A Universal Repository for Process Models

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Abstract. The rapid development of Internet during the last decade has supported enterprises in building novel infrastructures, setting up virtual organisations, and operating in larger geographical spaces. To manage this new environment, enterprises need to align their IT infrastructures to the business processes. Therefore, the interest in business process management using Process Aware Information Systems (PAIS) has been rapidly increasing. Solutions implemented in PAISs are often complex and time-consuming to develop. One way to address this problem is to utilize repositories of reusable process models. However, while repositories have proved to be successful within object-oriented and component-based development, similar success has not yet been achieved in the area of PAIS. This is because we still lack the critical mass of process models within a single repository and we lack transparency between different repositories. The main goal of the project is, therefore, to design the architecture of a universal process repository, i.e. a repository that is independent of process modelling languages, comprises a large number of existing process repositories, and is open for change and growth by any potential user. The long term goal of the project is to lay the foundations for a Business Process Management Wikipedia, which will become a universal knowledge resource on process models that can be used by researchers for empirical investigations in the business process management area.

1 Introduction

The rapid development of Internet technologies during the last decade has supported enterprises in building novel infrastructures, setting up virtual organisations, operating in enlarged geographical spaces, and relying on more complex systems than ever. These developments require that the internal processes of enterprises be streamlined and aligned with partner processes. Furthermore, the IT infrastructures need to be centered around the processes so that short lead times and maximum efficiency can be attained. Therefore, the interest in business process management and workflow systems has been steadily increasing. The term Process-Aware Information Systems (PAIS), introduced only a few years ago, represents by now a widely accepted information systems class with more than 11 000 references on a Google search.

A Process-Aware Information System is a "software system that manages and executes operational processes involving people, applications, and/or information sources on the basis of process models" [9]. An operational process consists of activities performed in an organization in order to create value for its customers. Operational processes are described by process models that are typically given in a graphical notation. Abstracting and making the process logic explicit through such models provide two main benefits:

- *Maintained focus on the business needs.* During information systems analysis and design, the focus is kept on the business processes and not their technical realisations. This focus, further strengthened by the graphical representation of the process models, promotes good communication with business users and facilitates alignment of information systems to business requirements.

– *Easy change management.* When a business process changes it is sufficient to capture the change in its graphical model, which will trigger synchronisation of the underlying system.

Providing huge potential, PAISs are often complex and time consuming to implement. One reason for this is the high inherent complexity of many business processes. Another reason is the difficulty of reaching consensus on how the processes shall be run when many stakeholders with different interests and goals are involved in their design. While the second factor can be difficult to address, we believe that there are effective solutions for managing process complexity. One solution is to collect and share process knowledge through a process model repository. Such a repository will contain models, each of them defining and graphically visualising a specific process according to a certain domain or problem description. The main benefits of such a repository are model reuse and knowledge exchange. There exist a number of efforts to build process model repositories, e.g. the MIT Process Handbook [14], SCOR [21], SAP's Business Map [20], INCOTERMS [13], and IBM's Patterns for E-Business [11].

2 Problem Statement

The approach of process model reuse is in line with current trends of object oriented and component based development where large repositories containing reusable solutions are provided. However, while the development within object oriented programming and component based development has reached the critical mass of content population so that the repositories have become widely used, such success has not yet been achieved in the area of PAISs. This lack of success can be attributed to a number of reasons:

– the process models in current repositories are typically given only on a high-level, which makes it difficult to transform them into executable solutions;
– the repositories are mostly proprietary, meaning that they can be enhanced or extended with new models only by the owners of the repositories;
– having a limited scope, the repositories are typically inflexible, meaning that they support only certain businesses, or that they offer only a single model for a certain business process scenario;
– the process models are not goal related making it difficult to get an understanding of what business goals, except for the core functionality, that are realised by a certain model.

Furthermore, the heterogeneity of current process model repositories makes it difficult to relate and share knowledge across them:

– it is difficult to search and navigate across repositories because they follow different business and process classifications;
– the repositories describe processes on different level of abstraction making it difficult to relate or compare them.

For the outlined reasons, we lack today the critical mass of documented models within a single repository and we lack transparency between different repositories so that they can be used as

a shared and standard resource. We envisage that these limitations can be overcome through *a universal repository of process models*, i.e. a repository that is independent of process modelling languages, comprises a large number of existing process repositories, and is open for change and growth by any potential user.

3 Project Goal

The main goal of the project is to design the architecture of a universal process repository. The project also aims at implementing this repository and making it openly available for researchers and practitioners. Furthermore, as a proof a concept the project will populate the repository with a sample.

The long term goal of the project is to lay the foundations for a Business Process Management Wikipedia[1]. While a navigation structure based on alphabetical organization and word-based reference system is appropriate for an encyclopedia, it is not sufficient for a process model repository. Instead, contextual information describing the models needs to be included in the repository structure. This information will describe how the process models are related to each other, how they are constructed from constituents, and how they contribute to the realization of various business objectives. Using this contextual information as a basis, the project will design adequate organisation and navigation structures as well as mechanisms for analysis and comparison of process models in the repository.

4 Extended Background

Today, there exists a variety of process repositories. The models collected in these repositories differ in granularity, form of presentation, and domain. With respect to process granularity, some repositories offer complete process models that describe processes fulfilling a certain business objective. Known repositories of this kind are MIT Process Handbook [14], SAP's Business Map [20], SCOR [21] and INCOTERMS [13]. Other repositories offer process patterns, i.e. domain independent and atomic process blocks, typically used as reusable components in the design of process models. Such repositories are the Workflow Patterns [2, 17, 19], UMM Patterns [22], and Service Interactions Patterns [7]. With respect to the presentation form, some repositories e.g. MIT's Process Handbook, describe processes only in a textual form, while others, e.g. SAP's Business Map, provide graphic based descriptions. Finally, while MIT's Process Handbook and SAP's Business Map cover several domains, SCOR and INCOTERMS have a more limited scope with SCOR focusing on supply chain and INCOTERMS focusing on international trade.

The above process repositories suffer from three major problems. First, the models are not related to business objectives as they have no relationships to business models and goals (except for the MIT's Process Handbook which classifies processes within a described set of business models); secondly, they are not uniform and easily reusable; thirdly, they cannot be transparently executed using PAISs as they are typically described in textual or high level forms.

[1] Wikipedia is "a multi lingual, web based, free content encyclopedia project" `http://en.wikipedia.org/wiki/Wikipedia`

The first problem has recently received much attention in the research community [10, 3], that is, business models with a focus on "what to do" have been recognized as a declarative foundation for the design of business processes (i.e. "how to do"). A business model defines a constellation of business actors, resources and the exchanges of these resources in a network. As with process models, there exists a variety of business models. Weill and Vitale pioneered the notion of atomic elements of e-business models by proposing a set of asset-centered business patterns [23]. IBM has recently proposed another set of business patterns focused on different types of interactions that may occur between users and business [11]. Within our research lab, SYSLAB[2] at KTH/SU, we have worked on the methodological support for chaining business models with business process models. In [4] and [5] we have classified business models based on different business goals, i.e. interests, intentions and strategies of stakeholders, motivating in this way why a certain business model should be used. A comprehensive method on utilising business models for deriving business process models was proposed in [3]. In the scope of the EU/NoE INTEROP project we have studied risks, temporal, logistical and other goal factors, and their role in determining the design of business process models [8, 6]. In a process repository, the process models need to be explained at a higher level in order to get understanding of what business model a certain process model supports, and they need to be classified according to the goals that will be satisfied through the use of a process.

The second problem can be addressed by using established process patterns in the design of process models. A number of proposals for process patterns are available today. The UN/CEFACT Modeling Methodology (UMM) proposes a set of patterns for business process transactions [22], where each pattern carries a set of default quality of service attributes (such as temporal, security requirements, etc.). The Workflow Patterns [12], a joint initiative of Eindhoven University of Technology (TUE) and Queensland University of Technology (QUT) led by van der Aalst and ter Hofstede, describe atomic process blocks solving common control-flow, data or resource problems that can be used for implementing business requirements in process models. In addition to the workflow patterns where the focus is set on intra-organisational processes, the Service Interactions Patterns [7], a joint effort of SAP and QUT, model the elementary service-based interaction blocks used in the design of inter-organisational processes. The outlined patterns may facilitate the design of process models to support certain goals, such as temporal goals, risk mitigation goals, and others.

The third problem can be addressed by requiring that process models be on a sufficient level of detail. Such process models could be directly executed using a PAIS, or at least transformed easily into an executable form. In [28] we have proposed a set of rules that need to be adhered when transfroming business process models to exeuctable process models. Furthermore, expressive modeling notations needs to be utilized in order to capture the necessary level of detail in the models. In relation to this, in cooperation with QUT and TUE, we have used the Workflow Patterns for evaluating leading process modelling languages [1, 18, 24–27].

[2] `http://syslab.dsv.su.se`

5 Solution Approach

A main principle of the proposed architecture is extensibility, meaning that the repository shall be open for change and growth by any potential user of it. A blueprint of the architecture is shown in Figure 1, containing Repository Data, a Repository Engine, Repository Meta Data, and User Roles.

The *Repository Data* is composed of a number of databases. Two different kinds of databases are identified: Pattern databases and Model databases. The pattern databases will consolidate and store business patterns such as [11] and [23], and process patterns, e.g. the UMM patterns [22], Workflow Patterns for control-flow, data and resources [12], the Service Interaction Patterns [7], etc. These patterns are used to build up models. Models can either be specific solutions or they can be of a more general character like reference models. To deal with complexity, the models can be decomposed into sub-models where the sub-models further detail the parts they are decomposing. Examples of model repositories which will be used to populate these databases are MIT's business and process models [14], SAP's business map [20], SCOR reference model [21], INCOTERMS [13].

User Roles define the different behaviour patterns for accessing the Repository. Potential roles are: Authors who add and edit models in the repository; Business Analysts (BA) who access and reuse models; Reviewers who discuss and review the models and their features; Moderators who control the model quality and invite reviewers to discussions when needed.

The *Repository Engine* realizes the access to the repository. It is the piece of software that takes care of the users' requests via the User Interface and provides search functionality. To facilitate advanced model and pattern search, the Repository Engine will rely on Repository Meta Data that is especially compiled for it.

The *Repository Meta Data* extends the traditional database meta data with Classification Schemes, Model Relationships and Meta Descriptions. The Meta Descriptions contain, as the name suggests, descriptions of models and patterns according to the Classification Schemes and Model Relationships. The Classification Schemes are taxonomies for structuring and describing the models and patterns. Two types of Classification Schemes are Business Frameworks and Goal Factors. Business Frameworks are aimed for a course grained structuring of the business/process models along some core dimensions such as domain, value chain, granularity, and level of control (e.g. structured vs. creative processes). Goal Factors are aimed for a more fine tuned description and structuring of the models and patterns. They include risk, safety, costs, time, convenience, conformance to standards, reliability, and responsiveness Finally, the Model Relationships describe the way in which process models are related to each other, e.g. through generalisation and aggregation, and how they are composed of process patterns.

6 Work Plan

The work will be structured into the following main tasks.

1. Development of Classification Schemes.

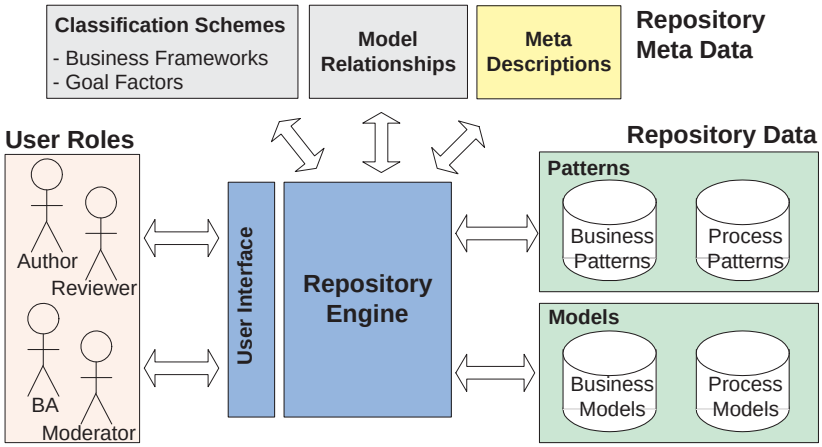

Fig. 1. Repository Architecture

- Detailed analysis and comparison of SCOR process level one and two [21], MIT business classification [14], Porter's value chain models [16] and other business taxonomies that will be used as input to the design of a common Business Framework.
- Identification and specification of a set of Goal Factors. This work will be based on our previous work on business and goal modeling for business process management [5, 8, 6].
- Analysis on and integration of existing Classification Schemes for process patterns. An example of such an approach is the work of Norta [15] where a pattern taxonomy in the form of a meta model is proposed.

  (January 2008 - December 2008)

2. Development of Model Relationships. MIT Process Handbook and our previous research will be taken as points of departure.

   (April 2008 - February 2009)

3. Set up of technical infrastructure for the repository. This will include selection and installation of software as well as design and definition of the pattern and model databases. Furthermore, it will include the establishment of maintenance services enabling model evolution.

   (July 2008 - September 2008)

4. Sample population of the databases. The purpose of this task is to populate a database for every category, i.e. a business patterns database, a process patterns database, a business models database and a process models database.

   - Process models and patterns from existing repositories will be prepared and entered into the repository together with their Meta descriptions according to the Classification Schemes defined during the first task.
   - The models will be cross-analyzed and their relationships will be documented according to the Model Relationships developed during the second task. Initially, modeling relationships for models within the different repositories will be studied. Later on, also model relationships across the different repositories will be investigated.

(September 2008 - December 2010)

5. Evaluation and Improvement. The repository architecture and the contents of its components will be evaluated based on the sample population in task 4. Based on this evaluation, the repository architecture will be refined.

   (July 2009 - May 2010)

6. Dissemination. Academic communities and companies that have worked on process repositories will be contacted and invited to join the repository population process.

   (starts February 2009 and continues throughout the project)

Tasks 1-5 correspond to a Design, Implementation, Validation and Improvement life cycle, while the sixth task is on dissemination. In addition to the sixth task, the results from the project will be communicated through international conferences and journal publications.

7 Benefits

The proposed project will bring a number of benefits to the Business Process Management (BPM) research area:

- The repository will become a universal knowledge resource on business and process models that can be used by researchers for empirical investigations in the BPM area;
- The repository architecture will contribute to:
  - improved classification schemes on business models (business frameworks);
  - improved classification schemes on business process models (goal factors) and process model relationships;
  - better understanding of the declarative foundations of process design;
  - better understanding of the use of process patterns for satisfying business objectives in the design of process models;
  - improved uniformity in the design of process models (using meta descriptions).

Additionally, the proposed repository of process models will provide a number of benefits for practitioners in the area of Business Process Re-engineering: availability of process models at a single place, support for fast development of business-aligned IT solutions, support for choosing process models tailored toward desired business goals and requirements, and openness for publishing new business and process models or improving existing ones.

8 Personnel

Funds are requested to finance the research of two staff, Petia Wohed and Jelena Zdravkovic, for a period of three years. The project will be supervised by Prof. Paul Johannesson, leader of SYSLAB laboratory at DSV, SU/KTH. The project is also supported by Prof. Wil van der Aalst from Technical University of Eindhoven (TuE). Continued cooperation with the research group of A/Prof. Arthur ter Hofstede from Queensland University of Technology (QUT) and Prof. Wil van der Aalst (TuE) is planned as the results from their Workflow Patterns Initiative will provide significant input for the pattern databases in the repository.

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