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BUSINESS PROCESS MODELLING AND ENTERPRISE IMPROVEMENT ANALYSIS

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Abstract: The main trends in developing an approach and tools for business process modelling are discussed. Business Process Management (BPM) and BPM Notation (BPMN) are presented. Moreover, the possibilities of C^{2}NIWA in a wide range of these tools running on a supercomputer are suggested. Firstly, the company development strategy can be planned. Secondly, quick and flexible changes of its processes can be modelled, analysed and implemented. An example of a business process is also presented.

Keywords: business process management, BPMN, business process automation, business architecture

1. Introduction

Improving the operation of an organization requires acquiring deep knowledge about the organization itself. It is possible to understand the purpose and operation of a company by defining a strategy and business modelling. Particularly, an efficient way to describe a company is to identify and define the business processes performed by an organization. Thereby, it is also possible to verify whether the actions of the organization follow the defined strategy and produce the expected outcome. A frequently used technique for increasing the effectiveness of a company is Business Process Management (BPM). Multiple software tools and systems supporting a process-based approach are available, from tools for defining processes in the BPMN notation and achieving process maturity, to process automation in the BPM Suite environment. Presently, it is crucial for companies to quickly and flexibly adapt to the rapidly changing market conditions, therefore,

it is highly desired that software providers should address those issues and deliver proper IT solutions for the business.

The BPTrends Pyramid shown in Figure 1 defines three different levels of Business Process Management (BPM) within an organization and the types of activities associated with each level. The figure perfectly describes the issues addressed by this article. We can see that business process activities occur at different levels within an organization: the enterprise level, the business process level and the implementation level. Understanding these levels is crucial to cover the whole field of business processes in organizations.

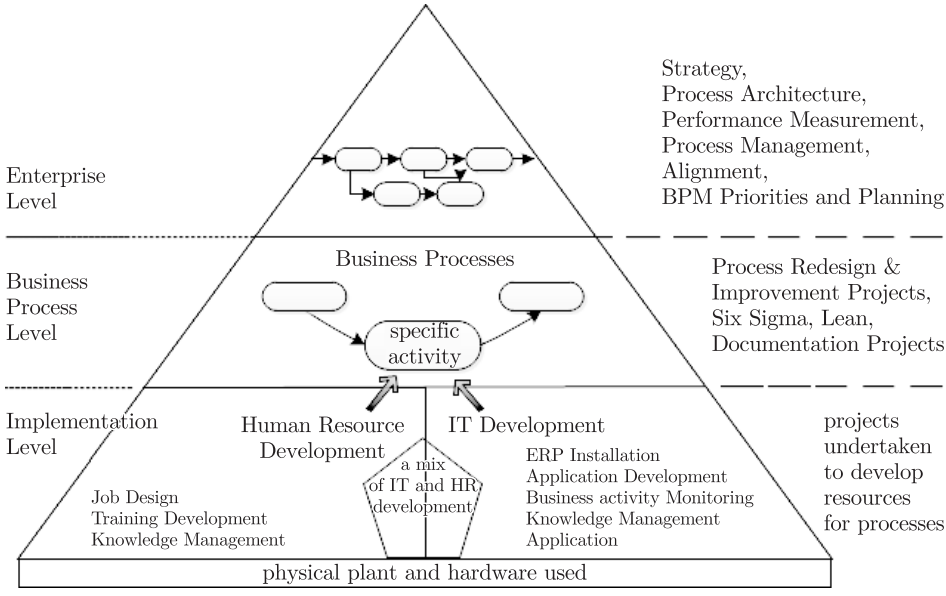

Figure 1. BPTrends Pyramid [1]

The enterprise level at the top of the pyramid is independent of day-to-day processes and does not involve establishment of a process management system, but developing a general strategy, defining the process architecture, process management and other issues.

The process level includes projects related to: document processes (ISO 9000), creation of new processes or redesigning existing ones, improving existing processes (Lean, Six Sigma). Process analysis, design and modelling activities also belong to this level and they are supported by dedicated IT applications and systems to address all of the organization's process needs and to establish priorities and plans to assure that processes are changed and maintained.

The implementation level provides the resources (new software applications to support or automate the process activities, training the employees required for implementing the process change project. On this level IT comes with specific tools, notations and methodologies (RUP, UML).

The paper is organized as follows. Section 2 gives an overview of the concepts: strategy, business process, business modelling, business process architecture, business process frameworks and business architecture. Section 3 describes the process management and Business Process Management. Section 4 refers to process modelling as a critical component in successful business process management (BPM). Section 5 covers business process automation. In Section 6 conclusions are made.

2. Strategy and Business Modelling

Organizations should build their strategy and find the business process paths that operationalize the strategy to find the best place in the market. Strategy is the direction and scope of an organization for the long term, which achieves advantage in a changing environment by its resources and competences with the aim of fulfilling stakeholder expectations [2]. To develop a strategy we should answer three main questions:

- Who are we? – What do we want to achieve, what do we want to offer? How do we differ from others? What are our strengths and weaknesses?
- Who are our customers and other stakeholders? – Who can be our clients (target market)? Why should they come to us? Who must be satisfied?
- What do we do for each other? – What is our value proposition? What will the customers and other stakeholders be prepared to offer for that value?

An efficient company cannot have significant divergence between the strategy (mission-vision-value statements) and processes which accomplish the strategy. A business process is a collection of step-by-step tasks that a business uses when it performs its work [3]. A step-by-step task means a sequence of steps and decisions made by people in many departments, initiated in response to a business event, that achieves a specific, measurable result (value) for the process customer and other stakeholders. It follows that an organization executes its strategic intent via its business processes.

To understand our organization we need to explore the processes. Business modelling will help us describe the organization, communicate and acquire information about it. A business model is a simple representation of the complex reality of a business. It delivers some information about the business to stakeholders (employees, customers and partners) [3]. Business modelling describes an organization in four specific groups of models:

- business motivation models, which describe business goals and the means for accomplishing these goals;
- business organization models, describing work groups and their interactions;
- business process models, which show the step-by-step tasks to accomplish the work;
- business rule models, which describe the laws, policies, and other guidance that constrain the work.

Each model has a different focus, different questions that it can answer and supports different analyses, but they complement each other. Their analysis can help detect a problem faster than it can be observed in the accounts (income statement and balance sheets). For example, if a restaurant has good books in a period of time but guest service time is long it leads to customers dissatisfaction and lower demand. If there are no corresponding processes and we passively wait to the end of the period to look at the balance sheets, it can be too late to fix the problem. In general, business models are created because they support analysis of complex situations and compliance with laws and policies. They capture knowledge that can be used later.

What kind of processes are we interested in after defining the strategy? The answer is the organization's key business processes against business requirements. Identifying and aligning them is the business process architecture. As explained in [4]: "Business process architecture imposes a top-down bird-eye view of an organisation. Depending on the method adapted, it is sometimes known as the process landscape or a high level process map providing an overall landscape view or map view of the business processes of business operation". Business process architecture can be developed by an organization itself (possibly with some mistakes) or by adapting an existing business process framework. The second approach saves time and presents a potential for adopting better practices. It provides faster identification of areas that need improvement. A business process framework is a hierarchical set of key business processes required to run a service-focused business and organise them into main areas (*e.g.* Strategy, Infrastructure and Product, Operations, Enterprise Management) [4]. In [5] the authors describe their nature in more detail, but also indicate them as business process reference models that often represent the best practice processes. In the literature [5, 6] the following are presented:

- eTOM – Enhanced Telecom Operations Map – a process framework for a telecom organization;
- SCOR – Supply Chain Operations Reference Model – a generic framework that describes the top 3 levels of a supply chain;
- VRM – Value Reference Model – a generic framework that describes all the Level 1–3 processes in a value chain;
- ITIL – Information Technology Infrastructure Library – a process framework that focuses only on the service processes provided by IT;
- COBIT – Control Objectives for Information and Related Technology – a framework for IT management and IT governance. It is a supporting toolset that allows managers to bridge the gap between control requirements, technical issues and business risks;
- APQC Process Classification Framework – a taxonomy of business processes that allows organizations to objectively track and compare their performance internally and externally with organizations from other industries.

As we have modelled our organization we can see that the organization's resources are managed 'vertically' via the organization chart. Business value is created, accumulated, and delivered, not up and down the functions as represented in the organization chart, but across the organization ('horizontally') as in the business process architecture. The functions collaborate via the business processes to create, accumulate, and deliver value to customers and other stakeholders in the form of a desired product, service, or other outcome. The organization chart is effectively silent on the all-important issue of cross-functional process work. It is quite alarming that in many organizations where there is no consciousness management and optimization of cross-functional business processes, nobody is responsible for the creation, accumulation and delivery of the value to customers and other stakeholders. This cannot be a good idea. Business processes are the only way for an organization to deliver or exchange such value with the customers. Therefore, business processes need to be thoughtfully managed and continuously improved to maintain an efficient flow of value with the customers and other stakeholders. Developing a more coherent view of the inter-relationships between the strategy and the process makes it much more likely that the strategy will be executed and the processes will be effectively managed.

Moreover, we can see similarity to the IT domain where: systems are modelled, people build the architecture of created systems, the enterprise architecture is done to see how the IT systems are using by business from the angle of processes. IT specialists are interested in the Enterprise Architecture Roadmap to plan changes in the IT systems. Currently, the most popular approach is to create the Business Architecture. Business Architecture describes the product and/or a service strategy, the organizational, functional, process, information, and geographic aspects of the business environment [7]. Identifying candidate Architecture Roadmap components based on the gaps between the current Business Architecture and Target Business Architectures is the highest level of describing the direction of future business evolution. It seems that keeping business permanent up-to-date is the most important thing. So it is important to plan the future and a suitable model for our organization.

3. Process Management and Business Process Management

The distinction between process management and business process management is crucial. As depicted in [8] and shown in Figure 2, process management (an activity which focuses on the process itself) is the way of operating and managing a business process on the operational level.

Process Lifecycle activities can be grouped into seven categories:

- Process identification – understanding the process scope and the ecosystem in detail; usually for a process that will be later automated;
- Process modelling (as-is) – representing the identified process using a modelling language;

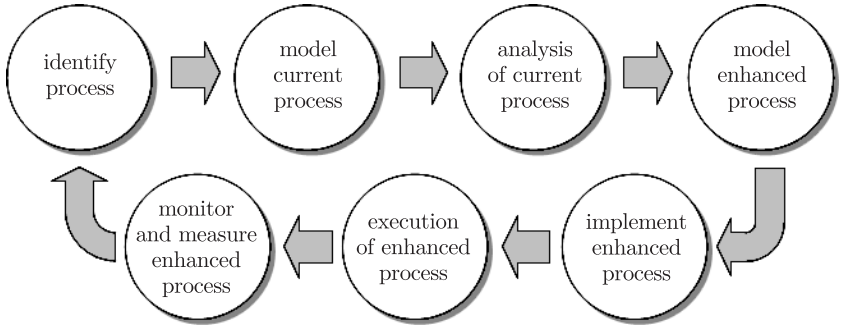

Figure 2. Process Lifecycle

- Process analysis – analysing current process performance and issues;
- Process improvement (to-be) – identification and evaluation of options for process improvement, considering constraints and resources;
- Process implementation – applying the improved process in the organization;
- Process execution (to-do) – performing the process manually or automatically;
- Process monitoring/controlling – guiding and controlling the daily operations.

Business process management (BPM) is a management approach oriented on the processes. BPM is an emerging field of knowledge and research, lying at the intersection of management and information technology [9]. On the one hand, we have a management approach, on the other hand, the IT systems to support it. In [9] BPM is also defined as follows: "supporting business processes using encompassing methods, techniques and tools to design, enact, control, and analyse operational business processes involving humans, organizations, applications, documents and other sources of information". The term 'operational business processes' refers to repetitive business processes performed by organizations in the context of their day-to-day operations, as opposed to strategic decision-making processes, which are performed by the top-level management of the organization. Note that this definition restricts BPM to operational processes, *i.e.* processes at the strategic level or processes that cannot be made explicit are excluded. In [10] BPM is referred as a set of structured methods and technologies for managing the operations of an organization (Figure 3).

In [11]: "The goal of BPM is to create a process-centric, customer-focused organization that integrates management, people, process and technology for both operational and strategic improvement". BPM encompasses methodologies and technologies for process definition (*e.g.* process modelling), process analysis (*e.g.*, Six Sigma, Lean Management), process improvement (*e.g.*, Business Process Reengineering, Process Innovation), process execution (*e.g.*, Process-aware Information Systems) and process monitoring and control (*e.g.*, Business Activity Monitoring) [12]. Such definition of BPM is suitable for the entire organization on all levels mentioned in Section 1.

BPM differs from business process reengineering (BPR), a management approach popular in the 1990s. BPR was seen as "the fundamental rethinking

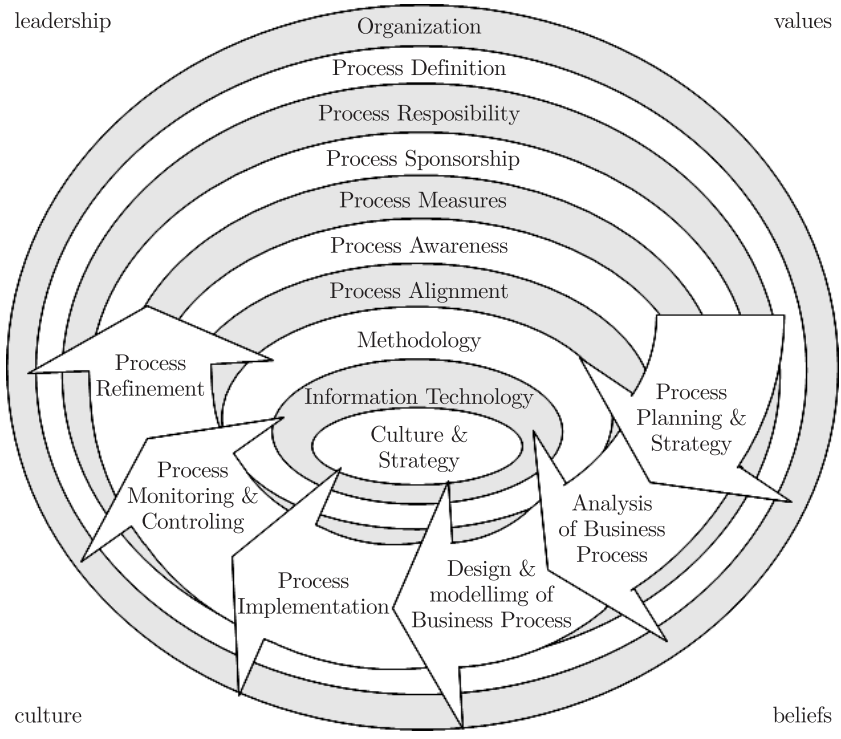

Figure 3. BPM Lifecycle [10]

and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service and speed" [13]. BPR does not aim at one-off revolutionary changes to business processes, but at their continuous evolution. Later in 2001 the same author said: "I no longer see myself as a radical person; instead I have become a process person".

BPM requires a top to bottom commitment from the organization, from executive leadership, who define and support the practice of BPM, to the individuals who work in teams to execute the processes for the customers. In this hierarchy we distinguish:

- Process owners – have strategic responsibility for their processes; they have a budget for improvement of the process, and they are strongly interested in optimizing the performance; They are members of the management committees or heads of major divisions;
- Process managers – have operational responsibility for their processes; they report to the process owner and apply for improvement projects; They are low or middle level managers;
- Process participants – working with the process and creating the value; they report to the process manager;
- Process analysts – have competencies in BPM in general and BPMN in particular. They support process managers as internal or external service providers

through all stages of the BPM life-cycle. They act as a bridge between business and IT;
- Process engineers – they use technology to implement the target state process modelled by the process analysts. They program the process logic so that the process engine can automate the process.

Individuals may possess BPM skills and organizations may possess BPM technologies, but without organizational commitment, the practice and benefits of BPM is unlikely to mature within an organization.

It is argued that BPM enables organizations to be more efficient, more effective and more capable of changing than in a functionally focused, traditional, hierarchical management approach. BPM helps organizations to gain higher customer satisfaction, product quality and shorter delivery and time-to-market periods.

4. Process Model

Along with the business process discovery, process modelling is a critical component in successful business process management. It is used to outline the organization's current ("as-is") processes to create a baseline for process improvements and to design future ("to-be") processes with those improvements incorporated. A process model is the basic description of a process. Process modelling often uses Business Process Modelling Notation (BPMN), a standard method of illustrating processes with flowchart-like diagrams that can be easily understood by both IT and business managers. Companies are still interested in adopting BPMN (it grew from 23% in 2005 to 60% in 2013). UML (activity diagrams), another modelling alternative, declined from 33% in 2005 to 18% in 2013, and BPEL decreased from 23% to 10% in the same time [1]. The issue is that many organizations, since they are on the early levels of process maturity, are using Graphics Modelling tools and Repository based Modelling tools. BPMN was developed to model processes as logical, chronological sequences of events. It is not designed for representing process landscapes, organizational structures, strategies, data, business rules, IT landscape, but BPMN process models are easy to combine with appropriate types of diagrams mentioned in the business modelling.

BPMN 2.0 aims at covering three basic models of Processes: *private* Processes (both *executable* and *non-executable*), *public* Processes, and Choreographies. For example: high-level *non-executable* Process Activities, detailed executable Business Process, As-is (old version) or To-be (new version), a description of expected behaviour between two or more business *Participants* – a Choreography, two or more *public* Processes.

A BPMN diagram may describe one or more process models. In general, certain tasks have to be carried out during a process (*activities*), perhaps under certain conditions (*gateways*), and things may happen (*events*) (see Figure 4). What connects these three flow objects are *sequence flows*, but only within a *pool*. Pool is the symbol for a participant and for its process. If connections cross the

pool boundaries, the process resorts to *message flows*. Additional information is provided by *artefacts* which can be assigned to every flow object through *associations*. BPMN 2.0 contains a data category which refers to the creation, processing and filing of information relevant within the scope of the process handling. Graphical notation for this element is presented in Figure 5.

Figure 6 presents the high level activities used to handle an Insurance Claim. This example shows only an insurance company's Private Process. There are two participants: a client and an insurance company in separate pools. They send some information (claim request data, missing data, claim amount, choice) or goods (money) to each other. The client's pool is the black box. It means that we will not describe the client's process. The model is focused on the insurance company's process. In the pool named "consideration of an insurance claim accident" there are three lanes named: clerk, medical expert and accounting department. It means that all tasks placed in the medical expert's lane are done by employees acting this role. The process starts when the client sends a claim request. Then a sequence of tasks is performed: data verification, claim creation. In the second task a new claim document is created. The "document and data verification" subprocess uses an interrupted error event named "incomplete data" to report directly to the main process. The subprocess is interrupted, the clerk performs the "complete missing data" task and then comes back to the data verification. The next step is done only if the data passed the verification. After the "create and analyse claim" task the control flow moves to the exclusive gateway (as the XOR decision). The insurance clerk can reject the claim or declare it as a standard claim or a non-standard claim (he/she can choose only one). If the rejected claim is chosen, he/she notifies the client about the rejection and rejects the claim by changing the claim document status to 'rejected' and the flow is finished. If it is declared that the claim as a standard claim, then the "set the disability percentage" task is executed. If a non-standard claim is selected, the control flow goes to the "estimation of claim components and their weight" task which is performed by the medical expert role. Next the control flow points to the task "calculate amount of damages" which is processed by the clerk role (the claim document is modified by the task). After that, the clerk is sending the amount of damages and waiting for the client's answer. Next he/she verifies the client's answer (if the message is in the form of an e-mail, it is necessary to read the e-mail to fill the variable which is checked in the condition "damages approved?"). When the damages are not approved by the client, then the control flow points the only task done by the medical expert. The next element in the process model is a parallel gateway and the tasks "close claim" which change the claim document status to accepted and the "make payment of damages" are done simultaneous. After the synchronization gateway the process ends.

The benefits from the process models are: information for the employees what will change and how this will affect their daily work, knowledge management, analysing variants of the same processes for finding the best one, managing

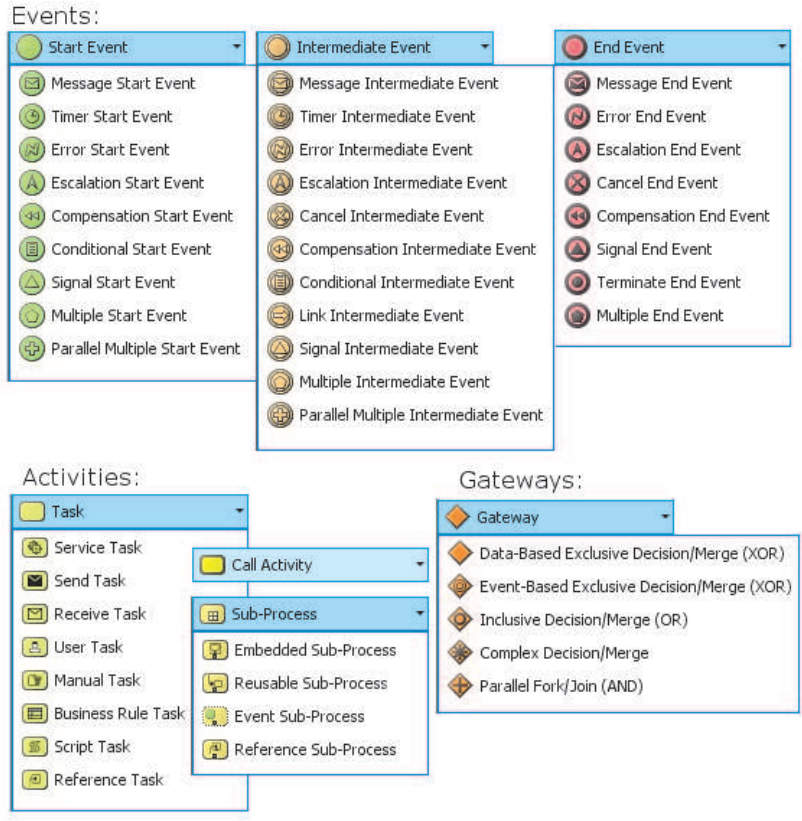

Figure 4. BPMN flow objects

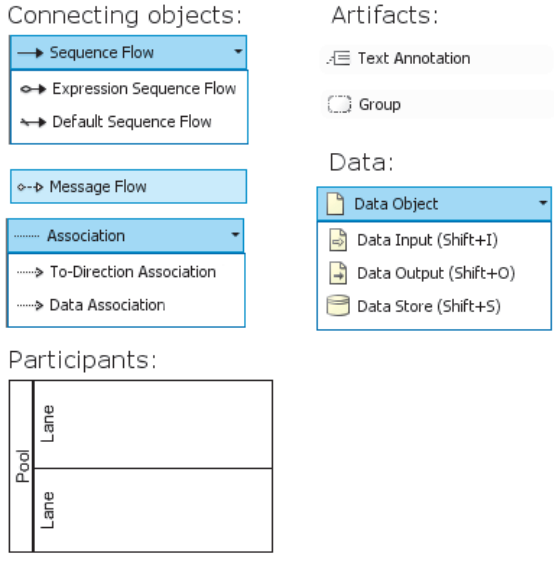

Figure 5. Remaining basic elements of BPMN

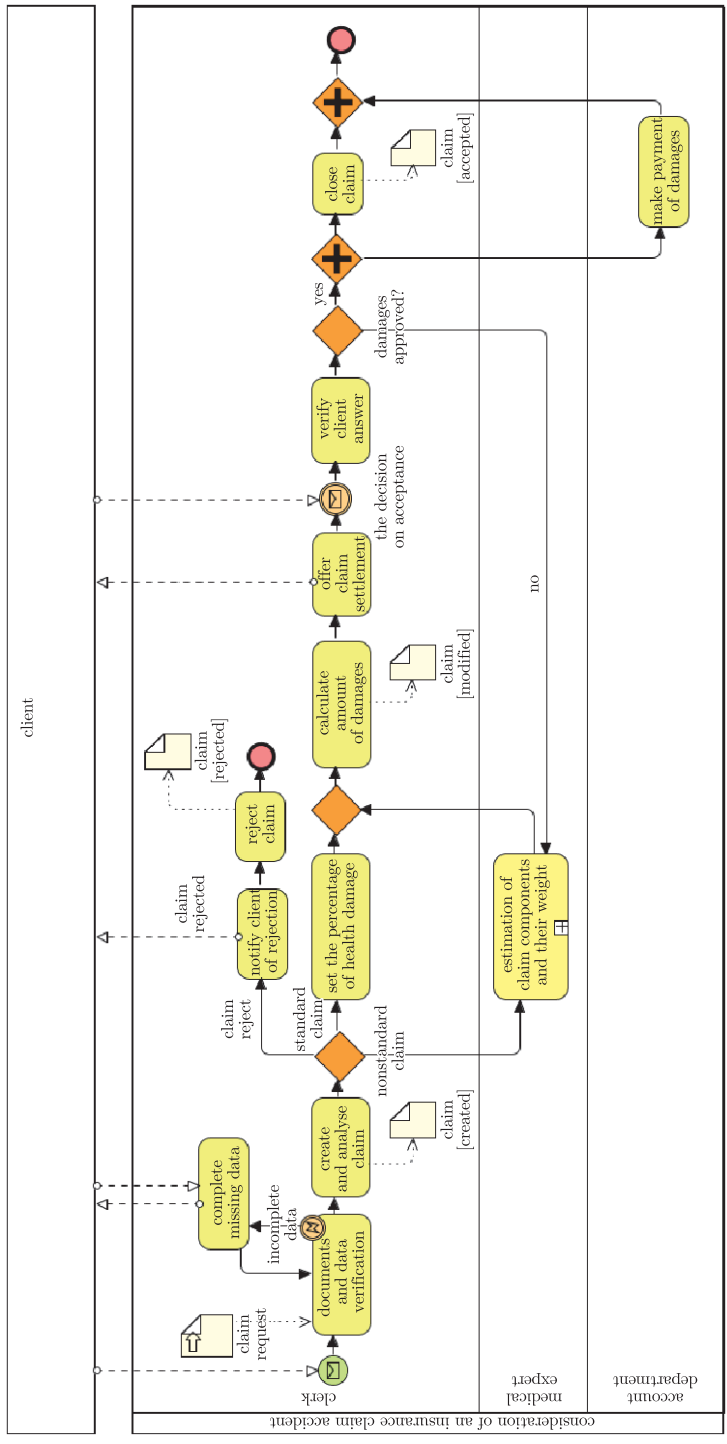

Figure 6. "Insurance claim" process in BPMN 2.0

compliance with a new regulation, capturing software requirements and executing them as a software (workflow) in a business process engine or BPM systems [3].

The main disadvantages are the time and cost of process modelling. The next drawback is the need to have a Process analysts as an internal or external service. Another issue is the level of the BPM maturity in the entire organization – all this explains why processes should be discovered, modelled and executed and who takes the responsibility for a given process.

In Figure 6 a *non-executable* detailed *private* Business Process interacting with one external *Entity* (or "Black Box" Process) is presented. Thus, the model type is used for a process that has been modelled for the purpose of documenting the process behaviour at a modeller-defined level of detail. As shown in Figure 4, the BPMN 2.0 standard provides different types of tasks. In the assumed process, the manual task, the send task and the received task (or the receive message event) may be used. Determining the type of each abstract task helps decide whether the process can be automated, partly automated or cannot be automated. BPMN supports more detailed descriptions (information required for execution, such as formal conditional expressions) that is used for modelling a private executable process that will be automated. In the above mentioned terms, the business process models serve as software development requirements and can be executed directly in special-purpose software engines.

5. Business Process Automation

As mentioned earlier, BPM usually combines management methods with information technology. BPM covers activities performed by organizations to manage and, if necessary, to improve their business processes. Software tools called business process management systems (BPM systems) have made such activities faster and cheaper. BPM systems monitor the execution of business processes so that managers can analyse and change the processes basing on real data. To achieve the present state of the business process automation (BPA), systems undergo a rapid evolution from workflow systems (around 1985) to the BPM Suite incorporated by means of business rules, process modelling, business intelligence and process mining. Among the major types of software tools used by business process practitioners (Figure 7), BPA tools are marked in blue. At the same time, the technology shifts from client-server-based to SOA or cloud-based technology. A review of the evolution is presented in [14]. The rapid evolution of BPMS products and vendor acquisitions have made it difficult for organizations to evaluate the functionality and benefits of the various tools.

The core BPA principles summarized in [15] are:

- Process automation does not necessarily mean that the entire process is fully automated;
- The central component of the process automation is the process engine, which runs the executable process model;

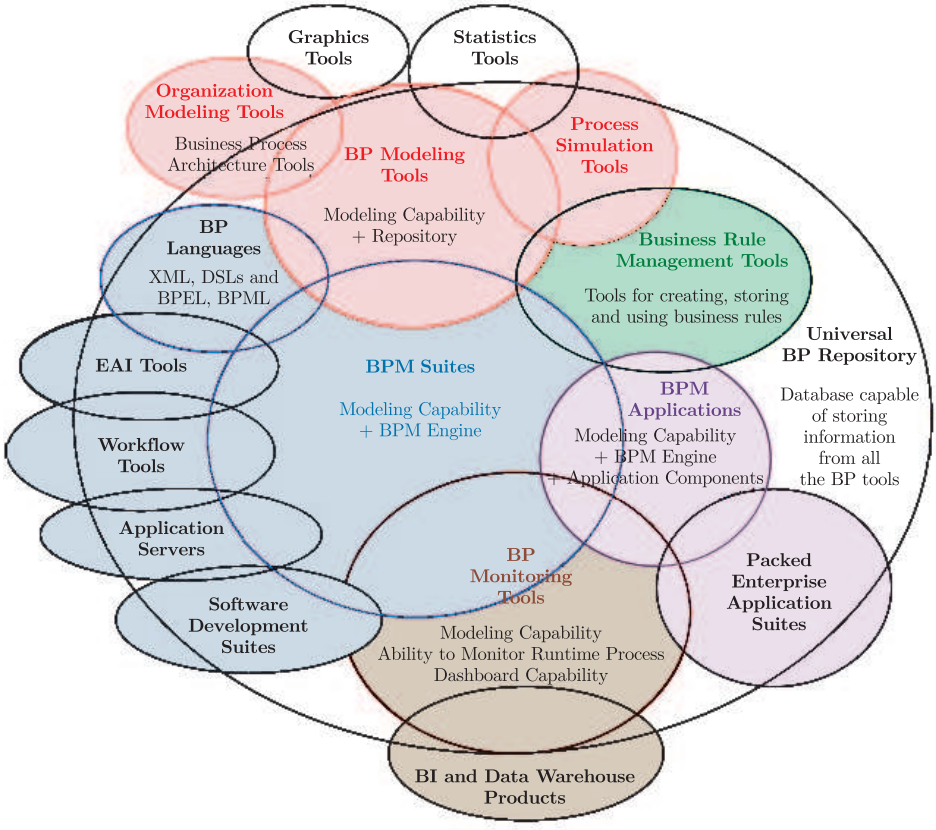

Figure 7. Major types of software tools used by business process practitioners [3]

- The process engine controls the process by informing the workers about the tasks that they need to do (human workflow) and handles the outcome of the work; It also communicates with internal and external IT systems (service orchestration) to accomplish service tasks;
- The process engine decides which tasks or service calls are performed, under what conditions, and accordingly the result of the task execution or service call. Thus, the people involved still can influence the operational sequence of an automated process.

The business rule management tools (in Figure 7 – green selected) are interesting and very important. They combine business modelling (business rule models) and process automation. Their role is modelling, storing, maintaining and processing of business rules. Leading BPM vendors deliver them as a part of a complex BPM solution. BPMN provides a business rule task that can be used in the executable process models. In this case, a rule task included in the process instance executed in the process engine is sent to the business rule engine for execution. Let us assume that, in the exemplary process discussed in Section 4, there is a rule "It is obligatory to set the minimum disability percentage to 3% if

the client has a broken elbow". And another – "It is permitted that a cash payment is made in the European Union currency, only if cash payment is applied to the bill and the amount of the bill is at least 100 zlotys". The second rule can be used by other processes, *i.e.* "travel assistance". In that context, if a change of the amount of damages from 100 to 200 in this rule is needed, then the modification of the rule happens only one time in the business rule model and all the processes perform it automatically.

In recent years commercial BPM tools have been rarely used in small and medium-sized enterprises because of their prohibitive cost of ownership. Open source solutions are available as well, however, they are less mature. In the BPTrends report 2014 [1] the current situation is summarized as follows: "As a direct consequence of both the recession and the rapidly changing BPMS offerings, most companies have not rolled out large scale BPMS implementations, choosing, instead, to experiment with a variety of tools from different vendors. We have often observed that many organizations purchased BPMS tools long before the organizations were mature enough to use the tools effectively. An organization needs to understand and redesign its business processes so that they are reasonably efficient before the organization can benefit from automating them."

6. Summary

In [16] Geoffrey Moore describes the lifecycle of new technologies. He specifies four groups of users:

- Innovators – companies that pursue new technologies aggressively to gain early advantage;
- Early adopters – companies that pursue new approaches aggressively to gain a significant competitive advantage;
- Early majority – companies that wait for a new approach to prove itself and then move quickly;
- Late majority – companies that wait until the new approach is well established and there is lots of support.

Figure 8 shows how business modelling has become more popular since the transformations have become more common. The organization must keep up with the changing situation on the market. Employees should understand new rules, new processes that they will follow. They should understand new goals and strategies. With the rapid pace of changes today, the need for transformation from today's inflexible business environment to an agile enterprise that can change direction rapidly has never been greater. It is not easy to apply Moore's model to the BPM market, because the market is split into the market engaged in helping companies improve their business processes and the market working to provide software tools for process automation.

Figure 7 shows how many tools are used by business process practitioners. The problem is that they are used from different perspectives and by various user groups of interest. The process modelling software tools have been widely

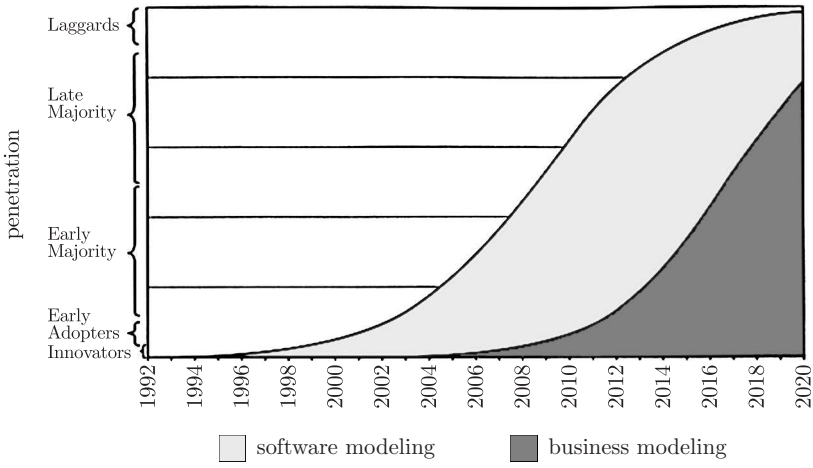

Figure 8. The rise of software modelling and business modelling [3]

adopted, but the BPMS tools are still in the Early Adaptor phase. As described in the BPTrends Report, the problem with any new technology is that it takes time to incorporate it into applications that deliver measurable improvements. Thus, there have been claims from vendors and reports from early adopters of both early successes and failures and, gradually, a track record has emerged.

The BPTrends Report also concludes that "Most organizations are at Level 2 on the CMM maturity scale with BPM. They have invested in defining their processes, but have not invested in aligning processes throughout the enterprise. In 2013, as in all years that we have surveyed organizations, the dominant concern is to reduce costs by making processes more efficient. Companies continue to spend money on BPM initiatives precisely because they hope that investments in process work will enable them to become more efficient and productive." In fact, from 2005 to now we have seen rapid growth in the business process management (BPM) market and in the services oriented architecture (SOA) market. We expect integration of these two trends. C^{2}NIWA offers previous described business process modelling and analysis possibilities. We concentrate on building competence in this field and try to transfer our BPM knowledge to all the interested parties.

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