Process Modeling: 
a Decision-Oriented Approach

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Abstract
The process modeling method presented in this paper enables companies to capture, analyze and improve their business processes by using an easy, intuitive graphical notation. The method will explicitly focus on decision points instead of process activities.

Keywords: process modeling, business processes

Introduction
Nowadays companies are facing multiple challenges with regard to rising complexity due to the dynamic and unpredictable environment on the one hand and the increase of competition and cost pressure in the global market on the other (Browning et al. 2007, Eversheim 1996, Schmelzer et al. 2008, Schuh 2011). According to a study by IBM, the majority of CEOs expect the world to become even more complex in the near future (IBM 2010). In order to deal with this situation, the need for effective and efficient business processes with low coordination effort is growing.

Business process management (BPM) is one way of remaining competitive in the market by improving the process performance in companies concerning quality, time, costs and customer satisfaction through the process-oriented design and optimization of processes (Chang 2006). Googling the term “Business Process Management” in February 2013 yields about 425 mil. hits and therefore underlines the importance of this approach. The interest in BPM is not only rated as very high by more than 40% of the participants taking part in a survey by Fraunhofer IPA (Westkämper 2011), but is also ranked among
the five most important strategic themes for companies (Roghé 2006).

According to Curtis et al. it has become a necessity for companies to enhance their business processes and thus to meet and exceed customer expectations (Curtis et al. 1992, Becker et al. 2008).

Traditionally a wide variety of approaches and notations have been used to implement a process-oriented organization where functional units are widely replaced by processes to reduce hierarchies and interfaces and thus reduce the coordination effort and become more flexible (Böhn et al. 2007, Schuh 2006). These approaches can be integrated either in a top-down or bottom-up oriented way, as is it shown in Fig. 2.

However, the implementation of BPM and the realization of optimization projects does not lead to the aspired process conditions in about 60% of the cases according to several specific surveys (Bartscher 2011, Freitag et al. 2011 ). The crucial problem is often the process modeling of the as-is status and its emphasize of single process steps and their chronological sequence. Hence, classic process modeling tools do not achieve sufficient benefit despite high effort and detailed visualization (Schuh, 2007).

The focal point of this paper therefore is to introduce a decision-oriented process...
modeling tool that will explicitly focus on decision points instead of process activities and enables companies to capture, analyze and improve their business processes by using an easy, intuitive graphical notation.

**Motivation**
The process modeling and visualization requires nearly 40% of the overall time needed for an optimization project and thus plays a key role in BPM (Rosemann et al. 2010). Only the decisive description of the companies’ processes and the creation of transparency by capturing current business processes in process models enables users and employees to organize and communicate internal business-specific knowledge, and thereby gain an insight into the complexity of business processes. Characteristic for highly interlinked and often weakly structured processes especially in administrative areas, like a purchasing or development process, is a high amount of communication and cooperation among stuff members (Nielen, Jeske, Schlick, Arning, Ziefle 2010). This is needed to facilitate the processing of information and ensure an easy and transparent decision-making process in companies and thus streamline processes, enhance quality and optimize the communication and collaboration of involved people (Nielen et al. 2010, Schuh 2007).

The experiences with industry projects of the Laboratory for Machine Tools and Production Engineering WZL of Aachen University show major difficulties in creating transparent decision points by using common modeling tools. The most relevant reason for the mentioned problem is the missing emphasize on the interfaces between different departments and hierarchy levels on which typically process weaknesses and bottlenecks can be found. The weak points are based on missing standardization, bad communication, and uncertain responsibilities which leads to nontransparent decision-making processes.

Hence, the key challenge lies in focusing on important decision points instead of process activities. Therefore, it is also necessary to determine involved persons, information input, the frequency of those decisions, and so forth.

Furthermore, user-friendly and error free graphical notation elements are required since on the one hand even today the actual process visualization in BPM projects is done by using pens and brown paper. On the other hand a high potential for misinterpretation by users is given caused by the high information density (Moody, van Hillegersberg 2008).

**State of the art**
The increasing popularity of process modeling tools has led to a rapidly growing number and a wide variety of approaches and notations that have been used for BPM and thus for reengineering activities, job descriptions and staff training (Curtis et al. 1992). With their help the business processes with all their interdependencies, information, material paths, processing times and involved parties are mapped, so that project teams gain a first transparent overview and deeper understanding of the actual process activities.

By comparing current („as-is“) and proposed („to-be“) business processes, managers can identify specific process transformations that could improve the overall performance (Schuh 2007). Some examples for frequently used and well-established modeling tools are presented below:
• Aris
• Business Process Modeling Notation (BPMN)
• Value Stream Mapping
• Aixperanto

The modeling tool ARIS focuses on the company’s organizational and operational structure and its realistic depiction, analysis and optimization. Also, it pays special attention to support business processes by the application of integrated information systems. Five general perspectives provides the structure of the initial analysis, the organization, the functions, the performance as well as data and control mechanisms. Furthermore, ARIS is using a special process modeling language called event driven process chain that characterizes processes mainly by their corresponding functional units and interdependencies. Moreover, ARIS is capable of identifying and roughly classifying process inefficiencies. Thus, a standardized and complete depiction of relevant process activities and characteristics are guaranteed. (Scheer 1992, Schmelzer et al. 2008, Hippner 2011, Seidlmeier 2004, Schuh 2011).

The Business Process Modeling Notation (BPMN) has been developed to enable both technical users and business users to represent complex process semantics by using easily understandable and intuitive graphical notation elements. It aims at facilitating collaboration in a company, and providing a knowledge basis for business process improvement. Therefore, BPMN has the four following basic element categories: Flow objects (events, activities, gateways), Connecting objects (sequence flow, message flow, association), swim lanes (pool, lane) and artifacts (data object, group, annotation). Nevertheless, some elements are characterized by their high level of graphical complexity, which sometimes leads to a time-consuming learning phase and difficulties at drawing the elements (Rosemann et al. 2010, OMG 2009).

Owing to its simple notation symbols, the value stream mapping depicts internal business processes in an easy, comprehensible form. All relevant information are recorded, starting from the order receipt up to the finished product, in order analyze and design the flow of materials and information and thus enhance the process performance. Although value stream mapping is often associated with manufacturing, it is also frequently used in indirect processes. Moreover, the value stream mapping uses standard symbols for representing different entities and proposes possibilities to eliminate waste in the value stream. Anyway, in comparison with other modeling tools the value stream mapping has weaknesses in depicting value streams of complex processes and the analysis of the as-is situation. (Klevers 2009, Erlach 2010).

Aixperanto illustrates and analyzes business processes as a whole and uses swim-lanes to distinguish between different departments like the purchasing or sale. Another aspect is the participation of involved employees from the beginning to make them aware of the problems that negatively affect the business process performance. Thus, employees are capable to find weak points and suggest possible improvement measures by their own. Furthermore, aixperanto uses self-explanatory and easy-to-understand symbols as well as colors, like the green-yellow-red logic taken from the traffic light, which helps employees...
describing their own business process. Weak points on interfaces between units or single process steps are marked by using kaizen flashes in order to gain a good overview of the problems and be able to immediately distinguished between well and bad performing business processes from each other. In addition both qualitative and quantitative parameters are analyzed and depicted in process symbols to generate a deeper understanding of the process. (Schuh 2006, Boos 2008).

The comparison of the four different business process modeling tools show, that ARIS, due to the five different layers, and BPMN are especially suitable for process documentation. Value stream mapping is more suited to analyze production processes, whereas aixperanto serves as a supportive tool for business process optimization. Nevertheless, no one of these methods completely fulfills the requirements of focusing on decision points instead of process activities.

Decision-oriented Approach
The approach developed is based on a decision-oriented visualization of business processes to support the identification and implementation of process improvement measures and also being suitable for a practice use. This means it does not claim to be a holistic approach and to cover all eventualities but rather tries to use as few parameters and variables as possible in order to guarantee a simple usage and feasibility. Therefore, the decision points within a process, which are usually bundled in meetings, are analyzed under special consideration of communication and thus weak points can be identified. Communication includes the collectivity of communicative processes and activities in value chains, support and management activities as well as their correlation. The new decision-oriented approach together with its elements and the procedure are described in this chapter.

Figure 3: Decision-oriented process model
Different levels and characteristic information
The approach used is divided into four different levels, the first illustrating the process based on selected decision points, the other ones representing the most important process information related to the relevant decisions depicted in the first level. In Figure 3, a summary of the overall business process modeling tool and the corresponding levels, namely involved people/ business units as the second level, input as the third and output as the last level, is presented.

The first level we describe are the single, decisive decision points which have to be identified, analyzed and inserted in the diagram on the x-axis according to their time sequence in the overall process on the one hand. The y-axis represents the frequency of decisions or meetings and can be divided to time intervals, like a daily, weekly or for example quarterly iteration as well as, if necessary, an ‘on demand’ nomenclature (see example in Fig. 3). The mentioned distribution of the y-axis needs to be considered by filling in the decision points on the other hand.

This depiction addresses two problems of current process modeling tools and process visualization and allows both of these to be achieved, it reduces complexity and ambiguity between different departments. Differences in interpretation can be avoided by enabling a company to dramatically simplify its processes by setting precise decision-making points and thus make sure that on the one hand all involved departments or targeted groups have the same understanding of the key decision gates where, e.g. decisions on the continuation of the project are made. On the other hand, that capturing and incorporating decision points will automatically send your prospects down the most relevant and targeted communication tracks. Moreover, the extraction of process activities and the removing of overlaps and duplication along the way leads to a reduction in complexity.

Another advantage of this classification is that you are able to easily track your decisions concerning frequency and number within a business process which means that it is possible to enhance the speed and responsiveness of an organization. In addition, you are more capable of initiating countermeasures at any deviations in the process.

The second level determines the persons or business units involved in the correspondent decision point. In this way it will be possible to obtain a good overview about interdependencies and missing decision-making power or authority in the process, so that you can quickly derive the required entities as well as identify needless or even redundant meetings.

The third and forth level are about input and output available for the decision points. This can be documents, decision papers, financial ratios, sales volume and so on. These information are mandatory in order to generate a standardized, fast process with less inquiries. The final result should be that all documents and needed data from the input and output are available at the right time in the process.

Visualization and assessment
Within the four levels of the new approach several visualization elements have been developed to make more information available on first sight, to get an visual clarity, to easily indicate special characteristics and to be able to asses the current process fast and efficient. To have an overview about the amount of people participating in the decision or
the meeting, one face symbol for one person involved is being used in level one. Moreover, the size of the circles reflect the importance of the decision or meeting, the greater the diameter, the more significant is the importance of the decision to be made.

The green-yellow-red method are commonly used in different process modeling tools like aixperanto to indicate which process activities are value-adding, or whether they are waste. Thus, it is possible to make a well informed decision in a relatively short time, on whether you should improve the process or not. Concerning the new approach the method is used in level two to support the team by quickly evaluating the distribution of responsibilities to the single decision points. Green background means a balanced, and a red background a un-balanced distribution of involved units and people. In level three and four the same method is taken into account to differ between sufficient and insufficient input and output documents and data in order to make an adequate, qualified decision and to have enough information to proceed with the process.

Using the visualization elements described above, an assessment of the as-is situation can easily be derived based on a comparison of the quality of available as well as of the amount of missing input and output documents and data. Additionally, a qualitative description is necessary to determining whether there exist interdependencies between two decision points and meetings or not and in which way the affect each other. It is also possible to quantify causal correlations between decision points, frequency or input and output with the aim of determine critical decision points, formulate options for action and thus make decisions on the strength of an improved information base in order to enhance the overall performance of the considered business process. To have an decision-oriented modeling tool that interlinks the decision points throughout the whole process and considers the correlating responsibilities as well as the relevant input and output information makes it easier to achieve an transparent, well structured and a more streamlined to-be process in an organization.

Implementation within the Automotive Supply Industry
The WZL has carried out a project with a client within the automotive supply industry at a German site, where the described decision-oriented modeling tool has been used. The task was to analyze and adjust the weak points, especially on the decision points, within the complaint process and thus to optimize the overall process performance. Therefore, the initial situation was mapped by the WZL and the involved employees during several meetings using the decision-oriented model on the one hand. To understand the complaint process as a whole and to reveal all possible weak points the activities of all involved people were also visualized by using aixperanto on the other hand. Figure 4 shows the to-be situation of the process and its improvements.
The generated results of the analysis could be used to indicate improvement potential and to re-organize the decision points concerning frequency, composition of responsibilities and necessity of individual regular appointments. Thus, the WZL was able to ensure the quality of the overall complaint process and to reduce the average lead time by as much as 30% (Figure 4). Through simple processes, clear rules and transparent decisions the motivation of the employees as well as the satisfaction of the customers have also been increased dramatically.

Conclusion
Today’s companies are using BPM to maintain their competitive position in a changing globalized market and therefore modeling tools to create transparency in order to improve their business processes. The problems of existing modeling methods have been showed, as they are not focusing on the decision-points on the interfaces between departments and hierarchy levels but rather on activities within a process. This paper demonstrated the need for a decision-oriented process modeling tool which already has been developed at the Laboratory for Machine Tools and Production Engineering WZL of Aachen University. Furthermore, the model has been explained on detail and its successful application in an industry case conducted by the WZL within the automotive supply industry has been described.

Further research is needed to advance the graphical notation elements as well as to incorporate this method into approved approaches in order to benefit from both, the detailed description of process activities and their week points as well as the special emphasize on decision points.

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