Towards a Framework for Object-aware Process Management

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Abstract. In comprehensive case studies we found out that many limitations of existing Process Management Systems (PrMS) can be traced back to the unsatisfactory integration of processes and data. In this PhD project, we aim at a deep and extensive understanding of the inherent relationships between processes and data, and thus want to overcome some of the fundamental limitations known from activity-centered PrMS. Overall, we target at a comprehensive framework providing integrated access to processes, data, and functions to its users.

1 Research Questions

Despite the widespread adoption of Process Management Systems (PrMS) there exist numerous processes currently not adequately supported by these PrMS. In particular, there is a contradiction between the way processes can be modeled and the work practices preferred by users [1, 2, 3]; e.g., many of these processes cannot be "*straight-jacked into activities*" [4]. Instead they can be characterized as *information-centric* [5], *knowledge-intensive* [4], and *unstructured* [2].
Starting with this basic observation, we define the following research questions:

Research Question 1: What are the common properties of the business processes currently not adequately supported by existing PrMS?
Expected Solution: Collection of properties concerning the different business perspectives; i.e., the inter-relationships between business processes, business data, business functions, and users.

Research Question 2: Which requirements must be fulfilled by a PrMS in order to adequately capture these properties?
Expected Solution: A set of requirements for PrMS enabling the support of the identified properties.

Research Question 3: How to support the requirements within an integrated process support framework?
Expected Solution: Concepts, methods and tools for realizing a PrMS enabling process support in tight integration with data to overcome the limitations known from activity-centered PrMS.

2 Background

In comprehensive case studies we found out that many limitations of existing PrMS can be traced back to the unsatisfactory integration of processes and data. In particular, in many cases process support necessitates *object-awareness*; i.e., focus is on the processing of business data being represented in terms of business objects. The latter comprise a set of attributes and are related to each other. To better understand the inherent relationships between processes and data, we perform a profound research on processes currently not adequately supported, including a systematic analyses of their properties. In summary, our process analysis has revealed the following major characteristics of object-aware processes:

1. *Object behavior:* The behavior of the involved business objects must be taken into account during process execution.
2. *Object interactions:* Interactions between business objects must be adequately considered; i.e., the behavior of individual objects must be coordinated with the one of related business objects.
3. *Data-driven execution:* Since the progress of a process mainly depends on available business objects and on their attribute values, process execution has to be accomplished in a data-driven manner.
4. *Integrated access:* Authorized users must be able to access and manage process-related objects at any point in time (assuming proper authorization).
5. *Flexible activity execution:* Activities must be executable at different levels of granularity. More precisely, while one user may work on a particular object instance, another one may process a number of related object instances in one go.

Though there exist several approaches targeting at a tighter integration of business processes and business data [4, 6, 7, 8, 9, 3, 1], as illustrated in Fig. 1, none of them supports all identified properties in an integrated and comprehensive way. In addition, some approaches only deal with the modeling of processes and data, but exclude process execution; e.g., they do not provide a well-defined operational semantics for the automatic enactment of the defined processes.

3 Significance

Contemporary PrMS have not achieved the technological maturity to adequately support object-aware processes yet. Instead respective processes are often hard-coded within business applications (e.g., ERP or CRM systems). As a major drawback, long development cycles result and even simple process changes may require costly code adaptions and high efforts for testing. For this reason, we target at the *generic support* of *object-aware processes*. Therefore, we aim at a deep and extensive understanding of the relationships between processes, data, functions, and users. We believe that generic methods, concepts and tools enabling a

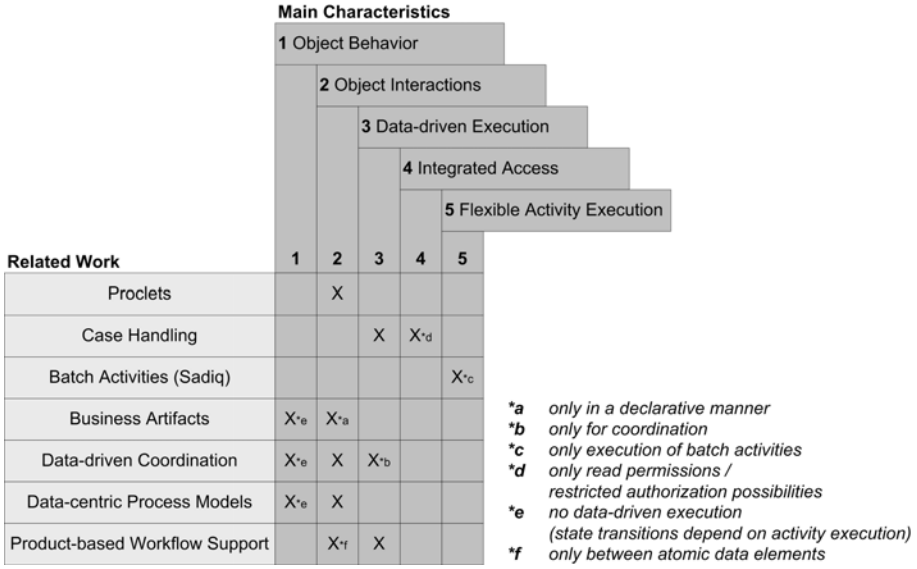

Fig. 1. Characteristics supported by existing approaches

tighter integration of the different business perspectives will provide an important contribution to overcome some of the fundamental limitations known from existing PrMS and will foster the realization of more flexible PrMS supporting daily tasks in a more natural way.

4 Research Design and Methods

Regarding research in the field of information technology (IT), there are two kinds of sciences: *design science* and *natural science* [10, 11]. Natural science research is a knowledge-producing activity comprising the two steps *discovery* and *justification* [10]. Design science, in turn, is a knowledge-using activity [10]. It aims at developing IT systems and comprises *building* and *evaluation* as the two major activities [11].

Generally, doing research means applying natural science. Regarding IT, however, design research is considered as being more successful and important. Nevertheless, technology and behavior cannot be separated from each other [11]. Thus, in accordance with [10, 11], it is an opportunity for IT research to make significant contributions by engaging in both. In summary, as illustrated in Fig. 2, IT research calls for synergistic efforts between natural and design science research [11].

For this purpose, our research activities are as follows (cf. Fig. 3) [12]:

We start with natural research to identify the properties of object-aware processes (cf. Research Question 1). Referring to Research Question 2, we evaluate

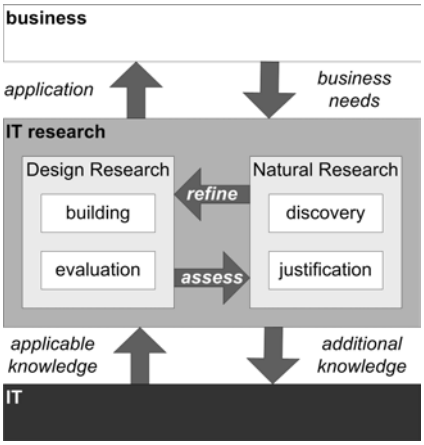

Fig. 2. IT Research [11]

existing approaches (using already existing applicable knowledge) to elicit the requirements for a PrMS supporting the identified properties. Finally, we address Research Question 3 and develop a comprehensive framework for object-aware process management based on design research.

4.1 Doing Natural Research: Property Investigation and Justification

To identify the properties of those business processes not adequately supported by contemporary PrMS, we perform a detailed *property investigation*. We then justify our findings with an extensive *literature study*.

Process analysis
Data Source: There exist process-aware business applications (e.g., ERP or CRM systems) not relying on PrMS. Instead they contain hard-coded process logic. To ensure that the processes considered in our property investigation are not "self-made" examples, but constitute real-world processes of high practical relevance, we particularly analyze processes as implemented in existing business applications. Amongst others, we analyze the processes implemented in the human resource management system Persis and the reviewing system Easychair [13, 14]. In addition, we rely on extensive practical experiences gathered when developing contemporary business applications; i.e., we have deep insights into their application code and process logic.
Selection Criteria: We evaluate the business applications in respect to processes, data, functions, and users while focussing on their inherent interdependencies.

Literature study
Ensuring importance: We complement our process analysis with an extensive literature study. This way we will show that other researchers consider one of

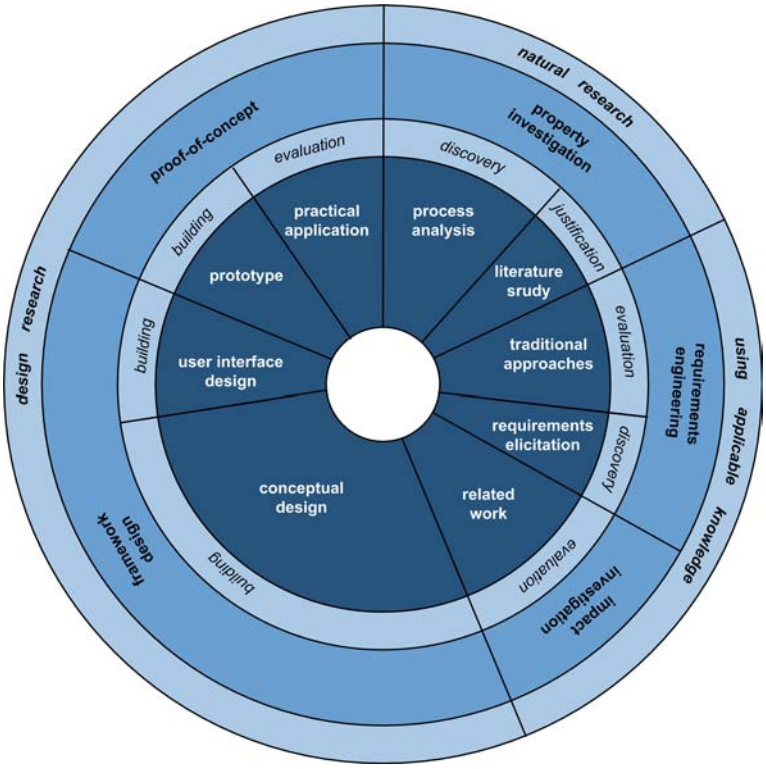

Fig. 3. Applied research methodology

the identified properties as being relevant as well.
Ensuring completeness: To not exclude important properties already identified by other researchers, we compare our analysis results with existing literature. However, we exclude properties in respect to process change and process evolution. Instead, our focus is on process modeling, execution and monitoring.
Ensuring generalisation: Interestingly, some authors refer to similar application examples as we do, while addressing different properties. Based on these insights we contrast the different application examples with the total set of identified properties. This way, we are able to demonstrate two things: First, the properties are related to each other. Second, broad support for them through a variety of processes from different application domains is required.

4.2 Using Applicable Knowledge: Requirements Engineering

Concerning Research Question 2, we first discuss to what degree existing PrMS cover the identified properties. More precisely, we evaluate which properties cannot be directly supported when applying traditional imperative and declarative

approaches [15]. Based on this evaluation we then elicit the basic requirements as inquired by Research Question 2.

4.3 Doing Design Research: Framework Design and Proof-of-Concept

Hevner et al [11] consider solution design as search process being inherently iterative. This has been also confirmed by other authors [16, 17]. In addition, Simon [16], describes the nature of the design process as a "Generate/Test-Cycle". The spiral model [17], in turn, defines an approach in which one and the same step is repeated several times, each time improving the results of the previous outcome. For this purpose, we will perform iterative walkthroughs. In particular, we revise our solution and improve it step by step. This will lead to different development versions. Additionally, we investigate in user interface design. This way, shortcomings concerning the usability of the framework design are identified at early project stages and can be considered in following iterative revisions. To evaluate our framework we are developing a proof-of-concept prototype for the modeling as well as the run-time environment. In addition, we apply the prototype to real-world cases. In particular, we use scenarios from the medical domain, order processing, and house building which are different from the ones we consider in the context of our process analyses. Finally, we elaborate the benefits of our approach when applying it to these processes as well as lessons learned.

5 Research State

We have already conducted extended analysis of processes from the area of human resource management and paper reviewing. In [13, 14] we reported on the basic challenges for integrating processes, data, functions and users, and we described the properties of object-aware process management in detail [18]. Based on a detailed comparison of traditional process support paradigms [15] we elicit the major requirements for object-aware process management [15, 18]. Currently, we are developing a comprehensive *framework for object-aware process management* [18, 19] as well as a proof-of-concept prototype. In future work we elaborate more detailed issues in the context of our framework and apply it to other real-world processes for evaluation (i.e., healthcare, order processing, house building).

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