The Chances of including Extrinsic Factors in Business Process Management

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Abstract. Business Process Management *(BPM)* focuses on organizing and improving business processes, whereby a process is a set of temporally ordered activities to achieve a defined goal. Additional perspectives besides the activity are considered to better adapt the process environment. However, the process environment is currently restricted to these perspectives. In the era of digitalization, the amount of produced and stored data expanded massively, but the information is not used in *BPM* yet. Hence, it must be investigated how these new information or *extrinsic factors* influence process execution and can be utilized with respect to *BPM* in general.

Keywords: Process Modelling, Process Discovery, Business Process Management, Context Aware Information Systems

1 Introduction and Motivation

A process model contains the execution order of activities of a process as a minimum requirement. However, most of the agile and flexible processes are described more accurate by including additional information. The flexibility of processes is investigated in [7]. To improve *BPM*, multiperspective process models are aiming at a more fine-grained adaption of the process' environment as this environment tend to be in fact rather varying than static. Currently, the multiperspective process model concerns five perspectives including for instance *who* is executing a task, *auxiliary tools* for completing a task or certain *data attributes* which are produced or consumed by activities [5]. The question that arose in this case asks, if the current process design is sufficient or if the consideration of even more information bear chances to lift *BPM* to a new level.

The research area of *BPM* is several years old and certainly the world has underwent a huge change since then. The volume of produced data is exploding reasoning from recent developments in electronic data processing (scalable computation and storage, *IaaS*). Using this technical infrastructure as catalyst, digitalization marks the start of a new era in industry and affects our personal and professional lives. The internetworking of physical devices in production (*IoT*) in conjunction with the acquisition and storage of a vast amount of data opens up new possibilities. The analysis of this *Big Data* has entered many areas

in economics and science yet, but is not excessively investigated in *BPM* since now. [6] provides an overview of potential synergy effects concerning *IoT* and *BPM*. The data affecting the process environment is more specified in Sect. 2 and suggestions for a target-oriented analyses w.r.t. *BPM* are proposed.

2 Extrinsic Factors and enclosed Chances and Challenges

To convey an initial feeling for whereof extrinsic factors can be generated from, a few examples of data sources are given in this section with a first proposal of a possible categorization.

Process Related Data is produced near the task execution itself regarding the physical proximity as well as from a logical point of view. For instance, IT-systems can capture information like the specification of devices in use for the task execution (performance indicators, display sizes, operating systems, etc.) or the bandwidth capacity when mobile devices are used within a network.

Organization Internal Data comprises all information belonging to the superior entity of process execution, e.g. a company or departments of government institutes. Examples are the prevailing temperature within a production hall, which affects the manufacturing process (quality of products, cycle times, etc.), conditions of stocks in internal warehouses or shift schedules coming from ERP-systems.

Organization External Data are not further restricted. OpenData-Initiatives follow the trend to provide public access to certain data. Several governments published demographic data, which can be included in process management as well as traffic data or tendencies on (finance) markets. In general, every data source not related to the superior entity of process execution can be used.

The following paragraph points out the dissociation of extrinsic factors and common data attributes. Some characteristics of extrinsic factors are shared with the commonly known data attribute in the multiperspective process model. Despite this certain resemblance, it is totally worth and necessary to distinguish data attributes from extrinsic factors for mainly two reasons.

Semantic Point of View. The core peculiarity of data attributes is the strong correlation to the process instance and the executed activity respectively. For instance, assume a fine management system for road traffic violations. Based on the level of fee to pay, the admonished person may prefer different payment options. The data attribute (fee) is thereby decisive for further execution and further mandatory for a valid process instance. In contrast, extrinsic factors have a rather global point of view on the process and are present even without a certain execution of the process. However, the factors may still influence the process. Moreover, the data attribute constitutes often one single value per one executed activity.

Technical Point of View. Most solutions reach their limits w.r.t. an efficient discovery of a model in the context of Process Mining, especially when considering a second perspective like the organizational perspective or the data attribute. Taking into account much more information will probably cause performance drops so considerations concerning this matter are required.

The following gives an overview of open questions and challenges regarding the implementation of extrinsic factors in *BPM*.

Selection of Extrinsic Factors. One core challenge is the selection of extrinsic factors, which actually do have an impact on the process. As stated, extrinsic factors comprise a variety of possible influence factors, whereas the characteristic of a process is usually restricted to a single domain. The variety forbids a brute-force approach to execute correlation analysis of any factor with the process model regarding the performance – at least with conventional computation methods.

Skilful combinations of multivariate statistical approaches with *Visual Analytics* techniques (see below) must be employed.

Semantic Challenges. What questions can we answer with the help of extrinsic factors? This problem touches almost every application case in the world of data science, and so is necessary to ask in the field of *BPM*. In [2] and [1] the process environment is used to optimize the control flow of processes. As stated, extrinsic factors do not correspond to single activities. Thus, they may also affect different perspectives of activities, like resources or the lifecycle of an execution (throughput or idle times). The extrinsic factors may also prevent processes from its execution while completely different processes are running. It has to be investigated, how current *BPM* supports this variety of information gain or how design or discovery purposes must be adapted.

Technical Challenges. Especially in context of declarative process mining, including extrinsic factors into the calculations poses a challenge regarding the performance. Even without concerning extrinsic factors, most of current solutions cannot finish in reasonable time. Hence, the computing time must be taken into account. A first approach to tackle this issue using *Big Data* technology was presented in [8].

Data Quality. Most of the time when using Data Science technology on a vast volume of data, the analysis is accompanied with trust issues. Algorithms are used as a black box and the computation model often bears a lack of transparency. The input information is badly subjected to quality services, although input information is untrustworthy and wrong or even too less input data causes wrong output information. Furthermore, the quality of the output data can suffer from bias, for instance when using a limited sample set from the whole recorded data in statistical analysis like in [4].

Visual Analytics. Visual Analytics is an interdisciplinary field providing interesting approaches helping analysts to investigate big-sized and especially multivariate data. These ideas can help to support conveying discovered

correlations and dependencies or can even applied in discovery procedures. A first approach is presented in [3].

Process Life Cycle. The vast amount and variety of data is not manageable in the *design phase*. However, in a re-design phase, when extrinsic factors were determined and the influence was disclosed within a preceded process mining step, process models may incorporate extrinsic factors. Therefore, it has to be investigated, if current *modelling* approaches must be extended to be able to denote the additional information. The (technical) difficulties of *process mining* were stated above and in an *optimization* step, extrinsic factors and process information can be included both in machine learning algorithms to automatically submit proposals for improvements to process scientists.

3   Conclusion

Business Process Management focuses on optimizing business processes. However, the high availability of data through digitalization or *IoT* is exploited only marginally since now. Current research considers process environment but shows drawbacks w.r.t. performance, quality of output data or the scope of the analysis. Thus, it has to be investigated how to boost the performance and which additional questions can be answered by *BPM* with extrinsic factors.

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