UNIVERSITÄT KOBLENZ · LANDAU

Institut für Wirtschaftsinformatik
Fachbereich Informatik
Universität Koblenz-Landau

ULRICH FRANK

ORGANISING THE CORPORATION: RESEARCH PERSPECTIVES, CONCEPTS AND DIAGRAMS

März 2001

Arbeitsberichte des Instituts für Wirtschaftsinformatik Nr. 25

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Abstract

"Multi Perspective Enterprise Modelling" (MEMO) is a method to support the development of enterprise models. It includes a number of specialised modelling languages, like the MEMO Object Modelling Language (MEMO-OML) or the MEMO Organisation Modelling Language (MEMO-OrgML). MEMO-OrgML is to provide concepts that help with the design of meaningful models that support systematic approaches to organisational analysis and design. Like any MEMO language, MEMO-OrgML should promote models that are intuitive for various groups of users - which includes the semantics of the concepts as well as the way they are rendered within a model. In order to be intuitive, the concepts and (graphical) symbols a modelling language offers should correspond to existing concepts and their visualisation. This is the subject of this report: It gives an overview of core concepts to be found in the literature on organisational analysis and design as well as common ways to visualise various aspects of an organisation. The concepts are discussed against the background of generic objectives related to organisational analysis (re-) design. It is the main purpose of this investigation to prepare for a major revision of the current version of MEMO-OrgML, hence to detect further and more detailed requirements an organisation modelling language should fulfil. Research into the phenomenon of organisation and organising has many facets. From the perspective of organisation theory, those studies - be they behaviouristic or hermeneutic - are of outstanding importance that aim at explanations and/or try to foster a deeper understanding of core concepts. They include the analysis of power, social psychology, the relationship between structure and performance or the use of metaphors to illustrate certain aspects of organisations. The focus of this report, however, is different: While useful insights provided by organisation theory will not be completely neglected, the emphasis is on terminology and language that is useful for the purpose of modelling organisations. As one result, the report presents a dictionary of essential terms and graphical symbols which are common to describe organisations.

1. Introduction

"Multi Perspective Enterprise Modelling" (MEMO) is a method to support the development of enterprise models. It includes a number of specialised modelling languages, like the MEMO Object Modelling Language (MEMO-OML) or the MEMO Organisation Modelling Language (MEMO-OrgML). MEMO-OrgML is to provide concepts that help with the design of meaningful models that support systematic approaches to organisational analysis and design. Like any MEMO language, MEMO-OrgML should promote models that are intuitive for various groups of users - which includes the semantics of the concepts as well as the way they are rendered within a model. The current version of MEMO-OrgML [Wen97] is mainly focussing on business process, while it lacks detailed concepts to describe organisation structure. For this reason, we have decided for a revision/enhancement of present version. Since a modelling language should provide concepts and symbols that are intuitive for people who shall use it, it is a good idea to have a look at existing terminologies, specialised languages or graphical representations used to render and speak about aspects that are relevant for organisational analysis and design. Against this background, we will analyse corresponding. The investigation serves to detect concepts and requirements that are useful for the revision of MEMO-OrgML. Its result will be documented in a dictionary of relevant terms or - as we could also say - in a natural language ontology of organisation.

While MEMO intends to emphasize an international perspective as much as possible, the majority of the literature that was taken into account for this report is german. This is for a simple, however surprising reason: It seems that describing and especially visualising organisations has a longer and richer tradition in Germany than in Anglo-Saxon countries (but that may be a wrong impression). This is especially the case for the representation of business processes.

2. Perspectives on Organisation

The term organisation has many facets. Therefore it is not surprising that there are numerous different approaches to research into the phenomenon of organisation. In the following section, we give an overview of three important perspectives of organisational studies which are then contrasted by the perspective that is chosen for this report.

2.1 Organisation as Subject of Rational Design

While organisations have been around for thousands of years, they became subject of specialised research at universities only at the beginning of this century. Max Weber analysed a type of organisation that was of outstanding relevance at his time: bureaucracies [Webe72]. Where Weber was interested in sociological aspects of organisations, there was another group of researchers that had a different motiviation: They wanted to guide executives in buildung up successful organisations. In Germany, some of the business schools that had been founded during the turn of the century were moved to universities. To the resistance of many academics from established disciplines, some of the early professors of "Betriebswirtschaftslehre" (business and administration) tried to build up an academic reputation. Part of this endeavour can be seen in the development of research subjects other than accounting or principles of trading. In parallel to this change at universities, there was a growing demand for well educated managers. It

was still common practice to employ former army officers as factory managers. The belief was that they would now how to deal with people. Against this background, the assumption that organisation matters gained more and more attention.

Within "Betriebswirtschaftslehre" there were early publications on organisation in the twenties. Their essential message was: organisation is of outstanding importance for a company's performance. Sometimes this message was presented in a rather enthusiastic way - which is illustrated by the title of an early textbook: "Organisation - Der Weg aufwärts!" ("Organisation - The way upwards!", [Nick22]). The investigations of organisations were based on the experience and prejudice of the authors who did not bother with testing their assumptions. Instead, they wanted to provide managers with guidelines and principles of organising. In the case of Nicklisch, this included political ideas of organisations: An organisation should be headed by a leader who should manage people in a patriarchal, authoritarian manner ("strict but just"). Because of the obvious similarities to the Nazi ideology (and Nicklisch' appeal to support the nazi regime [Nick33]), explicit political considerations were regarded as a non-subject of textbooks on organisation after the war. Another group of researchers in Germany focused on supporting rational administration and control by developing techniques to help with the documentation and monitoring of organisational procedures (for instance [Calm22]). Beside drawing attention to the subject, the most important contribution of early organisation studies was the development of a terminology to describe organisations or - in other words: the development of conceptual views on organisations. One author in particular, Nordsieck, stressed a process-oriented conceptualisation of organisation already in the thirties. He regarded the analysis and design of business processes as essential for increasing an organisation's efficiency. He differentiated various types of process control and introduced diagrams to render process types [Nord32].

Independently from organisation studies in Germany, there were two approaches in the US and in France that had a lasting impact on the discipline. Both were developed by engineers. Taylor, founder of the so called "scientific management", suggested to use engineering methods to improve the efficiency of organisations [Tayl11]. His focus was on the work done by workers and performed by machines in a factory. He performed time studies to analyse the movements necessary to accomplish certain tasks. Based on this knowledge, he designed efficient ways to organize the movements with respect to temporal and spacial order. He also studied the conditions of operating machines in an efficient way. In addition to reorganizing work on an individual level, Taylor also emphasized the need for managers and workers to be well trained - "both were equally subject to the regimen of science." ([Scot92], p. 35) With respect to the pivotal motivation of this report - enterprise modelling - it is remarkable that Taylor introduced large maps of the yard. They served as a medium to talk about the current organisation and to discuss ways to improve it: "Once the yard was mapped so that one could see at a glance the relationships in time and sequence between different jobs, it led, naturally enough, to the reorganisation of the yard itself ..." ([Ward64], p. 65)

Different from Taylor, the french Fayol focussed rather on administration than on the work at the factory floor. His "administrative theory" suggested an approach that should help with the "top down" design of bureaucratic organisations. He believed that organizing should result in precise and detailed specifications - both for work activities as well as the coordination of

work. In order to support managers with the task of organizing, he introduced 14 general principles [Fayo49]. For instance: The "unity of command" principle specifies that nobody should receive orders from more than one superior. The "exception principle" suggests to leave routine tasks to subordinates with superiors only interfering whenever an exception occurs. However, although he believed in clear principles, Fayol did not suggest to apply them without regarding the individual context: "For preference I shall adopt the term principles whilst dissociating it from any suggestion of rigidity, for there is nothing rigid or absolute in management affairs, it is all a question of proportion." ([Fayo49], p. 19)

While there are clear differences in detail, the approaches outlined above have one implicit assumption in common: It is sometimes called a *rational* or *mechanical* perspective on organisations. In an overdrawing sense, this position suggests that the organisation of a business firm can be designed very much like buildings or machines. In this perspective management mainly consists of three activities: plan, organize and control. Hence, the corresponding authors tend to abstract widely from psychological, sociological or political aspects. Also, they do not aim at descriptions or explanations of how organisations really are. Instead, their emphasis is on guidelines - including a specialised terminology - that are to foster more efficient organisations. Corresponding definitions of the term organisation reflect cleary this prescriptive and mechanical perspective on the subject. According to Grochla, an organisation consists of a system of rules (or expectations) for employees and of operations to be fulfilled by machines ([Groc78], p. 12). Its purpose is to guarantee that operations are being performed permanently on a regular base - in accordance with the firm's goals. In a similar sense, Blau and Scott emphasize that "the distinctive characteristic of ... organizations is that they have been formally established for the explicit purpose of achieving certain goals ..." ([BlSc62], p. 5).

2.2 Organisation as Subject of Empirical Research

In textbooks on organisations, it is often emphasized that we are all surrounded by organisations (both in the institutional and the instrumental sense). Nevertheless, we usually do not spend much effort on reflecting upon the way they have evolved or the way they work: "Because of the ubiquity ... they fade into the background, and we need to be reminded of their impact." ([Scot92], p. 3) Against this background a wide range of organisational studies aim at general descriptions of actual organisations and at explanations of how they function. To a large extent, these studies are based on the behavioristic research paradigm. It suggests to apply research methods that are common in science. They include various types of surveys as well as experiments. An early and prominent - although not examplary - case of behavioristic research are the so called "Hawthorne" experiments [RoDi39]. Other studies tried to identify and measure essential features of organisations in order to allow for substantial comparisons of organisations. Probably the most influential studies of the latter kind were performed by the so called "Aston group" [PuHi76]. They found that some of the six features they used to describe organisations were not mutually independent. Based on cluster analysis, they reduced the features to four so called organisational dimensions. By applying these dimension to the descriptions of many organisations, they discovered seven distinct types of organisations [PHH69] - among them "full bureaucracy", "workflow bureaucracy" and "personnel bureaucracy". From an economic point of view, it is not only interesting to develop an adequate taxonomy of organisations. Moreover, it is most appealing to learn about the efficiency of organ-

isations. In other words: How do organisation contribute to the success of a firm. There have been numerous empirical studies that analyzed the impact of selected aspects of organisations on a company's performance. While it was an attractive vision to identify the one best organisation for many if not all companies, the so called "contingency theory" - which can still be regarded as a dominant paradigm in today's organisation research - is based on the assumption that there is no one optimum way to organise a firm. Instead, it states "the best way to organize depends on the nature of the environment to which the organisation relates." ([Scot92], p. 89). Another group of empirical studies, sometimes referred to as the ecological approach, is concentrating on the life-cycle of organisations. Originally, they were inspired by the work of Darwin and an obvious analogy between organisations and biological species: They evolve over time, some survive, others languish and die. Hence, these approaches (like [HaFr77], [Aldr79]) aim at identifying characteristics, both within an organisation and in its surroundings, that contribute to a successful "life" or to "death".

Different from the rational perspective, empirical research emphasizes a descriptive rather than a prescriptive view. Nevertheless, it can deliver valuable insights for the design of organisations by identifying - context-sensitive - characteristics of an organisation that evidently contribute to a firm's success.

2.3 Organisation as a Social Phenomenon

Within the social sciences there are researchers who deny that applying natural science methods is suited to detect all aspects that are of relevance for a deep understanding of social phenomena. Instead, they favour a hermeneutic approach that aims at interpretations of social action and symbols. D'Andrade speaks of the "natural science approach" and the "semiotic approach": "On one hand, the natural-social science world view sees a complex system of causes as the web of interdependence and functional relations among the structural parts. The role of the scientist is to isolate these structures and measure these causes. The semiotic-social science view world view, on the other hand, sees a complex generation of meanings and symbols that serve to structure social action." ([D'An86], p. 25)

The hermeneutic perspective on organisation tries to contribute to a more adequate understanding of organisations. For this purpose, authors that feel committed to this perspective, often challenge common conceptions of organisation. This is especially the case for those concepts that are favoured within the rational perspective. Different from the image that organisations are based on clear goals and rules of action to serve these goals, Weick argues that cooperative work in organisations is hardly based on clear rules. Instead, he states that the informational inputs organisations operate on are "ambiguous, uncertain, equivocal" ([Weic69], p. 40). According to Weick, the absence of coherent goals is more likely to be typical for organisation than their existence. The notion of organisation as it is suggested by the rational perspective is a result of mystification. In this sense, Meyer and Rowan regard explicit organisational rules as "highly rationalized myths that are binding on particular organizations" ([MeRo77], p. 343).

If behavioristic research is regarded as being not appropriate, what else could be done to get a deep understanding of organisations that is not based on ideology and myths? This question touches a severe epistemological problem that has not been solved yet. Nevertheless, the proponents of a hermeneutic approach suggest that the analyis of social phenomena should be

based on common experience, and the use of analogies and metaphors. Morgan refers to successful managers and professionals in all walks of life who have become "skilled in the art of 'reading' the situations that they are attempting to organize or manage." ([Morg86], p. 11). In order to "develop deep appreciations of the situations being addressed (ibid), he suggests the use of metaphors: "... the use of metaphor implies a way of thinking and a way of seeing that pervade how we understand our world generally." ([Morg86], p. 12) He assumes that looking at a subject from different angles contributes to a better understanding of it - similar to Berger and Luckmann who state that the subject of thinking becomes gradually clearer with the number of perspectives that are used to look at it ([BeLu80], p. 11). For this reason, the method he recommends aims at constructing or finding metaphors that are suited to stress different views on the complex phenomenon of organisation:

> "Stated in more conventional terms, there is a difference between the full and rich reality of an organization, and the knowledge that we are able to gain about that organization. We can know organizations only through our experience of them. We can use metaphors and theories to grasp and express this knowledge and experience, and to share our understandings, but we can never be sure that we are absolutely right. I believe we must always recognize this basic uncertainty." ([Mor86], p. 341)

In [Morg86] he describes a number of metaphors or images on different levels of abstraction: "organisations as organisms", "organisations as political systems", "organisations as psychic prisons", "organisation as flux and transformation". Weick [Weic80] also uses metaphors and analogies. Especially those that do not stress evident associations at first sight, help to discover "hidden" aspects of organisations. For instance: To illustrate that individual perception and conceptualisation in organisations depend on common beliefs and socially constructed rules of action, he tells the story of three umpires who discuss how they call the strikes. The first says that he calls them as they are and the second umpire states that he calls them as he sees them. The third and smartest one says: "They do not exist before I call them." ([Weic80], p. 6)

The idea that there are aspects of organisation other than explicit structures, procedures and rules, became popular in the eighties with the term "organisation culture". The basic assumption is - similar to Morgan and Weick - that successful collaborative action in organisations depends very much on common values, symbols and individual commitment - hence on something one could call culture. While this assumption seems plausible, culture remains hard to conceptualize and to identify: "... an undefined, immanent characteristic of any society ... with varying and little understood incidence on the functioning of organizations." ([AlFi84], p. 194) Based on the idea that an adequate culture promotes organisational performance, two business consultants, Deal and Kennedy, suggested that introducing the right culture is a managerial task. However, they do not provide a substantial concept of culture ("shared values, heroes and heroines, rituals and ceremonies.", [DeKe84], p. 501). Instead, they describe features of organisation culture within a number of case studies they have conducted in successful companies. From a methodological point of view such an approach is hardly convincing because the causal relationships are not clear: Does success allow for a "nice" culture, or does the proper culture promote success? Despite these problems, it is important to not that culture deserves attention when it comes to analyse and (re-) design organisations.

2.4 Organisation Models as Medium and Subject of Discoursive Design

The short overview of different perspectives was to show that every single perspective has its particular advantages and shortcomings. In order to gain a deep understanding of organisations, it is probably a good idea to combine these perspectives since each of them contributes specific insights. The background of this report is enterprise modelling. Within MEMO, an enterprise model consists of a number of models that describe different perspectives on an enterprise. The organisation is one of these perspectives. An enterprise model is to serve a number of objectives. It should provide a medium for people to communicate about the current situation of a firm and about future options. That recommends representations that are intuitive for most participants. In addition to that, it should prepare the design of information systems which are in line with the organisation. In order to fully exploit the potential of information technology, the organisation may have to be redesigned. In this case, the model of the organisation serves as a blueprint of design. A seamless integration of organisation and information system recommends to map (we could also say: to reconstruct) parts of the organisation to the information system. For this reason, there is emphasis on precise or even formal descriptions of the corresponding aspects of an organisation.

In a way, such an approach reminds of the rational/mechanical perspective. There is, however, one crucial difference. We do not belief that organisations can be constructed like software systems. Informal aspects such as organisation culture, individual goals and preferences as well as individual and common learning are important determinants of successful organisations. Nevertheless, due to the complexity of the subject, it makes sense to abstract from certain aspects - not: to forget about them. Organisation models are abstractions that are introduced to facilitate the development of efficient information systems. Such an abstraction makes sense for two reasons. Firstly, in most firms, information technology has shaped almost every area of the organisation - we could also say: it constitutes organisational reality. Secondly, the mutual adjustment of organisation and information systems is a complex task that recommends to concentrate on selected aspects.

Therefore we recommend to treat organisation models as instruments, not as an expression of an epistemological preference. Notice that emphasizing the need for (semi-) formal descriptions of organisations does not mean to completely exclude other aspects. Even a model that is constructed in a formal language may foster vivid discussions that include concepts and interpretations which are not explicitly defined in the model. The maps of the yard that were introduced by Taylor illustrate this point: The map itself tells only little about the work that is done in the factory. However, it serves people as a common and stable reference they can use when they talk about other aspects of organisation. Enterprise modelling is certainly more than drawing maps of company buildings. MEMO aims at specifying (semi-) formal languages to describe certain aspects of a company. MEMO-OML serves to describe and design organisations. There is no doubt that a (semi-) formal language is not suited to represent any relevant aspect of an organisation. Nevertheless, the attempt to define a specific language for all participants of an organisation is at the core of organising which is characterised by Weick ([Weic80], p. 3) "as a consensually validated grammar for reducing equivocality ...". Although such a language should be (semi-) formal, it should also serve as a medium for human communication. That recommends not to create a new, artificial language from scratch. Instead,

such a language should include common concepts and corresponding representations (see chapters 3, 4). Notice that the concentration on those aspects of organisations which allow for (semi-) formal descriptions does not exclude to enrich corresponding models with associated analogies, metaphors, scenarios or case studies that may contribute to a deeper understanding of the phenomenon. Against this background,

3. Organisation: Core Concepts

The term ´organisation´ is ambique. On the one hand, it denotes social systems - with or without well defined goals. We call this the *institutional* aspect of the term. On the other hand, it denotes conventions, regulations etc. that serve to define the separation of concerns and the mode of cooperation within a social system. We call this the *instrumental* aspect of the term. In the common use of the term, both aspects are often intertwinned and the actual emphasis depends on the particular context. In the remaining part of this report the focus is on the instrumental aspect - which is in line with the origins of the word organisation that goes back to the Greek *organon*, meaning tool or instrument. If not explicitly expressed otherwise, the term organisation represents the instrumental aspect. For analytical purposes, the instrumental notion of organisation can be differentiated into two dimensions: *structure* describes the static aspects of an organisation (German: "Aufbauorganisation"), while *process* focuses on dynamic/operational aspects such as tasks and business processes (German: "Ablauforganisation"). In the following sections, we will identify essential concepts to describe structure and process. They are inspired by the terminology used in German organisation studies - for reasons outlined in 1.

3.1 Business Processes

The instrumental notion of organisation is mainly based on two pivotal concepts: *division of labour* and *coordination*. Division of labour results in elementary pieces of work. Combining them into efficient processes requires to coordinate (or synchronize) them. The German term "Ablauforganisation" denotes the system of processes within an organisation. It includes both administrative processes and production processes. The focus of this report - similar to most publications on organisational analysis and design - is on administrative processes. While numerous mathematical models have been developed to help with ressource planning and scheduling within production processes, the terms used to define the administrative business processes are mostly not introduced in a precise language. The following descriptions of these terms is an attempt to reconstruct their usage in the corresponding literature in a fairly representative way. It is mainly inspired by [LiSu89] and [Gait83], two of the most influential text books on the design of business processes.

An *activity* (German: "Verrichtung") is an elementary piece of work. Within a particular context it is not divided into smaller pieces. Usually, an activity is performed on an *object*. An object can either be a physical entity, like a paper form, a (traditional) file etc., a representation of a physical object, like a record representing a customer, or a non-physical object like a price (or its representation). Liebelt and Sulzberger characterize a *task* as a permanently effective request to act in a certain way. According to them, a task is described comprehensively only if it comes with an explicit list of all the activities (and the object they are performed on) which are required to accomplish it ([LiSu89], p. 18).

Task

Object	Activity
Order	*carry out*
Department	*manage*
Order Document	*write*
"	*edit*
"	*forward*
"	*file*

Table 1: Describing Tasks through the Assignement of Activities to Objects (translated from [LiSu89], pp. 19)

Other authors favour a less deterministic notion of a task (for instance: [Kosi62], pp. 32; [Groc82], pp. 184). Gaitanides makes a difference between the objective of a task and its content ([Gait83], p. 55). A task can be decomposed into subtasks. Apparently this includes the implicit constraint that decomposition hierarchies must not be cyclic ([LiSu89], p. 19). According to most authors, a task can be performed either by a human or a machine. However, that is apparently not the adequate level of granularity: Within a task, some activities may be performed by a machine (for instance: by software executed on a computer), others by a human. It seems that there is another reason for assigning a human to a task: Different from a machine (at least for the time being), a human can take *responsibility* for a task. Against this background, we suggest the following semantic reconstruction: An activity can be performed either by a machine or a human. Only a human can have *competence* (which should match the requirements of the task, [Groc82], S. 102) and *responsibility*. Notice that assigning both humans and machines requires appropriate concepts, like positions, roles or types of machines. They will be discussed in 3.2. Performing an activity may require *resources*. Ressources include tools and machines (like communication devices, calculators, staplers etc.) as well as material/energy that is consumed within an activity - such as paper, ink or electricity. Usually, *information* is introduced as a separate kind of input required in a task and produced by it. From our point of view it is remarkable that those authors that stress an organisational perspective mostly do not take into account common concepts to describe information stored in information systems (like records, entities, objects, operations ...).

A process is usually conceptualised as a sequence of tasks. Liebelt and Sulzberger differentiate between four types of sequential relationships between tasks: logical, temporal, spatial and quantitative ([LiSu89], pp. 26). Logical relationships between tasks are described as one of the two patterns: task1 OR task2; task1 AND task2. Similar to boolean algebra, logical terms can be combined. For instance: (task1 AND task2) AND (task3 OR task4) ... However, there is no precise definition of the meaning. It seems that OR represents an exclusive or only (but there is not explicit statement). Also, logical relationships are confused with temporal relationships ([LiSu89], pp. 26). Notice that the authors provide a more differentiated description of logical

relationships later by using graphical illustrations (see 4.1). The description of temporal relationships refers to durations, points in time and time intervalls. Again, there is no precise definition. Duration seems to be the time that is required to perform a task or an activity or the duration of a state. Points in time are simply defined as the time (or date!) when a task starts or stops. Intervalls are defined by a start time and an end time. Spatial relationships refer to physical movements required within a process. For instance: Order processing may require to transport the order document from one office to another. Quantitative relationships refer to the number of objects being processed. For instance: After being pre-processed, incoming orders will be collected to a certain number. Only then the next task, like creating delivery documents, will be triggered.

While the terms suggested in [LiSu89] are not representative in every aspect, they have one characteristic in common with most publications on the subject within organisation studies: They remain on a rather superficial and vague level - which does not mean to criticize them: For the purpose of organizing traditional processes (with no or little use of IS) ambiguity and incompleteness do not have to be a problem (while the precise use of language may cause problems with the recipients). Because the application of vague and ambiguous concepts

The concepts outlined above do not determine how to organise and specify a particular type of business process. In the literature there are dimensions of organisational design which can be used to characterize the description of a process type ([Gait], pp. 21). *Standardisation* denotes the degree to which certain activities are performed by routine procedures. In other words: The more standardized a process type, the less variety you can find within the execution of a particular instance. The level of *programming* increases with the rigour applied to define how activities have to be performed. Different from its meaning in most other disciplines (including computer science), the *formalisation* of a process increases with the extend of the written (natural language) documentation. Finally, the level of *specialisation* grows increases with the division of labour within a process. Obviously, these aspects are not dimensions in a strict sense: while standardisation and programming can hardly be distinguished, the aspects are not independent from one another: programming will usually require formalisation, chances for standardisation/programming will usually improve with the level of specialisation. For this reason, these "dimensions" cannot be used to characterize the specification of a process type in a convincing way. Nevertheless, they include aspects that are relevant for the design of a modelling language. Firstly, there is the formal rigour, a process specification should satisfy: It depends on the concepts provided by the language used for the specification. Secondly, standardisation is related to the *reuse* of activities or tasks that have been specified once in another context.

In recent years, the increasing popularity of the term "business process (re-) engineering" has drawn attention to a number of additional aspects. It is an essential idea of the (re-) engineering paradigm ([HaCh93], [Dave93]) that the outcome of a process is directed towards a *customer* - be it an external customer or an customer within the firm. The concept of a customer is to emphasize that a process has to be designed to fit the requirements of those who finally pay for the outcome. Furthermore, there is the concept of a *process owner*. The process owner is the person or the organisational unit that is in charge of the whole process. This concept denotes a pivotal difference from traditional function-oriented organisation: In order to avoid friction that is caused by many functional organisational units (like procurement, production, account-

ing, etc.) being in charge of different parts of a process, it suggests that one organisational unit is in charge of the whole process. This will be the case, too, if many organisational units participate in performing the process. The process owner is responsible for the performance and the outcome of the process. Also, the process owner represents the whole process in terms of inquiries or complaints made by a customer.

If the organisation and the management of processes are regarded as a critical success factor, the evaluation or measurement of a process becomes a relevant issue. There are, indeed, numerous concepts that have been introduced to evaluate and control processes with respect to relevant performance criteria. From an accounting perspective, activity based costing (or cost driver accounting) ([CoKa91], [HKM+93]) is aimed at assigning costs to processes - in other words: a process is regarded as a cost unit. Activity based costing is motivated by the need to analyse overhead expenses in order to allow for improved methods to assign direct costs to products or services a process is aimed at. In a nutshell, the implementation of activity based costing requires five steps [Webe00]. Process analysis aims at identifying the products or services that are produced within a particular process type. The second step consists of assigning costs to process types. This includes both, costs that are directly caused by the process as well as costs caused by resources that are used outside of the process as well. After that the *cost drivers* have to be identified. A cost driver is a factor that causes directly the consumption of resources - like the number of orders within a process. The next step serves to calculate the volumes of any cost driver within a reference period. Based on this information, the final step can be performed: assigning process costs to products and services that are subject of a process. From an accounting point of view, such a procedure leaves the accountant alone with a severe problem: How much effort should be spend to improve the accuracy of cost assignment? However, in this paper we can neglect specific accounting problems. We are only interested in terms/concept that are relevant to describe processes - not in methods to determine the state of particular instances. Therefore, we have to memorize the following concepts: cost driver, costs assigned to an activity, costs assigned to a process, costs assigned to products/services produced by a process.

3.2 Organisation Structure

As already outlined in 2.3., the emphasis of this report is on concepts used for organisational design. For this reason we will mainly take into account terms and concepts that are common within the rational perspective (2.1). In a simplified way, organisation structure can be regarded as an aggregate of *organisational units*. An organisational unit in turn can include a number of other organisational units. A *position* is an organisational unit that cannot be decomposed any further. Although it is not mentioned in many textbooks on organisations, a *role* is obviously a relevant concept, too. While roles are similar to positions, the concept of a role is orthogonal to the concept of a position: An employee can hold many roles at a time - more or less independently from his position. For instance: A system engineer (position) can act as a system administrator (role), database administrator (role) and as a consultant for C++ (role). Notice, that the difference between a role and a position is subtle because it is context dependent: A position in organisation A can be regarded as a role in organisation B. The concept on an organisational unit reflects the need for the division of labour. At the same time, organisational units include rules to guide coordination and control, expressed in concepts like *respon-*

sibility and *authority*. There are different principles that are applied to develop an organisation structure ([Schr98], pp. 132). Dividing labour with respect to *functions* recommends to create organisational units by grouping certain functions and related responsibilities. For instance: The overall organisation structure consists of departments like procurement, finance, accounting, marketing etc. In contrast to a function-oriented approach, an *object-oriented* approach (not to be confused with the use of the term in software engineering) leads to organisational units that are assigned to objects like products, markets or regions. On the highest level, these units are often called *divisions* (at least in large corporations). Often, both principles are combined. For instance: The marketing department may include organisational units that are assigned to particular products or product lines. Within a so called *matrix organisation*, function-oriented and object-oriented aspects are combined. For instance: The overall organisation structure is divided into *strategic business units* each of which is in charge of a particular product line. A business unit in turn is organized in a function-oriented way.

Usually, an organisational unit is characterized by a more or less comprehensive list of tasks it is responsible for. Also, there may be a description of the decisions that may be made within the unit without consulting other units as well as a definition of the authority to issue directives. An organisational unit may have none, one or many superordinated units as well as none, one or many subordinated units. In case an organisational unit may receive directives from one superordinated unit only, one speaks of *one line of command*. If it is possible that an organisational unit receives directives from more than one superordinated unit, one speaks of *multiple lines of command*. Different from organisational units which are embedded in a line of command, *staff units* do not have any subordinate or superior unit. Instead, they are usually assigned to one or more top management units in order to provide professional consultation (legal advice, strategic planning ...). Sometimes, the term *configuration* (German: "Konfiguration") is used to characterize an organisation structure with respect to the distribution of command ([Groc82], p. 25). It is defined by two quantities. The number of *levels in the hierarchy* and the average *span of control*. The span of control of a particular organisational unit is the number of directly subordinated units. Note that both quantities can be calculated from the description of an organisation structure.

In recent years, there has been growing awareness of organisation structures that put less emphasis on hierarchy. They are associated with terms like network organisation or team-oriented organisation. Different from hierarchical structures, the relationships between organisational unit are not determined by super- or subordination. Instead, they are characterized by terms like "cooperates with", "supports", "interacts with" etc. While basic concepts of team-oriented structures have been introduced already a few decades ago ([Like61], [Gole67]), the penetration of companies with networked information systems was accompanied by demands for corresponding organisation structures. They are mainly motivated by the assumption that an organisation with more independently acting units is more flexible ([WoJo96], [Quin92]) - which becomes an essential asset with the growing dynamics of markets and the need to handle "uncertainty, ambiguity, and risk" ([NoEc92], p. 290). Within a corporation, there are organisational units that serve as centers of competence ([Schr98], p. 201). Depending on tasks and goals to be accomplished, interaction and interdependency between different units is more or less intensive. Hence, the overall organisation structure can be visualised as a net of organisa-

tional units with various clusters of units that closely cooperate. Jarvenpaa and Ives speak of "knowledge nodes", where each node can be "an individual knowledge worker, a team of knowledge workers" and/or an "independent organization." ([JaIv94], p. 34) According to Badarocco, its "stronghold is the knowledge embedded in a dense web of social, economic, contractual, and administrative relationships." ([Bada91] pp. 13)

With respect to modelling an organisation, this recommends to introduce concepts that are suited to describe knowledge/competence in an adequate way. In its extreme form, a network organisation consists of many independent organisational units which may be distributed all over the world, thus constituting a "global web" [Reic91]. Depending on the level of interdependence and the marketing strategy, the network may represent an "inter-organisational system" or a "virtual corporation" ([DaMa93]). An inter-organisational system ([Klei96] , pp. 39) is based on a common information technology infrastructure which allows for increased connectivity and convenient access to distributed resources. From an organisational perspective, inter-organisational systems can exist on different levels of integration. On the one hand, an inter-organisational system can represent a loosely coupled group of companies that decided to interconnect some parts of their information systems. On the other hand, a group of companies that has established inter-firm business processes and is based on a high degree of mutual dependence, can also be regarded as an inter-organisational system. In the latter case, the network of companies may want to act as one company - for instance for marketing reasons. In this case, one speaks of a virtual corporation. In the case of a virtual corporation, corporate boundaries are hard to identify and they may move in time [PRW97]. Inter-organisational systems and virtual corporations are an attempt to combine the strength of relatively small organisational units - like flexibility and speed - with the strength of large corporations. In other words: They emphasize decentralized decision making and still allow for synergy through economics of scale:

> "... from a performance standpoint, networked organizations are seen to allow firms to retain small company responsiveness while becoming larger and more complex. ... The attractiveness of networked firms as such is that by adding IT as a design factor we may be able to design firms that can simultaneously increase size, complexity and responsiveness." ([RoSh91], p. 191)

With respect to the design of an organisation modelling language, these considerations have a number of implications. Firstly, an organisation does not have to belong to a particular company any longer. Instead, many companies can share it. This is also the case for organisational units or business processes. Secondly, in networked organisations information systems and communication media are of pivotal importance. We may also state: They are a vital part of the organisation. That requires rich concepts to describe the role of information technology and communication media within business processes or team-oriented decision processes [Joha88].

3.3 Projects

A *project* can be regarded as a special type of organisation. It has both, structural and dynamic aspects. The structural aspects include the positions, roles or organisational units that are involved in a project or have been especially created for the project. The dynamic aspects relate to a project as a process. It is the latter which is usually regarded as more relevant. Different

from a business process, a project is not repeated again and again. Instead, a project is characterized by its unique occurrence and a high degree of complexity. In other words: While a type of a business process has many instances, the type of a project has usually only one instance. As a consequence, the need for resources and time are usually harder to estimate than for business processes. Therefore, planning and management of projects mainly aim at reducing or isolating sources of uncertainty. For this purpose, it is common practice to apply the "divide and conquer" principle: the entire project is divided into tasks which are further divided into activities until the resulting activities are the same as or similar to well known activities. Depending on the level of complexity involved in a particular project, it can be helpful to apply formal procedures to optimize a project's dynamic organisation according to given goals - like minimization of execution time or costs. It is also common to assign probabilities to estimated times or amounts. Already forty years ago, operations research has produced a number of network planning techniques, such as CPM (Critical Path Method), PERT (Program Evaluation and Review Method) and MPM (Meta Potential Method) to support the planning of projects (for an overview see [MeMa95]). The methods differ mainly with respect to the abstractions they use. Some of them suggest to divide the whole process of a project into *activities*, others focus on *events*. However, events and activities are closely interrelated: an activity is triggered by an event and its termination produces one or more new events. Usually there are four different temporal relationships to arrange activities:

- activity B may begin only after activity A has terminated
- activity B may begin only after activity A has begun
- activity B may terminate only after activity A has begun
- activity B may terminate only after activity A has terminated

Due to the contingency that is typical for projects, much emphasis is put on reducing risk. This includes estimation of required resources and of the minimum/maximum time to complete a project. The term 'critical path' is intended to develop an idea of the time a project may take. A path is a sequence of activities between two events within a network that represents the dynamics of a project. A path is critical if its delay will delay the completion of the whole project ([MeMa95], p. 338). Similar to the description of business processes, often graphical notations are used to visualize the dynamic aspects of projects (see 4.3). Within CPM, critical paths can be explicitly visualized (see fig. 25).

Besides their procedural aspects, projects are also characterized by specific organisation structures. They are special for at least two reasons. Firstly, they are established for a limited time only. Therefore they can be regarded as temporal units. Secondly, a project may be performed together with other companies. Therefore it can include organisational units that cross corporate boundaries. An increasing number of companies faces complex tasks with a unique character. Therefore, integrating projects in an existing organisation becomes a relevant issue ([ClWh92], [Midl95]). Often, projects as temporal organisational units are orthogonal to permanent units, thus resulting in an overall matrix organisation. For instance: There are projects assigned to the marketing department or to the production department. In some companies, like consulting firms or software producers, the majority of work is done in projects. In these cases, the organisation structure clearly reflects the importance of projects. Beside a few permanent

organisational units, like "Controlling" or "Personell", the organisation structure is determined by projects. In this case, one can speak of a "project-oriented" organisation ([Schr98], p. 196). If it is common to manage several projects in parallel, the corresponding organisation is sometimes referred to as ’multi-project organisation’ ([Grün92]).

In textbooks on organisation studies, projects are usually a minor subject only. On the other hand, publications on project management often lack a substantial background in organisation theory. Different from general organisation studies, text books on project management emphasize mainly an engineering perspective and reflect upon practical experience. With respect to the complexity and contingency of projects, it makes sense to treat them separately from business processes and organisation structure in general. However, from a conceptual point of view, the relationship between projects and business processes is very interesting. Obviously, there are common features. On a high level of abstraction, a project can be regarded as a business process, the main difference being that a particular project is the sole instance of an implicit project type, while a particular process is one of many instances of a corresponding process type. The relationship between type and instance is of crucial importance: It is the prerequisite for defining concepts which can be applied (reused) in many cases. There is two ways to make use of existing knowledge about projects. Firstly, it is possible to define generic project types in terms of high level descriptions (for instance: so called process models for software development) that allow for extensive adaptations on the instance level. Secondly, and more challenging, one can take advantage of similarities between projects. In this case, the notion of similarity becomes crucial for the definition of specialised concepts and the reuse of knowledge about projects and project management. We will not try to define a concept of project similarity here, but we may conclude that project descriptions should take into account features that are suited to indicate similarities. Such features may include project goals, resources, involved technology etc.

3.4 Integration of Structure and Process

As already mentioned above, the differentiation into organisation structure and process happens mainly for analytical reasons: Abstracting from one of the two aspects decreases complexity. Nevertheless, there are obvious interdependencies. Both, organisational units and business processes are defined with respect to tasks that have to be performed or goals that have to be accomplished. Organisational units are responsible for a business process (or a part of it) and a business process in turn is the reification of the work to be performed in one or more organisational units. The following example (fig. 1), an excerpt of the specification of the position ’Clerk’ in a procurement department, illustrates this relationship. Those tasks which can be regarded as parts of business processes are typed in italic.

Name	• senior expert for procurement
Objectives	• obtaining goods and services for the company from the most appropriate sources - with respect to price and quality standards
Reports to	• head of department of procurement

Substitutes	• senior expert of procurement, head of department of procurement
Substituted by	• senior expert for procurement
Tasks	• monitor market developments • *detect and record competitive suppliers and products* • *determine delivery dates* • *check orders for correctness* • *ask for offers* • *decide for best offer* • advice other organisational units in terms of quality and other relevant aspects

Table 2: Excerpt of the Specification of a Position (adapted and translated from [Groc82], pp. 330)

However, from the standpoint of organisational design, the differentiation between structure and process makes a lot of sense. To design an organisation, one can start with the organisation structure or with business processes. In both cases, the focus is on goals or tasks.Early german organisation studies recommended to design the organisation structure by analysing the tasks (German: "Aufgabenanalyse", [Kosi62]). Beginning with the overall subject of the firm, the tasks or functions are decomposed. Decomposition continues until the size of a task is small enough to be assigned to a single position - or until the effort to be spent for further decompositon is regarded as too high. Organisational units result from the hierarchy of functions to be performed: For each function a corresponding organisational unit has to be defined (an organisational unit in turn may be responsible for more than one function). Fig. 2 illustrates a functional decomposition within car manufacturing company. Notice that these are functions - not organisational units.

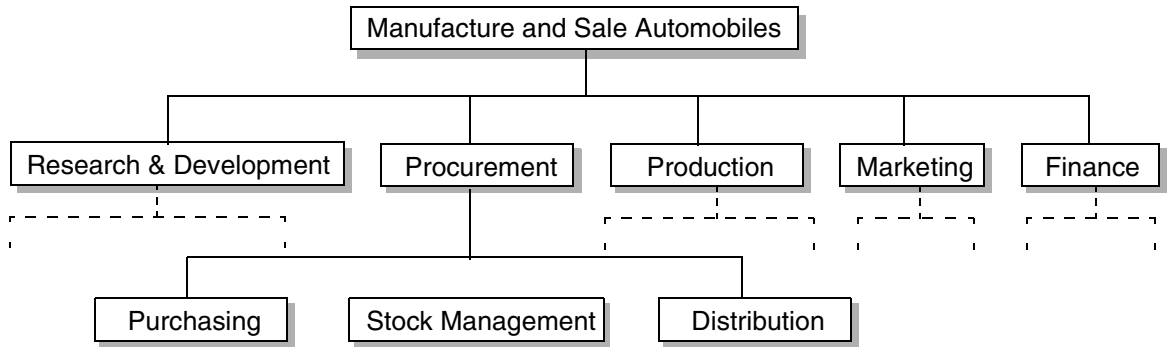


Fig. 1: Organisational Design through Functional Decomposition

Business process (re-) engineering recommends a slightly different approach: It does not focus on tasks but on processes. While processes are composed of tasks as well, the main difference is the motivation of the analysis. As already outlined above, a business process should be designed to meet the needs of its customer. Based on the assumption that the design of core processes is essential for the corporation to be competitive, the design of a process-oriented organ-

isation reflects the principle "structure follows process". First, the processes are defined, including all the tasks that are required. Then the tasks are grouped into homogeneous units which are then used to define organisational units. The management of projects also requires to integrate the procedural aspects of a project with the related organisation structure. For this purpose, organisational units and roles are assigned to activities.

4. Graphical Representations

The overview of the terminology used to describe business processes and organisation structure shows that there are a number of relevant terms - like task, activity, resource, organisational unit, responsibility - which should be taken into account for the specification of an organisation modelling language. At the same time it is obvious that the definitions of these terms are usually not comprehensive and precise enough to be used for a (semi-) formal modelling language. The definitions seems to be not comprehensive for two reasons. Firstly, they use colloquial terms that are sufficient for (human) understanding. Secondly, the descriptions of many concepts relies - at least in part - on graphical representations. The following overview of graphical representations of organisation serves two purposes. On the one hand, we are looking for further descriptions of concepts - in other words: for more semantic details. On the other hand, common graphical representations should guide the design of the graphical notation of the intended organisation modelling language.

4.1 Business Processes

When it comes to the description of processes, it seems that graphical representations are often more appropriate then mere textual descriptions. Therefore it is does not come as a surprise that there is a plethora of graphical notations to render business processes. In the following overview, we differentiate early approaches from those notations that are used in modelling tools. This is for two reasons. Firstly, early approaches usually neglect information and information technology. This is different with later approaches that are part of "process engineering" tools. Secondly, the intended modelling language will also be reconstructed for a tool ([Fra98], p. 11). Therefore, the notations deployed in tools are of special interest with respect to the purpose of this report.

4.1.1 Traditional Approaches

Early publications on graphical representations of business processes like [Nord32] aimed at visualising relevant aspects in an intuitive way. These publications usually lack a precise definition of the graphical notation. Nevertheless, they are valuable for our purpose in so far that the authors often have extensive experience in the field of process organisation. The work of [LiSu89] follows this tradition. On a high level of abstraction, they suggest decomposition diagrams which are popular in other areas as well. A decomposition diagram (fig. 2) allows to render how a process is decomposed into sub processes or activities. In principle, it is the same approach as the one shown in fig. 1, except for the difference that a process decomposition diagram always starts with an actual process as its root. While such a diagram allows to decompose a process down to detailed activities, its does not include any information about temporal or causal aspects of a process.

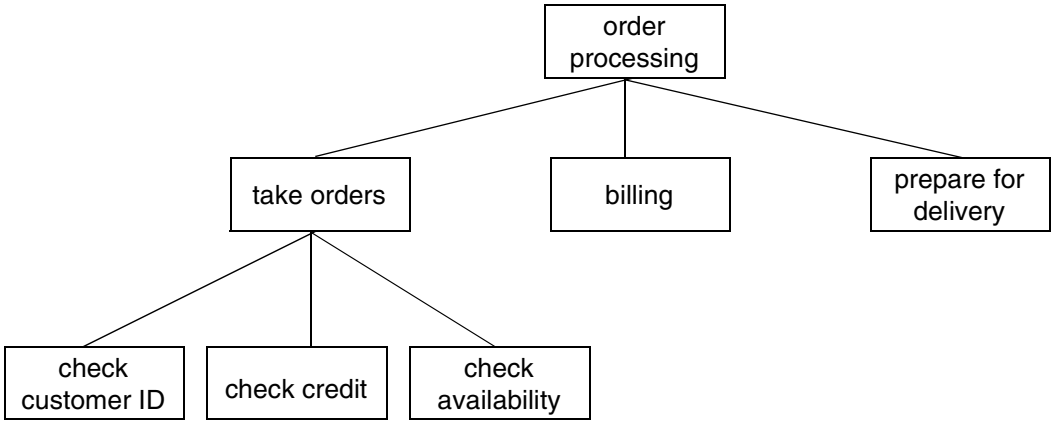


Fig. 2 Example of decomposition diagram

In order to render temporal or causal relationships within a process, many authors use diagrams that are inspired by techniques used to specify algorithms. Liebelt and Sulzberger, for instance, suggest a representation of processes that resembles control flow charts. A business process is rendered by rectangles that represent tasks or activities the meaning of which is illustrated by a name. The rectangles are connected by edges. Fig. 3 shows a small example. While there is no explicit definition of the temporal order of the activities/processes, it is obvious that the process starts with the activity at the top of the diagram. Its execution proceeds from the top to the bottom.

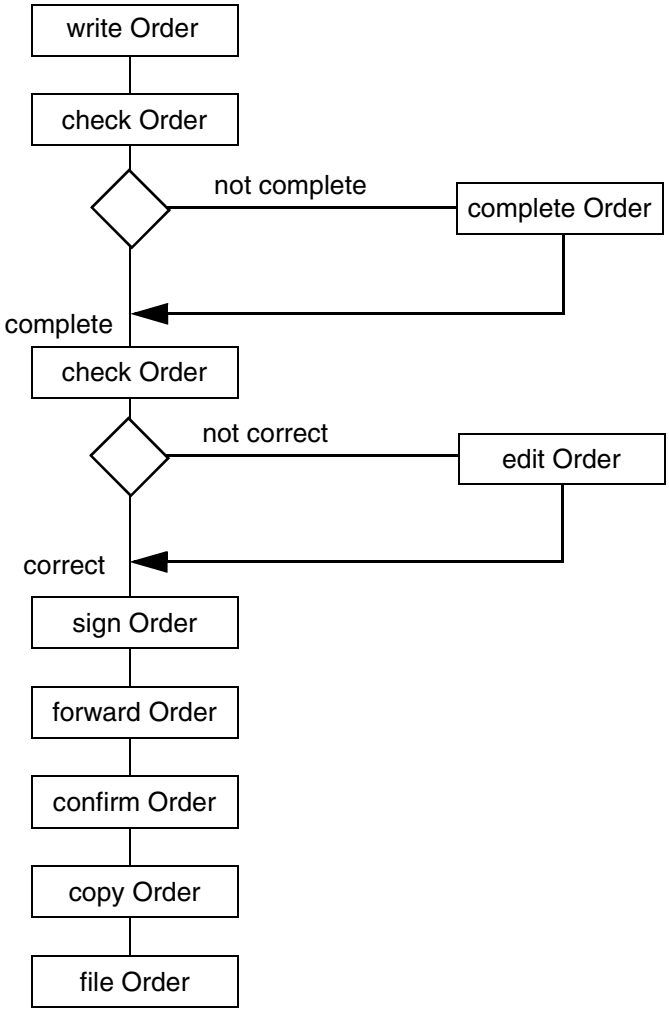


Fig. 3: Example for the Graphical Representation of a Business Process. Translated from [LiSu89], p. 22.

The example in fig. 3 illustrates that a graphical representation is helpful as a medium to foster discussions about a process (for instance: why would you check for completeness before checking for correctness?) - although it is ambiguous. Apparently, the representation includes temporal and logical aspects that determine the sequence of activities. Fig. 4 shows the different types of sequential relationships that are suggested by Liebelt and Sulzberger.

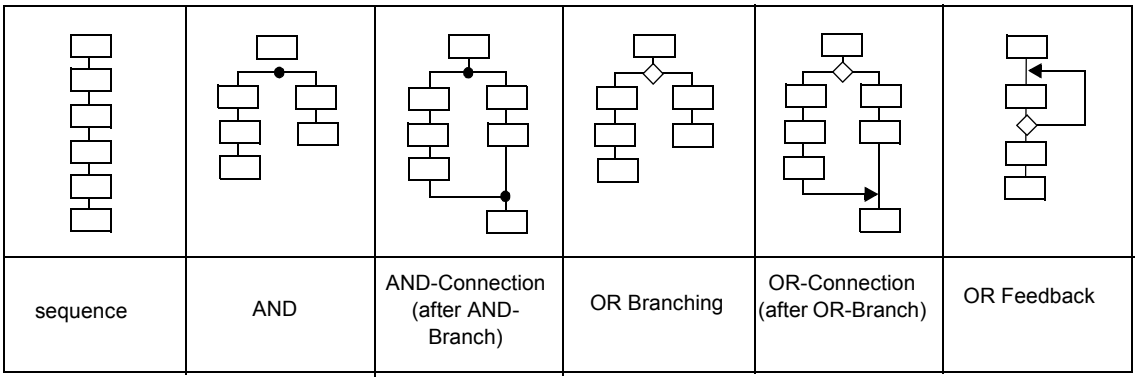


Fig. 4: Representation of temporal order and logical control. Translated from [LiSu89], p. 45

Obviously, formal rigour is not regarded as a relevant criterion. Sometimes the authors even do not follow their own recommendations. Fig. 5 shows a so called OR branch that is not - different from the templates in fig. 4 - rendered by a rhombus. Also, the name of the rectangle that is used to indicate the OR branch refers to an object (order) only. There is no explicit boolean expression. Hence, the meaning of the representation depends almost entirely on the observer's interpretation.

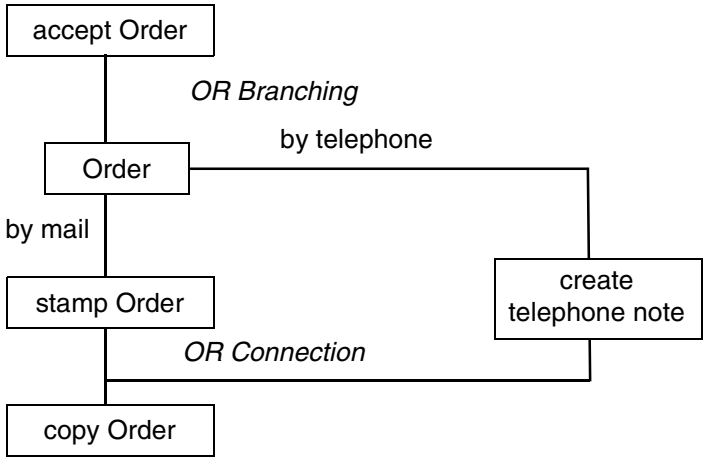


Fig. 5: Example for so called "OR Branching" and "OR Connection". Translated from [LiSu89], p. 44

While the notation used in fig. 5 focuses on temporal and logical aspects within the execution of a business process, there are other abstractions as well. Fig. 6 shows the visualisation of spatial relationships within a process. Note that there is no description of the notation. Instead the

authors use a simplified elevation of a building.

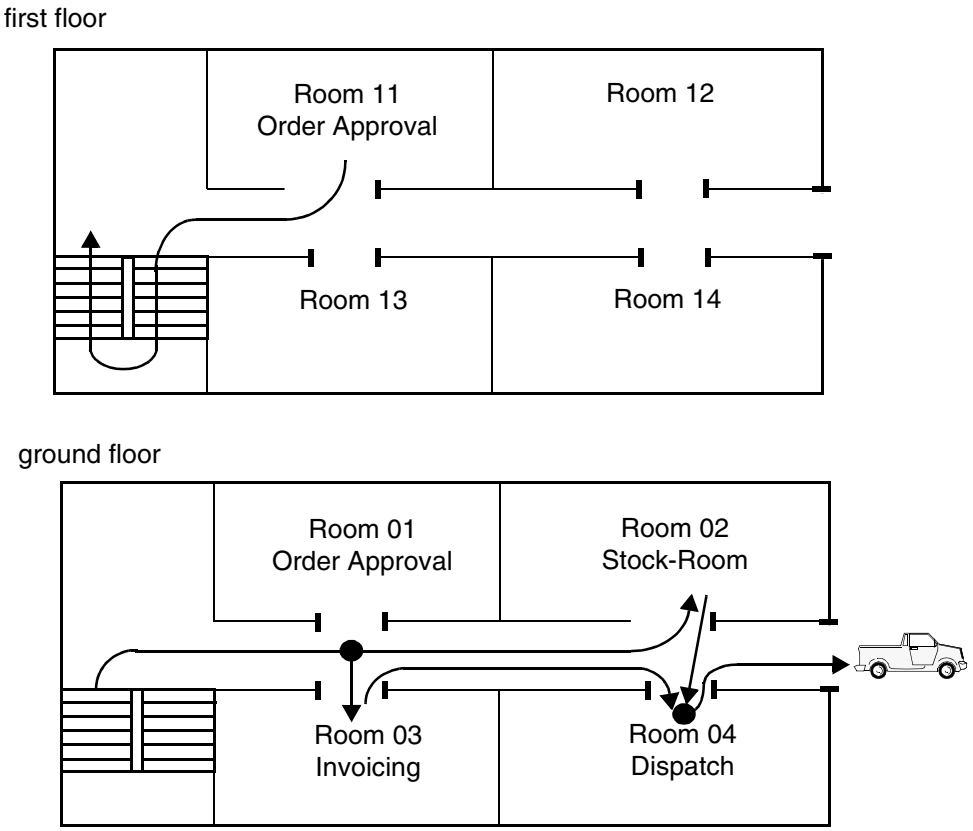


Fig. 6: Visualization of physical movements within a process. Translated from [LiSu89], p. 32

Although analysing the physical distribution of objects within a business process may reveal hints to improve the process, spatial aspects are of little relevance for administrative processes - which are at the focus of MEMO. This is for a number reasons. Within administrative processes the transportation of physical objects is mainly restricted to media that carry information - such as forms, files etc. However, with the increasing penetration of offices by information technology, physical distribution of information objects within one company is more and more vanishing. Even if it still happens, the management of the physical distribution will usually be not at the centre of re-organising efforts. In addition to that, elevations of buildings are not an appropriate abstraction in the long run anyway: Offices may move. Nevertheless, physical transportation of information objects should be taken into account within a process model, since it often indicates media clashes and therefore provides hints for process improvement.

The representation of a process in fig. 3 does not include special symbols to render objects that are handled within a process. Also, only one symbol is used to render activities. For graphical representations that give a more detailed and differentiated view of a business process, there is need for symbols to visualize (information) objects and different kinds of activities or operations. In the seventieth, there was an increasing awareness of electronic data processing as a key issue of organising processes. At the same time, organisation science had not developed a

suitable terminology to deal with corresponding concepts. Therefore, a number of authors (like [Gait83], [Groc82], [LiSu89]) adapted a notation which was standardized by the "Deutsche Institut für Normung" (DIN), the German national organisation for standardisation. The standard DIN 66001 defines symbols for flow charts. Fig. 7 shows that there are symbols for three different concepts: operations, data media and data flows. In addition to those, there are connection symbols.

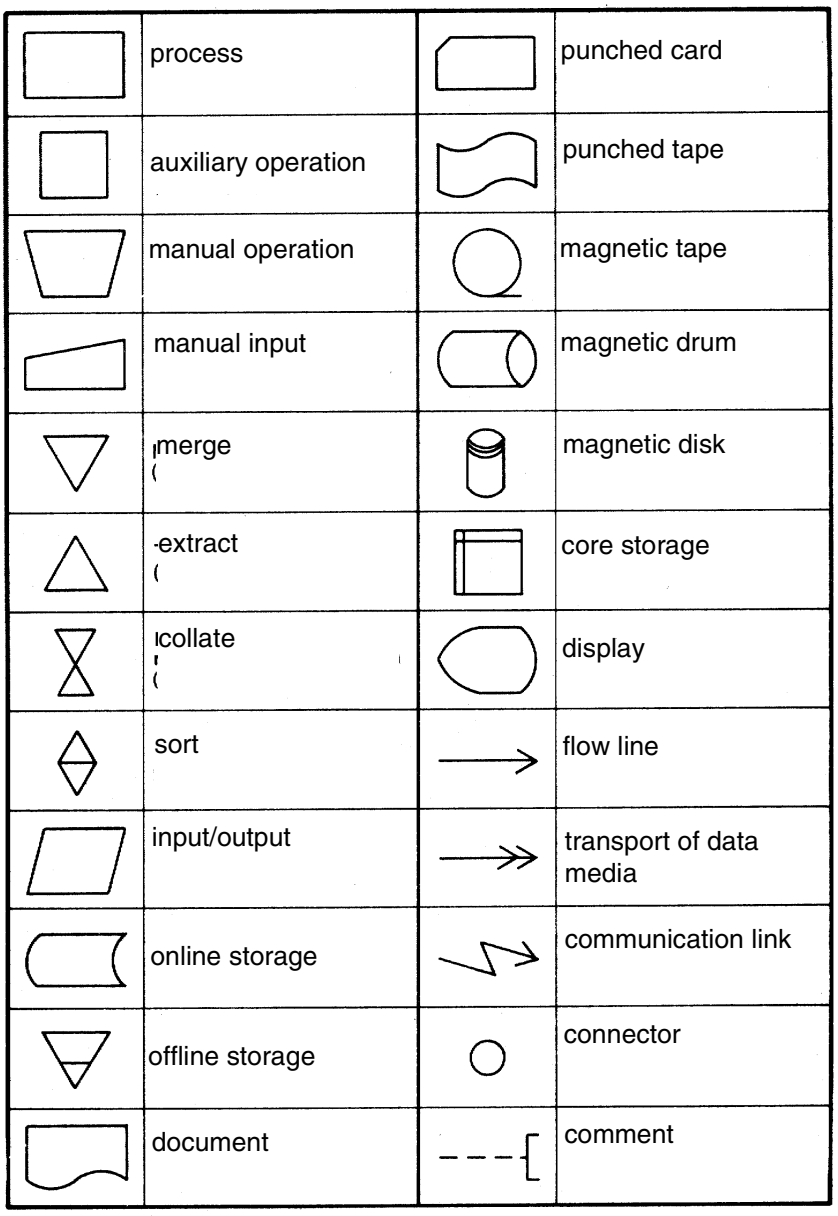


Fig. 7: Symbols to describe flow charts, according to DIN 66001. Adapted from [Groc82], p. 317.

To add further meaning, control flow diagrams, also specified within DIN 66001 are some-

times used in combination with flow charts. Fig. 8 gives an example of a flow chart and a corresponding control flow diagram, taken from [Lieb92].

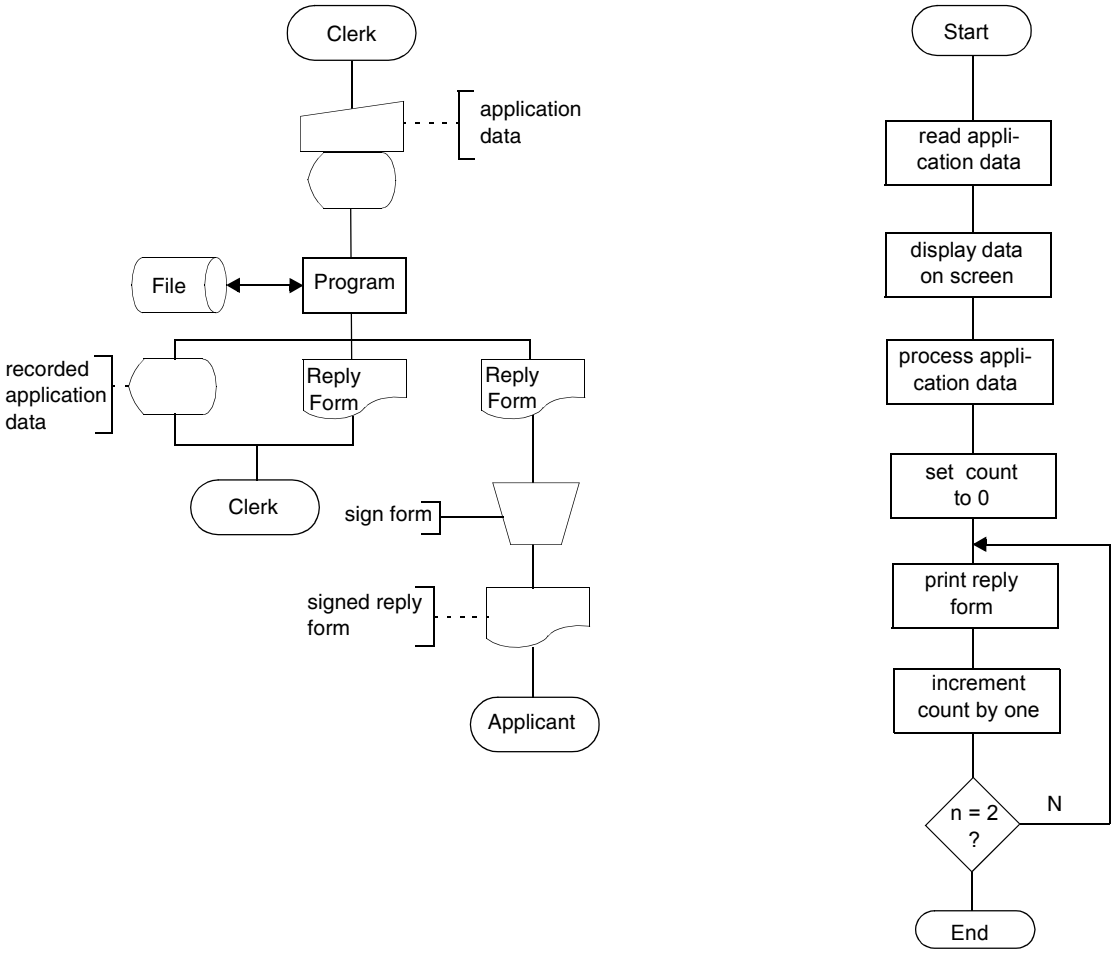


Fig. 8: Flow chart (left) and corresponding control flow diagram of business process (translated from [Lieb92], pp. 29)

The use of flow charts and control flow diagrams for the purpose of designing business processes is apparently accompanied by a number of drawbacks. The concepts symbolized within, especially those to represent data media, are not well suited for the representation of business processes. At first sight, this may be related to the fact that media such as punched cards or magnetic tapes are hardly used any more. While the corresponding symbols could be easily replaced with others to represent current technology, the essential objection remains: It is not an appropriate level of abstraction to take into account types of storage technology when it comes to organising business processes. This is even the case when the process models are to be used for the design of software. Control flow diagrams were introduced for the specification of algorithms. In most cases an administrative process will not - or cannot - be specified by an algorithm. In addition to that, control flow diagrams are not first choice any more for the design

of software, since they impose severe shortcomings with respect to the quality of software: They encourage "spaghetti code". Against this background, it does not come as a big surprise that examples shown in textbooks often lack the rigor that one would expect from flow charts or control flow diagrams. For instance: The flow chart in fig. 8 does not provide any explanation for the difference between edges with and without arrows (nor does the surrounding text). The corresponding control flow diagram would need further refinement to qualify as an algorithm (which might be a problem with "process application data"). With respect to the correctness of the control flow, it is not appropriate to use "count" and the variable "n" which are apparently identical.

Apparently flow charts and control flow diagrams are used with less rigour when applied to organisational design. One could argue that this is absolutely acceptable since the subject does not require the precision of language that is necessary for the implementation of software. Nevertheless this lack of rigour may be regarded as a problem. However, there is one important objection against flow charts and control flow diagrams. These diagrams are intended to be used for systems analysis and systems design. In order to be used in almost any application domain, they do not include domain specific concepts. When it comes to support people who are in charge of designing business processes, this level of abstraction seems odd: Normally, nobody would talk about business processes without a certain set of predefined terms - we could also say: without a specialised language/terminology. Fig. 9 gives an example of a notation that provides specialised symbols for modelling business processes. The corresponding diagram technique is called function diagram (German: "Funktionendiagramm"). It was introduced in the late twenties of this century by the dutchman Hijmans [Hijm29]. Later it was refined by Nordsieck [Nord32]. A function diagram allows to assign functions (or activities) to positions. Note that this is a combination of structure (positions are part of the organisation structure) and process. While concrete functions and positions are not part of the diagram technique, but have to be defined for a particular domain, the technique provides a number of symbols that characterise relationships between a position and a function. Although there is no formal definition of the relationships, the domain specific meaning that is associated with the symbols fosters a differentiated description of business processes. Fig. 10 shows an example of their application in a function diagram.

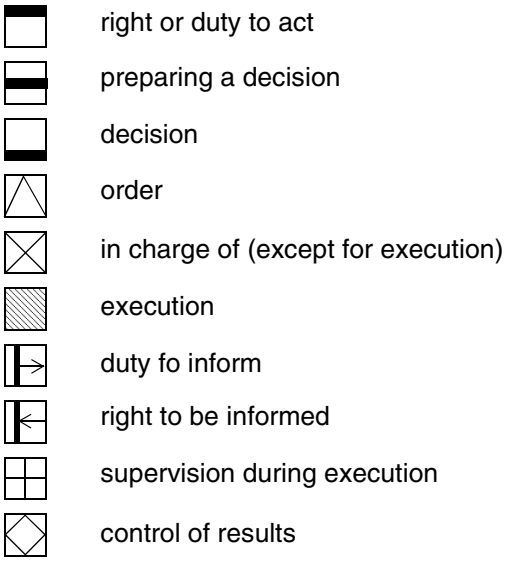


Fig. 9: Symbols used within function diagrams (translated from [Groc82], p. 311)

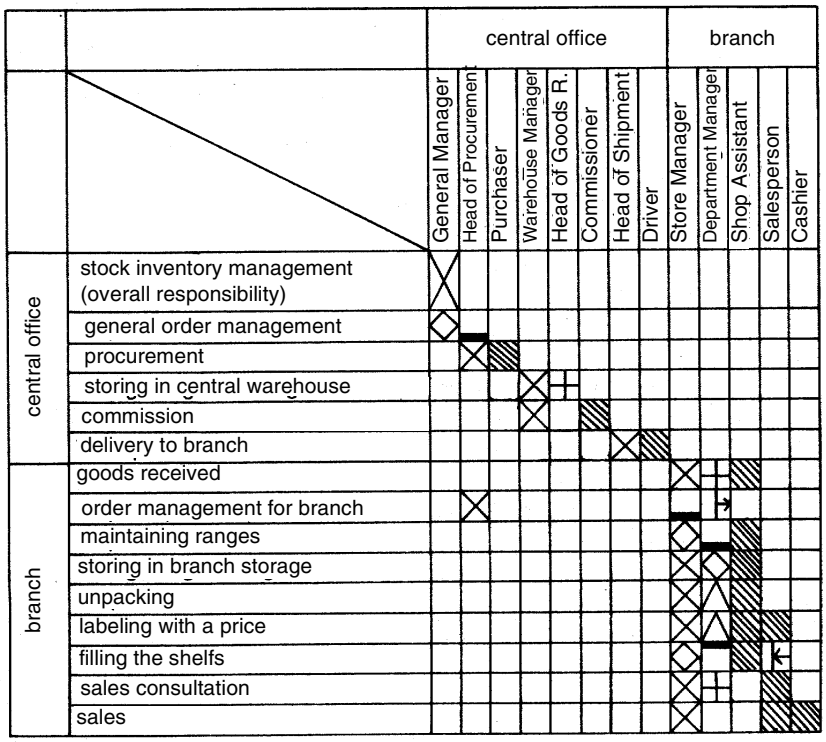
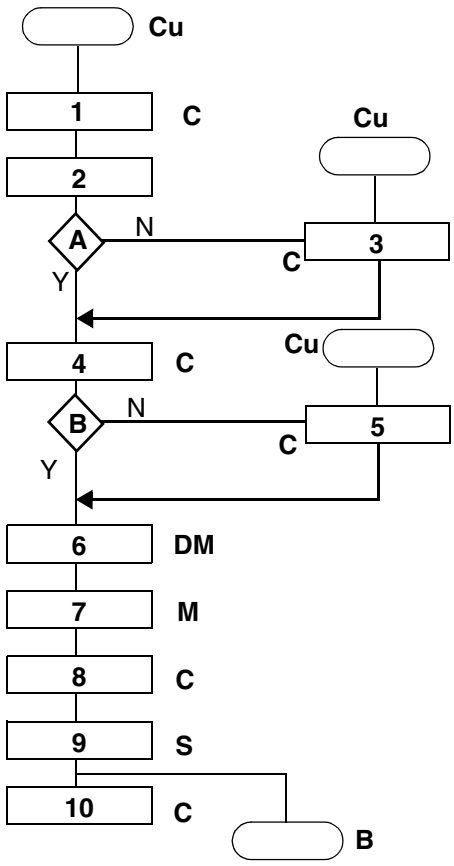


Fig. 10: Example of a function diagram (translated from [Groc82], p. 311)

Another way to introduce organisational concepts in graphical representations is the use of

structured annotations. This allows to assign positions and resources to activities and to add comments. Fig. 11 illustrates how to enhance the (slightly modified) diagram shown in fig. 10 with additional information.



Role/Position	Condition	Activity	Comment
Cu			Customer
C			Clerk
		1	receive and stamp order
		2	check for completeness
	A		order complete
		3	complete order
		4	check availability
		5	edit order
DM			department manager
		6	sign order
S			secretary
		7	copy order
		8	confirm order
M			Messenger
		9	forward order
		10	file order
B			Billing

Fig. 11: Enriching control flow diagrams with structured information (adapted and translated from [LiSu89], p. 126)

In many cases, traditional graphical representations suggested for organisational design will be better suited to describe business processes than plain text. Their use in a number of textbooks indicates that they are well known which in turn suggests that many people are familiar with them. However, to our knowledge there have been no empirical studies to evaluate these diagrams against the preferences and conceptualisations of users. From an analytical point of view, the potential advantage of providing a more intuitive visualisation of processes is contrasted by a number of shortcomings:

- Adopting visualisation techniques from systems analysis (like flow charts or control flow diagram) lacks concept that are specific to organisational design. Hence, the user of these techniques has to introduce domain specific concepts by himself.
- In addition to that, some of these visualisation techniques suggest a level of abstraction that

is not appropriate for the design of business processes - for instance by introducing symbols to represent data media and types of storage technology.

- Usually, diagrams are drawn without the explicit introduction of a corresponding language. There is no explicit (at the most a poor implicit) syntax and no explicit definition of the semantics. While the resulting ambiguity can be tolerated in an early stage of analysis, it will cause problems in later stages. On the one hand, lack of rigour makes it difficult to provide automatized support for the analysis and optimization of processes. On the other hand, models that include a substantial amount of ambiguity are not sufficient for the design of supporting information technology (such as workflow management systems).

4.1.2 Tool supported Business Process Modelling

In order to support a more convenient and consistent modelling of business processes, it makes sense to deploy specialized tools. While there are tools that support the design of processes only, other tools aim at an integration of process models with other parts of an *enterprise model*. In the following section we will focus on the latter, since they are more important with respect to the objectives of this report - prepare for the design of a modelling language as part of a method for enterprise modelling.

4.1.2.1 ARIS - Business Process Modelling with EPCs

ARIS ("Architecture of Integrated Information Systems", [Sche94], [Sche98]) is arguably the best known approach to enterprise modelling not only in Germany but also on an international scale. The architecture is a general framework to structure a company on a conceptual level. It differentiates four views: the 'data view', the 'control view', the 'process/function view' and the organisation view. Each view is further structured with respect to the level of abstraction from implementation aspects: 'domain concepts', 'IS concepts', 'implementation' (see fig. 12).

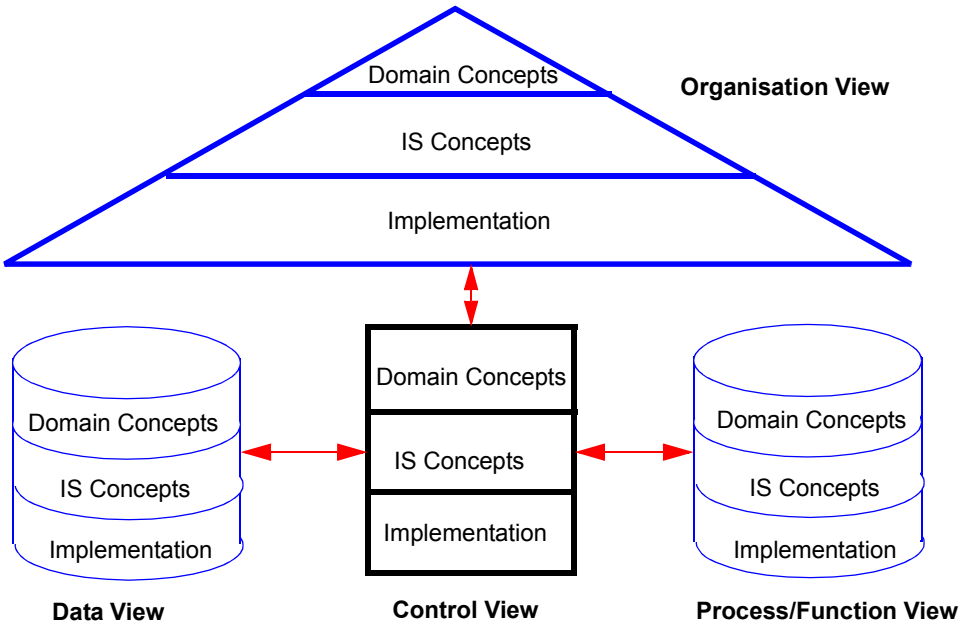


Fig. 12: The ARIS framework, [Sche98]

In addition to the high level modelling framework, ARIS is a modelling method which was later accompanied by a commercial tool ("ARIS Toolset"). To model business processes within an enterprise model, ARIS provides a modelling language known as event-driven process chains (EPC). An EPC is an ordered graph of events and functions. It provides various connectors that allow to express alternative and parallel execution of processes. Fig. 13 illustrates the symbols suggested for events, functions and control flow.

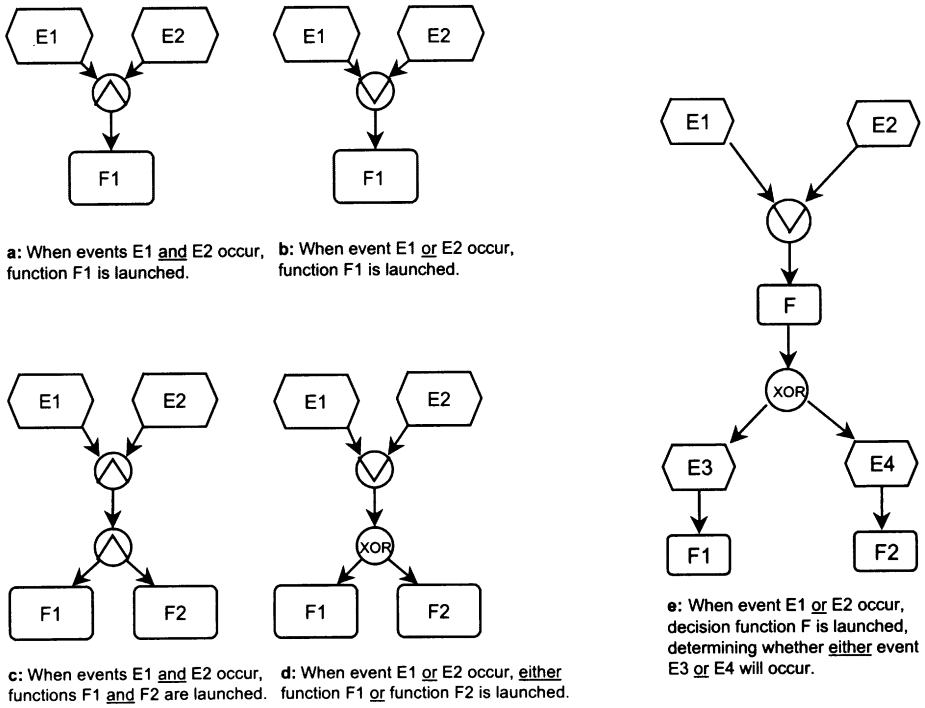


Fig. 13: Symbols and Control Structures used for Event-Driven Process Chains ([Sche99], p. 126)

Apparently, the temporal order of functions and events is from top to bottom, starting with the event(s) that trigger(s) the process. Fig. 14 shows an example of a business process represented as an EPC.

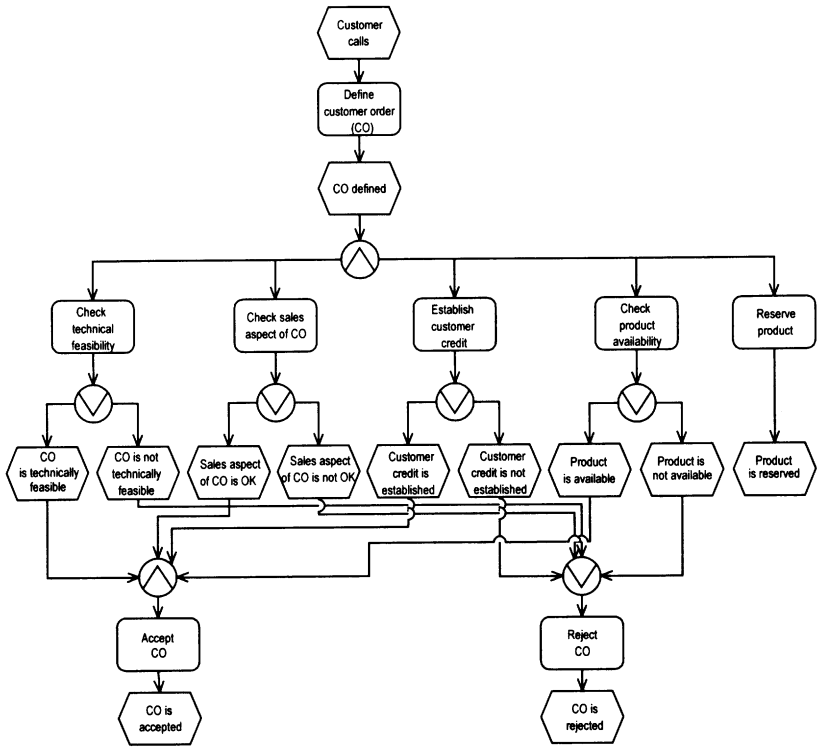


Fig. 14: Example of a Business Process represented by an EPC ([Sche99], p. 133)

The use of EPCs is to serve various purposes: documentation of existing business process types, blueprint for analysing and designing business processes and support for the design of information systems. In order to support the design of information systems, an EPC can be enriched with concepts used in static information models, like entity relationship models or object-oriented models. It is also possible to assign elements of a corresponding organisation structure, like organisational units, to a business process. Fig. 15 shows an EPC that includes references to concepts of an object model and to organisational units. While there is a formal definition of the syntax of EPCs ([KeTe98], EPCs lack a precise definition of their semantics. This is especially the case for the meaning of the logical connectors (for a comprehensive discussion of the semantic shortcomings of EPCs see [Ritt00]). This is also the case for corresponding object models which are specified in a rudimentary meta model. For this reason, EPCs are of limited use for the design of software.

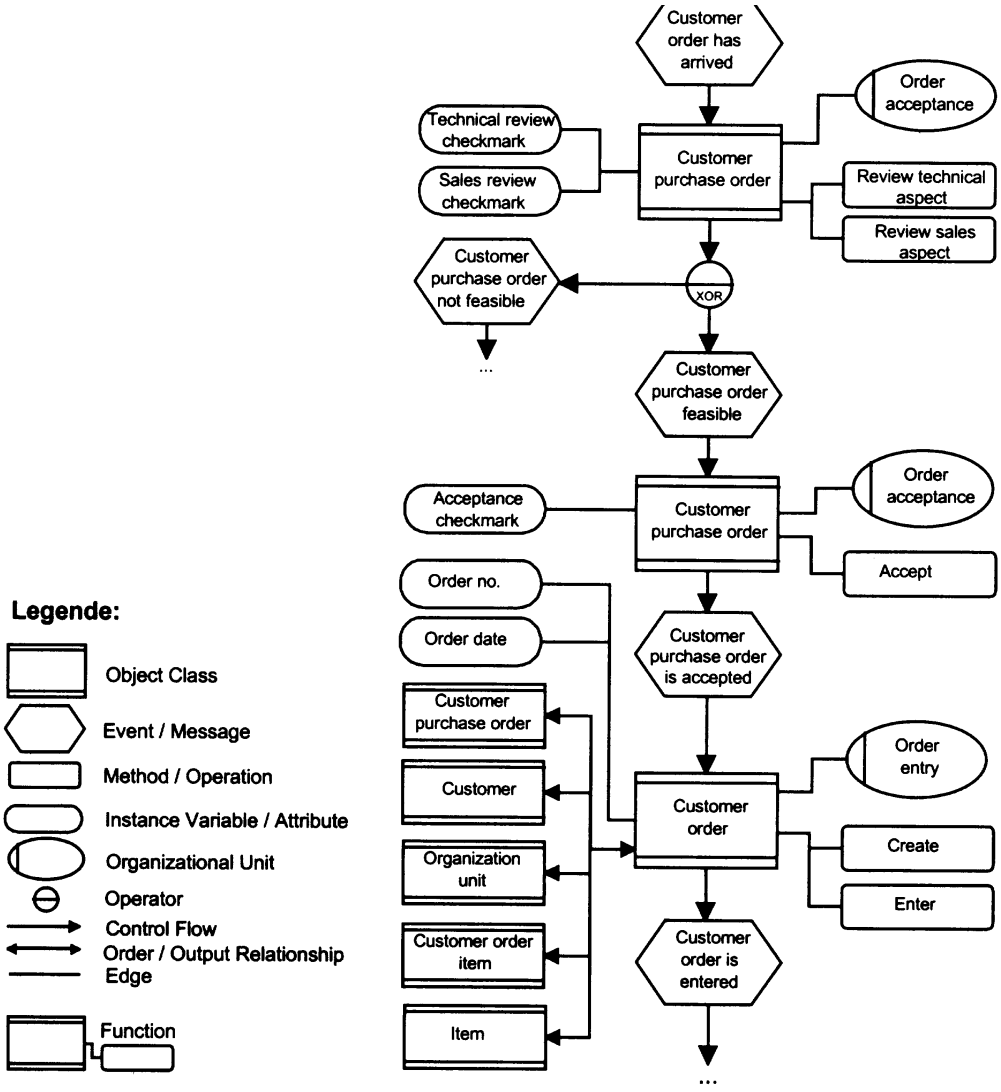


Fig. 15: Example of an EPC enhanced with additional concepts ([Sche99], p. 135)

The ARIS Toolset includes various editors that allow to design and edit organisation models such as organisational charts or - most important - EPCs. Fig. 16 illustrates the visualisation of a small organisational chart within the ARIS Toolset.

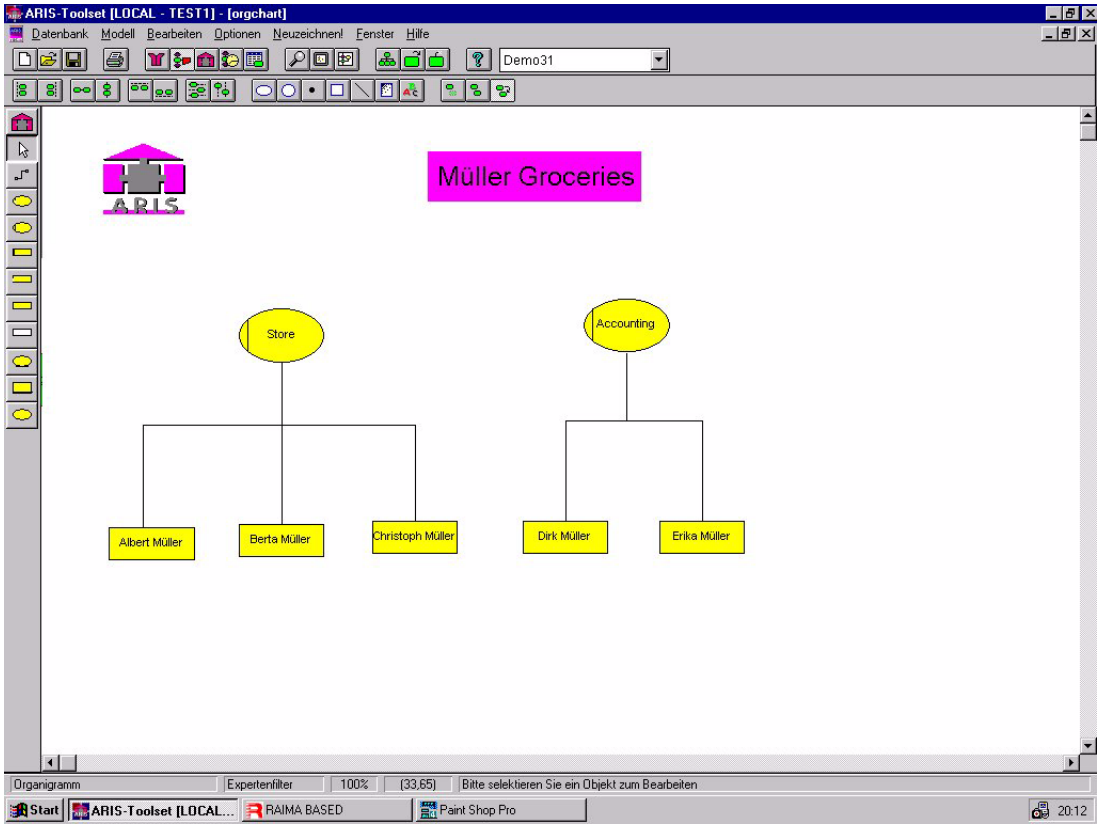


Fig. 16: ARIS Toolset: Organisational Chart in the ARIS Toolset

The elements of a business process that is depicted as an EPC can be assigned to organisational units (see fig. 17).

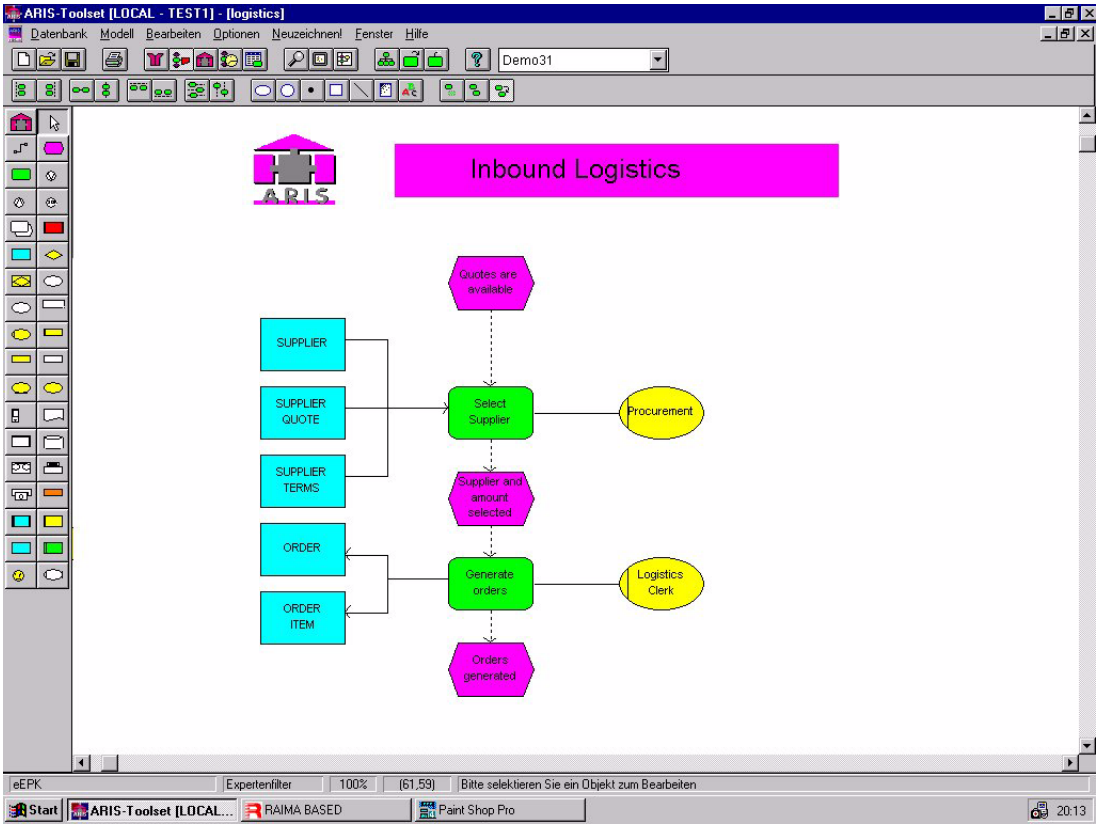


Fig. 17: ARIS Toolset: Referencing Organisationl Units from a Process Model

On a higher level of abstraction, ARIS allows to model decomposition hierarchies of processes (fig. 18).

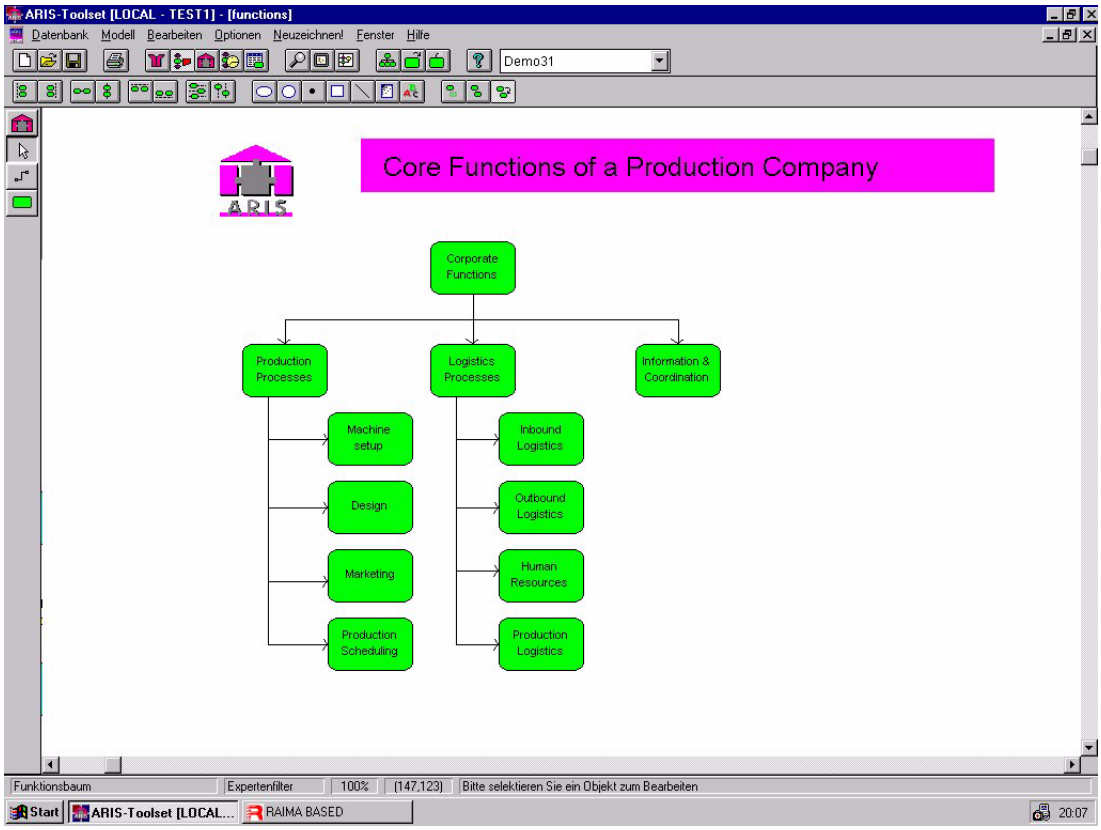


Fig. 18: ARIS Toolset: Decomposition Hierarchy of Business Processes

While ARIS allows for various perspectives on the enterprise, the integration of the corresponding aspects remains on a low level. Therefore, the tool does not guarantee the overall integrity of interrelated models.

4.1.2.2 INCOME - Business Process Modelling with Petri-Nets

Different from EPCs this approach originates from a formal concept widely used in computer science, namely Petri nets. There has been intensive research on Petri nets. Therefore using them allows to take advantage of corresponding results: procedures to check for deadlocks, simulation techniques etc. However, Petri nets are originally based on elementary concepts like places and transitions which make it awkward to design and understand models of even low complexity. To reduce this disadvantage, INCOME (Interactive Net-based Conceptual Modeling Environment, [OSS94], [Ober96]) is based on a special class of high level Petri nets, nested relation/transition nets (NR/T-nets). Nested relations allow for attributes which are relations themselves. Hence, they allow for more flexible descriptions of information structures than relations in first order normal form. The marking of a place within a NR/T-net is a nested relation. 'A transition in an NR/T-net represents a class of operations on relations in the transition's input- and output-places. An occurrence of a transition denotes one single occurrence of the respective operation. Operations may not only operate on whole tuples of a given relation but also on 'subtuples' of existing tuples.' ([OSS94], p. 5).

While NR/T-nets allow for a higher level of abstraction, they are still not intended for the development of models to be used as a medium for discourses with users or domain experts. Instead they are intended to provide an intermediate level between semi-formal models such as EPCs and implementation level languages. Thus NR/T-nets cater for (formal) analysis of processes. If their description is of sufficient detail, they also allow to generate code in an implementation level language.

There is a commercial tool that aims at making the INCOME concepts accessible to a wider range of users. For this purpose the tool uses intuitive symbols (see fig. 19).

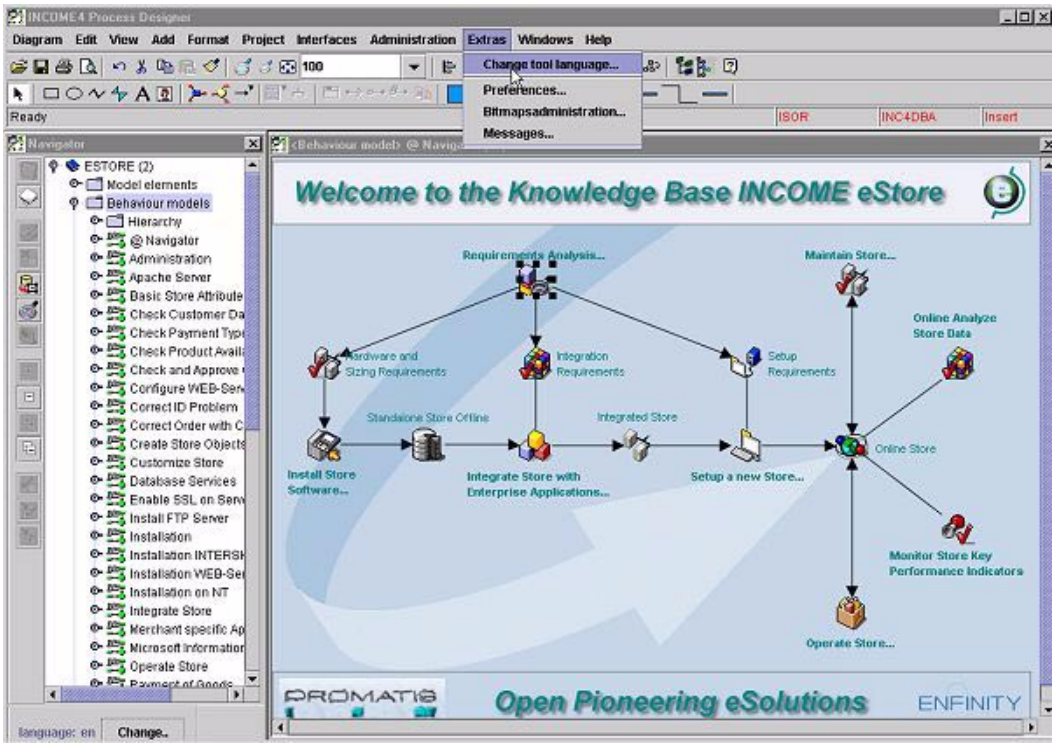


Fig. 19: Visualisation of a Business Process within the INCOME Tool

Since INCOME has a formal foundation, it offers a number of advantages over semi-formal approaches, such as richer capabilities to analyse processes formally, or the potential to generate executable code from a process model. Its shortcomings, on the other hand, result from the lack of comprehensive concepts to model organisations and economically relevant aspects of business processes (like required resources). With respect to software development, the evaluation of nested relations is ambivalent. They are more powerful than relations in first order normal form, but there are hardly any commercial database management systems that support them. Also, the abstractions they allow for are not as powerful as those offered by object-oriented approaches.

4.1.2.3 SOM - Business Processes as Interaction Schemata

Semantic Object Modelling (SOM, [FeSi94]) is one of the leading methods for enterprise modelling in Germany. SOM includes a language to model business processes. It is specified in a

meta model (see fig. 20). While the names of the concepts within the meta model look familiar, their semantics is unusual in part. This is due to the fact that Ferstl and Sinz are inspired by a cybernetic view of the enterprise (which is not very popular in conceptual modelling).

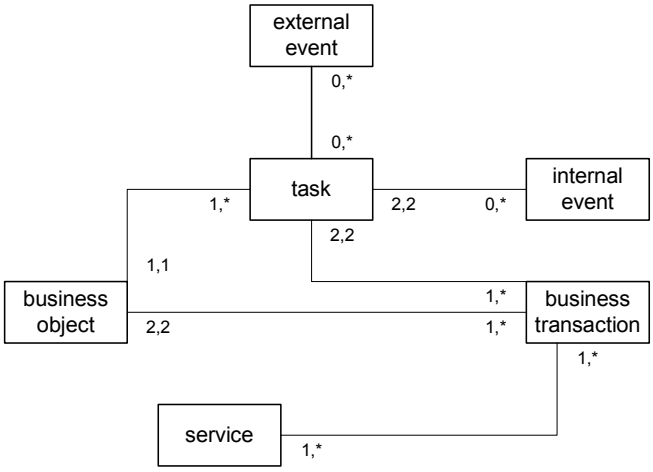


Fig. 20: Meta model of Business Process Modelling Language in SOM ([FeSi94], p. 6)

They use names like "object", "service" and "transaction" which are common for modelling languages in software engineering. However, within SOM they denote economic concepts: a business objects is an abstraction of people, machines etc. and does not imply the existence of a corresponding software artefact. A business service is produced by a business process (or a business transaction). A business transaction in turn is part of a business process. While this is compliant with the terminology used in business and administration, it stresses a level of abstraction that is different from those usually applied within modelling languages. A transaction is assigned to two tasks: one that "pushes" the transaction and another one that "pulls" it. To support analysis and design of a transaction, SOM proposes a general pattern to decompose a business transaction:

> "During the **initiating transaction**, the objects learn to know each other and exchange information on deliverable services. Within the **contracting transaction** both objects agree to a contract on the exchange of a service. The purpose of the **enforcing transaction** is to exchange the service between the objects." ([FeSi94], p. 7)

SOM suggests to develop process models be refining them step by step. To cover all relevant aspects, two diagrams are proposed: so called interaction schemata and task-event schemata. Interaction schemata stress a static view on a process: They represent business objects and the transactions (viewed as communication channels) between them. Task-event schemata serve to represent the dynamic behaviour of a business process. They include tasks, events and transactions (which are viewed as events in this case). On the highest level of abstraction there is only an interaction schema that depicts the producer and the receiver of a business service. This diagram is decomposed into a more detailed interaction schema and a corresponding task-event schema (fig. 21).

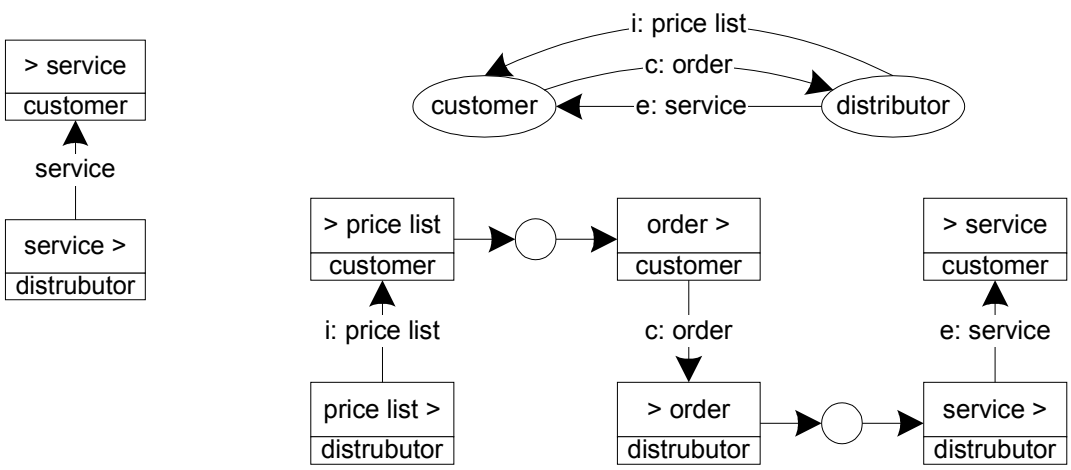


Fig. 21: Basic Interaction Schema (left) and Decomposition into more detailed Interaction Schema and Task-Event Schema (right) (according to [FeSi94], p. 8)

The decomposition process may continue over a number of levels. The final interaction schema also includes information about the organisation structure a process type is embedded in (fig. 22). The final interaction schema and the final task-event schema serve as an input for the analysis and design of the corresponding business information system. For this purpose, SOM suggests to identify object candidates and their protocols (services) within the final process diagrams.

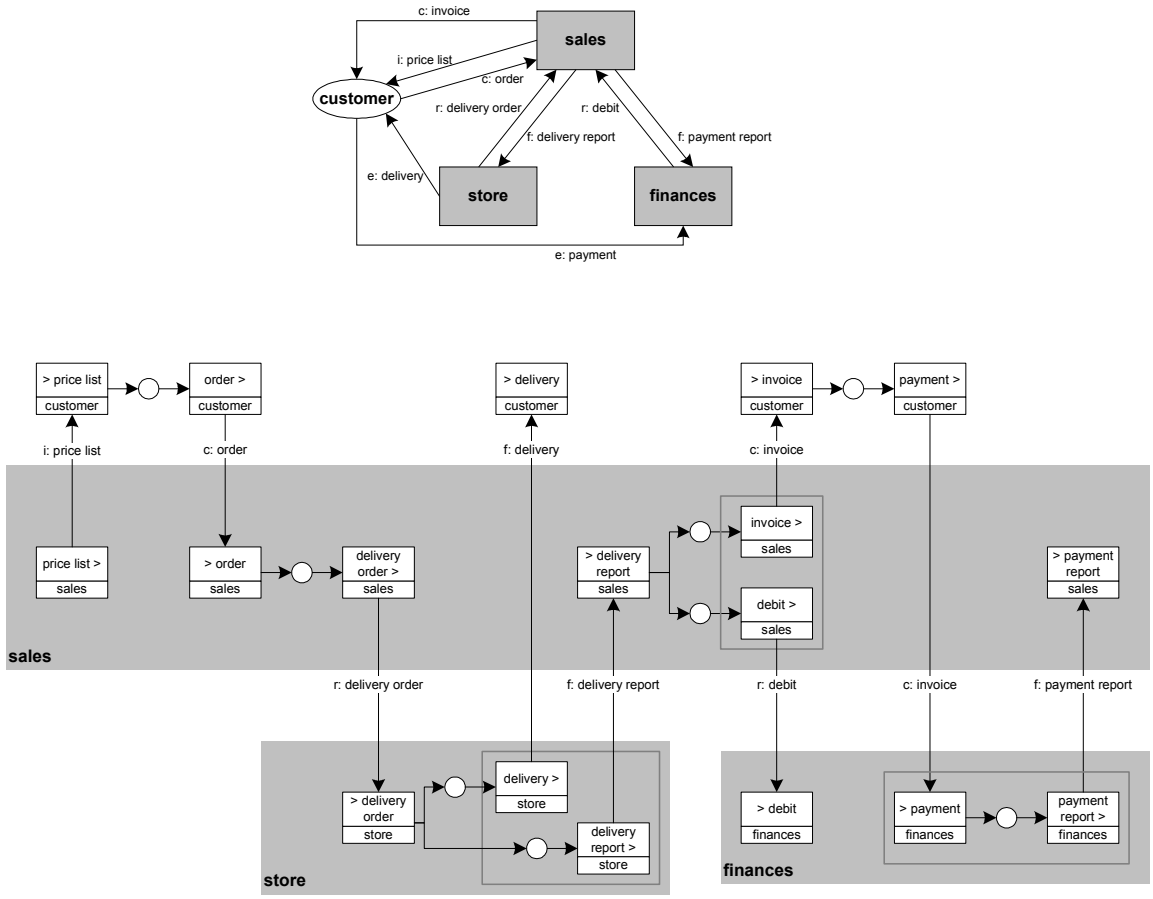


Fig. 22: Final Decomposition of a Business Process into Interaction Schema and Task-Event Schema ([FeSi94], p. 10)

SOM is supplemented by a tool (SOM pro, see fig. 23) that allows to edit and partially validate enterprise models. With respect to the subject of this report - identifying concepts that are suited/used to model organisations - SOM contains two relevant aspects. Firstly, it provides two different abstractions of business processes (interaction schemata and task-event schemata). Both views, a structural and a dynamic view, should be covered by appropriate concepts to model organisations. Secondly, it stresses three generic stages of a business process life-cycle: initiating, contracting and enforcing. These stages are helpful for analysis and (re-) design of business processes because they remind the analyst of important (if not necessary) parts of a business process model.

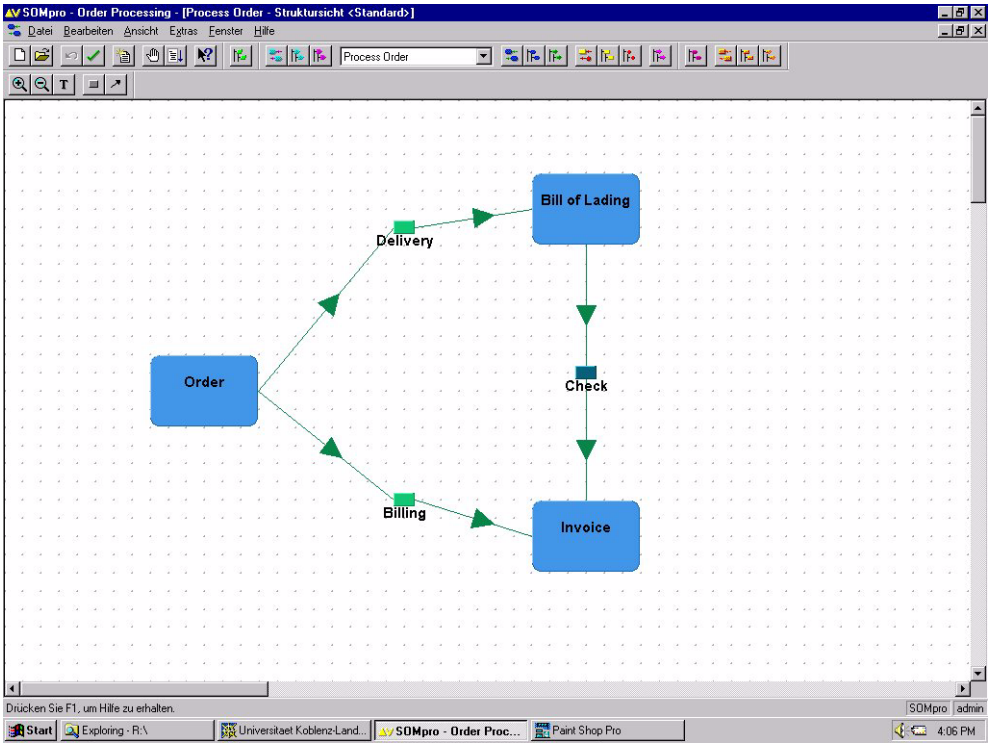


Fig. 23: Representation of an Interaction Schema in SOM Pro

The evaluation of SOM has to face a subtle problem. Some may argue that the concepts proposed by SOM - object, transaction etc. - are irritating because they do not correspond directly to the use of these notions in conceptual modelling or software engineering. On the other hand, proponents of SOM may emphasize that it is not the intention of a language for conceptual modelling to bother with concepts that are common in software engineering. Instead such a language should offer concepts that correspond to the perceptions of domain experts. Hence, it remains a matter of taste whether to like or dislike the core concepts featured by SOM. But apart from the modelling concepts, SOM offers a substantial advantage: It provides an elaborated process model that guides the analysis and design of information systems.

4.2 Visualisation of Projects

Visual representations of projects are of pivotal importance for project management. This is due to the fact that projects are not routine tasks. Every projects has its own peculiarities. To coordinate project work, it is necessary to create a common understanding of relevant parts of a project. A visual model can provide such a common reference. By abstracting from certain aspects it can also help to analyse (and redesign) projects. Therefore visual models of projects are a medium for discussing projects as well as an instrument for planning and controlling them.

A work breakdown structure serves to render how activities are composed to work packages. Fig. 24 shows a high level break down structure which can be decomposed and enhanced with

additional information.

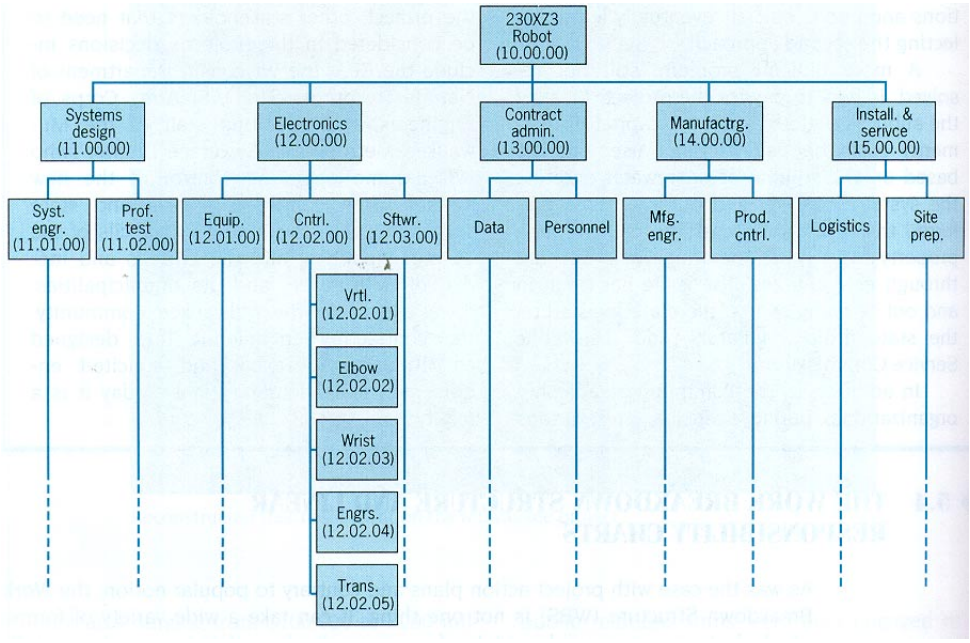


Fig. 24: Example of a Work Breakdown Structure ([MeMa95], p. 216)

Visual representations of projects as processes are very common in the literature on project management. They emphasize mainly scheduling aspects. Similar to models of business process types, project models serve to document projects and to support analysis and (re-) design. They do not, however, include references to information models (object models, data models). Another difference is the level of detail and formalisation applied to the description of activities. In business process models it is more likely to find descriptions of activities that are suited to guide their (partial) automation. This is also stressed by the fact that process models are used to specify workflows. Within diagrams to render projects automation of activities or supporting workflows is not an issue - which is not surprising since most methods originate from a time where computers were still exotic devices. There are, however, some approaches to use concepts and technologies for modelling and supporting business processes, such as workflow management systems, for the description and management of projects (for instance: [LeOb01]).The network planning techniques mentioned in 3.3 all come with specific notations to render projects. The CPM network shown in fig. 25 illustrates that the focus of this abstraction is on scheduling. Each activity is assigned a scheduled start and a scheduled finish. The activities in the top row are part of the critical path. Notice that the model does not include information about the resources required.

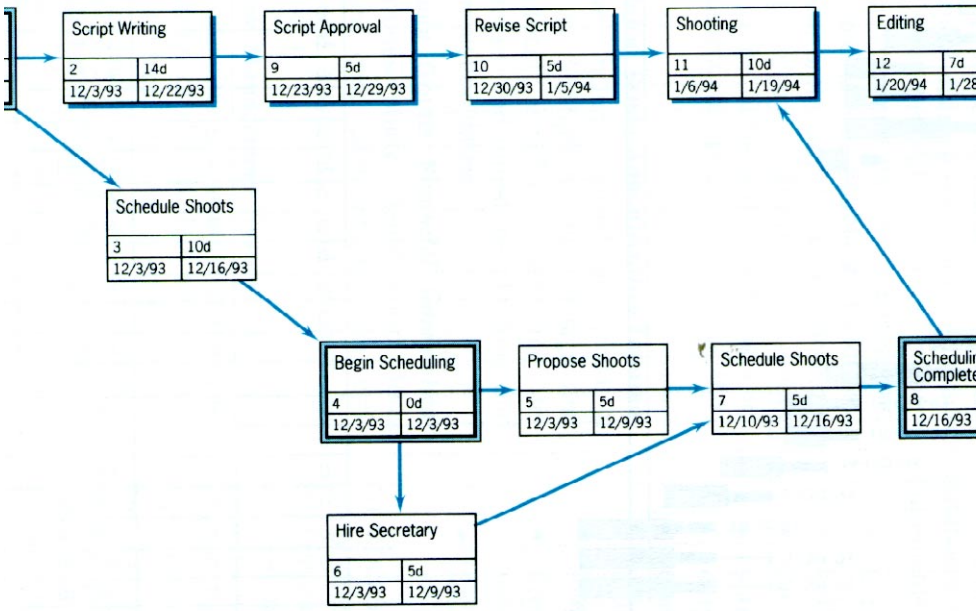


Fig. 25: Example of CPM Network, Critical Path shown ([MeMa95], p. 479)

4.3 Organisation Structure

Diagrams to visualize organisation structures have been used for long. The various flavours of organisational charts can be considered as the most popular representations of organisation structures. In fact, they are so popular that they are integrated in some of today's office packages to facilitate the drawing of a particular organisational structure. It may be a reason for the popularity of organisational charts that they are very simple. Usually, they use two concepts only: organisation unit and a relationship between units. Fig. 26 gives an example of an organisational chart.

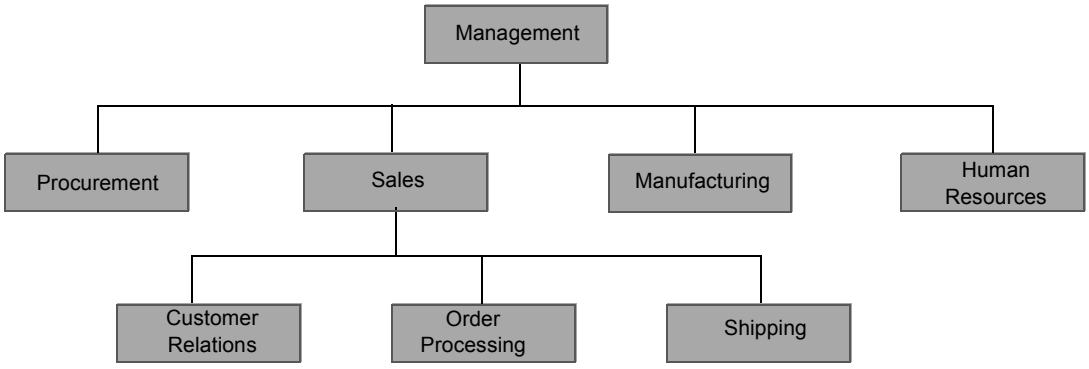


Fig. 26 Excerpt of an Organisational Chart with Emphasis on Aggregation

Usually, the semantics of relationships between organisational units, represented by edges, is not precisely defined. Firstly, there are different types of relationships which are not explicitly denoted. An organisational unit may be aggregated from other units. The example in fig. 26 suggests, at least in part, such an interpretation. Apparently the organisational unit 'Management' is an exception, however. The organisational chart in fig. 27 indicates that the edges represent lines of command or super-/subordination. Secondly, the edges are often not directed. The implicit direction of the relationships between the organisational units depends on the observer's interpretation - which is usually straightforward. For instance: In fig. 26, an organisational unit consists apparently of those other organisational units it is connected to on a lower level.

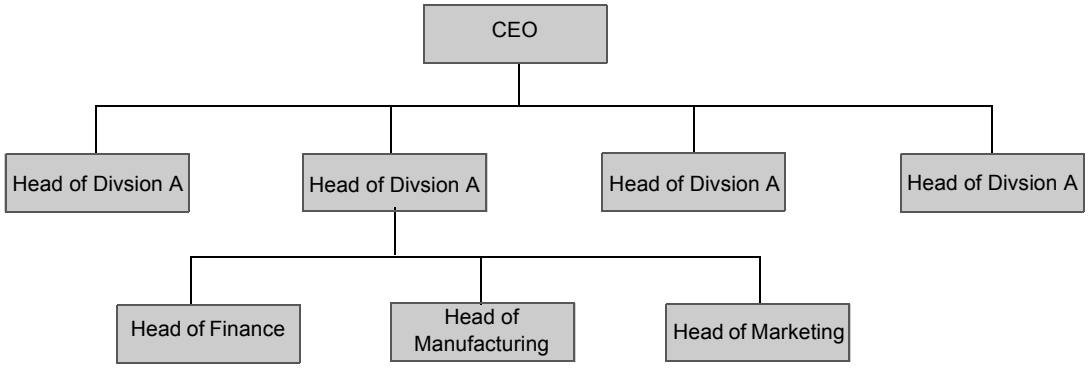


Fig. 27: Excerpt of an Organisational Chart with Emphasis on Line of Command

Fig. 27 represents an organisation with a single line of command: A particular position receives orders from no more than one superior position. It reflects Fayol's "unity of command" principle (see 2.1). For positions that include complex and diverse tasks, it can make sense to give up this principle. In this case, a position can receive orders from more than one superior units - depending on the specific context. For instance: A software-engineer may have to report to a marketing manager when it comes to features that are relevant for a product's marketing. When it comes to the design of the software, he has to report to the chief-software designer. Fig. 28 renders an organisational chart that represents an organisation with multiple lines of command.

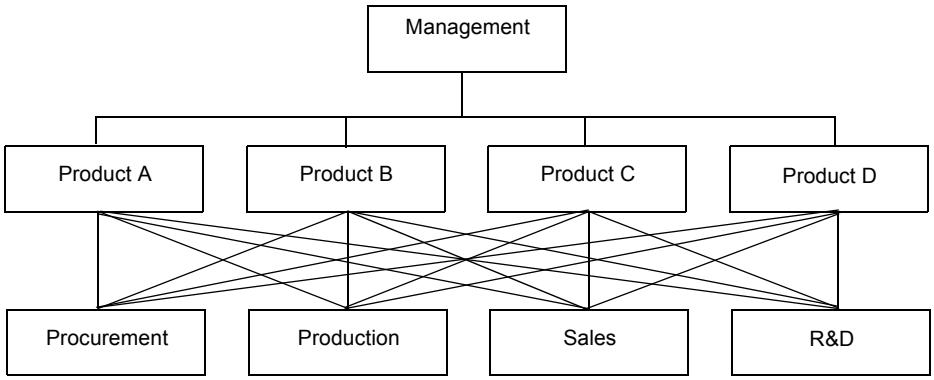


Fig. 28: Organisational Chart with Multiple Lines of Command

Two or more lines of command are essential for so called matrix (fig. 29) or tensor organisations. They deploy two or more dimensions for the division of labour (like 'product' and 'function') and the corresponding lines of command. Their graphical representation is based on symbols for organisational units and edges that render relationships between them. Tensor organisations recommend a three dimensional graphical visualisation (see fig. 30).

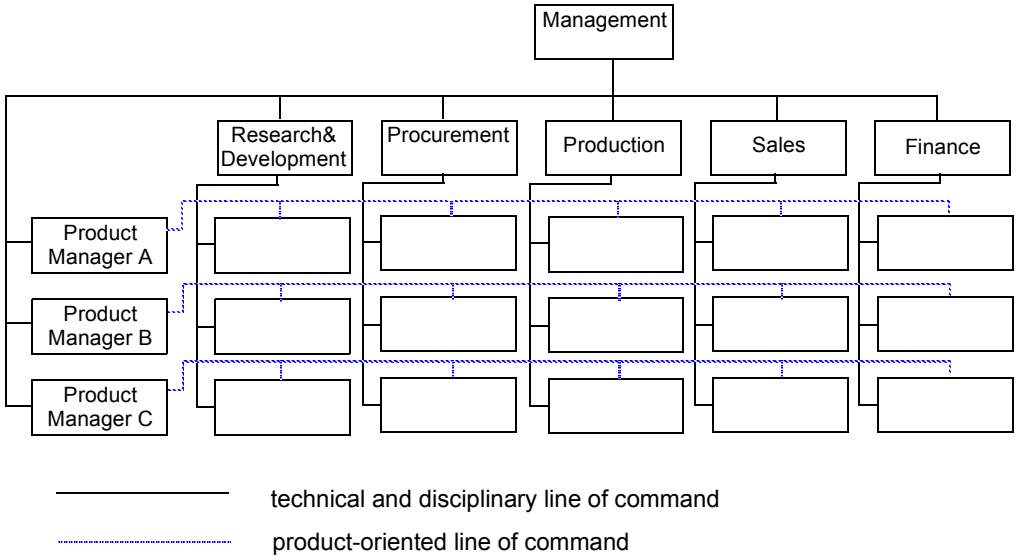


Fig. 29: Organisational Chart of Matrix Organisation

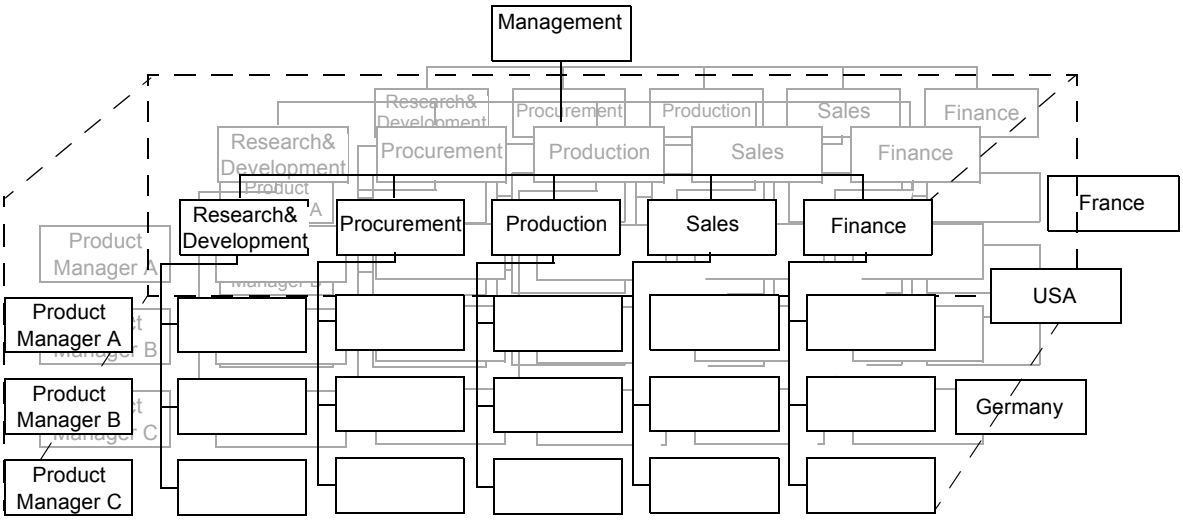


Fig. 30: Organisational Chart with three Dimensions (Tensor Organisation)

With respect to the design and use of a modelling language, it is important to reflect upon the level of abstraction that is associated with a particular concept or term. While a precise assignment depends on the design of a concrete language, there are some obvious differences in terms of abstraction. For instance: "organisational unit" may be regarded as a concept that is defined on a meta level. An instance of this concept denotes a particular unit like "marketing department" or "head of marketing". In the latter case, one will sometimes find organisational charts that are even more specific: The rectangle that represents the position includes the name of the employee who currently fills the position. The difference between the more general case "head of marketing" and the more specific one "John Miller" is a subtle one: "head of marketing" can be interpreted as the name of a type of organisational unit or as an instance of the concept "organisational unit" with a specific state (its name is set to "head of marketing"). Assigning a specific employee to a position will usually denote a specific state of this position. Fig. 31 shows an example where different levels of abstraction are deployed in one organisational chart.

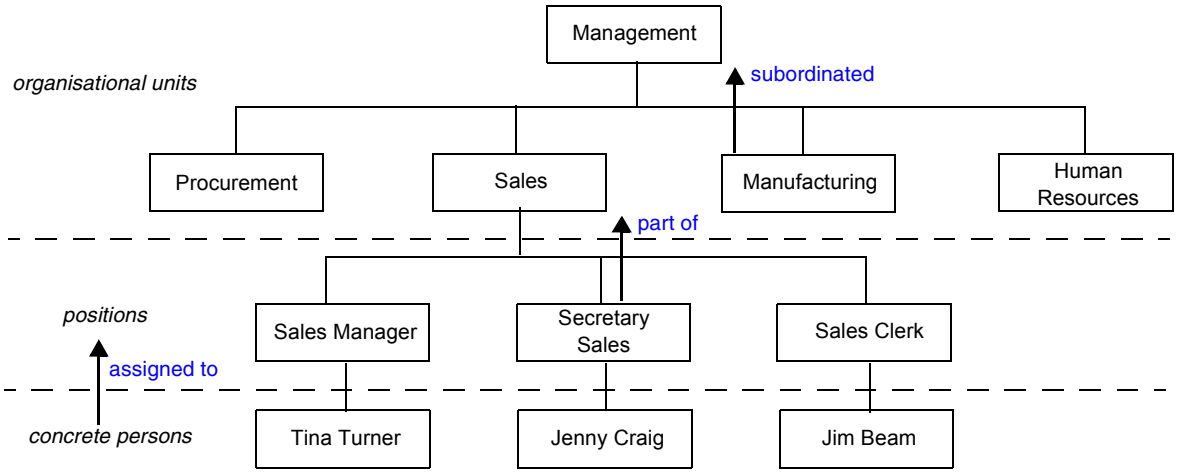


Fig. 31: Excerpt of an Organisational Chart with varying Semantics of Relationships

Organisational charts provide a high level blueprint of an organisation's structure. There are two measures that are directly related to an organisational chart: The *span of control* is defined as the average number of positions that are directly subordinated to a manager. The *depth of control* is defined as the number of levels that exist in the hierarchy. To produce a comprehensive description of an organisation, more information is required. Textbooks on organisation suggest logical structures especially for the detailed description of positions. While these structures, like the one exemplified in the table below, certainly support a systematic description of organisations, they are beyond the scope of graphical representations. However, they can be used in combination with graphical representations.

Structure to describe a Position

name
required skills
superior and subordinate positions
deputy
objectives
tasks
responsibilities
information (required for position, to be maintained by position ...)
communication (required communication media, positions/people to communicate with ...)

Table 3: Excerpt of attribute list used for the specification of a position, [Groc82], pp. 328)

4.4 Integrated Representations of Structure and Process

While organisation structure emphasizes static aspects whereas business processes focus on dynamic aspects, there are other representations which are in between. *Communication diagrams* combine static aspects with dynamic aspects: They visualize communication relationships between organisational units (static). At the same time they can be regarded of abstractions of processes as well: Communication occurs in business processes. Communication diagrams condense the communication relationships within a set of processes into a graphical representation that renders the intensity of communication between positions. Fig. 32 gives an example. There is not common concept of communication intensity. Sometimes the focus is on frequency, sometimes on duration. Notice that communication diagrams were introduced at a time where the use of electronic media like e-mail was of no relevance. With these media in place, there would be other options to define communication intensity - like amount of data or number of documents transmitted within a period of time.

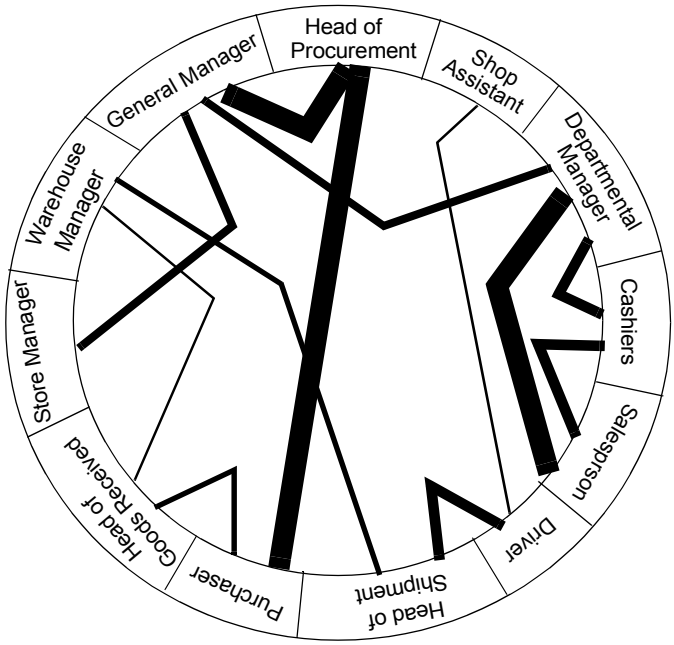
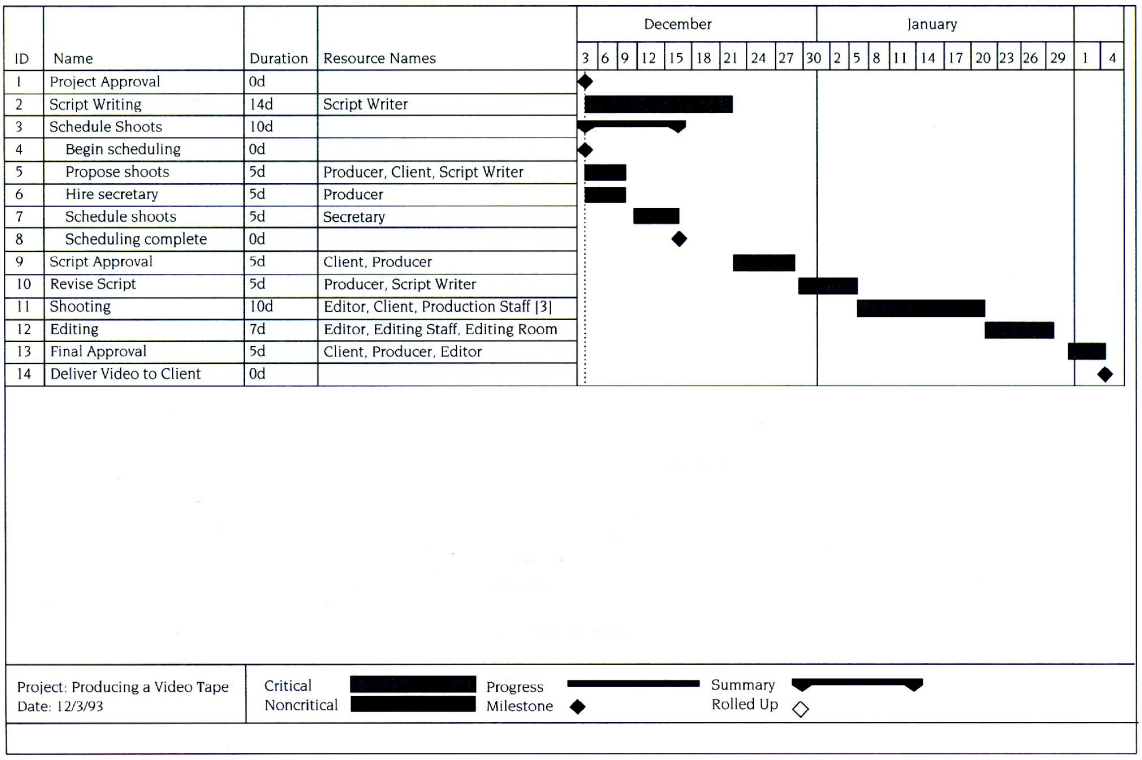


Fig. 32: Example of a Communication Diagram

Communication diagrams result from analysing the communication patterns discovered in processes. However, they do not provide an explicit association between concepts used to model processes with those used for the representation of organisation structures. Considering the complexity of process models and the size of their graphical representation, it does not come as a surprise that traditional, paper based diagrams hardly allow to render associations between process and structure. Fig. 10 shown above renders a so called function diagram that illustrates relationships between processes/tasks and positions. Modelling tools allow for more flexibility: Certain parts of an organisation structure, like positions or organisational units in general, can be inserted or faded out upon user request. In addition to that, a process model

represented by a specialized editor can be used to visualize process dynamics by the execution of simulation runs.

In traditional organisations an organisation structure is fairly stable. This is different in projects: For each projects it is necessary to plan the positions and roles to be filled within the project. This requires to look at the activities of a project. For this reason, diagrams that combine the visualisation of organisation structure and process are quite common in project management. Within the Gantt chart in fig. 33 resources - in this case roles - are assigned to activities.



ID	Name	Duration	Resource Names
1	Project Approval	0d	
2	Script Writing	14d	Script Writer
3	Schedule Shoots	10d	
4	Begin scheduling	0d	
5	Propose shoots	5d	Producer, Client, Script Writer
6	Hire secretary	5d	Producer
7	Schedule shoots	5d	Secretary
8	Scheduling complete	0d	
9	Script Approval	5d	Client, Producer
10	Revise Script	5d	Producer, Script Writer
11	Shooting	10d	Editor, Client, Production Staff [3]
12	Editing	7d	Editor, Editing Staff, Editing Room
13	Final Approval	5d	Client, Producer, Editor
14	Deliver Video to Client	0d	

Fig. 33: Example of Gantt Chart ([MeMa95], p. 478)

The 'linear responsiblity chart' in fig. 34 refers to the activities in a work breakdown structure. It gives a more comprehensive view of the function certain roles are in charge of within a project.

		Project Office				Field Operations	
	Task	Project Manager	Contract Admin.	Project Engineer	Industrial Engineer	Field Engineer	
Determine Need	A1	❍		●	▲		
	A2	■	❍	▲	●		
Solicit Quotations	B1	❍	■	▲		●	
Write Appro-priate Request	C1	■	▲	❍	●		
	C2		●	❍	▲		
	C3	●	■	▲		■	

▲ Responsible
● Support
■ Notfication
❍ Approval

Fig. 34: Example of a Linear Responsibility Chart ([MeMa95], p. 217)

5. A Glossary of Terms

While this report cannot cover all approaches to modelling organisations that exist, the approaches we have considered so far give an impression of popular terms, abstractions and symbols in the domain of analysing and designing organisations. The motivation of this report - to prepare for the design of a graphical organisation modelling language - recommends to take into account these concepts and their visualisation in order to provide prospective users with a tool they are familiar with - or at least: they have a good chance to become familiar with. Since the intended new version of MEMO-OrgML is to serve as a foundation for the design of modelling tools, there is need for a high degree of formal rigour. Therefore the traditional approaches described above are not appropriate for this purpose: They include a high degree of ambiguity. Therefore their use depends on an adequate interpretation by the user. Other languages which have been developed with modelling tools in mind, like EPCs, are certainly more appropriate. While EPCs do have a number of shortcomings, the main reason why they are not adequate at present time is their lack of a consistent integration with object-models.

The intended modelling language should offer a specialised terminology for analysing and designing organisations. To this end, the modelling language should cover the terms in the glossary - either by providing a 1:1 mapping of language concepts to terms in the glossary or by allowing to construct terms from language concepts.The glossary consists of two parts: organisation, including organisation structure and business process, and project. Many of the terms shown in the first glossary can be used with projects, too. The terms within these parts are listed in alphabetic order. The column on the right serves to indicate whether the term is suited for formalisation. Notice that formalisation is related to the context of this report. Also, evaluating

the chance to formalize a term is - to a high degree - a matter of subjective judgement.

Many of the terms listed below are used in other domains as well - with more or less deviating meaning.

- **f**airly well means that the essence of a term's semantic can be formalized. For instance: Span of Control, Productivity, Processing Time, Superior are terms that are characterized by an almost formal definition already.
- with **c**oncessions means that formalization is possible only if some inherent aspects of the term's meaning are neglected. Examples are Activity, Actor, Process, Project, Organisation Unit or Position are certainly more difficult to formalize. However, that implies to neglect some aspects which are not of pivotal importance within the domain of organisational analysis and design.
- **h**ardly is to say that formalization is not possible without extensive loss of semantics. This is the case with terms like Motivation, Power or Responsibility.

Usually, it will make no sense to formalize a term that can hardly be formalized. However, sometimes it is sufficient to use a term anyway to guide a user with structuring a description. For instance, a user may be asked to evaluate an actor's Motivation as either high, average or low. A formal or semi-formal description of the terms requires to take into account the relationships between terms. Therefore the glossary terms that are used to describe other terms of the glossary are highlighted in blue colour.

Term	*Description*	*Form.*
Action	An Action is a meaningful act or operation that cannot be decomposed into further meaningful acts. It is performed either by a human or a machine.	**c**
Activity	An Activity is composed of one or more Actions. It serves to fulfil one ore more Tasks. An Activity is a Process that is not decomposed any further.	**c**
Activity Based Costing	an accounting system that assigns costs to cost objects (product, Position, service, customer) in order to transform previously indirect costs into direct costs. Cost objects consume Activities (within Business Processes) which in turn consume Resources. The costs of the Resources consumed are assigned to the cost objects. Activity Based Costing aims at tracing rather than allocating each expense category to the particular cost object.	**c**
Actor	An Actor is either a human or a machine that performs Actions.	**c**
Authority to issue Directives	assigned to a Position or a Role - with respect to a set of Positions and/or Roles. The Authority to issues Directives may be restricted to object (e.g. a product), function (e.g. sales), disciplinary (e.g. salary increase; hiring; firing ...).	**c**

Average Processing Time	The time a Process of a particular type takes on average. It can either be estimated or calculated from simulations or on an empirical base.	**f**
Awareness	The ability of an Actor to perceive an Event.	**h**
Budget	assigned to an Organisation Unit, less frequently to a Business Process; an amount of money that is available in a period of time; a special type of Resource	**f**
Bureaucracy	A type of administrative Organisation that is characterized by a fixed Division of Labour among officials. It is intended to provide for a high degree of precision, stability and reliability. It is based on a mechanistic view of Organisation that applies rational techniques with 'equal relevance to human social organisations as to the control of the material world.' ([Gidd83], p. 202)	**h**
Business Process	A Process that is directed towards the creation of products or services within a business firm.	**c**
Capacity	assigned to an Organisation Unit, a Business Process or an Actor. Describes the amount of units that can be produced within a given time (for instance a day).	**f**
Centralisation	opposite to decentralisation. Centralisation is characterized by two interrelated aspects. First, Decision Making is restricted to a few centres of control. Second, to impose the first rule, the Organisation is clearly divided into hierarchical levels of command. Hence, Centralisation goes with hierarchies whereas decentralisation corresponds to flat Organisation Structures.	**c**
Client	A Client is either a Customer or an internal recipient (such as an Organisation Unit or a Role) of a product or service produced within a Business Process.	**c**
Coalition	A set of people and/or Organisations that share common interests. They cooperate or communicate in order to pursue these interests.	**h**
Communication Device	hardware or - more likely - a combination of hardware and software that facilitates communication - like a telephone, a mobile phone, a fax machine or a video conference facility	**f**
Communication Medium	a carrier of information used for communication purposes - like text, graphics, voice, audio, video	**f**

Competitive Advantage	From a Customer's perspective the Competitive Advantage is linked to desirable features of products and services - like quality, design, image etc. It results from corresponding Core Competencies. The more difficult it is to copy these Core Competencies the higher the Competitive Advantage (ceteris paribus).	**h**
Conflict	a situation where different options to act are not compatible; can be solved by consensus or directive	**h**
Control	serves to guide Actions, Tasks, Processes. Control is applied by comparing Goals and actual outcomes. It may require to redefine Goals.	**h**
Cooperation	If two or more Actors or Organisation Units work together to accomplish common (or allegedly common) Goals, they cooperate. Cooperation implies a (more or less precise) understanding of common rules, e.g. about the Authority to issues Directives, Responsibilities, access to Resources. Therefore, Cooperation requires communication and hence a common language.	**h**
Coordination	Division of Labour results in a set of Activities. It implies the need to combine these Activities so that they result in an intended outcome. This combination is called Coordination. Coordination can be more or less rigid. It is rigid if it is based on a precise definition of Activities and their logical and temporal order - e.g. by specifying Business Processes that do not allow for individual decisions. On the other hand, Coordination may consist of Goals only - stressing individual creativity and Responsibility. In the latter case, Coordination fits with concepts like Management by Objectives or Management by Exception. Within a specific type of Business Process, Coordination rigour is indicated by the existence of Goals and the chance of those who are responsible, to conduct the Process in a flexible way.	**h**
Core Business Process	a Business Process that is essential for a company's competitiveness. Typically, a Core Business Process takes advantage of a company's Core Competence.	**c**
Core Competence	A specific, outstanding competence of a company that is essential for its ability to produce products or services. Usually, it is suited to distinguish the company from its competitors. In any case it is pivotal for the company's Competitive Advantage. In most cases, the Core Competence is directly related to the ability to perform Core Business Processes.	**h**

Cost Driver	a cost object that consumes a considerable amount of the overall costs of a Business Process	**c**
Critical Success Factor	A particular aspect of a mission to reach a Goal (e.g. an aspect that is relevant to perform a Task or Business Process) that is critical for the success of the mission. Critical Success Factors may be availability of resources (e.g. skills of Employees); ability/knowledge to manage Processes; ability to preserve Competitive Advantage	**h**
Customer	A person or an Organisation that is - in principle - willing to pay for services or products offered by a company.	**c**
Customer Satisfaction	Level of satisfaction a Customer believes to gain by interacting with a company. A common approach to measure Customer Satisfaction is to conduct surveys with Customers. It can be used as a Goal and hence as an aspect to measure the Effectiveness of corresponding Business Processes.	**h**
Customer-Orientation	Customer-Orientation can be detected on an individual and on an organisational level. On an individual level it is expressed by the employees' attitude towards Customers: their commitment to try hard to accomplish a high level of Customer Satisfaction; their firm conviction that in the end Customers pay their salaries etc. On an organisational level, Customer-Orientation is expressed by formal rules that prescribe how to deal with Customers in specific situations (for instance in the case of a complaint). It can also be determined by analysing how much the organisation of Business Processes takes explicitly into account the Customers' needs.	**h**
Decentralisation	opposite to Centralisation	**c**
Decision-Making	From a rationalistic, prescriptive point of view Decision-Making consists of four steps: determining Goals, detecting alternative options to reach the Goals, evaluating the available options, choosing the optimal option. From a more realistic, descriptive point of view, it is common to take into account human factors that influence the process of Decision-Making - such as fear of failure, avoiding risk, delaying complex decisions etc.	**h**
Decision-Making Powers	Decision-Making Powers defines the types of decisions an actor may make. Within a centralized organisation Decision-Making Powers grows with the hierarchical level.	**h**
Division of Labour	Division of Labour in a corporation describes how the overall work is divided and assigned to Organisation Units.	**c**

Effectiveness	Effectiveness is to express the degree to which the Goals of Activities or Business Processes have been accomplished. The chances to measure it depend on the precision of the corresponding Goal definitions.	**c**
Efficiency	Efficiency serves to express how well certain means (inputs) are suited to accomplish a given Goal. If both, means and goals allow for quantitative measurement - e.g. cost and margin. Efficiency can be expressed as the ratio of input and output.	**c**
Employee	A human Actor who works for a company on a regular base. An Employee holds a Position and may fill one to many Roles.	**c**
Environment	The relevant Environment of a company consists of its Markets (both for procurement and sales), legal requirements, tax regulations, cultural peculiarities, general economic factors ... While some aspects of the relevant Environment can be described in a precise way, e.g. tax rates, the meaning of others, like cultural peculiarities, is hard to define in a formal language.	**h**
Event	a change of state that is relevant in a sense that it requires Action. The change of state can be related to information, Resources, people etc. It can also be caused by time, either by reaching a particular point in time or by a period of time that passed of. An Event can be generated by the completion of a Process. An Event can be composed of other Events. An Event may trigger a Process.	**c**
Exception	an unusual Event that hinders the intended outcome of a Process. It requires appropriate Actions to restore a Process. To prepare to quick Exception handling, it is recommended to define dictionaries with known Exceptions and corresponding Actions.	**c**
External Process	A Process that is performed by an external institution. Depending on the relationship with this institution, the chances to influence the outcomes of an External Process may vary.	**c**
Flexibility	Flexibility denotes the ability to react upon a changing context - like modified Goals, lack of resources etc. It can be regarded as a feature of Organisational Units, Actors, and Business Processes.	**h**

Formalisation	Formalisation aims at defining organisational rules precisely so that they determine the Actions of related Actors. While it is similar to the notion of formalisation in mathematics or computer science (avoidance of ambiguity), it is less restrictive because it does not mean to completely specify the semantics of organisational rules. It is sufficient to specify rules to an extend that the likelihood of misinterpretations is relatively small. Bureaucracy takes Formalisation to an extreme.	**h**
Function Diagram	A Function Diagram is a matrix that is used to assign tasks and responsibilities to Organisation Units.	**c**
Goal	orientation for Actions, Processes, Tasks - process-oriented or state-oriented, - serves to guide and control; if two Goals support one another, they are complementary; if they hinder one another, they are in conflict; if reaching one Goal excludes reaching the other Goal, the two Goals are contradictory.	**h**
Hierarchy	can be applied to Goals or Organisational Units. A Hierarchy of Goals is a directed graph that connects Goals with subgoals and supergoals. A Hierarchy of Organisational Units is a directed graph that connects Organisational Units with subordinated and superior Organisational Units.	**c**
Human Resources	This term stresses an economic perspective on Employees. Regarding Employees as Resources puts emphasis on specific abilities, availability, cost and its contribution to a company's competitiveness.	**h**
Incentive	Defining Tasks, Activities or Business Processes recommends to think about the Motivation of the Actors (Employees, Customers, suppliers ...) that are involved. Incentives are motivators for actors that are created or identified for this purpose.	**h**
Information Need	The information that is required to perform an Activity or a Business Process. It can be represented on various media and on different levels of formalisation.	**c**
Information Output	The information that is produced by an Activity or a Business Process.	**c**
Information Resource	This term stresses an economic perspective on information. Hence, there is emphasis on its Quality (with respect to Goals, Effectiveness ...), its availability, cost and its contribution to a company's competiveness.	**c**
Insourcing	the act of turning an External Process into an internal Process	**c**

Job Enlargement	increasing the amount of work assigned to a Position or Role	**c**
Job Enrichment	increasing the variety of work and the overall Responsibility assigned to a Position or Role	**h**
Job Sharing	assigning a Position or Role to more than one Employee. Typically accompanied by a reduction of total working hours of the involved Employees.	**c**
Line of Command	The Line of Command defines the superior Positions for Positions within an Organisation Structure, hence the Positions that are empowered to give instructions. *Single* Line of Command means that a Position may have no more than one superior Position. *Multiple* Line of Command allows for more than one superior Positions. In the latter case there is need for criteria that describe which superior Position is in charge of which type of command - for instance: product-specific, financial etc.	**f**
Management by Delegation	a general orientation for management that puts emphasis on proper delegation of Tasks and Responsibilities	**h**
Management by Exception	a general orientation for management that is characterized by a high degree of trust in the abilities of subordinates. Managers are supposed to intervene only, if Exceptions occur. In order to avoid confusion, there should be a common understanding of what is to be regarded as an Exception. Management by Exception can be combined with Management by Delegation.	**h**
Management by Objectives	a general orientation for Management - based on the assumption that it is the pivotal task of Managers to define and communicate Goals. Goals are the essential measure to guide and control collaborative work. Management by Objectives can be combined with Management by Exception.	**h**
Manager	a Position that has Management Tasks/Responsibilities to it - such as defining Goals, giving instructions (to at least one Subordinate) .... Sometimes used to denote the Employee who holds the Position.	**c**
Market	a virtual place where aggregated demand meets aggregated supply. Exchanges occur between buyers and sellers based on negotiated contractual agreements. Usually prices are the essential part of these agreements. Market prices result from the ratio of aggregated demand and aggregated supply.	**c**

Market vs. Nonmarket	Within Organisations the allocation and distribution of Resources is usually based on decisions about the optimal mix of production factors. This is a Non-market approach. In contrast to that, it is possible to create Markets within a company. In this case, the products and services supplied by one Organisation Unit would have to be purchased by others - forcing the producing unit to compete with external competitor and encouraging the consuming unit to look for more attractive alternatives.	**c**
Motivation	The personal reason a human Actor feels to perform a Task or Activity or - in general - to feel committed to Goals.	**h**
Organisation Culture	Organisation Culture denotes the phenomenon that Quality and Efficiency of collaboration in Organisations depend on attitudes and values the Employees share. It is indicated by common ideas of how to solve problems, common perception/conceptualisation of the enterprise, common perception and evaluation of the relevant Environment etc. Organisation Culture is communicated through rituals and ceremonies.	**h**
Organisation Development	alternative approach to accomplish appropriate organisational change. It puts emphasis on involving and empowering people - based on the assumption that successful change requires the commitment of all participants. Different from an engineering perspective on Organisation design, it aims at fostering processes of self-organizing. It does not have to be an exclusive alternative to Organisation design. Instead, it can also be regarded as a supplementary measure.	**h**
Organisation(al) Structure	Organisation Structure is an abstraction of Organisation that combines institutional and instrumental aspects. It consists of Organisation Units (institutional aspect) and their relationships (line of command, responsibilities ...) which stresses an instrumental view.	**c**
Organisation(al) Unit	An Organisation Unit is a part of an Organisation (institutional) that reflects a permanent principle of the Division of Labour within this Organisation. An Organisation Unit may contain other Organisation Units. The definition of Organisation Units can be based on functional aspects (e.g. 'Finance', 'Production', 'Marketing' ...), product-oriented (e.g. 'Trucks', 'Sport Cars' ...), market-oriented (e.g. 'North America', 'Europe', 'Consumer', 'Reseller' ...) or combination of these. Usually there is one Position that is in charge of an Organisation Unit.	**c**

Organisation, informal	Guidelines, rules etc. that are relevant for collaborative Action, but that are not included in the formal Organisation (instrumental). It puts emphasis on power and influence of informal (not official) (opinion) leaders. Similar to Organisation Culture. However, the emphasis is less on values and attitudes, but more on rules, guidelines and sanctions.	**h**
Organisation, institutional	In its institutional sense, the term Organisation denotes a social or socio-technical system - like a business firm, a non-profit organisation, public administration etc. An (institutional) Organisation has an (instrumental) Organisation.	**c**
Organisation, instrumental	In its instrumental sense, the term Organisation represents a system of more or less restrictive guidelines and rules as well as incentives and sanctions to promote/enforce them. As long as these guidelines etc. are official, i.e. they have been made explicit and supported by Management, they can be regarded as the formal Organisation - in contrast to the Informal Organisation.	**c**
Organisational Chart	A graphical visualisation of an Organisation Structure. Organisational Charts exists in various flavours - both in terms of their semantics and the symbols used.	**f**
Outsourcing	the act of turning an internal Business Process into an External Process	**c**
Parallel Processing	Two or more Processes are running in parallel if they do not depend on one another.	**f**
Perspective	The way a human Actor perceives and evaluates the world (Organisation, information system etc.) is influenced by his language, his professional education, his experience, his attitude etc. - one could also say by his 'Weltanschauung'. Depending on his 'Weltanschauung', a human Actor prefers specific abstractions or views of an enterprise. A Perspective represents a view - like a process-oriented representation of a company - and also reflects the corresponding background of an Actor.	**h**
Position	A Position is the smallest Organisation Unit. It does not contain any other Positions. Usually, a Position is assigned to one Employee. There are, however, exceptions of this rule (Job Sharing).	**c**
Power	the ability of a human Actor to influence the outcome of other human Actors' Decision-Making and Actions.	**h**

Process	A Process is an instance of a Process Type. It consists of other Processes and/or Activities (sub processes). Cyclic compositions are not possible (a Process must not contain itself). Sub processes are in causal and/or temporal order. Sub processes may run in parallel. Each Process can be assigned Resources it requires, Processing Time, Information Need, Organisation Units, Goals etc.	**c**
Process Monitoring	mechanisms and procedures that allow for evaluating an actual run of a Process against its Goals - like Efficiency, Quality ...	**h**
Process Type	A Process Type represents a class of Processes of the same kind. A Process Type can be composed of other Process Types. Composition on this level may be cyclic (different from the instance level).	**c**
Process Variant	If the type of a Process is changed only marginally, the resulting type can be regarded as a variant. Hence, the corresponding instances are Process Variants. While this seems to be an intuitive concept, a precise definition is difficult to give.	**h**
Processing Time	in general the time a Process takes to complete. There are, however, predicates that allow for a more specific descriptions of Processing Time: minimum, maximum, average.	**f**
Productivity	Productivity expresses the ratio of input to output. It can be related to Processes, Organisation Units or Actors.	**f**
Profit Centre	A Profit Centre is an Organisation Unit. It emphasizes Responsibility, independence and creativity - hence, a high degree of decentralisation. Profit (or loss) that is assigned to it is the pivotal instrument to guide and control a Profit Centre.	**c**
Qualification	describes the abilities a human Actor has or should have in order to perform certain Tasks or to fill certain Positions or Roles. There is a wide range of abilities, some of which can be described rather precisely (e.g. being able to type-write at a certain speed, or being in command of a particular foreign language) where others do not allow for a comprehensive formal description (e.g. social skills).	**h**
Quality	The Quality of products or services is determined by a set of features. Some Quality related features are easy to measure (e.g. the failure rate of a hard disk), others are more difficult to evaluate (e.g. the code of a software system). In any case Quality is an important aspect for the design, Management and monitoring of Business Processes as well as for the allocation of corresponding Resources.	**h**

Reliability	A human Actor is reliable if his Actions conform repeatedly to given expectations. The instances of a Process Type are reliable if they produce repeatedly outcomes that conform to those defined for the Process Type.	**h**
Resource	in general the input that is required to perform a Process or Task. Resource is an abstraction of human Actors, machines, devices and material required to produce products or services. Information is often regarded as a Resource, too. With respect to the outstanding importance of information for the design of information systems, more specific terms (such as document, object, service etc.) are required, some of which are defined within MEMO-OML.	**c**
Responsibility	A human Actor can be assigned Responsibility for a set of Tasks or Processes - either explicitly or implicitly (for instance by defining Responsibility through Goals that are to be pursued).	**h**
Role	A Role is defined by a set of functions/Tasks, the Actor who fills the Role, has to perform. It is usually less formal than a Position - and it is orthogonal to Position: An Employee who holds a Position can also fill a set of Roles.	**c**
Simulation	If the specification of a Process Type is comprehensive enough to allow for (at least: partial) automation, it is possible to execute a prototypical Process after it was initialised with the required data. Usually a prototypical Process will be based on assumptions that abstract from real world peculiarities. Hence, this kind of execution is a Simulation. Simulating Business Processes makes sense if a Process Type is complex in a sense that is allows for a large variety of particular Processes (in terms of the Resources consumed, the events that may occur etc.). In this case it is often not possible (or to expensive) to calculate the distribution of relevant Process measures.	**c**
Slack	an extra amount of Resources that serves to handle fluctuation of demand and/or to compensate for loss of Resources	**c**
Span of Control	assigned to a Position: the number of directly subordinated Positions	**f**
Specialisation	Specialisation aims at dividing labour to a high degree. Specialisation is motivated by the hope for increasing Productivity through the development of special skills.	**c**

Specification of a Position	A Position is specified by a set of Tasks, Goals and Responsibilities. The Specification of a Position also includes subordinated and superior Positions as well as Substitutes.	**c**
Staff	an Organisation Unit of experts that is directly assigned to one Organisation Unit (usually a top level unit). It has not superior or subordinated Organisation Unit (it is not a 'line' unit). The Staff experts are charged with gathering and summarizing information and giving technical assistance to generalist Managers who are responsible for making final decisions.	**c**
Standardisation	Standardisation aims at defining organisational guidelines, rules, sanctions etc. in a unified way for the whole corporation. Bureaucracy takes Standardisation to an extreme.	**h**
Subordinate	assigned to a Position: a subordinated Position - sometimes used to denote an Employee who holds a subordinated Position	**c**
Substitute	A Substitute can be defined on different levels of abstraction. A Position may be assigned as Substitute to another Position meaning that a corresponding Employee serves as a Substitute. It is also possible to define a Role as a Substitute of another Role. Finally, a Substitute can be defined on the level of particular Employees, e.g. Sam Smith is the Substitute of John Miller - both holding the same Position.	**c**
Superior	assigned to a Position: a superior Position - sometimes used to denote an Employee who holds a superior Position	**c**
Task	A Task is characterised by a non empty set of Goals it is to accomplish. It can be more or less complex. A Task is performed by one or more human Actors. Performing a Task may require to run a Process. It requires, however, a human Actor. The definition of a Task is usually related to Motivation and Responsibility.	**h**
Team	A set of human Actors that are working together to accomplish a common Goal (or what they perceive/ communicate as such).	**c**

Transaction Cost	an analytical cost category. Opposed to production costs (related to transforming input into output), transaction costs include costs that deal with the motivation of Actors (e.g. costs caused by incentives) or with the Coordination of Activities (e.g. the cost of obtaining information, cost of control ...). Determining Transaction Costs is relevant for deciding whether a Business Process is suited to be outsourced.	**c**

While many of the terms listed above are also used in the context of project management, the following terms are specific for project management.

Term	*Description*	*Form.*
Action Plan	an overall plan of a Project. It includes all (Sub-) Projects included in a Project as well as the Roles/ Positions that are in charge and the Resources required. It can be represented on various levels of detail.	**c**
CPM	Critical Path Method, a scheduling technique for Project Management. It is based on a Network representation of Projects. To support overall time management, Critical Path Method prescribes to assign deterministic time and cost to Project Activities - and to point out time/cost trade-offs. Usually, the Critical Path of a Project is shown within a CPM diagram.	**c**
Critical Path	The Critical Path of a Project includes all Activities that are critical, i.e. that - if delayed - will delay the whole Project. In other words: The Critical Path is the sequence of Activities that determines the total time for a Project.	**f**
Earliest Finish Time	the earliest possible time by which a Project Activity can finish	**f**
Earliest Start Time	the earliest possible time at which a Project Activity can start	**f**
Free Float	the time by which a Project Activity can expand without affecting subsequent Project Activities	**f**
Gantt Chart	a type of diagram that renders the planned progress of a Project as well as the Project Activities already finished. Serves to plan and schedule Projects. Progress of a Project is displayed against a horizontal time scale. PERT and CPM diagrams can be transformed into Gantt Charts without loss of semantics.	**c**
Latest Finish Time	the latest time a Project Activity may finish	**f**

Latest Start Time	the latest possible time by which a Project Activity can start without holding up the total Project	**f**
Level of Confidence	A rational number assigned to a Project Activity or the availability of Resources that expresses the related Risk or uncertainty. The number is within the interval 0 .. 1 - 1 expressing total confidence.	**c**
Linear Responsibility Chart	a type of diagram that assigns Tasks within a Project or Project Activities to Roles or Positions defined in a corresponding Project Organisation	**c**
Meeting	A gathering of human Actors that may be aimed at a set of Goals.	**c**
Milestone	an Event that is of outstanding importance for the success of a Project	**c**
Multiproject	a set of Projects that are interdependent, i.e. there may be a Project that depends on results produced by another Project. Usually the Projects of a Multi-project compete for the same Resources.	**c**
Network	an abstraction of a Project; a Network representation of a Project consists of Project Activities (usually drawn as arcs) and Events (usually drawn as nodes at the beginning and end of each arc). Such a Network is a directed graph. Therefore it renders the Project Activity precedence relationships.	**c**
Path	A Path consists of a series of connected Project Activities and Events. It may also contain other Paths.	**f**
PERT	Program Evaluation and Review Technique, a scheduling technique for Project Management - similar to CPM. It is based on a Network representation of Projects. To support overall time management, PERT allows to assign probabilistic time to Project Activities. PERT also allows to show the Critical Path of a Project within a PERT diagram.	**c**
Project	an organized endeavour to reach a set of Goals. It has a limited life time. Every Project has unique features - that does not exclude, however, that two Projects may be very similar. Because of their uniqueness, Projects include non routine Tasks and a relatively high amount of Risk. Projects consume Resources. Estimating the amount of required Resources is usually risky. A Project can be composed of other Projects (however, no cyclic compositions).	**c**
Project Activity	A Project Activity is either an Activity (Process) or a Project which is part of another Project.	**c**

Project Audit	a detailed examination of selected aspects of a Project - emphasis on comparing actual states against plans or Goals	**h**
Project Management, institutional	a group of Project Managers assigned to a Project	**c**
Project Management, instrumental	the function of planning, conducting and monitoring a Project	**h**
Project Manager	a Position that is in charge of managing a Project	**c**
Project Organisation	an Organisation Structure that includes all Organisation Units that are assigned to a Project	**c**
Project Team	a Team that is in charge of conducting a Project	**c**
Risk	If the outcome of a Project Activity or the availability of Resources is not predictable for sure, it involves Risk. Risk can be described by pointing to the factors that cause it. To allow for calculations (e.g. within Simulations), Risk can be quantified using Levels of Confidence.	**h**
Schedule	a plan of a Project that emphasizes time aspects (starting time; finish time; duration) of Project Activities.	**c**
Steering Committee	A group of Actors (usually managers) that gets together whenever a major Project reviews (or redesigns) are necessary. Usually it includes representatives of the various stakeholders of a Project.	**c**
Total Float	the time by which a Project Activity can expand without affecting overall Project time	**f**
Work Breakdown Structure	a type of diagram that shows the decomposition of Projects into Project Activities (Work Packages)	**c**
Work Package	A Work Package is a Project Activity: It is not divided any further.	**c**

This glossary is aimed at an overview of essential terms in professional languages. Usually, these languages include only one term for a type and the corresponding instance. Making a distinction between type and instance would require to introduce additional terms. While this is clearly necessary for further steps, namely the specification of modelling languages or ontologies (see below), it would produce confusion at this stage. Therefore, differentiating between types and instances is restricted to processes. It is not applied to other terms, such as activities, tasks, resources etc.

6. Conclusions and Future Work

This report was aimed at an overview of the (academic) universe of discourse about organisation(s). The glossary presented in the previous chapter serves to foster two interrelated strings of future research. Firstly, it is intended to guide the refinement of MEMO-OrgML, a model-

ling language for the description of organisation structure and related business processes. Secondly, we plan to further elaborate the terms in order to develop an ontology of organisation. Such an ontology, which would include both formal and semi-formal concepts, could be used as a supplement to modelling environments and as a conceptual foundation of knowledge management systems ([Fran99]). As this report shows, the terminologies related to business processes and projects are different because they originate in different professional traditions. At the same time, many aspects of business processes and projects are similar. With respect to the development and re-use of tools, the identification of conceptual similarities promises clear economic benefits. For this reason, we will put special emphasis on abstractions that are suited for both domains.

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References

[Aich97] Aichele, C.: Kennzahlenbasierte Geschäftsprozeßanalyse. Wiesbaden: Gabler 1997

[Aldr79] Aldrich, H. E.: Organizations and Environments. Englewood Cliffs, NJ: Prentice Hall 1979

[AlFi99] Allaire, H.; Firsirotu, M.: Theories of Organizational Culture. In: Organization Studies, Vol. 3, No. 3, 1999, pp. 193-226

[Bada91] Badaracco, J. L.: The Strategic Link: How Firms Compete Through Strategic Alliances. Boston, Mass.: Harvard Business School Press 1991

[BeLu80] Berger, P. L.; Luckmann, T.: Die gesellschaftliche Konstruktion der Wirklichkeit: Eine Theorie der Wissenssoziologie. Frankfurt/M.: Suhrkamp 1980

[BlSc62] Blau, P. M.; Scott, W. R.: Formal Organizations. San Francisco: Chandler 1962

[Burg95] Burghardt, M.: Projektmanagement. 3. Auflage, Erlangen: publicis mcd 1995

[Calm22] Calmes, A.: Der Fabrikbetrieb: Die Organisation im Zusammenhang mit der Buchhaltung und der Selbstkostenberechnung industrieller Betrieb. 7. neubearb., Leipzig: Gloeckner 1922

[Camp94] Camp, R.: Benchmarking. München, Wien: Hanser 1994

[ClWh92] Clark, K.; Wheelwright, S.: Organizing and Leading 'Heavyweight' Development Teams. In: California Management Review, Vol. 34, No. 3, 1992, pp. 9-28

[CoKa91] Cooper, R.; Kaplan, R.: Profit priorities from activity-based costing. In: Harvard Business Review, Vol. 0, No. 3, 1991, pp. 130-137

[D'An86] D'Andrade, R. G.: Three Scientific World Views and the Covering Law Model. In: Fiske, D. W.; Schweder, R. A. (Ed.): Metatheory in Social Science. Chicago: University of Chicago Press 1986, pp. 19-41

[Dave93] Davenport, T. H.: Process Innovation: Reengineering Work through Information Technology. Boston, Mass.: Harvard Business School Press 1993

[DaMa93] Davidow, W. H.; Malone, M. S.: The Virtual Corporation: Structuring and Revitalizing theCorporation for the 21st Century. New York: Harper Business 1993

[DeKe82] Deal, T. E.; Kennedy, A. A.: Corporate Cultures. Reading, Mass.: Addison-Wesley 1982

[DrWi99] Dröschel, W.; Wiemers, M.: Das V- Modell 97. München, Wien: Oldenbourg 1999

[Fayo49] Fayol, H.: General and Industrial Management. London: Pitman 1949

[FeSi94] Ferstl, O. K.; Sinz, E. J.: From Business Process Modeling to the Specification of Distributed Business Application Systems - An Object-Oriented Approach. Universität Bamberg 1994

[Fran98] Frank, U.: The MEMO Object Modelling Language (MEMO-OML). Arbeitsberichte des Instituts für Wirtschaftsinformatik. Universität Koblenz, No. 10, 1998

[Fran99] Frank, U.: An Object-Oriented Architecture for Knowledge Management Systems. Arbeitsberichte des Instituts für Wirtschaftsinformatik. Arbeitsberichte des Institut für Wirtschaftsinformatik der Universität Koblenz-Landau, No. 16, 1999

[Gait92] Gaitanides, M.: Ablauforganisation. In: Frese, E. (Ed.): Handwörterbuch der Organisation. 3. völlig neu gestaltete Aufl., Stuttgart: Poeschel 1992, pp. 1-18

[Gait83] Gaitanides, M.: Prozeßorganisation. München: Vahlen 1983

[GSV94] Gaitanides, M.; Scholz, R.; Vrohlings, A.: Prozeßmanagement - Grundlagen und Zielsetzung. In: Gaitanides, M.; Scholz, R.; Vrohlings, A.; Raster, M. (Ed.): Prozeßmanagement: Konzepte, Umsetzungen und Erfahrungen des Reengineering. München, Wien: Hanser 1994, pp. 1-20

[Gidd83] Giddens, A.: Profiles and Critiques in Social Theory. Berkeley: University of California Press 1983

[Gole67] Golembiewski, R. T.: Organizing Men and Power: Patterns of Behavior and Line-Staff Models. Chicago: Rand McNally 1967

[Groc78] Grochla, E.: Einführung in dei Organisationstheorie. Stuttgart: Poeschel 1978

[Groc82] Grochla, E.: Grundlagen der organisatorischen Gestaltung. Stuttgart: Poeschel 1982

[Gr¸n92] Grün, O.: Projektorganisation. In: Frese, E. (Ed.): Handwörterbuch der Organisation. 3. völlig neu gestaltete Aufl., Stuttgart: Poeschel 1992, pp. 2102-2116

[Habe92] Haberfellner, R.: Projektmanagement. In: Frese, E. (Ed.): Handwörterbuch der Organisation. 3. völlig neu gestaltete Aufl., Stuttgart: Poeschel 1992, pp. 2090-2102

[HaCh93] Hammer, M.; Champy, J.: Reengineering The Corporation: A Manifesto for Business Revolution. New York: Harper Business 1993

[HaFr77] Hannan, M. T.; Freeman, J.: The Population Ecology of Organizations. In: American Journal of Sociology, Vol. 83, No. 0, 1977, pp. 929-964

[Hijm29] Hijmans, E.: Une nouvelle mÈthode d'organisation par les graphiques de liaisons et d'attribution. In: Bulletin du ComitÈ National de l'Organisation Francaise, Vol. 0, No. 6, 1929, pp. 1-3

[HKM+93] Horvath, P.; Kieninger, M.; Mayer, R.; Schimank, C.: Prozeßkostenrechnung - oder wie die Praxis die Theorie überholt - Kritik und Gegenkritik. In: DBW, Vol. 0, No. 5, 1993, pp. 609-628

[JBR99] Jacobson, I.; Booch, G.; Rumbaugh, J.: The Unified Software Development Process. Reading, Mass., et al.: Addison-Wesley 1999

[JaIv94] Jarvenpaa, S. L.; Ives, B.: The Global Network Organization of the Future: Information Management Opportunities and Challenges. In: Journal of Management Information Systems, Vol. 10, No. 4, 1994, pp. 25-57

[Joha88] Johansen, R.: Groupware: Computer Support for Business Teams. New York, London: Free Press 1988

[KaNo92] Kaplan, R.; Norton, D.: The balanced scorecard - measures that drive performance. In: Harvard Business Review, Vol. 0, No. 1, 1992, pp. 71-79

[KeTe98] Keller, G.; Teufel, T.: SAP R/3 Process Oriented Implementation: Iterative Process Prototyping. Reading, Mass., et al.: Addison-Wesley 1998

[Klei96] Klein, S.: Interorganisationssysteme und Unternehmensnetzwerke. Wiesbaden: Gabler 1996

[Kosi62] Kosiol, E.: Organisation der Unternehmung. Wiesbaden: Gabler 1962

[Le C30] Le Coutre, W.: Betriebsorganisation. 1930

[LDE73] Leavitt, H. J.; Dill, W. R.; Eyring, H. B.: The Organizational World. New York: Harcourt Brace Jovanovich 1973

[LeOb01] Lenz, K.; Oberweis, A.: Modeling Inter-Organizational Workflows with XML Nets. In: (Ed.): Proceedings of the Hawaii International Conference On System Sciences. Los Alamitos, Ca.: IEEE Computer Society 2001

[Lieb92] Liebelt, W.: Ablauforganisation, Methoden und Techniken der. In: Frese, E. (Ed.): Handwörterbuch der Organisation. 3. völlig neu gestaltete Aufl., Stuttgart: Poeschel 1992, pp. 19-34

[LiSu89] Liebelt, W.; Sulzberger, M.: Grundlagen der Ablauforganisation. Gießen: Dr. Götz Schmidt 1989

[LiRe99] Lientz, B. P.; Rea, K. P.: Breakthrough Technology Project Management. London, San Diego, New York, Boston, Sydney, Tokyo, Toronto: Academic Press 1999

[Like61] Likert, R.: New Patterns of Management. New York: McGraw-Hill 1961

[Litk95] Litke, H.: Projektmanagement: Methoden, Techniken, Verhaltensweisen. München, Wien: Hanser 1995

[MeMa95] Meredith, J. R.; Mantel, S. J.: Project Management: A Managerial Approach. New York, Chichester, Brisbane, Toronto, Singapore: Wiley 1995

[MeRo77] Meyer, J. W.; Rowan, B.: Institutionalized Organizations: Formal Structure as Myth and Ceremony. In: American Journal of Sociology, Vol. 83, No. 0, 1977, pp. 340-363

[Midl95] Midler, C.: 'Projectification' of the Firm: The Renault Case. In: Scandinavian Management Review, Vol. 11, No. 0, 1995, pp. 363-375

[Morg86] Morgan, G.: Images of Organization. Thousand Oaks, London, New Delhi: Sage 1986

[Nick22] Nicklisch, H.: Der Weg aufwärts! Organisation. 2. Ed., Stuttgart: Poeschel 1922

[Nick33] Nicklisch, H.: Die Betriebswirtschaft im nationalsozialistischen Staat. In: DBW, Vol. 0, No. 0, 1933, pp. 172-177

[NoEc92] Nohria, N.; Eccles, R.: Face-to-Face - Making Network Organizations Work. In: Nohria, N.; Eccles, R.; Ibarra, H. (Ed.): Networks and Organizations. Boston, Mass.: Harvard Business School Press 1992, pp. 288-308

[Nord32] Nordsieck, F.: Die schaubildliche Erfassung und Untersuchung der Unternehmensorganisation. Stuttgart: Poeschel 1932

[Nord34] Nordsieck, F.: Grundlagen der Organisationslehre. Stuttgart: Poeschel 1934

[Ober96] Oberweis, A.: An Integrated Approach for the Specification of Processes and Related Complex Structured Objects in Business Applications. In: Decision Support Systems, Vol. 17, No. 1, 1996, pp. 31-53

[OSS94] Oberweis, A.; Scherrer, G.; Stucky, W.: INCOME/STAR: Methodology and Tools for the Development of Distributed Information Systems. In: Information Systems, Vol. 19, No. 8, 1994, pp. 643-660

[PRW97] Picot, A.; Reichwald, R.; Wigand, R. T.: Information, Organization and Management: Expanding Markets and Corporate Boundaries. New York: Wiley 1997

[PuHi76] Pugh, D.; Hickson, D.: Organizational Structure and Its Context: The Aston Programme. Lexington, Mass.: Heath 1976

[PHH69] Pugh, D.; Hickson, D.; Hinings, C.: An Empirical Taxonomy of Structures of Work Organizations. In: Administrative Science Quarterly, Vol. 14, No. 0, 1969, pp. 115-126

[Quin92] Quinn, J. B.: Intelligent Enterprise: A Knowledge and Service Based Paradigm for Industry. New York: Free Press 1992

[Rau96] Rau, H.: Benchmarking: Die Fehler der Praxis. In: Harvard Business Manager, Vol. 0, No. 4, 1996, pp. 21-25

[Reic91] Reich, R.: The Work of Nations. New York: Vintage Books 1991

[Ritt00] Rittgen, P.: EMC - A Modeling Method for Developing Web-based Applications. In: (Ed.): Proceedings of the International Conference of the International Resources Management Association (IRMA) 2000: Anchorage, Alaska. 2000, pp. 135-140

[RoSh91] Rockart, J. F.; Short, J. E.: The Networked Organization and the Management of Interdependence. In: Scott Morton, M. S. (Ed.): The Corporation of the 1990s: Information Technology and Organizational Transformation. New York, Oxford: Oxford University Press 1991, pp. 189-219

[Rolf98] Rolf, A.: Grundlagen der Organisations- und Wirtschaftsinformatik. Berlin, Heidelberg, New York, et al.: Springer 1998

[Sche94] Scheer, A.: Business Process Engineering. 2. compl. rev. and enlarged ed., Berlin, Heidelberg, New York, et al.: Springer 1994

[Sche98] Scheer, A.: ARIS: Vom Geschäftsprozeß zum Anwendungssystem. 3. völlig neubearbeitete und erweiterte Aufl., Berlin, Heidelberg, New York, et al.: Springer 1998

[Sche99] Scheer, A.: ARIS - Business Process Modeling. 2. compl. rev. and enlarged ed., Berlin, Heidelberg, New York, et al.: Springer 1999

[Schm83] Schmidt, G.: Organisation: Methode und Technik. 5. Ed., Gießen: Dr. Götz Schmidt 1983

[ScVr94a] Scholz, R.; Vrohlings, A.: Prozeß-Leistungs-Transparenz. In: Gaitanides, M.; Scholz, R.; Vrohlings, A.; Raster, M. (Ed.): Prozeßmanagement: Konzepte, Umsetzungen und Erfahrungen des Reengineering. München, Wien: Hanser 1994, pp. 99-122

[ScVr94b] Scholz, R.; Vrohlings, A.: Prozeß-Struktur-Transparenz. In: Gaitanides, M.; Scholz, R.; Vrohlings, A.; Raster, M. (Ed.): Prozeßmanagement: Konzepte, Umsetzungen und Erfahrungen des Reengineering. München, Wien: Hanser 1994, pp. 37-56

[Schr98] Schreyögg, G.: Organisation. 2. überarb. Aufl., Wiesbaden: Gabler 1998

[Scot92] Scott, W. R.: Organizations: Rational, Natural, and Open Systems. Englewood Cliffs, NJ: Prentice Hall 1992

[Tayl11] Taylor, F. W.: The Principles of Scientific Management. New York: Harper 1911

[Thom67] Thompson, J. D.: Organizations in Action. New York: McGraw-Hill 1967

[Ward64] Ward, J. W.: The Idea of Individualism and the Reality of Organization. In: Cheit, E. F. (Ed.): The Business Establishment. New York: Wiley 1964, pp. 37-76

[Webe00] Weber, J.: Stichworte: Balanced Scorecard, Controlling, Prozesskostenrechnung. In: (Ed.): Gabler's Wirtschaftslexikon. 15. Ed., Wiesbaden: Gabler 2000

[Webe72] Weber, M.: Wirtschaft und Gesellschaft. 5. Auflage, Tübingen: Mohr Siebeck 1972

[Webs92] Webster, F. E.: The Changing Role of Marketing in the Corporation. In: Journal of Marketing, Vol. 56, No. 1, 1992, pp. 1-17

[Wenz97] Wenzel, J.: Entwurf einer Modellierungssprache zur Beschreibung von Geschäftsprozessen im Rahmen der Unternehmensmodellierung. Diplomarbeit, Universität Koblenz-Landau 1997

[WoJo96] Womack, J. P.; Jones, D. T.: Lean Thinking: Banish Waste and Create Wealth in Your Corporation. New York: Simon & Schuster 1996

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