Batching vs. Non-batching in Business Processes

Challenges with regards to Batch Activities in Business Processes

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Abstract: A common phenomenon in operational business processes is batch processing. Batching is used to reduce cost or time by collectively executing several cases at specific activities in a business process. Recently, approaches were developed to explicitly design and execute batch activities in business process models, and to mine batch work from historic process execution logs. Process redesign suggests organizations to evaluate which activity should be designed in a case-based or batch-oriented fashion. However, it is not discussed how such an analysis should be conducted. This paper discusses current challenges on this topic. Further, it proposes a preliminary methodology for identifying beneficial batch activities and their configuration.

Keywords: process models; batch activity; process redesign

1 Introduction

For running a successful business, organizations strive for operation excellence in running their business processes to reduce costs, to improve productivity, as well as to increase customer satisfaction. Documenting, analyzing, improving, and automating business processes are key activities in this regards [Du13]. The main artifact in BPM (business process management) are process models which capture business processes with a process modeling language, e.g., BPMN (Business Process Model and Notation).

Batch processing is a common phenomenon in operational processes to reduce costs or processing time. Batching implies that several cases are collected at specific activities to process them as a group. For instance, in logistics, it is more cost-efficient to combine parcels to be sent to the same recipient instead of handling each one separately. Although batching of products or customers is well discussed in operations research [PK00, Me02], in BPM this concept is not well considered and discussed so far. The common assumption is that each process case “is assumed to have an independent existence and they typically execute without reference to each other"[Ru05].

Recently, approaches have been developed which enable modeling and executing batch activities in business processes [PMW14, Na15, PRM16]. Moreover, process mining

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techniques were proposed to identify batch activities from historic process execution information [Ma17b, We13]. Such approaches help to depict batch activities explicitly in process models and to identify them from historic logs. However, they do not discuss which batch activities are beneficial for a business process, and which are not. Process redesign literature suggests that it might be helpful for some processes to remove activities with batching, but in others it might be beneficial to introduce batching to improve the process flow time or cost [RM05]. Details on how to operationalize this recommendation are absent. In this paper, we discuss challenges in identifying beneficial batch activities and their configuration in Section 2. To this end, we highlight related work which can be leveraged and identify research gaps. Further, a preliminary methodology is sketched in Section 3.

2 Major Challenges in Identifying Batch Activities

This section discusses four challenges related to the identification existing or new batch activities (challenges 1 and 3), the evaluation of their benefits (challenge 2) and the identification of an optimal batch configuration (challenge 4).

Challenge 1 - Identification of existing batch activities. Process redesign usually starts with an as-is-analysis where the current process design is analyzed [Du13]. For discussing existing batch activities, recent approaches by Pufahl et al. [PMW14] or by Natschläger et al. [Na15] help to visualize them in a process model, also with their configuration.

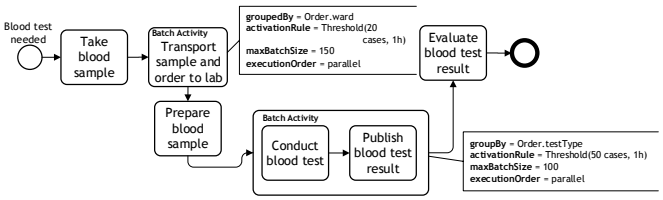

Fig. 1: Blood testing process with two batch activities.

For example, in Fig. 1 a healthcare process with two batch activities is visualized as a BPMN diagram. In this process, a blood sample is taken from a patient, if a blood test is needed. Then, the sample is brought to the laboratory where the blood sample is prepared for testing. The actual test is conducted by a blood analysis machine. After the test, the results are published in the central hospital information system, where they are accessible by the physicians for evaluation in the respecting ward. Within the given process, two batch activities are specified. As several blood test orders incur at a ward, the nurse will not bring each blood sample individually. Instead, she delivers several ones together to save transportation cost. This is captured by the batch activity *Transport sample and order to lab*. The second batch activity is the sub-process which consists of two activities and enables to collect multiple blood samples before a test run on a blood analysis machine is started. With the configuration parameters of a batch activity [PMW14], a process designer can specify the batch execution: which instances are grouped in a batch (*groupedBy*), when a batch is started (*activationRule*), how

many instances are allowed at maximum in a batch (*maxBatchSize*), and how the batch is executed, either parallel or sequential (*executionOrder*).

The first challenge relates to the identification of existing batch activities. Several complementary information sources can be used. Batch activities can be discovered together with process experts using interviews or workshops [Du13], or based on observations. However, in more flexible processes, extensive interviews or observations might be required. In this respect, techniques to automatically discover batching behavior from historic process execution data can be used [Ma17b, We13]. The insights retrieved using such techniques are determined by the level of granularity at which historic logs are recorded. Note that the expertise from process experts is still required to validate the findings from data.

Challenge 2 - Batching vs. no batching. After having identified existing batch activities, the benefit of batching needs to be determined. On the one hand, batch activities help to reduce costs or activity execution time by processing several cases collectively. In the blood testing process, machine costs can be saved. On the other hand, instances might experience increased cycle times as it requires certain time to fill a batch [PK00].

The challenge is to define performance indicators for batch activities with regards to the four performance dimensions cost, time, quality, and flexibility [Du13]. Examples are *activity costs*, *batch size*, *cycle time* detailed by the *turnaround time*[3] and *waiting time* at a batch activity [Pu18]. For each scenario, the appropriate performance indicators need to be identified. These ones then need to be measured, e.g., based on historical process execution data, and need to be interpreted to determine whether to continue with batching or not, and if yes, whether the current batch configuration should be improved (as is discussed in fourth challenge).

Challenge 3 - Hidden potential batch activities. Besides existing batch activities, potential new ones could also be identified. The challenge is how to identify beneficial candidates.

Two types of batch activities are distinguished: sequential and parallel ones. For parallel batch activities, where several items are processed simultaneously, a resource has to be able to process them at the same time. Thus, the resource perspective has to considered in such an analysis. For sequential batching, the resource still processes the cases individually, but setup times are reduced because the activity is executed on multiple cases one after the other. This requires a detailed analysis how much time during an activity execution is spent for getting familiar with the task or for setting it up and the actual execution. Potential new batch activity candidates need to be evaluated with regards to performance indicators as well. This can be supported by business process simulation. In [PWW17], an extensible BPMN process simulator was developed also supporting the simulation of batch activities.

Challenge 4 - Recommendations on batch activity configurations. Finally, after defining the batch activities for a business process, these also need an optimal configuration which

[3] Time an activity instance spends for batch execution, from waiting for it until its termination.

consists of a grouping parameter, an activation rule, a maximum batch size, and the execution order. While the latter two parameters are mainly dependent on the resource handling the batch activity, the grouping parameter depends on the type of cases being processed. The batch activation rule enables striking a balance between cost benefits and the influence of batching on process performance. While initial approaches have been developed to mine the current execution order and batch activation rule from process execution data [Ma17a], the recommendation of appropriate batch configuration parameters is still a challenge. This requires the development of simulation-optimization approaches or the usage of techniques from queuing theory [Me02] which might be supported by works on queuing mining [Se15].

3 Methodology for Integrating Batch Activities

Taking into account the challenges in Section 2, a preliminary methodology to integrate batch activities in business processes is proposed in Fig. 2.

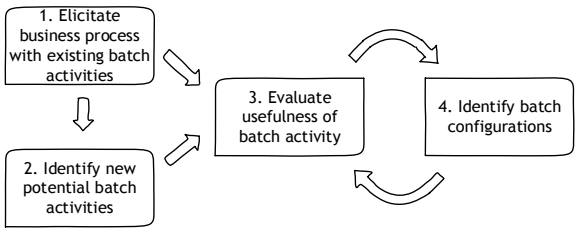

Fig. 2: Preliminary methodology for integrating batch activities.

If a business process is analyzed regarding its potential for batch activities, the business process should be first elicited with known process discovery techniques, such as evidence-based, interview-based, or workshop-based discovery [Du13]. Thereby, existing batch activities should be depicted in the process model, for instance, with the batch activity element presented in [PMW14]. Process mining techniques [vdA11, Ma17b] can support this step. Additionally, new potential batch activities can be identified in second step with the support of resource information, process execution data and expert knowledge. In the third step, the usefulness of the identified batch activities has to be evaluated. To this end, performance indicators for the batch activities have to be defined. Then, those are evaluated based on historic and/or simulated execution data. After having identified potentially useful batch activities, in the last step, their optimal batch configuration has to be determined. This step needs to be supported by simulation-optimization approaches.

4 Conclusion

In this paper, we motivated the necessity of batch activities in business process modeling. Moreover, we discussed the challenges of identifying existing batch activities and potential new ones, evaluating their benefit as well as configuring them correctly. Based on this, a

preliminary methodology was deduced for integrating batch activities in business processes. This will be developed further in future work by the authors.

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