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SEMANTIC BENCHMARKING OF PROCESS MODELS – AN ONTOLOGY-BASED APPROACH

Research-in-Progress

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Abstract

This article suggests an approach which allows the costly analysis of processes (e.g., in service-oriented architectures) for benchmarking to be partially automated, so that the performance indicators, as well as qualitative differences between processes become apparent. The approach is based on using appropriate ontologies, which make the process models both syntactically and semantically comparable. In this article, we present a conceptual model for this new approach to process benchmarking, a framework, as well as a software prototype for analyzing and comparing individual process models. We provide an overview of our multi-method evaluation methodology and delineate the technical, conceptual, and economic evaluation perspectives with their respective outcomes. This analysis allowed us to determine whether our approach is generally suitable for generating novel and useful information on different process models that describe the same problem domain.

Keywords: Benchmarking, Process Modeling, Ontologies, Business Process Management, Model Analysis

Introduction

Process benchmarking is a widespread methodology that helps organizations identify their potential for increased efficiency in comparison to other organizations. Benchmarking may also be used to compare and analyze the outcome of processes in service-oriented architectures. However, benchmarking approaches require a significant amount of analysis and depend on experienced and skilled benchmarking experts. As Drew pointed out in 1997, new ways need to be identified to make benchmarking less costly (Drew 1997). Although this statement was made more than a decade ago, the question regarding how this can actually be achieved remains largely unanswered.

This article suggests an approach that partly allows automating the costly analysis of processes, so that quantitative (e.g., diverging performance indicators) as well as qualitative (e.g., the level of detail of processes) differences between processes become apparent. The approach applies appropriate ontologies for the analysis, which make the process models both syntactically and semantically comparable. This approach is based on work by Ahlemann et al. 2006 and Höfferer 2007. The research described in this article can be characterized as a design science endeavor (Hevner et al. 2004; March and Smith 1995; Walls et al. 1992): We started our research with an in-depth analysis of related work and a deductive construction of the conceptual model outlined in this article. Our approach was evaluated by means of a software prototype that we specifically developed to serve two purposes: First, it allowed us to prove that the conceptual model can be generally implemented in terms of software systems. Second, it formed the foundation of an in-depth conceptual evaluation based on the benchmarking of existing process models. Prominent reference process models were used to obtain data for our analysis (SCC 2008; Scheer 1994; Schuh 2006). This analysis allowed us to determine whether our approach is generally suitable to generate novel and useful information on different process models that describe the same problem domain. Apart from these technical and conceptual perspectives, we also investigated the approach's economic potential through a basic cost/benefit analysis. This analysis revealed that certain institutional preconditions have to be met for our approach to be profitable in a real-world scenario.

This article is structured as follows: Section 2 describes the foundations and discusses process modeling, process benchmarking, and formal ontologies. Section 3 summarizes various approaches and the results of related work. Section 4 presents our approach by means of an overview, an elaboration of the conceptual model, and an example. The evaluation of this study's results, which is ongoing work, is discussed in Section 5. Section 6 summarizes the work, discusses its limitations, and makes suggestions for further research.

Foundations

Process Benchmarking

Benchmarking can be defined as an organizational process of continuous measurement and comparison with the objective to improve efficiency (Legner 1999). As a management technique, benchmarking has a long history. It gained wide prominence through the XEROX case published by Tucker, Zivan, and Camp in 1987 (Tucker et al. 1987). Over the decades, benchmarking has experienced several stages of development. Whereas the early attempts can be characterized as reverse benchmarking and were mainly product-oriented, contemporary approaches are global and focus on processes and strategies (Ahmed and Rafiq 1998; Kyrö 2003). Today, benchmarking is a mature field of research. According to Dattakumar and Jagadeesh, there were more than 350 publications on this topic in June 2002. The generic benchmarking concept has already been applied to almost all functional areas of contemporary enterprises (Dattakumar and Jagadeesh 2003). A wide spectrum of methods is available for benchmarking, especially process benchmarking (Legner 1999). Although the details of these approaches vary, Drew (1997) identified several fundamental characteristics that they have in common, namely: (1) Determine what to benchmark, (2) form a benchmarking team, (3) identify benchmark partners, (4) collect and analyze benchmark data, and (5) take action.

Process Modeling

According to the Workflow Management Coalition (WfMC), a business process is defined as (Fischer 2000): "A set of one or more linked procedures or activities which collectively realize a business objective or policy goal, normally within the context of an organizational structure defining functional roles and relationships." We apply this definition throughout our article and – as we focus on business scenarios – use it synonymously with the term process. Business process management (BPM) and web services communities have specifically yielded a wealth of languages and standardization approaches that aim at describing and representing business processes. In our approach, we refer to event-driven process chains (EPCs) (Langner et al. 1997) and the Unified Modeling Language (UML) developed in the early 1990s by Grady Booch, Ivar Jacobson, and Jim Rumbaugh (Rumbaugh et al. 1999). Both are widely used modeling languages in research and practice.

Formal Ontologies

Since the beginning of the 1990s, research on ontologies has become increasingly common. Its importance has been recognized in various IS research fields and application areas (Guarino 1998). The Semantic Web is one application area that relies on ontologies, which are used to structure the underlying data for comprehensive and transportable machine understanding (Maedche and Staab 2001). More generally, ontologies are used in the Information Systems (IS) discipline to formally represent knowledge. Furthermore, they facilitate knowledge sharing and reuse between various agents, regardless of whether they are human or artificial (Fensel 2004). A frequently quoted definition of an ontology within the IS discipline is based on Gruber (Gruber 1993): "An ontology is a formal explicit specification of a conceptualization." Over time, this definition was extended to a "...shared conceptualization for a domain of interest." This definition contains three constitutive characteristics of an ontology: An ontology should be machine interpretable (*formal),* types of concepts and their constraints should be defined *explicitly*, and an ontology should capture consensual (*shared*) knowledge.

Related Work

In recent years, the synthesis of the above mentioned research areas has gained much attention. For example, the research works on *Semantic Business Process Management* (e.g. Heinrich et al. 2008, Thomas and Fellmann 2007) and *Semantic Service Composition* (e.g. Hepp et al. 2005) – a synthesis of process modeling and formal ontologies – also, to some extent, discuss certain aspects of the comparison and semantic interoperability of process models.

Certain approaches in the literature could be compared to our study, although they differ in certain significant aspects. These studies are summarized in Table 1 and compared to our approach according to the following criteria:

- *Semantic approach:* Does the study use ontologies to analyze processes?
- *Benchmarking approach:* Does the study propose a process-benchmarking approach to analyze and compare individual process models?
- *Model comparison:* Does the study address the comparison of different process models?
- *Evaluation approach:* Do the authors present an evaluation approach and, if so, which kind of evaluation?
- *Problem domain and major difference:* On which problem domain does the study focus? What is the major difference between this approach and ours?

According to the criteria in Table 1, Liao et al.'s approach seems to be similar to our study. The authors propose an ontology-based method to describe software processes conceptually (Liao et al. 2005). One objective of their approach is to quantitatively analyze and benchmark software process attributes. However, the major differences between their and our study are their specific focus on software process models and lack of an approach for mapping different process models, i.e. they address only one specific process model at a time. Similarly, Höfferer's and Ehrig et al.'s approaches fail to provide concepts or means for benchmarking process models (Höfferer 2007; Ehrig et al. 2007). The other studies summarized in Table 1 differ from our approach in at least two or more significant ways. In addition, they mostly focus on a different, or even limited, problem domain, such as EPCs (e.g., Daneva et al. 1996, Thomas and Fellmann 2007), reference models (Fettke and Loos 2007), as well as software process models (Liao et al. 2005), and/or pursue a different objective, like planning process models (Heinrich et al. 2008).

Table 1. Summary of Related Work

References	Semantic Approach	Bench-marking Approach	Model Compari-son	Evaluation Approach	Problem Domain and Major Difference to Our Approach
(Liao et al. 2005)	Yes	Yes	No	Prototype	Focus on software processes and their models
(Lin et al. 2005)	Yes	No	No	n/a	Focus on the storage and retrieval of process models for reuse
(Thomas and Fellmann 2007)	Yes	No	No	n/a	Focus on a semantic annotation of EPCs to specify the semantics of individual process model elements
(Daneva et al. 1996)	No	Yes	Yes	Prototype under development	Focus on controlling the quality of business process models, based on EPCs and an extension of the ARIS toolset
(Fettke and Loos 2007) (Fettke and Loos 2003)	Yes	No	Yes (proposed)	n/a	Focus on evaluating reference models
(Chabrol et al. 2006)	No	No	No	n/a	Focus on a methodological approach to supply chain modeling and evaluating processes in the health care system
(Huth et al. 2001)	Yes	No	No	Prototype	Focus on assessing process instances to derive process models in groupware environments
(Höfferer 2007)	Yes	No	Yes	Prototype under development	Focus on the semantic interoperability of business processes
(Heinrich et al. 2008)	Yes	No	No	Prototype	Focus on partly automatically planning and modeling of process models
(Hepp and Roman 2007)	Yes	No	No	n/a (planned)	Focus on ontologically representing the business as well as the information systems perspective on business processes, and on translating between these two perspectives
(Ehrig et al. 2007)	Yes	No	Yes	Prototype	Focus on measuring the similarities between semantic business process models by (semi-)automatically detecting synonyms and homonyms among process element names

Ontology-supported Process Benchmarking: Our Approach

Overview

To date, process benchmarking has primarily been a "manual process" that requires individuals to take on the data collection and analysis tasks. Individuals are essential since the benchmarking information requires an interpretation of expert knowledge. This is due to information mostly being available in an unstructured form. However, even if semi-formal or formal process models are used, diverging terminology and domain knowledge prohibit a direct analysis. These models' careful translation to a common language and a common understanding is a precondition for their meaningful comparison. Owing to this complexity, software-based approaches to benchmarking focus mainly on performance indicators and do not qualitatively analyze the data gathered. A comparison of information models aimed at benchmarking leads to two fundamental problems: First, different modeling languages, based on non-compatible notations, may be used (syntactical aspect). Second, the semantics of both the modeling language constructs (semantic aspect I) and the modeled concepts may differ (semantic aspect II). The latter may be the result of different abstracting, detailing, typing, and naming methods (Pfeiffer and Gehlert 2005).

In our proposed approach, ontologies are used to overcome such problems. They are used to translate language constructs from one conceptual process modeling language into those of another language (syntactical aspect), to explicate the semantics of language constructs, and to identify equivalent language constructs (semantic aspect I). Moreover, they are used to represent general domain knowledge and to semantically map elements from one process model to those of another (semantic aspect II). These benefits of ontologies are realized in our approach through a modified and advanced benchmarking process based on ideas by Ahlemann et al. 2006 and Höfferer 2007:

1. A domain expert either creates or selects a domain ontology that describes the benchmarking domain.
2. A modeling expert creates a base ontology containing concepts that represent common process modeling language constructs and their semantics. This is most successful when using a reference metamodel that has already been used to transform process models from one language into another. This base ontology overcomes

the problems related to the syntactical aspect and semantic aspect I. Owing to the general characteristic of this ontology, it only needs to be developed once and can be reused for every language with the represented concepts.
3. A domain expert maps the process models' elements to be benchmarked to instances of the domain ontology. This overcomes semantic aspect II, because the semantics of each process step is now specified by a unified vocabulary.
4. Additional performance information, such as the services used and their costs, is captured for the process model elements.
5. The software tool developed for our approach automatically transforms the process model constructs into instances of the base ontology's concepts. Moreover, the mappings created in step 3 are used to map these instances to those of the domain ontology. Furthermore, it uses the additional performance information (step 4) to enrich the created instances. The result will be a new ontology, which can be used for futher analyses.
6. The benchmarking expert analyzes the instance ontologies semantically by means of either ontology query languages, or predefined performance and/or benchmarking metrics.

Ontology-based Analysis and Comparison of Process Models

To describe the concept of the ontology-based analysis and the comparison of process models in general, we draw upon the six previously outlined process activities. We specify that there is a domain ontology for the application domain at hand. This domain ontology should either be developed in advance, or a previously developed ontology should be used.

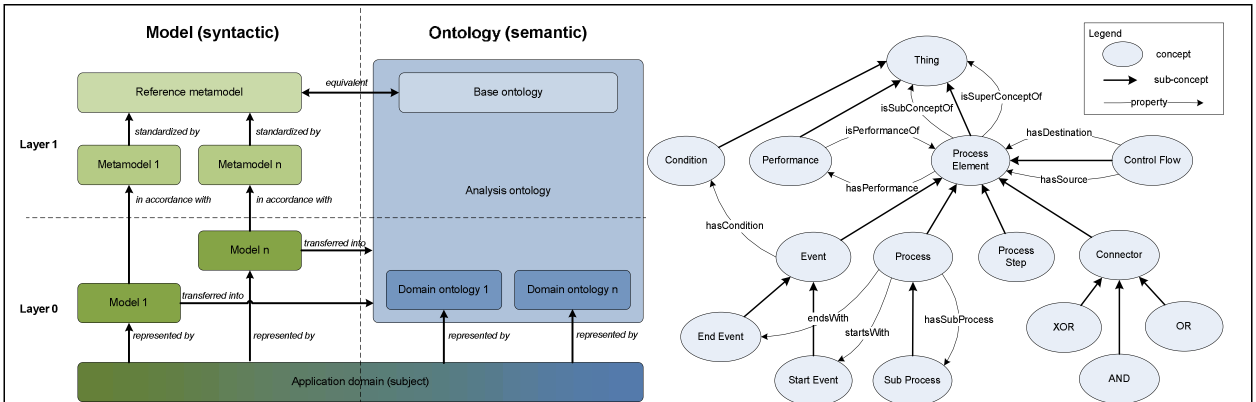

Figure 1. Syntactic and Semantic Coherence (Analysis, Domain, and Base ontology)

The *base ontology* (see right side of Figure 1) of our presented approach is a translation of the reference metamodel into an ontology (Ahlemann et al. 2006). This reference metamodel includes a way to possibly standardize and describe the modeling language's constructs. In our case, EPC and UML activity diagrams are used as examples of how to overcome the problem of using different modeling languages (syntactical aspect and semantic aspect I). Consequently, concepts that represent the standardized, and supposedly relevant, elemental types of metamodels become part of the *base ontology*. For instance, a modeled process's event is described as a sub-concept of the "Process Element". Through the use of the *base ontology* and by mapping the model constructs of different languages to the concepts, it is possible to realize a *syntactic* analysis of the transferred model constructs, albeit on a higher level of abstraction. The process elements have to be mapped to a domain ontology's concepts (semantic aspect II) for the ontology-based analysis and comparison of the process models. In contrast to Höfferer 2007, who described only exact mappings between ontology concepts and model constructs, our approach allows the use of three mapping types: 1. The model construct represents the domain concept exactly ("sameAs"), 2. A part of the model construct is represented by the mapped domain concept ("isSuperConceptOf"), 3. The model construct is represented by part of the mapped domain concept ("isSubConceptOf"). Furthermore, additional performance information (e.g., duration time, number of transactions, costs, etc.) will be captured in respect of these process elements. The left side of Figure 1 illustrates the relation and transformation between process models and metamodels on the one hand, and ontologies on the other. As a result of the automatic transformations, the analysis ontology can be used for benchmarking.

An Illustrative Example

Figure 2 illustrates our approach with a semantic comparison of two process models from the logistics domain.

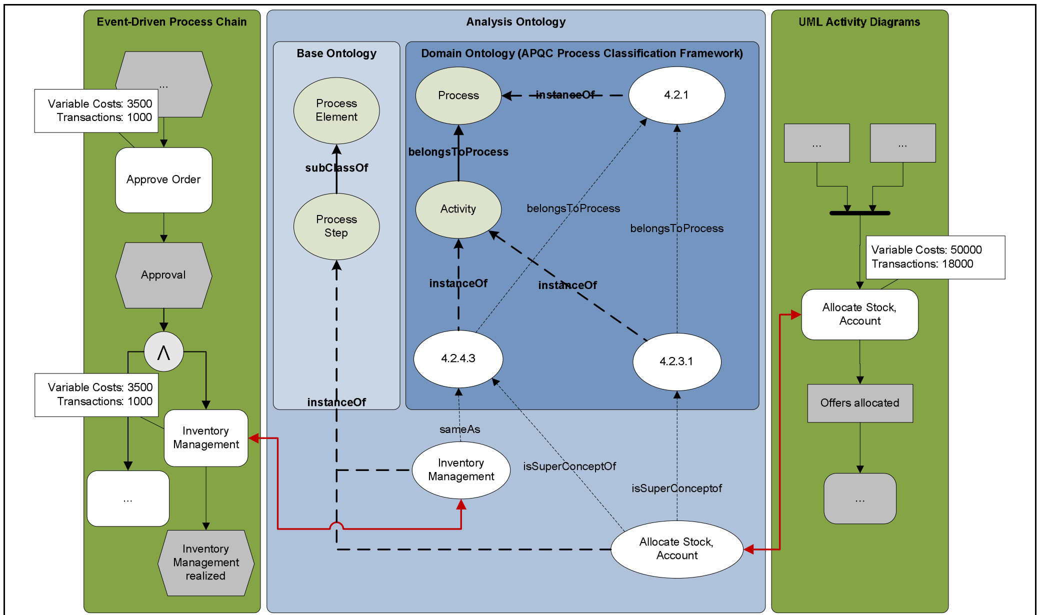

Figure 2. Example

The *Process Classification Framework*^{SM} (APQC 2008) taxonomy is used as the domain ontology (APQC = American Productivity Center and the American Productivity & Quality Center). In addition, the presented *base ontology* is used. One of the processes is modeled in UML and the other in EPC. The latter applies only three element types: function, event, and control flow. The UML diagram is an activity diagram and applies action, control flow, and object nodes as element types. Through the instantiation of the model constructs as instances of the base ontology concepts, the process model is transferred to the analysis ontology. This can be inferred from the instantiation of the function "Inventory Management" within the EPC in our example (arrow pointing from "Inventory Management" as an element of the EPC towards "Inventory Management" as an element of the analysis ontology in Figure 2). The example reveals that two element types, namely "function" (EPC) and "action" (UML), are syntactically equivalent and are transferred as instances of the "Process Step" (syntactical aspect and semantic aspect I). If the analysis ontology's generated instances are attributed to the domain ontology's instances (illustrated by arrows labeled "sameAs" or "isSuperConceptOf" in Figure 2), further conclusions can be drawn (semantic aspect II). We can, for example, conclude that a part of the process step "Allocate Stock, Account" of the UML activity diagram is identical to an EPC process step ("Inventory Management"). If additional performance information (e.g., Costs and Transactions) on the individual process steps is included, further conclusions can be drawn. We can also deduce that, as part of the UML activity diagram, information on the costs of the construct "Allocate Stock, Account" should be separated to make this construct comparable to "Inventory Management" within the EPC.

Evaluation

We followed a multi-method approach, reflecting different evaluation perspectives to assess the benchmarking concept outlined in this paper: The evaluation revealed that technical, conceptual, and economic insights were used to subsequently strengthen the concept and to specify potential application domains.

Technical Evaluation

The technical evaluation's primary objective is to prove that the concept can be generally implemented by means of a software system. We therefore explain how process models' semantic analyses can be implemented efficiently. In order to achieve these objectives, an experimental prototype, called SEMAT (SEMantic ATtribution), which emerged from a cyclic process of developing and testing design alternatives, was developed. The most current version of this prototype consists of several software components: *SEMAT Ontology Editor* is utilized for the creation of domain ontologies, *SEMAT Modeling Tool* for the modeling and attribution of the information models, and *SEMAT Analysis Tool* for the analysis of the models. A repository in the form of a database system was used for the central storage of all the results, as well as their recovery and further processing. Since an in-depth description of all the components would be beyond the scope of this research in progress article, our discussion focuses on the *SEMAT Analysis Tool.*The *SEMAT Analysis tool* is written in Java, which is utilized for the analysis and comparison of process models. Models can be loaded from the repository or imported from a comma separated (CSV) file. In order to analyze the process models within a single ontology, imported models are converted automatically into an OWL 1.1 (Patel-Schneider et al. 2006) analysis ontology. The prototype provides two alternative ways of calculating ratios for the interpretation of analysis ontologies. Analysts can choose one or more precompiled metrics that fulfill their needs, or run custom queries via SPARQL. SPARQL, the abbreviation of *SPARQL Protocol and RDF Query Language*, allows RDF file queries that resemble those of SQL. The results are displayed and can be exported to a CSV file for further analysis. The *SEMAT Analysis Tool* could create sound and determinable analysis ontologies if the domain ontologies were sound and determinable without cycles having to be generated when mapping. In conclusion, no technical limitations were found that would influence the general concept discussed here. For instance, the *SEMAT Analysis tool* supports activity-based costing analyses with an average runtime of 200 seconds for an analysis ontology of about 200,000 elements on a standard PC (of these 1,000 are domain elements; the rest are distributed over process elements, such as activities, control flows and performance information). Therefore, with some effort, the tool can be used to compare and analyze process models of high complexity.

Conceptual Evaluation

For the conceptual evaluation, we decided to focus our attention on procurement processes from three prominent reference models, namely Scheer's reference model for industrial business processes (Scheer 1998), the Aachener PPS Model (Schuh 2006), and the Supply Chain Operation Reference Model (SCOR) (SCC 2008) model. To describe and specify the exemplary problem domain at hand, the *APQC Process Classification Framework*^{SM} (PCF Version 5.0.3) (APQC 2008) taxonomy was transferred to a determinable OWL DL ontology and used as a domain ontology for further analysis. The PCF was developed by the APQC and member companies as an open standard to facilitate improvement through process management and benchmarking, regardless of industry, size, or geography.

Table 2. Mapping and Performance Information of the Reference Models

				APQC Process Classification Framework													
	Fixed Costs (PI_1)	Variable Costs (PI_2)	Transactions (PI_3)	0.0.0.0 (DC_1)	4.2 (DC_2)	4.2.1.3 (DC_3)	4.2.1.4 (DC_4)	4.2.1.5 (DC_5)	4.2.3.1 (DC_6)	4.2.3.3 (DC_7)	4.2.3.4 (DC_8)	4.2.3.5 (DC_9)	4.2.3.6 (DC_{10})	4.2.3.7 (DC_{11})	4.2.4.2 (DC_{12})	4.2.4.3 (DC_{13})	4.2.4.4 (DC_{14})
Aachener PPS ($C_{1,1}$)	4500	-	-		1												
Order Quantity Calculation ($C_{2,1}$)	-	6500	1000			2	2	2									
Preparation Of Requests ($C_{3,1}$)	-	8000	1000							3							
Evaluate Proposal ($C_{4,1}$)	-	4500	1000							3							
Select Supplier ($C_{5,1}$)	-	6000	1000							3							
Approve Order ($C_{6,1}$)	-	3500	1000									1					
Monitor Order ($C_{7,1}$)	-	3500	1000										2	2	2		2
Inventory Management ($C_{8,1}$)	-	3000	1000													1	
Scheer ($C_{1,2}$)	200000	-	-		1												
Develop Requisition, Allocation Cost Unit, Cost Unit Accounting ($C_{2,2}$)	-	60000	20000	2					2								
Request Supplier ($C_{3,2}$)	-	80000	10000								1						
Update Basic Data ($C_{4,2}$)	-	15000	10000	1													
Select Supplier and Order Quantity, Account Supplier, Impersonal Account, Create Pro Forma Invoice ($C_{5,2}$)	-	70000	20000	2			2				2						
Printing Of Purchase Orders and Transmission ($C_{6,2}$)	-	60000	20000									1					
Monitor Order ($C_{7,2}$)	-	120000	20000										1				
Create Dunning ($C_{8,2}$)	-	40000	3000	1													
Quality Testing ($C_{9,2}$)	-	180000	12000											2			2
Create Reclamation, Correct Data ($C_{10,2}$)	-	40000	2000	2													
Account Receipt ($C_{11,2}$)	-	20000	18000	1													
Allocate Stock, Account ($C_{12,2}$)	-	50000	18000	2												2	
Invoice Verification ($C_{13,2}$)	-	100000	18000	1													
Correct Invoice ($C_{14,2}$)	-	40000	1000	1													
Account Invoice ($C_{15,2}$)	-	60000	18000	1													

The PCF classifies operating and management processes into 12 enterprise-level categories, which include process groups and over 1,500 processes and associated activities. The PCF, associated measures, and benchmarking surveys can be downloaded and completed free of charge from www.apqc.org/OSBCdatabase. The transformation of the entire PCF leads to four concepts ("Category," "Process Group," "Process," and "Activity") and 1031 individuals (mostly activities). Furthermore, an individual "No Match" was created for every PCF concept. Consequently, the reference models' unspecified constructs could also be mapped to the domain ontology. All elements of the process models have to be mapped to the domain ontology. To make matters less complicated, the discussion focuses only on Scheer's reference model and the Aachener PPS Model. These two models were enriched by random performance information, such as the number of transactions, variable costs, and fixed costs, which may occur in real-world scenarios. This additional information allows automatic activity-based costing and further analysis. Table 2 illustrates the used mappings to the PCF, as well as the assumed performance values. We used the three mapping types as previously described: (1) = "sameAs", (2) = "isSuperConceptOf", and (3) = "isSubConceptOf". The mapping procedure's first results indicated that it was impossible to allocate exact mappings of all the models' constructs to the domain ontology. In order to overcome this difficulty and to enhance the quality of these mappings, two authors mapped these models individually. The interrater reliability was found to be good (interrater percentage agreement: > 95 %).

Towards an Economic Evaluation

It is obvious that the benchmarking approach proposed in this paper will only be feasible when the costs of process models' annotation are lower than the benefits gained from improved benchmarking efficiency. Although the annotation of process models can be partly automated using semantic matching algorithms (Giunchiglia et al. 2007, Guarino 1997), it is still a time-consuming task that needs to be carried out by experts. Therefore, it is sensible to search for application scenarios in which the relatively high model preparation and transformation costs are counteracted by applying a large number of the respective models. We therefore suggest that our approach is best implemented by a clearing centre that regularly carries out benchmarking projects for one or more specific domains. Such a clearing centre is responsible for collecting, annotating, transforming, and storing process models as well as domain ontologies. It could offer benchmarking services to interested parties by comparing their process representations to those previously processed and transformed. Consequently, the relatively high model preparation costs are distributed across a large number of organizations that utilize the benchmarking data. Moreover, the costs of developing and maintaining an adequate ontology and corresponding software systems are subsequently affordable and can be organized centrally. This business model's specific value proposition presumes that the benchmark offered is based on a large number of benchmarking participants and an automated, but rich, qualitative analysis that is, at the same time, relatively cheap since it does not require experts' involvement. We assume that the income generated by benchmark offerings is directly dependent on the number of benchmarks available, since benchmarking becomes more attractive when a larger number of organizations' information is available. Moreover, a large benchmarking database will facilitate marketing activities and, thus, promote acceptance of the services offered. In addition, this applies to network theory (Liebowitz et al. 1995). In fact, each additional benchmarking participant makes the offer more attractive for all the others, which could lead to an exponential relationship.

Conclusions

The theoretical implications of the presented approach are threefold. First, we have proposed a novel and innovative approach to benchmarking, which makes benchmarking more efficient and effective, and, at the same time, more meaningful. Second, the proposed approach can be supported efficiently by the developed SEMAT prototype that demonstrates and proves the approach's general viability. Third, fundamental conceptual building blocks have been defined that could be used for further research. Moreover, the approach can generate novel and interesting information on adequate performance metrics by means of benchmarking analyses of process models referring to different prominent reference models (e.g. SCOR). Nevertheless, there are implications for practice. The proposed concept bears the potential to change the way process benchmarking is currently carried out. However, in-depth knowledge of ontology engineering, and information modeling is still required to implement the concept. A reference architecture needs to be developed for such an information system and process modeling tools need to be implemented. The adoption of the concept will require some time until fundamental research has brought about significant information in all relevant areas. While we acknowledge our study's limitations, they simultaneously indicate directions for further research. One major aspect is that time has to be spent on the investigation of adequate metrics and queries for process model analysis. In addition, control-flow-related problems have to be solved. For example, since process models may involve cycles, decision points, and complex routing, it is difficult to determine in what order the process step should (most probably) be carried out. Even though the concept is viable, for real-world scenarios, an advanced synthesis of the results obtained from the automatic analysis would further increase the relevance for practice, for example, by automatically creating meaningful benchmarking. Ultimately, the economic analysis outlined above, is only a first step and research in progress. Empirical findings from the application of the proposed approach in real-world scenarios would support the validation of the propositions underlying this research. This will be included in our future work.

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