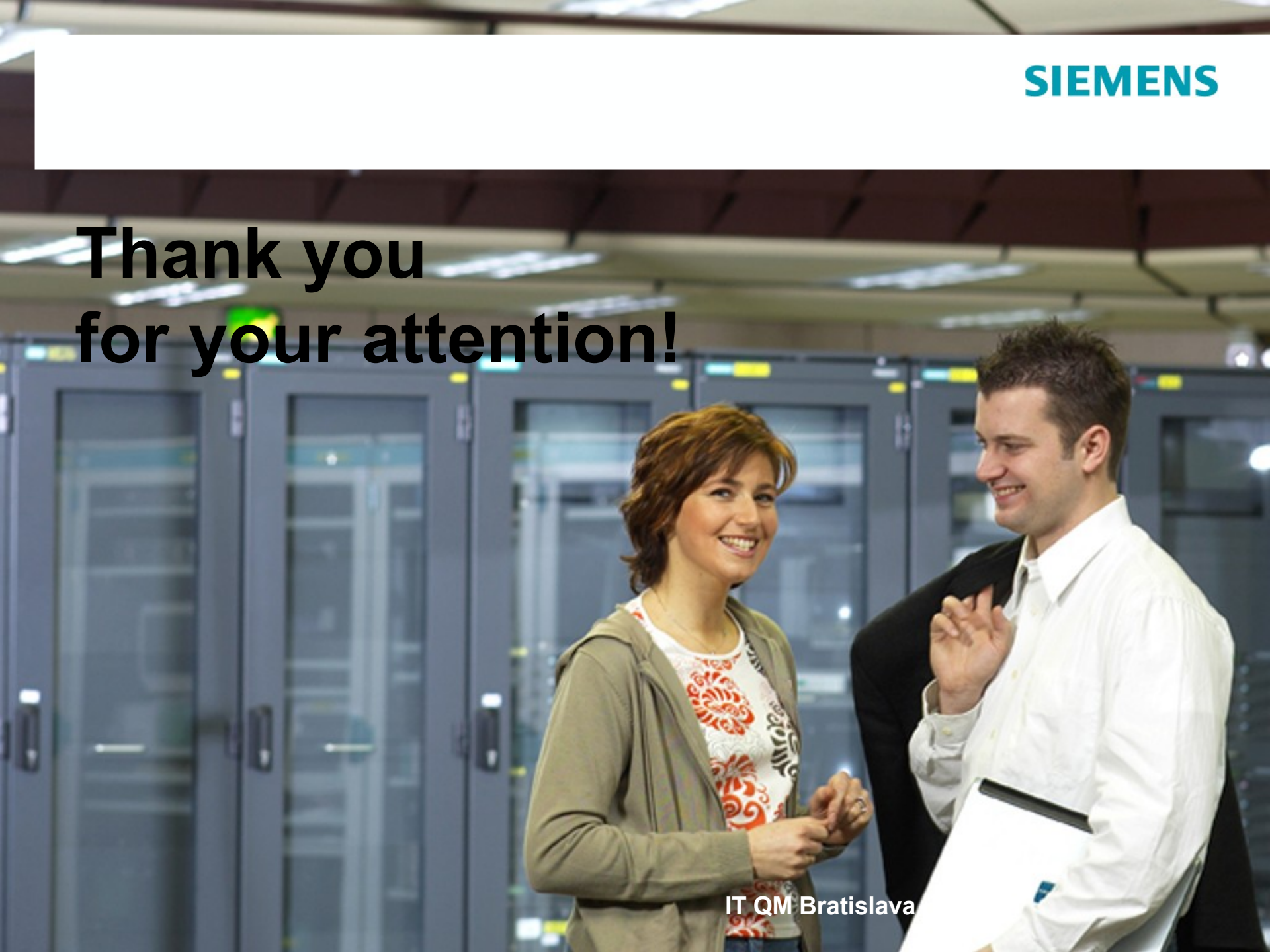
Thank you for your attention!



Farbpalette mit Farbcodes

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Primäre Flächenfarbe:

R 255 G 255 B 255

Sekundäre Flächenfarben:

R 215 G 225 B 225	R 170 G 190 B 195	R 130 G 160 B 165
R 220 G 225 B 230	R 185 G 195 B 205	R 145 G 155 B 165

Akzentfarben:

R 255 G 210 B 078	R 245 G 128 B 039	R 229 G 025 B 055	R 000 G 133 B 062	R 000 G 084 B 159	R 000 G 000 B 000
R 255 G 221 B 122	R 248 G 160 B 093	R 236 G 083 B 105	R 064 G 164 B 110	R 064 G 127 B 183	R 064 G 064 B 064
R 255 G 232 B 166	R 250 G 191 B 147	R 242 G 140 B 155	R 127 G 194 B 158	R 127 G 169 B 207	R 127 G 127 B 127
R 255 G 244 B 211	R 252 G 223 B 201	R 248 G 197 B 205	R 191 G 224 B 207	R 191 G 212 B 231	R 191 G 191 B 191
R 255 G 250 B 237	R 254 G 242 B 233	R 252 G 232 B 235	R 229 G 243 B 235	R 229 G 238 B 245	R 229 G 229 B 229