Problem solving methods

MICHEL-INSTITUT GmbH

Welcome / introduction of the participants

- Name
- Role / capacity
- Experience (quality management, problem solving methods, etc.)
- Expectations
- …

Problem solving methods

Organizational matters

Problem solving methods

Organizational matters

coffee break

Problem solving methods

Organizational matters

Problem solving methods

General overview

- Quality management basic principles
- Facilitation techniques
- Ishikawa / FTA
- 5-why-method
- 8 D-report

Problem solving methods

Initial situation

- „What is a problem?“
  - …
  - …
- „A problem always has more than one cause!“

- **Hence the problem itself doesn‘t need solving, but rather the root of the problem needs to be fixed!**

Problem solving methods

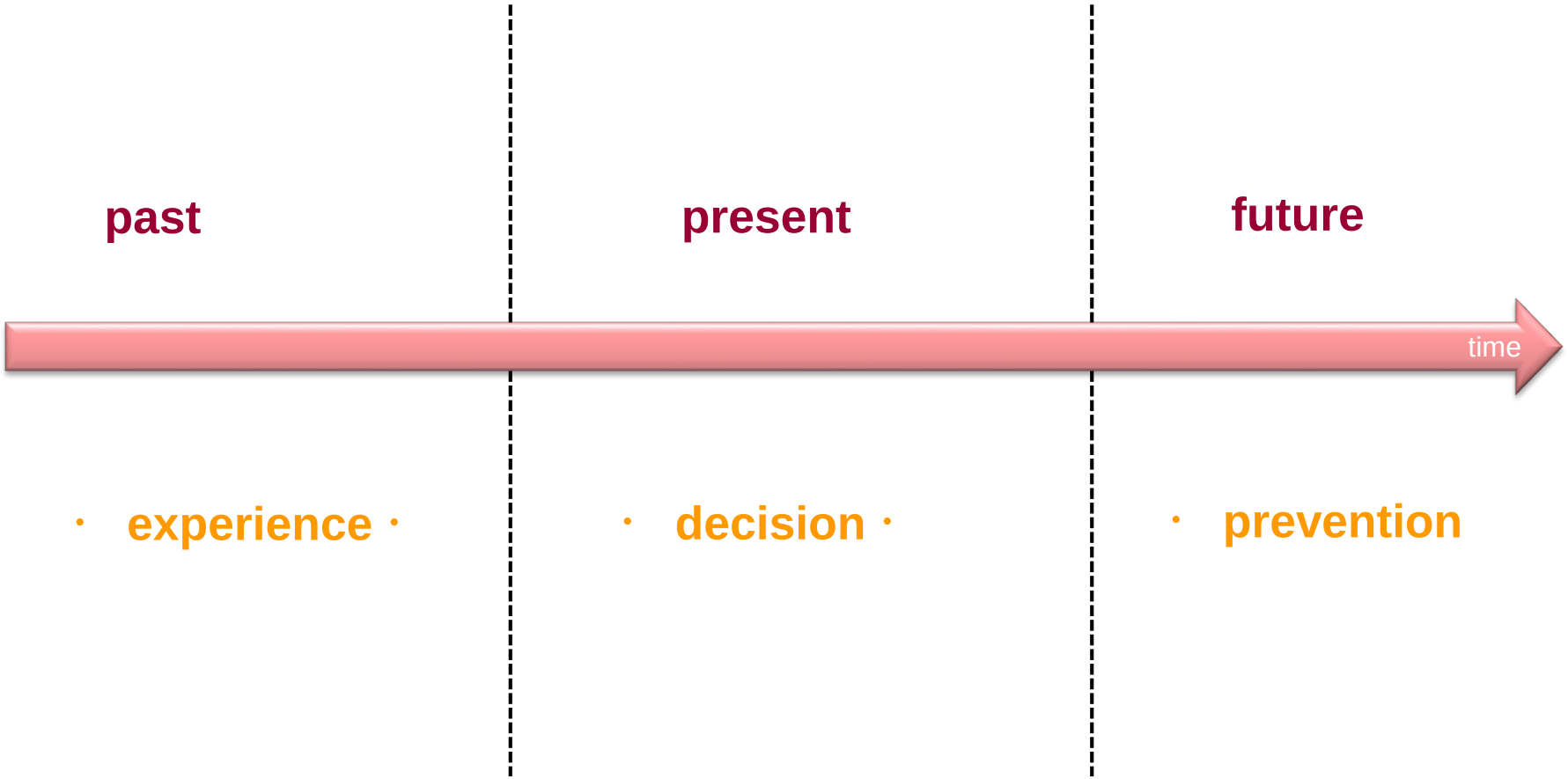
Initial situation

Problems result from…

Problem solving methods

Initial situation

Timeline concerning problems



Problem solving methods

General overview

- **Quality management basic principles**
- Facilitation techniques
- Ishikawa / FTA
- 5-why-method
- 8 D-report

Problem solving methods

General overview

- **Quality management basic principles**
  - What is quality?
  - TQM – Total Quality Management
  - Quality management and process management
  - Improvement
  - Quality management basic principles
  - Types, principles and phases of an audit
  - Benchmarking
  - Key indicators, as seen through the use of a BSC (balanced scorecard)

Problem solving methods

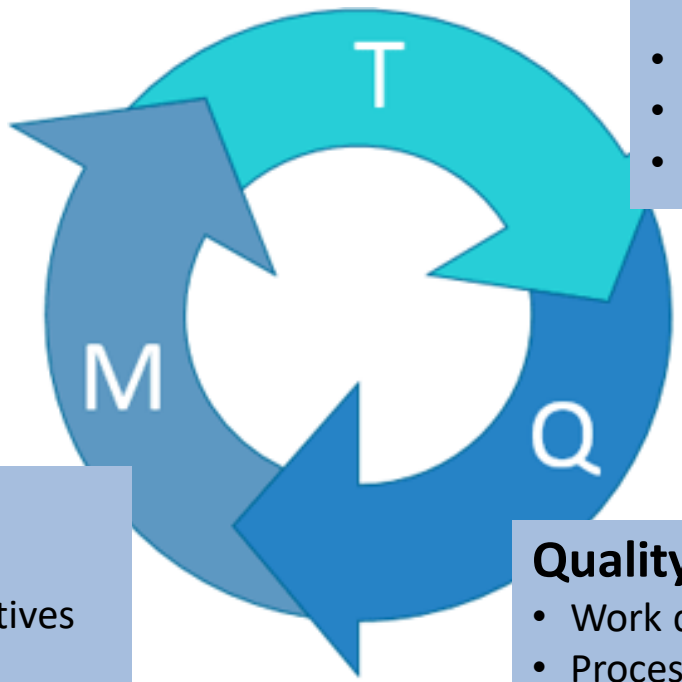
Quality management basic principles

- **What is quality?**

Problem solving methods

Quality management basic principles

- **TQM – Total Quality Management**



Total
- Cross-departmental and cross-functional
- Customer focus
- Employee focus
- Company focus

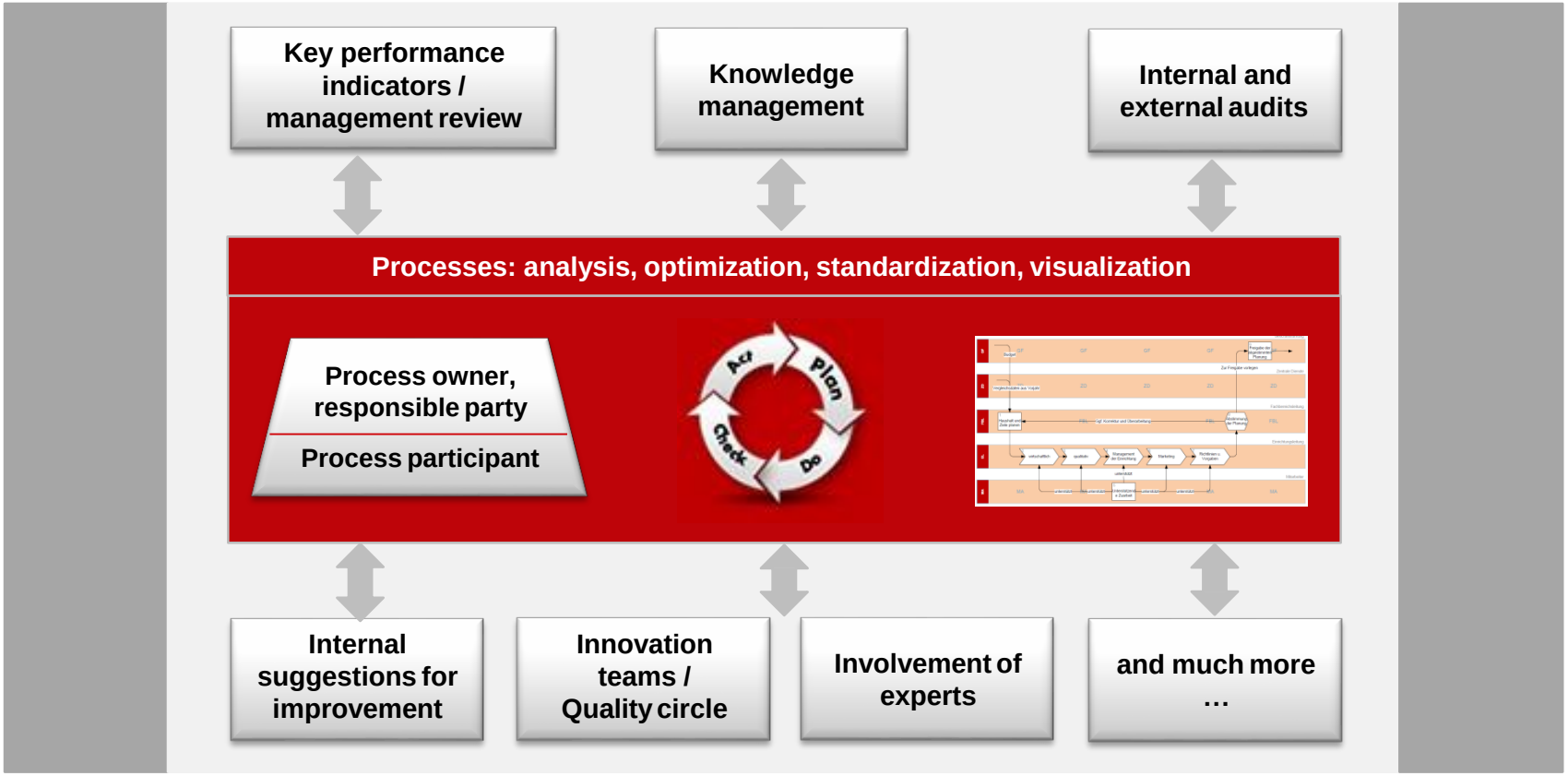
Management
- Leadership quality
- Quality policy and objectives
- Environment policy and objectives
- Capacity for teamwork and learning ability
- Communication skills

Quality
- Work quality
- Process quality
- Product quality
- Information quality
- Business quality
- Environment quality

Problem solving methods

Quality management basic principles

- **Quality management and process management**



source: www.wuerth-industrie.com

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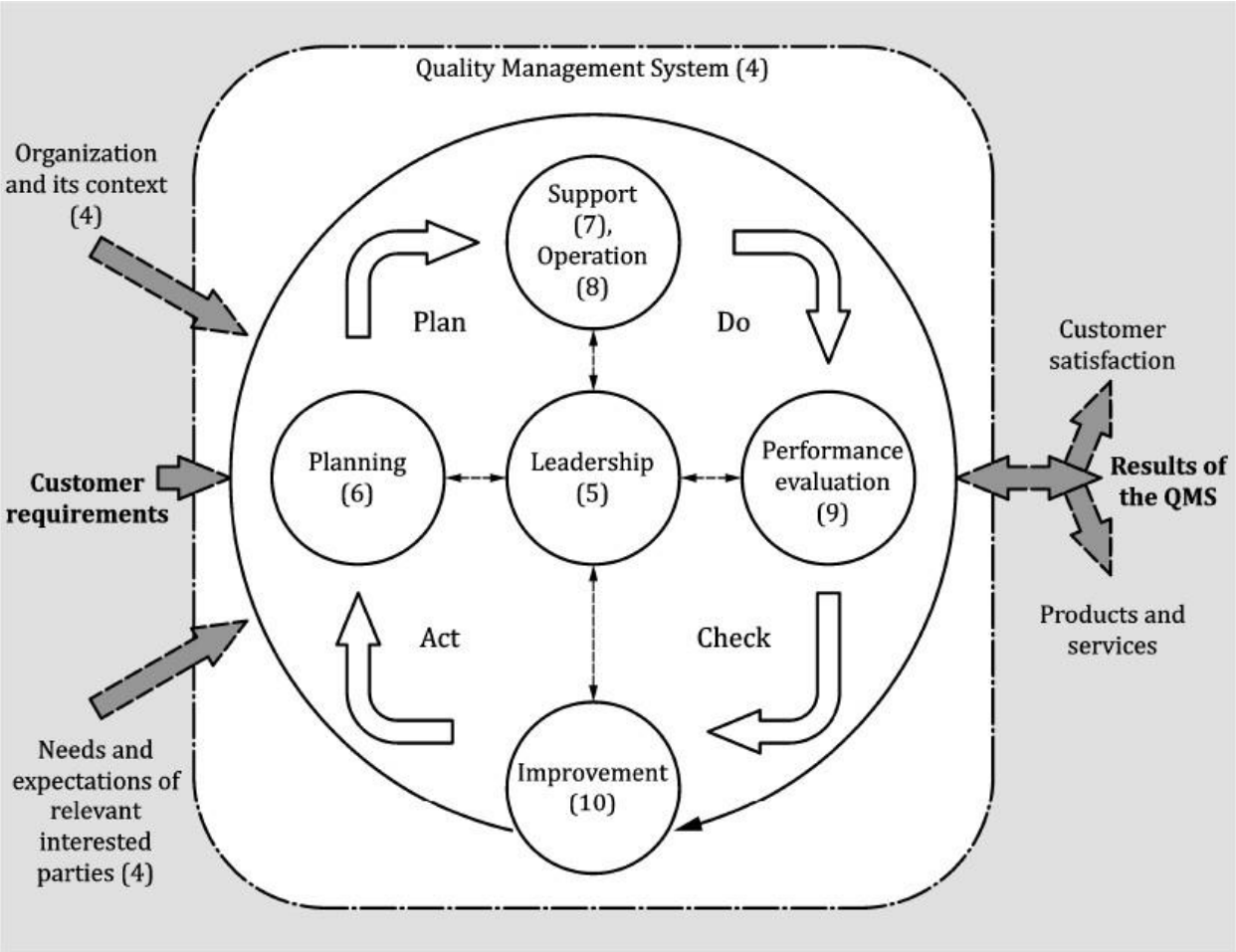
Quality management basic principles

- **Quality management and process management**

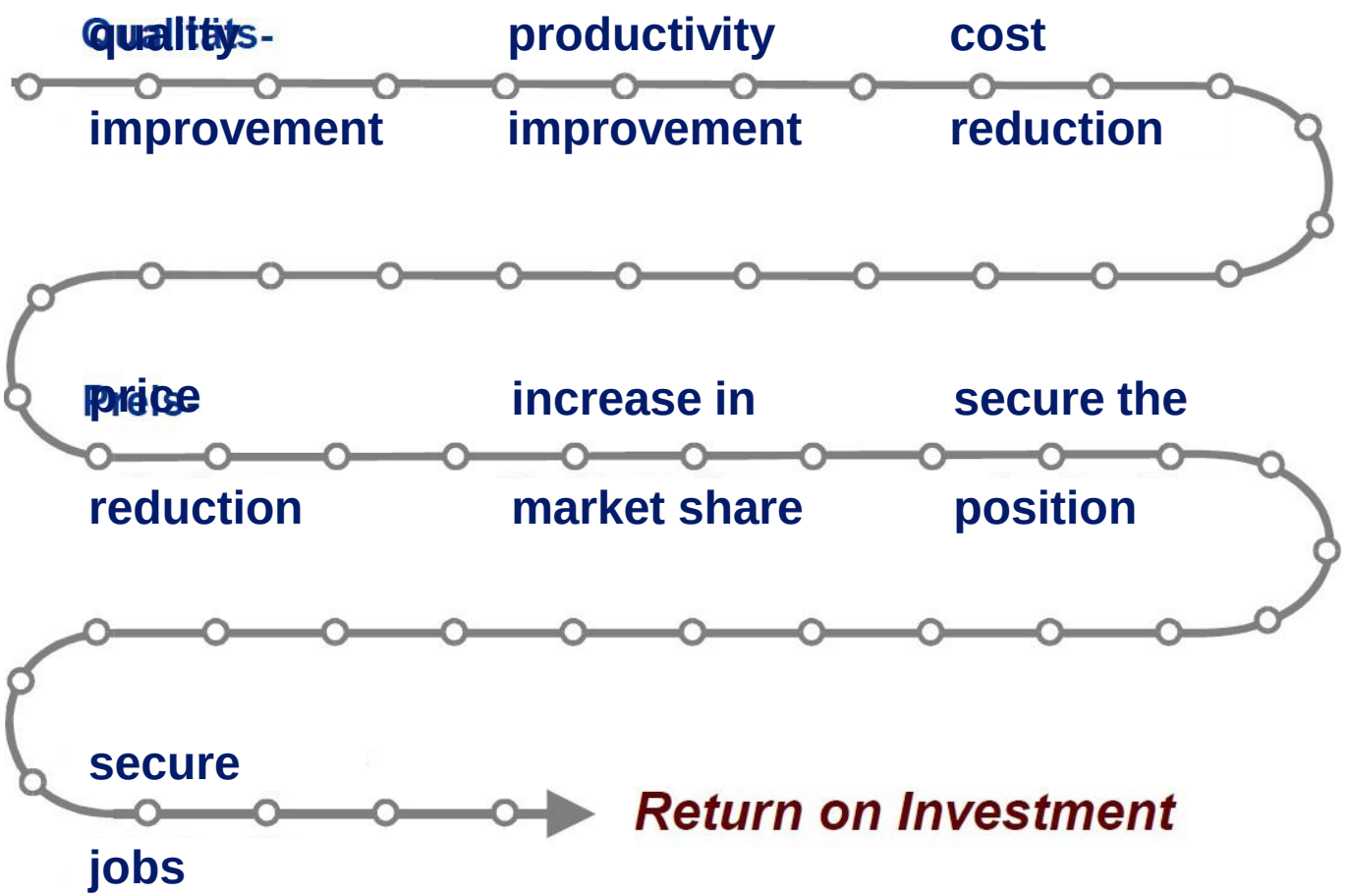


Source: DIN EN ISO 9001:2015

Problem solving methods

Quality management basic principles

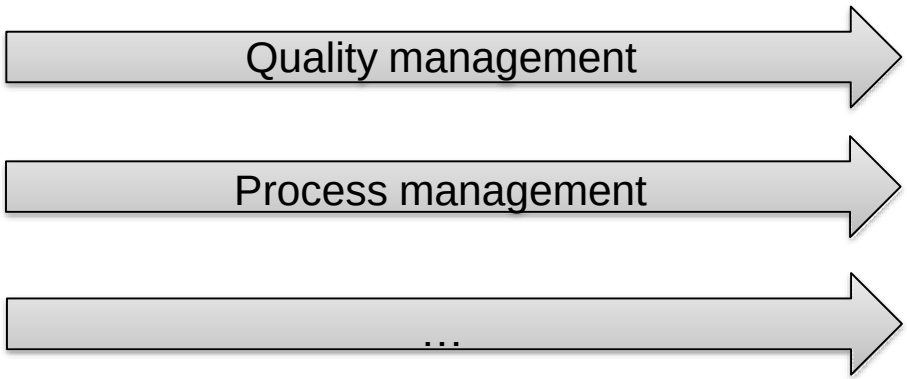
- **Demings chain reaction**



Problem solving methods

Quality management basic principles

- **(Continuous) improvement**



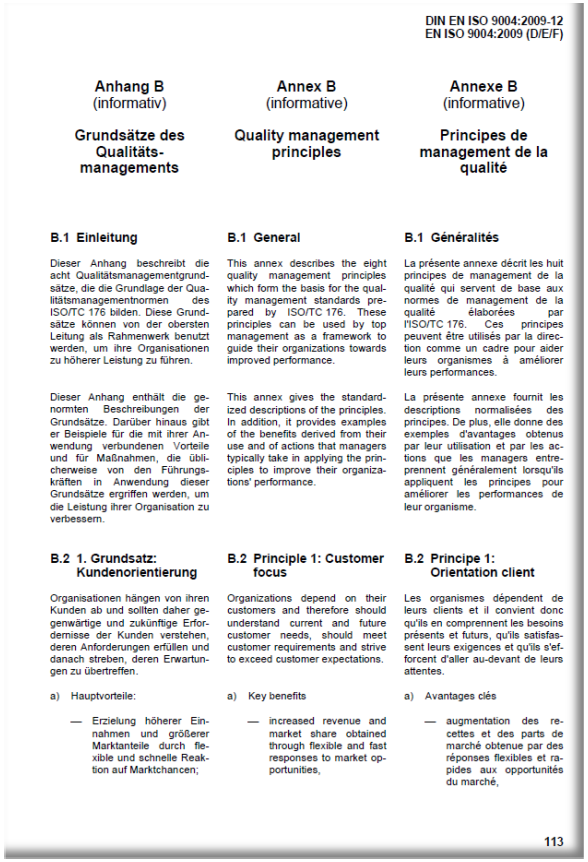
Improvement and
satisfaction of the interested parties

Problem solving methods

Quality management basic principles

Quality management basic principles /1

9004:2009 / annex B



DIN EN ISO 9004:2009-12
EN ISO 9004:2009 (D/E/F)

Anhang B (informativ)	Annex B (informative)	Annexe B (informative)
Grundsätze des Qualitäts-managements	**Quality management principles**	**Principes de management de la qualité**

B.1 Einleitung

Dieser Anhang beschreibt die acht Qualitätsmanagementgrundsätze, die die Grundlage der Qualitätsmanagementnormen des ISO/TC 176 bilden. Diese Grundsätze können von der obersten Leitung als Rahmenwerk benutzt werden, um ihre Organisationen zu höherer Leistung zu führen.

Dieser Anhang enthält die genormten Beschreibungen der Grundsätze. Darüber hinaus gibt er Beispiele für die mit ihrer Anwendung verbundenen Vorteile und für Maßnahmen, die üblicherweise von den Führungskräften in Anwendung dieser Grundsätze ergriffen werden, um die Leistung ihrer Organisation zu verbessern.

B.2 1. Grundsatz: Kundenorientierung

Organisationen hängen von ihren Kunden ab und sollten daher gegenwärtige und zukünftige Erfordernisse der Kunden verstehen, deren Anforderungen erfüllen und danach streben, deren Erwartungen zu übertreffen.

a) Hauptvorteile:

— Erzielung höherer Einnahmen und größerer Marktanteile durch flexible und schnelle Reaktion auf Marktchancen;

B.1 General

This annex describes the eight quality management principles which form the basis for the quality management standards prepared by ISO/TC 176. These principles can be used by top management as a framework to guide their organizations towards improved performance.

This annex gives the standardized descriptions of the principles. In addition, it provides examples of the benefits derived from their use and of actions that managers typically take in applying the principles to improve their organizations' performance.

B.2 Principle 1: Customer focus

Organizations depend on their customers and therefore should understand current and future customer needs, should meet customer requirements and strive to exceed customer expectations.

a) Key benefits

— increased revenue and market share obtained through flexible and fast responses to market opportunities,

B.1 Généralités

La présente annexe décrit les huit principes de management de la qualité qui servent de base aux normes de management de la qualité élaborées par l'ISO/TC 176. Ces principes peuvent être utilisés par la direction comme un cadre pour aider leurs organismes à améliorer leurs performances.

La présente annexe fournit les descriptions normalisées des principes. De plus, elle donne des exemples d'avantages obtenus par leur utilisation et par les actions que les managers entreprennent généralement lorsqu'ils appliquent les principes pour améliorer les performances de leur organisme.

B.2 Principe 1: Orientation client

Les organismes dépendent de leurs clients et il convient donc qu'ils en comprennent les besoins présents et futurs, qu'ils satisfassent leurs exigences et qu'ils s'efforcent d'aller au-devant de leurs attentes.

a) Avantages clés

— augmentation des recettes et des parts de marché obtenue par des réponses flexibles et rapides aux opportunités du marché,

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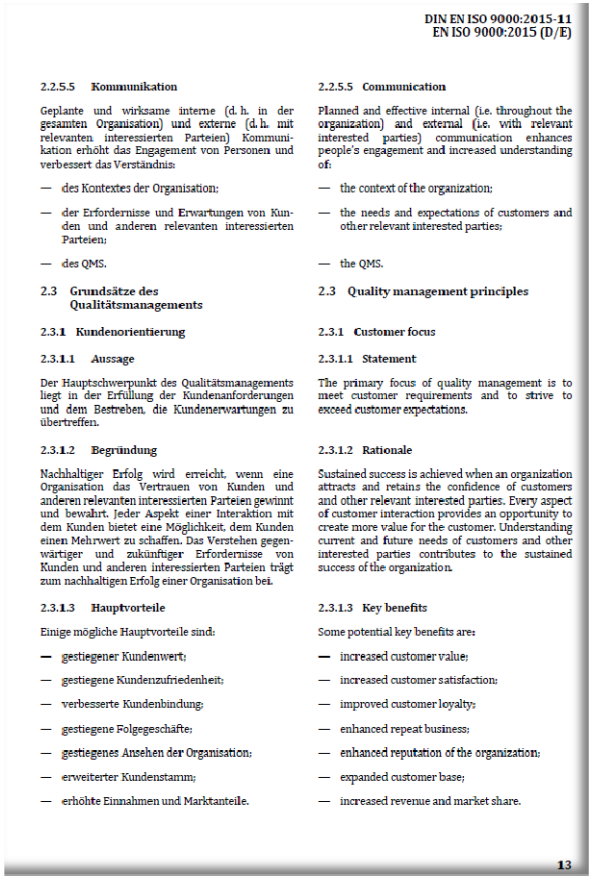
9000:2015 / chapter 2.3



DIN EN ISO 9000:2015-11
EN ISO 9000:2015 (D/E)

2.2.5.5 Kommunikation

Geplante und wirksame interne (d. h. in der gesamten Organisation) und externe (d. h. mit relevanten interessierten Parteien) Kommunikation erhöht das Engagement von Personen und verbessert das Verständnis:

— des Kontextes der Organisation;

— der Erfordernisse und Erwartungen von Kunden und anderen relevanten interessierten Parteien;

— des QMS.

2.3 Grundsätze des Qualitätsmanagements

2.3.1 Kundenorientierung

2.3.1.1 Aussage

Der Hauptschwerpunkt des Qualitätsmanagements liegt in der Erfüllung der Kundenanforderungen und dem Bestreben, die Kundenerwartungen zu übertreffen.

2.3.1.2 Begründung

Nachhaltiger Erfolg wird erreicht, wenn eine Organisation das Vertrauen von Kunden und anderen relevanten interessierten Parteien gewinnt und bewahrt. Jeder Aspekt einer Interaktion mit dem Kunden bietet eine Möglichkeit, dem Kunden einen Mehrwert zu schaffen. Das Verstehen gegenwärtiger und zukünftiger Erfordernisse von Kunden und anderen interessierten Parteien trägt zum nachhaltigen Erfolg einer Organisation bei.

2.3.1.3 Hauptvorteile

Einige mögliche Hauptvorteile sind:

— gestiegener Kundenwert;

— gestiegene Kundenzufriedenheit;

— verbesserte Kundenbindung;

— gestiegene Folgegeschäfte;

— gestiegenes Ansehen der Organisation;

— erweiterter Kundenstamm;

— erhöhte Einnahmen und Marktanteile.

2.2.5.5 Communication

Planned and effective internal (i.e. throughout the organization) and external (i.e. with relevant interested parties) communication enhances people's engagement and increased understanding of:

— the context of the organization;

— the needs and expectations of customers and other relevant interested parties;

— the QMS.

2.3 Quality management principles

2.3.1 Customer focus

2.3.1.1 Statement

The primary focus of quality management is to meet customer requirements and to strive to exceed customer expectations.

2.3.1.2 Rationale

Sustained success is achieved when an organization attracts and retains the confidence of customers and other relevant interested parties. Every aspect of customer interaction provides an opportunity to create more value for the customer. Understanding current and future needs of customers and other interested parties contributes to the sustained success of the organization.

2.3.1.3 Key benefits

Some potential key benefits are:

— increased customer value;

— increased customer satisfaction;

— improved customer loyalty;

— enhanced repeat business;

— enhanced reputation of the organization;

— expanded customer base;

— increased revenue and market share.

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Quality management basic principles

Quality management basic principles /2

8 basic principles → 7 basic principles

	9004:2009		9000:2015
Customer focus	**B.2**	Customer focus	**2.3.1**
Leadership	**B.3**	Leadership	**2.3.2**
Involvement of people	**B.4**	Engagement of people	**2.3.3**
Process approach	**B.5**	Process approach	**2.3.4**
System approach to management	**B.6**		
Continual improvement	**B.7**	Improvement	**2.3.5**
Factual approach to decision making	**B.8**	Evidence-based decision making	**2.3.6**
Mutually beneficial supplier relationships	**B.9**	Realationship management	**2.3.7**

Problem solving methods

Quality management basic principles

Audits: types of audits

SYSTEM AUDIT

Questions regarding, for example:
- Targets
- Cost analysis
- Personal qualification
- Product liability
- Tasks, skills, responsibilities

RESULT:
- Change in objectives
- Qualification measures
- QM-documentation changes
- Change in responsibilities

PROCESS AUDIT

Questions regarding process requirements, for example:
- Handling
  - by hand
  - mechanically
  - robotically
- Joining procedures
  - screwing
  - bolting
  - glueing

RESULT:
- Measures for process improvement
- Statements of ability

PRODUCT AUDIT

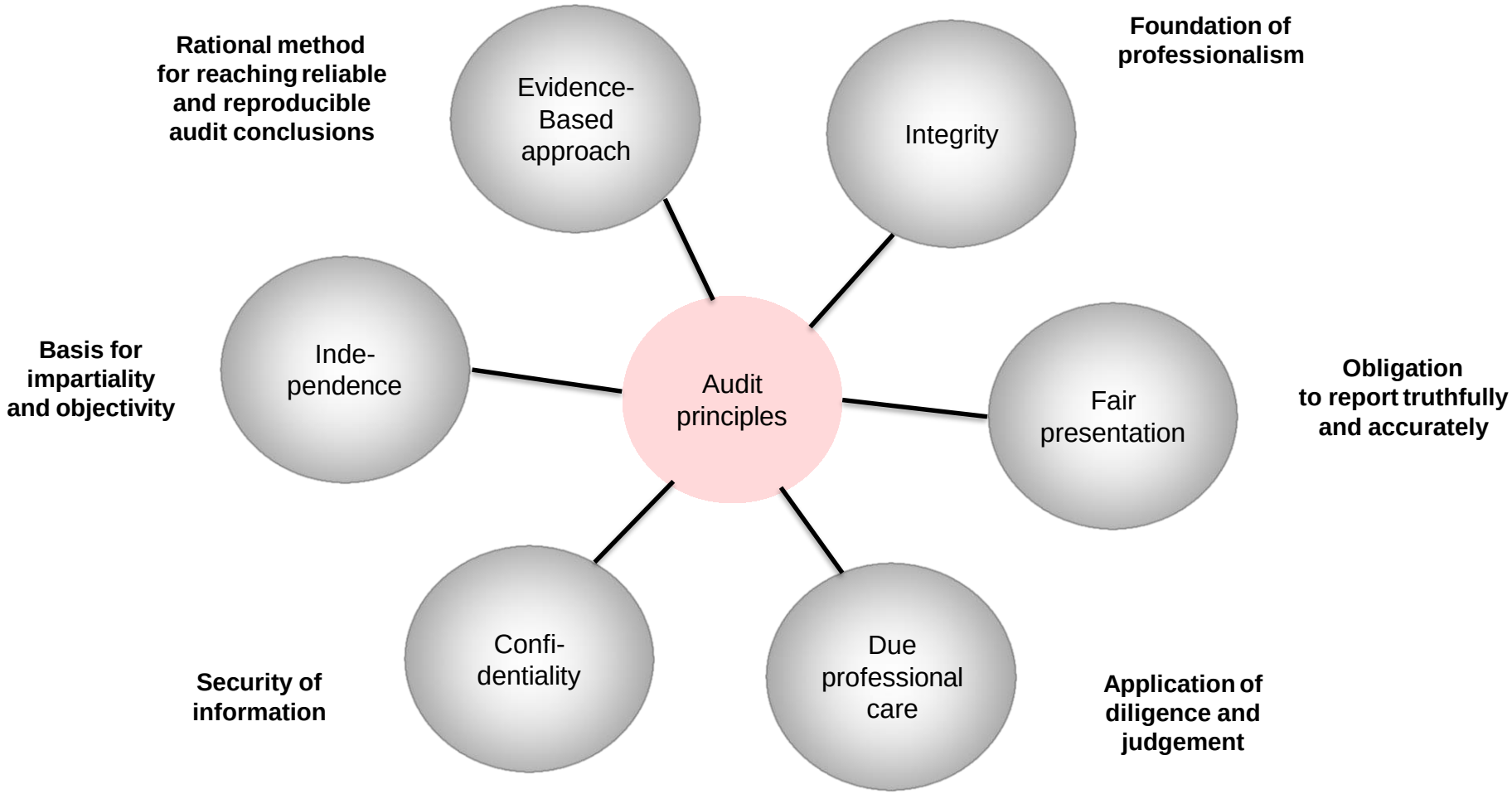
Questions regarding individual characteristics, for example:
- Product concept catalogue
- CSR
- Specifications
- Customer complaint
- List of defects

RESULT:
- statement of isolated defects
- Improvements
- Rework
- …

Problem solving methods

Quality management basic principles

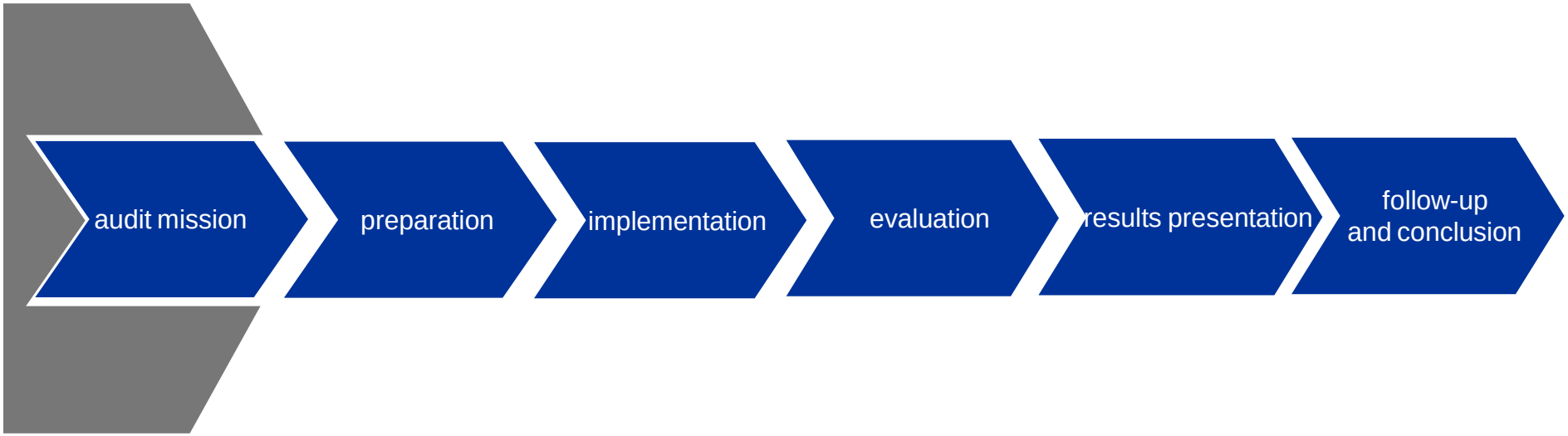
- **Audits: principles of auditing (according to DIN EN ISO 19011)**



Problem solving methods

Quality management basic principles

- **Audits: phases of an audit**



Problem solving methods

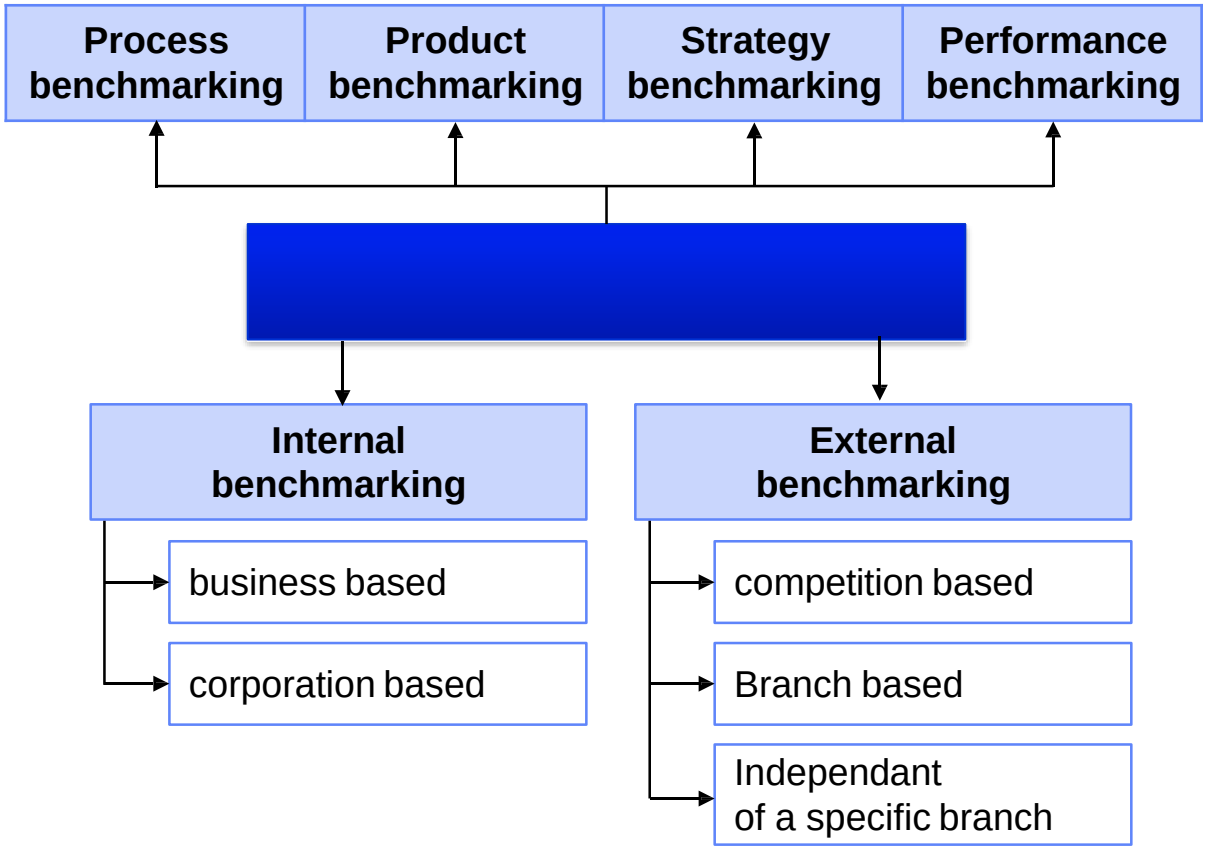
Quality management basic principles

- **Benchmarking**

- **Aim:**
  Process improvement, performance improvement, product and/or organization improvement through the example of a comparable partner.
- **Application:**
  Look for exceptional top performances either externally or internally. Depending on the aim, the bench marking objectives are compared to each other regarding both quantity and quality, in order to determine best practices and utilize them within the own organization.

Quality management basic principles

Benchmarking types



Problem solving methods
Quality management basic principles

Internal bench marking: pros and cons

INTERNAL BENCHMARKING	PROS	CONS
Criteria		
Information gathering	simple	reluctance to reveal own advantages
Scope	applicable for all scenarios	---
Finalize relevant indicators	simple	coordination difficulties possible
Select partners	simple	---
Contact partners	simple	fear of internal change
Exchange	simple (exchange of process models easier through the use of identical modelling methods)	problems of responsibility
Positioning	illustrate internal best performances	external positioning not possible
Comparability	high	internal prejudices
Acceptance	counteracts resistance to change	fear of blame being cast
Feasibility	relatively simple	heed rules for global comparison (i.e. tax restrictions)
Competition problem	disclosure of all data possible; no sharing of trade secrets with third parties	---
Results	easily comparable results	limited view/ no groundbreaking innovations
Legal problems	none	---

Problem solving methods
Quality management basic principles

External benchmarking

perspective / criteria	competition based benchmarking	branch based benchmarking	benchmarking independant of a specific branch
information acquisition	difficult and time consuming, complex	time consuming, complex, complicated	simple
scope	highly limited	limited	comprehensive
opportunities for improvement	medium	high	very high
selection of partners	simple	simple	difficult without support
making contact	easily possible	simple	difficult
willingness to exchange datas	barely existing	generally existing	very high
positioning	possible	possible, but complex	possible, but complex
comparability	simple, but not for important processes	medium	only on an abstract level
competition issues	highly limited	existing	barely existing
applicability	good	possible	possible
legal issues	often	seldom	in very rare cases

source: Hanser-Verlag

Problem solving methods

Quality management basic principles

- **BSC – balanced bcorecard**

  - A balanced scorecard is a mangement tool which communicates between strategic and operative levels.

  - It ensures that the relevant targets (particularly customers and finances) are consistantly followed up on.

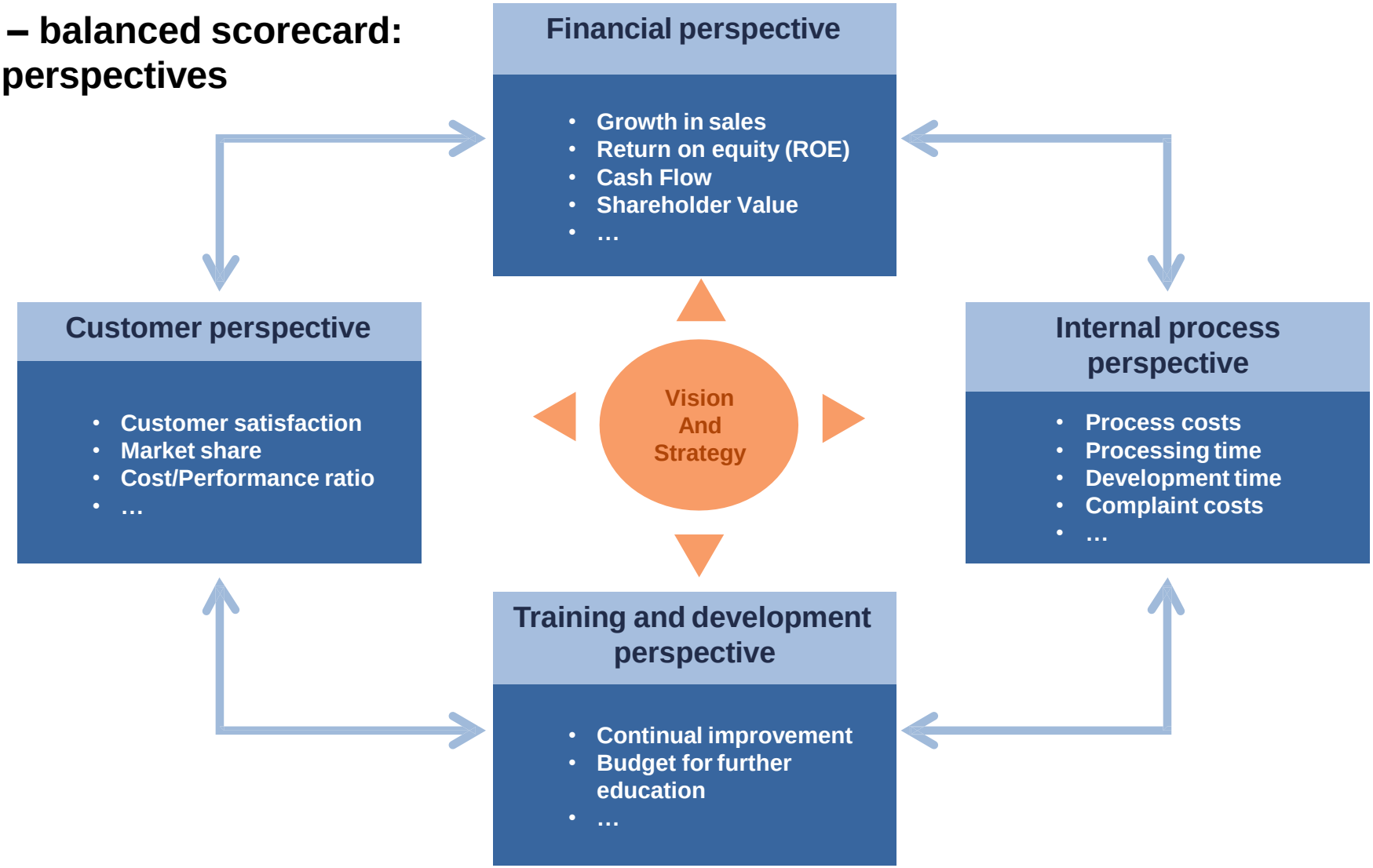
  - It can be adapted to all types of businesses and situations.

  - The success of the implementation of the balanced scorecard is not dependent on the observance of formalities, but rather on the mediation among the employees.

Problem solving methods

Quality management basic principles

- **BSC – balanced scorecard: four perspectives**



Quality management basic principles

BSC – What is a scorecard?

- „Balanced“ is only one element of the concept.
- In the end, the main concern is the design of a scorecard/report sheet.
- The company‘s key performance indicators, i.e. indicators and/or aims, are what is relevant.
- A scorecard contains a multitude of indicators that are chosen based on the principle of balance.

Quality management basic principles

- **Key indicators, as seen through the use of a BSC (balanced scorecard)**

  - Which indicators are needed for each individual perspective? Do they influence each other causally?
  - How are they defined and who is responsible for their monitoring?
  - Which targets are reasonable regarding these indicators?
  - Determine which other units within the company need scorecards (departments, sales representatives, etc.?).
  - Coordinate the individual indicators and targets with the company scorecard.

Quality management basic principles

BSC – balanced scorecard: interpretations

Classic (mis-)interpretations of a BSC approach	„Correct" interpretations of a BSC approach
A balanced scorecard is a key indicator system.	A balanced scorecard is a management tool supported by key indicators.
The development of balanced scorecards follows the top-down approach.	A balanced scorecard is a team based approach that takes the management and the respective employees into account.
A balanced scorecard is a control system.	Balanced scorecards are forward-looking, i.e. part of the planning system. They support the operationalizing of the planning.
A balanced scorecard has only four standard perspectives: customers, finances, internal business processes, training and development.	A balanced scorecard has multiple perspectives of differing content and count; the scope is the decisive factor.
A balanced scorecard serves as the control instrument for the entire company.	Balanced scorecards can be utilized on many levels (business units, divisions, departments). A system of balanced scorecards can be developed for the entire company.

Problem solving methods

General overview

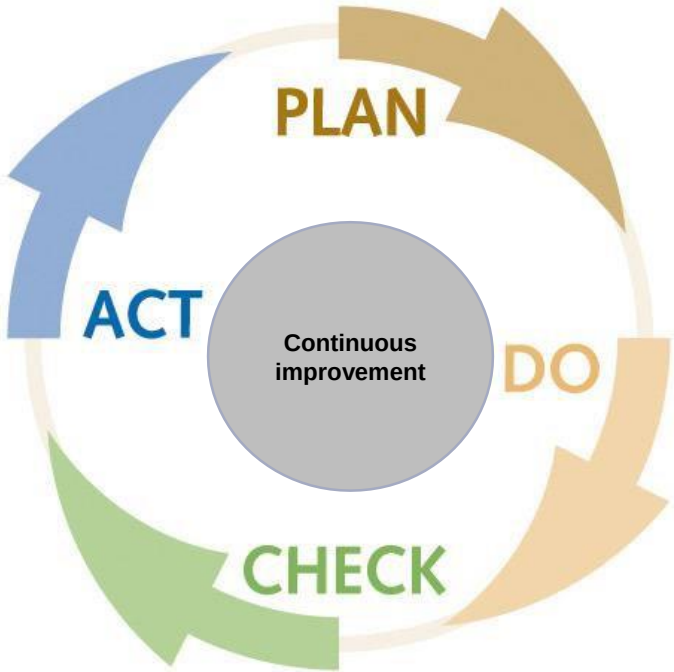
- Quality management basic principles
- **Facilitation techniques**
- Ishikawa / FTA
- 5-why-method
- 8 D-report

Problem solving methods

Facilitation techniques

Facilitation during the problem solving process

- The continuous search for the cause of problems is the basic idea of the problem solving process.
- The individual phases of the problem solving process are illustrated in the PDCA cycle.



Problem solving methods

Facilitation techniques

PLAN

- The decisive problem is generally not clearly visible.
- It is hidden by a multitude of additional problems.
- This makes it all the more important to find the ‚right problem' and rectify it.
- The base of the problem solving process is a situation analysis.
- During this phase, information and data regarding the underlying situation concerning the problem and the environment are systematically gathered.
- Environmental factors, which directly or indirectly influence the initial situation, need to be determined.
- The result is a simplified model-like presentation of the environment.
- It should be kept in mind that limiting the scope of the research greatly influences the amount of solutions.

Problem solving methods

Facilitation techniques

DO

- Most problems, in order to make them manageable, need to be broken down into their underlying structure. Hereby the structure, the context and/or principles need to be recognized and defined.
- Subsequently, the root causes need to be determined, classified and rated.
- Alternatives for the problem solving need to be determined.
- Utilize the team‘s creativity to obtain new ideas. Existing thought and behavior patterns may need to be rejected.

Facilitation techniques

CHECK

- The consequences of the differing solution alternatives will be determined during their implementation.
  If solutions based on experience and practical experiments are not feasible, a simulation can be implemented.
- Once the effect of the individual solutions has been determined, the results are compared to each other in regards to the objective and in regards to the preferences of the decision makers and are subsequently consolidated in a list according to the preference order.
- This list of preferences serves as the decision basis for the approach.
- Additional criteria, which could not previously be taken into account, can alter the outcome.

Problem solving methods

Facilitation techniques

ACT

- **Implementation phase**.
- An effective facilitation during team meetings, in which potential solutions are conceived, ensures that the ideas are realized through the creation of a list of clearly defined tasks and responsibilities (with a corresponding time schedule for the implementation) .
- The review of the effectiveness of the implemented solutions can result in references for further improvement.
- Documentation of the developed solutions, in order to conclude the decision making process and the individual steps in a comprehensible fashion.

Problem solving methods

Facilitation techniques

The facilitator

- The facilitator has a central function within a group.
- Internal / external facilitator.
- The facilitator coaches the participants and steers the communication process.
- The facilitation mainly serves the purpose of improving interpersonal communication.
- The acceptance of the facilitator is essential and is primarily influenced by two factors:

  - **methodical skills** (mastery of the individual techniques)
  - **social skills** (control of the network of relationships within a group). Social tact.
  - additional skills:
    flexibility (react to required changes during the facilitation), individual style (no trained and/or artificial behavior, but rather authentic behavior)

Problem solving methods

Facilitation techniques

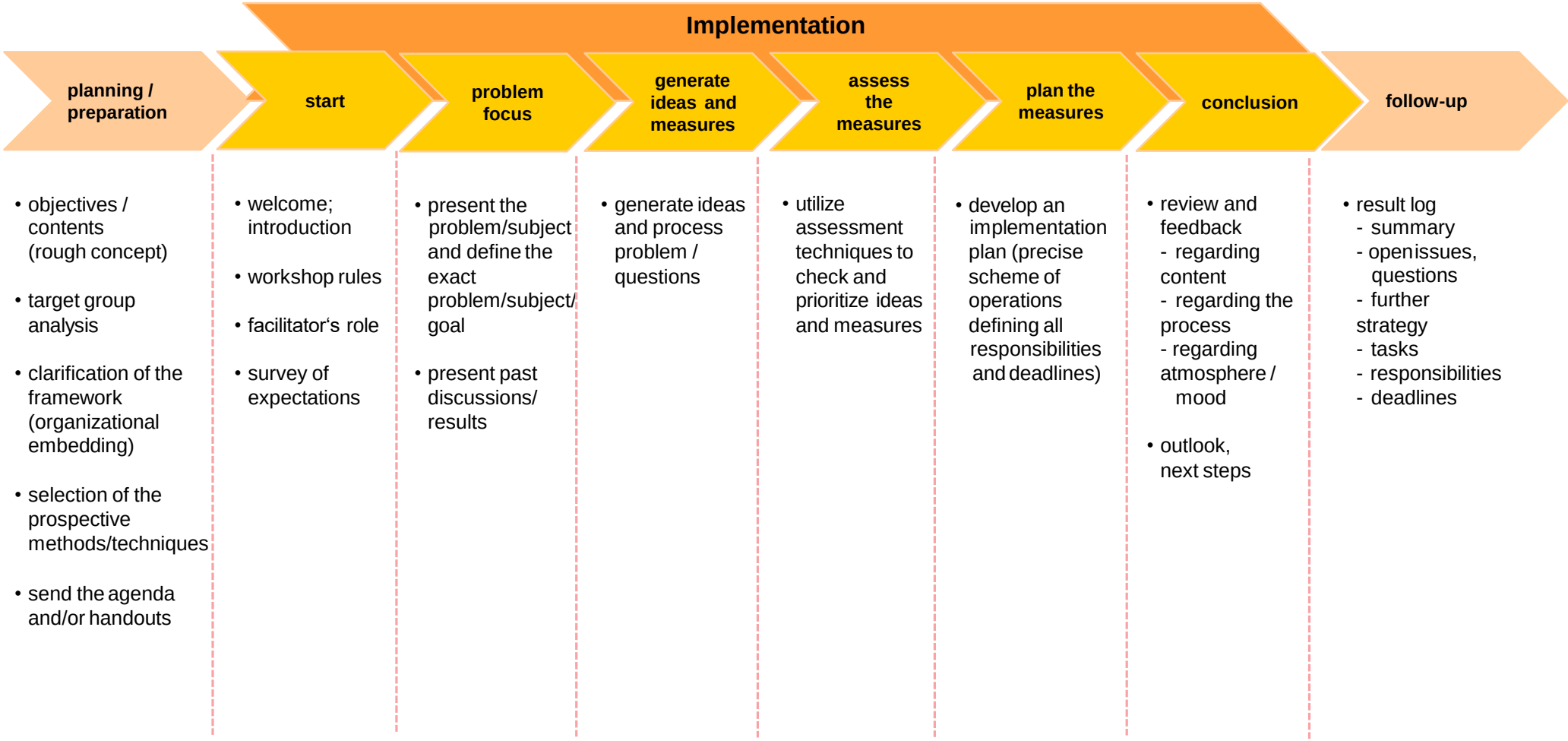
The team

- Constraints and communication patterns hamper the facilitation of team meetings and workshops.
- Meeting and workshop participants can be sorted into eight general categories:

1. The positive minded participant.
2. The talkative participant.
3. The thick-skinned participant.
4. The contentious participant.
5. The know-it-all.
6. The naysayer.
7. The lofty participant.
8. The inquisitive participant.

Problem solving methods
Facilitation techniques

The facilitation process



Facilitation techniques

Facilitation techniques

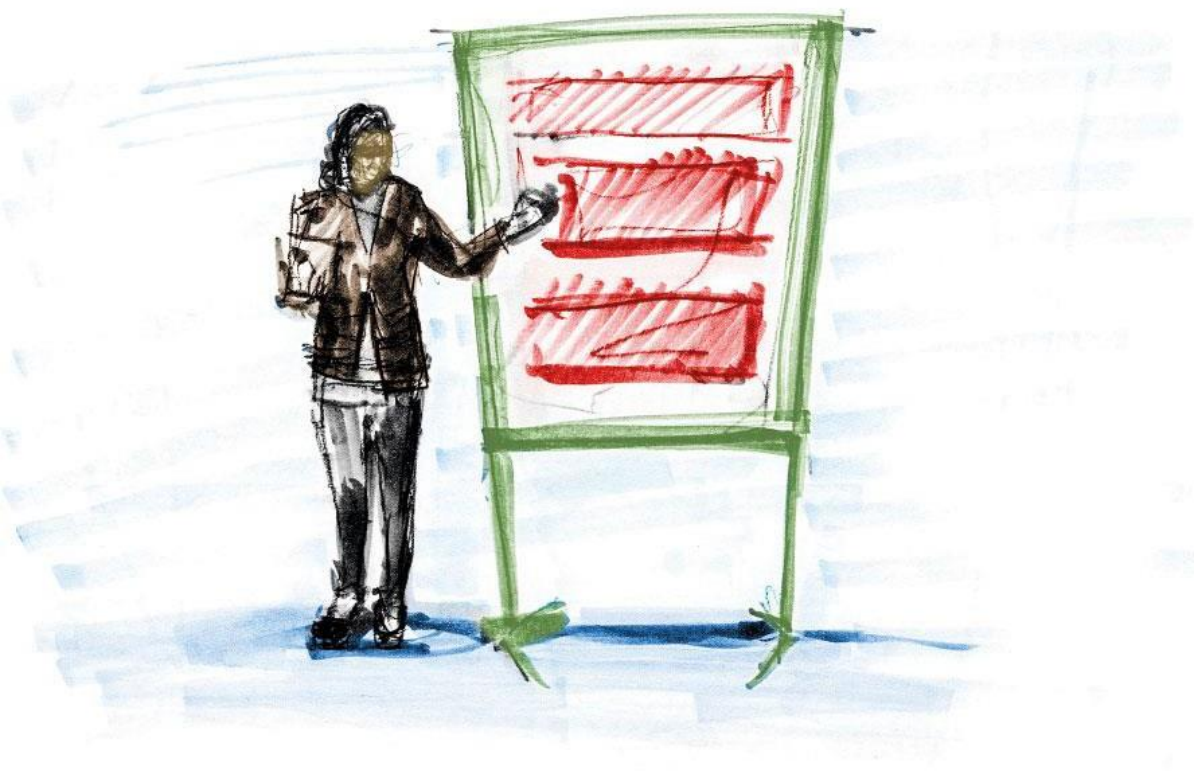
- **Basic techniques**
  - Consistent visualization.
  - Participant activation.
  - Positive atmosphere.

Problem solving methods

Facilitation techniques

Facilitation techniques: examples

- flashlight
- brainstorming
- questioning techniques
- flashcards
- rating system
- feedback
- activity catalog
- catalog of issues



Problem solving methods
Facilitation techniques

- **Example:** questioning techniques

Question type	Example	Possible application
Opening question	"How are you experiencing the situation at the moment?" "What do you see as conducive and what as obstructive?"	As an intrduction to a subject and to disclose the most important aspects of the problem.
Follow-up question	"Which further steps result from this?" "What consequences does this have for you?"	To provoke further thought and/or to derive measures from previous ideas and suggestions
Completeness questions	"Which arguments / causes can be found in addition?"	To verify and complete approaches and ideas that have already been found.
Perspective questions	"What does this proposal mean for the employees (suppliers / customers / ...)?"	To steer the interest to previously ignored and neglected aspects.
Check	"I`d like to refer this question to the group: what to you think about it?" "What would your suggestion be?"	To promote discussions, safeguard neutrality, include participants or encourage them to find a solution on their own.
Clarification and paraphrasing questions	"What exactly to you mean by that?" "Did I understand you correctly, that ...?" "Are you trying to say, that ...?"	To better understand expressions of opinion of those participants, that express themselves neither confidently nor eloquently.
Reverse questions	"What do we have to do to scare our customers off?"	To loosen things up when the flow of ideas stops or the motivation has reached a new low within the group.
Limitation and demarcation questions	"Which subject should definetely be discussed today?" "Which criteria should be minimally met by the solution?" "What should the solution not be able to do?"	To promote focussing on and distinguishing between the relevant and less important aspects and subjects.
Balancing and concluding questions	"How satisfied are you with today´s results?" "What would be utilizing for your work from today´s meeting?"	To evaluate and complete the workshop / meeting and to obtain feedback.

Problem solving methods

Facilitation techniques

Example: flashcards

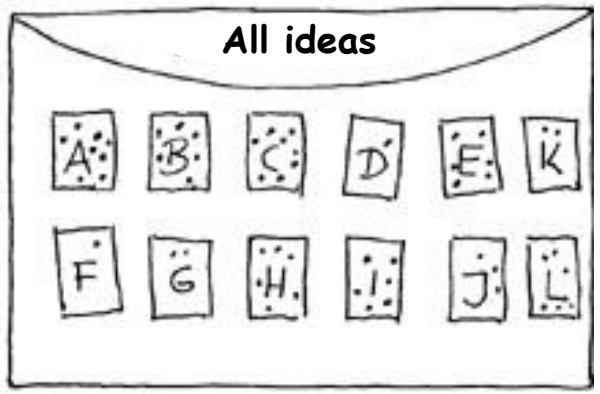
- The goal is to collect ideas, problems and an approach to solving them and questions or issues quickly by a number of people.
- … initial questions to focus the participants
- … collection of group opinions and knowledge
- … collect a broad spectrum of expertise and knowledge

Problem solving methods

Facilitation techniques

Example: rating system

- Different alternatives should be compared and rated by the team members.
- The decision making can expose group opinions and conflicts or moods, esteem, expectations and attitudes.
- Focal points can be determined and decisions can be made.



Problem solving methods
Facilitation techniques

Example: activity catalog

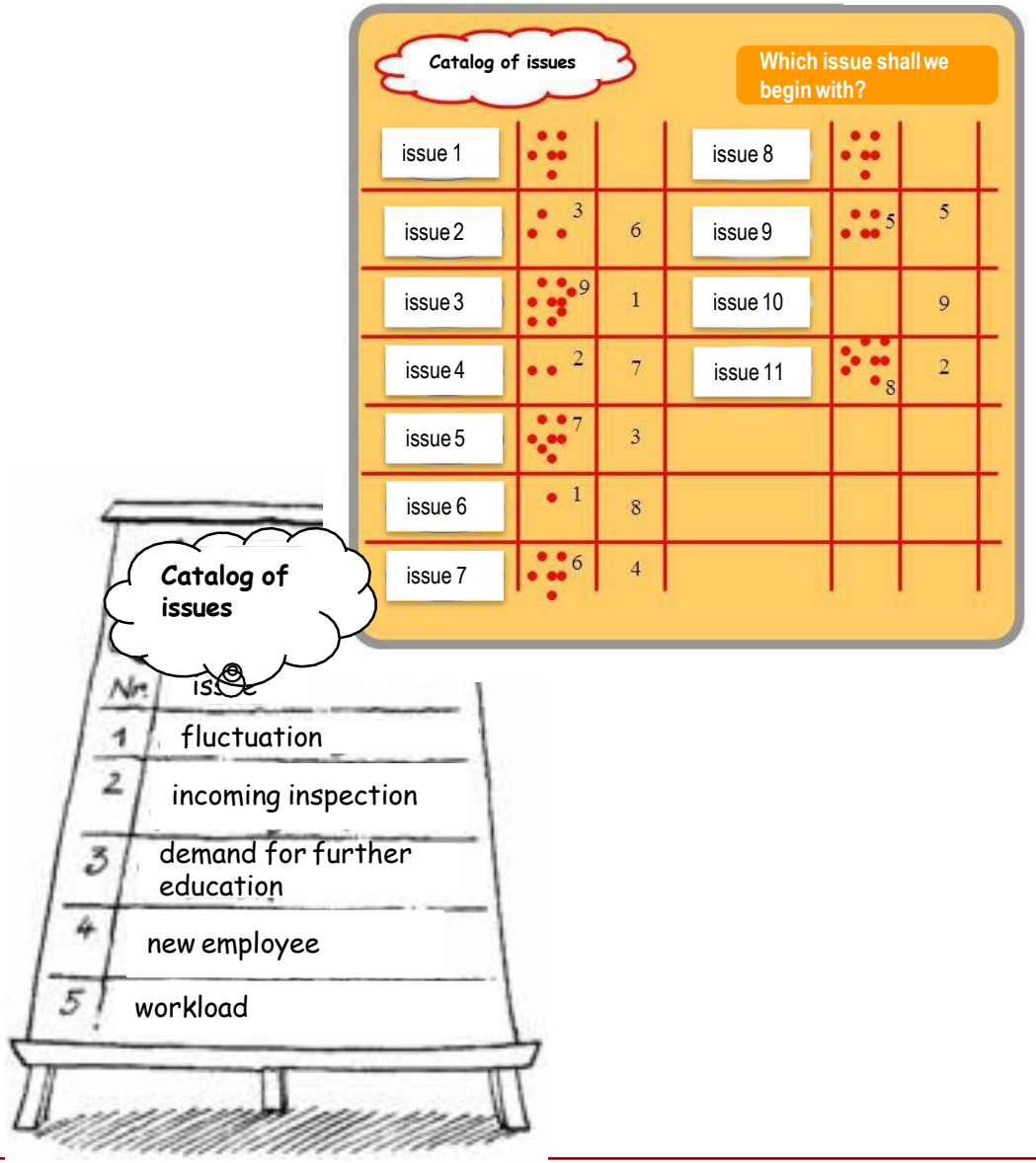
Who	does what	with whom	until when	for what reason	succes review/ feedback
Ms. Miller	Development of proposed solution A for increased quality in production sector X	Mr. Malone	16. April	Subitem for the decision paper for the devisional management	Mr. Schneider
Mr. Baker	Clarify technical feasibility for idea-no. 5 with Mr. Malone from department XY	Mr. Edwards	28. März	Preparation for additional planning during the next meeting	Mr. Bishop (feedback for the entire team)
Mr. Franklin	Compile list of the system components in need of maintenance	Ms. Johnson	2. April	Condition for the cost estimate	Mr. Schneider
…	…	…	…	…	…

Problem solving methods

Facilitation techniques

Example: catalog of issues

- It is important to keep track of all issues or topics not yet discussed during the initial clarification process of all relevant issues.
- Prioritization of the individual subjects by the group.
- Usually in combination with a rating system (quantifier).



Problem solving methods

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Problem solving methods

General overview

- **Ishikawa / FTA**

- Ishikawa: history, background
- Ishikawa: objective
- Ishikawa: synonyms
- Ishikawa: approach
- Ishikawa: examples
- Ishikawa: pros/cons (strengths/weaknesses)

- FTA: introduction
- FTA: history
- FTA: aims
- FTA: phases / steps / symbols
- FTA: example
- FTA: pros/cons (strengths/weaknesses)

Problem solving methods

Ishikawa

History / background

- Dr. Kaoru Ishikawa, University of Tokyo, Japan, 1915 - 1989
- The creator of the Ishikawa-diagram is a pioneer of Japanese quality control.
- CWQC (Company Wide Quality Control): comprehensive quality concept for the improvement of the business performance.
- Key success factors of the Ishikawa theory are the active participation of all employees and a strictly systematical approach.
- Applicable for all branches, processes and types of problems.
- In worldwide use since 1943.

Problem solving methods

Ishikawa

Ishikawa-diagram

- A cause and effect diagram is a graphic presentation of the causes that result in a specific outcome or that influence this outcome decisively.
- In this way, all problems should be identified and their influence and dependency on each other should be outlined by the diagram.
- Through multidisciplinary teamwork during the preparation, different views of the problem are linked.
- This targeted approach ensures full concentration on the problem and not on individual personal interests.
- The multitude of possible causes are divided into main and secondary causes.
- This ensures a clear classification.
- In addition, dependencies between the causes are visible.

Problem solving methods

Ishikawa

Ishikawa-diagram: synonyms

- Cause and effect diagram
- Fishbone diagram
- Christmas tree diagram

Problem solving methods

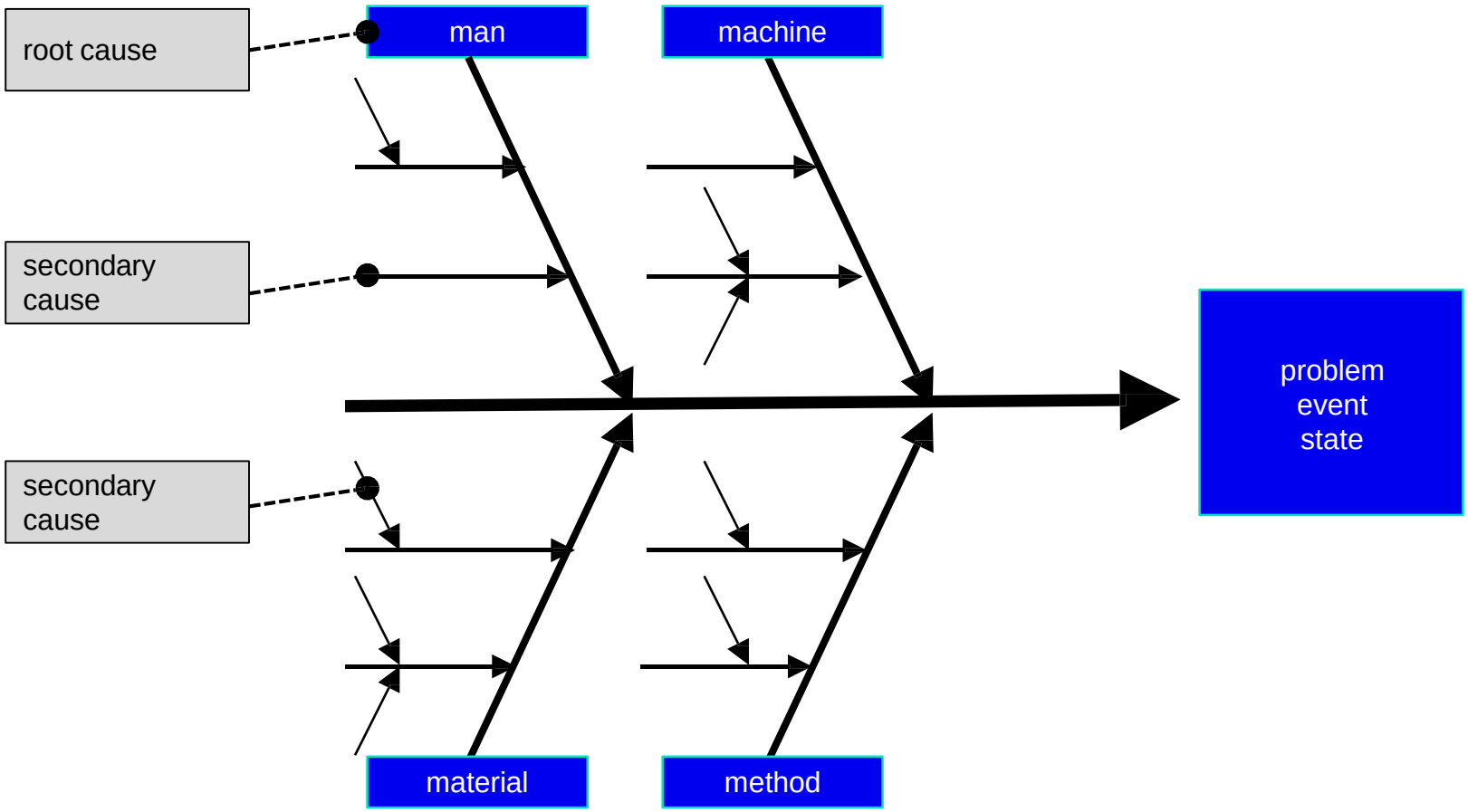
Ishikawa

Ishikawa-diagram: approach

1. Exact definition of the problem (problem description).
2. Determination of the root causes / categories for possible causes.
   Most often the M‘s (man, method, material, machine) are used;
   can be supplemented with milieu (environment), measurement/measuring method, money …
   No more than eight general categories should be used.
3. Determine the secondary/individual causes, for example through brainstorming or by using the 5-why-technique (keeping the level of detail in mind).
4. Assessment or rather prioritization of the secondary and individual causes through a rating system.
5. Derive action plans for the problem solving.
6. Implementation and controlling of the optimum solution.

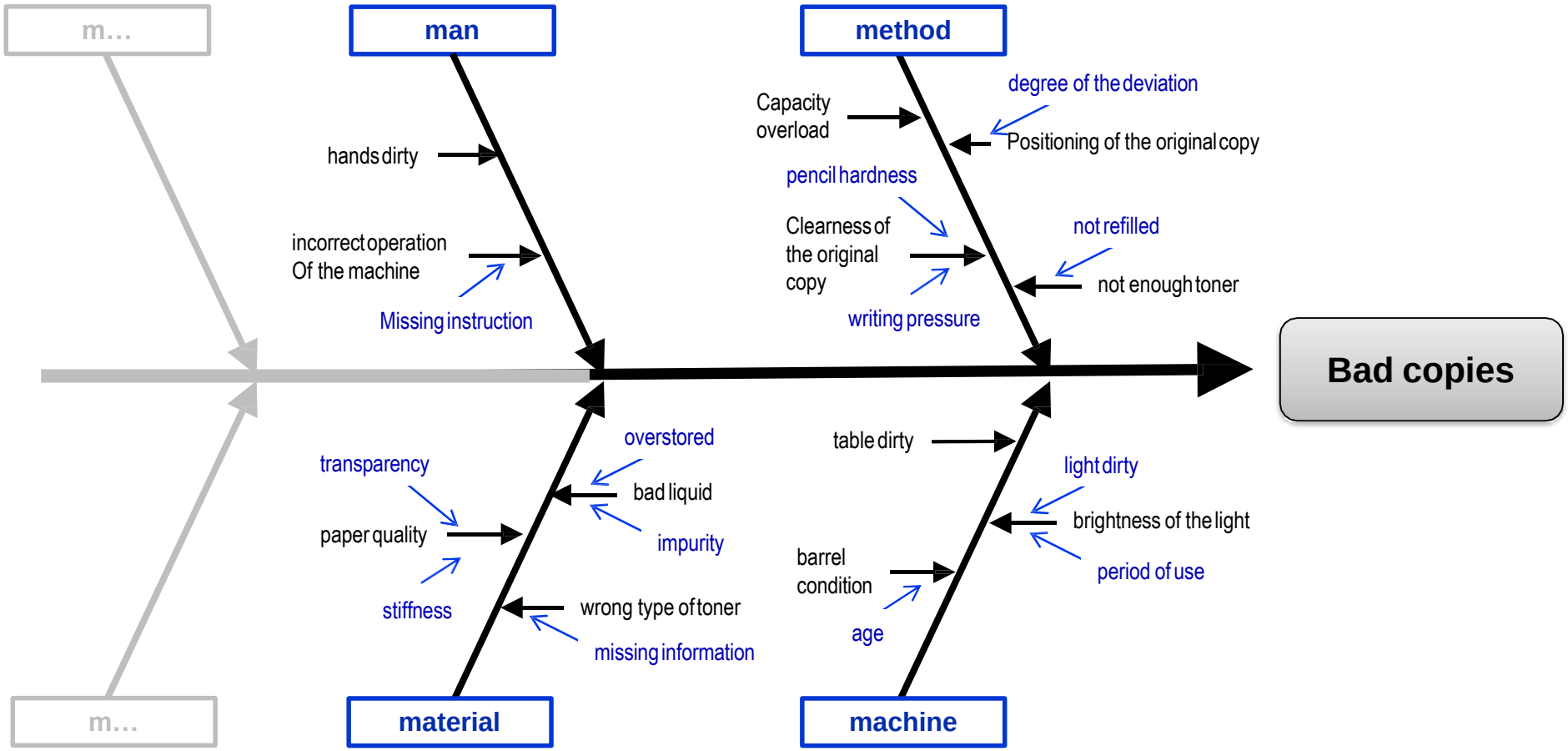
Problem solving methods
Ishikawa

- **Ishikawa: base**



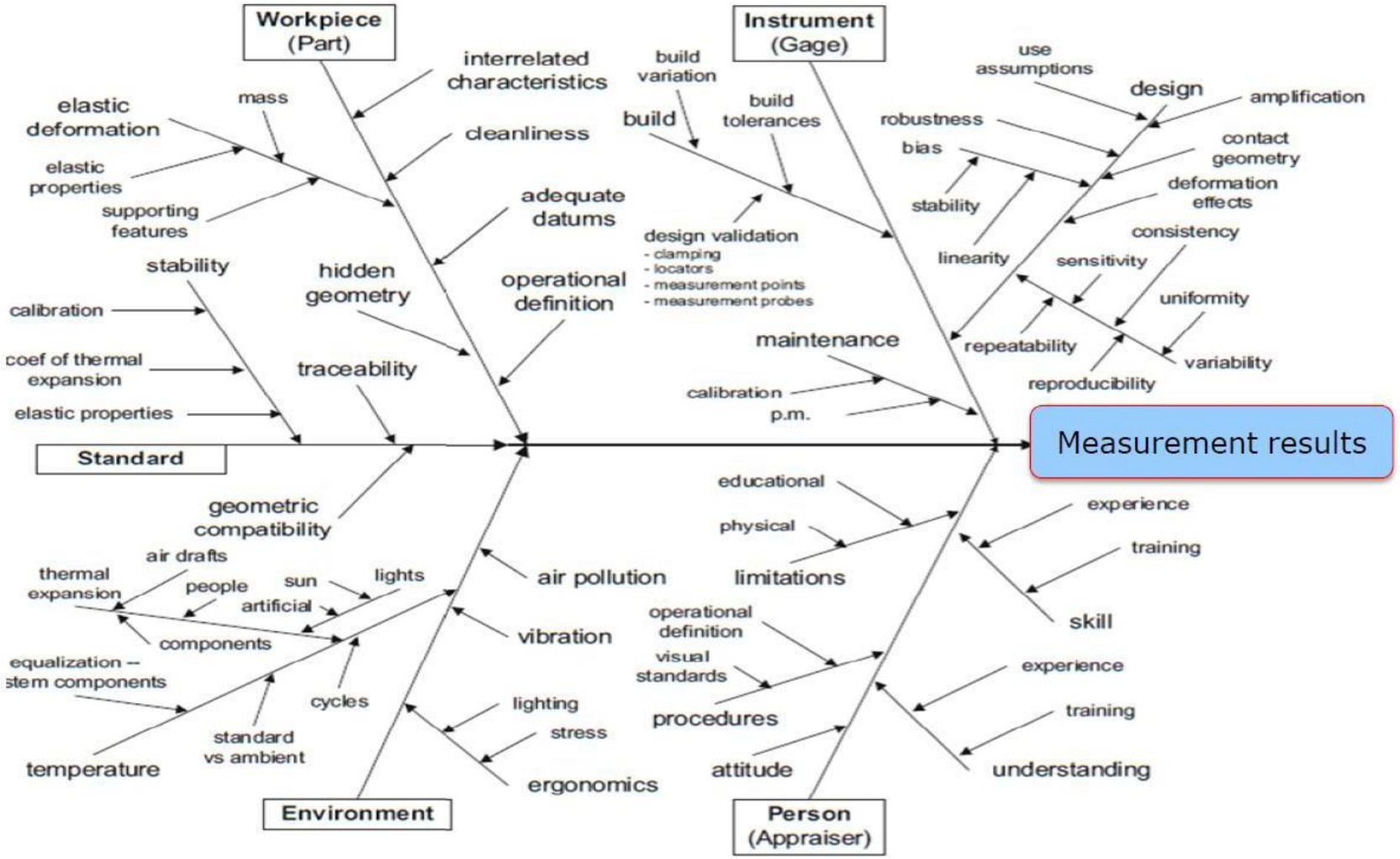
Problem solving methods
Ishikawa

Ishikawa: example 1



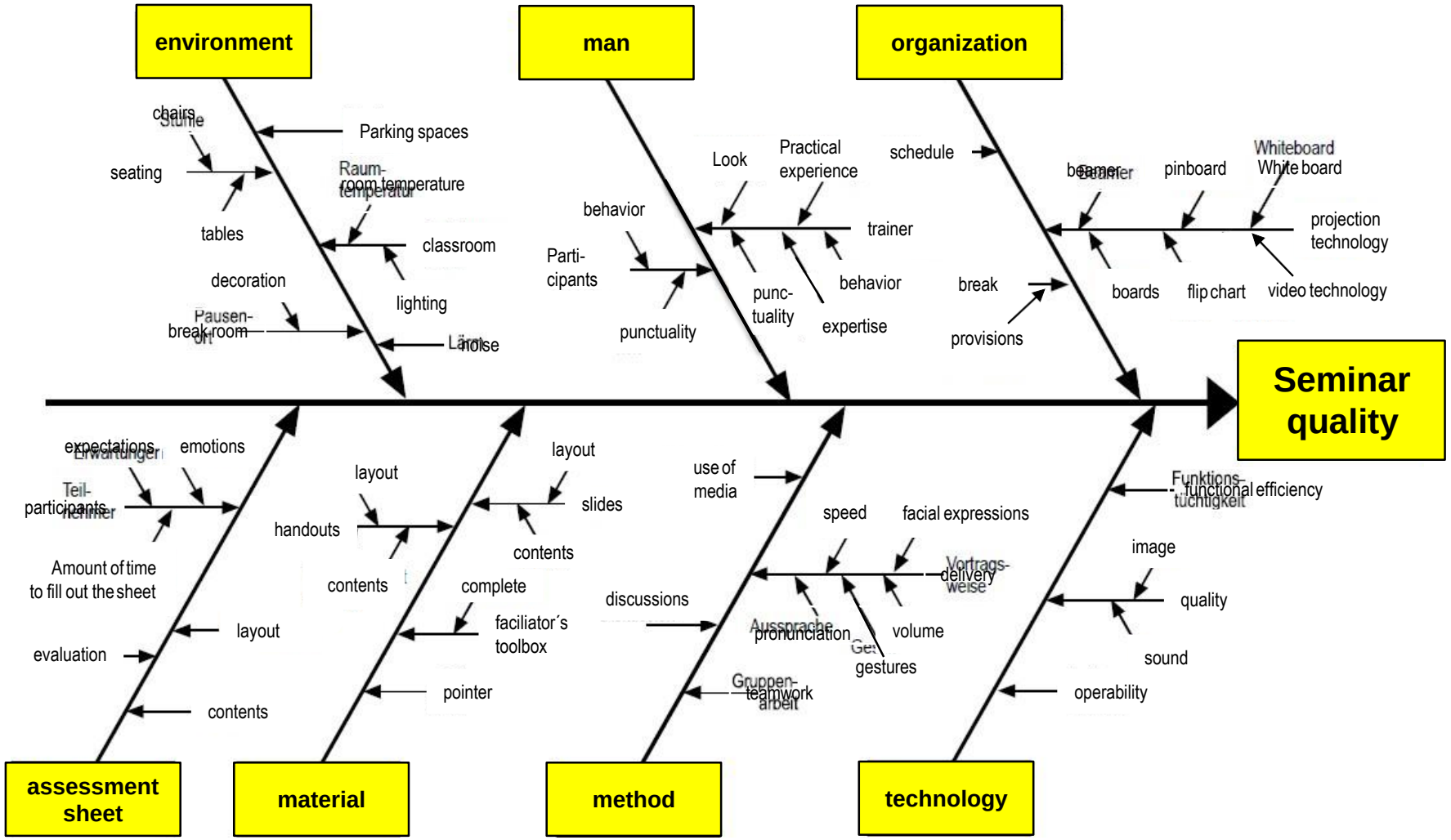
Problem solving methods
Ishikawa

- **Ishikawa: example 2**



Problem solving methods
Ishikawa

Ishikawa: example 3



Problem solving methods

Ishikawa

Ishikawa-diagram: pros and cons

- **Pros / strengths**
  - Systematic and detailed listing of the causes of the problem.
  - Universally applicable (optimization of processes, products and costs).
  - Clear and complete visualization of all conceivable aspects of a problem (a limited view of the causes is thus avoided).

- **Cons / weaknesses**
  - Possible high complexity.
  - Interaction between causes is not noted.
  - Very time consuming.
  - Strong in problem analysis but not in problem solving.
  - Non-preventive.

Problem solving methods

FTA (fault tree analysis)

Introduction

- FTA – Fault Tree Analysis – is a method which shows a graphic connection between a top event (system failure, hazard,..) and the causes of this top event.
- Deductive procedure, i.e. the possible causes for unwanted top events are tracked going outward from its origin.
- Causes can either be singular or appear in combination with other causes and lead to a specified error.

- **Top-down-analysis**

Problem solving methods

FTA (fault tree analysis)

History

- **1960‘s:**
  Developed by H.A. Watson for Bell Laboratories in New Jersey (USA).
  Application in air and space flight (i.e. Boing aircrafts).
- **1970‘s and 1980‘s:**
  The planning of nuclear power plants led to its international spread.
  Emergence of analysis algorithms and the supporting software.
- **1990‘s:**
  Application in the automotive industry.
  Software-tools for the construction and the evaluation of the FTA.
- **Today:**
  Application in nearly all branches, in particular where system errors cause lives or create high costs.
  Distribution of FTA in software development.
  Standardization according to DIN 25424-1/-2 (1981/1990) and DIN EN 61025 (2007).

Problem solving methods

FTA (fault tree analysis)

Objectives of the FTA

- **Model and evaluate the system realistically (on a component base):**
  - In order to detect failure types and failure causes.
  - In order to establish functional connections between the failures.
  - In order to describe the effects of failures on the system.

- **FTA is used for:**
  - Preventive quality control.
  - System analysis.
  - Problem solving for new errors.

- **Analysis of the reliability of a qualitative or quantitative approach:**
  - Qualitative: identify weaknesses
  - Quantitative: calculate key indicators

Problem solving methods

FTA (fault tree analysis)

Phases of FTA (3 phases / 7 steps)

PHASE 1
Analyse the system

1. Detailed examination of the system under consideration

PHASE 2
Develop the fault tree

2. Specify unwanted results
3. Compile failure criteria
4. Define the failure types of the components
5. Create a fault tree
6. Evaluate the inputs of the fault tree

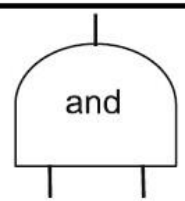
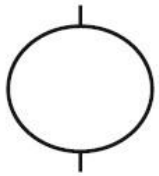
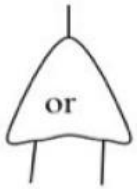
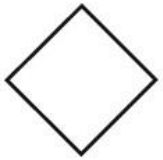
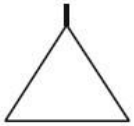
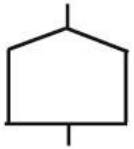
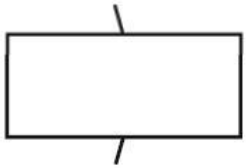
PHASE 3
Evaluate the fault tree

7. Evaluate the fault tree

Problem solving methods

FTA (fault tree analysis)

Symbols: events and logical links (gates)

gate		event	
	UND-Gatter (AND gate)		Basisereignis (Base event)
	ODER-Gatter (OR gate)		Nicht untersuchtes Ereignis (Not investigated event)
	Transfer-Gatter – ein (Transfer gate - in)		Kleines Haus (Small house)
	Transfer-Gatter – aus (Transfer gate - out)		Fault event

source: risikomanager.org

Problem solving methods

FTA (fault tree analysis)

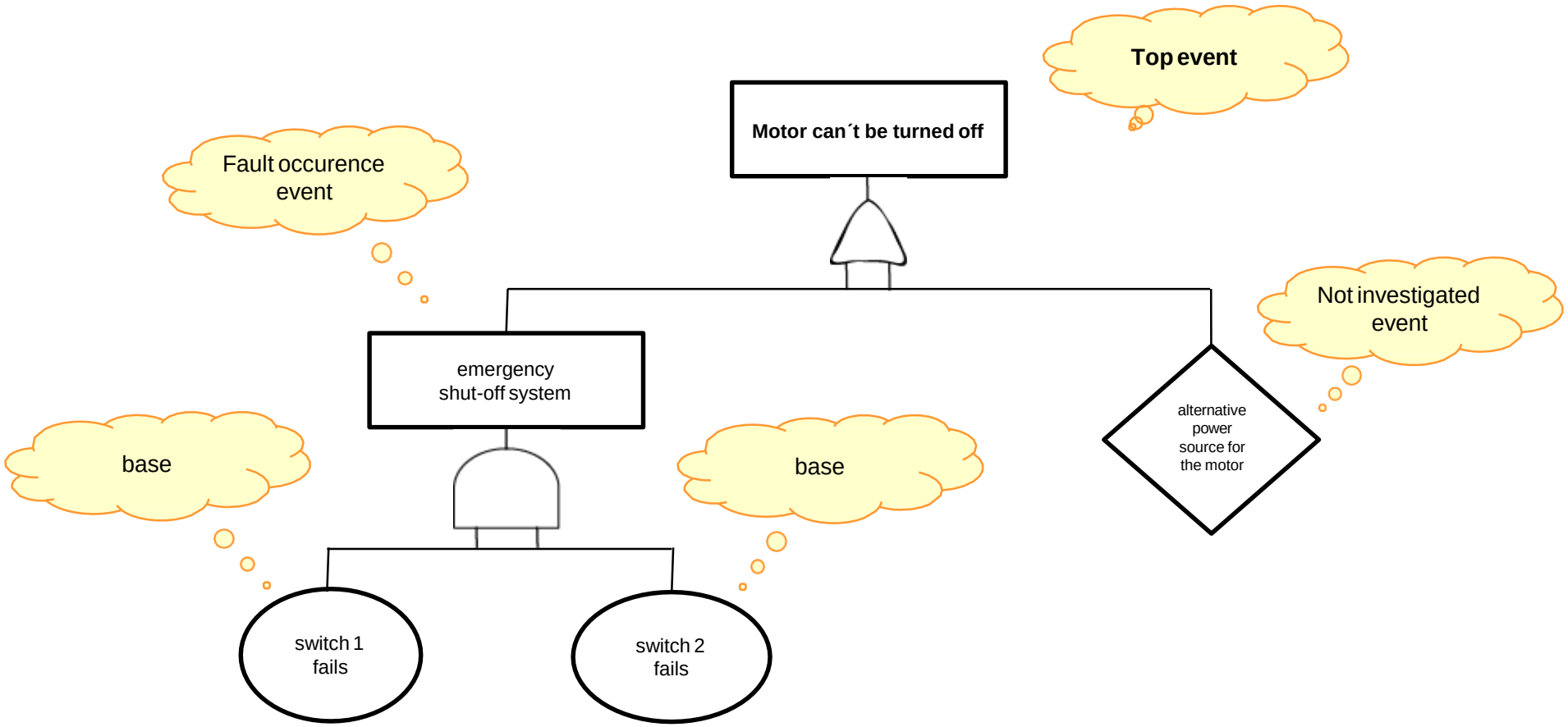
Symbols: events and logical links (gates)

Base event	Events, which aren`t investigated further. Their occurence and their probability are known.
Not investigated event	These events can´t be broken down any further. Reasons for this can be missing data or the fact, that a break-down is not necessary.
Small house	These events are not error / fault sources, but rather can occure during regular operation. They can also occur in combination with other events, in which they need to be examined as a fault source.
Fault event	These events can be broken down into top-down events (with the help of logical connections),
AND-gate	All in-coming events need to be fulfilled for the out-going event to be fulfilled.
OR-gate	One or more event needs to be fulfilled for the out-going event to be fulfilled.
Transfer gate on / off	The transfer-gate enables the separate analysis of complex systems, in which the fault tree consists of multiple pages.

source: Hanser-Verlag

Problem solving methods
FTA (fault tree analysis)

Example: fault tree



FTA (fault tree analysis)

FTA (fault tree analysis): pros and cons

- **Pros / strengths**
  - Determination of combinations which lead to an error.
  - Quantitative und qualitative results.
  - All potential failure combinations are systematically recognized.

- **Cons / weaknesses**
  - The bigger the fault tree, the harder the application of the method.
  - Computing time increases exponentially for each increase of nodes.
  - Each failure requires its own fault tree.
  - Human error is not measurable.
  - It is not possible to identify all cause and effect relationships.

Problem solving methods

General overview

- Quality management basic principles
- Facilitation techniques
- Ishikawa / FTA
- **5-why-method**
- 8 D-report

Problem solving methods

5-why-method

Objective and prerequisites

- Tool for quality and process optimization.
- The main aim of this analysis tool is not just to highlight obvious failure causes, but rather to also find the hidden causes and not just eliminate the existing symptoms.
- Through the selective use of why questions, an answer should be found as to which main cause in the production process, or in one production step, led to which specific problem.
- The aim of 5-why is to let qualified individuals discuss all possible causes of a specific problem within a process.
- It is a prerequisite that the responsible parties have sufficient knowledge of the process.

Problem solving methods

5-why-method

Additional prerequisites

- Presumptions regarding the origin of the problem should never be made · leads to possibly incorrect conclusions.
- Ideally, the facts should be collected directly from the individuals involved in the process; documents, components and process steps are best collected and/or reviewed on-site.
- A question results in an unequivocal answer until a resulting new question does not have an answer.
- Don‘t stop too soon, but rather keep asking questions.

Problem solving methods

5-why-method

Approach

The approach of the 5-why-method typically consists of 4 steps and is as effective as it is simple.

1. **Problem description**
2. **Analysis of causes**
3. **Preventive measures**
4. **Assessment of the effectiveness**

Problem solving methods

5-why-method

1. Problem description

- Firstly, a quick description of the problem through the use of the following key questions is established (a sketch or a photo can be used to illustrate the problem):

  - **What?** What happened? What is the error/problem? (product, plant, unit, operation, process, communication)
  - **How?** What does the problem look like? How does it present itself? What are the consequences of the problem?
  - **Who?** Who was involved? Who is affected (product, department, customer)? Who has to be informed?
  - **Where?** Where (geographically) did it happen, where was the error noticed, where did the problem become noticible?
  - **When?** When did the incident take place? When did the problem first become noticible?
  - **How much?** What is the extent of the problem?

Problem solving methods

5-why-method

2. Analysis of causes

- Following the description of the problem, a root-cause-analysis is conducted.
- This step is the key element of this method.
- A why question is posed, which is followed by an additional why question in regards to an answer of the previous question.
- This is repeated at least five times, resulting in a deep dive into the root cause of the problem.
- The resulting conclusion should be an answer to the initial problem.

Problem solving methods

5-why-method

3. Preventive measures

- After the core reason has been found by the previous steps, appropriate preventive measures need to be established. The implementation of these measures must be precisely planned and documented, and the resulting responsibilities must be clearly defined.
- Devise an action plan.

Problem solving methods

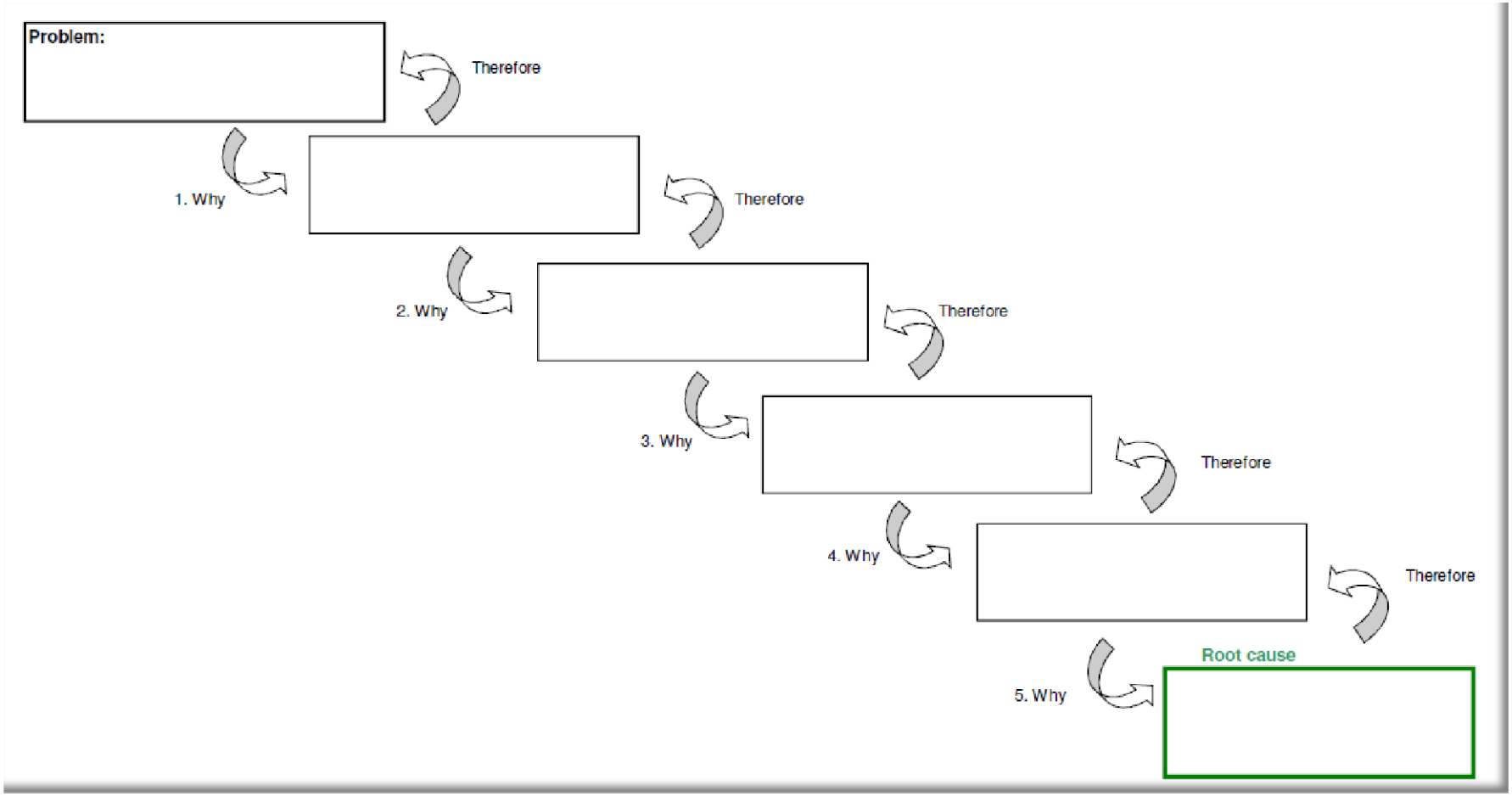
5-why-method

4. Assessment of the effectiveness

- The fourth and last step consists of a check of the effectiveness of the remedial measures.
- Directly after implementation, the result of the measures should be monitored.
- Does the problem still exist or has it come up again?
- Were the measures effective?
- If it is a recurring measure, such as regularly scheduled maintenance, then a repetitive control makes sense.

Problem solving methods
5-why-method

Example: worksheet



Problem solving methods

5-why-method

Example 1: non-compliance with a delivery date

?????

- **Why (1. why) aren‘t the delivery dates met?**
  - ➢ Answer: „Because the vendors make assurances they cannot keep and they do not coordinate their actions with production.“
- **Why (2. why) don‘t the vendors align their assurances with production?**
  - ➢ Answer: „Because they use promised delivery dates as a sales argument and rely on the belief that production can somehow manage to meet the deadline.“
- **Why (3. why) do the vendors rely on that?**
  - ➢ Answer : „Because the vendors do not have access to the scheduling within production and can only vaguely estimate the required production times.“
- **Why (4. why) don‘t the vendors have access to the scheduling?**
  - ➢ Answer : „Because the vendor‘s internet access isn‘t working yet.“
- **Why (5. why) isn‘t the access working?**
  - ➢ Answer : „Because the access hasn‘t been installed yet“.

Problem solving methods

5-why-method

Example 2: error during the packaging of mounting kits
(Apparently, a cable was not included in the packaged mounting kits.

Only one lot is affected).

?????

- **1. Why did it happen?**
  - ➢ An employee forgot to pack the cable.
- **2. Why did it happen?**
  - ➢ The cable wasn‘t supplied by a different employee, as should be done according to the defined process.
- **3. Why did it happen?**
  - ➢ The employee thought that articles with the article-code B do not have to be supplied by another employee.
- **4. Why did it happen?**
  - ➢ The employee was only temporarily picking goods and was obviously not sufficiently trained..
- **5. Why did it happen?**
  - ➢ Non-existence of a training plan containing the relevant content for the individual job assignments.

Problem solving methods

5-why-method

5 why-method: pros and cons

- **Pros / strengths**
  - simple
  - fast
  - cost-efficient

- **Cons / weaknesses**
  - Sensitivity of the questioner is required.
  - Possibility of redundant information.
  - In many cases, there is more than one cause for a problem.
  - The 5-why-method always only targets one cause.

Problem solving methods

General overview

- Quality management basic principles
- Facilitation techniques
- Ishikawa / FTA
- 5-why-method
- **8 D-report**

Problem solving methods

8 D-report

- **Aim, approach**

- **Aim**
  Systematical solutions to problems.

- **Approach**
  For problems that, aside from the sustainable problem solving, also require immediate measures.

  That is, cases in which quick and professional action is needed.

  Corrective and preventive measures ensure the sustainability.

Problem solving methods

8 D-report

- **Basis and use**

- Procedure model to remedy problems.
- 8 D = 8 disciplines, 8 steps
- 8 D is mainly used for the processing of customer complaints.
- Serves as a roadmap for the problem solving.
- The standardization of the approach should make the sustainable solving of problems become routine.
- Team work.
- Structured 8D-form.

Problem solving methods

8 D-report: example roadmap

steps	main tasks	tools	results
step 1: form teams	– choose the problem solving team (including team leader)	8D-report	– the problem solving team is selected
step 2: describe the problem	– determine, describe and define the problem	error log sheet; histogram; Pareto-diagram	– the problem is clearly described and defined
step 3: determine immediate measures	– remove defective parts from the entire circulation – take measures which ensure the delivery capability	temporary work plan; temporary control plan	– the customer (internal/external) no longer has to deal with the problem
step 4: analyse causes	– determine possible causes of the problem – determine and depict cause-effect correlations	cause-effect diagram; progression graph; correlation graph	– core reasons for the problem are identified
step 5: determine corrective measures (including performance tests)	– develop, rate and choose possible corrective measures – test chosen corrective measures and verify the effectiveness	FMEA; test plan; process capability	– the effectiveness of the corrective measures is verified
step 6: embed the corrective measures in the organization	– embed the corrective measures in the organization – cancel the emergency measures	work plan; control plan; training plan	– corrective measures are sustainably embedded in the organization
step 7: take preventive measures	– make the resulting conclusions available for other existing products/processes – make the resulting conclusions available for future products/processes	construction **guidelines**; audit-checklist; FMEA-software / FMEA-data base	– resulting conclusions are also applied to other products/processes
step 8: conclude problem solving process	– verify the successful implementation of the measures agreed on and conclude the problem solving process	8D-report	– the problem solving process is completed

Problem solving methods
8 D-report

Step 1: form team

Main tasks	Results
Choose the problem solving team (including team leader).	The problem solving team is selected.

- Once a problem becomes apparent, a team leader is named and the team is assembled.
- The team leader is responsible for the correct implementation of the eight steps.
- The team must have sufficient knowledge of the products and/or processes involved in order to solve the problem.

8 D-report

Step 2: describe the problem

Main tasks	Results
Determine, describe and define the problem.	The problem is clearly described and defined.

- First in-depth team meetings take place during this step.
- It is the teams job to determine, describe and define the problem as clearly and thoroughly as possible.
- The team has to take care to stay on the cause and effect level during this step.
- The team is not allowed to try to find the causes for the problem or to start planning solutions during this step.

8 D-report

Step 3: determine immediate measures

Main tasks	Results
Remove defective parts from the entire circulation. Take measures which ensure the delivery capability	The customer (internal/external) no longer has to deal with the problem.

- The customer must be protected from the impact of the problem before the (possibly time consuming) search for the causes is begun.
- Main task 1:
  Remove defective parts from the entire circulation
  (for example screening tests for the complete supply chain: goods receipt, own production, warehouse, transport, customer).
- Main task 2:
  Take measures which ensure the delivery capability
  (for example one hundert percent screening tests, special transports).

8 D-report

Step 4: analyse causes

Main tasks	Results
Determine possible causes of the problem. Determine and depict cause-effect correlations.	Core reasons for the problem are identified.

- Firstly, the team needs to garner an overview of the possible causes of the problem. Afterwards, the actual causes need to be identified and their influence on the problem needs to be depicted.
- Main task 1:
  Determine possible causes for the problem and depict them in a suitable manner (for example through brainstorming, mindmap, Ishikawa-diagram).
- Main task 2:
  Identify actual causes and determine the correlation between the causes and the existing failure
  (for example progression graph, error log).

8 D-report

Step 5: determine corrective measures (including performance tests)

Main tasks	Results
Develop, rate and choose possible corrective measures. Test chosen corrective measures and verify the effectiveness.	The effectiveness of the corrective measures is verified.

- The objective of this step, beginning with the identification of the root causes, is to develop suitable corrective measures and to verify their effectiveness. The corrective measures need to sustainably eliminate the problems.
- Main task 1:
  Develop, rate and choose possible corrective measures
  (for example FMEAs, adjust training program).
- Main task 2:
  Test chosen corrective measures and verfiy the effectiveness
  (for example process capability test).

Problem solving methods

8 D-report

- **Step 6:** embed the corrective measures in the organization

Main tasks	Results
Embed the corrective measures in the organization. Cancel the emergency measures.	Corrective measures are sustainably embedded in the organization.

- After step 5 has established that the planned corrective measures eliminate the problem, these measures need to be sustainably embedded in the organization.
- In order to embed the corrective measure, it is, among other things, necessary to update the specifications. This concerns, for example, the work instructions, test instructions, control plans, training and maintenance plans.
  Approval of the altered processes by the customer (if needed PPAP, PPF).
- Following the organizational embedding, the emergency measures still in operation (for example one hundert percent testing) need to be revoked, unless otherwise agreed on with the customer (for example only after so-and-so many days of error free production).

8 D-report

Step 7: take preventive measures

Main tasks	Results
Make the resulting conclusions available for other existing products/processes. Make the resulting conclusions available for future products/processes.	Resulting conclusions are also applied to other products/processes.

- It is the objective of step 7 to make the resulting conclusions available for existing, as well as for future, products and processes.
- Check and analysis of similar products and processes, in order to determine if the corrective measures are feasible here as well (preventive measures).
- If needed, adjustment of audit check lists.
- The central tool for the prevention of the problem solved in steps 1 to 6 is the FMEA.
- Make the results available for other departments (for example r&d).

8 D-report

Step 8: conclude problem solving process

Main tasks	Results
Verify the successful implementation of the measures agreed on and conclude the problem solving process.	The problem solving process is completed.

- The team leader must make sure that all measures agreed on during the problem solving process are implemented.
- The problem solving process is formally concluded.
- The team leader informs his team of the successful conclusion and thanks them for their assistance.

Problem solving methods

8 D-report

Key questions

- Is the problem solving conducted systematically?
- Is a common thread visible throughout the steps needed to solve the problem?
- Are effective tools used for the individual steps of the problem solving?
- Is all information presented in a clear and precise manner?
- Does the use of the model and the tools ensure that the knowledge of the experts is focussed on the problem?
- Does the problem solving take place in a coordinated manner?
- Are measures consequently tracked?
- All problems lastingly eliminated?
- Is there a learning effect for existing as well as for future products and/or processes?

Problem solving methods

8 D-report

- **Example: 8D-form according to VDA (dated 04/2010)**

Lieferant (Supplier) *Anschrift (Adress/Location)*			
8D – REPORT			
Beanstandung (Concern Title)		**Beanstand.-Nr.** (Ref. No.)	**Eröffnet am:** (Start Date)
Berichtsdatum (Status Date)	**Teilebezeichnung:** (Part Name) **Zeichnungsnummer/Index:** (Part Number/Index)		
1 **Team** **Name,Abt.** (Depmt) **Teamleiter** (Champ.)	2 **Problembeschreibung** (Problem Description) **Fehlercharakter** (Problem Profile Description)		
3 **Sofortmaßnahme(n)** (Containment Action(s))		**% Wirkung** (Effect)	**Einführungs-datum** (Implem. date)
4 **Fehlerursache(n)** (Root Cause(s))		**% Beteiligung** (Contribution)	
5 **Geplante Abstellmaßnahme(n)** (Chosen Permanent Corrective Action(s))		**Wirksamkeitsprüfung** (Verification)	

6 **Eingeführte Abstellmaßnahme(n)** (Implemented Permanent Corrective Action(s))	**Ergebniskon-trolle** (Controls)	**Einsatz-termin** (Implement. date)
7 **Fehlerwiederholung verhindern** (Action(s) to Prevent Recurrence) Implementation for example in: - Product FMEA - Process FMEA - Control Plan - Procedure - ...	**verantwortlich** (responsible)	**Einführ. -termin** (Implem. date)
8 **Teamerfolg würdigen** (Congratulate your Team)	**Abschluss-datum** (Close Date)	**Ersteller** (Rep.by) Tel.,Fax-Nr.

Problem solving methods
8 D-report

- **Example: filled out**

8D-Report

Vorgang / Concern title Example: Axial run-out of precision ring n.o.k.	**Reklamationsnummer / Complaint no.** Schaeffler 214999999 Lieferant / Supplier 12345	**Reklamationsdatum / Complaint opening date** 2011-08-01	
Name Lieferant / Supplier Sample supplier	**Produktionsstandort / Production site** Sample city	**Revision 8D-Report** 04	**Revision Datum / Date** 2011-08-17
Zeichnungsnummer / Drawing no. F-123456789	**Zeichnungsstand / Drawing revision** AC	**Teilebezeichnung / Part name** Precision ring Ø20	
Schaeffler Werk(e) / Plant(s) Herzogenaurach, Hirschaid	**Liefermenge / Quantity delivered** 100	**Beanstandete Menge / Quantity claimed** 12	

1 Team

Name	Abt./ Dept.	Kontakt/ Contact (Email, Phone)
Meyer F.	Quality	meyer@sample.com
Mueller S.	Production	mueller@sample.com
Huber A.	R&D	huber@sample.com
Teamleiter/ Champion		
Boss G.	Q-Mgr.	boss@sample.com

2 Problembeschreibung / Problem description

Axial run-out from face to inner boreØ n.o.k.
Nominal: 0,05
Ist: bis zu 0,1

3 Sofortmaßnahme(n) / Corrective action(s)

	Einführungsdatum / Implementation date
1. Check of stock: No parts on stock at present	2011-08-01
2. Check customer stock: In the Herzogenaurach plant another lot with the same defect was found. In the Hirschaid plant no parts were on stock.	2011-08-02
3. Check of stock in transit to customer: At present there are no parts on the way to the customer	2011-08-01

8 D-report

8 D-report: pros and cons

- **Pros / strengths**
  - Universally applicable.
  - Eliminates problems quickly and sustainably.
  - Prevents the occurrence of similar problems.

- **Cons / weaknesses**
  - Effort in connection with the embedding in the organization.

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Untere Sandstraße 53

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