1 State-of-the-art

Business Process Management (BPM) [11, 24, 26] is an area of computer science that focuses on studying all aspects of the processes that underlie organizations. A process is typically defined as a structured, measured set of activities designed to produce a specific output for a particular customer or market [5] and can be anything from the assembly of a car in a factory to the treatment of a patient in a hospital. IT plays a big role in the management of such processes: we use software to design, execute and analyse processes and use formal methods from computer science to model our processes unambiguously, allowing us to prove formal correctness properties (e.g. checking that a process model does not contain dead-ends) and design algorithms to improve our processes (e.g. finding the most efficient way of fulfilling the requirements of the process model). [1, 2, 10, 15, 25]

Traditionally, BPM practitioners have used flow-based process notations [23] which describe the order of work as a flow between activities. Such notations are considered suitable for structured work, such as manufacturing processes, because they directly visualize the possible steps in the process and how to proceed from one to the next. However, it has been observed that these notations fall short when one needs to model flexible processes that allow for a large degree of variability: modelling all possible choices as a flow diagram leads to so-called spaghetti models, which contain too many nodes and edges to be understandable by the users. It has been proposed that in these cases it is best to directly model the business rules that give rise to the process using constraint-based notations [12, 19] and then derive the possible steps from those rules when executing the process.

While there is a significant body of work on constraint-based notations, there has as-of-yet been little adoption by industry. In [20] we investigated this issue through a seminar with BPM practitioners where we discovered that they were wary of changing towards the new constraint-based notations because it requires them to make a significant paradigm switch: instead of modelling in terms of the control-flow, they need to model their process in terms of business rules. However, they were interested in combining the new techniques and benefits it offers with the flow-based paradigm that they are used to. We therefore proposed that investigating such hybrid approaches is a worthwhile field of research on its own with many open research questions. The proposal has met with enthusiasm from the academic BPM community and several other researchers have started looking at some of the open questions we identified. [3, 6, 7, 27]

Finally, a new area of the BPM field, called process mining [22], has gained prominence over
the last few years. It is centred around the observation that we tend to model ideal versions of our processes which rarely match reality, therefore we should use records of real-life behaviour and data to guide the design and improvement of process models. In the real world most domains contain both structured and flexible processes and in many cases even a single process can contain both distinctly structured and flexible parts. For example, in hospitals the processes handling patient care may contain both very rigid treatment plans (because they deal with potentially dangerous medicine) and very flexible treatment plans which leave most of the decision making to the doctor so that he may fine-tune the treatment to specific patients. There exists an extensive body of work on process mining for both flow- and constraint-based notations [4, 9, 13, 14, 17, 18, 21] separately, but combining the two paradigms still needs to be investigated. Our initial work in this direction [16] has shown that a hybrid technique will yield more concise and understandable models.

2 Project Goals

The hybrid BPM paradigm has started to come into focus over the past two years [3, 6, 7, 27] with several research groups investigating the open questions that we identified. I plan to take a leading role in this exciting new field of research through the following main activities:

1. Investigate and develop hybrid BPM notations and techniques together with international and local collaborators.

2. Work closely with industrial partners in order to apply and test the research in practice and raise awareness and interest for hybrid technologies.

3. Increase awareness of the hybrid paradigm within academia by a) publishing at high-ranking international venues, b) organizing one or more workshops on the topic of hybrid BPM technologies and c) write a book on the subject together with my collaborators, a common method of dissemination in the BPM field[11, 22, 23, 24, 26].

The research will consist of four focus areas: a) Research into notations for hybrid modelling, done by investigating existing notations and discovering to what extend they exhibit properties of the flow- and constraint-based paradigms, identifying which notations are suitable for the hybrid paradigm and developing new notations. b) Development of techniques such as verification and mining of hybrid models and techniques for combining flow- and constraint-based models. c) Development of suitable guidelines and strategies for working with hybrid BPM technologies. d) Investigation of the requirements for tools that support hybrid modelling notations and methodologies. The research will be centred around the following hypotheses:
1. Allowing practitioners to use constraint-based technologies in addition to (instead of as a replacement for) flow-based technologies will help them adapt to this new paradigm more easily.

2. Combined support for flow- and constraint-based notations will allow modellers to pick the notations most suitable to specific parts of their processes. This in turn will yield more concise and therefore more easily readable and understandable models.

3. Combined support for flow- and constraint-based techniques will allow modellers to use the different paradigms for modelling different perspectives of the same process.

4. Hybrid process mining techniques will allow for the discovery of more easily understandable and more relevant models from real world data.

I will primarily develop the theoretical foundations from which these hypotheses can be tested, i.e. I will develop hybrid notations and their underlying formal mathematical semantics and various algorithmic techniques for verification, improvement and discovery of such models. I will also work towards testing the hypotheses through case studies and seminars with practitioners, facilitated through cooperation with the industrial partner.

The development of hybrid notations and techniques poses a significant challenge to the BPM community [20]. The current paradigms differ on a very elementary level: users of the flow-based approach think about the behaviour of a system and design step-based diagrams, whereas users of the constraint-based approach think about the rules of a system and design constraint-based requirement specifications. To combine the paradigms, a unifying low-level formalism must be found that allows for identifying flow- and constraint-based parts of a process. Existing techniques and methodologies will need to be adapted to allow for combining these very different points of view on a process and capitalize on their individual strengths. Another major challenge, which remains a hotly debated topic in the community, is to identify for which scenarios one paradigm is more suitable than the other. For example in the field of process mining, to construct a meaningful hybrid model from real-world behaviour, it is critical that we successfully identify which parts of the observed behaviour are modelled best in the flow- or constraint-based paradigm.

The resulting notations and techniques will form the basis from which industrial parties can develop software tools that support flow-, constraint-based and mixed process models, which in turn will enhance process support for the business community at large. We have seen the need for hybrid techniques confirmed in a recent project with the Danish mortgage credit institute BRFkredit, where the process modellers were interested in using constraint-based notations, but also wanted to be able of viewing their processes in the familiar flow-based notations [8].
References


