Semantic Event-driven Process Chains

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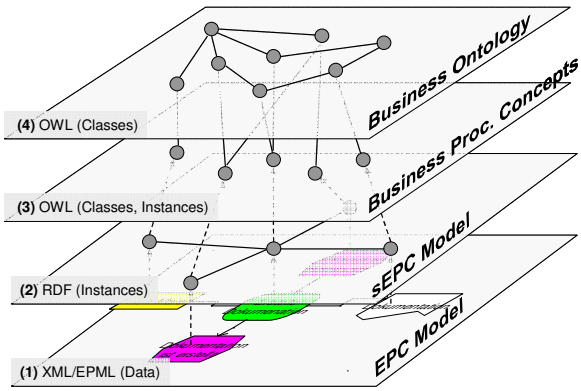
The event-driven process chain (EPC) is a semi-formal modeling language for the description of business processes [1]. It is used for the planning, visualization and analysis of business processes in the realm of business process management. EPC models essentially consist of a set of functions and events, which are connected via a control flow using arcs and connectors. On the one hand, EPC models are used to describe processes from a business perspective. On the other hand, EPC models are used to facilitate the adoption and customization of process oriented information systems, thereby serving as a staring point for the actual implementation [6].

Research regarding the semantics of the EPC so far mainly concentrated on the formal semantics of the available language constructs [2; 3; 4; 5; 7]. The labels of the individual elements of an EPC model were not considered in these investigations so far, although they significantly contribute to the overall use of an EPC model. Usually, the designer of a model adds these labels in a natural language. Hence, a substantial part of the semantics of an EPC model is bound to natural language, introducing a high degree of ambiguity and misinterpretation risk. As long as a model is provided and read only by one individual, this is less problematic. However, if models of different modelers are united, queried and translated, or semantics contained in the models should be validated automatically and leveraged for the configuration of an information system, it is necessary to have clearly defined semantics for each of the model's elements.

This problem can be solved by associating the elements of an EPC model with concepts of a formal ontology, which can be referred to as semantic annotation. In order to make use of this semantic annotation and to shift from event driven process chains to semantic event driven process chains (sEPC), a four-layered approach has been developed by the authors (cp. figure to the right). The different layers are ordered according to the increasing degree of abstraction from the underlying EPC model to more general semantics. The topmost layer 4 contains the business ontology comprising all relevant concepts of an enterprise context and their interrelationships as OWL classes and properties (cp. http://www.w3.org/2004/OWL/). This ontology might be created by merging different ontologies which conforms to the open world assumption of OWL. As a representation language, the OWL-DL subset of OWL is used in order to gain the maximum of expressive power while retaining computational completeness. Going from the top to the bottom, in the next layer 3, these general concepts are used to create new, specialized concepts for the representation of the semantics of individual business process elements, e.g. distinct functions like "order processing" or events like "order received". On this level, additional information can be added like semantic restrictions or details regarding the technical implementation and execution of processes in a centralized and consistent manner. These concepts are instantiated afterwards in the same layer; the instances of business process concepts, produced thereby, can correspond with physically existing entities in the enterprise (e.g. resources). In the underlying layer 2, the instances of the upper layer are used to generate a semantic description of business processes. This is accomplished by establishing a graph based flow



between the instances of the upper layer 3 for each semantic event driven process model, thereby using information of the bottom layer 1 for the concrete flow and the instances involved in this flow. In order to represent a sEPC model, the expressive power of RDF is sufficient. To transform EPC models into sEPC models, the EPC models on layer 1 have to be extended slightly with semantic mapping information. That is, the modeler must associate instances of layer 3 to the EPC process model on layer 1. Technically, this annotation information is added to the XML representation of an EPC model using attributes. For the later transformation, a XSLT stylesheet has been developed which consumes an annotated EPML/XML-model and produces the corresponding RDF/XML representation. For storing and querying the generated sEPC models, a preliminary prototype has been developed at the Institute of Information Systems (IWi) which uses a relational database and the Jena framework. The prototype allows querying sEPC models using the SPARQL query language from the W3C in conjunction with an inference engine.

The overall benefits of our approach are:

- Process models can be queried on a semantic level. With the use of inference engines it is possible to infer new facts that are not contained in the original model. For example, if inventory is defined to be made up of physical things which can be sold to customers, and there is a process which consumes such things, it can be inferred that the process reduces inventory.
- Advanced validation opportunities of process models are achieved. The validation of a sEPC model is done against all restrictions established in the ontology layers 3 and 4. Therefore, it is possible to impose policies for all business processes in a centralized way.
- The execution of processes can be facilitated as the ontology easily can be extended with technical information, thereby bridging the gap between business and technical process models. For example, a BPEL representation can be generated from a sEPC model using execution information added to the ontology classes on layer 3. Consequently, the alignment of business process concepts with the IT-infrastructure can be done in a centralized way without redundancy.
- Queries are possible both on the process concepts level (level 3) and on the instance level (level 2) hence allowing a user or potential business partner to discover available process element types before retrieving instance data from a sEPC repository.
- The expenditure for the internationalization of process models can be reduced as the translation of process model element labels is required only once per process element type on level 3 in contrast to the translation of individual model element labels.

Further research will be done regarding suitable ontologies and tools for the annotation of process models. Therefore, a prototype for a sEPC repository is currently under planning that will provide interfaces or plug-ins for well-established modeling tools.

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