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# Development and Evaluation of Appropriate Methods for Visualisation and Analysis of Information Flows in Processes

## in Indirect Areas of Production in the Context of Continuous Improvement Process Activities at an Automotive Manufacturer

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## Abstract

Nowadays, the trend of increasing complexity in the automotive industry leads to extensive information flows in production planning. In indirect areas of production, the usability of methods for process mapping, especially for information flows, is often limited in the context of continuous improvement process (CIP) activities. This thesis aims to develop and evaluate appropriate methods required for the visualisation and analysis of information flows in processes. This is in order to optimise them.

At the beginning of the research, a detailed literature review and the participation in training sessions provide the necessary knowledge of the subject matter, relating to process modelling as well as process optimisation. This thesis examines the categorisation of practical relevant applications and how these are determined. Therefore, specific requirements are gathered in order to derive assessment criteria for choosing an appropriate method or a set of methods. A new concept is developed in the second part of the empirical study, an innovative approach to using various methods. Thereby the methodology is evaluated by experts, verified in tests and validated afterwards.

The strategy for dealing with complexity in processes is chosen by applying the evolved concept. In preparation of CIP workshops, the developed morphological box enables the selection of an appropriate method for coping with various scenarios of already known operation purposes.

Keywords: information flow, indirect area of production, process mapping, continuous improvement process, CIP, process modelling, process optimisation

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# 1 Introduction

The trend towards of increasing in complexity in the automotive industry results in a constant surge of information flows in production planning and preparation: the so called indirect areas[1]. The number of interactions increases greatly in the related communication and in addition problem handling becomes more comprehensive. This leads to a greater number of participants that are involved within the framework of the Continuous Improvement Process (CIP) activities. In general, sufficient information is required for efficient processes. The challenge is to deal with the growing information flows. Process modelling enables transparency, as it is the basis requirement for process optimisation. Existing methods are often limited and do not satisfy the need of usability in CIP workshops. Therefore, this thesis deals with the development as well as the evaluation of methods for visualising and analysing information flows in processes.

## 1.1 Task and Problem Specification

The automotive industry has always been challenging. In 1946, Drucker called it the industry of industries (Drucker, 1946, p.149). Today, the automotive industry is still one of the biggest sectors of industry, with 84,100,167 vehicles produced globally in 2012 (International Organization of Motor Vehicle Manufacturers, 2013). According to KPMG International Cooperative the automotive industry is being shaped by four key forces (KPMG, 2013, p.12):

- Environmental challenges
- Growing urbanisation
- Changing customer behaviour
- Growth and globalisation

In order to succeed, automotive manufacturers must deal with a multidimensional, global environment (KPMG, 2013, p.60).

[1] Indirect areas are all organisational units, which are not directly involved in the physical creation of products in a flow production (direct areas). In particular, the indirect areas not only consist of the purely administrative departments, but also preliminary as well as accompanying structural units of production with the task of planning and designing. (Fehr et al., 2011, p.711)

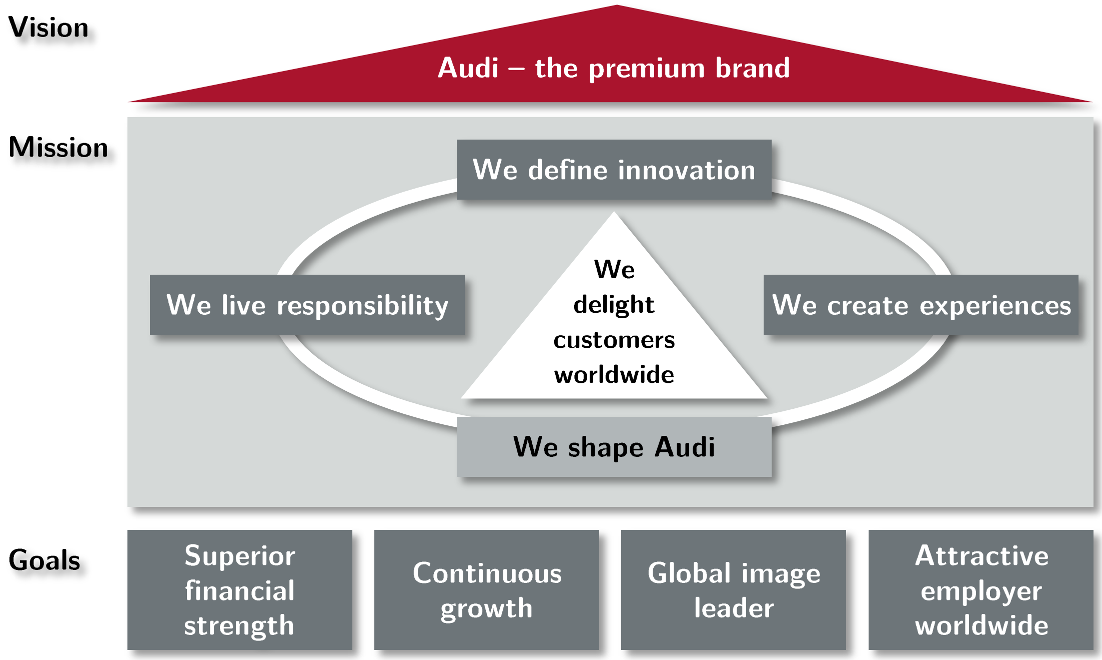


Figure 1.1: Audi Brand Strategy 2020, c.f. (AUDI AG, 2012a, p.142)

To meet these challenges, the AUDI AG formulated their strategy. The requirements for production are derived from the Audi Brand Strategy 2020 (see Figure 1.1), defined in the area of action as "We shape Audi". It is described how, in the future, processes and structures must constantly be refined and developed in order to maintain their sustainable and profitable growth. (AUDI AG, 2012a, p.143-144)

**Requirements for Production - Quo Vadis?**

- Rising production capacities
- Higher frequencies of start-ups for vehicles
- Increasing complexity
- Growing efficiency
- More projects over less time

(AUDI AG, 2013c, p.6)

Audi's ambition to compete on the global market is demanding. The AUDI AG changed from local to global production. In 2000 Audi had three production plants in Central Europe and produced 6 series with 18 models. Nowadays, in 2013, Audi has 17 production plants all over the world and produces 12 series with 48 models. These two examples show how growth and globalisation influence the automotive industry. (AUDI AG, 2013b, p.4-10)

Another remarkable example is the progress of complexity. The high derivatisation leads to more segments with a smaller number of units and hence directly to more complex planning. There is a high impact on production, more precisely on the production locations of AUDI AG. Additionally, the number of supplier locations, part numbers and handling of load carriers has increased significantly over the past few years. (AUDI AG, 2013c, p.12)


Figure 1.2: Challenges in Automotive Industry 2013-14, (Ernst & Young, 2013, p.1)

Ernst & Young interviewed 32 of their senior partners about the challenges of their clients in the automotive industry (see Figure 1.2). Ernst & Young identified five main topics that will dominate automotive companies' performance and capital agenda in 2013. These topics will have an effect on success. These topics are the following (Ernst & Young, 2013, p.1):

- State of competition
- New operating environment
- Connecting with customers
- Organisation efficiency and flexibility
- Resource management

One major theme is organisation efficiency and flexibility. Therefore sufficient information as well as data is required for making better informed decisions. (Ernst & Young, 2013, p.5) This results in a demand for the constant optimisation of information flows.

Flexibility is a requirement for efficient processes and structures. The challenge is to create the balance between standards and discipline on the one hand, and flexibility and creativity on the other hand. Standardised processes and stable structures ensure an efficient multi project management. (AUDI AG, 2013c, p.5)

Another aspect is resource management, actually securing resources across the value chain. In fact, leaders perceive an urgency to have transparency within their organisation and secure access to key resources. (Ernst & Young, 2013, p.6)

Transparency is an essential requirement during times of change in terms of responsibilities, processes, structures etc. According to Zimmermann, transparency is the premise for simplification of complex structures that have evolved over time. It is essential for awareness in order to deal with process design of complex processes. (Zimmermann, 1997, qtd. Friedli and Schuh, 2012, p. 172)

The increasing complexity in production due to the constant surge of information requires approaches to deal with integrated and sustainable information as well as the needed communication processes. Standardised provision of data as well as transparent processes leads to improved availability and utilisation of relevant information in indirect areas of production. (Risch, Berndt, and Franke, 2011, p.706-710)

In modern, information-rich and knowledge-rich working processes, the biggest losses occur through information deficits in the information flows. These information deficits appear between enterprises, organisations, departments or groups and customers. The required information is missing, incomplete, delayed or inapplicable. This leads to a situation in which sufficient proceeding is hindered or not possible at all. So deficiencies of information are the collective root of various problems in processes of enterprises. (Hacker, 2008, p.11)

Therefore, there is a demand for the development and evaluation of appropriate methods for the visualisation and analysis of information flows in processes. Particularly in indirect areas of production in the context of continuous improvement activities.

## 1.2 Aim and Scope of the Thesis

The thesis focuses on analysing basic methodologies for mapping information flows described in literature and carrying out an analysis of existing methods already used in practise. However, their usability in the context of CIP workshops is often limited. Pre-investigations revealed that there is a demand for extensive research on existing methodologies in order to find appropriate methods and with the purpose of checking how practical they are for application in workshops in indirect areas of production.

The aim of the initial situation analysis of existing methodologies for visualisation and analysis of information flows is the assessment of these in the context of practical relevant applications in CIP workshops. Furthermore it is necessary to derive an appropriate method or a set of methods for usage in CIP workshops in indirect areas of production. The following scope is determined for considering the aspects mentioned above:

1. Determination and categorisation of practical relevant applications
2. Gathering and if necessary, categorisation of specific requirements of the developing methodology
3. Derivation of assessment criteria for the appropriate approach for the methods for information flows analysis
4. Capture and specification of practice-related methods for the visualisation and analysis of information flows
5. Evaluation of determined methods in the context of relevant performance
6. Definition of requirements and action plan for implementation
7. Validation of the developed methods during the pilot phase in a CIP project

## 1.3 Methodological Approach

The thesis is treated like a project so project management tools are used. An appropriate process flow is designed to draft the planned project. The thesis is divided into five phases (see Figure 1.3). The aim of the structured overview of the project phases is to define results in order to determine the key activities. According to these results, the progress and the prosperity of the project becomes measurable. Furthermore it provides a rough planning of the schedule. Additionally, important mile stones are specified, which have an essential influence on the time line of the project.

### Project Set Up / Initiation

First of all, the objectives are adapted in order to generate the project task. Then conversations with experts in the department are carried out. Sufficient literature research then leads to a diversified literature list of various themes in line with the topic of the thesis. The preoccupation with the theory on the one hand and the participation in training for CIP moderators on the other hand means that the required knowledge of the subject matter, especially in process modelling and problem solving. The outcome provides an overview of pre-selected methods for process visualisation and analysis. By the end of the first phase, the gathering and sorting according to the categorisation of specific requirements is conducted. Also, the official project kick-off with all stakeholders takes place at the end of the first phase.

#### Initial Situation Analysis

At the very beginning of the second phase, the practical relevant applications are determined and categorised. This is done by analysing previous workshops. An important method for collecting information is interviewing people who use process modelling. As a result of these expert interviews, a list of key statements is created. The derivation of the assessment criteria as well as the arrangement of these via the analytic hierarchy process leads to the key aspects of the requirements for process modelling. Finally the catalogue of assessment criteria results in the list of selected potential methods.

#### New Concept / Action Planning

The next step is the development of a new concept. Actually evolving a new approach results in using various methodologies, combining existing methods and developing them further. A workshop with CIP trainers is used to evaluate the determined methodology in the context of relevant performance in order to gain feedback and to understand their expectations. Furthermore their experience enables the requirements for the methodology in terms of practical usage for CIP activities to be identified. An action plan is defined for implementing the potential improvements. At the end of this phase, the intermediate results are presented.

#### Implementation / Evaluation

The execution of the action plan takes place at the beginning of the fourth phase. Modifications resulting from the evaluation workshop are implemented to derive a final methodology from the previous concept. As agreed in the project set up, a guideline for applying the evolved methodology is developed. Afterwards, a pre-testing with two CIP trainers is arranged for refining the methods and to evaluate them under workshop conditions. The outcome is the final model of the methodology for visualisation and analysis, as a result of the review and performance check.

#### Documentation / Completion

Finally, the thesis is documented and the quality is checked in terms of form, extent and scientific requirements. A guideline is finished and the final presentation is prepared.

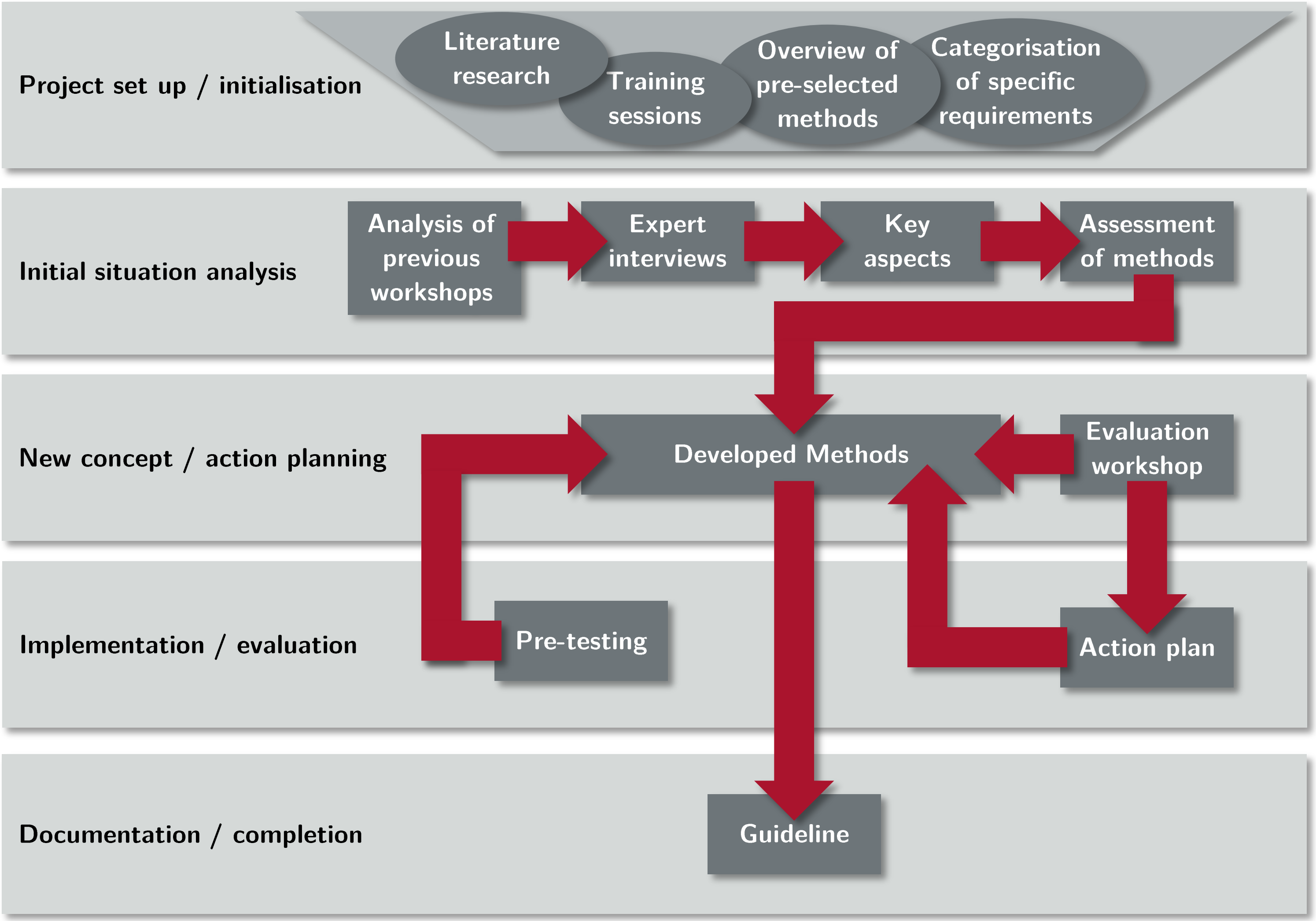


Figure 1.3: Applied Methodological Approach, author's own work

# 2 Theoretical Basics of Continuous Improvement and Production Systems

This chapter provides an overview of the theory of CIP and production systems in general. It starts with an introduction of the Toyota philosophy to provide an understanding of the culture of improvement as well as the origin and the purpose of *Kaizen*. CIP is a synonym of *Kaizen*. An overview is given about how the Toyota Production System (TPS) was formed, as TPS is the basis for all modern production systems. The next part deals with the implementation of Japanese principles in the western automotive industry. Actually, it approaches the topic of the transformation of TPS and *Kaizen* in the United States of America (USA) and in Germany. Then the Audi Production System (APS), which was derived from the TPS, is described with its principles. The CIP cascade shows how the APS is carried out within the enterprise. This leads to the CIP approach, which is used in the indirect areas of production at Audi. The operational organisation and also the fields of action according to the so called CIP navigator are introduced. This results in the four stage implementation model for the indirect areas of production, which deals with process optimisation.

## 2.1 Toyota Philosophy

The first approach for the TPS was developed in Japan more than 100 years ago. Over decades, Japanese industry, especially the automotive industry, has developed concepts and strategies for sustainable success in enterprises. Toyota played a leading role in the development of these principles. Thereby this long-term philosophy was significantly coined by some experts, many of them related to Toyota. In fact, the Toyota philosophy is the mother of all modern production systems.

### 2.1.1 Japanese Mentors and Pioneers

As previously mentioned, some experts played a leading role in developing and executing the Japanese management tools and spreading them all over the world. This chapter gives an overview of the correlation of the people, who have influenced and evolved the culture and methods to be explained later on.

**William Edwards Deming** is regarded as the "Grandmaster" of quality. Deming essentially influenced the Japanese industry after World War II (WWII), when he introduced the concept of quality and the principal statistical methods of quality control. In Japan he has found a receptive audience and his teachings were put into practice from vision. He is famous for the Plan-Do-Check-Act (PDCA) cycle, which has been named after him. (Tsutsui, 1996, p.295-300; Deming, 2000, p. vii)

**Ohno Taiichi**[1] - is considered to be the father of TPS and he is also credited with the creation of the Toyota Just-In-Time (JIT) system. As the Head of Production, he emphasised the importance of the elimination of *Muda*. He is known for his very simple statements. (Ohno, 1988, p.ix-xii) For example Ohno Taiichi said:

> "All we are doing is looking at the time line, from the moment the customer gives us an order to the point when we collect the cash. And we are reducing that time line by removing then non-value-added wastes." (Ohno, 1988, p.ix)

**Toyoda Eiji** is the nephew of Toyoda Sakichi, the founder of Toyota. Toyoda Eiji, together with Ohno Taiichi, developed the "Toyota Way", which consists of the core concepts like the *Kanban* system (Dawson, 2004). He was appointed as the fifth president of Toyota Motor and he became the longest serving chief executive. In 1989 he launched the Lexus brand to compete in the luxury car market. (Dawson, 2011)

**Shingo Shigeo** was an industrial engineer, a world leading expert on manufacturing practices and the TPS. He had been teaching thousands of people in industrial engineering and documented the fundamentals of the TPS. Furthermore Shingo introduced the words of *Poka-yoke* and Single-Minute Exchange of Die (SMED). He was productivity improvement consultant and has held training courses in various industry sectors for different enterprises. (Shingo and Robinson, 1990, p.371-380)

**Imai Masaaki** is known as a "Lean guru" because he is the father of *Kaizen* and the founder

[1] Japanese names are written in the order family name (surname), followed by a given name, in order to follow the Japanese practice of placing the family name first, partly to standardise the notation of Japanese names, but primarily out of common courtesy. This is opposite to the situation in Europe or the USA. (Ohno, 1988, p.xix)

of the Kaizen Institute. He has been a pioneer and leader in spreading the *Kaizen* philosophy around the world. The following is a well-known quote by Imai Masaaki: “The starting point for improvement is to recognize the need.” (Kaizen Institute Ltd, 2013)

**Iwata Yoshiki** the founder of Shingijutsu Global Consulting (SGC) was a member of the Toyota Autonomous Study Group, where they developed the *Kaizen* system of Toyota. As a pupil of Ohno Taiichi, he contributed to establishing TPS. Iwata founded SGC with the aim of promotion *Kaizen* all over the world, furthermore to introduce it to various industries by consulting world-class companies. (Shingijutsu Global Consulting USA, Inc, 2012)

**Nakao Chihiro** spent the first 27 years of his career working for the Toyota Group where he was mentored and trained by the famous Ohno Taiichi. As the founder of Shingijutsu Ltd he dedicated himself to the aim of spreading the principles of TPS around the globe. (Shingijutsu USA, 2012)

In the 90s, Iwata Yoshiki and Nakao Chihiro consulted Porsche AG in order to return back to profitability by successfully implementing the *Kaizen* methodology (see subsection 2.2.2).

### 2.1.2 Culture of Improvement

If you are not getting better, you are getting worse! Therefore, continuous improvement is a natural process. The endeavour for continuous improvement is a long-term process. It requires consequent planning and stamina till it becomes implicitness. Potentials for improvement can be found by every individual employee or by teams. The management must create a climate, by changing the behaviour, which allows the CIP. This should lead to cooperate culture of continuous improvement, in which every employee has the motivation to improve her or his own work on a constant basis. (Brunner, 2011, p. 6)

As Ford (1926) writes in his book *Today and tomorrow*: “Humans like to follow the tradition.” This is maybe acceptable in someone’s private life, but in the professional life obsolete habits must be eliminated (Ohno, 1988, p.106). It is not easy to change culture. The following story should show why “we have always done it like that” -behaviour in many enterprises or situations leads to failure:

> “ Four monkeys were put into a room. In the center of the room was a tall pole with a bunch of bananas suspended from the top. One particularly hungry monkey eagerly scampered up the pole, intent on retrieving a banana. Just as he reached out to grasp the banana, he was hit with a torrent of cold water from an overhead shower. With a squeal, the monkey abandoned its quest and retreated down the pole. Each

> monkey attempted, in turn, to secure the banana. Each received an equally chilly shower, and each scampered down without the prize. After repeated drenchings, the monkeys finally gave up on the bananas. With the primates thus conditioned, one of the original four was removed from the experiment and a new monkey was added. No sooner had this new, innocent monkey started up the pole than his (or her) companions reached up and yanked the surprised creature back down the pole. The monkey got the message – don't climb that pole. After a few such aborted attempts, but without ever having received a cold shower, the new monkey stopped trying to get the bananas. One by one, each of the original monkeys was replaced. Each new monkey learned the same lesson: Don't climb the pole. None of the new monkeys ever made it to the top of the pole; none even got so far as a cold shower. Not one understood precisely why pole climbing was discouraged, but they all respected the well-established precedent. Even after the shower was removed, no monkey ventured up the pole. " (Hamel and Prahalad, 1994, p.55-56)

First of all, measurable aims must be defined to mark the beginning of the CIP. The precondition is to analyse the initial situation and to define the target state process in order to illustrate the upgrade measures. This then forms the basis for an annual improvement program, where the results are reviewed quarterly. (Brunner, 2011, p.7)

The systematic application of improvement programs was originally based on the "Deming Wheel" by Deming in 1950. The Japanese interpretation of it led to the so called PDCA-cycle. The improvement process is visualised as a moving wheel with four activities. (Moen and Norman, 2010, p.24-28)

The PDCA-cycle consists of (Moen and Norman, 2010, p.25-26):

- **Plan**: In the planning phase the approach or the action plan for the improvement process is determined.
- **Do**: During the Do-phase the action plan is executed.
- **Check**: The results are compared with the predefined key performance indicators of the initial situation.
- **Act**: Finally, an action plan is defined, to ensure the obtained results in a sustainable way and to avoid the return of the previous state after a certain time.

### 2.1.3 The Origin and Purpose of *Kaizen*

The Japanese word *Kaizen* is composed of two characters (shown in Figure 2.1). One represents "change" (kai) and the other means "for the better" (zen). Put together, *Kaizen* means continuous improvement. (Imai, 2010) *Kaizen* and CIP are used as synonyms.

改善

Figure 2.1: Kaizen Symbol, c.f. (Brunner, 2011, p.11)

Improvement - concerns everyone - every individual employee (management board, managers and workers) - and reduces expenses. The *Kaizen*-Philosophy consumes Japanese's way of living - in their professional life or in their social life - the aim should be continuous improvement. This concept is so natural and obvious for Japanese people that they are not aware of the fact that they are constantly *Kaizen*-thinking. (Imai, 1997, p.15)

The *Kaizen* strategy is the most important Japanese management concept - the key to the success of their competitive advantage. The way of *Kaizen* is based on the principle of small steps and the considerate observation as well as the perception of small moments, altogether this leads to great achievements. *Kaizen* is a continuous process, using common sense and low funds, which leads to success in the long-term. It is possible to restore the original situation easily without high expenditure and without much risk. (Imai, 1997, p.15)

According to Imai, *Kaizen* means everyday - everybody - everywhere - improvement. (Imai, 2010)

The following are the seven main ideas behind CIP (J. Witt and T. Witt, 2006, p.15-25):

- CIP intends to use the knowledge and experience of employees for operational improvement.
- CIP turns work into a reflexive task.
- CIP is for all employees.
- CIP focuses the problems on the operational level of the employees.
- CIP is considered as teamwork and it promotes a team-oriented cooperative culture.
- CIP is institutionalisation as a system.
- CIP needs a lot of motivation from all participants.

Instead of *Kaizen*, in Western civilisation, the collective suggestion process is also called "quality cirlces". (Womack, Jones, and Roos, 1990, p.56)

Most of the typical Japanese management tools, like Total Quality Control (TQC) or JIT etc. are summed up by one term: *Kaizen*. It is an umbrella concept for all these practices (shown in Figure 2.2). (Imai, 1997, p.16)

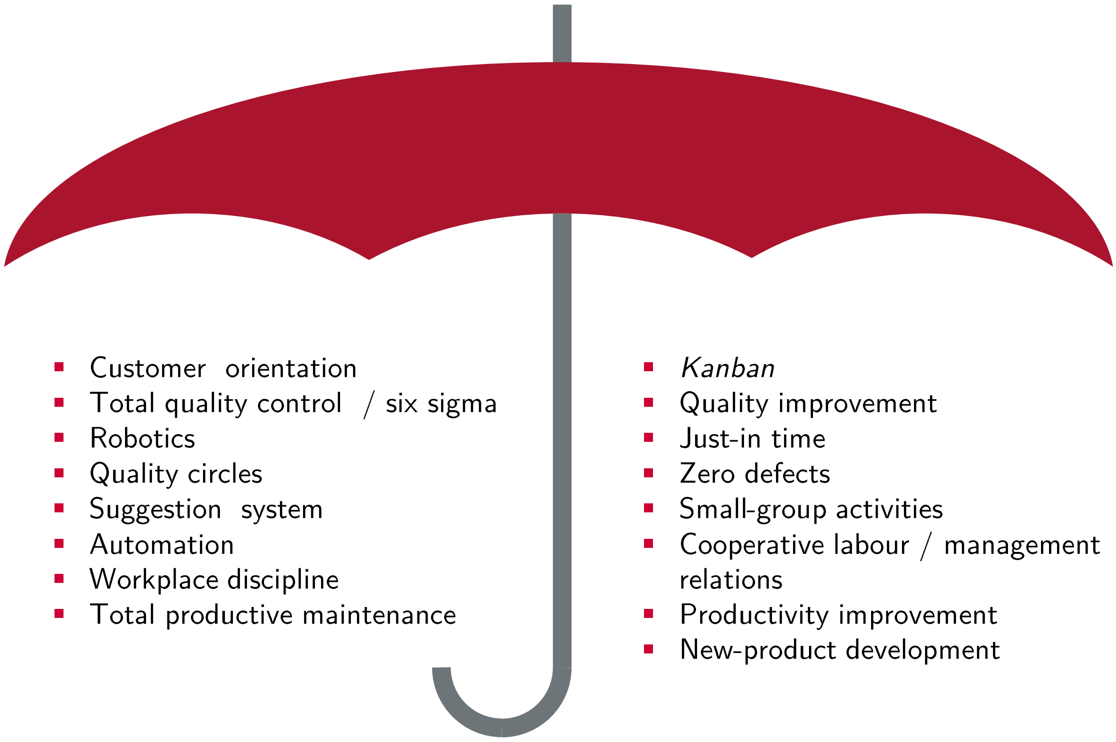


Figure 2.2: Kaizen Umbrella, c.f. (Imai, 1994, p. 25)

### 2.1.4 Toyota Production System

The TPS was generated in a time of need. After WWII there was a lack of resources in Japan and certain restrictions on the market required the production of small batches of many variants during a period of low demand. The aim was to increase productivity of production through continuous and complete elimination of all waste. The TPS is built on this principle and the equally important respect of humanity, which is the basis for the approach created by the founder of Toyota, Toyoda Sakichi, his son Toyoda Kiichiro and the chief production engineer, Ohno Taiichi. (Ohno, 1988, p.xii-xv)

Over the decades, Toyota was applying and improving TPS daily on the shop floor level without documenting the theory on it. Employees were continually learning new methods and also further developed methods through actual practice on the shop floor. Strong communication within the network spread the knowledge across other Toyota plants and ultimately to suppliers. It was clear that the task of teaching TPS to the employees was never ending. In the end an appropriate approach for simple representation was needed and so the famous TPS house (shown in Figure 2.3) was established. (Liker, 2004, p.33)

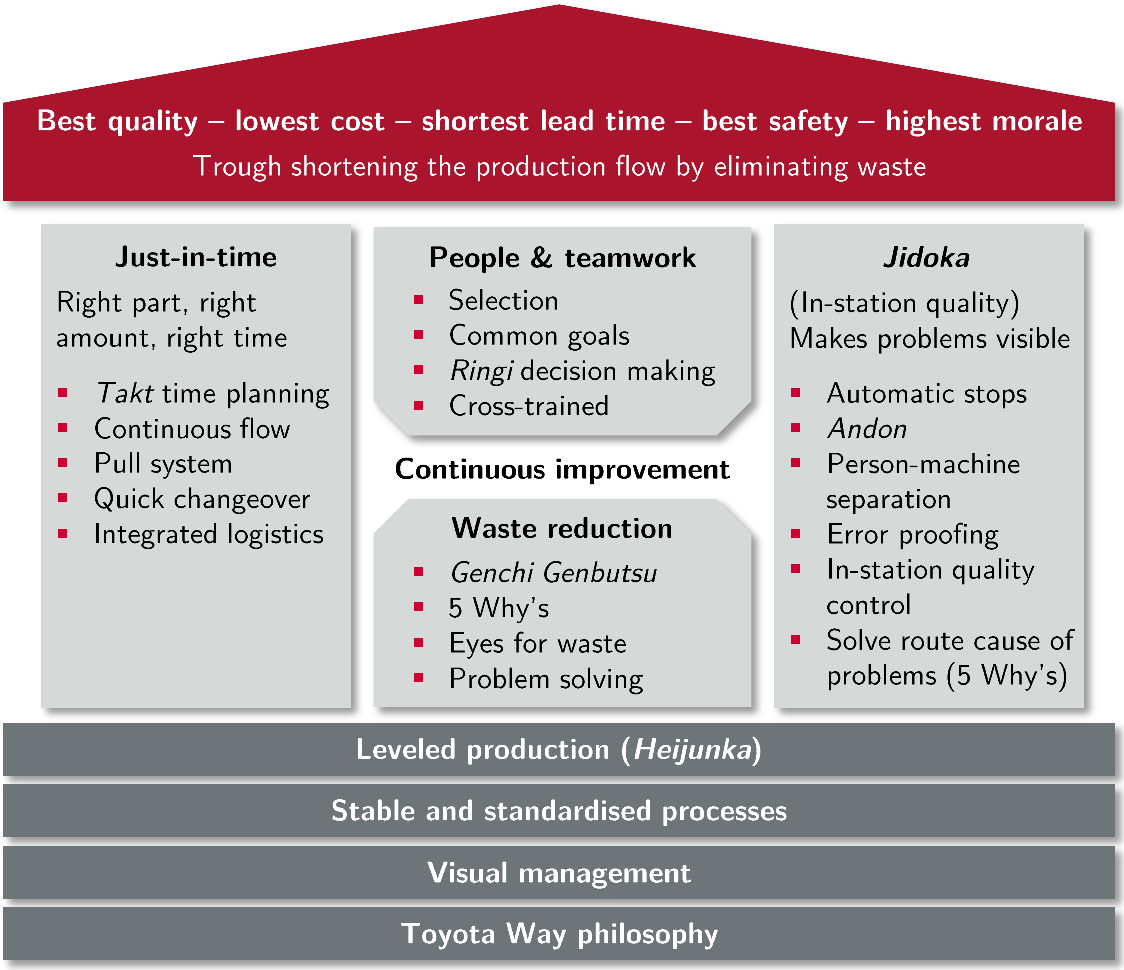


Figure 2.3: TPS House, c.f. (Liker, 2004, p.33)

TPS is not just a collection of management tools, but a sophisticated system of production in which all elements contribute to a holistic system. It deals with supporting and encouraging the employees for the CIP in their daily work. In fact, TPS is executing the golden rules of the Toyota Way, not only on the shop floor level, but also within the whole enterprise. (Rother, 2009, p.22-27)

When Cho Fujio, the former Chairman of the Board and Representative Director of Toyota Motor Corporation, was interviewed by Mr. Liker, he answered the question on what is unique to Toyota's remarkable success as follows:

> "The key to the Toyota Way and what makes Toyota stand out is not any of the

individual elements ... . But what is important is having all the elements together as a system. It must be practiced every day in a very consistent manner - not in spurts." (Liker, 2004, p.XV)

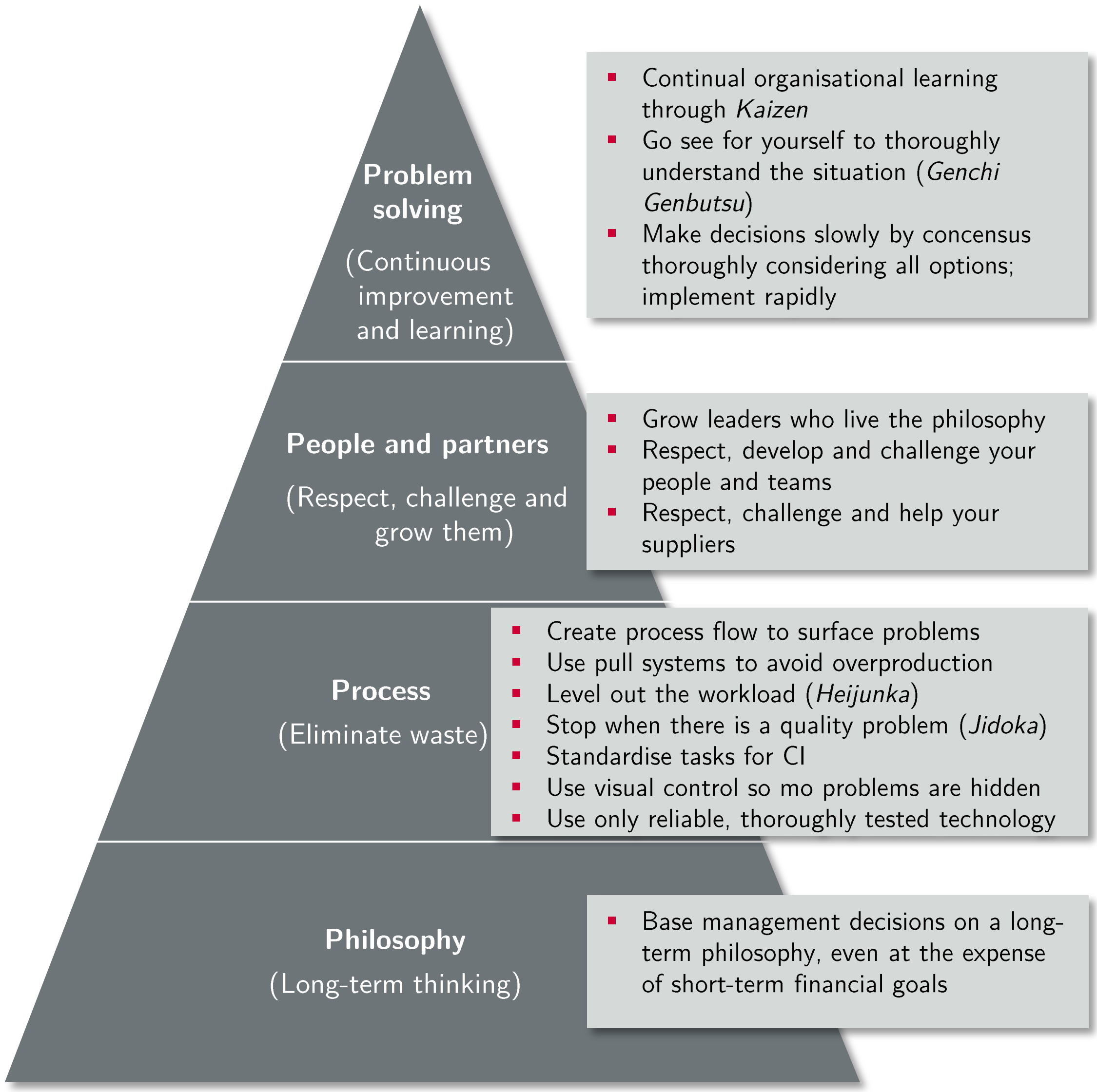


Figure 2.4: 4 P Model of the Toyota Way, c.f. (Liker, 2004, p.6)

In general, the Toyota Way consists of 14 principles, which are divided into the following four principle categories (shown in Figure 2.4) (Liker, 2004, p.35-41).

The heart of the TPS is the elimination of *Muda*, which means waste. The first question is always: "What does the customer want from this process?" This refers to both the external customer as well as the internal customer, who enters the picture - at the next steps of the process. This is the basic approach and it defines value.(Liker, 2004, p.27) Ohno identified seven types of *Muda* in production (Ohno, 1988, p.19-20). These types of waste can be found not only on the shop floor in production but also in indirect areas (Liker, 2004, p.28-29):

- Overproduction
- Waiting (time on hand)
- Unnecessary transport or conveyance
- Overprocessing or incorrect processing
- Excess inventories
- Unnecessary movements
- Defects
- Un-used employee creativity

In addition, Audi defined unergonomic work procedures and insufficient communication as further elements (AUDI AG, 2012c, p.20). Womack and Jones added the design of goods and services that do not meet the customer's needs (Womack and Jones, 2003, p.355).

## 2.2 Implementation of Production Systems in Western Automotive Industry

The challenge of implementing the Toyota philosophy in order to establish a production system lies in changing the behaviour and culture of the enterprises. Over decades the Japanese people have developed different approaches and policies. As Drucker has said:

> "It would be folly for managers in the West to imitate these policies. In fact, it would be impossible. Each policy is deeply rooted in Japanese traditions and culture." (Drucker, 1971, p.110)

It is not as simple as just copying an existing philosophy. Furthermore it is necessary to adapt advantageous methods and implement them into the present environment, which is quite challenging.

The Japanese mentality is based on the strong identification of the Japanese people with their work. The un-reflected transfer of this approach to Europe, for example, shows that this considers the operational and process know-how of well-educated employees to a minor degree. Disregarding potential leads to weak results. If employees are not involved in the change process, motivation will be lost by forcing the establishment of new structures and processes. This results in the "Not Invented Here" syndrome, where employees do not accept change. The big difference in mentality and culture leads to challenges. The key to success is to combine the advantages of both worlds and to define a complementary approach according to the existing conditions. (Schuh, 1998, p.23-24)

There is one big difference in Europe. Let us use the case of Porsche as an example of a classic German firm where the main focus was on the product itself. As common in Germany, the top managers at Porsche were brilliant product engineers. In their opinion the enterprise with the best product, designed by the best engineers, would win in the long run and survive in the market. (Womack and Jones, 2003, p.191-192) In contrast, Toyota focuses on processes (see Figure 2.4) according to their 4 P model (Liker, 2004, p.87).

### 2.2.1 The “First Lean Wave”

In the early 90s, Japanese, US-American and European automotive manufactures were compared to each other in the famous study of the Massachusetts Institute of Technology (MIT), which led to the development of the “lean management” concept. The focus was primarily on production, so the term “lean production” was formed. The term was originally coined by John Krafcik, a researcher from International Motor Vehicle Program (IMVP)[1] (Womack, Jones, and Roos, 1990, p.13). Later on, expansion of the entire enterprise followed. Lean management is defined as management with the goals of high efficiency, flexibility and superior quality.

In table 2.1, General Motors (GM) and Toyota plants are compared, which shows it was possible to transform the Japanese concept to the USA. The New United Motor Manufacturing, Inc. (NUMMI) is a joint venture of GM and Toyota. The NUMMI plant in Fremont achieved the same quality and almost the same productivity as the Toyota plant Takaoka in Japan.

| | | GM Framingham | NUMMI Fremont | Toyota Takaoka |
|---|---|---|---|---|
| Adjusted assembly hours | (per car) | 31.0 | 19.0 | 16.0 |
| Assembly defects | (per 100 cars) | 135.0 | 45.0 | 45.0 |
| Assembly space | (per car) | 8.1 | 7.0 | 4.8 |
| Inventories of parts (average) | (time) | 2w | 2d | 2h |

Table 2.1: Comparison of GM Framingham, NUMMI Fremont, Toyota Takaoka, 1987 (IMVP-World Assembly Plant Survey 1989, qtd. Womack, Jones, and Roos, 1990, p.83)

[1] The IMVP is the oldest and largest international research group, which was founded at the MIT, with the goal to understand the challenges facing the global automotive industry (Womack, Jones, and Roos, 1990, p.4-7).

### 2.2.2 Best Practice Example: Porsche or „Anders ist besser!“

Porsche is a best practice example for implementing lean production in a German company. In his book *Anders ist besser: Ein Versuch über neue Wege in Wirtschaft und Politik*, Wiedeking describes how he became President of the Executive Board of Porsche AG in very tough time and how he transformed it to the most profitable automotive manufacturer worldwide.

Everything started in 1991 when Wiedeking arrived at Porsche and became the Head of Production. At this time the sales slide was steepening and the earnings went down from a little profit to a loss in the next year. (Womack and Jones, 2003, p.197) At the same time the Japanese car industry was starting to attack the German luxury cars (Sanger, 1990).

First of all Wiedeking decreed his direct reporting employees the book *The machine that changed the world* of Womack, Jones, and Roos. Second step was that he organised trips to Japan with a team of engineers and foremen in order to visit the plants of Toyota, Nissan and Honda. So they recognised on the one hand that Porsche is far behind on every competitive dimension compared with the Japanese enterprises and on the other hand nobody in the Japanese automotive industry considered Porsche to be a serious competitor. In 1992 the pressure became even higher during the time of worldwide recession. The summed up losses were more than 100 billion euros. The only chance was to cut costs dramatically. (Wiedeking, 2008, p.184-186)

He understood that it was necessary with help from outside to change the production methods in a sustainable and radical way. Wiedeking had an accurate imagination of how a lean enterprise should look like, but he had never implemented such a system. Furthermore the situation was at the same time so dramatically that they could not risk anything any-more. (Wiedeking, 2008, p.192-193) Finally he could convince the famous Japanese *Sensei*[1] from Shingijutsu to come to Germany and consult Porsche (Linden, 1994, p.62)

As Wiedeking commented the arrival of the *Sensei* he wrote in his book:

> “They [the Japanese consultants; note from the author] were the hight priests of the unvarnished truth, and this was not only my temper, but rather my conviction, that only this medicine could cause sustainable recovery of the enterprise.” (author’s own translation, Wiedeking, 2008, p.193)

At the first meeting 1992 in Stuttgart Iwata Yoshiki presented Wiedeking and his employees the unvarnished truth. Iwata Yoshiki criticised:

[1] The Japanese word *Sensei* means teacher or master.

> "Everybody talks about what they have already achieved, but he believes only what he sees and that is catastrophic. Most of the things I have seen at Porsche are like it was 30 years ago in Japan." (author's own translation, Linden, 1994, p.66)

His colleague Nakao Chihiro continued with a theatrical tour de force. He insisted Wiedeking to accompany him to the shop floor of the plant. After arrival at the assembly lines he asked loudly: "Where is your plant? This is obviously the warehouse!" After he was told this was the engine assembly shop, he announced that if this was a Porsche plant it was clear that they could not earn any money. So after he was reported by an employee that he was right and Porsche is losing a lot of money daily, Nakao came to the decision to launch radical improvement activities immediately. (Womack and Jones, 2003, p.201) According to the philosophy of lean production excess inventory is definitely waste and must get eliminated (Liker, 2004, p.29).

A crucial situation happened when they decided upon the first improvement activity. In fact the course of action was to cut the shelf height in half from 2.5 to 1.3 meters in order to get rid of the excess inventory. Wiedeking was dressed in the blue Porsche jumper for the round trip. Suddenly Nakao handed him a circular saw and told him to cut every rack at 1.3 meters. This was a very powerful signal to the employees. This top manager is not just taking decisions, he is ambitious to implement the results straight and quickly. According to the *Kaizen* credo "Just do it!". (Wiedeking, 2008, p.195-197)

Porsche has implemented consequently the lean production. Extensions and improvements led to their own production system called Porsche Production System (PPS). (Wiedeking, 2008, p.201)

## 2.3 Audi Production System

Of course Audi has established their own production system with the name APS. In the Audi production strategy 2020 (shown in Figure 2.5) APS is one principle and therefore it is playing a leading role (AUDI AG, 2012d).

The Member of the Executive Board - Production of AUDI AG, Dr.-Ing Frank Dreves has already said:

> "Our aim is a value-added oriented, synchronous enterprise. A company that is focused on short lead times, low inventory and continuous improvement, based on clear standards, and thereby to act people-oriented." (author's own translation, AUDI AG, 2012c, p.7)

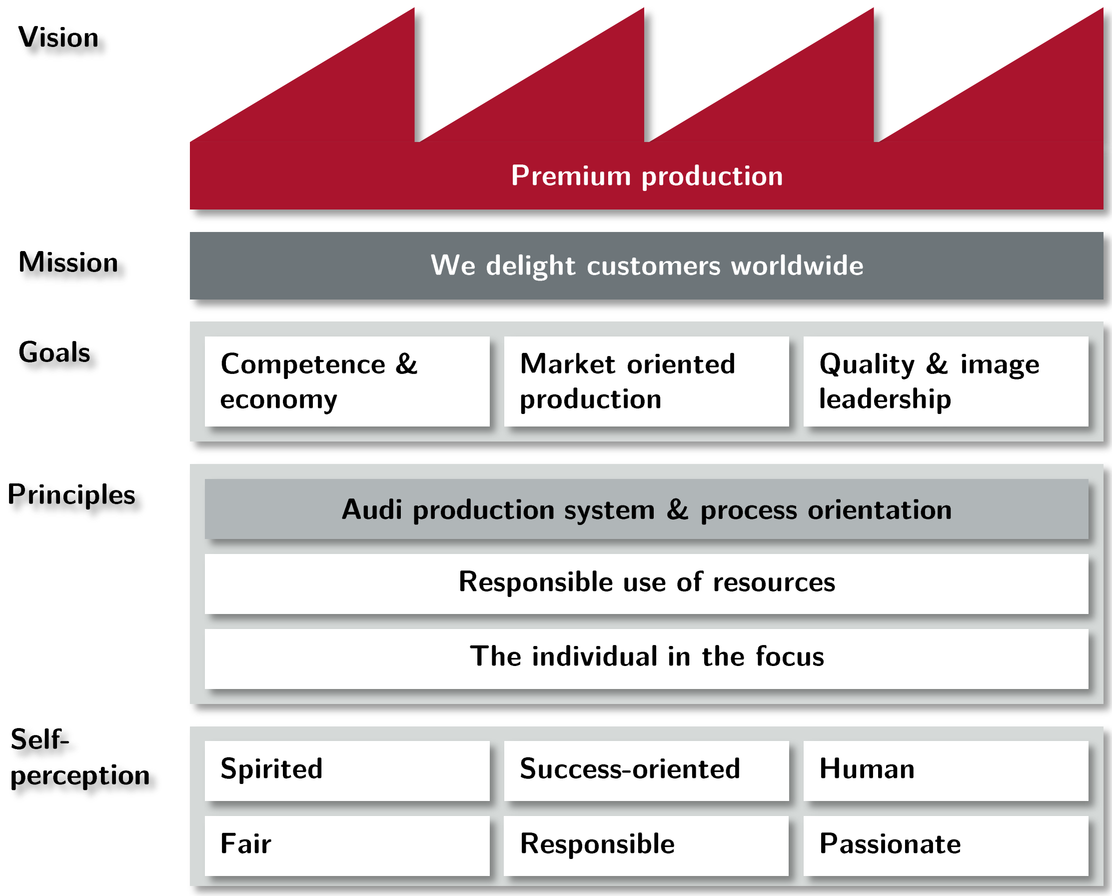


Figure 2.5: Audi Production Strategy 2020, c.f. (AUDI AG, 2012e)

### 2.3.1 Audi Production System House

What has the APS in common with a house? The analogy can be seen as following. A house needs a foundation, supporting structure (four pillars), framework elements and a roof. Otherwise it would not be stable, a single weak point would decimate the solid house. Every single element of the house is important. Furthermore the interaction of all elements is sufficient to stabilise the complete system.

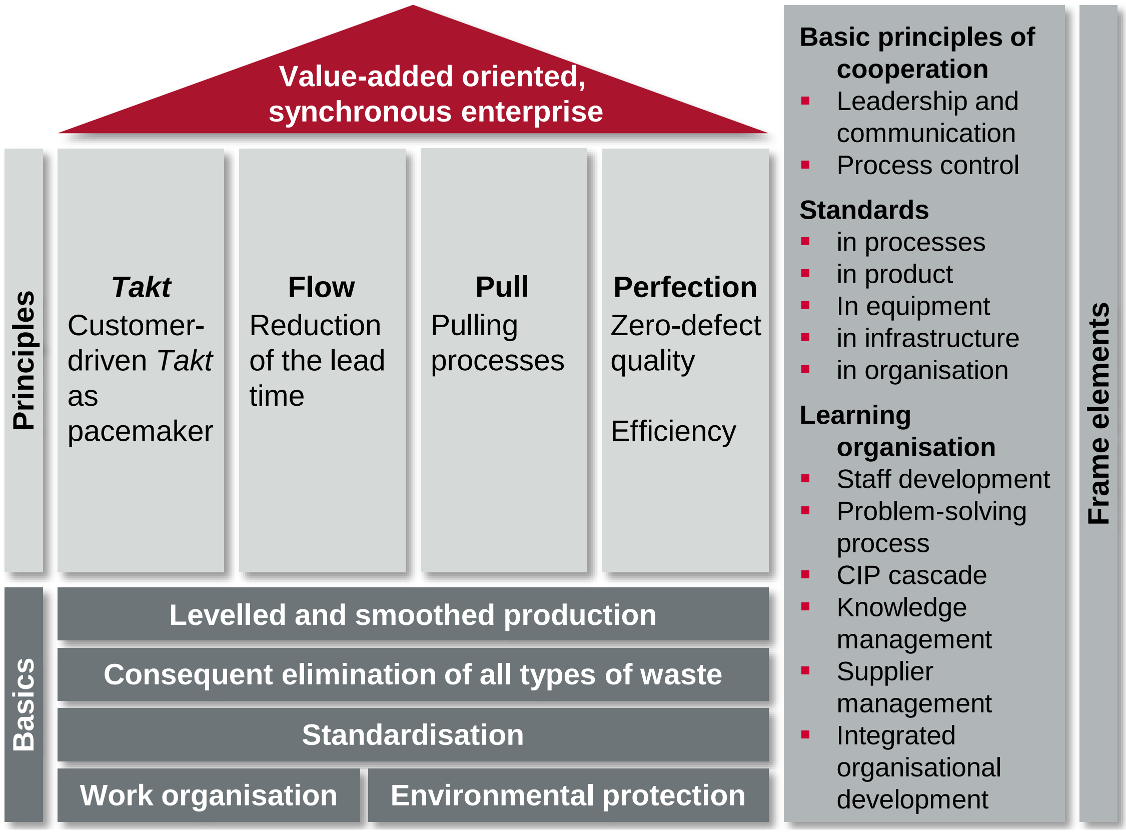


Figure 2.6: APS House, c.f. (AUDI AG, 2012d)

The APS house (shown in Figure 2.6) consists of a foundation, actually the basics for stable processes and whereon the overall production system is relied on. On this basis are the four pillars *takt*[1], flow, pull and perfection, which are supporting the roof which is representing the aim - a value-added oriented, synchronous enterprise. Additionally there are some frame elements, which have to be considered within the whole optimisation process.

[1] *Takt* time means a precise interval of time, as in a musical meter and was first introduced in German aircraft industry as it embraced mass production in 1930s. Japanese engineers have imported the term and with the spread of lean thinking it became established also in English. (Womack and Jones, 2003, p.259-260; Shiomi and Wada, 1995, p.14)

**Basics** represent the foundation of the APS house and support the principles in terms of the four pillars.

***Takt*** characterises the approach of *takt* time, which precisely synchronises the rate of output to the demand of the customer.

**Flow** reduces the lead time by reducing the stock and batch size. This ensures the transparency of processes and any defects are therefore recognised immediately.

**Pull** infers that no good or service is produced upstream until it is demanded downstream by the customer. Thereby stock will be reduced and any unnecessary process steps will be avoided.

**Perfection** describes the principle of possessing zero defects and continuous improvement. This leads to the reduction of costs and also leads to stable processes.

**Frame Elements** specify the basic principles of cooperation, standards and the learning organisation.

(AUDI AG, 2012b)

### 2.3.2 Continuous Improvement Process Cascade

The implementation of the value-added oriented, synchronous enterprise is carried out by the approach of the CIP Cascade (shown in Figure 2.7).

Ergonomic workplaces are the basis of a people-oriented company. The aim is to identify value streams in order to eliminate waste and to finally design lean processes with short lead times. Therefore this ensures a continuous improvement in efficiency. The CIP Cascade is symbolised by four chronological consecutive waves, which are divided in seven stages. The first two waves focus on process optimisation, whereas wave 3 and 4 focus on product optimisation.

Wave 1 concentrates on optimisation in the direct areas of production, whereas wave 2, the indirect areas of production are optimised with the top-down and the bottom-up approach. In wave 3 the product development and the product process are positioned, before the Start of Production (SOP)

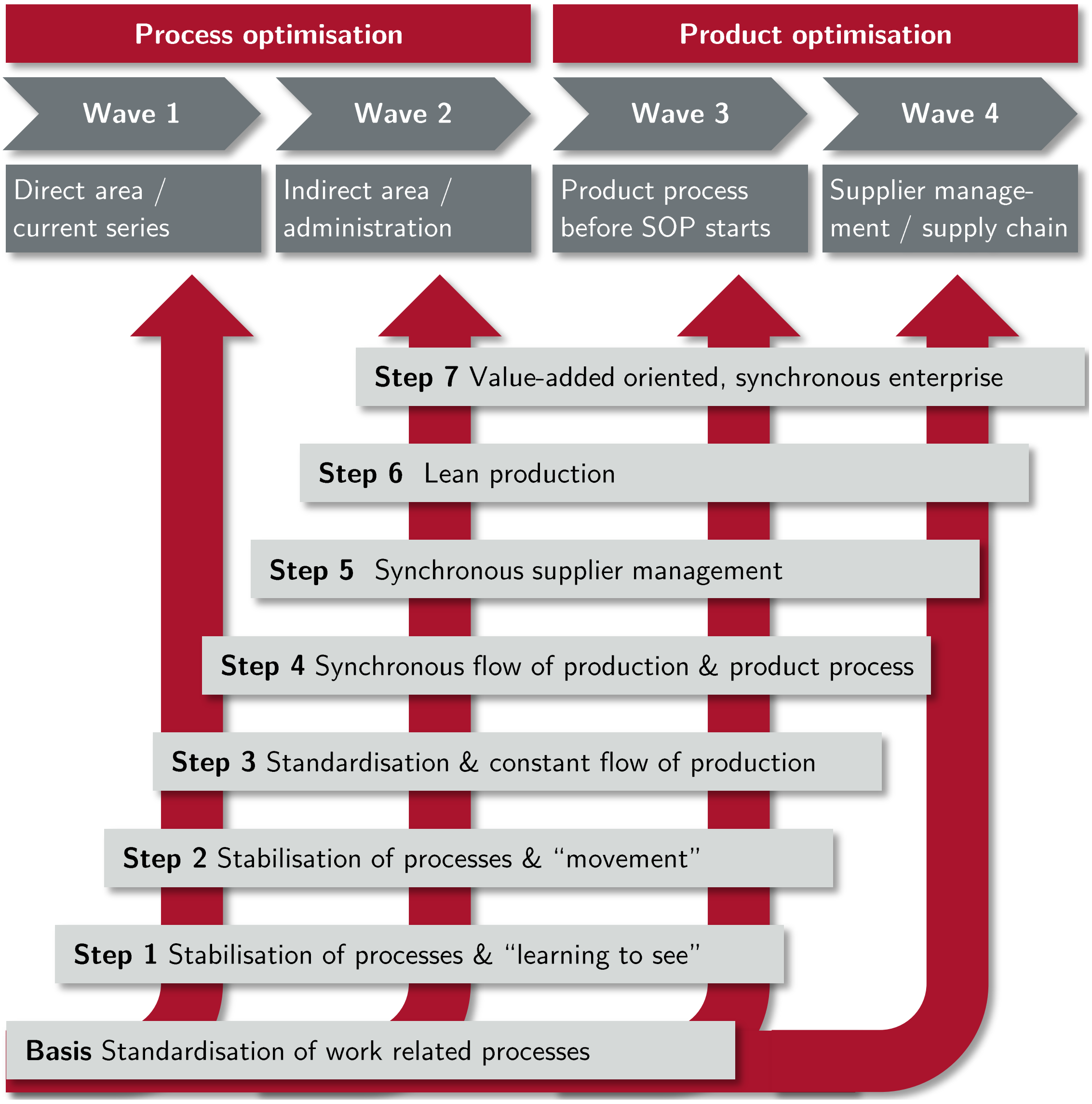


Figure 2.7: CIP Cascade, c.f. (AUDI AG, 2012c, p. 48)

starts. Wave 4 handles optimisation along the entire supply chain and supplier management. (AUDI AG, 2012c, p.49-50)

## 2.4 Continuous Improvement Process in Indirect Areas at Audi

In the direct area of production the CIP has proven itself to be of value. Therefore the next logical step was to implement the methods of CIP into indirect areas of production. To meet the requirements of a holistic production system, it had to be spread throughout the entire enterprise.

### 2.4.1 Operational Organisation

The approach of the design of continuous improvement in the indirect area of the business segment production is based on a certain role delineation and responsibility (shown in Figure 2.8). Duties and responsibilities are clearly defined. The aim is to establish continuous improvement activities comprehensively throughout the enterprise.

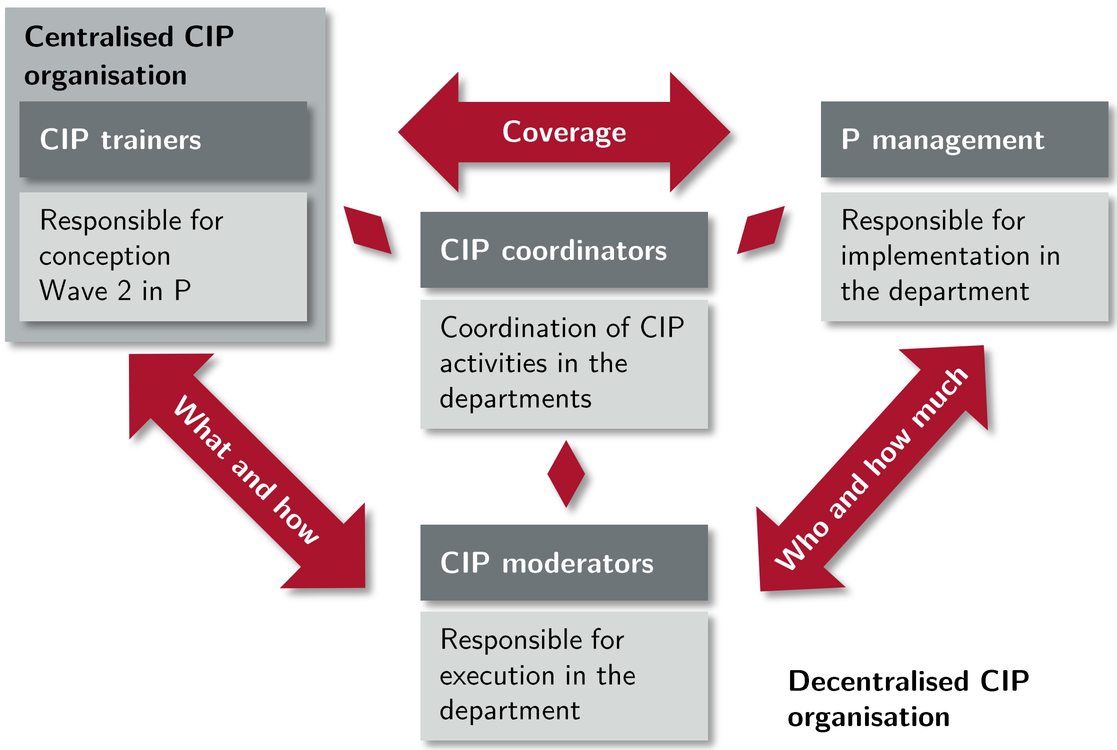


Figure 2.8: Role Delineation and Responsibility, c.f. (AUDI AG, 2013a, p.54)

The centralised organisational unit of Production System Indirect Area (I/PG-A8) is in charge of implementing the CIP into the indirect areas and consists of the core workforce and the temporary employees from other departments within the indirect areas of production (or even from other plants). These employees are the so-called **CIP trainers**. They hold the following core competences (see subsection 2.4.2):

- Designing of new workshop concepts and further development of CIP methods
- Carrying out trainings in order to qualify CIP moderators
- Supporting CIP moderators in performing any workshops
- Integrating the acceptance of CIP within the enterprise.

The decentralised organisation consists of CIP moderators, CIP coordinators and management of the business segment Production (P). The **P management** is responsible for CIP implementation within their departments, thus providing the necessary resources and capacities. Furthermore, it is accountable for nominating appropriate candidates to become CIP moderators.

The **CIP moderators** serve as contact and follow the continuous improvement activities in their assigned scope. In particular, they perform the CIP workshops. They work as permanent staff in an indirect area of production, at which they are released for continuous improvement activities for a specified amount of their work time. The CIP moderators are directly assigned by their supervisors to carry out the workshops. Their duties are to plan, design and perform the CIP workshops. In specialised training sessions, carried out by CIP trainers, CIP moderators acquire the required methodological skills. In six annual gatherings the CIP moderators from all of the indirect areas of production get together. At these so-called „Jour fixes“- meetings, they are informed of current continuous improvement topics. The meeting provides an opportunity for the integration and exchange of experiences between the centralised CIP organisation and the CIP moderators.

The **CIP coordinators** are responsible for the on-going continuous improvement activities and to coordinating the integration in their division of indirect area of production (for example the division of Production Planning and Plant Planning (I/PG)). They represent the interface between the centralised CIP organisation, CIP moderators and the P management. The CIP coordinators put forward any concerning issues, prioritise the reparation of them and monitor the implementation of the CIP cascade and report directly to the P management about the progress.

### 2.4.2 Fields of Action and Continuous Improvement Process Navigator

The specification of the different fields of action in the indirect areas of production takes place in the form of the CIP navigator (shown in Figure 2.9).

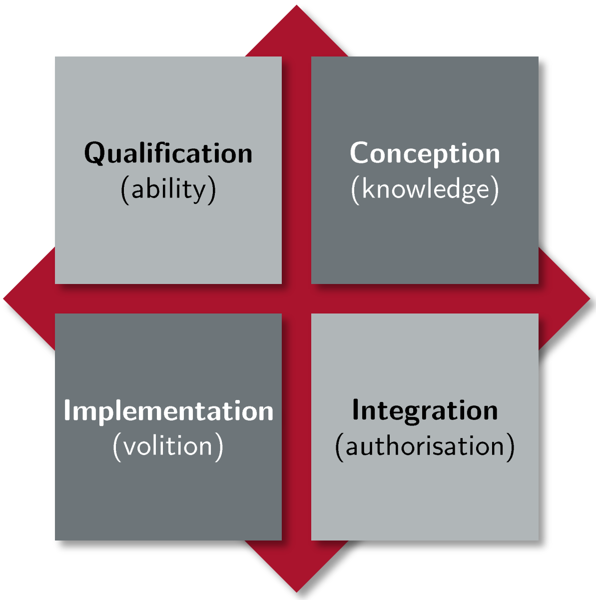


Figure 2.9: CIP Navigator, c.f. (AUDI AG, 2012c, p. 54)

The **conception** for execution is described in the APS and it has been thoroughly tested and proven. The four-stage implementation model structures the CIP.

The **qualification** of the decentralised CIP organisation provides the capability for completing the CIP. With the moderators of the departments, the decentralised CIP organisation is conducted. This boosts the local continuous improvement competence.

The **implementation** is performed throughout departments. The responsible manager supervises the execution and the content of the improvement activities. This results in a situation wherein the participants can focus on the design of the processes.

The **integration** of the continuous improvement activities in the planning and strategic considerations of the departments is down to the appropriate management. The target resolution for execution and objectives also takes place here.

(AUDI AG, 2012c, p. 55)

### 2.4.3 Implementation Model

A structured approach is required for the implementation of APS (CIP cascade, see subsection 2.3.2), which is adopted according to the circumstances of the indirect areas of production . Therefore a compressed four stage model was designed by I/PG-A8 (shown in Figure 2.10).

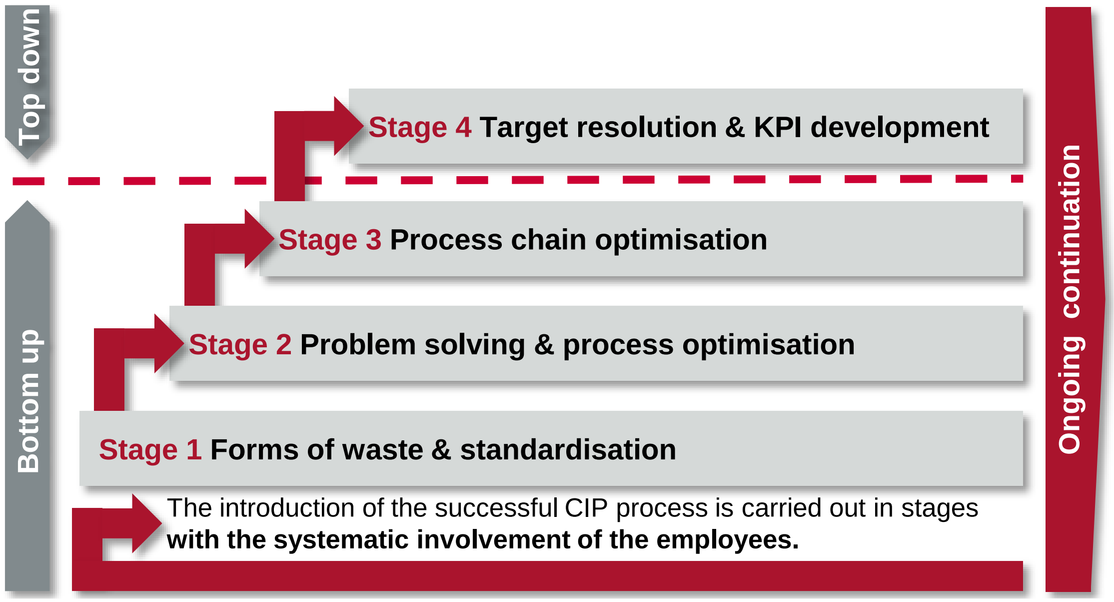


Figure 2.10: APS Implementation Model for the Indirect Areas of Production, (AUDI AG, 2012c, p. 52-53)

**Stage 1: Forms of waste & standardisation** Efficient work place and efficient teams, familiarise with CIP, "learning to see"

**Stage 2: Problem solving & process optimisation** Problem solving, process mapping, process optimisation and function analysis

**Stage 3: Process chain optimisation** Problem solving and process optimisation in the process chain, optimisation of cooperation and dealing with barriers of communication

**Stage 4: Target resolution & Key Performance Indicator (KPI) development** Effective and efficient target resolution, navigation and correction through performance measurement

The continuous endeavour leads to success on the way to a value-added oriented, synchronous enterprise. (AUDI AG, 2013c, p. 15)

The appropriate methods for visualisation and analysis of information flows in processes deal with stage 2 and stage 3.

# 3 Initial Situation Analysis of Potential Methods

The objective of the initial situation analysis is to find appropriate methods for the visualisation and analysis of individual processes, especially in terms of the information flows. For this purpose, specific methods are required, in order to achieve transparency within the processes and to enable comparison a between different process alternatives, as this is the basis for process optimisation. The purpose of the analysis is to obtain an overview of existing methods derived from research of literature, expert knowledge contrived CIP workshops and definition of assessment criteria. The first step is to carry out a research in order to find a broad selection of methods in different areas of business process modelling, industrial engineering, software engineering and project management.

In section 3.1, a brief overview of pre-selected methods is provided. User statements and specialist literature in the study by Günthner and Schneider (2011) are the basis of gathering and categorisation of particular requirements. Thereby this study deals with holistic process representations for internal logistic processes. The basis requirements from the study are assimilated according to the needs of the thesis. Afterwards, the general operation purpose of process models is researched. The next step is the determination and categorisation of practical relevant applications according to the content of the CIP workshops based on data prepared for the management conference of production. The aim of interviews with experts is to collect information about the current and future topics in CIP workshops. Furthermore, the benefit is the accumulation of experience based on the expertise of the interviewees. The assessment of the pre-selected methods is applied in section 3.5. Firstly, a suiting assessment technique is chosen. At this juncture a catalogue of assessment criteria is defined. The criteria are classified and organised into a hierarchy, clearly described and sorted according their severity. After this, matching methods are selected for further development as well as modification in order to create a new methodology for visualisation and analysis of information flows.

## 3.1 Overview of Preselected Methods for Process Visualisation and Analysis

First of all, it is necessary to achieve a broad perspective in order to search for various methods. This aids in collecting a selection of methods in different areas of business process modelling, industrial engineering, software engineering and project management. Thereby a preliminary selection of methods (see Figure 3.1) is chosen for the analysis.

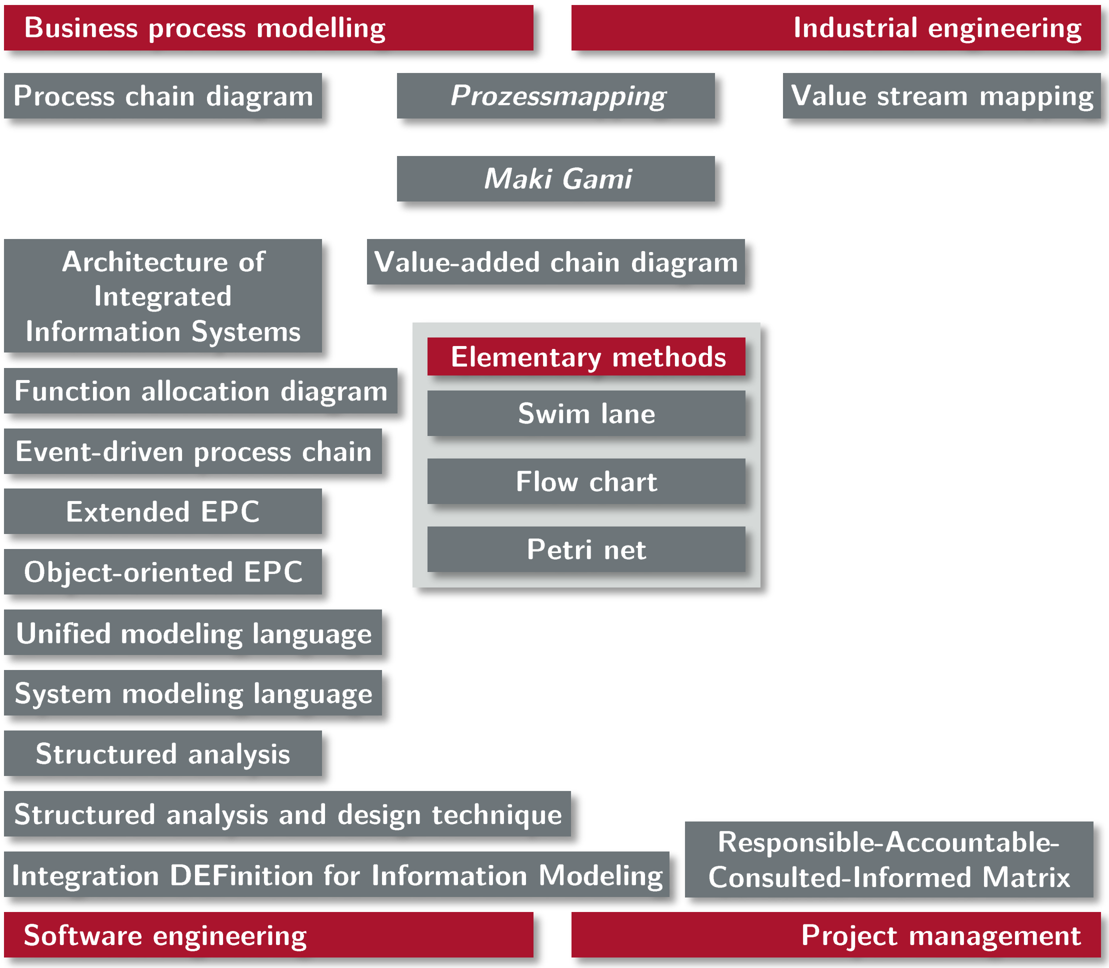


Figure 3.1: Overview of Preselected Methods, author's own work

The approach for the pre-selection will follow. Several criteria are necessary for this selection. First the method must be capable of mapping processes. There is a differentiation of methods used in business process modelling and industrial engineering. The process models are different, depending on the level of detail. Another aspect involves collecting methods from the area of software engineering, which are then used to determine data and information flows. In order to handle responsibilities, which are required to deal with information, a tool from project management is taken in consideration. Some elementary methods are the basis for alternative extended methods. Thereby the research concentrates on the extended versions. A premise of the investigation is to discover methodologies which are utilisable in the environment of a CIP workshop.

Subsequently, several methods for process analysis and visualisation are introduced. These methods are the basis for further development of the new concept methodology.

#### *Prozessmapping*

Prozessmapping (PMA) is the standard method for process analysis and visualisation in indirect areas used at Audi. The methodology is capable for simple processes mostly within an organisational unit. Therefore it is easy to understand, relatively fast and intuitively deployable. Hence, it is particularly suitable for the bottom-up approach. The aim is to understand and to visualise the journey of a product or service from the defined input until the defined output, including all the essential process steps, decisions, loops and interfaces. (AUDI AG, 2013d) Therefore with PMA, it is possible to recognise potential bottle necks and to identify any waste. It generates transparency within the processes and leads to the identification and improved problem solving capability of the employees. Motivation, creativity and innovation skills of the employees are actively stimulated. (C. Kostka and S. Kostka, 2011, p.87)

#### *Maki Gami*

*Maki Gami*[1] process map visualises processes in indirect areas (for example in offices). The objectives are to analyse the current state and to redesign for the future state. It makes processes transparent and it gives a holistic view of the enterprise and its surroundings. (Makigami Info, 2013)

PMA and *Maki Gami* are very similar and both methods are merged for further investigations. From now on, the term PMA is used as a synonym for both.

#### Value Stream Mapping

Value Stream Mapping (VSM) is a very useful method for visualisation of material and information flow as well as for the consideration of the associated lead time over several processes (Rother, 2009, p.43). VSM provides a “common language” and understanding so that everyone has the same vision. It is like a road map, it shows the way of the journey, but it is only a guide. (Liker and Meier, 2006, p.42)

[1] In Japanese *Maki Gami* means literally “Role of Paper”.

Rother and Shook put the topic of the value stream aptly when they said:

> "Whenever there is a product for a customer, there is a value stream. The challenge lies in seeing it." (Rother and Shook, 2003, p.v)

In the first step, it is necessary to identify the target product, product family or service. The second step is to draw a current state value stream map on the shop floor, with the aim to create transparency. The next step is to draw a future state value stream map, while assessing the current state value stream in terms of creating flow by eliminating waste. Finally, the continuous implementation of the derived action plan takes place in order to reach the predefined future state condition. (Rother and Shook, 2003, p.3-16)

#### Business Process Model and Notation

Business Process Model and Notation (BPMN) is a methodology for the visualisation of business processes. It is a flow-chart based notation with a broad range of complexity, from simple to more complex and even sophisticated models. BPMN is capable of representing various levels of details. (White and Miers, 2008, p.23). The syntax of BPMN is similar to an Event-Driven Process Chain (EPC), although there are differences concerning the event types (Rosemann, Schwegmann, and Delfmann, 2012, p.71). BPMN is used for business purposes such as process documentation, improvement business analysis, stakeholder communication and it is used for technical purposes like process simulation, service analysis and workflow engineering (Recker, 2008, p.2). BPMN is standardised by the Object Management Group (OMG), the latest version is BPMN 2.0, this was released in 2009 (Allweyer, 2009b, p.13).

#### Value-added Chain Diagram

The Value-added Chain Diagram (VCD) is used to structure business processes from the strategic levels of an enterprise in order to acquire a general overview. The actual usage is for the visualisation and description of functions, which are directly value adding. (Seidlmeier, 2006, p. 23) The so-called primary functions are based on the value chain by Porter (Porter, 2004, p.38-39). Explicit constriction and outsourcing of details leads to concentration on the essentials. This ensures a functional overview model from the management perspective on the business processes. (Grief, 2005, p.71)

#### Function Allocation Diagram

The Function Allocation Diagram (FAD) is used to visualise input and output of a function. The complexity of the whole process model is reduced by the outsourcing of details. (Lehmann, 2008, p. 54) The focus of FAD is in the description of information flows. Therefore interfaces and system transactions are determined (for example of documents, data etc.). (Scheer and Klein, 2004, p.113-115)

#### Process Chain Diagram

Business processes are illustrated in a Process Chain Diagram (PCD) as a complete system (Scheer, 1984, p.22-23). The essential context of the Architecture of Integrated Information Systems (ARIS) business process model is shown in a concise manner. The tabular form increases the clarity of arrangement compared to the visualisation of EPC, but it is becoming more and more difficult to display complicated procedural structures, such as loops. (Scheer, 2001, p.15-16)

#### Systems Modeling Language

Systems Modeling Language (SysML) is a graphical language, based on Unified Modeling Language (UML) for modelling technical systems of any kind. Thereby it is supporting systems engineering in all fields. (Alt, 2012, p.29-32) UML was developed during the establishment of object-oriented software development. At first sight, business process modelling has nothing necessarily in common with object-oriented software development or software development in general. A large amount of processes are usually supported by software. This results in a close relationship between business process modelling and software development. (Oestereich, 2003, p.12)

#### Structured Analysis and Design Technique

Structured Analysis and Design Technique (SADT) is a fundamental tool of systems analysis and derived from classical systems analysis of the 1960s and 1970s (Yourdon, 1986, p.35). SADT is based on the methodology Structured Analysis (SA) described by DeMarco in his book from 1978. A huge advantage is the simple graphical notation to illustrate components of the model and their interfaces. It should consist of all essential information in order to describe the system. (Raasch, 1991, p.85)

#### Integration Definition for Information Modeling

Integration Definition for Information Modeling (IDEF1X) is a modelling language (semantics and syntax) for the development of logical data models. IDEF1X is capable of creating a graphical information model which represents the structure and semantics of information within an environment or system. (National Institute of Standards and Technology, 1993, p.1) An IDEF1X diagram consists of entities, attributes and relationships. While the entities act like nouns, the relationships act like verbs and the attributes act like adjectives. (Bruce, 1992, p.77)

#### Responsible-Accountable-Consulted-Informed Matrix

The Responsible-Accountable-Consulted-Informed (RACI) chart is a popular type of the Responsibility Assignment Matrix (RAM) (Crowe, 2005, p.257). It defines the interrelationships and dependencies between functional areas (Hightower, 2008, p.83). The advantage of the RACI matrix is the differentiation of four different forms of responsibility. RACI is the abbreviation for the four words: responsible, accountable, consulted and informed (Bohinc, 2012, p.21). Sometimes this is written as Responsible-Accountable-Supported-Informed (RASI) and sometimes as Responsible-Accountable-Supported-Consulted-Informed (RASCI), where the “S” stands for supported (Hightower, 2008, p.83).

## 3.2 Gathering and Categorisation of Specific Requirements

First of all, the study by Günthner and Schneider (2011) enables one to define the basic requirements for process mapping in general. It is necessary to assimilate the outcome according to the needs of the thesis. These requirements are the basis for the later derived appropriate assessment criteria.

### 3.2.1 Basic Requirements for Process Mapping

In the study *Forschungsbericht: Methode zur einfachen Aufnahme und intuitiven Visualisierung innerbetrieblicher logistischer Prozesse* by Günthner and Schneider (2011), a survey for empirical research is performed, in which a methodology is developed in terms of a holistic process representation for internal logistic processes. Process engineers of various industrial companies were asked about their requirements for methods in order to map processes. The result of the questionnaires provides an impression of the hands-on experience and leads to appropriate requirements. The results are step-by-step refined with special literature and by the expertise of the researches involved in the project. (Günthner and Schneider, 2011, p.43)

The approach of the research project is different as it focuses on internal logistic processes. In logistic processes material flows, resources and information flows play the leading role in the context of the process design. It is necessary to concentrate on information flows, according to the topic of the thesis. Consequently the outcome is modified and derived, but it suits well for basic requirements of process mapping in general.

The results of the survey from process engineers and the performance indicators from literature led to the basic requirements of process mapping (see Figure 3.2).

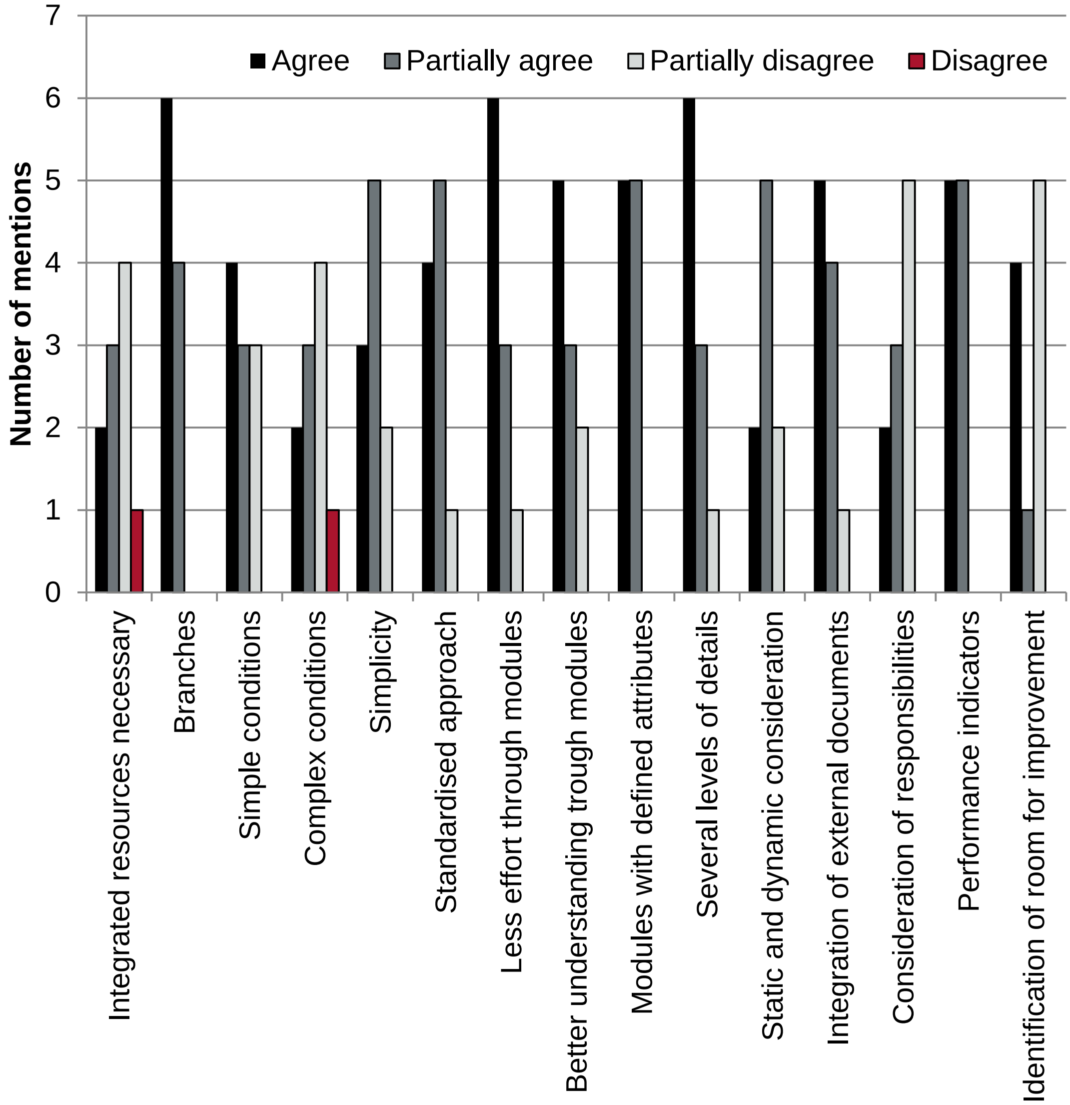


Figure 3.2: Basic Requirements for Process Mapping, c.f. (Schneider, Hohenstein, and Günthner, 2011, p.6)

### 3.2.2 Derivation of Assessment Criteria

Based on the data (shown in subsection 3.2.1), the following four criteria groups can be defined according to the requirements of the methods (Schneider, Hohenstein, and Günthner, 2011, p.6):

- Requirements for Process Design
- Requirements for Process Logic
- Requirements for Process Understanding
- Requirements for Process Performance

Each group consists of individual criteria, which are separated and listed in the catalogue of assessment criteria (shown in Table 3.4). First of all, it is necessary to explain each individual criterion.

#### Process Design

Process design is the essential competence for a method to record and to visualise processes.

1. **Forward**: Transmission of information is a fundamental procedure, describes how information is received and forwarded to others (for example, temporary intermediate storage of process data)

2. **Transform**: Transformation of information (for example, digitalisation of information in hardcopy form)

3. **Processing**: Processing of information, by change or assessment (for example, carrying out an order from a customer)

4. **Interaction Problems**: Between various participants of a process as well as barriers to communication and cooperation (for example, various members of diverse departments)

5. **Information**: Type of information (for example, a table or a list)

6. **Information carrier**: The medium (for example, in digital form)

7. **Superordinate system**: (IT-)system (for example, Enterprise Resource Planning (ERP) systems)

8. **Hierarchy**: Different responsibilities (for example, the clarification of roles and responsibilities)

### Process Logic

Process logic is the ability to illustrate the actual sequence of process and structure of the system.

9. **Branches**: Branches are necessary in order to link subsidiary systems in a logical way
10. **Boolean conditions**: Boolean operators are used to combine branches in mathematical logic for example, conjunctions (AND) as well as disjunctions (OR)
11. **Individual conditions**: Individual, informal conditions are used to visualise alternative operation sequences at branches
12. **Parallel sequences**: Visualisation of parallel sequences

### Process Understanding

Process understanding does not only depend on the extent and complexity of the investigated system, but is influenced by the individual capability of every person.

13. **Unambiguity**: Irreproachable distinctness of elements
14. **Simplicity**: Focus on the essential requirements of the objective, avoid excess details
15. **Structuredness**: Comprehensible approach with fixed rules, arrangement and syntax
16. **Symbols**: Utilisation of symbols improves visualisation of processes
17. **Static and dynamic consideration**: Visualisation of static and dynamic consideration
18. **Level of details**: Varied levels of abstraction
19. **Differentiation of process types**: Various process types (for example, value-adding process steps)
20. **Prioritisation**: Highlight of process steps (for example, bottlenecks)

### Process Performance

Process performance is evaluated by using KPIs in a qualitative and quantitative manner. Four different categories are available for the evaluation of the results and at least one will match. The criteria of effectivity[1] are adherent to schedules and process quality. On the other hand criteria of efficiency are adherent to quantity and effort.

> "If you can't measure it, you can't manage it - and more importantly, you can't claim it as a success." (Rosemann, 2006b, p.384)

21. **Adherence to schedules**: Allocation of results on schedule (for example, reduction of cycle time)

22. **Process quality**: Improved performance of process objectives (for instance, achieve agreed upon process goals and project aim)

23. **Quantity**: Improved performance at same input / resource management (for example, avoid external services)

24. **Effort**: Same performance by reducing input / resource management (for example, fixed costs and investment)

## 3.3 Determination and Categorisation of Practical Relevant Applications

The aim of section 3.3 is to determine and to categorise existing applications to show the utility of process models. Therefore in the beginning, various scenarios of practical relevant applications from literature are described. Later on, results from a former investigation of conducted workshop topics are compared to these scenarios in order to find any matching analogies.

### 3.3.1 Operation Purpose of Process Models

> "All organizations are on a journey–a never ending voyage where the focus is on improving how things are done (however that is measured) ..." (White and Miers, 2008, p.19)

[1] A fundamental differentiation in management literature between effectivity and efficiency is originally from Drucker, who has written in an article in the Harvard Business Review (HBR):

> "It is fundamentally the confusion between effectiveness and efficiency that stands between doing the right things and doing things right. There is surely nothing quite so useless as doing with great efficiency what should not be done at all." (Drucker, 1963, p.53–60)

Various operation purposes have apparent and diverse requirements with regard to contents and method, on process models. Below, several different operation purposes are described.

### Process Oriented Reorganisation

Process oriented reorganisation is the most popular operation purpose for process models. On the one hand it can be Business Process Reengineering (BPR) (revolutionary) or on the other hand CIP (evolutionary). (Rosemann, Schwegmann, and Delfmann, 2012, p.53)

The attributes of process reengineering and process improvement are compared with one another (shown in Table 3.1 ).

| Attribute | Reengineering (Revolution) | Improvement (Evolution) |
|---|---|---|
| Initial point | New process | Existing process |
| Aims of change | Customer satisfaction, efficiency | Efficiency, customer satisfaction |
| Scope of change | Radical | Incremental |
| Occurrence of change | Discontinuous | Continuous |
| Implementation of change | As a project | As a permanent task |
| Impetus / driver of change | Top down, management, project team | Bottom up, all employees |
| Impact of change | Wide, across functions | Within the processes |
| Type of change | Cultural, process-related structural | Cultural, process-related organisational learning |
| Risk | High | Low |

Table 3.1: Attributes of Process Reengineering and Process Improvement (Schmelzer and Sesselmann, 2004, p.249)

In times of crisis BPR is largely the only way for a radical change, to break the mould in terms of traditions, structures and positions of power. In this situation, improvement by small steps is not so efficient in a short period of time. The reengineering-boom of the 90s is over, nevertheless BPR is still up-to-date. The procedure of changing business processes from time-to-time is not a question of fashion; it is a question of survival. (Schmelzer and Sesselmann, 2004, p.254)

The definition of BPR has been coined by Johansson, Davenport, Hammer and Champy.

BPR means “starting over”. According to Hammer and Champy it means precisely:

> “Reengineering, properly, is the fundamental rethinking and radical redesign of busi-

> ness processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service, and speed." (Hammer and Champy, 1995, p.32)

Similar to the approach of BPR is the concept of process innovation, it broaches the issue of fundamental change and therefore an improvement in business processes (Schuh, 2006, p.9). According to Davenport (1993, p.11) there are important differences between innovation (radical) and improvement (incremental). The top-down oriented framework of process innovation consists of five steps: identifying processes for innovation, identifying change levers, developing process vision, understanding existing processes, and designing and prototyping the new process (Davenport, 1993, p.25).

> "After all, it was easier to create detailed models than it was to create real change within organizations, ..." (Davenport, 2004, p.1)

The nature of continuous improvement relies on two things: consistency, incremental gains and occasional innovation (Hodgetts, 1993, p.100) .

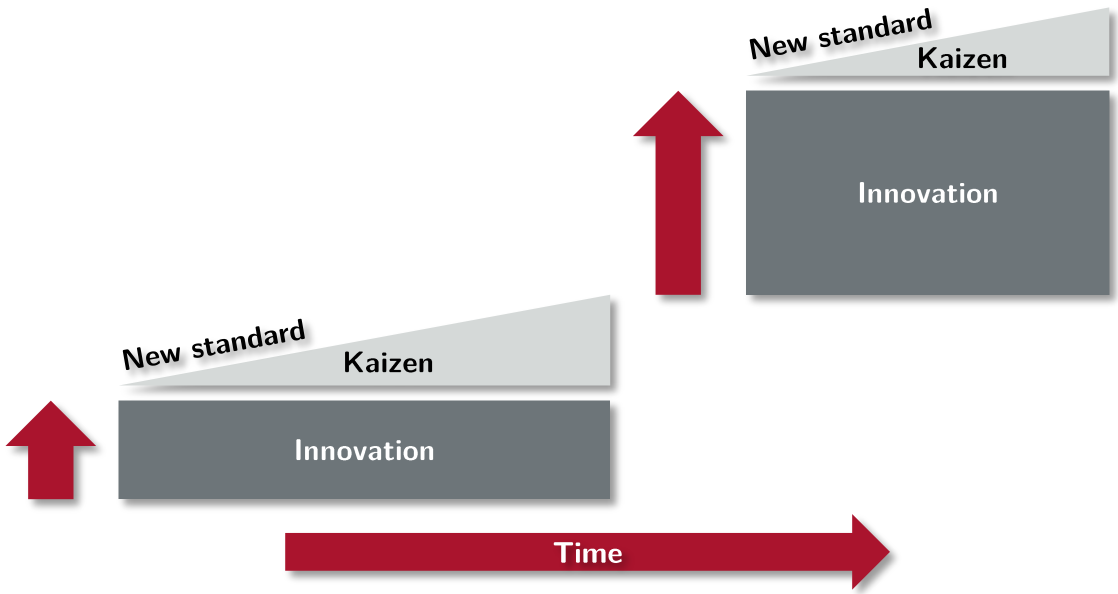


Figure 3.3: Innovation plus *Kaizen*, c.f. (Imai, 1994, p.51)

In fact innovation can move a company from one level to the next, but without *Kaizen* it would be impossible to keep the status quo. That means *Kaizen* activities are required to sustain the current condition and also to improve it (see Figure 3.3). (Imai, 1994, p.51)

Process Oriented Reorganisation is like continuous improvement, a never-ending voyage. Hodgetts has written a striking metaphor:

> Every morning in Africa,
> a gazelle wakes up.
> It knows it must outrun
> the fastest lion
> or it will be killed.
>
> Every morning in Africa,
> a lion wakes up.
> It knows it must run faster
> than the slowest gazelle
> or it will starve.
>
> It doesn't matter whether
> you are a lion or a gazelle -
> when the sun comes up,
> you'd better be running.
> (Hodgetts, 1993, p. 116)

The process models are the basic approach for process improvement; clear process models to identify the weak points are indispensable.

#### Continuous Process Management

Continuous process management compromises of the permanent planning, executing and controlling of processes. Under the direction of the process owner, the process models (target data) are compared with the actual process realisation (actual data). In case of any discrepancies, the reasons must be interpreted. On the one hand the reason can be an inadequate process model, or on the other hand an insufficient process execution in terms of effectiveness or efficiency. Hence, continuous process management causes process controlling. (Rosemann, Schwegmann, and Delfmann, 2012, p.54) The identification of discrepancies and performances monitoring are the major aspects of process controlling. Thereby the internal and external influencing factors are investigated to initiate the necessary counteraction. (Seidenschwarz, 2008, p.41-42)

#### Organisation Documentation

The main focus for organisation documentation is to increase transparency within the processes in order to ensure improvement of communication. Additionally the general availability and complexity of the documentation in the particular organisation unit should be enhanced. The process models should be intuitive for every member of the organisation unit. A higher frequency in change of processes compared to the structural organisation lead to high requirements according the continuous actualisation of process models. (Rosemann, Schwegmann, and Delfmann, 2012, p.53) Within the Volkswagen Group the ARIS software is used as the standard process modelling tool. It is explicitly described in the *Audi Prozessmanagement: Konzernkonventionenhandbuch*. (AUDI AG, 2011)

#### Benchmarking

Benchmarking is the comparison of company-specific structures and performance with selected internal or external references. In the context of process modelling, it can be distinguished among the comparison of process models, and on the other hand the benchmark of key performance indicators of the processes. (Mertins and Kohl, 2010, p.125-128) Benchmarking may ensure the need to establish business process management and to avoid prejudices before implementation. Furthermore, it is an important instrument for defining competitive oriented process objectives. (Schmelzer and Sesselmann, 2004, p.19) The basic requirements involve the availability and comparability of the relevant processes or process models. Moreover benchmarking is the initial step accomplished by companies that are involved in BPR and CIP activities (Talluri, 2000, p.1).

#### Workflow Management

> "A workflow is a specific representation of a process, which is designed in such a way that the formal coordination mechanisms between activities, applications, and process participants can be controlled by an information system, the so-called workflow management system." (Muehlen, 2004, p.39)

Workflow management systems steer the control flow during the execution of processes with data, which is allocated by the system. In particular the different views of organisation, data and control are required in detail to ensure the visualisation of information for individual members of the organisation unit. (Speck and Schnetgöke, 2012, p.202-203) The difference between workflow process models and business process models is the stepwise refinement. (Galler, 1995, p.3)

#### Simulation

Simulation enables the experimentation of the system behaviour over time. It is possible to analyse the impacts of planned modifications of the model and therefore to identify the weak points. A simulation consists of following steps: definition of objectives, collection of information, modelling, conduct of experiments, analysis and evaluation of results. Typical results obtained can be; cycle time, waiting time, length of queues,workload and process costs. (Allweyer, 2009a, p.252-253) With this additional information, there is the possibility to choose the most attractive solution between different alternatives (Rosemann, Schwegmann, and Delfmann, 2012, p.58). Simulations enable for the following objectives of process models:

- Checking the feasibility
- Ensuring the functional-content correctness
- Evaluating alternatives

Process models with high complexity are required for capable simulations. It is only profitable for processes with a high degree of structure and volume. (Freund and Götzer, 2008, p.163-165)

#### Knowledge Management

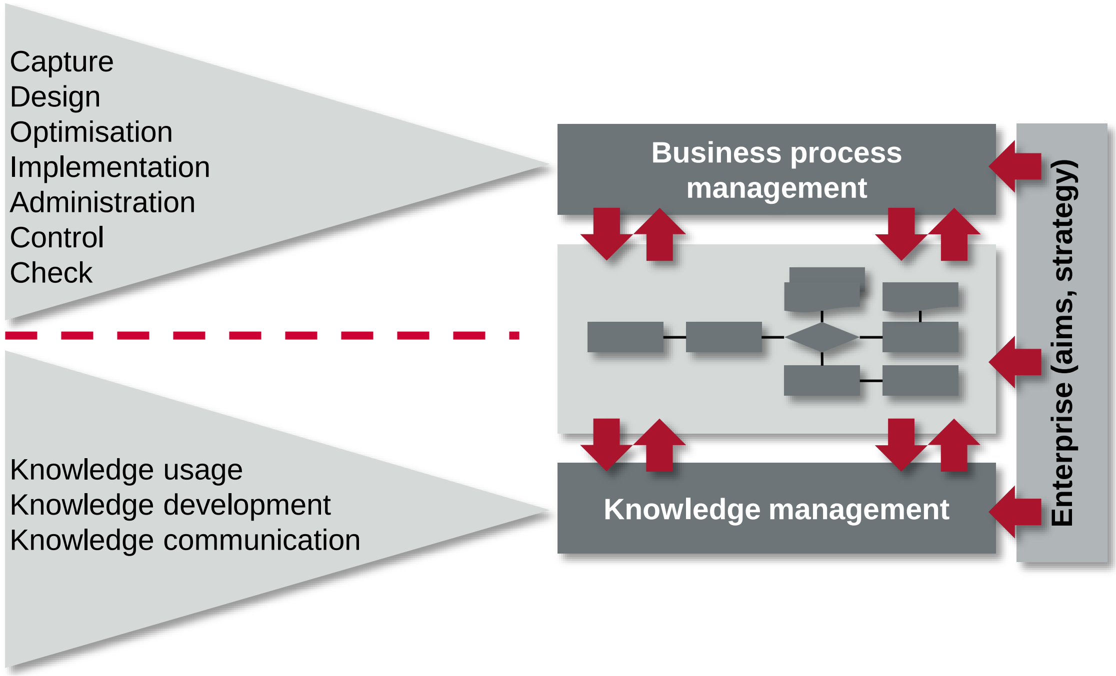


Figure 3.4: Orientation and Functional Area of Business Process Management and Knowledge Management in the Business Processes of an Enterprise, c.f. (Abecker, 2002, p.27)

There is a close link between knowledge management and business processes in an enterprise. While performing a process there is a continuous access to knowledge and simultaneously new knowledge is generated. The objective of knowledge management is to utilise the existing and newly generated knowledge within the enterprise. There is a differentiation between process knowledge and functional knowledge (see Figure 3.4). (Abecker, 2002, p.26-27)

The aforementioned operation purposes have various content-related and methodical requirements for process models. The content-related view of a process model is different, for a workflow model, for example, the specifications of the input and output of data are essential. (Rosemann, Schwegmann, and Delfmann, 2012, p.59) Compared with interaction problems, the focus is on who is dealing with the input and output. This shows different methods for various operation purposes are required yet again.

### 3.3.2 Analysis of Workshop Topics

The analysis of workshop topics is based on two former investigations for the P management conference in different indirect areas of production in Neckarsulm and Ingolstadt.

The qualitative analysis of the different workshop topics, (achieved by structuring different patterns) leads to the result that certain recurring archetypes are always a part of the CIP workshops. The following groups are identified by clustering the results of the analysis:

- Process Standardisation
- Process Simplification
- Change Management
- Process Performance
- Process Quality
- Process Check
- Communication Efficiency
- Clarification of Responsibilities

### 3.3.3 Comparison of Operation Purpose and Workshop Topics

Various operation purposes are defined, as described in subsection 3.3.1. It is not trivial to find the fitting correlation of the attributes to be related to the workshops carried out. As an example, the purpose of organisation documentation is used for process standardisation. But it is not so easy to distinguish because organisation documentation is also used to improve the communication efficiency. The reason for identifying the clustered attributes is to qualify any suiting methods. There are various operation purposes and different archetypes of workshops which require appropriate methods. The challenge is to collect enough information to be able to determine which method can be useful for a certain workshop topic. This is not so important any more for experienced moderators, they can already trust in their gut feeling to make the correct decisions, based on their experience. It is significant for moderators with less experience to rely on instructions in order to improve their certainty and avoid doubts and any fear of failure.

### 3.3.4 Attribute Matrix

The purpose of the attribute matrix (see Table 3.2) is to hold a basis for choosing a suitable method during the preparation of a future workshop. In this matrix the attributes are compared to the pre-selected methods. The method which best suits to the pre-analysed workshop topics is shown. According to the workshop topics that appeared in the past, the outcome of the former investigation was not satisfying. Nevertheless the importance of the preparation of a CIP is acknowledged, special attention is given to this topic in subsection 4.1.1.

| Attributes | BPMN | PMA | VSM | VCD | PAD | PCD | SysML | SA | IDEF | RASI |
|---|---|---|---|---|---|---|---|---|---|---|
| Process standardisation | • | • | • | • | • | • | • | • | • | · |
| Process simplification | • | • | • | • | • | • | • | • | • | · |
| Change management | • | • | • | • | • | • | • | • | • | · |
| Process performance | • | • | • | · | · | · | · | • | · | |
| Process quality | • | • | • | · | · | · | · | • | · | · |
| Process check | • | • | • | • | • | • | • | • | • | · |
| Communication efficiency | • | • | · | • | • | · | • | · | · | · |
| Clarification of responsibilities | · | · | · | • | • | · | · | · | · | • |

Table 3.2: Attribute Matrix

## 3.4 Expert Interviews

Firstly, appropriate candidates for the interview are selected. A premise for the interview is that everyone is aware of process mapping and experienced in the execution of CIP workshops. Altogether there are five interviewees, four of them are chosen in different indirect areas of production at Audi and one person is chosen from another company.

The objective of the expert interviews is to collect information about the current and future topics in CIP workshops. Furthermore, it is necessary to investigate the challenges in workshops that have already been conducted. Thereby the benefit is the collection of experience based on the expertise of the interviewees.

### 3.4.1 Approach of Interview

The methodology for the expert interview is based on the socio-scientific research process (see Figure 3.5).


Figure 3.5: Structure Empirical Methodology for Expert Interviews, c.f. (Gläser and Laudel, 2010, p.35)

### Verbalisation of the Research Question

Every empirical research is based on a question to close the knowledge gap. It develops strategic considerations and steers the concentration of the researcher (Gläser and Laudel, 2010, p.62).

### Pre-Studies

Pre-studies are investigations in preparation for the actual research with the aim to collect the required knowledge. This preliminary work should be undertaken whenever possible. The first argument against pre-studies is time pressure, but this is disproved, due to time saving otherwise. (Gläser and Laudel, 2010, p.107)

### Development of Research Strategy

During preparation of an empirical research, numerous strategic decisions must be taken in order to substantiate the intention step-by-step (Gläser and Laudel, 2010, p.93).

### Expert Interview

The adequate technique for this application is the guided interview. Thereby a list of open questions concerning different topics and specific required information is asked. (Gläser and Laudel, 2010, p.111) Details about this so-called interview guideline are described in subsection 3.4.2 .

The selection of the appropriate interviewees results from answering following questions (Gorden, 1980, p.147-160):

- Who does posses relevant information?
- Who is able to give precise information?
- Who is willing to share information?
- Who is available?

With the permission of the interview candidates it is possible to make audio recordings. This makes it easier for the interviewer to focus on the questioning and ensures better results concerning the analysis of the interviews afterwards. The disadvantage is that people may react unnaturally. (Gläser and Laudel, 2010, p.157)

### Analysis of Results

The analysis of the results according to Mayring (2003) is oriented on the model of the summarised content analysis. An appropriate basis for the interpretation is a summary.

> "The aim of the analysis is to reduce the amount of the material in order to keep the essential content through abstraction to generate a manageable frame, which is still the effigy of the raw material." (author's own translation, Mayring, 2003, p.58)

#### Interpretation of Results

The last phase of the research is the most creative, varied and difficult. When the research question is verbalised there is a similar situation, which comes full circle with regard to the beginning. Theoretical knowledge and experience are needed to obtain a promising result. (Gläser and Laudel, 2010, p.261)

### 3.4.2 Interview Guideline

#### Preliminary Remark

It is recommended to avoid immediately asking the first question right at the start. A formal acceptance is essential and that means that the following steps should be fulfilled. The interviewee ought to be briefed on the objectives of the research and the interview. It is extremely important to ensure privacy and confidentiality. Permission is required to make audio records, if requested. It is recommended to ask approximately 8 to 15 questions within one hour. The interview guideline should be clearly arranged and the content should be a maximum two pages. (Gläser and Laudel, 2010, p.144)

#### Basic Principles for the Selection and Arrangements of Questions

Questions ought to be simple and easy to understand. The intelligibility is more important than the openness. In general, the questions should be arranged in a natural order, which means content that belongs together is asked consecutively in the interview. The first question should break the ice and lighten the mood. The next question should signalise knowledge. It is recommended that sensitive issues and provocative questions are asked in the last section. The tricky situation is to manage the balance because at the very end, the conversation should finish on a positive note. (Gläser and Laudel, 2010, p.145-149)

#### Subsequent Check and Modification of the Interview Guideline

After finishing the development of the interview guideline, a final control is necessary; checking the following issues (Ullrich, 1999, p.436-427):

- Why is it necessary to ask this question? (theoretical relevance or technical function)

- What is asked? (content related dimension and possible answers are checked)
- Why is the question expressed in this way? (type of questions)
- Why is the question at the concrete position? (structure of the interview guideline)

Finally the interview guideline should be specialised for every individual in order to achieve the best results.

> "You informed questions signal the interviewees that you have done your homework, made an effort, and have not just come to pick their brain. You have gone as far as you can go with the available material and now you need some help." (H. J. Rubin and I. Rubin, 1995, p.198)

### 3.4.3 Key Statements of Expert Interviews

The execution of the expert interviews according to the mentioned approach with interview guidelines brings the following results:

- Experienced moderators develop and modify methods further on their own

  According to Ohno, the real power of lean systems is the following: problems are brought to the surface and people are forced to think about it. This generates the basis for a learning community, where individuals have the capacity to learn. The real benefit is to share the captured knowledge with others and create a new standard. (Liker and Meier, 2006, p.39) The establishment of meetings, where experience is exchanged, yield in further development of the moderators and the refining of existing methods. It stimulates people to have new ideas and to provide open discussions. (Wahren, 1998, p.147-148)

- Audi *Prozessmapping* is suitable for almost all applications

  It is not a big surprise that PMA has been established as the standard method in the indirect areas of production. The advantage that employees are already familiar with this method makes it very usable and this leads to a high acceptance amongst the participants.

- Numerous workshop topics: barriers to communication and cooperation, interaction problems

  Communication is the basis for cooperation. It is trivial without communication people cannot work together. For CIP an intensive and open communication culture is essential. Every communication situation has its own certain rules, which are necessary to ensure effectivity and efficiency of the communication process. (J. Witt and T. Witt, 2006, p.101-118) Personal factors influence the ability to understand process models (Mendling, Reijers, and Cardoso, 2007, p. 61).

- Challenge of process visualisation is the level of detail

  It is essential to use different levels of detail for visualisation of processes. The more complex the processes are, the more various levels of detail are necessary in order to gain an overview of the system and to provide enough details. (Freund and Götzer, 2008, p.50)

- Symbols support visualisation in workshops

  In their book Rother and Shook use a set of symbols or icons to represent processes and flows etc. The symbols provide a "common language" but they have to be kept consistent within the enterprise so that every participant will know and understand the drawn models. (Rother and Shook, 2003, p.11)

- A guideline with additional methods would be very helpful

  A guideline should provide methods that can be followed, step by step, in order to understand the practical usage. Tools and techniques are well documented to ensure that everyone can use them. It should provide additional knowledge, even for experienced moderators and trainers.

- Methods must be practicable in a workshop environment

  Most of the tools for modelling are tailored for the individual proceeding of specialised experts, according to Heeg, Zsack, and von der Heydt, Rainer (1997). These methods are too abstract and hardly consider the mastery of tasks in groups. Appropriate modelling tools must support participation and cooperation of the participants. It is not only a mutual understanding of the processes that should be developed. A dialogue about the particular processes should be initiated, which is the basis for the development of a good discussion culture. (Heeg et. al 1997, qtd. Friedli and Schuh, 2012, p.174)

- Many problems in workshops of human origin

  Cultural and social aspects must be considered, due to the fact that many problems are of human origin. According to Scholz (1997), organisations are influenced remarkably by cooperative cultural aspects in terms of existing behaviour patterns and values. International cooperation enhances the difficulty of finding a common ground in spite of barriers (cultural diversity, language barriers, terminology as well as understanding obstacles and so on). (Werth et al., 2010, p. 300)

- Morphological box in order to choose the appropriate method

  It is possible to determine the various workshop topics according to some diverse scenarios.

The obtained results do not claim universal validity due to the small number of interviewees, but it gives an impression of the initial situation. The key statements of expert interviews are taken into serious consideration for the further development of methods.

## 3.5 Assessment of Methods

The approach to the assessment of the criteria is as follows. The trainers of the I/PG-A8 department were evaluating the criteria of the four categories and the process criteria groups using the pairwise comparison technique. The author was grading every method for each assessment criteria using a rating scale.

### 3.5.1 Selection of Assessment Technique

The next step is to find an adequate technique for the assessment of methods. The introduced assessment criteria are mostly qualitative but the required utility is quantitative. Pairwise comparison of the individual criteria on a hierarchic basis is necessary to ensure confirmability.

Analytic Hierarchy Process (AHP) is a powerful model for solving problems quantitatively. It incorporates judgements and personal values in an analytical way. Thereby, AHP connects components of one part of the problem with those of another to obtain the combined outcome. It is capable of identifying, understanding and assessing the interactions of a system in a holistic perspective. Some advantages of AHP are that it deals with complexity, uses hierarchic structuring and tracks consistency. (Saaty, 2008, p.23-25)

### 3.5.2 Key Aspects of Analytic Hierarchy Process Analysis

The key aspects of the criteria groups are identified using the pairwise comparison technique. Seven trainers compared the defined criteria within the groups in order to determine the focus of each. Following this, the results of the AHP analysis are identified.

### Requirements for Process Design

The main focus is the requirement of process design according to hierarchy as well as barriers to communication and cooperation or interaction problems. Forwarding and processing of information is trivial (see Figure 3.6).

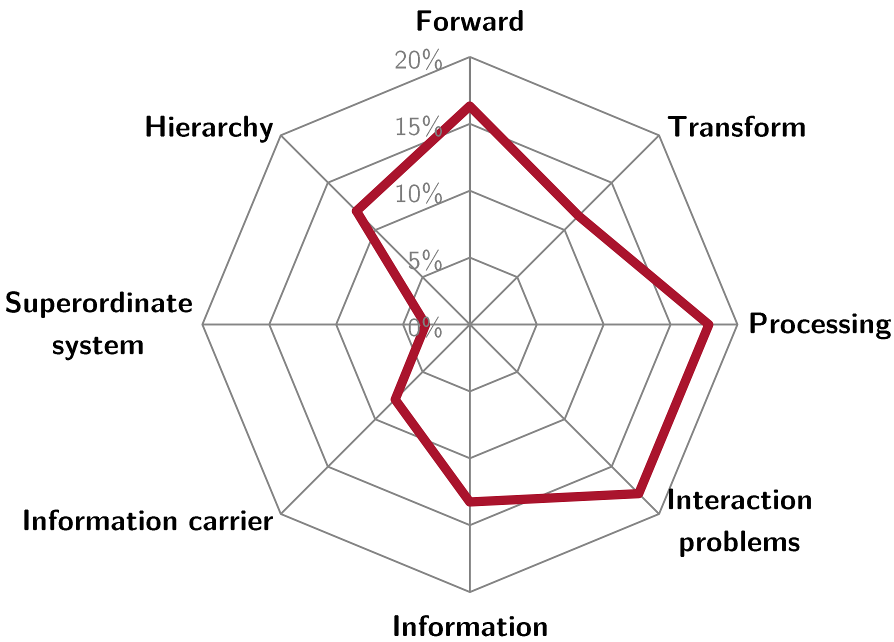


Figure 3.6: Requirements for Process Design

### Requirements for Process Logic

Branches and parallel sequences are the most important requirements for process logic (see Figure 3.7).

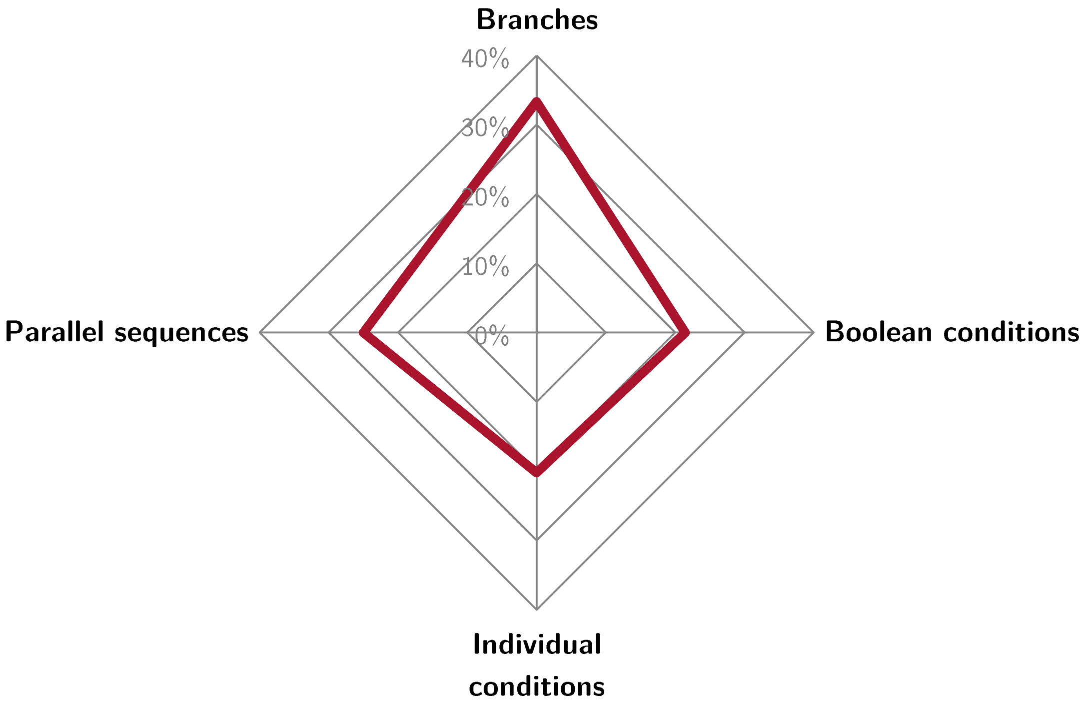


Figure 3.7: Requirements for Process Logic

The process logic focuses on visualising the branches of processes in order to illustrate the structures of the real process sequence.

#### Requirements for Process Understanding

The most important requirements for process understanding are unambiguity, simplicity and structuredness (see Figure 3.8).

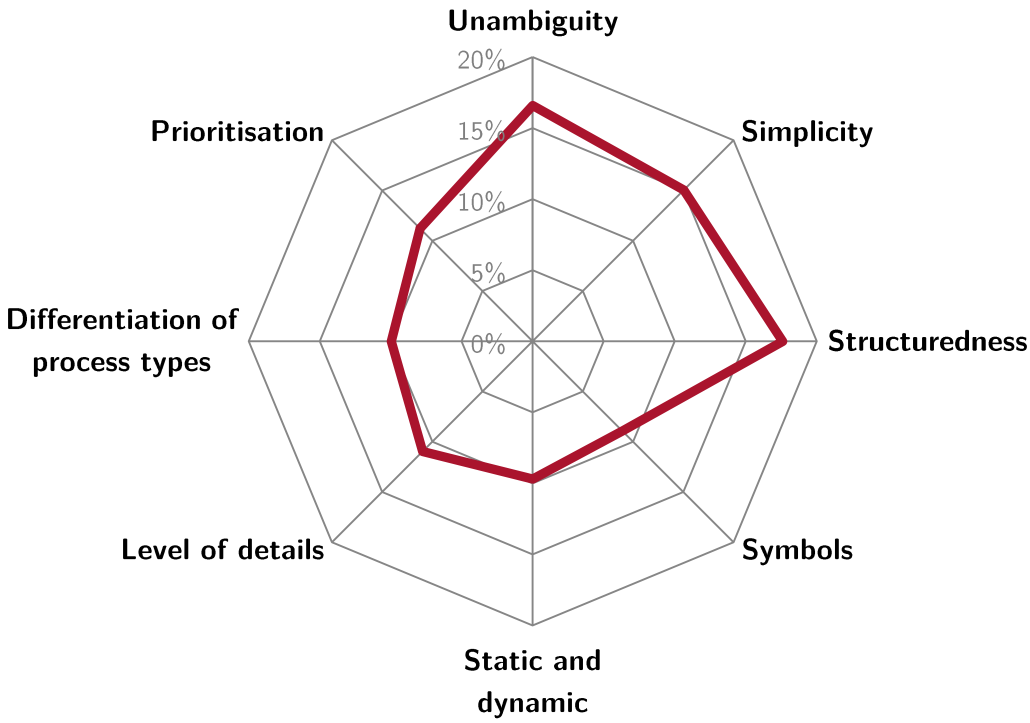


Figure 3.8: Requirements for Process Understanding

A very interesting aspect is that the study of Mendling, Reijers, and Cardoso (2007) approves this fact. Model-related factors influencing model understandability are unambiguity, simplicity and structuredness. (Mendling, Reijers, and Cardoso, 2007, p. 60)

### Requirements for Process Performance

The process quality and adherence to schedules have the focus according to the requirements of process performance (see Figure 3.9).

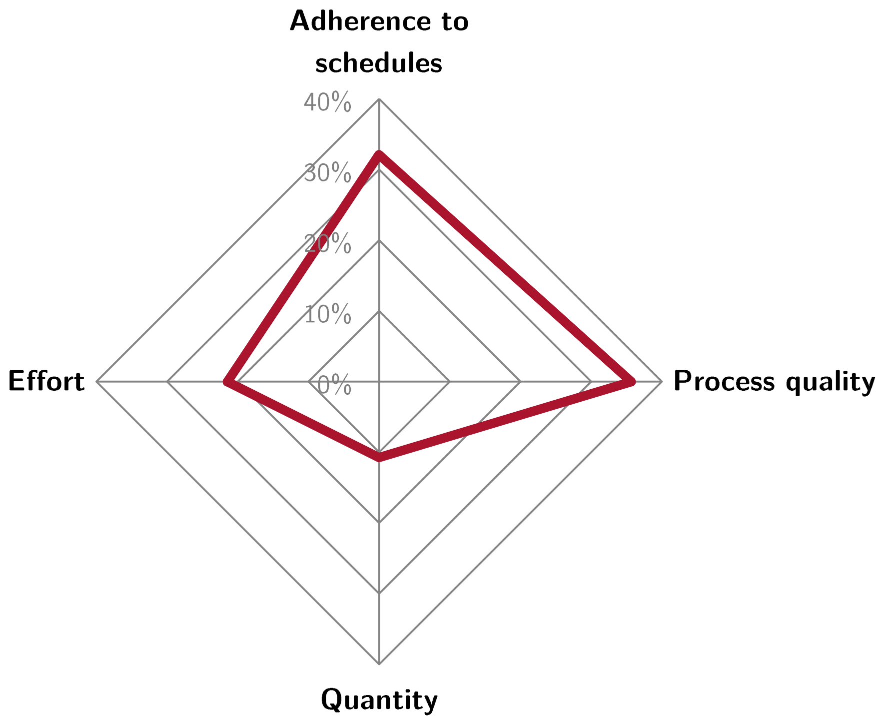


Figure 3.9: Requirements for Process Performance

Both requirements are from the criterion of effectiveness. So in this case according to the requirements for process performance, doing the right things is more important, as Drucker once said.

#### Requirements for Criteria Groups

The process understanding is most significant of the diverse requirement criteria groups (see Figure 3.10).

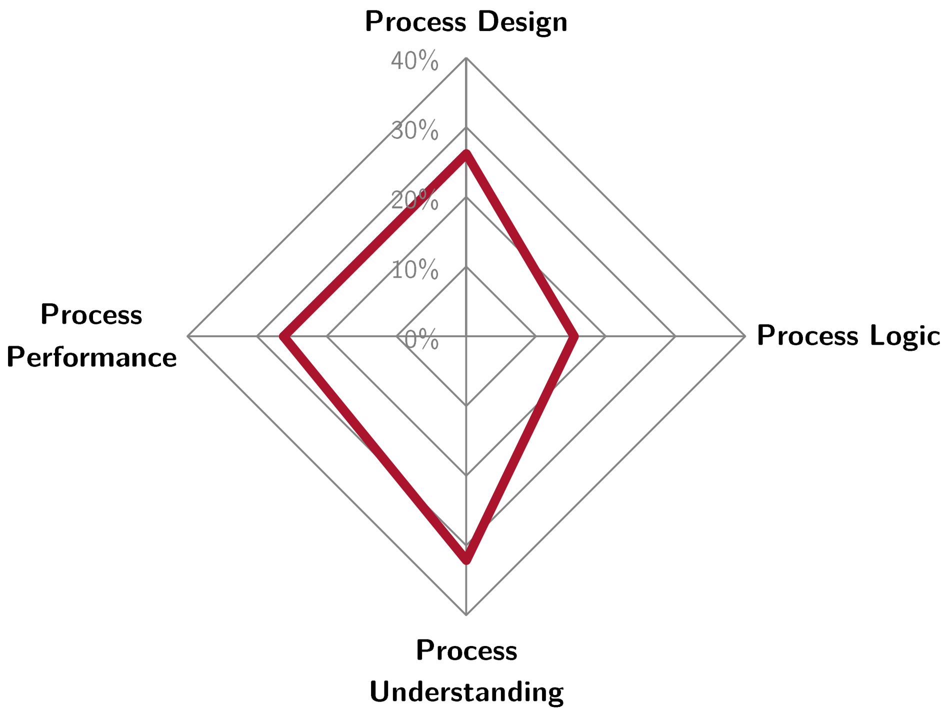


Figure 3.10: Requirements for Criteria Groups

### 3.5.3 Catalogue of Assessment Criteria

In Table 3.4 ten potential methods, which were selected in section 3.1, are assessed according to the defined criteria. For each assessment criteria, every method is graded with a rating scale between (4) and (1). It is divided into the following scales:

- Requirement is completely fulfilled (4)
- Requirement is partly fulfilled (3)
- Requirement has the tendency not to be fulfilled (2)
- Requirement is not fulfilled (1)

The weighting results from the AHP analysis (see Table 3.3). Therefore the particular weighting from every assessment criterion consists of the overall requirement of every process criteria group multiplied by the individual weighting.

| # | Assessment criteria | Individual weighting | Criteria group weighting | Particular weighting |
|---|---|---|---|---|
| 1 | Forward | 16 % | Process design 26 % | 4 % |
| 2 | Transform | 11 % | | 3 % |
| 3 | Processing | 18 % | | 5 % |
| 4 | Interaction problems | 18 % | | 5 % |
| 5 | Information | 13 % | | 3 % |
| 6 | Information carrier | 8 % | | 2 % |
| 7 | Superordinate system | 3 % | | 1 % |
| 8 | Hierarchy | 12 % | | 3 % |
| 9 | Branches | 33 % | Process logic 15 % | 5 % |
| 10 | Boolean conditions | 21 % | | 3 % |
| 11 | Individual conditions | 20 % | | 3 % |
| 12 | Parallel sequences | 25 % | | 4 % |
| 13 | Unambiguity | 17 % | Process understanding 32 % | 5 % |
| 14 | Simplicity | 15 % | | 5 % |
| 15 | Structuredness | 18 % | | 6 % |
| 16 | Symbols | 9 % | | 3 % |
| 17 | Static and dynamic consideration | 10 % | | 3 % |
| 18 | Level of details | 11 % | | 4 % |
| 19 | Differentiation of process types | 10 % | | 3 % |
| 20 | Prioritisation | 11 % | | 4 % |
| 21 | Adherence to schedules | 32 % | Process performance 26 % | 8 % |
| 22 | Process quality | 36 % | | 9 % |
| 23 | Quantity | 11 % | | 3 % |
| 24 | Effort | 21 % | | 6 % |

Table 3.3: Weighting of Individual Assessment Criterion

| # | Assessment criteria | Weighting | BPMN | PMA | VSM | SysML | VCD | FAD | PCD | SA | IDEF | RACI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Forward | 4 % | 4 | 4 | 4 | 4 | 2 | 2 | 3 | 4 | 3 | 1 |
| 2 | Transform | 3 % | 4 | 4 | 3 | 4 | 2 | 2 | 2 | 4 | 2 | 1 |
| 3 | Processing | 5 % | 4 | 4 | 2 | 4 | 2 | 2 | 2 | 4 | 2 | 1 |
| 4 | Interaction problems | 5 % | 3 | 3 | 2 | 2 | 3 | 4 | 4 | 3 | 3 | 4 |
| 5 | Information | 3 % | 4 | 4 | 2 | 4 | 2 | 4 | 4 | 4 | 4 | 1 |
| 6 | Information carrier | 2 % | 4 | 3 | 2 | 4 | 3 | 4 | 3 | 4 | 3 | 4 |
| 7 | Superordinate system | 1 % | 4 | 4 | 3 | 4 | 4 | 4 | 4 | 3 | 4 | 1 |
| 8 | Hierarchy | 3 % | 3 | 3 | 1 | 1 | 2 | 2 | 3 | 1 | 1 | 4 |
| 9 | Branches | 5 % | 4 | 2 | 2 | 4 | 2 | 4 | 4 | 3 | 4 | 1 |
| 10 | Boolean conditions | 3 % | 4 | 3 | 1 | 4 | 1 | 1 | 4 | 1 | 4 | 1 |
| 11 | Individual conditions | 3 % | 4 | 1 | 1 | 4 | 1 | 1 | 1 | 1 | 4 | 1 |
| 12 | Parallel sequences | 4 % | 4 | 4 | 4 | 4 | 4 | 1 | 1 | 4 | 4 | 1 |
| 13 | Unambiguity | 5 % | 3 | 4 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 4 |
| 14 | Simplicity | 5 % | 2 | 4 | 3 | 3 | 4 | 3 | 3 | 3 | 3 | 4 |
| 15 | Structuredness | 6 % | 4 | 3 | 3 | 4 | 4 | 3 | 4 | 3 | 4 | 4 |
| 16 | Symbols | 3 % | 4 | 2 | 4 | 3 | 1 | 1 | 2 | 2 | 2 | 1 |
| 17 | Static and dynamic consideration | 3 % | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 4 | 1 | 1 |
| 18 | Level of details | 4 % | 4 | 3 | 2 | 2 | 4 | 4 | 3 | 2 | 2 | 1 |
| 19 | Differentiation of process types | 3 % | 1 | 2 | 3 | 2 | 4 | 2 | 1 | 1 | 1 | 1 |
| 20 | Prioritisation | 4 % | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 1 | 1 | 4 |
| 21 | Adherence to schedules | 8 % | 3 | 3 | 3 | 2 | 4 | 1 | 1 | 2 | 2 | 1 |
| 22 | Process quality | 9 % | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 1 |
| 23 | Quantity | 3 % | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 1 |
| 24 | Effort | 6 % | 4 | 4 | 4 | 2 | 4 | 1 | 1 | 2 | 2 | 1 |
| | | 100 % | 3,15 | 2,93 | 2,43 | 2,82 | 2,75 | 2,09 | 2,39 | 2,59 | 2,59 | 1,88 |
| | | | 1st | 2nd | | 3rd | 4th | | | | | |

Table 3.4: Catalogue of Assessment Criteria

### 3.5.4 Potential List

The assessment of the different pre-selected methods according to the defined catalogue of assessment criteria leads to following result:

- BPMN (1st)
- PMA (2nd)
- SysML (3rd)
- VCD (4th)

The four methods with the highest ranking are taken into consideration for the further development of an appropriate methodology. The method with the best result is BPMN. Due to its complexity it is not suitable for executing in CIP workshops. SysML, is disqualified as well because there is no significant benefit in using it instead of PMA in terms of visualisation and analysis of information flows. As mentioned before (see subsection 3.4.3) PMA is very capable, here it is ranked in the second place. VCD also has a lot of potential, especially in the field of process understanding compared to PMA. This assessment shows the demand on different methods for various applications because the determined methods have different strengths and weaknesses within their characteristics.

## 3.6 Summarised Results of Initial Situation Analysis

It is worth highlighting the importance of the preparation, conducting and finally post-processing of a CIP workshop. This is due to the fact that inexperienced moderators should be prepared for it. A major aspect is that one single method does not cover all existing requirements. Various levels of detail in process visualisation lead to a very high complexity. Therefore a strategy for complicated processes or larger CIP projects is required. For instance, a stepwise approach where several diverse methods are used, is recommended. Therefore different resolutions of processes can be visualised. The usage of the standard method of Audi PMA is capable. It should be used as a basic method with extensions and supplementary methods for other purposes. In particular, an additional method is needed for dealing with barriers to communication and cooperation as well as interaction problems. The awareness that experienced moderators are developing and modifying methods on their own is not new, but it is important to consider. The premise is that the practicality of all methods during workshops is given. For example, symbols make the visualisation much easier. Whereas very complicated methods cannot be used in CIP workshops. It must be considered that the implementation of new methods requires the acceptance of the users. So first the new methodology must be evaluated by experienced moderators and verified in tests during a pilot phase. Then the results lead to the validation of the developed methods. Finally the methods and the approach of using them must be documented in detail with a brief description - preferably with a guideline.

# 4 Developed Methods for Visualisation and Analysis of Information Flows

As a result of the analysis in chapter 3, the second part of the empirical work concentrates on the development of a customised methodology, which is necessary in order to fulfil the requirements of diverse applications in the context of CIP activities. The usability in workshops has a high priority. It is a premise so the methods must be practicable and easy to use. The design of a CIP workshop and the information how it conducted is introduced. The next step is the description and the approach of the developed and evolved methods. Section 4.3 deals with the important topic of implementation of the determined methods. An evaluation workshop results in feedback and commitment of the trainers. For practical experience a pre-testing is conducted in order to validate the results. Finally the methodologies are documented briefly with a detailed description for utilisation in a guideline as well as compressed in the so called Audi Brief Description (AKB).

## 4.1 Continuous Improvement Process Workshop

There are three phases of a CIP workshop: preparation, the actual workshop and sustaining as well as continuous improvement afterwards (Liker, 2004, p.277-278).

### Overall Constraints of Continuous Improvement Process Workshop

The methods must be practicable in a workshop environment and so the use paper and glue instead of laptop and beamer is recommend. A pin board with brown paper and glue has the advantage of flexibility. Colourful cards or symbols cut out of paper can be stuck onto the board easily. If needed, the symbols can be arranged and it will save time. Of course it is possible to use a laptop and a beamer to visualise the process but this is not recommended. The disadvantages are that the general train of thought of workshop participants gets bothered and an additional person is requested, otherwise the moderator is not able to do her or his job. (Wiegand and Franck, 2004, p.96)

> "Make sure that the way you visualize your models is liked, intuitive and well-accepted by your users." (Rosemann, 2006a, p.254)

### 4.1.1 Preparation for the Workshop

During the first phase, sufficient preparation is important in order to increase the efficiency of a workshop. In preparation for the CIP workshop, it is necessary to interview the initiator in order to obtain appropriate details about the content and the topic of the proposed continuous improvement activities. The morphological box (see Table 4.1) deals with diverse scenarios of potential applications of process modelling in order to facilitate the work of choosing a suitable method or a set of methods for the appropriate operation purpose. In addition, it is necessary to clarify scope and the process owner must set measurable objectives for the workshop participants to achieve. The targets should be ambitious, to ensure that all involved employees are challenged to come up with innovative process changes instead of just simply optimising the existing process (Liker, 2004, p.278). Furthermore it is useful to collect all relevant information or data in advance. A schedule, which defines a certain duration for every issue, ensures firm time management and avoids time wasting discussions (Wiegand and Franck, 2004, p.40).

| Scenarios | VCD | PMA | SIPOC | PAD | RACI |
|---|---|---|---|---|---|
| Visualisation of new processes | ● | · | · | · | · |
| Greenfield planning (new plant) | ● | · | · | · | · |
| Restructuring of organisational units | ● | · | · | · | · |
| Definition of future state processes | ● | ● | · | · | · |
| Visualisation of current state processes | · | ● | · | · | · |
| Overview of factual and structural problems | · | ● | · | · | · |
| Process optimisation | · | ● | · | · | · |
| Standardisation of processes | · | ● | · | · | · |
| Measuring of process performance and quality | · | ● | · | · | · |
| Optimisation of information flows | · | ● | ● | · | · |
| Reduction of system interfaces | · | · | ● | · | · |
| Checking for redundancies of documents or data | · | · | ● | · | · |
| Illustration of source-sink-relationships of documents or data | · | · | ● | · | · |
| Role allocation in organisation units (for example holiday replacement) | · | · | · | ● | ● |
| Allocation of competences (who is authorised to approve anything?) | · | · | · | · | ● |
| Allocation of qualifications (who is capable for functional decisions?) | · | · | · | ● | · |
| Allocation of information flows (who has the permission to get certain information?) | · | · | · | ● | ● |
| Clarification of responsibilities | · | · | · | · | ● |

Table 4.1: Morphological Box

### 4.1.2 Conduction of Continuous Improvement Process Workshop

The first step in any improvement process is to identify the customer's needs in order to determine the processes, which are supporting or adding value. Afterwards the current state is analysed. As a result the future state is developed. An appropriate action plan is required and this is the basis for successful implementation of the evolved future state vision. It is required to start with the initiation of the predefined action plan before the workshop is over, according to *Kaizen* credo - "Just do it!" The last phase of the CIP workshop is to set performance indicators that will evaluate progress towards the future state and ensure that gains achieved during the workshop are implemented in a sustainable way.

The flow of a typical CIP workshop is visualised in Figure 4.1.

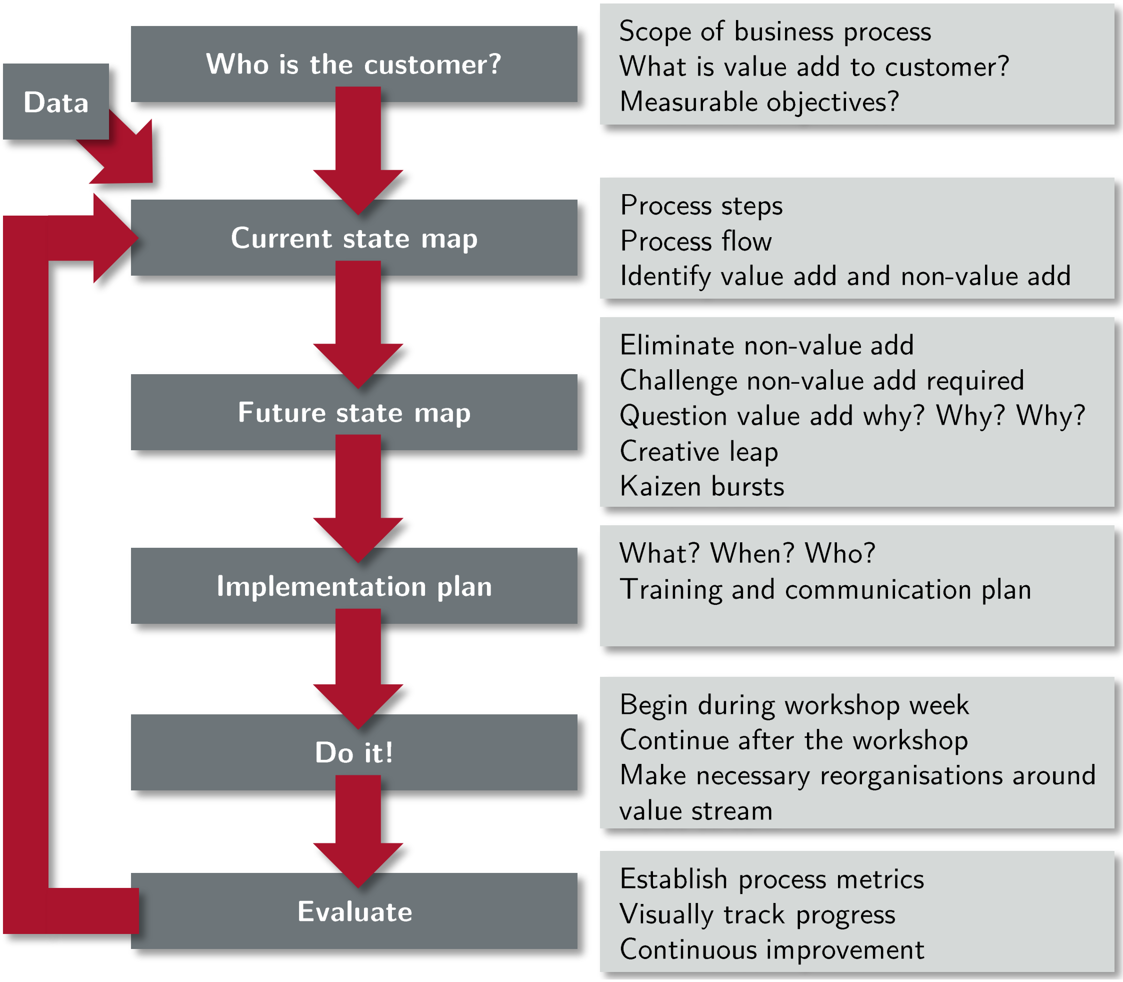


Figure 4.1: Flow of a CIP Workshop, (Liker, 2004, p.279)

### 4.1.3 After the Workshop - Sustaining and Continuous Improvement

Following the CIP workshop, the team continues to implement the future state. According to the PDCA cycle, this is the check-act part. The team should establish follow up meetings on a weekly basis to monitor following (Liker, 2004, p.284):

- Review the status of the open issues from the action plan
- Check measuring performance to ensure improvements are being made
- Discuss additional opportunities for improvements
- Continue to improve the process

The participation of the management is essential to achieve real power. Managers should pay attention and constantly review the results. When the team achieves key milestones in implementation, the management should also provide recognition. After 100 days the CIP moderator should evaluate the results. The achievement of the workshop is the basis but it should ignite the spark of continuous improvement of the current state and that should take place automatically.

## 4.2 Description and Approach of the Methods

The following approach to using the developed methodology is recommended for a CIP workshop. On the one hand separate methods are chosen for particular topics. Initially, it is important to determine the scenario of the potential application for the CIP workshop. Using the morphological box (see Table 4.1) for choosing the appropriate methods is recommended. For complex processes or larger CIP projects, a stepwise procedure is recommended, according to the level of detail. The following approach for stepwise appliance is proposed:

#### Step 1

The VCD procures an overview of the process. The level of detail is quite low.

#### Step 2

The PMA with extensions visualises system interactions of information flows, loops and additional expenses. The Supplier-Input-Process-Output-Customer (SIPOC) diagram supports the visualisation of input and output of information or data.

#### Step 3

The Process-Step Allocation Diagram (PAD) enables the outsourcing of details. That means it complements the visualisation of single process steps with details and additional information. The RASI matrix determines the responsibilities and competencies.

Whether all methods are executed in the appropriate order depends on the assignment of tasks and the particular process.

### Overall Constraints of Information Flows

A very crucial aspect is determining particular information in order to visualise and analyse information flows. In fact, the following basic questions about information have been answered (see Figure 4.2):

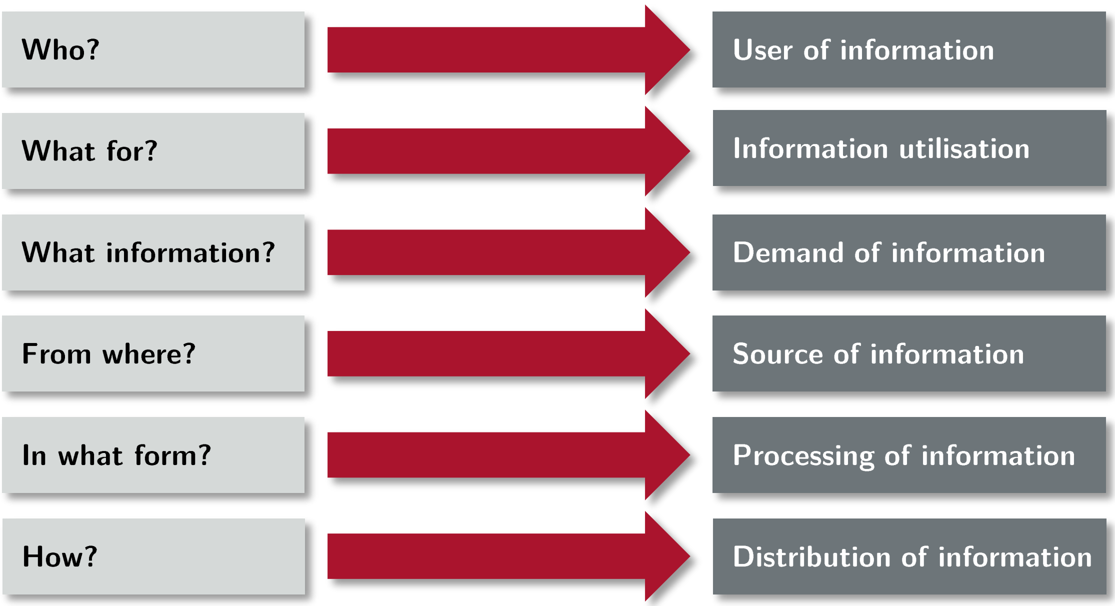


Figure 4.2: Basic Questions About Information, (Tochtermann, 2006, p.6)

It is necessary to distinguish the following descriptions of the information to check completeness of information flows in processes.

| Description | Details |
| --- | --- |
| **Content** of the information | • Basis or minimal information<br>• Additional or ideal information |
| **Purpose** of the information | • Correct execution of the particular process step<br>• Additional information<br>• Compliance of the allowed standard procedures<br>• Forwarding of work assignments to other employees<br>• Error prevention<br>• Optimising of benefit for customer or colleagues |
| **Information carrier** | • Oral<br>• Written<br>• Regular or institutionalised<br>• Irregular or spontaneous |
| **Time of availability** of the information | • Before the start of order processing<br>• With the start of order processing<br>• During the order processing<br>• After order processing |
| **Importance** of the information | • The information is always important<br>• The information is under certain conditions important<br>• The information is essential (minimal information)<br>• The information is "only nice to have" (ideal information) |
| **Quality** of the information | • The information is available<br>• The information is missing |
| **Completeness** of the information | • The information is complete<br>• The information is incomplete |
| **Timeliness** of the information | • The information is punctual available<br>• The information is not punctual available |

Table 4.2: Completeness of Information Flows (Hacker, 2008, p.82-86)

### 4.2.1 Value-Added Chain Diagram

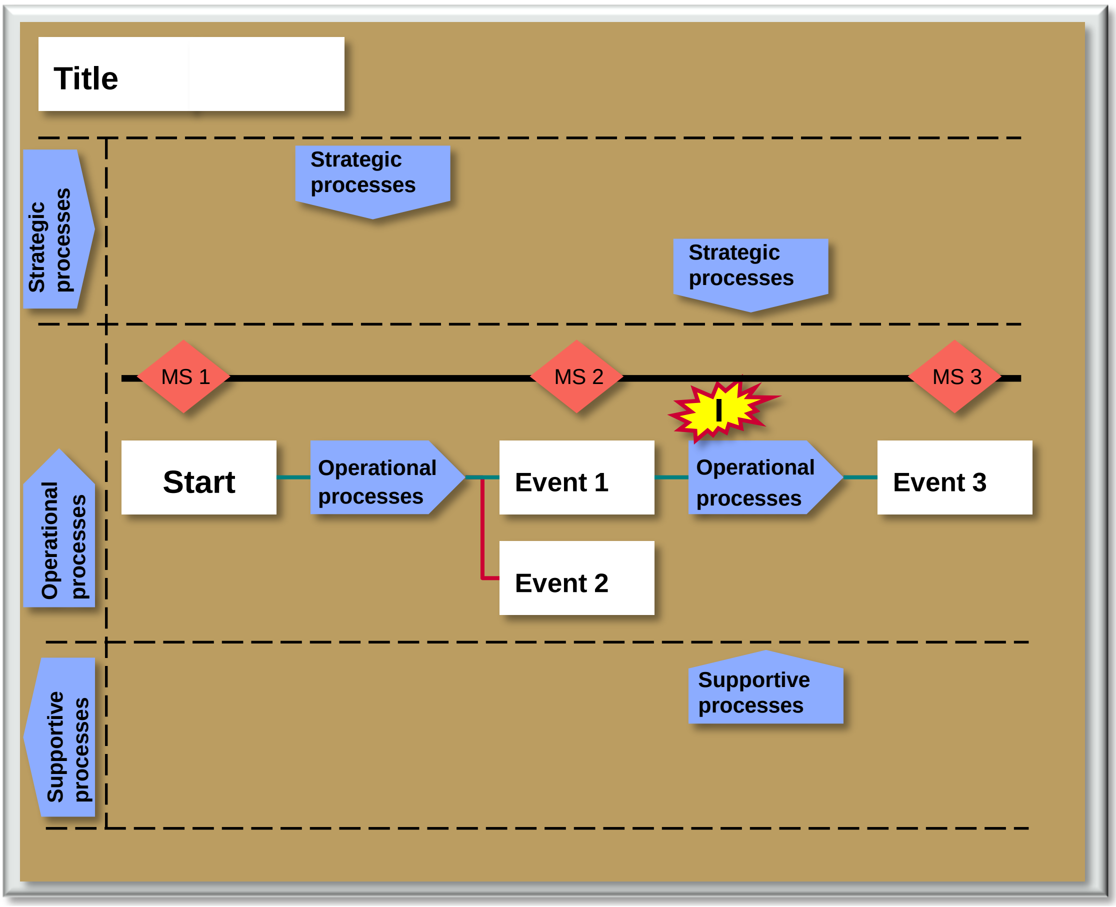


Figure 4.3: Value-Added Chain Diagram, author's own work

The VCD is used as an overview model of the process.

It is essential to deal with complexity, especially in extensive projects. To maintain an overview of the system, it is necessary to use different levels of detail for modelling. According to the top-down approach, it starts with a rough overview of the process landscape. Later on it refines the processes as well as the process steps more and more in detail. (Freund and Götzer, 2008, p.50) A holistic view is necessary to develop an action plan for elimination of waste in consideration of the big picture. This is the key to success. Of course, actions to improve particular process steps are reasonable and necessary but only the combination of an overall context of processes leads to a powerful impact of improvement. (Klevers, 2013, p.63) Lean management uses the holistic approach for optimisation of the whole enterprise and should avoid partly suboptimal improvements (Drew, McCallum, and Roggenhofer, 2005, p.39). The level of details within a process should remain otherwise it leads to problems with modularisation. (Wiegand and Franck, 2004, p.97).

With the VCD it is possible to represent processes of the top or strategic level in an enterprise. The actual usage is the visualisation and description of processes, which are directly involved in value creation of the company. (Seidlmeier, 2006, p.23) It is based on the value chain by Porter (see figure 4.4).

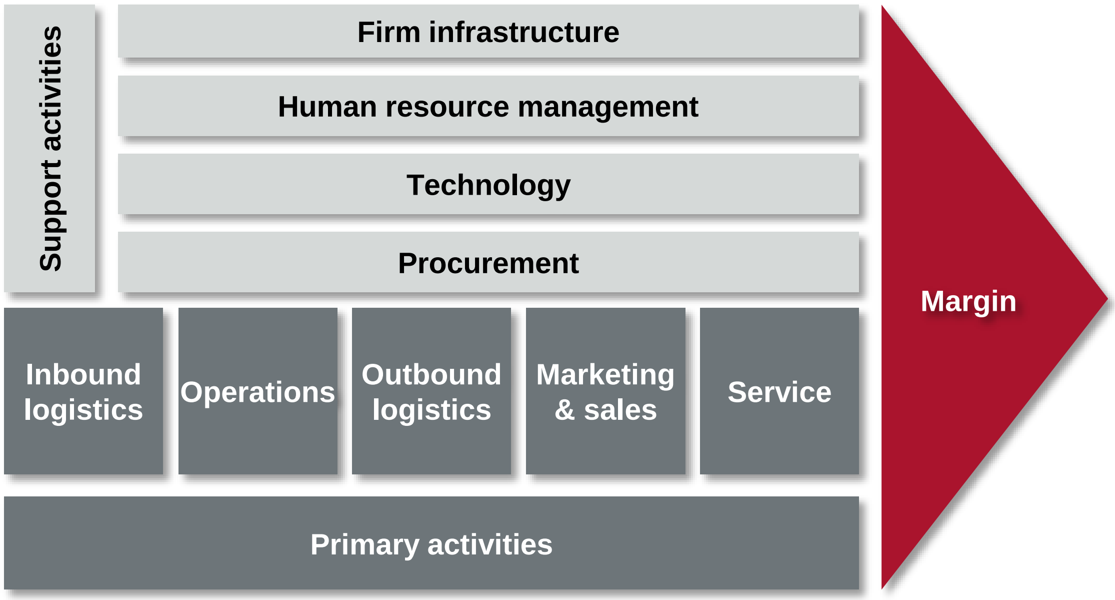


Figure 4.4: The Generic Value Chain, c.f. (Porter, 2004, p.37)

In general, the process or process-steps are divided into three different types: strategic, operational and supportive activities (AUDI AG, 2011, p.21). According to Suter, four different process types are derived: value-creating, value-defining, management and service / support processes. The differentiation of value-creating and value-defining is explained as follows. All processes, which are creating the value for the customer according to the daily-business perspective are allocated to the group of value-creating processes. Value-defining processes have an output with a long-term effect for the enterprise and do not directly produce an output for the customer. (Schantin, 2004, p.63-65)

Milestones can be visualised with a VCD in order to mark significant instants of time.

Furthermore the illustration of hierarchic relationships (process oriented superorder) by nesting of various VCD is possible, similar to the function tree (Lehmann, 2008, p.58).

Therefore, this method is particularly suitable for management level (Gadatsch, 2010, p.100).

According to the *Audi Prozessmanagement: Konzernkonventionenhandbuch*, it is used only for the two highest (strategic) levels for modelling processes in the Volkswagen Group (AUDI AG, 2011, p.11). Using the VCD also at lower levels, when the operation purpose is suitable is recommended.

In summary, VCD can act as an introduction for more detailed process models (Allweyer, 2009b; Becker, 2012).

### 4.2.2 *Prozessmapping* with Extensions

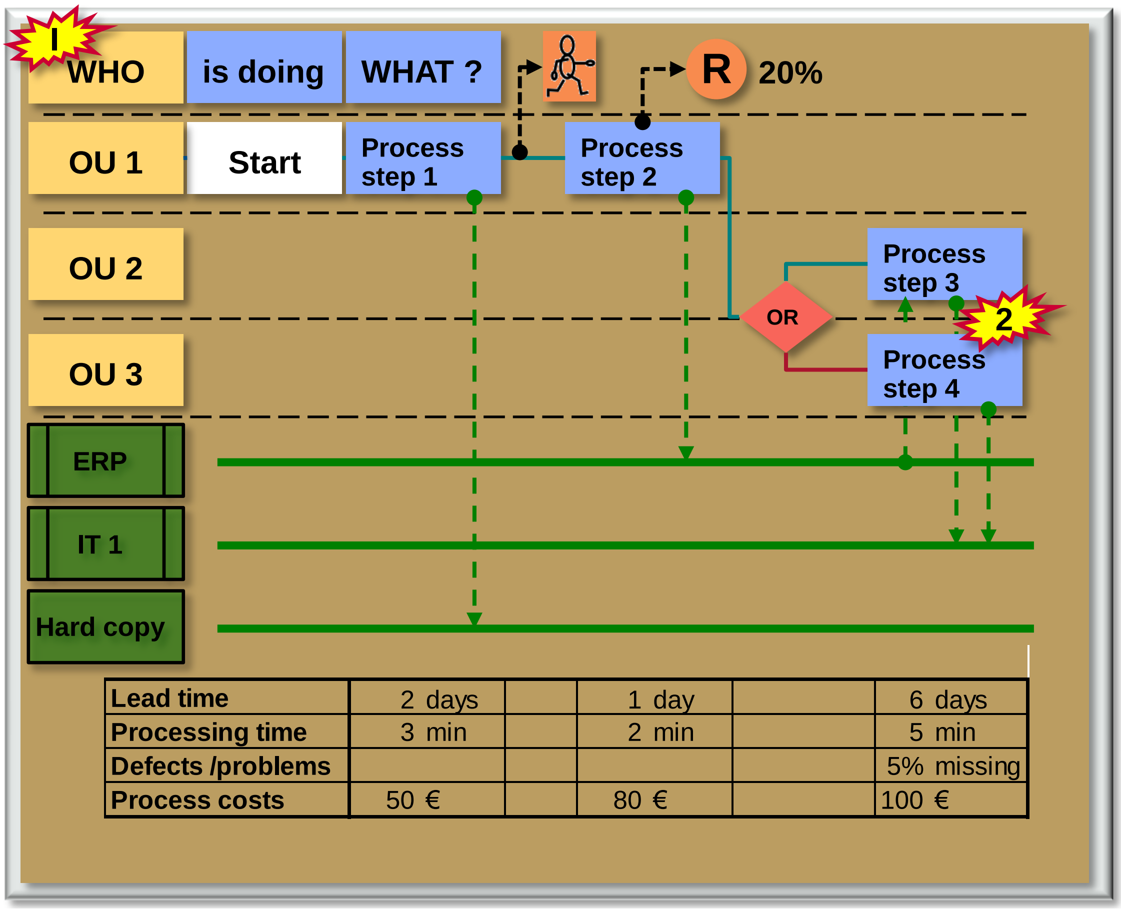


Figure 4.5: *Prozessmapping* with Extensions, author's own work

In indirect areas, the visualisation of the system interactions is useful, especially having so-called system pipelines. These system pipelines enable the input and output of information or data of every process step. They enable the visualisation, if there is one process step with more than one system for the input of information or data. Perhaps even various systems are fed with the output. (Klevers, 2013, p.182) This ensures transparency in order to track the completeness of information or data in the complete process easily (Risch, Berndt, and Franke, 2011, p.707).

Another aspect in indirect areas, in office processes, for example, is that information used is often not complete and so further enquiries are necessary. Enquiries for other participants or departments are time-consuming and certain activities cannot be interrupted. This leads to the situation that processes cannot be completed and the partly processed documents or data must be stored. At a later time the activity can be restarted. (Klevers, 2013, p.182-183) So excessive reviews or checking someone else's work are redundant activities, in fact waste in form of over-processing (Tapping and Shuker, 2003, p.46). To mark this situation in the process model, the symbol "R" is introduced, which stands for redundant activities, with the approximate amount of enquiries in percent.

Finally, office processes do not occur at only one work place. Very often, physical documents or files must be searched in other locations, stored as well as copied and sent. As an example, the way to the printer takes needless time. (Klevers, 2013, p.185) The arrangement of work areas of office equipment in central locations saves time and better planning avoids multiple trips. All unnecessary work movements are waste in form of motion. (Tapping and Shuker, 2003, p.47) With the visualisation of a stick figure, a process step with expenditure of time is shown in the process model.

### 4.2.3 Supplier-Input-Process-Output-Customer Diagram

In a SIPOC diagram, the supplier stands for the input and the customer for the output. So this enables the visualisation of documents or data for input and output via various systems. The different categories are listed column by column. The process steps are specified in chronological order. Therefore, the correct sequence and completeness of the process steps can be checked.

The aim is to systematically capture all documents or data which refer to the process.

The source-drain-relationship guarantees completeness and leads to transparency within the processes. (Risch, Berndt, and Franke, 2011, p.707)

To deal with complexity it makes sense to reduce the level of detail. (Lehmann, 2008, p.155-156)

So the SIPOC diagram is a useful addition to PMA to support it on a more detailed level.

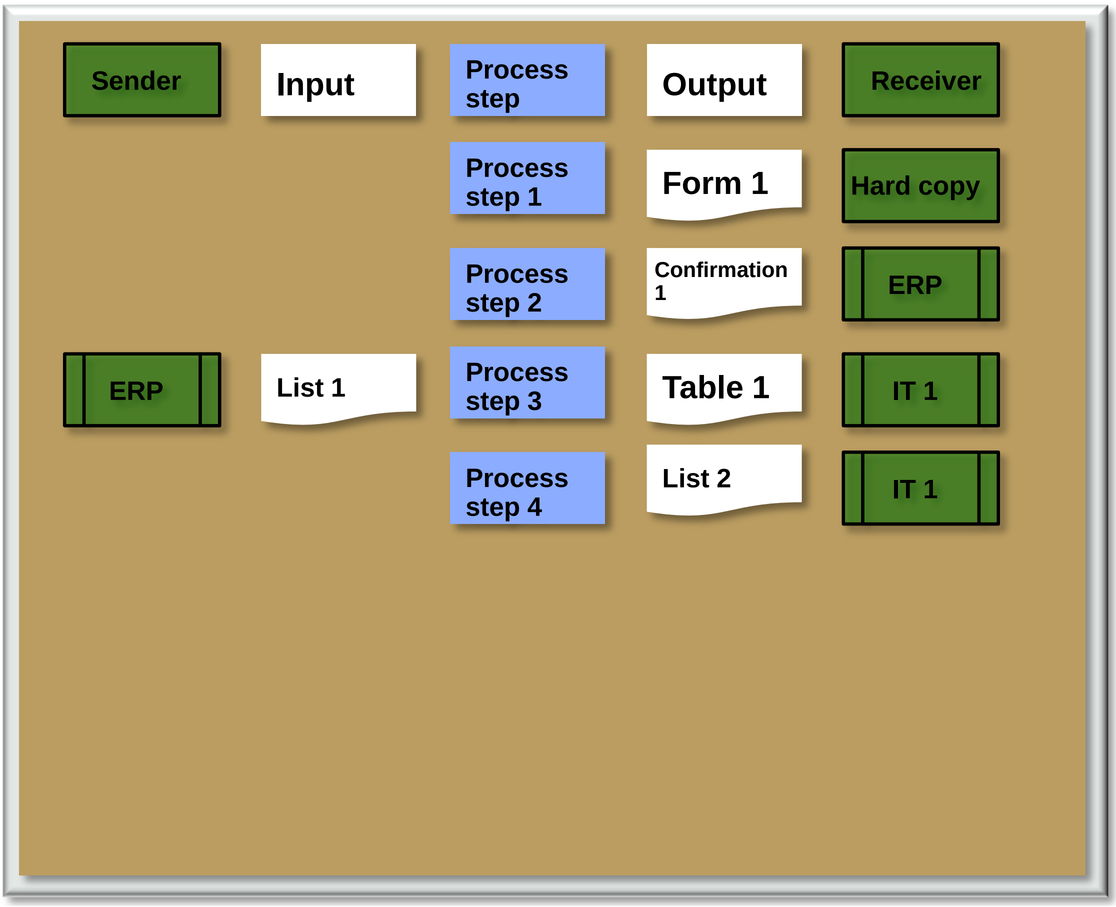


Figure 4.6: Supplier-Input-Process-Output-Customer Diagram, author's own work

### 4.2.4 Process-Step Allocation Diagram

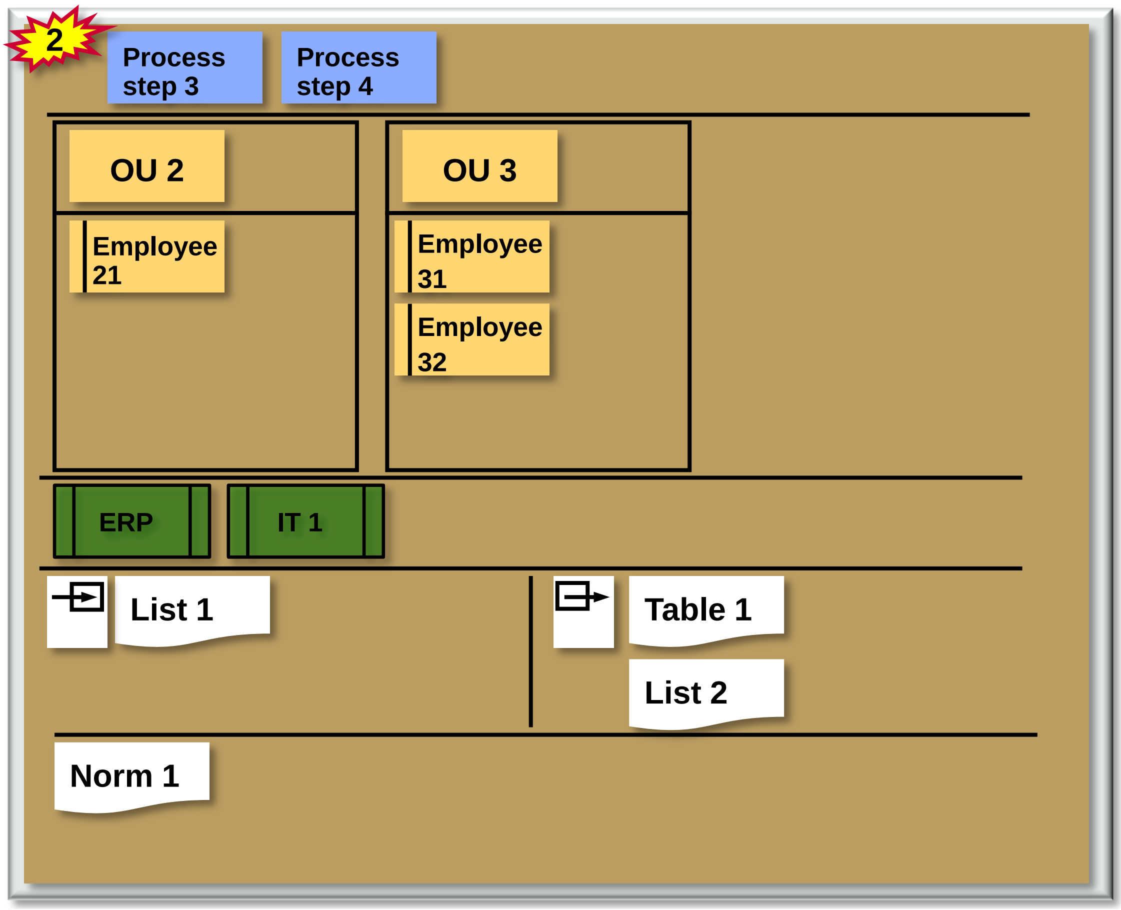


Figure 4.7: Process-Step Allocation Diagram, author's own work

The PAD is derived from the FAD. The input and output of a function are illustrated. (Lehmann, 2008, p.54) With the PAD, a detailed description of the process steps is possible. As well as relationships of information objects, with this method it is feasible to visualise resources like organisational units or systems within one single model. (Seidlmeier, 2006, p.21-22)

The level of complexity is reduced by outsourcing details. This leads to the situation that with PAD, the relevant process step is described in more detail. (Lehmann, 2008, p.54)

The focus of PAD is the description of information flows. Therefore, interfaces and system transactions are better illustrated. In general this method can illustrate responsibilities for the analysed process step, for instance within an Organisational Unit (OU). (Scheer and Klein, 2004, p.113-114)

The separate visualisation of the PAD avoids overloading the actual process model.

### 4.2.5 Responsible-Accountable-Supported-Informed Matrix

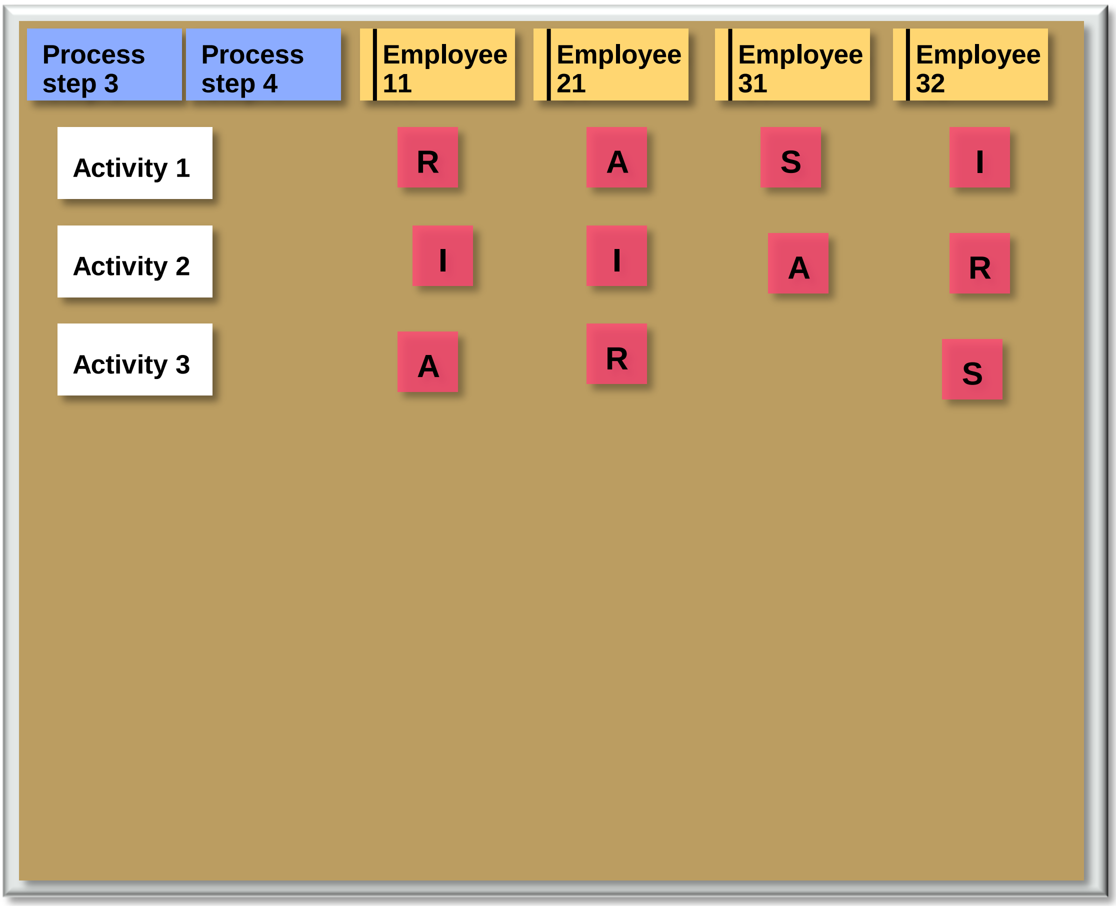


Figure 4.8: RASI, author's own work

The RASI matrix is a method for clarifying roles and responsibilities (Melton, 2007, p.75-76). Of course RASI and RACI are related to each other. In this case RASI is used because of the negative connotation of the term "consulting" within the enterprise. The following various assigned roles are defined (Hightower, 2008, p.83):

- **Responsible** refers to the person, who is in charge of the execution or applying the activity. It is interpreted as the responsibility in a disciplinary matter.
- **Accountable** this role is ultimately accountable for authorising a particular activity. The person who is in charge in legitimate way.

- **Supported** refers to a person or group, who are playing a role in a supporting manner. This person or group may have a specific subject matter expertise.

- **Informed** pertains to individuals, who must be notified regarding the progress and the results of the tasks. These are people or groups with a "need to know".

## 4.3 Implementation of Determined Methods

A major aspect for successful implementation is the emphasis on the importance of user acceptance. Acceptance is a predisposition to use a new particular methodology. Without acceptance, without an intention to incorporate the methods into the existing system, it is not possible to succeed. It is necessary to benefit from expert knowledge of the trainers, when applying a new approach. Their experience in conducting workshops and teaching existing methods in the training is the basis for implementing the newly determined methods.

### 4.3.1 Evaluation Workshop

First of all, the expectations of the experienced trainers are asked and discussed. Then the new concept, a collection of new and evolved methods, is presented. Feedback of the trainers is generated. Another aspect is the benefit of their experience. Furthermore, it is ensured, with their commitment, that potential barriers to acceptance are removed. The newly designed methodology and the particular methods are evaluated and structured with the technique of Strengths-Weaknesses-Opportunities-Threats (SWOT) analysis. The weaknesses and threats especially are discussed in order to acquire suggestions for improvement for further development of the new concept. An action plan is defined with the aim to modify the methods according to the trainer's advice.

### 4.3.2 Pre-Testing

The pre-testing is an essential step in verification of the developed methods in the context of practical usage. Therefore, it is simulated with an experienced trainer in order to choose the appropriate method for a specific CIP workshop topic, which was already carried out in the past, in order to test the usability and functionality under actual conditions. The aim of the pre-testing is to fulfil the requirements according to the workshop environment and to evaluate the applicability of the guideline for the information flow analysis.

### 4.3.3 Validation

After the pre-testing is finished, the experience gained leads directly to the validation. The constructive feedback of the involved trainers results in final improvements and modifications of the drafted guideline.

## 4.4 Documentation

The necessity for documentation is obvious in order to capture knowledge, to establish a standard and to teach new employees. According to Imai, there can be no *Kaizen* without standardisation (Imai, 1994, p.26-27). So for internally defined methods, standard procedures are requested.

### 4.4.1 Guideline

In the guideline (see Appendix A) the developed methodology is well documented and there is a detailed description of the used methods. The target group should be moderators and trainers. Starting with beginners to moderators with more experience, it should provide a good basis of the techniques for information flow visualisation and analysis.

### 4.4.2 Audi Brief Description

The purpose of the AKB is to have a short version of a described method with the format of a postcard. The fundamentals of the method are described in a simple way on two pages, front and back (shown in Appendix B). The idea is to have a collection of all AKB, with standardised methods and techniques in a small booklet of this format. The obvious advantage is that the moderators can use this AKB booklet easily everywhere because the small format is user-friendly.

# 5 Final Remark

The successful implementation of lean management in indirect areas is more than just a collection of methods. The change of the corporate culture in order to influence the cultural factors of identification, communication and participation in a positive way by using methods for continuous improvement is most relevant. Therefore, it is necessary to apply visual management for process modelling within the framework of CIP.

## 5.1 Summary

Initially, this thesis discusses the origins of the Toyota philosophy in order to understand the importance of the culture of improvement and the purpose of *Kaizen*, which resulted in Toyota's sophisticated production system. The next step describes the successful implementation of Japanese management tools and the policies in western automotive industry in the USA and Germany. Like all modern production systems, the APS is derived from the TPS. The production system of the AUDI AG and how it is implemented within the business segment of production is described briefly. The CIP in the indirect areas at Audi is specified in detail.

The empirical study of the thesis is divided into two parts. The first part is about the initial situation analysis. The basis is an overview of a preliminary selection of methods. Then the gathering and categorisation of specific requirements is carried out in order to derive appropriate assessment criteria. The next step is to determine and to categorise various scenarios of practical relevant applications to show the utility of process models and topics of the previous workshops. The aim of the expert interviews is to collect information on current and future topics of CIP workshops with the help of the expertise of the interviewees. Finally, the pre-selected methods are rated by the defined catalogue of assessment criteria.

The second part of the empirical study deals with the developed methods and the recommend approach for using them. Initially, the conduction of a CIP workshop is described. The preparation and the post-processing are essential when carrying out a successful workshop. Then the appropriate methods are illustrated and described in detail. Various actions are applied for implementation of the determined methods, in order to fulfil the premise of usability. In the evaluation workshop, the expectations of the CIP trainers are retrieved and their feedback enables the modification of the methods according to their needs. In the pre-testing, two experienced trainers verify the practical usage of the developed methods under actual conditions. Additionally, the guideline is evaluated in the context of applicability in the workshop environment. Finally, the validation results in the fine tuning of methods, the approach of implementing them and the final guideline.

## 5.2 Conclusion

The holistic approach and the clarification of responsibilities are major aspects of the improvement of complex processes. For larger CIP projects, it is even necessary to develop a strategy: a stepwise approach, for instance, in order to deal with complexity and for implementing sustainable solutions.

The sufficient preparation of a CIP workshop is an important issue. As are the details of the content and topic of the proposed continuous improvement activities, which are used in choosing appropriate methods. The developed morphological box deals with diverse scenarios of potential applications of process modelling. The key to success is to select the proper method for the current task or to adapt it to the situation. A tool is only as good as the skills of the worker using it! The moderators must be aware of the fact that utilisation of a method itself does not guarantee success.

The difficulty is to find the right balance between using existing, well known or already established methods. It is also not easy to implement new methods to form tailored techniques for customised solutions. It is especially hard to gain acceptance when implementing a new approach. This is a very sensitive topic.

Another issue is that progress of further development is natural and the key to success is the involvement of engaged employees. The key is finding people, who are dissatisfied with existing situations in their system. Their enthusiasm about improving the system provokes remarkable and sustainable solutions. The advantage of the further development of existing tools by experienced moderators is underrated. It is a challenge to allow them enough freedom for their own input and yet to work with standardised techniques or procedures. In addition, it is difficult to collect the knowledge within the CIP community.

Furthermore, it is difficult to develop new methods for dealing with new challenges. As mentioned earlier the immense power of a learning community lies in to sharing knowledge and further developing existing methods. The turnover of employees in the CIP field presents a big challenge of sharing existing knowledge between experienced and new employees. It is also an opportunity to introduce new ideas and people who question existing systems.

Finally, the last success factor is to embed sufficient time for change in the daily work. Therefore it is necessary to provide the employees with enough time for their CIP activities.

## 5.3 Future Prospects

The continuous improvement of existing methods and the further development of new methodologies are required to face future activities. Furthermore, the adjustment of techniques used in other fields leads to state of the art tools for new tasks. Another fundamental aspect is the detailed recording of activities and workshop topics. A standardised database, regularly updated by all involved moderators to include the latest workshop topics and evaluated methods for the appropriate tasks would help in capturing knowledge and refining existing approaches. This would also enable analysis for periodic reports and it also forms the basis for future challenges.

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# Abbreviations

| | |
|---|---|
| **AHP** | Analytic Hierarchy Process |
| **AKB** | Audi Brief Description |
| **APS** | Audi Production System |
| **ARIS** | Architecture of Integrated Information Systems |
| **BPMN** | Business Process Model and Notation |
| **BPR** | Business Process Reengineering |
| **CIP** | Continuous Improvement Process |
| **EPC** | Event-Driven Process Chain |
| **ERP** | Enterprise Resource Planning |
| **FAD** | Function Allocation Diagram |
| **FIPS** | Federal Information Processing Standards |
| **GM** | General Motors |
| **HBR** | Harvard Business Review |
| **IDEF1X** | Integration Definition for Information Modeling |
| **I/PG** | Production Planning and Plant Planning |
| **I/PG-A8** | Production System Indirect Area |
| **IMVP** | International Motor Vehicle Program |

| | |
|---|---|
| **JIT** | Just-In-Time |
| **KPI** | Key Performance Indicator |
| **MIT** | Massachusetts Institute of Technology |
| **NUMMI** | New United Motor Manufacturing, Inc. |
| **OU** | Organisational Unit |
| **OMG** | Object Management Group |
| **P** | Production |
| **PAD** | Process-Step Allocation Diagram |
| **PCD** | Process Chain Diagram |
| **PDCA** | Plan-Do-Check-Act |
| **PMA** | Prozessmapping |
| **PPS** | Porsche Production System |
| **RAM** | Responsibility Assignment Matrix |
| **RACI** | Responsible-Accountable-Consulted-Informed |
| **RASCI** | Responsible-Accountable-Supported-Consulted-Informed |
| **RASI** | Responsible-Accountable-Supported-Informed |
| **SA** | Structured Analysis |
| **SADT** | Structured Analysis and Design Technique |
| **SGC** | Shingijutsu Global Consulting |
| **SIPOC** | Supplier-Input-Process-Output-Customer |
| **SMED** | Single-Minute Exchange of Die |

| | |
|---|---|
| **SOP** | Start of Production |
| **SWOT** | Strengths-Weaknesses-Opportunities-Threats |
| **SysML** | Systems Modeling Language |
| **TPS** | Toyota Production System |
| **TQC** | Total Quality Control |
| **UML** | Unified Modeling Language |
| **USA** | United States of America |
| **VCD** | Value-added Chain Diagram |
| **VSM** | Value Stream Mapping |
| **WWII** | World War II |

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# Appendix A

## Leitfaden: Informationsflussanalyse

Vorgehensweise Methodik

Stand: 20130906

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## Inhaltsverzeichnis


- Problemstellung & Motivation
- Vorgehensweise Stufenmodell
- Beschreibung der Methoden
  - Wertschöpfungskettendiagramm (WKD)
  - Prozessmapping (PMA) mit Ergänzungen
  - LIPOK Diagramm
  - Prozessschrittzuordnungsdiagramm (PZD)
  - RASI Matrix
- Details zu Informationsflüssen
- Morphologischer Kasten
- Übersicht zusätzliche Methoden & Verwandte Schulungsunterlagen bei Audi




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## Problemstellung & Motivation





## Problemstellung

Anhaltender Trend zur Komplexitätssteigerung in der Automobilindustrie:

- ▶ Informationsflüsse in den indirekten Bereichen werden komplexer
- ▶ Anzahl der Schnittstellen in der dazugehörigen Kommunikation steigt kontinuierlich
- ▶ Viele Beteiligte werden involviert
- ▶ Problembearbeitung wird umfassender

Prozessverbesserungsaktivitäten mit KVP-Workshops:

- ▶ Beteiligte in Optimierungsprojekte einbinden
- ▶ Gemeinsame visuelle Darstellung der Informationsflüsse anbieten
- ▶ Prozessverbesserungen gemeinsam erarbeiten

## Motivation

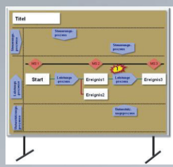
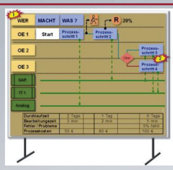
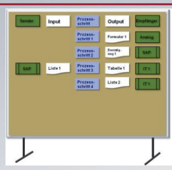
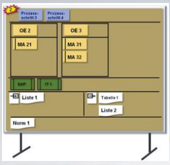
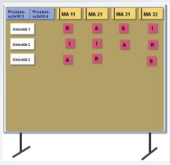
- Schlanke Informationsflüsse von Prozessen
- Ganzheitliche Prozessbetrachtung
- Reduktion von Schnittstellen
- Schaffen von Transparenz
- Eliminieren von Verschwendung
- Bewusstsein für Verschwendung von Informationsflüssen schaffen
  Beispielsweise:
  - Bereitstellung von unnötigen Informationen über den Bedarf hinaus
  - Redundante, veraltete oder fehlerhafte Dokumente
  - Unzugängliche, nur schwer interpretier-/lesbare Arbeitsdokumente





## Übersicht Stufenmodell

## **Stufenmodell**
Visualisierung

| | | |
|---|---|---|
| *Stufe 1* | Wertschöpfungskettendiagramm (WKD)  | |
| *Stufe 2* | Prozessmapping (PMA) mit Ergänzungen  |  LIPOK Diagramm |
| *Stufe 3* | Prozessschrittzuordnungs-diagramm (PZD)  |  RASI Matrix |




## **Stufenmodell**
Vorgehensweise

Stufenweises Vorgehen wird empfohlen
(bei KVP Kaskaden, längeren Workshop Reihen und sehr komplexen Prozessen)

Stufe 1:
- WKD verschafft Überblick (Gesamtheitliche Sichtweise auf den Prozess)

Stufe 2:
- PMA Ergänzungen visualisieren Systeminteraktionen von Informationsflüssen, Rückschleifen und Mehraufwand
- LIPOK unterstützt die Visualisierung von Input/Output der Informationen

Stufe 3:
- PZD ermöglicht die Auslagerung von Details, d.h. einzelne Prozessschritte werden im Detail visualisiert und mit zusätzlichen Angaben ergänzt
- RASI Matrix stellt die Verantwortlichkeiten und Zuständigkeiten im Prozess dar

Abhängig von der Aufgabe müssen nicht alle Methoden der Reihe nach angewendet werden

## Wertschöpfungskettendiagramm (WKD)

9 Leitfaden Informationsflussanalyse, Paul Schirl, I/PG-A8

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## Wertschöpfungskettendiagramm (WKD)
Merkmale

- Verwendung als Überblicksmodell: schafft Gesamtblick auf den Prozess
- Darstellung von unterschiedlichen Prozesstypen einer Wertschöpfungskette (Steuerungs- / Leistungs-/ Unterstützungsprozesse)
- Visualisierung von Meilensteinen
- Illustration von hierarchischen Zusammenhängen über Schachtelung von WKDs
- Einsatz gut für das Management geeignet
- Anwendung auch in den unteren Ebenen (nicht nur Ebene 1, 2 wie bei ARIS)

10 Leitfaden Informationsflussanalyse, Paul Schirl, I/PG-A8

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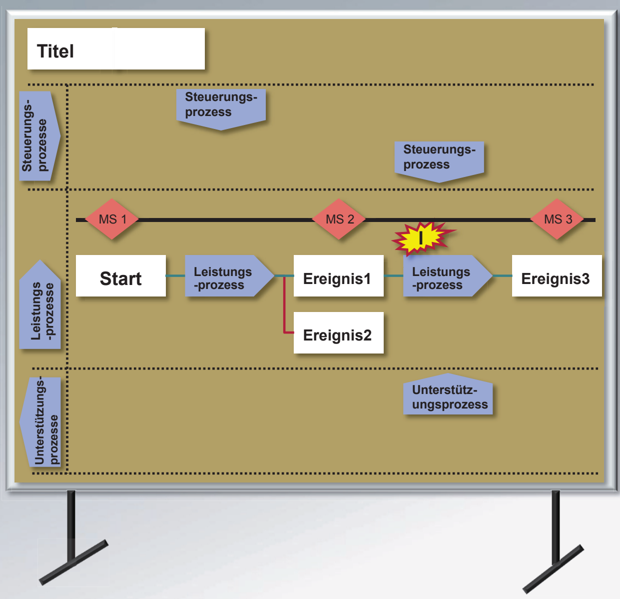
## Wertschöpfungskettendiagramm (WKD)
Visualisierung






## Wertschöpfungskettendiagramm (WKD)
Vorgehensweise (1)

- Links oben mit Moderationskarten den Prozesstitel und mittig die Zeitleiste visualisieren
- Leistungs- (mittig) / Steuerungs- (darüber) / Unterstützungsprozesse (darunter) darstellen
- Sicht definieren (aus welcher Perspektive wird der Prozess betrachtet)

## Wertschöpfungskettendiagramm (WKD)
Vorgehensweise (1) Nutzen

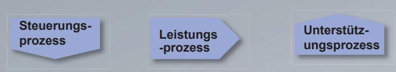
- Der Prozesstitel stellt sicher, dass jederzeit für alle Teilnehmer sichtbar ist, welcher Prozess gerade visualisiert wird.
- Die Zeitleiste wird erst später benötigt, der dafür vorgesehen Platz sollte aber am Anfang schon reserviert werden.
- Einteilung der Prozesstypen: in der Mitte beginnen mit den Leistungsprozessen, darüber die zugehörigen Steuerungsprozesse und darunter die benötigten Unterstützungsprozesse
- Die Sichtweise muss am Anfang definiert werden. Es muss für aller Beteiligte klar sein aus welcher Perspektive der Prozess betrachtet wird.



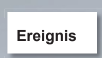


## Wertschöpfungskettendiagramm (WKD)
Vorgehensweise (2)

- Zwischen Steuerungs- / Leistungs- / Unterstützungsprozesse unterscheiden und auf Moderationskarten schreiben




- Ereignisse auf Moderationskarten schreiben



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## Wertschöpfungskettendiagramm (WKD)
Vorgehensweise (2) Nutzen

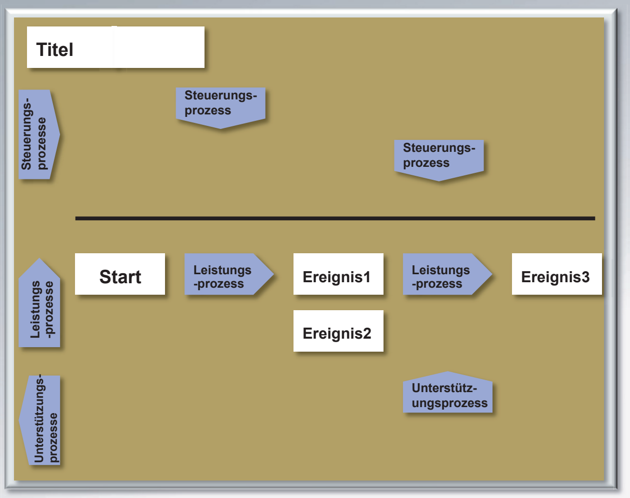
- Die betrachteten Steuerungs- / Leistungs- / Unterstützungsprozesse und Ereignisse auf Moderationskarten schreiben. Die Vollständigkeit kann dabei überprüft werden.
  - **Steuerungsprozesse** planen und regeln die Leistungsprozesse. Sie haben „push“-Charakter, d.h. sie machen initiativ (pro aktiv) Vorgaben für den Leistungsprozess und überwachen ihn. Sie umfassen die für die Optimierung und Anpassung von Leistungsprozessen erforderlichen Planungs- und Prüfprozesse, sowie die Prozesse zum Aufbau und zum Betreiben von Managementsystemen.
  - **Unterstützungsprozess**e sollen den reibungslosen Ablauf der Leistungsprozesse sicherstellen. Sie haben „pull“-Charakter, d.h. sie leiten ihre Anforderungen reaktiv aus dem Leistungsprozess ab. Unterstützungsprozesse dienen der effizienten Aufrechterhaltung der Leistungsprozesse sowie der Steuerungsprozesse. Sie orientieren sich dazu an den kritischen Prozessschritten des Leistungsprozesses.
  - Im **Leistungsprozess** erfolgt die für den Endkunden relevante Wertschöpfung des Unternehmens. Der Leistungsprozess orientiert sich am Unternehmenszweck und wird durch konkrete Anforderungen der Kunden bestimmt und dementsprechend entwickelt. Er verläuft bereichsübergreifend.
  - Ein **Ereignis** entspricht dem Output des vorigen bzw. dem Input des nächsten Leistungsprozesses. zBsp. ein Ereignis ist: „Maschinenstörung liegt vor“

(nach 2011: Audi Prozessmanagement – Konzernkonventionenhandbuch Version 2.4.8 S.13-15)



## Wertschöpfungskettendiagramm (WKD)
Vorgehensweise (3)

- Prozess darstellen: Leistungsprozesse mit den Ereignissen, dazu zugehörig die jeweiligen Steuerungs- und Unterstützungsprozesse



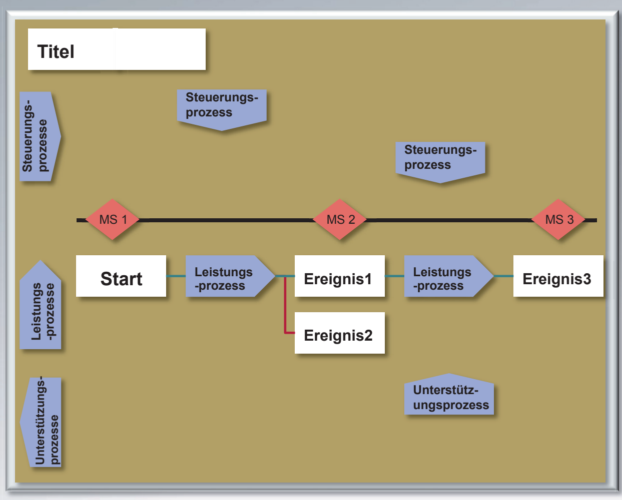
## Wertschöpfungskettendiagramm (WKD)
Vorgehensweise (3) Nutzen

- Nun wird sichtbar welche Ergebnisse sich aus den einzelnen Leistungsprozessen ergeben und in welcher Reihenfolge die Leistungsprozesse angeordnet werden. Welche Steuerungs- / Unterstützungsprozesse werden für den Leistungsprozess benötigt und wo?
- Abschließend wird der Prozess gemeinsam mit den Teilnehmerinnen und Teilnehmern noch einmal durchgesprochen. Bei Bedarf werden Änderungen ergänzt.



## Wertschöpfungskettendiagramm (WKD)
Vorgehensweise (4)

- Pfad einzeichnen — Ergebnis i. O. — Ergebnis n. i. O.
- Meilensteine visualisieren MS 1



## Wertschöpfungskettendiagramm (WKD)
Vorgehensweise (4) Nutzen

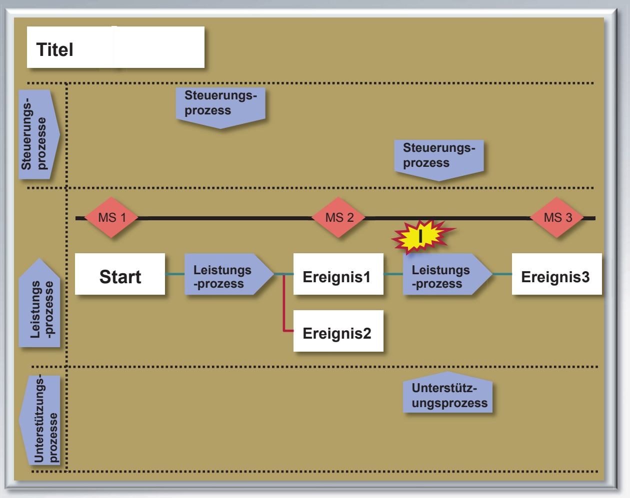
- Der Pfad verbindet die Leistungsprozesse und die Ergebnisse miteinander und ermöglichet somit den zielgerichteten Durchlauf der Prozesse. Für den i.O. Pfad grüne und für den n.i.O. Pfad rote Farbe verwenden.

- Die Meilensteine werden verwendet, um markante Zeitpunkte zu kennzeichnen. Dabei ist zu beachten, dass zuerst mit dem Ende begonnen wird und dann bis zum Anfang die Meilensteine berechnet werden.




## Wertschöpfungskettendiagramm (WKD)
Vorgehensweise (5)

- Kaizen Blitze markieren und nummerieren
- Abgrenzungen horizontal auf Brownpaper markieren (in der obersten Zeile Steuerungsprozesse, in der Mitte die Leistungsprozesse und darunter die Unterstützungsprozesse).



## Wertschöpfungskettendiagramm (WKD)
Vorgehensweise (5) Nutzen

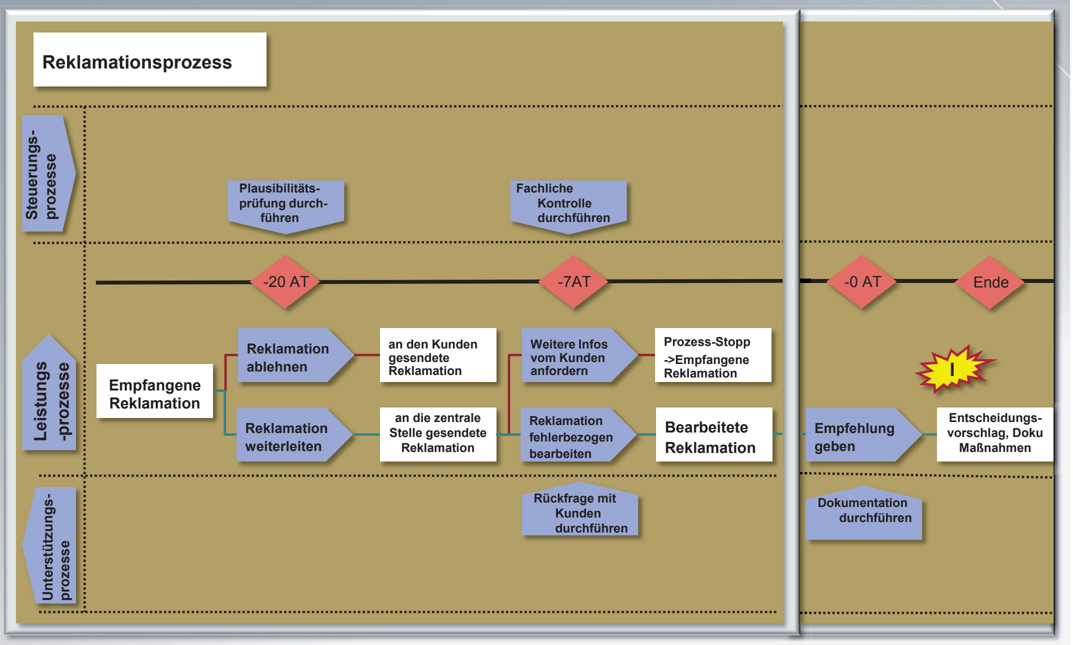
- Mit Kaizen Blitzen werden Potentiale, Synergie Effekte oder Redundanzen markiert und nummeriert. Bei mehren Stufen ist es sinnvoll die Nummerierung zu unterscheiden(zBsp. WKD = römische Ziffern, PMA = arabische Ziffern).

  Zuerst eine Priorisierung vornehmen, das bedeutet bei mehren Kaizen Blitzen werden zuerst Leistungsprozesse betrachtet. Anschließend können diese Prozesse im Detail mit dem PMA modelliert werden.

- Die Abgrenzungen strukturieren den Prozess.



## Wertschöpfungskettendiagramm (WKD)
Praxisbeispiel



## Prozessmapping (PMA) mit Ergänzungen

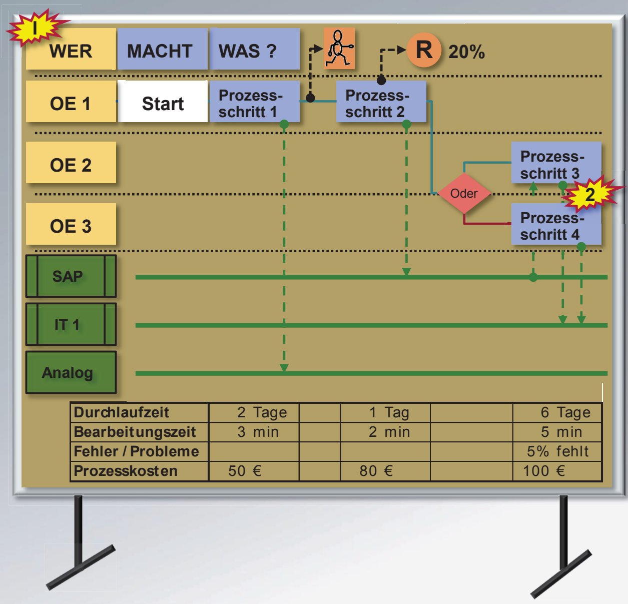




## Ergänzungen zu Prozessmapping (PMA)
Merkmale

- Darstellung von Systeminteraktionen mit „System Pipelines“
- Visualisierung von Rückfragen an andere Prozesse / Bereiche mit „R“
- Darstellung von Tätigkeiten mit erheblichen Zeitaufwand mit „Männchen“
(bspw. durch Verlassen des Arbeitsplatzes von Mitarbeiterinnen und Mitarbeitern während des Prozesses)

## Prozessmapping (PMA) mit Ergänzungen
Visualisierung



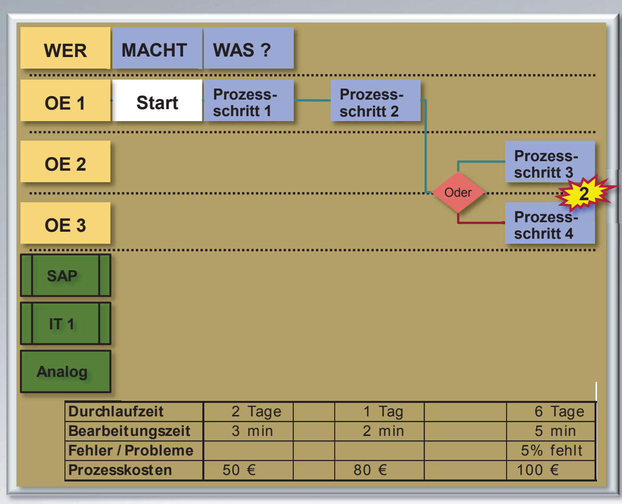

| | | | | | |
|---|---|---|---|---|---|
| Durchlaufzeit | 2 Tage | | 1 Tag | | 6 Tage |
| Bearbeitungszeit | 3 min | | 2 min | | 5 min |
| Fehler / Probleme | | | | | 5% fehlt |
| Prozesskosten | 50 € | | 80 € | | 100 € |





## Prozessmapping (PMA) mit Ergänzungen
Vorgehensweise (1)

- PMA wie gewohnt durchführen (siehe AKB zu PMA)




| | | | | | |
|---|---|---|---|---|---|
| Durchlaufzeit | 2 Tage | | 1 Tag | | 6 Tage |
| Bearbeitungszeit | 3 min | | 2 min | | 5 min |
| Fehler / Probleme | | | | | 5% fehlt |
| Prozesskosten | 50 € | | 80 € | | 100 € |

## Prozessmapping (PMA) mit Ergänzungen
Vorgehensweise (1) Nutzen

- Prozesse verstehen - „Sehen lernen"
  - Prozesse sichtbar und verständlich machen
  - Gemeinsame Basis (gemeinsames Verständnis) in Bezug auf den Prozess schaffen
- Prozesse verbessern (Fokus auf Prozessabläufe / Prozesskosten)
  - Erhöhung der Zufriedenheit von Mitarbeitern / Beteiligten etwa durch klare Informationen, geregelte Kommunikationswege, Standards, vereinfachte Abläufe ohne Nacharbeit und unnötige Schleifen, weniger Wartezeiten
  - Erhöhung der Kundenzufriedenheit etwa durch Verkürzung der Durchlaufzeiten und Verbesserung der Qualität
  - Bessere Einbindung der Lieferanten etwa durch klare Vorgaben, Anforderungen, Vereinbarungen
- Prozessorientierung
  - Verantwortung und Mitdenken: Beteiligte verbessern den Prozess
  - Konsens: Beteiligte vereinbaren mit (internen) Lieferanten und Kunden Regeln in Bezug auf den SOLL-Prozess
  - Nachhaltigkeit: Stabilität und Ergebnissicherheit

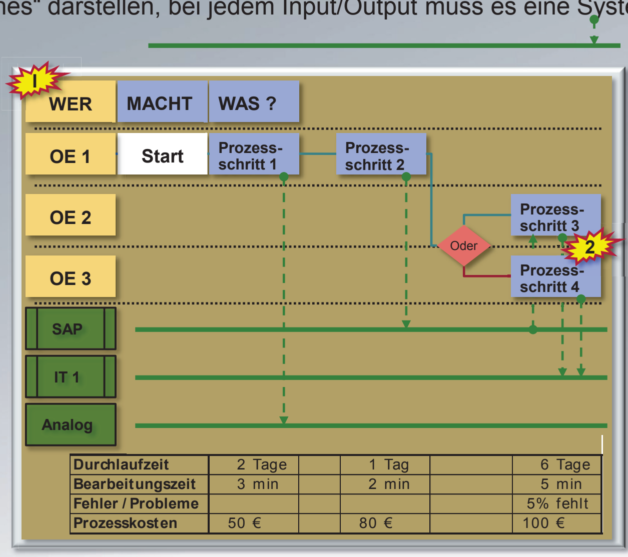
(nach 2013 Audi Wiki – KVP Welle 2 , Warum Prozessmapping?)





## Prozessmapping (PMA) mit Ergänzungen
Vorgehensweise (2)

- Kaizen Blitz (ganz links oben) auf Brownpaper platzieren, zeigt Zugehörigkeit zu WKD
- „System Pipelines“ darstellen, bei jedem Input/Output muss es eine Systeminteraktion geben



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## Prozessmapping (PMA) mit Ergänzungen
Vorgehensweise (2) Nutzen

- Der Kaizen Blitz zeigt Zugehörigkeit zu WKD. Mit Kaizen Blitzen werden Verschwendungen sowie Potentiale im Prozess markiert und nummeriert. Bei mehren Stufen ist es sinnvoll die Nummerierung zu unterscheiden(zBsp. WKD = römische Ziffern, PMA = arabische Ziffern).

- Die „System Pipelines“ stellen bei jedem Prozessschritt die Systeminteraktion von Input/Output dar. Dabei wird visualisiert, aus welchen System kommen und wohin gehen die Informationen. Eine zeitliche Abfolge ist dabei auch sichtbar, wann müssen die Informationen vorhanden sein.

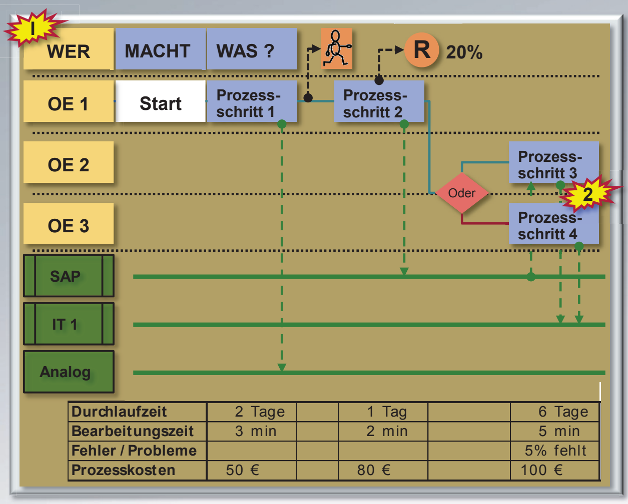




## Prozessmapping (PMA) mit Ergänzungen
Vorgehensweise (3)

- Bei Rückfragen an andere Prozesse/Bereiche mit „R“ visualisieren (Häufigkeit in %)


- Tätigkeiten mit erheblichen Zeitaufwand und bei denen der Arbeitsplatz verlassen wird, mit „Männchen“ kennzeichnen



## Prozessmapping (PMA) mit Ergänzungen
Vorgehensweise (3) Nutzen

- Die Visualisierung von Prozessschritten bei denen Rückfragen an andere Prozesse/Bereiche auftreten werden deutlich sichtbar gemacht.
- Sichtbarmachen von Tätigkeiten, bei denen der Arbeitsplatz verlassen werden muss.



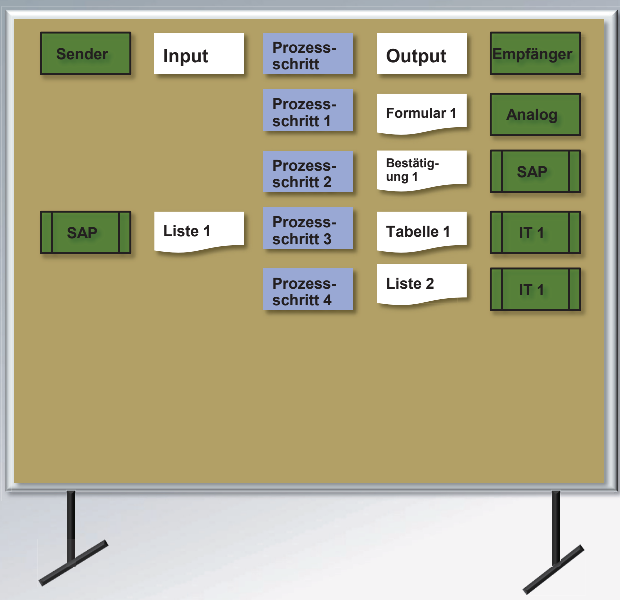
## LIPOK Diagramm

## **LIPOK Diagramm**
Merkmale

- Darstellung welche Dokumente über welche Systeme ein- bzw. ausgegeben werden (Sender statt Lieferant und Empfänger statt Kunde)
- Systematische Erfassung und vollständige Aufnahme aller Arbeitsdokumente / Daten
- Dokumentation von Quelle-Senke-Beziehungen
- Ergänzung zu PMA
- Reduzierung von Komplexität
- LIPOK Abkürzung für:
  - Lieferant
  - Input
  - Prozessschritt
  - Output
  - Kunde

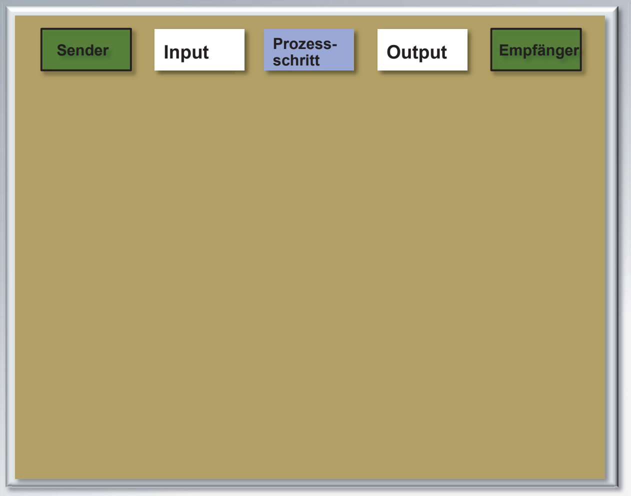


## **LIPOK Diagramm**
Visualisierung



## LIPOK Diagramm
Vorgehensweise (1)

- Zwischen Systemen / Dokumenten / Prozessschritten unterscheiden und auf Moderationskarten schreiben System Dokument Prozess-schritt
- Visualisierung beginnen (von der Mitte nach außen, von oben nach unten)



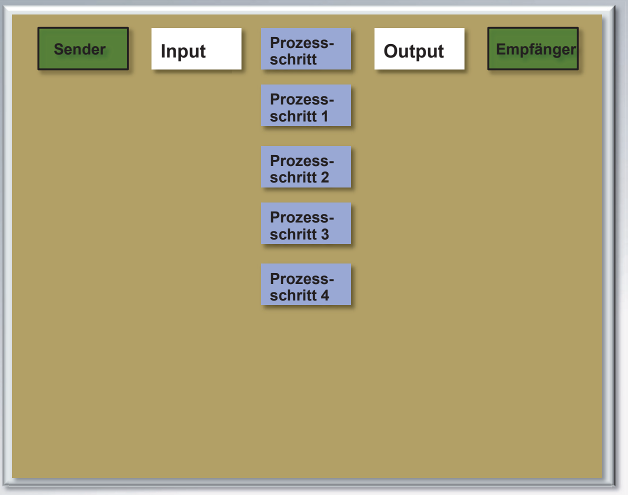



## LIPOK Diagramm
Vorgehensweise (1) Nutzen

- Die betrachteten Systeme / Dokumente / Prozessschritte auf Moderationskarten schreiben. Die Vollständigkeit kann dabei überprüft werden.
- Die spaltenweise Visualisierung der unterschiedlichen Kategorien wird dadurch sicher gestellt.

## LIPOK Diagramm
Vorgehensweise (2)

- Prozessschritte auflisten





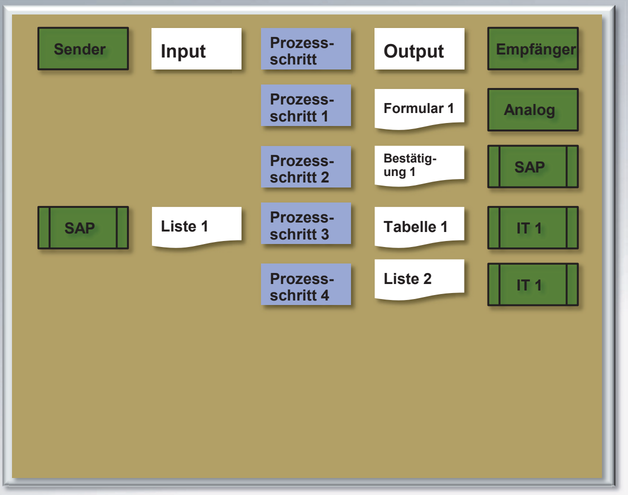


## LIPOK Diagramm
Vorgehensweise (2) Nutzen

- Die Prozessschritte werden damit chronologisch aufgelistet. Zusätzlich kann hier die Vollständigkeit der Prozessschritte noch einmal überprüft werden.

## LIPOK Diagramm
Vorgehensweise (3)

- Input / Output visualisieren
  - Welches Dokument geht rein?
  - Welches Dokument kommt raus?
- Sender / Empfänger visualisieren
  - Welches System liefert Input?
  - Welches System liefert Output?






## LIPOK Diagramm
Vorgehensweise (3) Nutzen

- Die ein- und ausgehenden Dokumente werden für jeden Prozessschritt visualisiert.
- Für jeden Prozessschritt wird sichtbar, welches System Informationen liefert (Sender) und welches System die Informationen erhält (Empfänger).

## Prozessschrittzuordnungsdiagramm (PZD)

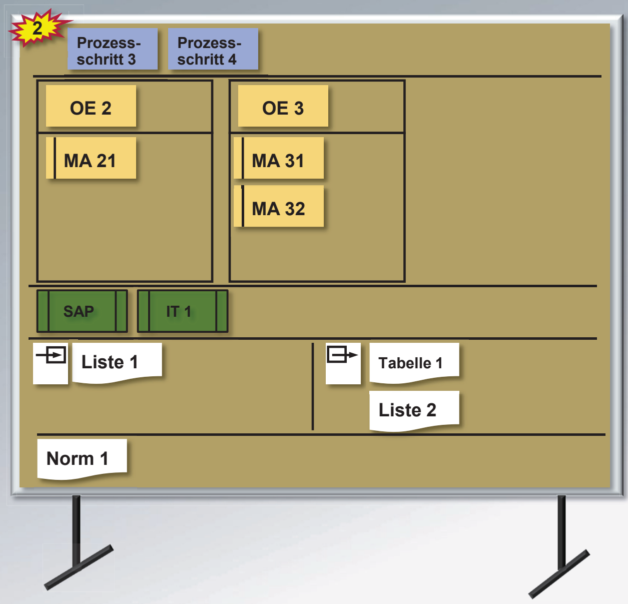




## Prozessschrittzuordnungsdiagramm (PZD)
Merkmale

- Detaillierte Beschreibung der Prozessschritte
- Visualisierung von Beziehungen von Ressourcen und Informationsobjekten
- Verbesserung der Übersichtlichkeit
- Darstellung separat um das Prozessmodell nicht zu überladen

## Prozessschrittzuordnungsdiagramm (PZD)
Visualisierung







## Prozessschrittzuordnungsdiagramm (PZD)
Vorgehensweise (1)

- Kaizen Blitz (ganz links oben) auf Brownpaper platzieren, zeigt Zugehörigkeit zu PMA
- Prozessschritte (ganz oben) auf Brownpaper platzieren

## **Prozessschrittzuordnungsdiagramm (PZD)**
Vorgehensweise (1) Nutzen

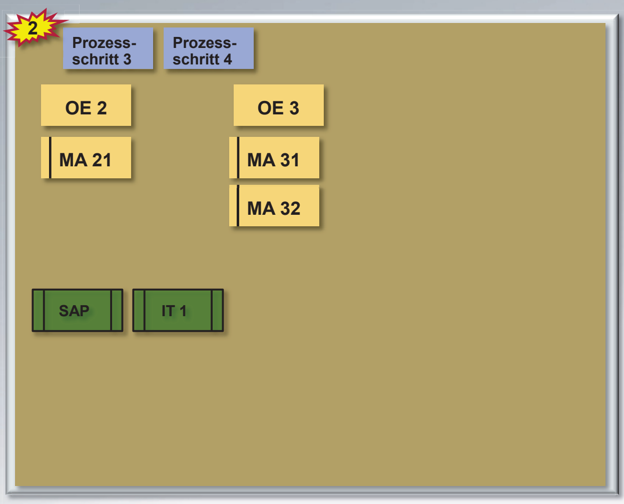
- Der Kaizen Blitz markiert Verschwendung und Potential im Prozess. Bei mehren Stufen ist es sinnvoll die Nummerierung zu unterscheiden(zBsp. WKD = römische Ziffern, PMA = arabische Ziffern).
- Die Moderationskarten (ganz oben) auf Brownpaper zeigen Zugehörigkeit des PZD, welche Prozessschritte im Detail betrachtet werden.





## **Prozessschrittzuordnungsdiagramm (PZD)**
Vorgehensweise (2)

- OE mit MA (Zweite Zeile, pro OE ein Fenster) auf Brownpaper platzieren
- Systeme (in der Mitte) auf Brownpaper platzieren



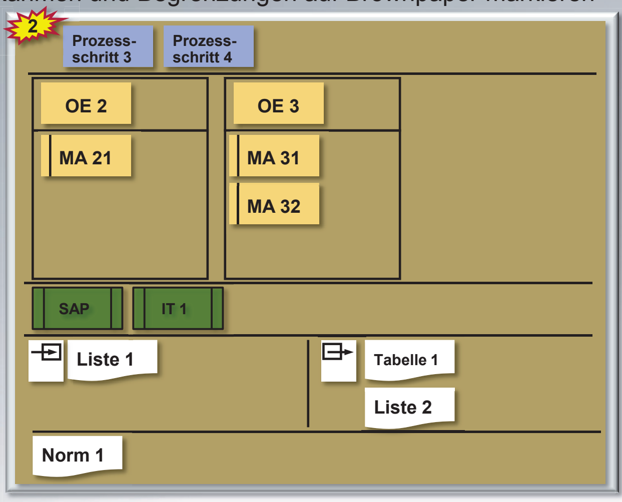
## Prozessschrittzuordnungsdiagramm (PZD)
Vorgehensweise (2) Nutzen

- Damit wird visualisiert welche Rollen der OE pro Prozessschritt zugeordnet sind und welche Systeme pro Prozessschritt zugeordnet sind.



## Prozessschrittzuordnungsdiagramm (PZD)
Vorgehensweise (3)

- Dokumente (vorletzte Zeile, Input links / Output rechts)
- Normen / Regelungen (ganz unten) auf Brownpaper platzieren
- Abschließend Rahmen und Begrenzungen auf Brownpaper markieren

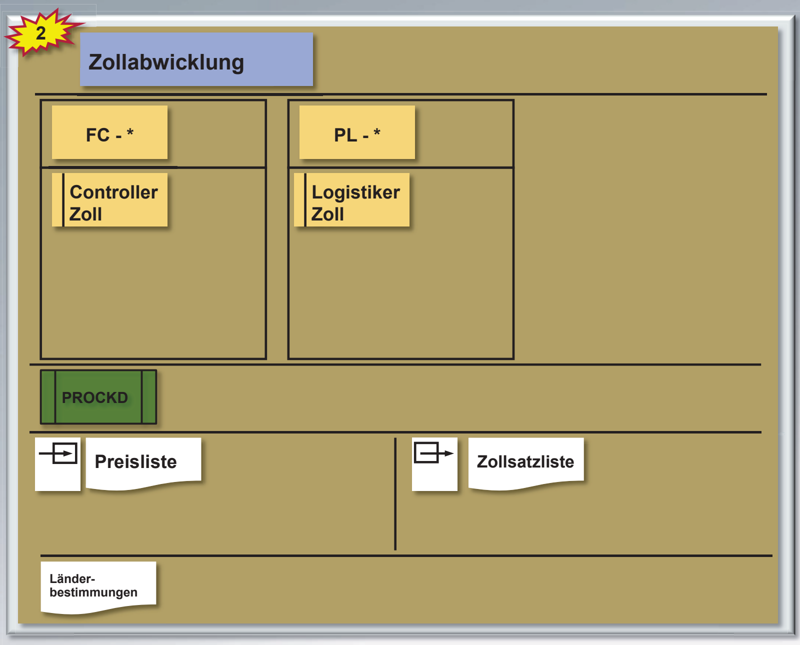


## Prozessschrittzuordnungsdiagramm (PZD)
Vorgehensweise (3) Nutzen

- Damit wird dargestellt welcher Input/Output der Dokumente pro Prozessschritt stattfindet und visualisiert welche Normen/Regelungen pro Prozessschritt relevant sind.
- Der Rahmen und die Begrenzungen strukturieren das Brownpaper.



## Prozessschrittzuordnungsdiagramm (PZD)
Praxisbeispiel



## RASI Matrix





## RASI Matrix
Merkmale

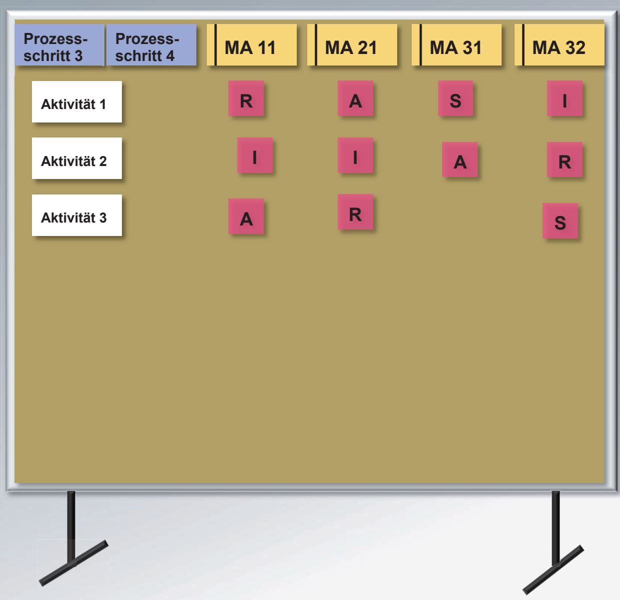
- Klärung von Verantwortlichkeiten und Zuständigkeiten
- Unterscheidung unterschiedlicher Formen von Verantwortung
- RASI Abkürzung für:
  - Responsible (=ausführend)
  - Accountible (=verantwortlich
  - Supported(=unterstützend, beratend)
  - Informed (=informiert)

## RASI Matrix
Details

- **Responsible** (=ausführend) – Durchführungsverantwortung:
  Die Mitarbeiterin beziehungsweise der Mitarbeiter oder die Prozessbeteiligten, die die Initiative für die eigentliche Durchführung (durch Andere) geben oder die die Aktivität selbst ausführen. Wird auch als Verantwortung im disziplinarischen Sinne interpretiert.
- **Accountible** (=verantwortlich) – Kostenverantwortung:
  Die Person, die im rechtlichen oder kaufmännischen Zusammenhang die Verantwortung trägt. Die verantwortliche Person ist diejenige, welche die Aufgabe im Sinne einer Kostenstelle verantwortet.
- **Supported** (=unterstützend, beratend) – Fachverantwortung:
  Eine Person oder Gruppen, die beratende Unterstützung einbringen sollen oder müssen. Darunter versteht man die Verantwortung aus fachlicher Sicht.
- **Informed** (=informiert) – Informationsrecht:
  Individuen oder Gruppen, die Informationen über den Verlauf und/oder das Ergebnis der Tätigkeit erhalten. Sie können auch die Berechtigung haben Auskunft zu erhalten.

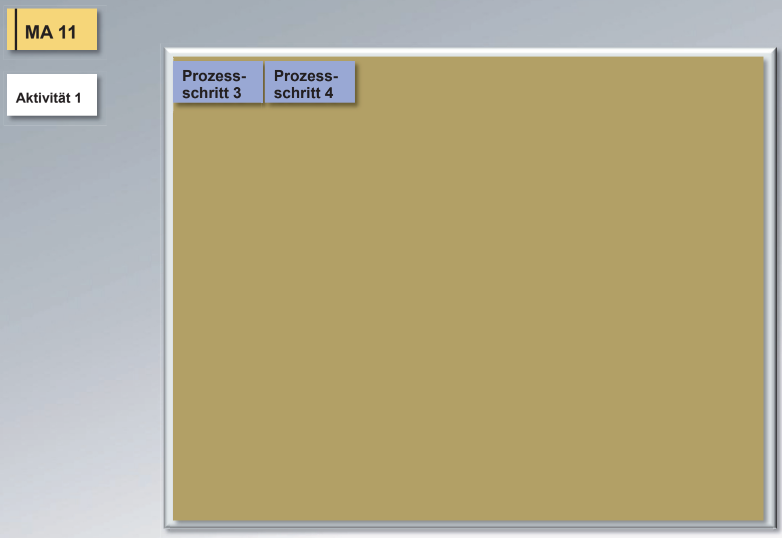


## RASI Matrix
Visualisierung



## RASI Matrix
Vorgehensweise (1)

- ▶ Prozessschritt(e) platzieren (links oben)
- ▶ Zwischen Rollen / Aktivitäten unterscheiden und auf Moderationskarten schreiben



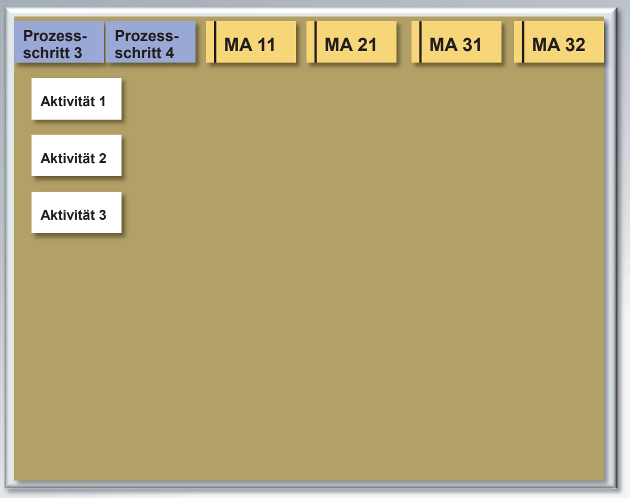



## RASI Matrix
Vorgehensweise (1) Nutzen

- ▶ Die Moderationskarten (links oben) auf Brownpaper zeigen für welche Prozessschritte die Verantwortlichkeiten in der RASI Matrix visualisiert werden.
- ▶ Die betrachteten Rollen / Aktivitäten auf Moderationskarten schreiben . Die Aktivitäten werden durchnummeriert. Dadurch wird sichtbar, ob alle beteiligten Personen und relevanten Aktivitäten berücksichtigt sind.

## RASI Matrix
Vorgehensweise (2)

- Horizontal werden die Rollen in Spalten aufgenommen (OE, Personen)
- Vertikal werden die Aktivitäten gelistet



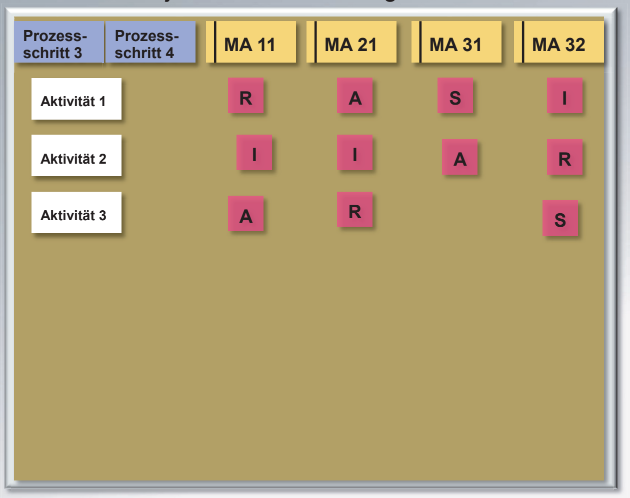



## RASI Matrix
Vorgehensweise (2) Nutzen

- Ermöglicht eine strukturierte Visualisierung der Rollen und Aktivitäten in den betrachteten Prozessschritten. Die Vollständigkeit kann noch einmal überprüft werden.

## RASI Matrix
Vorgehensweise (3)

- Zellenweise werden die Verantwortlichkeiten visualisiert
  - Grundsätzlich nur ein „A“ pro Zeile, mehrere „R“, „S“ und „I“ pro Zeile möglich
  - Nicht jede Person muss an jeder Aktivität beteiligt sein







## RASI Matrix
Vorgehensweise (3) Nutzen

- Stellt die Klärung von Verantwortlichkeiten und Zuständigkeiten sicher. Dabei werden zellenweise die Verantwortlichkeiten visualisiert. Ermöglicht die Überprüfung ob wirklich jeweils eine Rolle pro Aktivität verantwortlich ist. Kann sichergestellt werden, dass alle Personen informiert werden. Können Redundanzen vermieden werden? Gibt es eine Vertreterregelung? Etc.

## RASI Matrix
Praxisbeispiel

| Anlagen-wartung | Techniker vom Anlage-hersteller | Instand-halter | Schicht-führer | Betriebs-ingenieur |
|---|---|---|---|---|
| Termin vereinbaren | R | S | I | A |
| Anlage untersuchen | A | R | S | I |
| Ersatzteile beschaffen | A R | S | | I |
| Reparatur durchführen | I | R | S | A |

61 Leitfaden Informationsflussanalyse, Paul Schirl, I/PG-A8

Audi Vorsprung durch Technik

## Details zu Informationsflüssen

62 Leitfaden Informationsflussanalyse, Paul Schirl, I/PG-A8

Audi Vorsprung durch Technik

## Details Informationsflüsse
Fragestellungen um Vollständigkeit der Infos zu prüfen

- WER? ----------------> Informationsnutzer
- WOZU? ----------------> Informationsnutzung
- WELCHE INFORMATION? ----------------> Informationsbedarf
- WOHER? ----------------> Informationsquelle
- IN WELCHER FORM? ----------------> Informations(auf)bereitung
- WIE? ----------------> Informationsverteilung

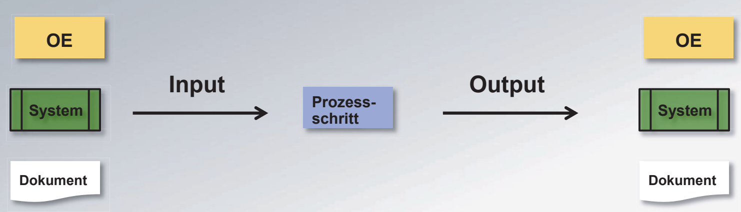
(nach Tochtermann K., 2006: Vortrag Wissensmanagement und Prozessmanagement S.6)



## Details Informationsflüsse
Systematik

- Welche Informationen sind zur Erfüllung des Prozessschrittes nötig?
- Von Wem?
- Woher?
- In welcher Form?
- In welcher Qualität?
- …

- Welche Informationen entstehen beim Prozessschritt?
- Für Wen?
- Wohin?
- In welcher Form?
- In welcher Qualität?
- …



## Morphologischer Kasten





## Morphologischer Kasten

| Szenarien / Themen | WKD | PMA | LIPOK | PZD | RASI |
|---|---|---|---|---|---|
| Darstellung neuer Prozesse | x | | | | |
| Greenfield Planung (bspw. neues Werk) | x | | | | |
| Umstrukturierung von OE | x | | | | |
| Soll Prozess Definition | x | x | | | |
| Visualisierung von Ist Prozessen | | x | | | |
| Übersichtliche Darstellung von Sach- / Strukturproblemen | | x | | | |
| Prozessoptimierung | | x | | | |
| Standardisierung von Prozessen | | x | | | |
| Messung von Prozessleistung / Qualität | | x | | | |
| Optimierung von Informationsflüssen | | x | x | | |
| Reduktion von System-Schnittstellen | | | x | | |
| Überprüfen von Redundanzen von Dokumenten / Daten | | | x | | |
| Darstellung von Quelle-Senke-Beziehungen von Dokumenten / Daten | | | x | | |
| Rollenverteilung in OE (bspw. Leitervertretung, Urlaubsvertretungen) | | | | x | x |
| Ausstattung von Kompetenzen (wer ist befugt etwas zu genehmigen?) | | | | | x |
| Qualifizierungsverteilung (wer ist befähigt fachlich etwas zu entscheiden?) | | | | x | |
| Informationsflussverteilung (wer wird informiert?) | | | | x | x |
| Klärung von Verantwortlichkeiten | | | | | x |

## Übersicht zusätzliche Methoden und weiterführende Literatur



## Übersicht zusätzliche Methoden

1. Business Process Model and Notation BPMN
2. Wertstromanalyse WSA
3. Wertstrom-Management WSM
4. Funktionszuordnungsdiagramm FZD
5. Vorgangskettendiagramm VKD
6. Ereignisgesteuerte Prozesskette EPK
7. Erweiterte Ereignisgesteuerte Prozesskette eEPK
8. Unified Modeling Language UML / System Modeling Language SysML
   - Aktivitätsdiagramm
   - Interaktionsübersichtsdiagramm
   - Sequenzdiagramm
   - Zustandsdiagramm
   - Anwendungsfalldiagramm

## Weiterführende Literatur

Zu 1. White S. A., Miers D., 2008: BPMN modeling and reference guide
Zu 1. Allweyer T., 2009: BPMN 2.0 Business Process Model and Notation

Zu 2. Rother M.,Shook J., 2011: Sehen lernen
Zu 3. Klevers T., 2013: Wertstrom-Management

Zu 4. Lehmann F.R., 2008: Integrierte Prozessmodellierung mit ARIS
Zu 5. Scheer A.W., 2001: ARIS - Modellierungsmethoden, Metamodelle, Anwendungen

Zu 6./7. Staud J., 2006: Geschäftsprozessanalyse
Zu 6./7. Becker J., Kugeler M., Rosemann M., 2012: Prozessmanagement

Zu 8. Rupp C., Queins S., Zengler B., 2007: UML 2 glasklar
Zu 8. Oestereich B., 2003: Objektorientierte Geschäftsprozessmodellierung mit der UML
Zu 8. Alt O., 2012: Modellbasierte Systementwicklung mit SysML

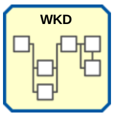


## Verwandte Schulungsunterlagen bei Audi

## Verwandte Schulungsunterlagen bei Audi

- WIKI – KVP Welle 2
  - Methodenbausteine
  - Qualifizierungsinhalte
- Audi Kurzbeschreibungen (AKB)
  - Prozessmapping (PMA)
  - Prozess-Übersichts-Diagramm LIPOK
- AKB - Fibel

# Appendix B




## Audi Kurzbeschreibung Wertschöpfungskettendiagramm

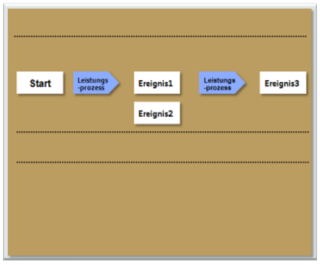
Das **Wertschöpfungskettendiagramm** verschafft als Überblickmodell einen Gesamtblick auf den Prozess und ermöglicht eine Darstellung von unterschiedlichen Prozesstypen wie Steuerungs-, Leistungs- und Unterstützungsprozesse.

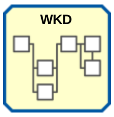
### Prozesstypen und Ereignisse

| | |
|---|---|
| **Steuerung** | Steuerungsprozesse planen und regeln die Leistungsprozesse. |
| **Leistung** | Im Leistungsprozess erfolgt die für den Endkunden relevante Wertschöpfung des Unternehmens. |
| **Unterstützung** | Unterstützungsprozesse sollen den reibungslosen Ablauf der Leistungsprozesse sicherstellen. |
| **Ereignis** | Ereignisse sind die Resultate der Leistungsprozesse. |

### Arbeitsblock 1

- Schwimmbahnen vorzeichnen auf Brownpaper
- Zwischen Steuerungs-, Leistungs- und Unterstützungsprozesse unterscheiden und auf Moderationskarten schreiben
- Ereignisse auf Moderationskarten schreiben
- Leistungsprozess darstellen

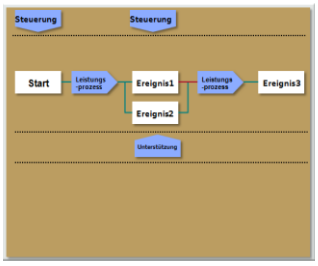





**Audi Kurzbeschreibung**
**Wertschöpfungskettendiagramm**

## Arbeitsblock 2

- Pfad einzeichnen
  - Ergebnis I.O.
  - Ergebnis n. I. O.
- Steuerungs- und Unterstützungsprozesse visualisieren




## Arbeitsblock 3

- Meilensteine visualisieren


- Kaizen Blitze markieren und nummerieren (beim WKD mit römischen Ziffern)