Corporate Semantic Business Process Management

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1 Overview of Semantic Business Process Management

1.1 Business Process Management

Modern organizational trends are modulating the focus of many businesses to reorganize themselves around their business. The trends in the new networked economy make business processes and the management of these processes more dynamic and knowledge intensive than in (Weske et al. 2004). The Gartner Group predicted that by 2015 (Light 2005) there would be an explosion of interest in business process management suites and their integration with underlying software infrastructure.

In the dynamic business environments, complex organizations emphasize the importance of Business Process Management (BPM). By managing processes with continuous improvements, while the organization can reduce costs, increase efficiency, and strengthen the ability to respond to change (Weske et al. 2004). Many companies already use BPM efficiently to increase their operating flexibility. Managing business processes means focusing on the important activities and resources of a company, such as: markets, strategy, people, financial aspects, material management, intellectual properties, data and information. The aim is to

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design and control the organizational structures in a very flexible way so they can rapidly adapt to changing conditions.

Business processes are often modeled using informal graphical methods because these techniques are perceived to be more intuitive to common users. BPM systems facilitate the management of business processes using graphical process models (van der Aalst et al. 2000). These models are unique because they are derived from graph theory formalisms. They use mathematical modelling that controls business processes in ways that other enterprise systems cannot (Basu and Blanning 2000; Curtis et al. 1992). Informal graphical modelling techniques, such as flowcharts do not permit mathematical analysis and control.

Several formal graphical process model techniques have been developed for BPM Systems e.g. Petri nets, state charts, Unified Modelling Language (UML) diagrams, Business Process modelling Notation (BPMN) and Business Process Execution Language (BPEL) diagrams.

A formal graphical process model should not only be comprehensive but must also be easy to understand because manual organizational activities are involved and so that it can be used as a platform for communication between various business people (Curtis et al. 1992).

BPM standards and specifications are based on grounded BPM theory and are eventually adopted into software and systems (van der Aalst et al. 2000; Basu and Blanning 2000).

Business process modelling has a very large literature; nevertheless there are different views, concepts and misconceptions in this area. The various Business Process Management solutions provide different modelling approaches, but the basic logic behind the modelling methods remains the same. The various approaches include the definition of activities, descriptions, and responsible positions or roles for execution. While process modelling is a traditional and well-grounded topic, the various possible motivations for modelling a process, the various sources of models, and the resulting variety of requirements on the formalisms used for representing processes are often not considered.

BPM applications are used to describe the organizational processes, together with the required information and other resources (including human resources) needed to perform each activity. Business processes are defined as sequence of activities. Each elementary task should have an organizational actor to perform it. A well described process model contains all the relevant tasks and their description. In our opinion it is necessary to unambiguously define who is responsible for the execution of each activity in terms of the RACI (Responsible, Accountable, Consulted, Informed) matrix (Jacka and Keller 2009), bridging the organizational model and the process model. Generally BPM methodologies' requirements are satisfied with the definition of the type of job role, emphasized in the RACI matrix. In our approach the job role is interpreted as a bridge between the task and the actor. One or more job roles are assigned to a position, the positions fill up the organization. The position and job role may relate to each other in several ways (1:1, 1:m, n:1, m:n) (Gábor and Szabó 2013).

One of the objectives of BPM is the transformation of informal knowledge into formal knowledge and facilitates its externalization and sharing (Kalpic and Bernus 2006). The relevant knowledge is embedded and strongly related to the roles as a building element of the organizational structure. The competences relates to the job role, considered as content. Competences mean knowledge, skill and attitude that are necessary for sufficient execution. The knowledge extraction refers to the content, while the type of the job role has more organizational aspects than knowledge management. In order to properly include the job role knowledge into the process model an extended RACI matrix should be used, where the description of task from the knowledge perspective is added to the RACI. In a turbulent environment both the roles and required competencies are changing, therefore the knowledge articulation cannot be independent from the permanently updated business process model.

BPM stages include modelling and analyzing the current process as well as the optimizing and redesigning of new processes. Process design is, therefore, a continuous process for several reasons, for example:

- New organizational concepts can arise.
- New Best Practice cases become available as reference models.
- New technologies are invented.
- New knowledge is obtained from processes, which have just been implemented, leading to an adjustment of the process.

BPM includes process engineering (design and modelling), execution, monitoring, optimizing and re-engineering. An additional feature of these applications of process modelling is the ability to simulate.

BPM Systems designed to allow the direct control of the business processes by operational level managers. This unique feature has allowed managers to monitor, change, and rapidly adapt business processes and data flows to meet the changing needs of dynamic business environments despite these managers being geographically dispersed (Weske et al. 2004; Light 2005; Basu and Blanning 2000).

It is not easy to analyze business processes, or to define and install them because a lot of business information, such as information about events, actors, conditions and artifacts are needed to understand the process. If businesses and business strategies are changing, the underlying business processes also have to be changed and adopted. Once a model of a business process is available, various analytical methods can be used to check if the process delivers the product or service in the most optimal and cost-effective way. In particular, each task can be analyzed to ensure its added value to the business and to prevent the waste of time and resources (Weske et al. 2004).

BPM is also an approach for managing the execution of IT supported business operations using the managerial process approach. In general, BPM Systems use formal graphical process models for three levels of abstraction:

- the business level,
- the execution level,
- the evaluation level.

The business level graphs that define business processes can be transformed into execution graphs. The executions of business processes can be evaluated, and by using the results the business graphs can be improved (Basu and Blanning 2000).

Formal graphical process models based on a meta model can be used as a starting point for the development of workflow-based applications. These process models must be comprehensive, understandable and formal at the same time (Green and Rosemann 2000).

BPM Systems support the collection and integration of real-time information by interfacing with a variety of enterprise systems, architectures, and technologies (Harmon and Hall 2006; Vernadat 2002).

BPM Systems integrates several major IT components and areas of research, including (Harmon and Hall 2006):

- process modelling tools,
- simulation tools,
- business rule management tools,
- BPM applications,
- business process monitoring tools,
- software modelling and development tools,
- enterprise architecture integration tools,
- workflow management tools,
- business process modelling languages,
- organization and enterprise modelling tools.

1.2 Semantic Business Process Management

In spite of BPM having attracted significant attention from both research and industry, the degree of mechanization in BPM is still very limited and does not provide a uniform representation of an organization's processes on a semantic level, which would be accessible to semantic functions, such as intelligent queries (Lautenbacher and Bauer 2006). In this respect BPM tools and techniques include fundamental problems such as:

- difficulty in querying and reusing business processes (Hepp et al. 2005),
- inability to automatically transform a business process model into an executable workflow model (Basu and Blanning 2000),
- lack of semantic description in business process execution language specifications, such as BPEL for dynamic discovery and automatic composition of web services (Hepp et al. 2005),
- difficulty in integrating business processes across organizations (Hepp and Roman 2007; Hoefferer 2007),

- difficulty in the connection between static and dynamic process data (Gábor and Szabó 2013).

Semantic web technologies and semantic web services technology provide suitable large-scale, standardized knowledge representation techniques to overcome the above mentioned problems. The term semantics means the study of meaning in language, or the study of relationships between signs and symbols and what they represent. It also indicates the meaning or the interpretation of a word, sentence, or other language form (Fensel et al. 2005). Fensel and his colleagues have proposed combining the Semantic Web field, the BPM and the provided consolidated technology, which they have dubbed semantic business process management (SBPM) (Fensel et al. 2005; Hepp et al. 2005).

SBPM is a new approach increasing the level of automation of BPM, for example, in the translation between business and IT. The basic idea of SBPM is to combine Semantic Web Services frameworks, ontology representation, and BPM methodologies and tools, and to develop a consolidated technology (Karastoyanova et al. 2008).

Ontology definition is the key element in providing a visual and textual representation of the processes, data, information, resources, collaborations and other measurements. Several authors have drawn parallels between the ontologies and the role of XML in data representation. Ontology is responsible for conceptualization and for structuring knowledge embedded in business processes. Ontologies are state-of-the-art constructs to represent rich and complex knowledge about things, their properties, groups of things, and relations between things.

The use of web-based ontologies and their contribution to business innovation has received a lot of attention in recent years (Berners-Lee et al. 2001). Ontologies provide the means to freely describe different aspects of a business domain, and basically provide the semantics making it possible to describe both the semantics of the modelling language constructs as well as the semantics of model instances. It describes not only data, but also the regularity of connection among data.

The most important description language of the semantic web is the OWL (web ontology language) preferred by W3C (Hepp et al. 2007). With web-based semantic schema such as the OWL, the creation and the use of specific models can be improved, furthermore the implicit semantics contained in the models can be partly articulated and used for processing. The goal is to be able to apply machine reasoning for the translation between the spheres, in particular for the discovery of processes, process fragments and for process composition (Benjamins et al. 1996).

The use of ontologies is a key concept that distinguishes SBPM from conventional BPM. The role of ontologies in SBPM means emphasizing the opportunity to embed process structure information in ontologies. Ontologies are used to structure its underlying knowledge and enable comprehensive and transportable machine understanding. They facilitate knowledge sharing and reuse between various agents, regardless of whether they are human or artificial (Fensel et al. 2005).

The principle of ontological completeness states that there needs to be a direct relationship between the design constructs used in graphical process models and the ontological real world constructs they represent (Wand and Weber 1993). From the ontological completeness perspective, design constructs are symbols, notations, while semantics (graphical process model constructs) are used to explicitly map ontological (real world) constructs. These design constructs can be interpreted according to the meanings of the ontological constructs in the real world from the users' individual aspects. The completeness means that a graphical grammar used by graphical process models must contain constructs that enable it to model any real world entity in which a user is concerned. When reading a symbol users should be able to comprehend the information stored in it. With this object an unequivocal relationship between the graphical symbol and its meaning in the real world has to exist (Wand and Weber 1993).

The object of SBPM is to support the flexible and efficient implementation of BPM by bringing semantics to the business processes so that both the business and IT worlds can traverse them without too much physical effort (Hepp and Roman 2007). A number of studies related to SBPM have attempted to carry out the aim of SBPM in an effort to realize the initial promise of BPM. Hepp and Roman (2007) proposed upper level ontologies associated with business processes (e.g., organization and resources, business functions, logics and strategy) by listing some informal competency questions (Hepp and Roman 2007).

Some research in SBPM has primarily dealt with the representation of a semantically annotated business process model by incorporating semantics into specific business process models created using specific modelling methodologies (Scheer et al. 2005). The objectives of these studies are business process integration (Lautenbacher and Bauer 2006) and the semantic extension of EPC modelling methodology (Thomas and Fellmann 2007). The focus in these studies is on the semantic and representational differences in the design of business processes in different organizations, which means different terms, different modelling notations, and different representations of the same business process. Building semantically rich business processes may appear to be a costly, time-consuming, and complex task. However the resulting knowledge in processes, once created and continually managed, can be highly useful in both the business world and the IT world. Thereby flexible and efficient BPM can be achieved by reducing the time and cost involved in developing new business processes. The semantically richer business process information makes it possible to check stronger conditions.

Some other research has focused on examining business processes using semantic technology such as ontology. Celino and his colleagues introduced several technologies for semantic business process analysis, including process mining and reverse business engineering, and described how those technologies could benefit from the use of semantic information (Celino et al. 2007). Pedrinaci and Domingue developed event ontology to support the monitoring of events at a specific time and process mining ontology to integrate diverse knowledge that can be utilized to mine business processes (Pedrinaci and Domingue 2007).

The generation, processing and visualization of ontologies are supported by an extensive set of tools and frameworks. This general but formalized representation can also be used for describing the concepts of a business process.

Within SBPM two types of ontologies are utilized: domain ontologies and process ontologies. Domain ontologies support process modelling, amongst others, in terms of describing the actual data that is processed during process execution. Through this semantic description of the data business process analysis can be semantically enhanced since the semantic meaning of the data is preserved during every phase of the process lifecycle (Herborn and Wimmer 2006).

According to our current knowledge, process ontologies have no precise definition in academic literature. Some refer to process ontology as a conceptual description framework of processes (Koschmider and Oberweis 2005). In this interpretation process ontologies are abstract and general. In contrast to this, task ontologies determine a smaller subset of the process space, and the sequence of activities in a given process (Gábor and Szabó 2013).

The domain ontology provides vocabulary of concepts and their relationships, and captures the activities performed on the theories and elementary principles governing that domain. Process ontology identifies all the artifacts that describe a process, regardless of whether it is structured or not. It makes it possible to clearly and unambiguously build all the process elements linked with the domain ontologies that specify enterprise concepts, as well as the business rules, roles, outcomes, and every other interdependency.

In our approach the concept of process ontologies is used, where ontology holds the structural information of processes with multi-dimensional meta-information partly to ground the channeling of knowledge embedded in domain ontologies. The attempt is to undertake the tasks and provide an extension for the standard ontology definition in the form of an annotation scheme to enable ontologies to cover all the major aspects of business process definition.

The chapter focuses on the SBPM aspects of the solution utilized in the ProKEX[1] project. We demonstrate a semi-automatic methodology to extract, organize and preserve knowledge embedded in business processes to enrich organizational knowledge base. In the semantic approach, the only thing we can handle operationally is the piece of knowledge which is necessary to complete the given process stage. The solution is based on the connection between the process model and corporate knowledge base, where the process structure will be used for building up the knowledge structure in an ontology. We discuss how to establish the links between model elements and ontology concepts. The objective of this approach is to transform the business process into process ontology and to combine it with the knowledge base as a domain ontology in a dynamic, systematic and well-controlled solution.

[1] ProKEx: Integrated Platform for Process-based Knowledge Extraction, EUREKA project, http://prokex.netpositive.hu.

In the next sections, the examples will be outlined as a proof of evidence. In the case study we illustrate the solution related to the processes of a medium-sized, Hungarian insurance company operating both in the Life and Non-Life line of insurance business.

2 Knowledge Extraction from Process Models

The current chapter describes the proposed solution for capturing every aspect of a business process, extended with the identification and mapping of the knowledge items. The modelling procedure set forth in this section is applied in the case study.

2.1 Business Process Modelling

Business Process Modelling is the first phase of the Business Process Management lifecycle. In the ProKEX project business process models were implemented by using the BOC ADONIS modelling platform (BOC Group 2013). We selected this tool because of its popularity in modelling practice. However, our approach is transferable to other semi-formal modelling languages such as ARIS, etc.

ADONIS is a graphical Business Process Modelling language. The main modelling object is the activity. The ADONIS modelling platform is a business meta-modelling tool with components such as modelling, analysis, simulation, evaluation, process costing, documentation, staff management, and import–export. Its main feature is its method independence. A part of our 'Loss claim management' the business process model can be seen in Fig. 1.

There are several attributes that can and have to be set or defined when modelling a business process in ADONIS. The "skeleton" of a business process can be easily formed with activities, decision points, parallelism and merging objects, logical gateways and events, but this can be—and needs to be—detailed more.

The vertical level in detail of a business process model provides its focus point: operational areas, process areas, process models, sub-processes, detailed activities, or even deeper; the algorithms.

The horizontal level in detail of a business process model provides the level of extra information of the business process: organizational information can be specified in an organogram (working environment model in ADONIS) then the roles can be referred in the RACI matrix of the process model; the inputs and the outputs can be linked to the business process model with the IT system elements as well. If needed, key performance indicators and risk with controls can be specified for the process models too.

The decision about which levels to use from the abovementioned, and the degree of detail necessary always depends on the scope of the modelling project. A business process model is complete when it is detailed enough for proper usage.

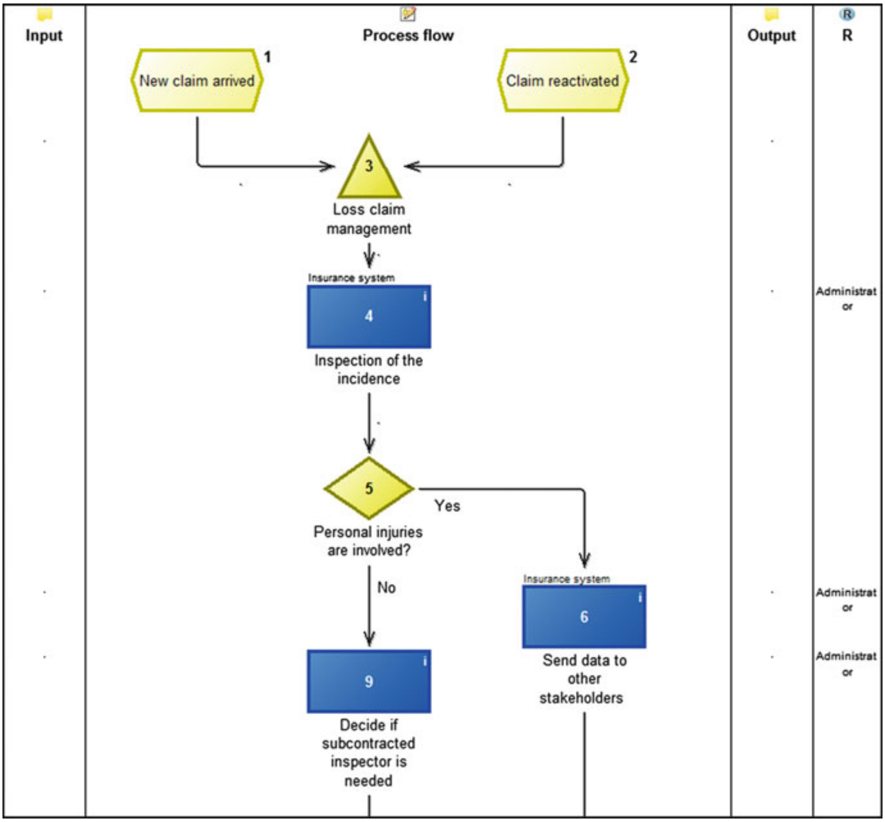

Fig. 1 The start of 'Loss claim management' process

So all projects with business process modelling have to start with the specification of the usage and needs, which gives the conventions of modelling. The book of conventions has to be known and accepted by everybody who is in the project. Based on this, everybody can model business processes in the same way, with the same degree of detail, and the models will mean the same for everybody.

In the ProKEX project business process models are used to gather knowledge from them. The following parameters have to be set to achieve this goal during the modelling of business processes:

- the logical "skeleton" of the business process model with the core objects (e.g. task, parallelism, merge, etc.);
- the organizational structure needed for the business process model, in one or more working environment models;
- the inputs and outputs needed for the business process model, in one or more document models;
- the IT elements needed for the business process model, in one or more IT system models;

- name of activities in the business process models;
- description of activities in the business process models;
- the Responsible role for all the activities in the business process models;
- input, output, IT system information for all the activities in the business process models, where available.

These parameters are no more than in an average modelling situation, so this meets average business needs. We will show, that based on the business process model, we are able to harvest the required knowledge for the business process.

2.2 Initial Modelling of Processes

The basis of our multi-lateral approach is general control-flow oriented business process models. The process modelling starts with the close observation of an existing, real-life process at the given organization. The first stage is to conduct interviews with all of the stakeholders of the process to be recorded at the company, assess already existing process documentation, and document the process development meetings and materials prepared during the actual project. A thorough inspection of the underlying IT infrastructure is also necessary.

The ever-recurring problem of capturing processes is the level of granularity. Setting this appropriate level can be thought of as an optimization problem in itself. If a process model is too superficial it will not contain enough information to draw conclusions, conduct redesign or utilize it in any other way. A modelling architecture with unnecessarily frittered details or a model with inhomogeneous granularity results in confusing process architecture, and consumes unnecessary resources to create, maintain and manage. Ternai et al. collect the parameters that have to be set in order to use a process model as a basis of semantic transformations (Ternai and Török 2011), The level of granularity in modelling a process is set to grant the ability to attach corresponding concepts, such as roles or information objects to the model.

At this point, the process structure, and meta-information for the IT and organizational viewpoints are recorded, all relevant information resources are elaborated, but organizational knowledge is unstructured, hard to identify and has various, heterogeneous sources.

2.3 Additional Modelling Layers

After finalizing the basic process flow, the specific activities within the process model have to be aligned with roles and responsibilities. We have to capture a view of the inner stakeholders of the organization. The first stage is to collect all the roles that are related to the given process and gradually examine which roles have any relation with a given activity. This task is carried out on the theoretical ground of the RACI responsibility matrix. It is necessary to determine which explicit roles are being played by which stakeholder at the level of a given activity. More precisely, we define according to the RACI which role is Responsible for the performance of the activity, which role is Accountable for it, which roles need to be Consulted during the execution of the activity, and who to be Informed about the advance, obstacles, completion or other information related to the given activity.

This knowledge is the basis of the proposed output, namely to be able to present the knowledge items required by a person in a given role, or in a broader perspective, in a given position.

There are two additional modelling dimensions that play an important part in enriching process information:

Many organizations have a well-structured IT infrastructure map, and in a higher-level process model, IT architecture elements are assigned to the process model at activity level. Modelling tools incorporate sub-models of the company's IT infrastructure. In this sub-model we define the major systems, tools or resources, which will play an active role in our processes, and associate these elements at the activity level of the process model.

Documents are also essential artifacts of business processes; various documents playing various roles are created, transferred, and utilized as a source of knowledge and information. These documents have to be taken into account throughout the complete BPM lifecycle, and in this way also incorporated into the process models.

2.4 Multilateral Process Views: Process Coupling via Semantic Transformations

The resulting complex process models contain interconnected, multilateral information in the following areas of the recorded processes:

- process structure, process hierarchy
- organizational structure, roles and responsibilities at activity level
- mapped explicit knowledge
- IT architecture
- document structure

In order to make use of this holistic process-space semantic transformations need to be applied to the models. The goal is to provide a machine-readable representation for further utilization in the form of ontologies.

Since the complex process models hold both process knowledge and domain knowledge these transformations have to be conducted respectively.

2.5 Process Ontology Creation

In this section, the focus point is the mapping of conceptual models to ontology models by using the meta-modelling approach. Meta-models provide intuitive ways of specifying modelling languages and are suitable for discussion with non-technical users. Meta-models are particularly convenient for the definition of conceptual models.

In our proposed approach, we discuss how to establish the links between model elements and ontology concepts. Ontologies basically provide semantics and they can describe both the semantics of the modelling language constructs as well as semantics of model instances (Kramler and Murzek 2006). There are three ways to create business process ontologies; reusing or extending an existing ontology; using a framework (such as the framework of SUPER[2] project); or transforming the output of a BPM tool into an ontology format. In our solution we used a process ontology we created using the output of a BPM tool, and our own mapping method.

In order to extend and map the conceptual models to ontology models, the models are exported in the structure of the ADONIS XML format. Every object from the business process model will be an 'instance' in the XML structure, the attributes have the tag 'attribute', while the connected objects (such as the performer, or the input/output data, which are stored in another model in the Adonis tool) have the tag 'interref'. A part of an XML export can be seen in Fig. 2.

The "conceptual models—ontology models" converter maps the Adonis Business Process Modelling elements to the appropriate Ontology elements at the meta-level. The model transformation aims to preserve the semantics of the business model. The structure of the business process model can be transformed with all of its objects and their attributes into the process ontology. The general rule we follow is to express each ADONIS model element as a class in the ontology and its corresponding attributes as attributes of the class. This transformation is carried out by the means of the XSLT script that performs the conversion. A sample part of the transforming XSLT code (mapping the 'Input' to an ontology element) can be seen in Fig. 3.

In order to specify the semantics of ADONIS model elements through relations to ontology concepts, the ADONIS business model must first be represented within the ontology. In regard to the representation of the business model in the ontology one can differentiate between a representation of ADONIS model language constructs and a representation of ADONIS model elements. ADONIS model language constructs such as "activity", as well as the control flow are created in the ontology as classes and properties. Subsequently, the ADONIS model elements can be represented through the instantiation of these classes and properties in the ontology.

The process ontology metamodel is based on previous results (Ternai and Török 2011), but it is extended in order to manage multiple processes in one ontology. It is as follows (Fig. 4):

- Process_stage: class, activity of the process
- Actor: class, represents a Role which is part of the RACI

[2] http://ip-super.org.

```
<INSTANCE id="obj.197304" class="Activity" name="Inspection of the incidence">
<ATTRIBUTE name="Position" type="STRING">NODE x:8.5cm y:8cm index:55</ATTRIBUTE>
<ATTRIBUTE name="Description" type="STRING">The first and foremost information to collect is to
decide if personal injuries are involved or not. This is vital since claims with personal injuries in
the Non-Life domain statistically results in an order of magnitude higher disbursements then other
claims, so the insurer has to conduct a particularly precautious procedure. </ATTRIBUTE>
<INTERREF name="Responsible for execution">
<IREF type="objectreference" tmodeltype="Working environment model" tmodelname="Book" tmodelver=""
tclassname="Role" tobjname="Administrator"></IREF>
</INTERREF>
<INTERREF name="Accountable for approving results"></INTERREF>
<INTERREF name="Cooperation/participation"></INTERREF>
<INTERREF name="To inform"></INTERREF>
<ATTRIBUTE name="RACI/DEMI visualisation" type="EXPRESSION">EXPR val:0</ATTRIBUTE>
```

Fig. 2 XML export of the business process model (fraction)

```
<xsl:for-each select="//INTERREF[@name='Input']/IREF[generate-id() = generate-id(key('IREF',
@tobjname)[1])]">
    <xsl:variable name="className" select="functx:words-to-camel-case(@tobjname)" />

    <Declaration>
        <Class>
            <xsl:attribute name="IRI">#<xsl:value-of select="$className" /></xsl:attribute>
        </Class>
    </Declaration>

    <SubClassOf>
        <Class>
            <xsl:attribute name="IRI">#<xsl:value-of select="$className" /></xsl:attribute>
        </Class>
        <Class>
            <xsl:attribute name="IRI">#Data</xsl:attribute>
        </Class>
    </SubClassOf>

</xsl:for-each>
```

Fig. 3 Fraction of XSLT code transforming 'Input' attribute to an ontology element

- IT_system, class, the supporting IT system element of the activity
- Data_object, class, inputs and outputs of the activity
- Parallel, Merge, Decision_point: classes, other objects from the process models than activity
- followed_by: relation of the Process_stage class, connects a following activity to the previous one
- performed_by: relation, connects a Process_stage with an Actor
- uses_system: relation, connects a Process_stage with an IT_system
- uses: input: relation, connects a Process_stage with a Data_object, if it is the input of the activity
- produces_output: relation, connects a Process_stage with a Data_object, if it is the output of the activity

The linkage of the ontology and the ADONIS model element instances is accomplished by the usage of properties. These properties specify the semantics

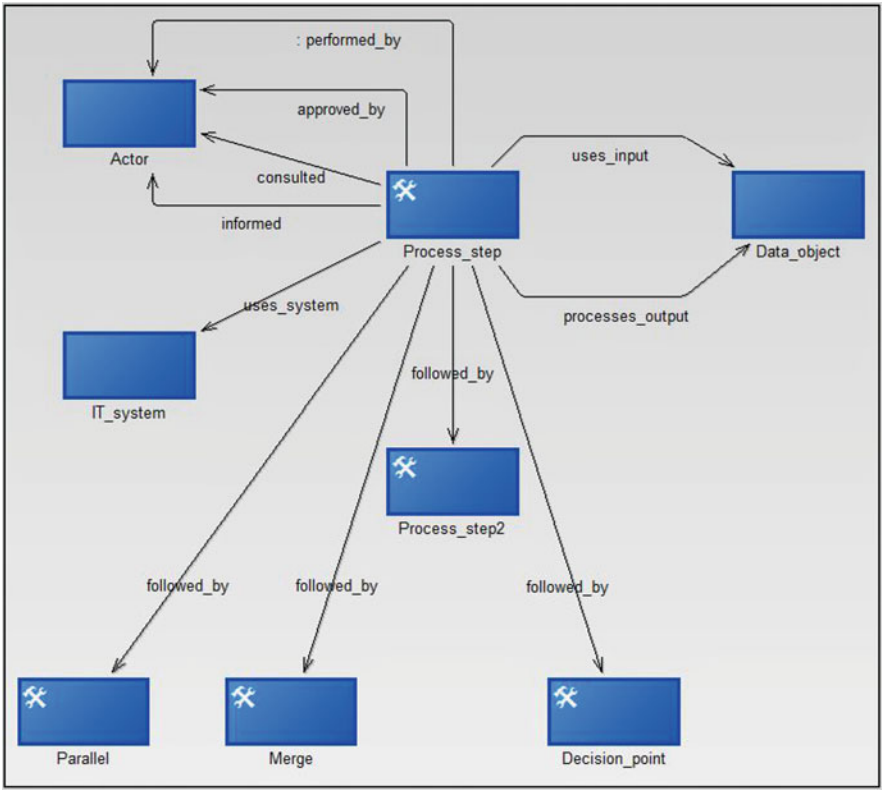

Fig. 4 The process ontology metamodel

of an ADONIS model element through a relation to an ontology instance with formal semantics defined by the ontology.

3 Case Study

In the course of the Insurance pilot of the ProKEX project we modelled close to 100 processes of an insurance company. Our project partner is a medium-sized, Hungarian insurance company operating both in the Life and Non-Life line of insurance business. The insurance company is relatively young, and founded by Hungarian stakeholders only 8 years ago. The business processes are well-grounded enough for a deeper inspection, and they are not hindered by legacy organizational fixations, but provide the necessary means for process enhancement and efficiency improvement.

For the case study we selected two complex processes that enabled us to envision the proposed solution.

3.1 Loss Claim Management

The first process is the loss claim management of the Non-Life branch. Loss claims arise either from new claims of the insured parties or from reactivating a claim when new information emerges regarding the issue. Every aspect of the issue is collected in a virtual claim issue file. The process starts with the inspection of the incident. The first and foremost information to collect relates to whether personal injuries are involved or not. This is vital since claims with personal injuries in the Non-Life domain statistically result in order of magnitude higher disbursements than other claims, so the insurer has to conduct a particularly cautious procedure. In most cases, especially if the estimated loss exceeds a given limit, an inspection or a verification of evidence is necessary. This is undertaken by subcontracted inspectors, who are the experts in the issue's insurance coverage field. This sub-process involves comprehensive support of integrated IT systems which organize the information flow between the roles played by the parties. If the amount of loss is determined, a decision mechanism within the insurer organization is triggered that results in a final decision on the claim. Throughout the process several notifications and correctional provisions might be necessary among the parties, aided by the underlying IT infrastructure.

When the insurer decides the magnitude and other conditions of the disbursement an administrative sub-process takes place involving the notification of the stakeholders of the issue, the decision on the further existence of the insurance contract, and managing the effective payment of the disbursement. If the loss results in the contract becoming obsolete, (e.g. a vehicle is deemed a total loss), the insurance contract is discontinued by the insurer, which might require further action in settling overdue or overpaid balances.

If a third party is involved, and the loss claim has been fully undertaken by the insurer, a regression process starts, that attempts to identify the insurer of the third party and negotiate based on the legal regulation or bilateral agreements between the insurers.

3.2 New Insurance Offer

The new insurance offer process was recorded for the Life insurance field-of-business of the insurance company. In many ways it can be regarded as a strongly regulated sales activity. It starts by creating a personalized offer for a prospective insured client and ends with the contract signature or the denial.

A request for a new offer always originates from an agent or representative distributor of the insurance company. The original offer documentation is prepared in one of the sales support systems. When the documentation arrives a workflow issue is created automatically with all the necessary information about the parties and the proposed life insurance contract. From this point the progress of the offer can be tracked through the workflow issue. The person responsible for the offer is a designated employee of the new-business department.

The first task is to determine the identity and the eligibility of the main parties of the offer, basically the life insured, the contracted, the beneficiary parties, and the agent eligible for commission. All available information about the parties are recorded on the issue with special care for data integrity, duplication elimination and data quality management. If any of the parties are already existing parties on other contracts of the insurer, the necessary connections have to be created, since these connections might influence the decisions on the current issue.

The agent on the offer has to be a contracted, active insurance provisioning partner of the insurer. The examination of the agent includes a thorough inspection involving a designated scoring method, including the calculation and update of the so-called "ABC indicator", which qualifies the agent based on the commission balance, the outstanding premiums of the agent's contracts, and the rate of early contract deletion. The offer issue continues on two parallel threads: health and financial risk assessment.

Based on the conditions of the offer and the regulations of the insurer, the administrator has to decide, whether it is necessary to conduct a health risk evaluation. In this case, the issue is handed over to the designated health risk assessment team. The health risk evaluation can take place simply based on the available documentation and statistical data, or it might require a medical examination of the life insured parties. If the medical examination is necessary, it has to be ordered from a third party service provider. At the end of the sub-process, the team submits a recommendation to the new business administration, where a decision is made, that in some cases includes the insurers' leading medical expert.

The term for the financial risk assessment in the insurance domain is prevention. The aim of the prevention sub-process is twofold: it stops the customer from undertaking a financial commitment that is beyond his/her financial means, and also protects the insurer from entering into a contract that is likely to fail abortively. The prevention starts with an internal evaluation of the customer, and if necessary, includes a personal interview usually conducted over the telephone. The interview itself is a workflow sub-process that leaves out the agent and directly contacts the contracted party. It ensures that there is a clear intention for the contract that all the necessary information was received, and the contractor is aware of the obligations and risks arising from the proposed life insurance contract.

If both types of risk assessment have been successfully concluded the new business department examines if all the necessary proclamations and statements have been received by the insurer. In the event that any obligatory elements are missing, the department contacts the agent or the contractor directly and requests the completion of documents. This sub-process might require multiple workflow issues. If the time interval for the completion exceeds a designated limit the offer is closed and the parties are notified.

The final inspection is conducted by two responsible team members to avoid potential abuse. Upon denial of the offer, the new business department issues official notification of the parties and closes the offer. If the final decision is positive, the offer receives an approved status. In the life insurance domain there is no prolonged payment, after the final approval the issue is an order waiting for financial settlement. When the first premium arrives to the offer, it is automatically converted to an active contract state.

3.3 Transforming a Process Model to a Process Ontology

In this section we present our approach via the two above described business processes. At the starting point there are only the two business processes modelled in Adonis Business Process Management Toolkit.

3.3.1 The Graphical View of the Process Model

In a business process model, there are objects relevant to the model and to understanding the process itself. A graphical process model has different object shapes for different parts of a process. Generally, there are tasks, gateways, lines and other objects—based on the granularity of modelling. In the Adonis BPM Toolkit, the basic object is the 'Activity'.

In Fig. 5, there is an activity from a process model. In this graphical representation the following can be seen:

- The name of the activity
- The input (left side) and the output (first lane in the right) documents
- The RACI information (other four lanes in the right)
- IT system (in the upper left corner)
- A letter 'I', indicating that there is a description written for this activity
- The number of the activity in the process model

Every object in the process model has a Notebook, where its properties can be set. Opening this Notebook, the aforementioned attributes (name, input, output, IT system) can be modified. An important attribute is the description of the activity, which is only visible in the Notebook (Fig. 6).

There are not only Activities in a process model, but Triggers, Decision points, Parallelities and Merges, as well as End events too. For our purposes Triggers are not important, but the others are.

A Decision point is in Fig. 7, with two possible following activities. This means that only one of them will be executed during the process since a decision point is an exclusive gateway.

In Fig. 8, the Parallelity and the Merge can be seen. This means that both of the activities are carried out in the process simultaneously, and when both of them are ready the process can move to the next activity following the Merge object.

3.3.2 The XML Export of a Process Model

In order to create the process ontology it is first necessary to create an XML export from the process model. The XML is a well-structured, machine readable format, therefore it is suitable for our purposes.

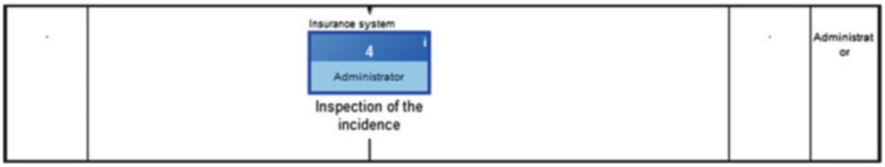

Fig. 5 Activity in the process model

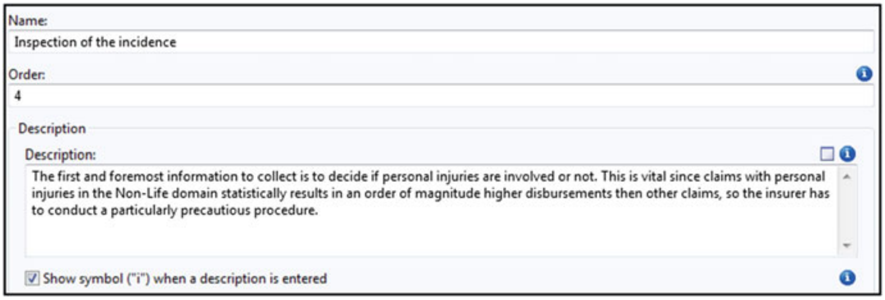

Fig. 6 Description in the Notebook

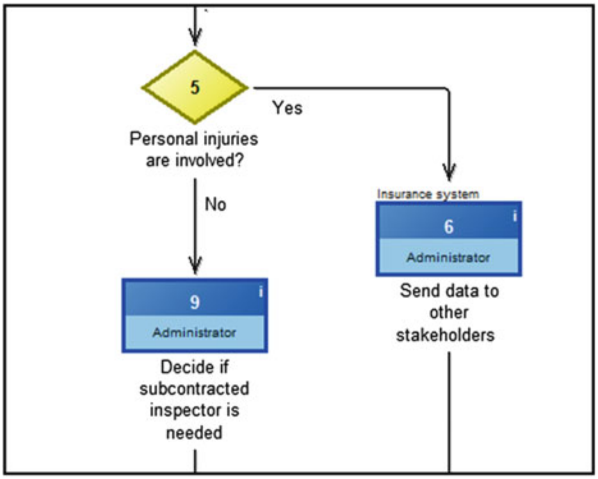

Fig. 7 Object nr. 5 is a Decision point

In Fig. 9 it can be seen that in the process model export every object has the tag <INSTANCE>, and their attributes have the tag <ATTRIBUTE>. The description is in the <ATTRIBUTE type= “Description”>, as a string.

In Fig. 10 <INTERREF> tag is used instead of <ATTRIBUTE>. In a process model, when an object is stored in another model, but when we want to link it to another object, <INTERREF> tag will be used in the export. For example, in Fig. 10, for the Activity “Delegate inspector” the Document “Claim” is linked as an

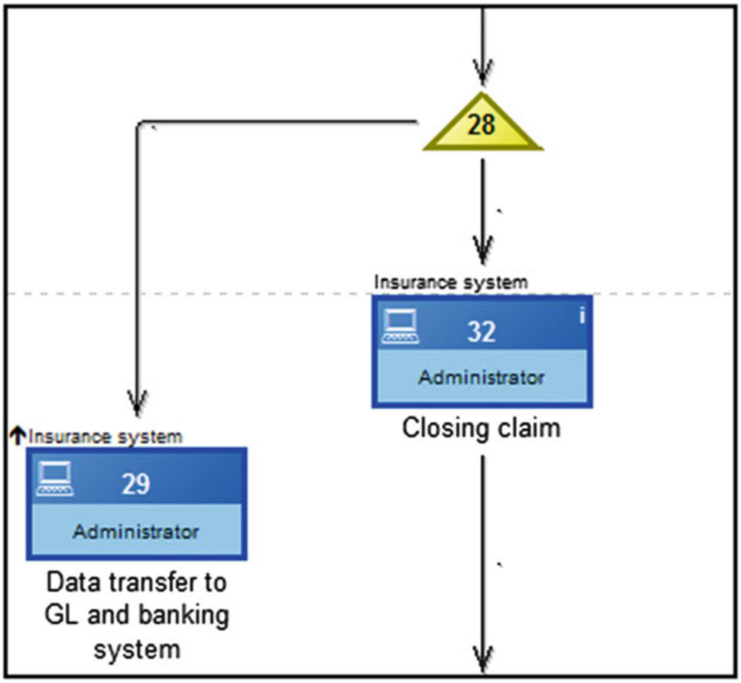

Fig. 8 Object nr. 28 is Parallelity

```
<ATTRIBUTE name="Description" type="STRING">The first and foremost information to collect is to
decide if personal injuries are involved or not. This is vital since claims with personal injuries in
the Non-Life domain statistically results in an order of magnitude higher disbursements then other
claims, so the insurer has to conduct a particularly precautious procedure. </ATTRIBUTE>
```

Fig. 9 XML export for attribute 'Description'

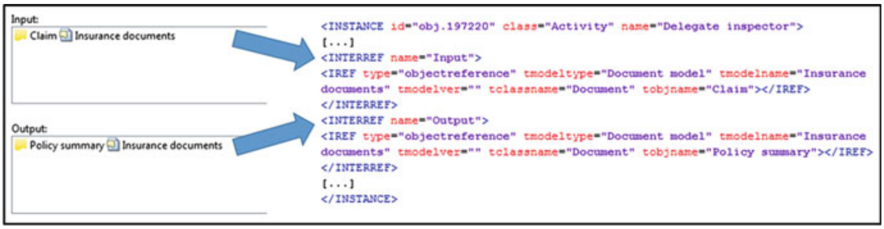

Fig. 10 Input and Output attributes in Notebook and in the export

Input, and the Document "Policy summary" is linked as an Output from the Document model "Insurance documents".

The same method is used for IT system elements, so for Activity "Report in IT system" the IT system "ClaimHandler" is linked from the IT system model "Insurance IT", as can be seen in Fig. 11.

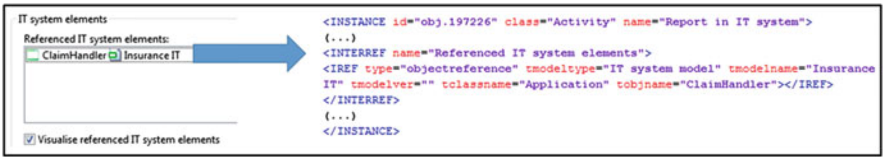

Fig. 11 IT system element in Notebook and in the export

In a process model, clarifying roles and responsibilities is often carried out by a responsibility assignment matrix (RACI matrix), which describes the participation by various roles in completing tasks for a business process.

RACI are acronyms derived from the four key responsibilities most typically used: Responsible, Accountable, Consulted, and Informed.

- **Responsible**: Those who do the work to achieve the task. There is at least one role with a participation type of responsible, although others can be delegated to assist in the work required (see also RASCI below for separately identifying those who participate in a supporting role).
- **Accountable** (also **approver** or final **approving authority**): The person ultimately answerable for the correct and thorough completion of the deliverable or task, who also delegates the work to those responsible. In other words an accountable must sign off (approve) work that the person responsible provides. There must be only one accountable specified for each task or deliverable.
- **Consulted** (sometimes **counsel**): Those whose opinions are sought, typically subject matter experts; and with whom there is two-way communication.
- **Informed**: Those who are kept up-to-date on progress, often only on completion of the task or deliverable; and with whom there is just one-way communication.

IT system element in Notebook and in the export

The Notebook view of the RACI is in Fig. 12, and its export is in Fig. 13, where the <INTERREF> tags are used again, since the Roles are stored in a "Working environment model" in Adonis.

Since we want to use the process model not only as a structural definition of tasks but also as the holder of the required knowledge of each task and their responsible roles, we have ran text-mining algorithms to gather knowledge elements from the process models.

3.3.3 The Process Ontology of the 'Loss Claim Management' Process

The process ontology of the Loss claim management process is generated from the process model, via XML and XSLT transformation. The meta-model of the ontology was described above, so those classes can be seen in Fig. 14, in Protégé 5.

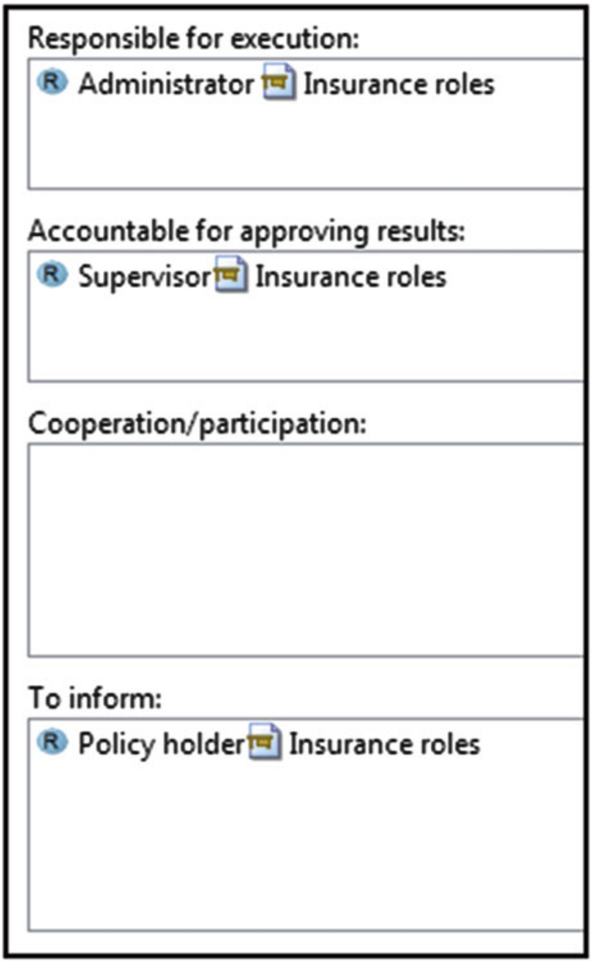

Fig. 12 RACI in Notebook

```
<INSTANCE id="obj.197271" class="Activity" name="Finalizing amount to be paid">
(...)
<INTERREF name="Responsible for execution">
<IREF type="objectreference" tmodeltype="Working environment model" tmodelname="Insurance roles"
tmodelver="" tclassname="Role" tobjname="Administrator"></IREF>
</INTERREF>
<INTERREF name="Accountable for approving results">
<IREF type="objectreference" tmodeltype="Working environment model" tmodelname="Insurance roles"
tmodelver="" tclassname="Role" tobjname="Supervisor"></IREF>
</INTERREF>
<INTERREF name="Cooperation/participation"></INTERREF>
<INTERREF name="To inform">
<IREF type="objectreference" tmodeltype="Working environment model" tmodelname="Insurance roles"
tmodelver="" tclassname="Role" tobjname="Policy holder"></IREF>
</INTERREF>
(...)
</INSTANCE>
```

Fig. 13 RACI in the export

Fig. 14 The process ontology classes in Protégé 5

It is worth mentioning that the process itself is now a class, but it is a development issue whether creating a class 'Process' would be better in order to manage more business processes in one ontology.

In Fig. 15 all the classes are open (except the Process_stage), and their objects can be seen. These are the objects which will be linked to the activities (that are in the Process_stage class in the ontology).

As the "skeleton" of the process is formed by the activities, the most important class in the ontology is the Process_stage. In Fig. 16 the Process_stage NotificationFromDenyingClaim is detailed. We can see that this activity is followed by an End, so the process stops here if the claim is rejected. It is performed by the Administrator, and the Policyholder is informed of it. The activity has an output, the InfoLetter, and the activity itself belongs to the LossClaimManagement process.

The process ontology contains the activities of the process model as class Process_stage, decision and other logical gateways as classes Decision_point, Merge and Parallel, and—what is more important for us—the connections between these objects, so evaluating the Process_stage instances we can see the inputs and output of them, their responsible role, and description as an annotation.

Making process ontology from the process model is an innovative way of extracting knowledge from process models. In the ontology one can easily see all the tasks for one person (or role). Based on that, those tasks can be investigated more thoroughly. All the tasks have a description (since we have set this attribute as a mandatory attribute in Sect. 2.1), so the information there can be investigated with text mining methods, which we will discuss in another section of the book.

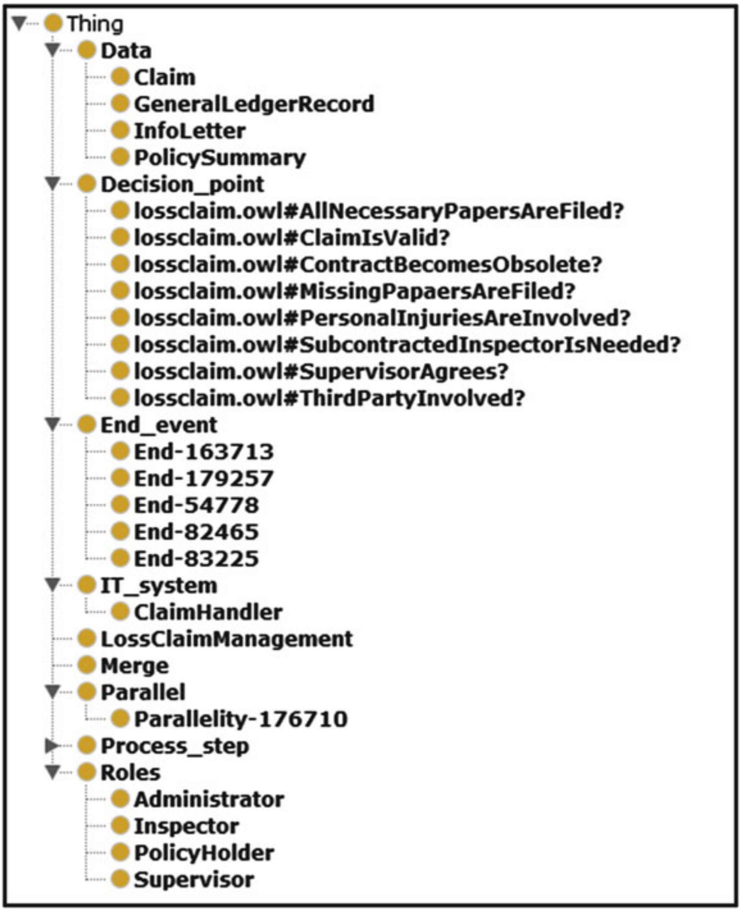

Fig. 15 Objects in the ontology classes

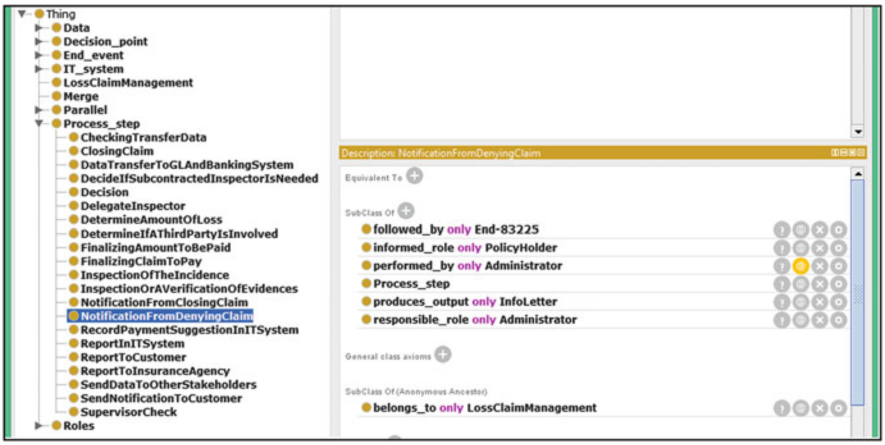

Fig. 16 Objects in the ontology classes

4 Conclusion

The chapter focused on the possible SBPM aspects of the solution utilized in the ProKEX project. We demonstrated a methodology to extract, organize and preserve knowledge embedded in business processes to enrich organizational knowledge base partways automatically. In the semantic approach, the area of knowledge necessary to complete the given process stage can be managed operationally. The solution is based on the connection between the process model and corporate knowledge base, where the process structure will be used for building up the knowledge structure. A common form of knowledge base is the ontology, which provides the conceptualization of a certain domain. We discussed how to establish the links between model elements and ontology concepts. The objective of this approach is to transform the business process into process ontology and to combine it with the knowledge base as a domain ontology in a dynamic, systematic and well-controlled solution. In the case study we illustrated the solution related to the processes of a medium-sized, Hungarian insurance company operating both in the Life and Non-Life line of insurance business.

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