



Applying Intellectual Capital in Business Process Modelling

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Abstract

Business process modelling is one of the most important stages of process management in an organisation. A reliable model which correctly reflects reality facilitates process analysis and further improvement based on the Business Process Management (BPM) cycle.

Process models, in addition to expressing sequences of activities, possible process flows and task types, can store various types of information on the tangible and intangible aspects (resources) of the enterprise involved in its implementation. At this point, the very important aspect of skills, competences and knowledge of employees, which are essential for the performance of tasks and activities within the process, are often omitted.

This article presents the possibilities of extending the process model

with information on the intellectual capital used in a given process or generated as a result of process implementation. This information facilitates an in-depth analysis of the process in the context of the existing intangible capital in an organisation, and indicating places in the process which can extend this resource, influencing its more effective management.

The article proposes a description of activities in the BPMN process model, taking into account the nature and type of knowledge required to perform a given task as well as knowledge created in the organisation as a result of task implementation. The proposed extension of the process model is illustrated by the example of a process of fixed assets ordering.

Keywords: process modelling, intellectual capital, BPMN, process management

Introduction

Enterprises operate mainly on the basis of manufacturing specific products or providing specific services, which are created as a result of the implementation of specific processes. These processes are composed of various tasks and activities. What they have in common is that every such process is associated with the use of the organisation's resources. The resources can be tangible (employees, machinery, tools and other operating resources) or intangible (information, know-how, work technologies, knowledge and skills). By presenting the functioning of the enterprise in this way, one can emphasise two basic factors which influence the implementation of the strategy adopted by it, i.e. its processes and resources.

One important element of the successful operation of an enterprise is the in-depth knowledge of the implemented processes (in terms of its model and problems found within) and the resources used in them. Often such knowledge of a very important resource – intellectual capital (e.g. the skills, competences and knowledge of personnel) is very cursory, yet it is crucial for the correct execution of tasks and activities in the process.

Process analysis, also in terms of resources, is facilitated by business process modelling. Process modeling is the initial stage of the BPM cycle, which leads to the improvement of the organisation's processes, and, as a result, to its improved operation. Process modelling is

increasingly often assisted by various types of software tools, which provide the management with the possibility of creating a graphical model of the enterprise's operation by illustrating the processes with a breakdown into tasks and activities performed. Modelling employs not only tools assisting business processes, such as ERP (Enterprise Resource Planning), CRM (Customer Relationship Management) systems or WMS (Workflow Management Systems) and DFD (Data Flow Diagrams), but, more importantly, tools strictly designed for this purpose (ARIS, Bizagi, Corporate Modeler, etc.).

Nowadays, process modelling utilises various methods of creating and describing models. These models can be created according to specific standards or formalisms, for example BPMN (Business Process Model and Notation), EPC (Event-driven Process Chain), BPEL (Business Process Execution Language), UML (Unified Modeling Language) and Petri nets.










This article presents the possibilities of extending the BPMN process model with information on the intellectual capital used in a given process or generated as a result of process implementation, as illustrated by the selected example, which is presented further in the paper.

Managing intellectual capital in an organisation

Building a 21st-century organisation is associated with the notion of broadly understood smart organi-

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Tab. 1. Main elements of BPMN 2.0 [Source: own work based on: (Rademakers T., 2012)]
 Tab. 1. Główne elementy notacji BPMN 2.0

ICON	NAME	DESCRIPTION
	Pool	A pool represents the container for the activities of a process. Best practice is to use the process name for the pool name.
	Lane	A lane represents a role within a process model. In most cases, this is an organizational unit or a role definition.
 Task  Subprocess  Call activity	Task	A task is a piece of work that has to be executed as part of the process definition. A task can be an automated activity or a manual activity.
 Start event  Intermediate event  End event	Event	Start event – A start event is the trigger to start a new process instance. End event – An end event is the last step before the process instance is completed. Note that the end event has a thicker circular border than the start event.
	Gateways	Parallel – A parallel gateway is used to indicate that activities can be executed simultaneously or that all incoming activities must be completed before the process progresses to the next activity. Exclusive – An exclusive gateway is used for conditional logic. Based on a condition, only one of the outgoing sequence flows will be followed.

sation. This is emphasised by paying attention to intangible resources, which constitute an important creative, executive and decision-making element. Among those, the knowledge, experience and skills of every employee working for the enterprise constitute a special resource. It is the employees who extend the organisation's knowledge by preparing procedures, regulations, patents, rules and methods applying to the implemented tasks, building the intellectual capital of the organisation. This presentation of intellectual capital can be summarised by the definition proposed by the International Federation of Accountants (The Accountants Association in Poland, 2001), according to which intellectual capital is the "total capital of an enterprise related to the knowledge encompassed within. It is composed of the knowledge and experience of employees, customer trust, brand, contracts, IT systems, administrative procedures, patents, trademarks and process efficiency".

Indicating the employee as the "carrier" and creator of knowledge illustrates a problem which can be faced by managers – how to manage a resource which cannot be seen, how to perform its inventory to determine its quantity/value held by the organisation and found in its processes.

Indicating that knowledge is the fundamental element for intellectual capital, on the basis of which its remaining elements are created, provides us with a ba-

sis to make an attempt at defining what kind of knowledge is needed in a given process, and what kind of knowledge is needed to implement the individual tasks and activities (e.g. in which tasks we need specialists, and which activities can be carried out in accordance with the previously devised procedures).


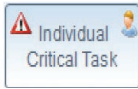





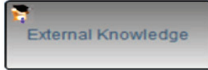
Knowledge which constitutes the basis for intellectual capital can be available in the organisation in the form of structured signs, symbols and specified words that constitute a set which is available at any time (e.g. in the form of documents, procedures and databases). In the case of structured knowledge we refer to it as formal knowledge or, in other words, explicit knowledge. Tacit knowledge is the other type of knowledge. It is related to people and results from their talents, skills and experience, which cannot be easily formalised.

The problem of identifying knowledge does not stem solely from its nature of an intangible resource of an organisation, but also from the multitude of its classifications, e.g. in a report by the Organisation for Economic Co-operation and Development (OECD), it was divided into four categories (OECD, 2000):

- know-what – refers to knowledge about facts. It is information determined using data or bits.
- know-why – refers to the principles and laws of nature, human mind and society.
- know-how – refers to specific skills or capabilities.

Tab. 2. Selected elements of BPMN4KM [Source: (Hassen M. B., Turki M.& Gargouri F., 2017)]

Tab. 2. Wybrane elementy koncepcji BPMN4KM

ELEMENTS	MODELING NOTATION	ELEMENTS	MODELING NOTATION
Internal Knowledge		Organizational Critical Activity	
Tacit Knowledge		Physical Knowledge Support	
Conscious Knowledge		Expert Collective	
Explicit Knowledge		External Knowledge	

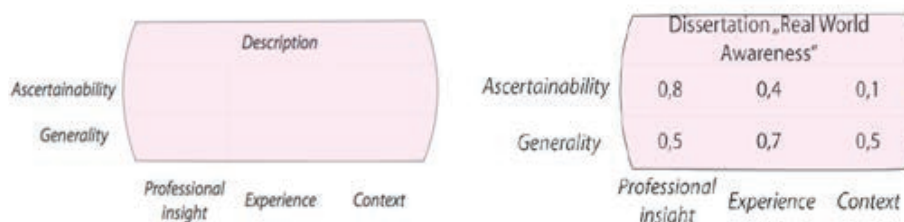


Fig. 1. Modeling of knowledge in KMDL [Source: Gronau, N., Weber, E., 2016]

Rys. 1. Modelowanie wiedzy w KMDL

- know-who – indicates who is a specialist in a given field, information about the extent of their knowledge and skills.

Furthermore, there is also expert knowledge provided by specialists in a given field and collective knowledge resulting from collective intelligence.

The correct identification of the sources of knowledge, including the preparation of knowledge maps, taking into consideration places of its application, is among the main challenges of knowledge management in enterprises (Brzychczy E., 2013). The remaining are:

1. Making the employees aware of the essence and meaning of knowledge management in the enterprise.
2. Obtaining tacit knowledge.
3. Taking care of the process of creating new knowledge.
4. Effective knowledge sharing and use.
5. Updating knowledge.

Identifying knowledge in relation to the tasks which are carried out as part of a specific process can provide a basis for better management of this intangible

resource. The selection of appropriate staff and tools for specific activities conducted within the process can significantly impact on the optimisation of work and improve the management of other resources of the organisation.

Further parts of this article present the possibilities of modelling business processes, taking into consideration the organisation's intellectual capital.

Business process modelling using BPMN

Business process modelling is one of the most important stages of process management in an organisation. A reliable model which correctly reflects reality facilitates process analysis and further improvement based on the Business Process Management (BPM) cycle.

Several notations, which allow the creation of graphical models, are used in process modelling. These include, e.g. DFD (Data Flow Diagrams), UML (Unified Modeling Language), EPC (Event-Driven Process Chain) and BPMN (Business Process Modeling Notation), with the last one being the most popular in business practice.

The main elements of BPMN facilitate the expression of a sequence of activities, possible flows within

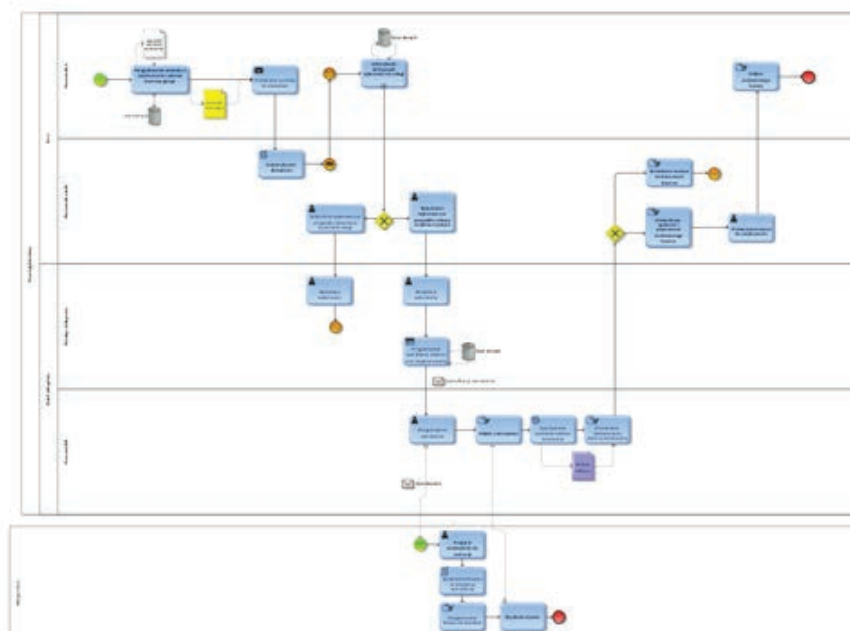


Fig. 2. Model of a selected process [Source: own work]
Rys. 2. Model wybranego procesu

the process, type of tasks (manual or automatic), inputs and outputs for individual tasks/activities, as well as places or positions in which they are performed.

The most important symbols of BPMN are presented in Table 1.

In process modelling it is important to identify the individual tasks forming part of the analysed process, determine their order, indicate the possible alternative flows in the process and indicate the resources necessary to implement the process tasks/activities. At this point, in addition to identifying the elements of explicit knowledge (e.g. required inputs and outputs, documents used or generated in the process), it is also worth taking into consideration the aspect of tacit skills, competences and knowledge, which are necessary to perform a given task/activity in the process. Process modelling with the use of basic BPMN makes it possible to visualise the indicated elements, except for the latter (i.e. employees' skills, competences and knowledge).

The literature presents various proposals of extending basic BPMN, which include BPMN4KM (Hassen M. B., Turki M., & Gargouri F., 2017), and KMDL®[(Gronau, N., Weber, E., 2016),(www.kmdl.de)]. Both these extensions include elements which facilitate process modelling, taking into account the elements of intellectual capital, including the knowledge used in an analysed process.

The concept proposed by the team of Mariam Ben Hassen, Mohamed Turki, Faïez Gargouri (Hassen M. B., Turki M.& Gargouri F., 2017) is based on a graphical indication of information about the source of

knowledge understood as collective knowledge, expert knowledge, explicit knowledge and tacit knowledge, as well as the manners of knowledge conversion. For this purpose, selected graphical icons, symbols and colours, presented in Table 2, are used.

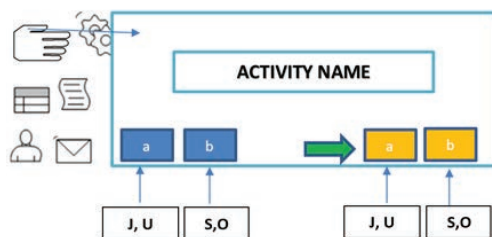
The concept in question distinguishes, i.a. (Hassen M. B., Turki M.& Gargouri F., 2017):

- knowledge type: external, explicit and internal,
- organizational value of knowledge entry: propositional, procedural, strategic and familiarity,
- knowledge organizational coverage: individual or collective,
- knowledge sources (for internal knowledge): tacit, latent and conscious.

KMDL® (Knowledge Modeling and Description Language) (www.kmdl.de) is another proposal. It is a language used for the description of knowledge-based business processes. The premise behind this concept is to analyse the origin of knowledge and information facilities, as well as knowledge flow, in order to draw conclusions on the generation of knowledge and information facilities. The manner of presenting intellectual capital in this concept, along with an example of use, are presented in Figure 1.

Both aforementioned proposals, including the IT tools made available, provide the user with an opportunity to perform knowledge inventory and to indicate knowledge used as a basis for activities.

An example of modelling a selected process, taking into consideration the intellectual capital aspect



Rys. 3. Proponowany opis wiedzy w modelu procesu
Rys. 3. Proponowany opis wiedzy w modelu procesu

As indicated above, the application of BPMN makes it possible to graphically present the activities/tasks carried out within a given process. Figure 2 presents an example of a model of a process of fixed assets ordering in BPMN notation.

The presented process model includes five participants from two organisations. The first is a production company represented by: an office employee, department manager, purchase department employee and purchase committee. The other is a goods provider. In the production company the process starts with the preparation of a request to launch a project. The modeled process in the default flow includes the following, consecutive tasks: preparation of a request to launch a project → submission for approval → automatic approval → list of available service providers → gate branching into two paths:

1) selecting the contractor in the case of an orders for services → acceptance of the contractor → transition to another process;

2) selecting the contractor in the case of a purchase of fixed assets → acceptance of the contractor → preparation of supply and warehousing specifications → order preparation → order acceptance for processing → checking the goods against the specification → preparing the goods for dispatch → sending the goods → receiving the ordered product → preparing an order acceptance report → handing over the ordered product to its place of use → branching gate:

1) determining that the goods are compliant and correct → handing over the goods for use → receiving the ordered goods → end of process;

2) defects observed in the goods delivered → transition to another process.

The aforementioned tasks have their specificity in the model related to the manner of performance and can be divided into manual tasks, user tasks, business rule tasks, script tasks and service tasks. Databases have been indicated for tasks which require them, and they should be used when performing a given task and for selected document flows.

The indicated process can be found in every enterprise; however, depending on the specificity of a given

industry, it can be subject to additional requirements or approvals (e.g. in a mining company).

In order to include knowledge resources in the developed model, the authors propose a certain simplification and modification of the BPMN4KM method. This proposal includes:

- taking into account the following types of knowledge (including the respective symbols):
 - a) in terms of nature of knowledge: E – indicating explicit knowledge / T – indicating tacit knowledge,
 - b) in terms of type of knowledge: S – indicating specialist knowledge / G – indicating general knowledge.
- extending the model with information on knowledge generated in the organisation as a result of the performed task/work.

The task icon accompanied by additional symbols may appear as in Figure 3.

In the top left corner, the user, using BPMN, inserts the symbol of the task, and to be more precise, the method of its performance (in the case of a script or business rules, also the database in which the task is executed). The bottom left corner displays information about the nature of knowledge needed to perform the task, divided into explicit and tacit knowledge, as well as the specification of the type of this knowledge (specialist or general knowledge). Additionally, the indicated arrow points to the possibility of creating new knowledge as a result of performing the task. In such a case, the symbols visible in the bottom right corner will refer to newly created knowledge.

The proposed method makes it possible, first and foremost, to determine whether knowledge used in task performance has been already recorded in the form of working regulations, procedures, job description, i.e. whether it is explicit knowledge which can be used by every employee, or if the performance of the task requires additional skills, experience or competences. Furthermore, it is possible to indicate whether the performance of a given task is associated with the requirement to have specialist knowledge, which is crucial for, e.g. planning staffing in the process.

A fragment of the model taking into consideration the knowledge resources in a given process is presented in Fig. 4.

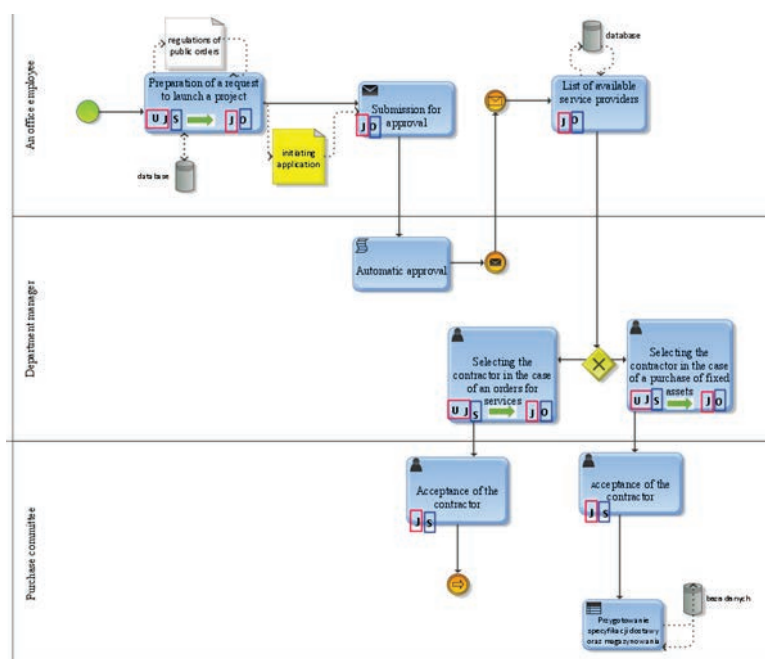


Fig. 4. Proposed knowledge description in a process model [Source: own work]
Rys. 4. Proponowany opis wiedzy w modelu procesu

The presented identification of the nature and type of knowledge used and created as a result of the execution of tasks in a process makes it possible to obtain additional information supporting knowledge (as well as process) management in the organisation. The models which account for the proposed extension of the description of knowledge can prove useful in optimising the use of information resources, indicating tasks as part of which new knowledge is generated (to store and share it within the organisation in the appropriate way) and planning the use of human resources (in the context of one's knowledge and skills).

Conclusions

Process modelling is indispensable to analyse and further improve an organisation's processes. Intellectual capital, used and created within tasks or process activities, is an important factor and should be taken into consideration in the created models.

In this article, its authors pointed to the possibility of reflecting intellectual capital in process models, utilising the concepts described in the literature. Based on

these, they proposed certain simplifications and modifications of describing knowledge in the process model. The proposal includes a distinction between the knowledge needed to perform the task and the new knowledge resulting from its implementation, taking into account the nature of the knowledge (explicit or tacit knowledge) and its type (specialist or general knowledge).

The proposed knowledge description in a process model is illustrated with an example of a part of the process of fixed assets ordering.

Process models, which take into account information on intellectual capital, provide valuable information as regards the management of knowledge in the organisation, at the same time influencing operational activities in respect of process management, especially regarding the optimisation of 21st century's most important resource – personnel, and, in particular, their knowledge, competences and skills facilitating correct process execution.

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Modelowanie procesów biznesowych z uwzględnieniem kapitału intelektualnego organizacji

Modelowanie procesów biznesowych jest jednym z najważniejszych etapów zarządzania procesami w organizacji. Rzetelny i właściwie odwzorowujący rzeczywistość model umożliwia dokonanie analizy procesu i jego dalsze doskonalenie w oparciu o cykl BPM (Business Process Management cycle).

Modele procesu, oprócz wyrażenia sekwencji czynności, możliwych przepływów w procesie, rodzaju zadań mogą przechowywać różnego rodzaju informacje odnośnie do aspektów (zasobów) materialnych i niematerialnych przedsiębiorstwa zaangażowanych w jego realizację. W tym miejscu często pomijany jest bardzo ważny aspekt jakim są umiejętności, kompetencje i wiedza pracowników, które są niezbędne do wykonywania zadań i czynności w procesie.

W niniejszym artykule prezentujemy możliwości rozszerzenia modelu procesu o informacje dotyczące kapitału intelektualnego wykorzystywanego w danym procesie lub generowanego na skutek realizacji procesu. Informacje te umożliwiają pogłębioną analizę procesu w kontekście istniejącego kapitału niematerialnego w organizacji oraz wskazanie miejsc w procesie, które mogą powiększać ten zasób organizacji, wpływając na bardziej efektywne nim zarządzanie.

W artykule zaproponowano opis czynności w modelu procesu notacji BPMN z uwzględnieniem charakteru i rodzaju wiedzy potrzebnej do wykonania danego zadania oraz powstałej w organizacji w wyniku jego realizacji. Zaproponowane rozszerzenie modelu procesu zaprezentowano na przykładzie procesu składania zamówienia na usługę.

Słowa kluczowe: modelowanie procesu, kapitał intelektualny, BPMN, zarządzanie procesami