Technical Consequences of the Nature of Business Processes

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Abstract

The paper is a reflection on the nature of business processes and the way which their nature necessarily manifests itself in business process modeling methodologies and languages. Respecting the nature of business processes is an essential condition for the meaningfulness of a process model. The importance of this topic is also emphasized with the fact that not all methodologies nor languages respect the nature of business processes sufficiently.

The paper briefly summarizes main facts about and principles of business process management and points out the main natural features of business processes which have to be necessarily respected in modeling methodologies and languages. Then their main resulting features are analyzed in mutual relationships by examples from MMABP methodology. In occasional contexts the paper also contains some critical reflection of current process modeling approaches and BPMN language.

Keywords: Business Process Modeling, Business Process Management, Process Modeling languages, BPMN, ARIS, IDEF, Cybernetics.

1. Introduction

Over 20 years after the idea of business process-driven management was born there still exist essential insufficiencies in the understanding of how business processes should be modeled in order to respect this idea. These insufficiencies influence even the existing modeling standards. As creating the model of business processes is a necessary first step in the process of implementing the process-driven management idea, this situation should be regarded as a main blocker of the needed putting this idea into the real life.

On the other hand, there exist theories, methods and ideas, already known in other contexts, which directly address the problems and features behind the above mentioned insufficiencies of the current state. As usually, the root of the problem is not the insufficient knowledge basis but rather the insufficient realizing of the proper context.

The aim of this paper is to draw attention to the essential features of the business processes and business systems in the context of their modeling. The needed reflection of these essential features in the modeling language and methodology will be analyzed. In addition, the basic insufficiencies of the contemporary approaches to the business process modeling will be pointed out together with the outline of possible ways of their overcoming.

As a basis of the main principles used in considerations in this paper we use the MMABP methodology [11], [14], [2]. MMABP (Methodology for Modeling and Analysis of Business Processes) is a 'language independent' methodology based on the set of meta-models which define the basic concepts and express the basic principles of the methodology, and completed with the set of techniques, consistency rules and patters. MMABP is generally open in terms of principal ability to be completed with newer concepts, principles, techniques, etc. if they are consistent with its principles and the meta-models. As the MMABP is based on meta-models instead of particular languages it can be also used as a basis for the evaluation of any modeling language towards the principles.

The paper is divided into three main sections. In the second section, after this introduction, we briefly explain the main features of the nature of business processes following the root ideas of the business process management. Based on the idea that business processes

represents the integration of both managerial and technical aspects of the business we look at it from the points of view of management as well as cybernetics. Third section contains some reflections on the consequences of the main findings from the second section. We argue there for process states and consequential rules for the process description granularity together with the integrating idea of service-oriented approach to the business system conception as a general 'technical' consequence of the idea of process driven management. In conclusions we then briefly summarize the main ideas of the paper and outline some other consequences which call for further elaboration.

2. The Nature of Business Processes

The idea of process-based organization is excellently expressed in [8]. The authors argue for so-called 'Business Process Re-engineering' which means complete radical change of the way which the organization is managed. The proposed way of the organization management is based on the idea that an organization has to build its behavior on objectively valid structure of its business processes to be able to fully exploit the possibilities offered by the technology progress. This condition is typically not fulfilled in traditionally managed organizations where hierarchical organization structure prevents seeing, as well as managing, the crucial process chains which should be the central subject of change due to the technology progress. For achieving the needed ability to fully exploit the technology progress the traditional hierarchical way of management should be rejected and substituted with the management style based on the objective model of business processes of the organization.

The very significant role in this radical revision of the traditional approach to the organization management play information technologies (IT). IT has a double function in this process. On one hand the turbulent development of IT can be regarded as a determining reason for the necessary change of the way which organizations are managed in order to allow them to be flexible enough for exploiting the new technology possibilities. On the other hand IT is a main tool for this radical change; IT allows managing the organization the way which has been previously impossible. Particularly it allows handling the business the way which is closer to its natural substance, i.e. more simple that the traditional one. IT undertakes the role of the main lever for the development of the business.

The essential importance of IT in Business Process Re-engineering (BPR) also works as a basis for the typical mistaken idea that BPR is a clearly technical matter. Even if this idea can be met very often especially in the field of process modeling (including unfortunately also modeling languages, namely BPMN [1]) it is fatally dangerous in the context of BPR. Just the essential importance of the technical aspects of the business in the process-oriented organizations causes that any underestimating of non-technical aspects of business processes can completely destroy the effect of the process-oriented management. Therefore, we regard the technical consequences of the nature of business processes in business process modeling methodologies critically important.

2.1. Business Process From the Point of View of Management

One of the main ideas stated in the previous section is that 'organization has to build its behavior on objectively valid structure of its business processes to be able to fully exploit the possibilities offered by the technology progress'. This idea presumes that there are some objective facts, conditions and rules, following from the business system itself, which determine the quality and correctness of business processes. The collection of such rules is can be called '*system causality*'. Nevertheless, business system is defined not only by rules but also by the behavior of its actors. System causality can restrict but not fully determine the behavior of business actors. The reason for behavior of business actors is not just that they can but that they need or just simply want. Thus, to make the model of the business system complete it is necessary to

take into the account also the concept of intentions, purposes, business goals. Not only the system causality but also *intentions* of actors should be modeled[6].

Business system causality is the main subject of the object-oriented approaches to business processes which can be found mainly in the field of 'process ontologies' as the ontological point of view is naturally object- (system-) oriented. Some work, oriented on the methodical aspects of business processes modeling, can be found in [5] and [3] for instance. Special kind of these ontological attempts, highly relevant for our problem as it takes into the account also the intention, is so-called 'goal-oriented' business process modeling. In [4] the explanation of this approach can be found: 'While traditional approaches in business process modelling tend to focus on 'how' the business processes are performed (adopting a behavioural description in which business processes are described in terms of procedural aspects), in goal-oriented business process modelling the proposals strive to extend traditional business process methodologies by providing a dimension of intentionality to the business processes'. Although this approach clearly distinguishes between the system and the process view of processes it is still focused just on some particular aspects of processes and especially do not take into the account their collaboration.

To understand the 'business essence' of the collaboration of processes one primarily has to differentiate two basic functional types of processes: the *key* versus *support* ones. As customer needs are constantly changing, the processes in the organization should change as well. That means that any process in the organization should be linked to the customer needs as directly as possible. Thus, the general classification of processes in the organization distinguishes mainly between:

- *Key processes*, i.e. those processes in the organization which are linked directly to the customer, covering the whole business cycle from expression of the customer need to its satisfaction with the product / service.
- *Support processes*, which are linked to the customer indirectly - by means of key processes which they are supporting with particular products / services. To understand the 'business essence' of the collaboration of processes one primarily has to differentiate two basic functional types of processes: the *key* versus *support* ones.

Main differences between key and support business processes can be found in Table 1.

Table 1. Essential differences between key and support business processes.

	Key process	**Support process**
Customer's needs	Fulfilled directly.	Fulfilled indirectly, through key processes.
Responsibility	Management – oriented. Responsible primarily for the context of the whole business case from the customer point of view.	Production - oriented. Responsible for the quality of its service, not for the context in which it is used.
Dynamics	Very dynamic, often changing, permanently developing, every instance is an original.	Rather static, stable, offering standardized and multiply usable services.

The value of the key process is given by its direct contact with the value for the customer as it is the main goal of the process. The values of other (support) processes is given by the

6 The problem of intentionality versus causality is a serious philosophical topic which contains also the problem of 'free will' and other, in the philosophical community still 'live', topics. Moreover, in the context of the business system modeling this problem also covers the essential differences among various concurrent approaches to the basic issues of the theoretical economics. Although this problem would generally require more discussion, for the purpose of this paper let us reduce it just to the need of taking into the account in the business process modeling also the intentions of actors.

services by which these processes support other (supported) processes. This way every process is ultimately connected to the value for the customer either directly (key process) or through its services for other processes.

As it follows from the previous paragraph, the whole system of processes of the process-managed organization is a network (non hierarchical net structure) which is *customer-centered*. All processes mutually collaborate on the basis of support services which all are finally targeted through the key processes to the value for the customer. Traditional, principally non flexible, hierarchy of organization units is replaced with the collaborative, principally flexible, customer-centered network structure of business processes. All the system is tied together by services by which the processes mutually support each other. Such system can be therefore called '*service oriented view of business*'.

2.2. Business Process From the Point of View of Cybernetics

In the previous sub-section we discussed the need for intentionality in business processes. Intentionality, or more traditionally purposefulness, is an important topic also for the ideas connected with the field of technology in such phenomena like Business Process Management Automation in general, particularly robotics and similar. In the legendary article [12] which is usually regarded as root of cybernetics the authors expressed the idea which essentially influenced the later development of cybernetics: 'all purposeful behavior may be considered to require negative feed-back'. The concept of negative feed-back is explained there as follows: *'...the behavior of an object is controlled by the margin of error at which the object stands at a given time with reference to a relatively specific goal. The feed-back is then negative, that is, the signals from the goal are used to restrict outputs which would otherwise go beyond the goal'.*

According to the basic work in the field of process-driven management ([8]) business process always follows some goal. The goal is a fundamental attribute of a business process as it is regularly used in matured methodologies like in [7] for instance. That means that business process is always an intentional process. By the term 'intentional process' we mean the process of purposeful behavior of interested object following some goal. For instance, if we personalize the business process to the behavior of its actors, namely of the process manager, we can undoubtedly see his (her) behavior as an intentional behavior which follows the goal of the process.

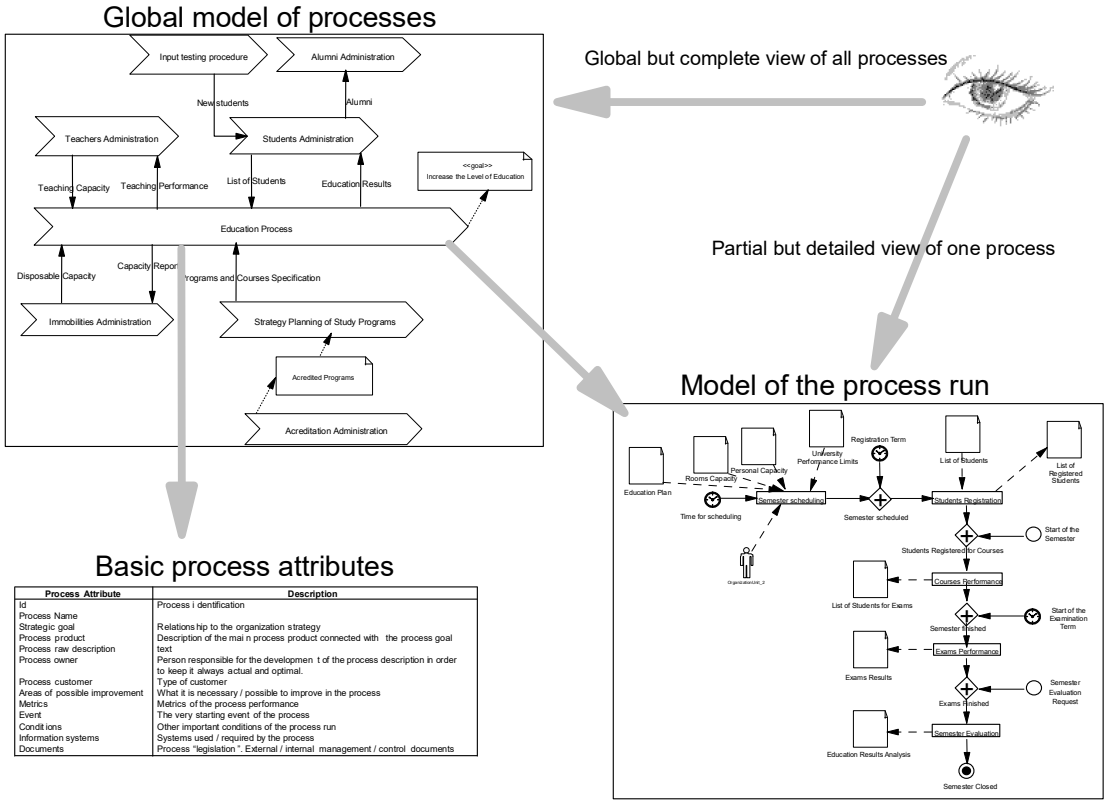
Concluding from previous two paragraphs one can find that every business process, as it is an intentional kind of process, have to have some negative feed-back which ensures restriction of its outputs in order to keep them in the margins of its goal. This characteristic strongly distinguishes the business process from the process in general (ie. in just technical /physical sense) as well as from processes which do not need any feed-back like machine-managed or fully automated processes running without a contact with their environment.

3. Main Resulting Features of the Modeling of Business Processes

3.1. System versus process-oriented model of business processes

In the sub-section *1.1. Business Process From the Point of View of Management* the principal need to distinguish between key and support processes is mentioned as a basic condition for understanding the 'business essence' of the collaboration of processes. This difference in process types is a system attribute, i.e. it is not visible from the process described just as an algorithm (like with use of BPMN [1]). It requires looking at the whole system of processes. Therefore, it is necessary not only to model the process as a process (i.e. the run of it) but also as a part of the system of processes which is a collection of collaborating processes mutually connected with services. MMABP calls this model Global process model. As a system view this model shows the system parts (business processes) and their mutual relationships (cooperation) and that way it allows the needed functional differentiation of processes; clear distinguishing between the key and support ones (see Figure 1).

Unfortunately, this need is still not sufficiently reflected by the current BPM methodologies. It is well visible also as the state of the art of business process modeling languages. For example BPMN (Business Process Model & Notation) [1], even if it is established as a worldwide standard in the field of business processes modeling, it is still mainly oriented just on the description of internal algorithmic structure of a business process and disregards the global view on the system of mutually cooperating processes. The only way of modeling the cooperation of different processes in BPMN is using 'swimming pools and lanes' in the Collaboration Diagram. Unfortunately, the global aspects of the system of business processes cannot be sufficiently described this way nor its completeness ensured. The BPMN primarily views processes as sequences of actions in the time line. But the global model requires seeing processes primarily as objects (relatively independent of the time), distinguishing different kinds of them (especially the key versus support ones), describing their global attributes (like the goal, reason, type of customer, etc.), and recognizing their essential relationships to other processes which all is obviously impossible to describe as a process flow.



Process Attribute	Description
Id	Process i dentification
Process Name	
Strategic goal	Relationship to the organization strategy
Process product	Description of the mai n process product connected with the process goal
Process raw description	text
Process owner	Person responsible for the developmen t of the process description in order to keep it always actual and optimal.
Process customer	Type of customer
Areas of possible improvement	What it is necessary / possible to improve in the process
Metrics	Metrics of the process performance
Event	The very starting event of the process
Conditions	Other important conditions of the process run
Information systems	Systems used / required by the process
Documents	Process "legislation ". External / internal management / control documents

Fig. 1. System process view versus detailed view on process in MMABP.

One of the mostly accepted 'de facto' standards which fully supports the system (objectoriented) view of business processes is the Eriksson-Penker Notation [7]. It was created as an extension of UML [18] which corresponds with the above discussed 'object nature' of the global view on processes. This notation distinguishes between the 'Business Process View' which illustrates the interaction between different processes and the 'Business Behavioral View' which describes the individual behavior of the actors of one particular process. This way it respects the important difference between the global object-oriented view of a process system and the detailed process-oriented view of a single process. Therefore, MMABP methodology presented in this paper uses the Eriksson-Penker process diagram as a complement to the BPMN in order to compensate the absence of the global view in this language (see Figure 1). Detailed explanation of the methodical need for global model of processes as well as related criticism of the BPMN can be also found in [13].

3.2. Process states

One of the basic topics discussed in the section *The Nature of Business Processes* and viewed in both its sub-sections from managerial and technical points of view is the *intentionality in business system*. Sub-section *1.2. Business Process From the Point of View of Cybernetics* then concludes that to be a business process the process must be connected with its environment via so-called 'negative feedback'. The 'negative feedback' is implemented in MMABP as the concept of *process state*.

In the case of business process the feed-back is represented by the input to the process from its environment which is causally connected with some process output. The value of the input should influence the following behavior of the process in terms of keeping it in the margins of its goal. This means that 'intermediate' inputs to the process (i.e. none-starting inputs to the process coming between its starting and end points) are critically important parts of the business process distinguishing it from other, non-intentional (i.e. non-business), processes. Working with processes we have to take into the account even the time dimension; every input to the process from its environment has to be synchronized with the process run. Thus, in each part of the process where some input which influences the following process run is expected the process state has to be placed. Process state means such point in the process structure where nothing can be done before the input to the process occurs, i.e. point of waiting for the input.

Process state thus represents the essential need to synchronize the process run with expected events. This need follows from the fact that the event is always an objective external influence and thus it must be respected. From the physical point of view such respect means synchronization – waiting for the event. As BPMN do not recognize the concept of process state there is no other way than to express the process state with the general symbol for synchronization – the 'AND gate'. In order to distinguish between the general synchronization and its specific meaning as a process state we complete the BPMN with the stereotype <<process state>>.

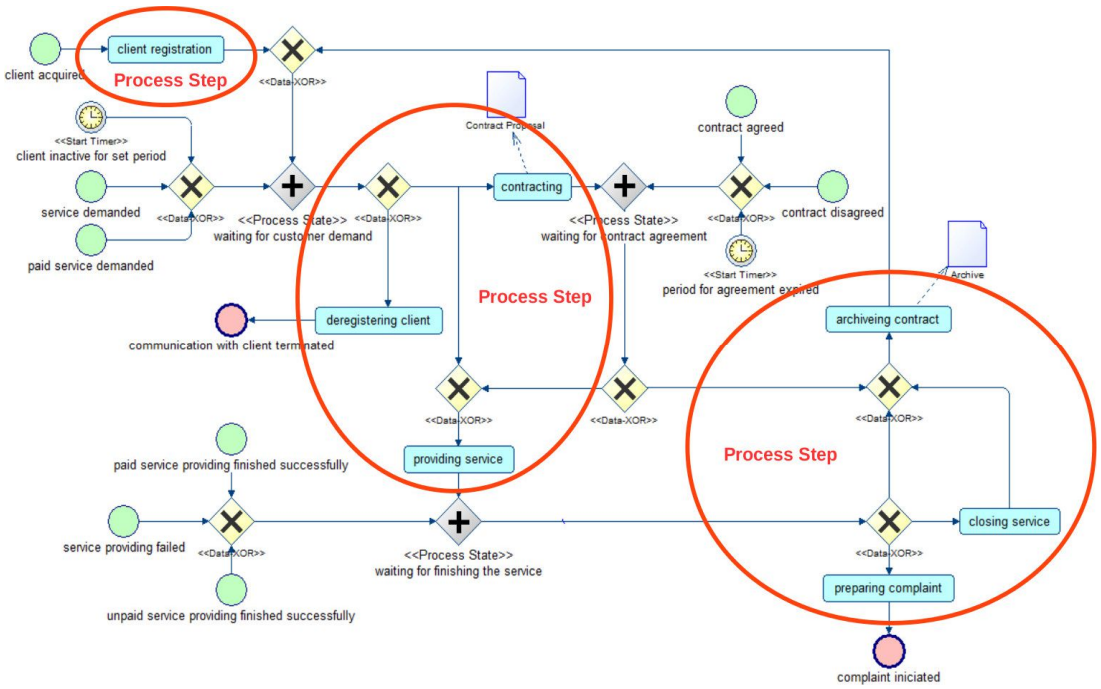


Fig. 2. Example of the use of process states in the BPMN language.

One of the most important ideas following from the concept of process state is that there can not be a sequence of process steps uninterrupted by the process state. This rule reflects the essence of the definition of an elementary *process step*:

(a) the process step is regarded as elementary if there is no objective reason for its interruption,
(b) the reason for the interruption of the step is objective if it comes from outside of the process.

Rule (b) of this definition means that each objective reason for the process interruption is represented by an event (external influence) in fact. Thus, any step of the process, no matter how technically complex it is, must be regarded as elementary if there does not exist an external influence (event) which the process has to respect (i.e. wait for). This consequence well illustrates the fact that the elementariness of a business process step is not only its physical but much more a functional attribute as the business process itself is always more than a physical process (algorithm) only. This way the methodology prevents the analyzer from the pointless unlimited dividing of the process activities which is a frequent mistake in the field of business process modeling. The necessity of such safety fuse in the methodology against the unlimited division of activities is given by the fact that in the field of process-oriented modeling the aggregation is a dominating type of abstraction (unlike in the field of object-oriented modeling where the generalization is a dominating type of abstraction). This fact manifests itself in the principally unlimited possibilities of division of activities known as a rule: any single process activity can be decomposed into the structure of sub-activities – a process. As the division of activities is physically unlimited the methodology has to define some logical – functional definition of the very low level: the level of the process elementariness.

Figure 2 shows the example of the process with states represented with the symbol of synchronization (AND gate). It also illustrates the rule of 'needed objective reason for the process interruption'. For instance, the first two states in this process represent waiting for the action of a customer. The objectiveness of this state is obvious as the customer can never be regarded as a part of the enterprise. From the enterprise point of view the customer is always an independent actor, a representative of the free will. Therefore, the process cannot continue unless the will of the customer is known (either via the direct action or as an information gathered indirectly by means of the timer (see events in process states at Fig.2)). The third state represents waiting for the action of another - supporting - process (service). Even in this situation the reason for waiting is objective although awaited events come from inside of the enterprise. In this case the objectiveness is given by the transfer of the responsibility. For the service is not responsible the main but the supporting process. This state thus represents the collaboration of processes (see also the sub-section 1.6).

3.3. Granularity of Process Description

The MMABP rule of 'needed objective reason for the process interruption' discussed in the previous sub-section works also as a determiner of the 'proper' granularity of the process description. In fact, it addresses just one from the four process abstraction levels which MMABP distinguishes:

1. *Enterprise functionality level* (functional division of the organization to different process areas according to different key processes of the organization).
2. *Business process level* (Process Map – Global model of processes).
3. *Process step level* (process description with process states according to the rule of 'needed objective reason for the process interruption'.).
4. *Activity level* (more detailed decomposition of process activities according to the states of crucial business objects).

Detailed description and explanation of four process abstraction levels can be found in [17]. From the characteristics of particular process levels is visible that activities, mentioned generally in the previous sub-section correspond to the so-called 'process steps'. Figure 2 illustrates the process model on the level of process steps. The process step can consist either of one activity (see the *client registration* step) or even more time-independent activities connected to one structure (see both remaining process steps). In this example both structures represent mutually exclusive activities. Exclusivity ensures their time-independence as at the

given moment only one activity exists. Another possible structure, which is not illustrated there, is a structure of parallel activities (connected with the AND gate). Even parallel activities have to be regarded as time-independent, because they all run in the same time. The only incorrect structure is a sequence of activities which is a representative of the clear time-dependency (ie. the time of one activity is dependent on the time of another one).

Regarding the reasons for as well as crucial circumstances of using process states it is obvious that '*process step*' (as well as the *process state*) reflects primarily the *collaboration.* This topic is discussed in detail in the following sub-section.

3.4. Collaboration of processes

Figure 3 shows different problem areas connected with the process-based organization. Three exemplary viewpoints at the figure together address three substantial parts of the organization's life: content, technology, and people. Each particular point of view is characterized by typical questions which should be answered by the methodology in the given field.

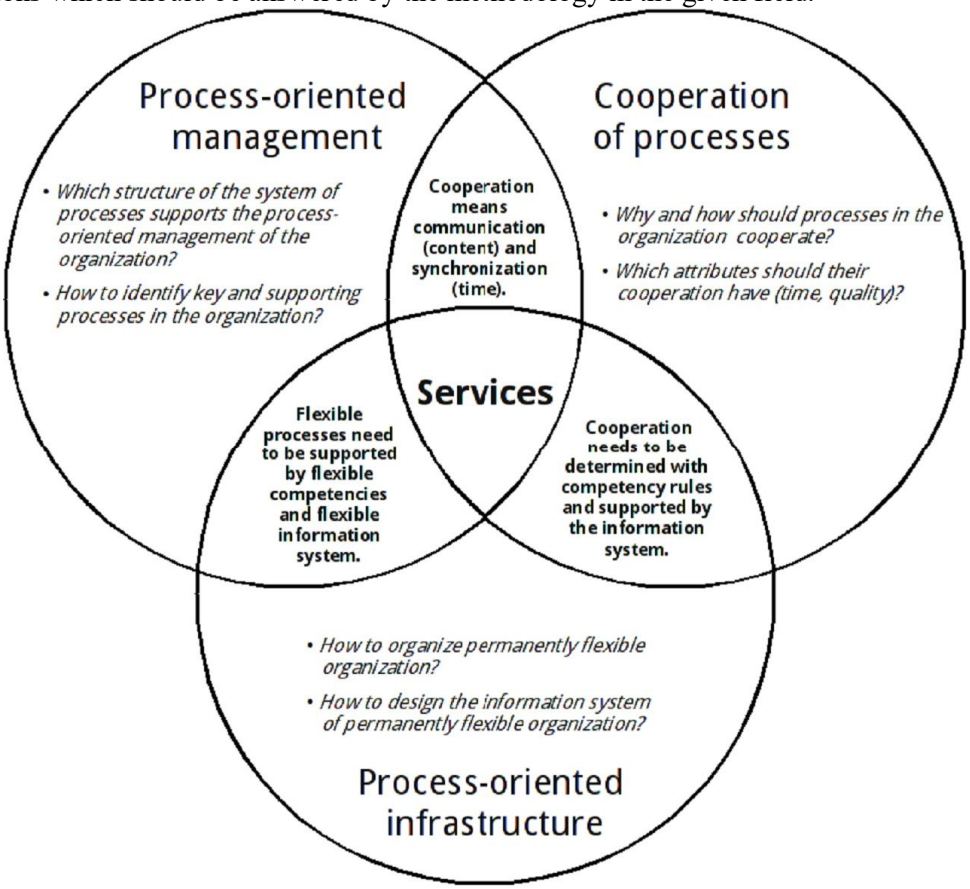


Fig. 3. Service as a common denominator of content, technical, and human aspects of the organization management (source: [15])

From previous sub-sections follows that the common concept visible in all discussed topics is the collaboration of business processes. The need for having two basic types of model: system and detailed, process-oriented, ones is caused by the need to distinguish between two basic functional types of processes: key and support ones. The reason for distinguishing between key and support processes raises from the need for creating such structure of mutually collaborating processes which ensures that all processes follow the same goal: the value for the customer. Every support process is connected with the value for the customer through supporting the other processes. Therefore, the most important aspect of the detailed model of the process (i.e. model of the process run) is the identification of those points in the process which represent the collaboration with other processes – identification of process states. Finally, *process states play*

the role of the determiner of such granularity of the process description which is driven mainly by the collaboration with other processes.

Following the idea of the service-oriented view of business expressed in the sub-section *1.1. Business Process From the Point of View of Management* we can see that the common denominator of all important aspects of the organization management is the *service* (see Figure 3). The concept of service connects together both managerial and technical points of view of business process. It plays the crucial role in understanding of the functional meaning of processes (key versus support processes) as well as in understanding of their mutual positions (collaborative network instead of the control hierarchy). The concept of service also plays the important role from the technical point of view on business processes:

- The MMABP business process modeling technique uses the service as a universal form of the description of mutual relationships between two collaborating processes. Every pair of relationships between two collaborating processes is described as a single service in terms of *request for the service* and *service delivery*. Subsequently, the details of the service are specified using the standard attributes of the *service* taken from the general theory of SLA (Service Level Agreement). That allows the central expression of all important aspects of the organization management connected with the collaboration of two particular processes in once: content of the service together with the human aspects in the form of mutual responsibilities of actors, and also the technical aspects like technical parameters of the service (time and data requirements, etc.).

- In the implementation of the system of processes then the service plays the role of the precise definition of technical as well as human and other organizational requirements which should be handled and supported with the technology.

4. Conclusions

This paper is a reflection on the nature of business processes and the way which their nature necessarily manifests itself in business process modeling methodologies and languages. It points out the most important aspects and principles of business processes management and tries to reflect them in the features of the technical and methodical support of the business process modeling. We can summarize the main those features as follows:

- Necessity to model the process system as well as process details.
  Two basic types of models: the global (system-oriented) and the detailed (process-oriented, algorithmic) should be created separately but in mutual connection.

- Necessity to model the states of the process and to recognize different, mutually completing events.
  The cybernetic principle of the 'negative feed-back' causes recognizing the process states. The necessary negativeness of the feedback then requires to model mutually completing events (i.e. waiting for more than just one event) in order to reflect the fact that there always must be some objective reason for the decision about the further run of the process (in order to restrict the further process run to the relevant direction in terms of the process goal).

- Necessity to keep four levels of the granularity of process description (abstraction levels).

- Necessity to pay the proper attention to the collaboration of processes.
  Outputs and states of two collaborating processes should be taken together as parts of one service (as a superior concept covering both) which allows the permanent integration of all important aspects of the process management in the process model.

The paper also critically evaluates existing business process modeling standards, mainly BPMN (Business Process Model & Notation). It is because BPMN can be regarded as a

worldwide de-facto official standard and also because it contains, unfortunately, most insufficiencies. Other popular and significant standards ([7], ARIS [16], IDEF [10]) are not so problematic like BPMN, nevertheless they still cannot be regarded as completely perfect from the point of view of outlined necessary features. For instance, although process states are present in all of them some way, ARIS does not clearly distinguish between them and events, Eriksson/Penker methodology as well as IDEF take them just as a technical issue.

Topics discussed in this paper also represent serious challenges for the future development of business process modeling and management methodologies. Especially the further elaboration of the topic of intentionality in business processes seems to be the most important. This topic represents the direct relationship between the managerial and technical meaning of business process management and thus it is critically important for its meaningfulness. The paper already mentions the important influence of the ontology engineering area by this topic ([4]). In other connected areas, especially in Philosophy the concept of intentionality is elaborated in more detail which actually calls for implementing also in the field of business process modeling languages ([6], [9]).

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