Towards Business Process Modeling for Knowledge Management

Mariam Ben Hassen, Mohamed Turki and Faïez Gargouri
University of Sfax, ISIMS, MIRACL Laboratory - B.P. 242, 3021 Sfax, Tunisia
{mariembenhassen, mohamed_turki}@yahoo.fr, faiez.gargouri@isims.rnu.tn

Keywords: Knowledge Management, Knowledge Identification, Sensitive Process, Core ontology of organization's processes Business Process Modeling.

Abstract: In an organizational context, the characterization and modeling of the business processes are necessary to localize knowledge that need to be capitalized. In this paper, we propose a new multi-dimensional meta-model of business processes modeling for knowledge management, entitled BPM4KI (Business Process Meta-Model for Knowledge Identification). This meta-model aims to enrich graphical representation of business process by integrating all aspects of process modeling: the knowledge, informational, functional, behavioral, organizational and intentional perspectives. It helps to identify and localize the crucial knowledge that is mobilized and created by these processes. Moreover, it has been illustrated through a medical process in the context of the organization of protection of the motor disabled people of Tunisia.

1 INTRODUCTION

More and more organizations are becoming aware of the importance of tacit and explicit knowledge owned by their members which corresponds to their experience and accumulated knowledge about the firm activities. Thus, in order to improve their performance, such organizations become conscious of the necessity to effectively identify, preserve, share and use the organizational knowledge mobilized and created by their business processes (BPs). This knowledge represents a competitive, decisive and lasting advantage and a source of wealth to be valorized.

According to the literature review, in term of the process view several researchers and practitioners have been focusing on the management of the BPs. Particularly in the information systems engineering, many works have been developed ((Curtis et al., 1992) (Melao and Pidd, 2000) (Nurcan et al., 2005) (Mili et al., 2010)) and aim at modeling, improving and optimizing the BPs. In accordance with the knowledge management view, few methods focusing on process analysis for knowledge identification have been proposed by researchers on KM ((Grundstein, 2000) (Tseng and Huang, 2005) (Saad et al., 2009) (Turki et al., 2014a; 2014b)). There have been several attempts to integrate the domain of KM and BPM. We quote process oriented Knowledge Management approaches ((Suyeon et al., 2003) (Gronau et al., 2005) (Heisig, 2006) (Zhaoli et al., 2008)) and knowledge oriented BPM approaches ((Zhang and Li, 2005) (Woitsch and Karagiannis 2005) (Weidong and Weihui, 2008) (Supulniece et al., 2010) (Bušinska and Kirikova, 2011) (Bušinska et al., 2011) (Sultanow et al., 2012) (Liu et al., 2012) (Netto et al., 2013)).

However, the integration of BPM and KM has not yet received sufficient attention. In fact, the knowledge dimension (i.e. the knowledge used or generated by activities, the sources of knowledge, explicit knowledge, tacit knowledge, individual and collective dimension of knowledge/activities, etc.) needed for BPM is not explicitly represented, integrated and implemented in BP meta-models.

The current paper proposes a new multi-perspective meta-model of the BPs for KM, entitled BPM4KI (Business Process Meta-Model for Knowledge Identification). This meta-model aims to enrich the graphical representation of BPs and improve the localization of crucial knowledge (i.e. knowledge on which it is necessary to capitalize) mobilized and created by these processes. In fact,

Ben Hassen M., Turki M. and Gargouri F.
Towards Business Process Modeling for Knowledge Management.
DOI: 10.5220/0005885200260036
In *Proceedings of the Fifth International Symposium on Business Modeling and Software Design (BMSD 2015)*, pages 26-36
ISBN: 978-989-758-111-3

more the organization's processes are sensitive, more they can mobilize crucial knowledge.

BPM4KI covers all aspects of BPM and KM. It consists of six perspectives: the functional, organizational, behavioral, informational, intentional and knowledge perspectives. The first five perspectives are inherited from (Nurcan, 2008) as typically oriented towards business modeling and enriched by some new concepts defined by the core ontology of organization's processes (COOP) proposed by Turki et al. (2014b). We extend the above-mentioned perspectives with the « knowledge perspective » in order to address all relevant issues related to KM.

Furthermore, we intend to integrate and implement the proposed BPM4KI meta-model in the Business Process Modeling Notation (BPMN 2.0). In practice, the result of the BPMN 2.0 extension will be used to well modeling the sensitive business processes (SBPs) which are likely to mobilize crucial knowledge.

The remainder of this paper is organized as follows: Section 2 presents related work to analyze existing work on BPM for KM. Section 3 describes the proposed BPM4KI meta-model. Section 4 illustrates the application of BPM4KI based on a real case study. Section 5 concludes the paper and underlines some future research.

2 RELATED WORK

In this section, we present main methodologies focused on BPM for knowledge identification which have been proposed by researchers on KM. We consider the Global Analysis METHodology (Grundstein, 2000), the identifying crucial knowledge methodology (Saad et al., 2009), the Sensitive Organization's Process Identification Methodology (Turki et al., 2014a), as relevant to the BPM-KM area. We have selected to discuss them in this section, following a literature survey.

The Global Analysis Methodology (GAMETH) proposed by Grundstein (2000) comprises three main phases gathering the following steps: (i) «Identifying the sensitive processes» specifies the project context, defines the domain and limits of the intervention and determines the processes targeted to be deeply analyzed. According to this author, "*A sensitive process is a process, which represents the important issues which are collectively acknowledged: weakness of the process which risks not attaining its objectives, obstacles to overcome; (iii) difficult challenge to take in charge; (iv) produced goods or services which are strategic in regard to the organization's orientations*". (ii) « Identifying the determining problems» aims at distinguishing the problems which weaken the critical activities, (i.e. the activities that could endanger the sensitive processes due to dysfunctions and constraints which affect it and generate determining problems). (iii) «Identifying the Crucial Knowledge» is intended to define, localize and characterize the knowledge to be capitalized.

The methodology for identifying the crucial knowledge proposed by Saad et al. (2009) is based on the GAMETH framework. It aims at capitalizing the knowledge mobilized and created in the course of a project. It is composed of three phases: (i) Determining «Reference Knowledge»; (ii) Constructing Preference model; (iii) Classifying «Potential Crucial Knowledge».

Turki et al. (2014a) and Turki et al. (2014b) have in depth dealt with the issue of identifying « Sensitive organization's processes ». They have proposed a new multi-criteria methodology entitled SOPIM (Sensitive Organization's Process Identification Methodology) and a Core Ontology of Organization's Processes (COOP) to help the assessment and identification of SBPs. SOPIM is composed of two main phases: (i) Construction of the preference model, and (ii) Exploitation of the preference model (decision rules) to classify the «Potential Sensitive organization's processes».

Each approach mentioned above, defines a set of phases for modeling and identifying the SBPs. However, we note that the BPM step has not been studied in depth. In particular, we have noted the lack of expressiveness BPM formalisms that explicitly integrate all relevant aspects related to knowledge dimension and other aspects which cover the BPM. In order to remedy for this lack, this paper aims to extend and consolidate previous work made by Saad et al. (2009) and Turki et al. (2014a) in order to cover the gap between BPM and KM and address an important problem that is not often dealt with KM methodologies. Exactly, our mission aims to enrich and optimize the operation of "modeling and representation of identified SBPs" in order to increase the probability of localizing and identifying the crucial knowledge. This reduces the cost of the operation of capitalizing on knowledge.

The first step to address existing limitations and achieve this objective is the specification of a precise conceptualization, together with a subjacent representation notation, that precisely describes all SBP essential characteristics as well as the dynamics with which knowledge is mobilized and created

during a SBP, is still an open issue. In fact, this is not a trivial task, since SBP involve many subjective and complex concepts that are subject to different interpretations. We briefly describe in the following the most important specific particularities for SBPs modeling, highlighting its key features.

An SBP is a particular type of BP. It has its own characteristics that distinguish it from BPs processes (see (Turki et al., 2014b). we deduce and adopt for our notion of SBP the following characterization. A business process is described as « sensitive », if at least one of the following requirements is fulfilled: (i) It mobilizes crucial knowledge (which is considered as immaterial resource). It contains activities based on acquisition, sharing, dissemination, storage, creation, (re)use of organizational knowledge, and collaboration among participants. (ii) It is very dependent on the tacit and explicit knowledge (individual and collective) embedded in the stakeholders' minds (experts, specialists, etc.), and in the actions. (iii) It is very complex, with a high number of (individual and collective) actions which are flexibles, high number of critical activities (which mobilizes very important organizational tacit knowledge, high degree of tacit knowledge held by a very small number of experts or individual /collective knowledge poorly mastered to solve critical problems, diversity of information and knowledge sources as well as large flow of knowledge, etc.). (iv) It mobilizes a large number of business domains / skills (in terms of internal and external organization unit involved in the process). Its execution involves many participants and the assistance of many experts, with different experience and expertise levels. (v) It has a high number of collaborative activities that mobilize, share and generate new, very important organizational knowledge (tacit and / or explicit) created at the time of interaction among agents. So that, it focus on the dynamic conversion of knowledge (Nonaka & Takeuchi, 1995). (vi) It possesses a high degree of dynamism in the objectives' change associated to it. The influence of intentions and experiences of the agents in decision making is very important. (vii) Its contribution to reach the organization's strategic objectives is very important. In short, we can conclude that flexibility, efficient collaboration and effective knowledge management are the key requirements for specifying SBPs. Due to those characteristics, organizing the knowledge in SBPs and building a SBP model are not an easy task. The selection and adoption of a suitable BPM formalism for SBPs modeling is critical, although challenging. In this context, several BPM approaches have been proposed in information system engineering (particularly in BPs engineering). Some traditional BPM formalisms that are largely used in current research and practice scenarios in organizations like Event Driven Process Chain (EPC) (Korherr and List, 2006), UML 2.0 Activity Diagrams (AD) (OMG, 2011a), Process Specification Language (PSL) (Schlenoff et al., 2000) and Business Process Modeling Notation (BPMN 2.0) (OMG, 2011b) have been adapted to allow the explicit representation of the intrinsic elements of knowledge within BPs, but they do not include all the required features necessary to describe a SBP. It is obvious that these formalisms are suitable for process perspective representation, but poorly present data, information and knowledge (flows) which are not be represented separately and clearly in the process models. However, this distinction is useful and essential for our modeling context. Besides, the literature shows a set of formalisms dedicated to knowledge- intensive processes representation (Gronau et al., 2005) (called also Process-oriented knowledge modeling approaches) that focus on storing and sharing knowledge, including Business Process Knowledge Method (BPKM) (Papavassiliou et al., 2002), Knowledge Modeling Description Language (KMDL 2.2) (Gronau et al., 2005), Oliveira's methodology (Oliveira, 2009), Notation for Knowledge-Intensive Processes (NKIP) (Netto et al., 2013), etc. Some major limitations can be emphasized in this category. One the one hand, these approaches did not experience a wide adoption among organizations and are very incipient. On the other hand, they lack the ability in an adequate manner to model the process perspective (the structural, organizational and informational dimensions). Moreover, some proposals do not explicitly differentiate tacit knowledge from explicit knowledge. In addition, there are deficits in the conversion of the knowledge types (such as internalization, externalization, socialization and combination) (Nonaka & Takeuchi, 1995) and the person-related knowledge modeling that are relevant in SBPs due to, for instance the high degree of tacit knowledge developed and exchanged among agents through inter-organizational collaboration.

Furthermore, following the study of BPs meta-models and ontologies associated with the main BPM formalisms, we notice that the defined concepts -actions specification (Process, Activity, Sub-process, Task) do not take into account the individual / collective dimension of the actions. However, taking into consideration such a

dimension is very important in our context given that we are interested in the localization of knowledge mobilized to achieve the process. This knowledge taken in the action may be either individual (tacit or explicit) or collective and organizational (tacit or explicit). Despite it mobilizes crucial knowledge within an organization and their key role for organizational KM, existing BPM formalisms have shortcomings in their ability to represent SBPs. None of those proposals include or address conveniently all or at least most of the SBPs particularities and characteristics as well as the essential issues of KM. This leads to ambiguity and misunderstanding of the developed SBPs models. Based on the results discussed in this section, the SBPs representation is a lot more difficult. So, such formalism should take into account all semantic dimensions and criteria enabling to characterize in depth the notion of process. Therefore, there is a need to precisely define the specification of a SBP, including the concepts and relationships between them that adequately address the knowledge within their actions and all SBP essential aspects.

In order to propose a solution that is capable of explaining a SBP, considering both the knowledge within their actions and other relevant aspects aimed to meet the new requirements of BPM, we propose a meta-model of the BPs for knowledge identification, called BPM4KI, to characterize the concepts useful for the modeling and analysis of SBPs, in order to locate the knowledge mobilized and created by these processes, which may be crucial.

3 BPM4KI: A META-MODEL OF THE BUSINESS PROCESS MODELING FOR KNOWLEDGE IDENTIFICATION

In order to localize and identify in depth the crucial knowledge, we propose a new Business Process Meta-model for Knowledge Identification (BPM4KI). We have summarized and structured the main concepts (of the field of BP and KM) that we judge essential and relevant for the characterization and modeling of the SBP in a meta-model for synthesis, represented as a UML class diagram.

The generic meta-model we have developed is based on the core ontology COOP proposed by Turki et al. (2014b) and categorized according to the framework of Nurcan (2008). COOP provides taxonomy of concepts which are defined in a rigorous and consensual way, we quote: Action, Action of Organization, Individual Action, Action of Collective, Collective, Organization, Distal Intention, Deliberate Action, Sensitive Process, Critical Activity, etc. While the Nurcan's framework consists of five perspectives, each one of them focuses on a process aspect: functional, organizational, behavioral, informational and intentional. As these perspectives do not capture all relevant aspects related to knowledge dimension, we have extended the abovementioned framework with a further perspective, namely the knowledge perspective. It should be noted that Knowledge might be considered as one of the business process dimensions, because knowledge is related to action, it is implemented in the action, and is essential to its development (Grundstein, 2000). It is created as a result of process execution, knowledge is used to perform a process, and it is distributed among process participants (Heisig, 2006).

Figure 1 presents BPM4KI in terms of classes and relationships between classes. The defined concepts that make up the COOP ontology are marked in gray in the meta-model. In the following, we describe the six perspectives contained in the BPM4KI meta-model.

The ***Functional Perspective*** represents the BP elements which are being performed (i.e. activity, sub-process and tasks). Hence, as illustrated in Figure 1, the BPM4KI meta-model part that can be used to model this perspective is inspired by Turki et al. (2014b). It regroups generic classes related to (inheriting from) the `Action` meta-class (With respect to our notation, the informal labels on BPM4KI concepts appear in the text in the `Courrier new` font with First Capital Letters). An `Action` can be individual or collective. An `Individual Action` *is carried out* by (*hasForAgent)* a `Human`. While a `Collective Action` is *carried out by* a `Collective`, is *controlledBy* a `Collective Intention` and *hasForProperPart* at least two `Individual Action` contributing to it. A `Business Process` is an `Action of Organization` (which in turn a specialization of `Collective Action`) carried out by a group of individuals affiliated with the organization. Any `Business Process` *hasForproperPart* a set of `Organizational Activities` coordinated and undertaken according to an intentionally defined objective. An `Organizational Activity` can be either an `Organizational Unit Action` or an `Organizational Individual Action` according to whether their agent is

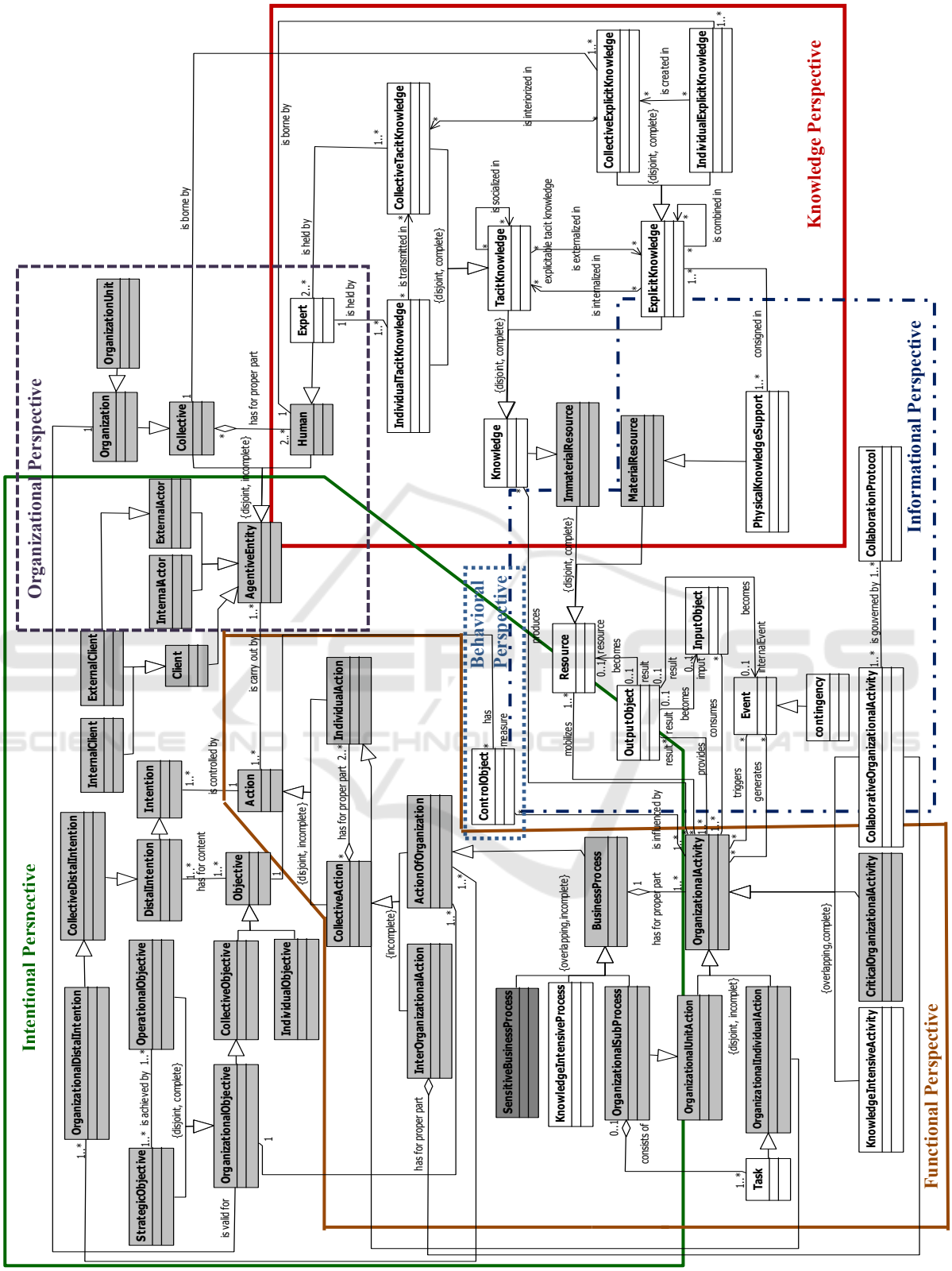

Figure 1: A multi-dimensional meta-model of the business processes for knowledge identification "BPM4KI" *(categorized according to six perspectives)*.

performed by an Organization Unit or a Human affiliated to the Organization). An Organizational Sub-Process is an Organizational Unit Action which *is a proper part* of a Business Process. Furthermore, an Organizational Activity can either be qualified as a Critical Organizational Activity, or as a Knowledge Intensive Activity or Collaborative Activity. They can also be described as critical.

The ***Organizational Perspective*** represents the different participants (agents) invoked in the execution of process elements as well as their affiliation. The basic element of this perspective is Agentive Entity. An Agentive Entity is an entity which has a capacity to carry out (and therefore to repeat) Actions (in particular deliberate actions). It can be specified in the form of a Human, an Informal Group, or an Organization, internal or external to an Organization. Any Collective Action *hasForAgent* a Collective.An Organization is a Collective (structured and formal) which can carry out an Action of Organization.

The ***Behavioural Perspective*** basically describes the control flow and the logical sequence of elements to be executed in a process. It includes synchronization, decision- making conditions, entry and exit criteria, sequence, iteration, etc. The basic element of this perspective is Control Object (such as pre-conditions, post-conditions, triggers, performance indicators, etc.).

The ***Informational Perspective*** describes the informational entities which are generated, consumed, or exchanged within a process or an activity as well as their structure and the relationships among them. This perspective contains mainly the generic classes Resource with its derived class Material Resource (and the specialization class Physical Knowledge Support), InputObject, OutputObject, Event, and Collaboration Protocol. In fact, for its accomplishment, an Organizational Activity uses Input Objects (materials, data or information), mobilizes Material Resources and/or Immaterial resources to produce Output Objects (data, information, services, results, outputs) and under the influence of Control Objects. It can be triggered by Events, which can in turn produce Events. A Contingency is an external and unpredictable event that influences the process execution (the elements produced or handled and decisions made) (França et al., 2012). It should be emphasized that data object and information object (which is stored by electronic media or written down in documents) form the basis for knowledge sharing and the creation of new knowledge objects.

The ***Intentional Perspective*** describes major BP characteristics and captures important BP context information (such as goals and their measures, strategies, the deliverables, the process type and the customer), in order to ensure the BP flexibility (Nurcan, 2008) (List and Korherr, 2006). The meta-model elements of this perspective are inspired by the COOP ontology (Turki et al., 2014b). It comprises mainly the central concepts Distal Intention, Objective, Organizational Objective, Sensitive Business Process, Output Object (deliverables), Control Object (performance measures) and Client.Each Business Process meets an Organizational Objective (which is an Objective) intentionally defined. A Distal Intention *hasForContent* an Objective. So, this process *isControlledBy* a Distal Intention, in particular an Organizational Distal Intention (which is a Collective Distal Intention). Then the Business Process is a Deliberate Action (Turki et al., 2014b). Every OrganizationalDistal Intention *hasForContent* an Organizational Objective. Depending on whether the content of a Collective Distal Intention or an Individual Distal Intention, an Objective can be either an Individual Objective or a Collective Objective. A Collective Objective *isValidFor* an Organization, then it is an Organizational Objective which can be either a Strategic Objective or an Operational Objective. Each Business Process must provide a result which has a value to the organization's Clients. (It is therefore a Culminated Process (Turki et al., 2014b). Then, Output Object (i.e. deliverables which are either services or products) can be located in the behavioral perspective as well as in intentional perspective. A Business Process satisfies one or more Clients, which are either internal or external to the Organization. A Business Process has a certain process type. In COOP, the authors (Turki et al., 2014b) distinguish different categories of BPs classified according to several

dimensions: *granularity*, *value*, *affiliation*, *repetition* and *piloting*. For instance, according to the level of process granularity, we distinguish between `First Level Process` and `Organizational Sub Process`. Depending on the affiliation dimension of the agents operating in the process, we specify three process classes: *Internal Process*, *External Process* and *Partial External Process*. Additionally, we propose to distinguish two other categories of BP according to the *complexity* dimension: `Sensitive Business Process` and `Knowledge Intensive Process`. Their objectives are frequently changed.

Last but not least, the ***Knowledge perspective*** provides an overview perspective of the organizational and individual knowledge mobilized by an organization as well as the knowledge flow proceeding within and between organizations. It describes all relevant aspects related to KM. Then, it emphasizes knowledge collection, organization, storage, transfer, sharing, creation and reuse among process participants. Therefore, it specifies the different opportunities of knowledge conversion. This perspective distinguishes also between knowledge used to perform (BP) and knowledge created as a result of BP activities. It identifies the different types of knowledge (tacit/explicit dimension) mobilized and created by each type of activity, the different sources of knowledge, their localization (where they are created or stored and where they are used), tacit and non-explicitable knowledge, persons holding them, their nature and their organizational coverage (individual/collective dimension).The basic elements of this perspective (Figure 1) are `Immaterial Resource`, `Knowledge`, `Tacit Knowledge`, `Explicit Knowledge`, `Physical KnowledgeSupport` and `Expert`. An `Organizational Activity` mobilizes and produces different types of `Knowledge` (which is an `Immaterial Resource` of an organization). `Knowledge` comes in two dimensions explicit and tacit. Each kind of `Knowledge` can be held individually or collectively and is localized in different knowledge sources. `Tacit knowledge` originates and is applied in the minds of the owners of knowledge and hence it is almost impossible to put into a document or a database, as well as difficult to communicate and share. `Explicit knowledge` is typically structured and retrievable and often becomes embedded in documents, repositories, organizational routines, practices, norms, etc. Organizational collective knowledge integrates a company's experiences, company-specific knowledge, culture, decision-making procedures, the detail of BPs, etc. An `Individual Tacit Knowledge` *is held by* one `Expert` (a `Human` who carries out `Actions` with high levels of expertise, creativity and). A `Collective Tacit Knowledge` *is held by* at least two `Experts` (which constitute a `Collective`). An `Individual Explicit Knowledge` *is born by* a `Human`. A `Collective Explicit Knowledge` *is born by* a `Collective` (i.e. an `Organization`). `Explicit` Knowledge is often stored in one or more `Physical Knowledge Support` (i.e. media, as documents, computer system, etc.) enabling their dissemination, sharing and use. A `Physical Knowledge Support` is a `Material Resource` (informational resource), having source of knowledge information interpreted and mobilized by the actors during the execution of their activities. Then, this concept can be located both in the knowledge and Informational perspectives. A `Collaborative Organizational Activity` mobilizes and produces new `Collective Knowledge` by a set of interactions (between individuals). A `Critical Activity` mobilizes different types of `knowledge`: (i) imperfect individual and collective knowledge (tacit or explicit) (i.e. missing, poorly mastered, uncertain, etc.) which are necessary for solving critical determining problems; (ii) important, diverse and heterogeneous knowledge recorded on multiple sources of knowledge (dispersed and sometimes lacking accessibility); (iii) expertise and/or rare knowledge held by a very small number of experts (which have high levels of expertise, creativity and innovation); (iv) very important tacit organizational knowledge, often linked to competences, abilities and practical experiences of their holders. This activity is based on several experiments. Besides, it may threaten `Sensitive Business Processes`. It should be noted that some concepts are shared by different perspectives. For instance, the `Collaborative Activity` concept belongs to all perspectives.

Once modeled, the BPs can be graphically represented, using BPM formalism in order to localize the knowledge that is mobilized and created by these processes. For this reason, we have selected the most popular standard for BPM, namely, the Business Process Modeling Notation (BPMN 2.0). However, despite its strength representation, this notation does not support the key concepts of BPM4KI (`Sensitive Business Process`,

Table 1: Graphical representation of the different extended elements.

Concept	Sensitive Business Process	Critical Organizational Activity	Collaborative Activity	Expert	Knowledge	Individual Tacit Knowledge	Collective Tacit Knowledge	Individual Explicit Knowledge	Collective Explicit Knowledge
Notation									

`Collective Action`, `Tacit Knowledge`, `Critical Organizational Activity`, `Expert`, etc.). To remedy at this lack, it should be necessary to extend the BPMN 2.0 notation with several additional concepts. To achieve this goal, we start by defining some specific graphical icons relating to each new proposed concept (see Table 1). Then, in future work, we plan to integrate and implement the extension that we brought to the BPMN specification. In this paper we use these new icons in section 4 to highlight this extension.

4 CASE STUDY

We aim to validate the proposed meta-model through its application in the context of the Association of Protection of the Motor-disabled of Sfax-Tunisia (ASHMS). This organization is characterized by highly dynamic, unpredictable, complex and highly intensive knowledge actions. We are particularly interested in the early care of the disabled children with cerebral palsy (CP). An in depth analysis of this care has been made by Turki et al. (2011). In fact, the knowledge used and produced during the treatment of children with CP is very important, heterogeneous and recorded on various scattered sources. One part of this knowledge is embodied in the mind of health professionals. Another part, is preserved in the organizational memory as reports, medical records, data bases, or therapeutic protocols). The created knowledge stems from the interaction of a large number of healthcare professionals from several specialties (such as neonatology, neuro-pediatrics, physical therapy, orthopedics, psychiatry, physiotherapy, speech therapy, and occupational therapy) and located on geographically remote sites. The raised problem concerns on the one hand, the insufficiency and the localization of medical knowledge necessary for decision-making, and on the other hand, the loss of knowledge held by these experts during their scattering or their departure at the end of the treatment. Thus, the ASHMS risks losing the acquired know-how for good and transferring this knowledge to new novices if ever no capitalization action is considered. This organization should focus on only the so called crucial knowledge, that is the most valuable/important knowledge.

Our main objective consists in providing better localization and identification of different types and modalities of pragmatic medical knowledge necessary to the conduct of the medical care process for children with CP. As a matter of fact, this SBP is made up of several sub-processes. It consists of a succession of many actions in the form of medical and paramedical examinations and evaluations. As an example, we mention: Process related to neonatology care, process related to neuro-pediatric care, process related to physiotherapy, etc. These processes require taking into consideration certain medical information contained in the medical records as well as certain medical knowledge (results of para-clinical exams, hospitalization reports, medical records, practice guidelines, etc.).

An enriched graphical representation of the medical care process for children with CP modelled according to BPM4KI meta-model improve the localization of the crucial knowledge mobilized and produced by the critical activities. Moreover, it allows the various stakeholders involved in the medical processes to preserve, share and transfer the tacit knowledge as well as to evaluate the amount of lost knowledge if a person -owner of knowledge- leaves the organization (in order to identify which tacit knowledge in this case should be transformed into explicit knowledge).

In this study, we take into consideration the results of experimentation of the methodology SOPIM proposed by Turki et al. (2014a) for the early care of children with CP. We recall that the proposed multi-criteria methodology was conducted and validated in the ASHMS organization. It aims at evaluating and identifying SBPs (i.e. the processes which can mobilize knowledge on which it is necessary to capitalize) for knowledge localization. Furthermore, the BPM4KI meta-model is based on the core ontology COOP (Turki et al., 2014b) comprising the key concepts inherent to the BP

domain which are useful for the characterization and conceptualization of SBPs.

We have opted for the « Process related to the neuropediatric care of a child with CP » to illustrate the contributions of our enriched meta-model. Indeed, this process is very complex in terms of the large number of critical and collaborative activities that make it up, the neuropediatric fields, the large amount of knowledge mobilized, the multitude of knowledge sources, etc. Some of its activities are very dependent on the participants experience, expertise and creativity. We have used the BPMN 2.0 specification (OMG, 2011) in order to enrich the graphical representation of neuro-pediatric care process (modeled according to BPM4KI).

Thus, we have opted for the use of an open source modeling tool namely Aris Express 2.4 (IDS Scheer, 2013). The obtained model is the result of many individual meetings for review and validation with the Neuro-Pediatrician. Figure 2 illustrates an excerpt from the BPMN model of the process related to the neuropediatric care of a child with CP enriched with knowledge dimension.

During our experimentation, we have identified different types of medical knowledge mobilized for each type of activity related to this process. We have distinguished missing or poorly mastered knowledge necessary to resolve critical problems, expertise, unexplainable tacit knowledge and mastered knowledge necessary and relevant to the proper functioning and development of the activity or produced by the activity. We have also identified the different sources of knowledge, their localization, actors who hold the knowledge, the places where they are usable or used, their nature (like experience, basic knowledge, general knowledge), their degree of formalization, their organizational coverage, as well as their quality (perfect or imperfect).

For instance, the knowledge A_3K_{p1} related to « Synthesis assessment of neuro- and psycho-cognitive, neurosensory and praxo-gnosic development of young children at risk and its disorders» is produced by the critical activity A_3 « Qualitative and quantitative evaluation of the intellectual functioning » .This knowledge can be stored in the following physical media: the neurological assessment sheet, neuropsychological assessment, the sensitive assessment sheet and the neuro-motor assessment. These assessments are recorded in the personal medical records and in the overall clinical picture of the child. This knowledge is located internally within the Neonatology department in the University Hospital Hedi Chaker. It is captured in the various archives drawers or patients' directories. A_3K_{p1} is of a scientific, technical and measure nature which is related to patients. It represents a collective explicit knowledge, part of which can be represented in the form of an individual explicit knowledge recorded on the care data collection sheet of the Neuro-pediatrician. This knowledge is imperfect (general, incomplete and uncertain). A_3K_{p1} is mobilized by the activity A_4 « Establishing an investigation plan ».

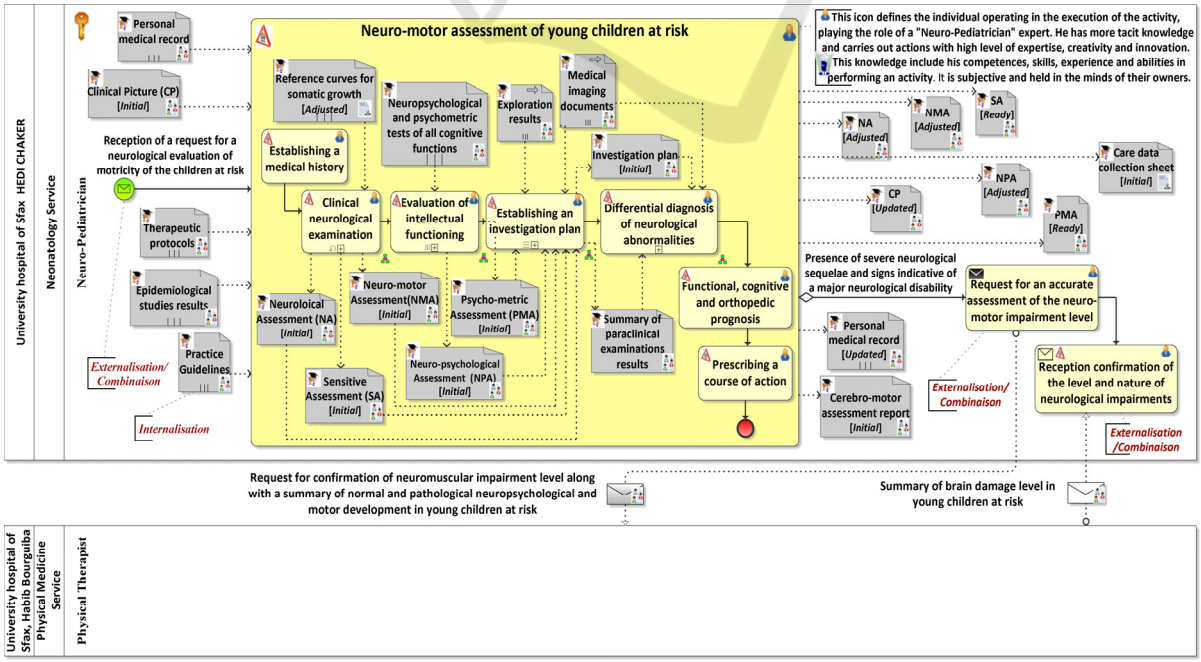

Figure 2: An extract of the graphical representation model of the process of neuropediatric care of a child with CP carried out with ARIS Express 2.4 tool.

The proposed BPM4KI meta-model highlight the following contributions: (i) its suitability for a full and enriched graphical representation of actual SBPs, (ii) validation of its comprehensibility as well as the choice and suitability of the type of modeling by the actors involved in the medical care process for children with CP (who lack experience in BPM), (iii) a better knowledge localization, and (iv) a deeply characterizing of the identified knowledge in order to determine which ones are more crucial.

Furthermore, extending BP models with the knowledge dimension would provide the following benefits: (i) illustrating the knowledge and knowledge sources involved (used, generated, created and/or modified) in the processes and activities, (ii) illustrating the way in which specific knowledge flows among the activities, or how a specific source is used and modified through the activities, and (iii)illustrating transfers of knowledge between sources, and among activities as well as the different opportunities of knowledge conversion.

5 CONCLUSIONS AND FUTURE WORK

In this paper, we have focused on the problem of BPs modeling to improve the localization and the identification of crucial knowledge. Therefore, we have proposed a new BPs meta-model, called «BPM4KI», which highlights the key concepts and relationships characterizing SBPs, relying on the core ontology COOP. The aim of this meta-model is to develop a comprehensive and enriched graphical representation of BPs, which integrates all the dimensions of processes modeling: the knowledge, functional, organizational, behavioral, informational and intentional dimension. It has been illustrated by a model of neuropediatric care process of a child with CP through, using the BPMN 2.0 standard.

Various research lines will be performed to complete and deepen the so-called problematic of knowledge identification mobilized by SBPs. Firstly, we consider evaluating the expressiveness of BPM formalisms and their suitability for the representation of SBPs while taking the conceptualization defined by BPM4KI as an evaluation framework. In this context, our objective consists in guiding and justifying the choice of the most suitable formalism to characterize and improve the knowledge localization. Secondly, in order to justify the choice of BPMN 2.0 for SBPs modeling, we intent to adopt the multi-criteria decision making approach (Roy and Bouyssou, 1993). In fact, the proposed BPM4KI should help to construct a coherent family of criteria for the evaluation of the different PBM formalisms. Thirdly, we consider an extension of the BPMN 2.0 for KM. This extension must take into consideration, on the one hand, the knowledge dimension, and on the other hand, integrate the new concepts of BPM4KI (and represents issues relevant at the intersection of KM and BPM). A full and rich representation of BPs (modeled according to BPM4KI) shall allow a better localization and identification of crucial knowledge on which we must capitalize. This extension of BPMN 2.0 will be integrated into a more general framework supporting the SBPs modeling. This framework advocates a MDE approach considering (i) at the CIM level, a specific meta-model, the BPM4KI meta-model for modeling SBPs (ii) at the PIM level, an extension of the BPMN meta-model for visualizing and user validating the modeled SBPs, and finally, (iii) at the PSM level, several meta-models for implementing the different extensions (e.g. XPDL and BPEL meta-models).

REFERENCES

Bušinska, L. and Kirikova, M. (2011). Knowledge Dimension in Business Process Modeling. In *IS Olympics: Information Systems in a Diverse World: Selected Extended Papers at CAiSE Forum*. United Kingdom, London: Springer, 186-201.

Bušinska, L., Supulniece, I. and Kirikova, M. On data, information, and knowledge representation in business process models. *In: The 20th International Conference on Information Systems Development (ISD 2011)*, Edinburgh, Scotland. Springer, 24-26.

Curtis, B., Kellner, M.I. and Over, J., (1992).Process modelling. *Communications of the ACM*, 35(9) 75-90.

França, J.B.S., Netto, J.M., Carvalho, J.E.S., Barradas, R.G., Santoro, F.M. and Baião, F.A. (2012). Towards Knowledge-Intensive Processes Representation. *Business Process Management Workshops (BPM 2012)*, 126-136.

Gronau, N., Korf, R. and Müller, C. (2005). KMDL-Capturing, Analysing and Improving Knowledge-Intensive Business Processes. *Journal of Universal Computer Science*, vol. 11, no. 4, pp. 452-472.

Grundstein, M., (2000). From capitalizing on Company Knowledge to Knowledge Management. In *Knowledge Management, Classic and Contemporary Works by Daryl Morey, Mark Maybury, Bhavani Thuraisingham, Cambridge, Massachusetts*. The MIT Press, Chapter 12, 261-287.

Heisig, P. (2006). The GPO-WM® Method for the Integration of Knowledge Management into Business Processes. In *6th International Conference on*

Knowledge Management (I-KNOW 2006). Graz, Austria, 331-337.

List, B., Korherr, B., (2006). An evaluation of conceptual business process modelling languages. *Proceedings of the 2006 ACM symposium on Applied computing (SAC'06)*, Dijon, France. ACM Press.

Liu, D.R., Lai D. R., Liu C.H. and Chih-Wei, L. (2012). Modeling the knowledge-flow view for collaborative knowledge support. *Journal of Knowledge-Based Systems* 31, 41-54.

Melao, N. and Pidd, M. (2000). A conceptual framework for understanding business processes and business process modelling. *Infomation Systems Journal*, 10, 105-129.

Mili, H., Tremblay, G., Boujaoude, G., Lefebvre, E., Elabed L. and Boussaidi, G. El. (2010). Business Process Modeling Languages: Sorting Through the Alphabet Soup, *ACM Comput*: Surv, 43(1).

Netto, J.M, Franca, J. B. S., Baião, F.A. and Santoro, F. M. (2013). A notation for Knowledge-Intensive Processes. *Proceeding of the 2013 IEEE 17th International Conference on Computer Supported Cooperative Work in Design (CSCWD)*, 190-195.

Nurcan, S., Etien, A., Kaabi, R., Zoukar, I., and Rolland, C. (2005). A strategy driven business process modelling approach. *Business Process Management Journal*, 11(6), 628-649.

Nurcan, S., (2008). A Survey on the Flexibility Requirements Related to Business Processes and Modeling Artifact. *Proceedings of the 41st Hawaii International Conference on System Sciences*. IEE, Hawaii, USA, 7-10, 378.

OMG (2011a). Unified Modeling Language (UML). Version 2.0. from http://www.uml.org/

OMG (2011b). Business Process Modeling and Notation (BPMN). Version 2.0. from http://www.bpmn.org/

Nonaka, I., Takeuchi, H. (1995). *Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*. Oxford University Press.

Oliveira, F.F. (2009). Ontology Collaboration and its Applications. *MSc Dissertation. Programa de Pós-Graduação em Informática*, Universidade Federal do Espírito Santo, Vitória, Brazil.

Papavassiliou, G., Ntioudis, S., Abecker, A., Mentzas, G. (2002). Business Process Knowledge Modeling: method tool. *Database and Expert Systems Applications*. Greece. p.138-142.

Saad, I., Grundstein, M., Sabroux, C., (2009). Une méthode d'aide à l'identification des connaissances cruciales pour l'entreprise. Revue SIM, Vol 14, n° 3.

Schlenoff, C., Gruninger, M., Tissot, F., Valois, J., Lubell, J., Lee and J. (2000).The Process Specification Language (PSL) Version 1.0 Specification, from http://www.mel.nist.gov/psl/

Sultanow, E., Zhou, X., Gronau, N., and Cox, S. (2012). Modeling of Processes, Systems and Knowledge: a Multi-Dimensional Comparison of 13 Chosen Methods. *International Review on Computers and Software*, 7(6), 3309-3319.

Supulniece, I., Businska, L. and Kirikova, M. (2010). Towards Extending BPMN with the Knowledge Dimension. *In BPMDS and EMMSAD 2010*, Tunisa. LNBIP: Springer, Heidelberg, vol. 50, 69- 81.

Suyeon, K., Hyunseok, H. and Euiho S. (2003). A process-based approach to knowledge flow analysis: a case study of a manufacturing firm. *Knowledge and Process Management*, vol 0 (4), 260-276.

The IDS-Scheer (2013). http:// www.ids-scheer.com/

Tseng, B. and Huang, C. (2005).Capitalizing on Knowledge: A Novel Approach to Crucial Knowledge Determination. *IEEE Transactions on Systems, Man, and Cybernetics*: Systems and Humans, 35, 919-931.

Turki, M., Saad, I., Gargouri, F. and Kassel, G. (2011). Towards Identifying Sensitive Processes for Knowledge Localization. *International Workshop on Knowledge Management and Collaboration (KMC'2011), Proc. of the 2011 International Conference on Collaboration Technologies and Systems (CTS'2011)*, 224-232.

Turki, M., Saad, I., Gargouri, F. and Kassel, G. (2014a). A Business Process Evaluation Methodology for Knowledge Management based on multi-criteria decision making approach. *Information systems for knowledge management.* ISBN:978-1-84821-664-8,Wiley-ISTE.

Turki, M., Kassel, G., Saad, I. and Gargouri, F. (2014b). COOP: A Core Ontology of Organization's Processes for group decision making. *Journal of Decision Systems*, 23(1), 55-68.

Roy, B. and Bouyssou D. (1993). *Aide multicritère à la décision: méthodes et cas*, Economica Paris.

Weidong, Z. and Weihui, D. (2008). Integrated Modeling of Business Processes and Knowledge Flow Based on RAD. *In IEEE International Symposium on Knowledge Acquisition and Modeling*, China, 49-53.

Woitsch, R. and Karagiannis, D. (2005). Process Oriented Knowledge Management: A Service Based Approach. *Journal of universal computer science* 11(4), 565-588.

Zhang, X. and Li, M. (2005) Workflow-based knowledge flow modeling and control. *Chinese Journal of Software*, vol16 (2), 184-193.

Zhaoli, Z., Zongkai, Y. and Qingtang, L. (2008). Modeling Knowledge Flow using Petri net. *In IEEE International Symposium on Knowledge Acquisition and Modeling Workshop*, Wuhan, China, 142-146.