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The Business Process Technology Research Group

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Abstract: In this paper the Business Process Technology research group at the Hasso Plattner Institut, University of Potsdam and its relevance for the EMISA special interest group is presented. The paper starts by reviewing the main research areas and contributions to the research community the group has provided, before sketching some of the current research topics the group is working on. In addition to the conceptual research results, the prototypes developed by BPT in the context of the BPT architecture are introduced, which relate to process modeling, event processing, and process execution.

Keywords: Business Process Modeling; Event Processing; Decision Management; Case Management; Blockchains

1 General Orientation

The Business Process Technology research group ("BPT") was founded in 2001. The mission of BPT is addressing real-world problems in business process management with formal approaches and engineering useful prototypes.

In capturing real-world problems and in devising formal approaches, modeling plays a key role. While process modeling is essential, it is by far not the only aspect that needs representation in models. Research results include modeling of events, cases, decisions, and resources. Models are not a research result *per se*, but models are used for particular purposes. These range from a better, a precise understanding of the problem domain to models that are blueprints of information systems to be engineered for illustrating the feasibility of the conceptual solution.

The group has a record of research prototypes that are provided to the international research community. The tools that BPT has developed over the years range from programming libraries for process-related data, like the jBPT library [PW13], to process engines for flexible workflow management and, later, case management [HW16]. The group is probably best known for the development of Oryx [DOW08], an extensible web-based process modeling and analysis framework that has led to the foundation of Signavio, which is today a well-established company in the area of business process modeling and analysis.

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With the general approach of BPT to address real-world problems, to use models to devise conceptual solutions and to engineer systems to show the feasibility of the solutions, in its research, BPT uses methods and techniques that also play an important role in the EMISA special interest group.

2 Research Topics

2.1 Batch Activities in Business Processes

Business process management (BPM) supports organization in process improvement and automation by capturing business processes in process models. These serve as blueprints for a number of process instances. However, process instances are typically considered running independently of each other. *Batch processing* – the collectively execution of several instances at specific process activities – is a common phenomenon in operational processes to reduce cost or time. In our group, we have developed a concept for *batch activities* that allows stakeholders to explicitly configure their batch activities in process models, which can be then automatically executed [PMW14]. This was also implemented in an existing, open-source BPM system, Camunda [PW16b]. We extended this approach to batch activities over multiple business processes [PW16a].

2.2 Decision Management

A company's value chain is directly affected by how well it designs and coordinates enterprise decision making. Therefore, decision modeling is applied complementary to business process modeling. Coupling the two disciplines comes with various challenges. Thus, a criteria for the sound integration of process and decision models was defined [BW17] by our research group. Variations of those criteria lead to different degrees of decision soundness, described in [BHW17]. All decision soundness notions require knowledge about the possible outputs of the decision model. In [BW18], an approach is reported that efficiently determines the possible outputs of decision tables. Additionally, decision-aware compliance checking verifies semantic properties of business processes while considering complementary decision logic [HBW18].

2.3 Case Management

Case Management (CM) is a paradigm to support the design, execution, monitoring, and evaluation of knowledge-intensive processes. These types of processes are often found in domains where highly trained workers (i.e., *knowledge workers*) deal with very diverse units of work (i.e., *cases*). In our group, we have developed the *fragment-based Case*

Management approach [HW16, He18] that reuses BPMN (Business Process Model and Notation) concepts – the industry-standard for process modeling. A fragment-based case model consists of structured parts – i.e. *process fragments* – that are flexibly combined at run-time based on data conditions. The approach is supported by the Chimera engine [Ha15], which is an on-going implementation project[2] in our group. Currently we use the Chimera engine to realize the SMile project[3], a national funded project to innovate the last mile logistics of parcels.

2.4 Event Handling

Business processes today are often run in a distributed environment with several participants. Events are a form of message/signal exchanges between the partners. Also, processes can receive events from external sources like a sensor or a traffic API. The information carried by the events are then used to improve the flexibility or decision making of the business processes [Ja17]. An event processing platform connects to different event sources, operates on event streams, and notifies the event consumers about specific event occurrences. In our research group, our research group was the first one integrating a BPM system with an event processing platform [Be16] to support different IoT scenarios. Further, we research on various aspects that need to be considered while using events in business processes as discussed by Janiesch et al. [Ja17], for example, event binding, event subscription, event buffering [MHW17, MWW17].

2.5 Choreographies and Blockchains

Businesses are interacting with each other. Choreography diagrams were introduced to represent interactions between business processes, run by different partners. While there is considerable work on using process models during process implementation, there is little work on using choreography models to implement interactions. We developed a novel approach to enhance choreography diagrams with execution information. The approach is based on the REST architecture style [Ni15, NWM18], which is an important technology for communication between interacting systems.

To address the security and transparency needs of interacting business processes, recently blockchain technology was proposed as an enactment platform for interacting business processes [Me18]. We argue that decisions are an essential aspect of interacting business processes, and, therefore, benefit from being executed on a blockchain. The immutable representation of decision logic can be used by the interacting processes, so that decision taking will be more secure, more transparent, and better auditable. The approach is based on a mapping of the DMN language S-FEEL to Solidity code to be run on the Ethereum blockchain [Ha18].

[2] https://github.com/bptlab/chimera
[3] http://smile-project.de/

3 BPT System Architecture

In this section, the BPT system architecture is presented whereby the different BPT prototypes and their interrelation are introduced. In the center of the BPT architecture is *Chimera*[4], the flexible process engine, and its process modeler *Gryphon*[5].

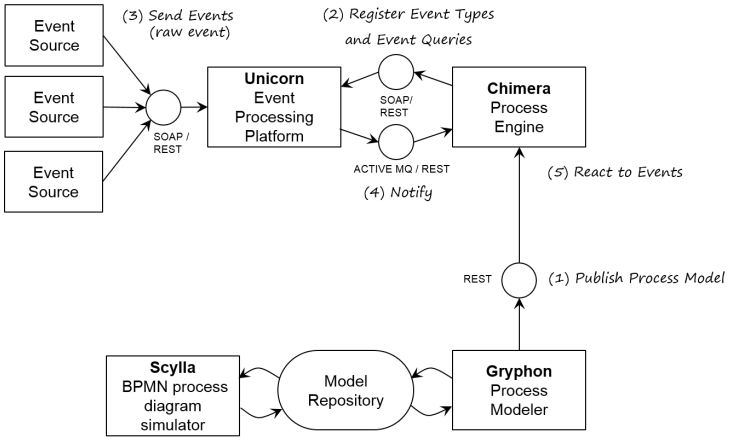

Fig. 1: BPT System Architecture: Prototypes developed at BPT and their interrelation.

Gryphon is based on *bpmn.io* (a BPMN 2.0 rendering toolkit and web modeler) and allows, additionally to traditional process modeling, the design of fragment-based case models as described by [HW16]. The defined process/case models can be stored in a model repository. For a pre-evaluation of the process models, *Scylla*[6] [PW17] – an extensible simulator for BPMN process diagrams – can be used. This java-based BPMN simulator is open-source and can be extended by well-defined entry points based on a plug-in structure. As input, the simulator needs a BPMN process diagram. In its interface, then the simulation and the resources needs to be configured. As soon as a simulation is finished, the simulator provides as output an XES event log and a log with the basic statistics, such as flow time, process costs, and resource utilization.

The designed case models in *Gryphon* can be also published via a REST interface in *Chimera*. There, the case model can be started and executed for different cases by case managers. The case execution can be enriched by receiving also external events via *Unicorn* to trigger process fragments or continue the execution of process fragments as described in [Be16]. *Unicorn*[7] is an event processing platform developed in our group. In general, event processing platforms are responsible to observe, filter, compose, and process events from different sources and provide them to event consumer based on their defined event

[4] https://bptlab.github.io/chimera/
[5] https://github.com/bptlab/gryphon
[6] https://github.com/bptlab/scylla
[7] https://github.com/bptlab/Unicorn

queries. Unicorn builds on top of Esper[8] and can be connected to several event sources, such as small sensors, weather or flight tracker APIs etc. We provide a full integration of the three systems *Gryphon*, *Chimera*, and *Unicorn* to allow the integration of external events in the execution of cases, for instance, for the implementation of IoT use cases as presented in [FVH18]. In *Gryphon*, the process designer can define event queries in BPMN message events. When the case model is deployed to *Chimera*, the event types and queries given in the message event of the case model are registered in *Unicorn*. As soon as the event is received in Unicorn, it notifies the Chimera engine where it triggers or continues the respective process fragments.

The combination of *Gryphon*, *Chimera*, and *Unicorn* is currently applied in the SMile research project[9] to realize the process of the "wish-time" delivery of parcels. In SMile, the goal is to deliver a parcel at the first try in a so-called *micro-depot*, which is in the close neighbourhood of the recipient. From there the parcel can be delivered by small, local delivery service to the recipient at a desired time frame.

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