Associative Intelligence for Object-Centric Process Mining with MPM (Extended Abstract)

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***Abstract*—Complex processes nowadays are analyzed and improved with process mining software. Despite the high analytics quality of commercial tools like MEHRWERK ProcessMining (MPM), process mining projects often face a substantial problem: the need to determine one case identifier to align all events into one process variant. This "one case notion" complicates projects as it does not adhere to reality. Object-centric process mining (OCPM) relaxes the "one case notion" and allows the definition of process instances by objects that interact with each other. Due to this, OCPM represents processes more realistically. Commercial tools need to fully implement the concept of OCPM into their software functionalities to make its advantages of complexity reduction, simplification of data and event log modeling and thus gained understanding available to a vast group of industrial users. Therefore, the software MPM is extended with OCPM and proposes first approaches to handle topics like conformance checking, inter-object influence, or object-attribute analysis.**

***Index Terms*—Object-Centric Process Mining (OCPM), Conformance Checking, MEHRWERK ProcessMining (MPM)**

I. Introduction

The motivation to overcome the problems of traditional process mining originates from the work of Wil van der Aalst [1], which is based on the concepts of multi-entity and artifact-centric process mining [2].

MPM is (to our knowledge) the first self-service business intelligence based process mining tool to include OCPM as a feature. A strong advantage is that it is based on the Qlik © Sense platform with its associative engine which provides an intuitive way of analyzing (multi-object) processes which is shown in a collection of case studies[1].

The demo application created with the OCPM-data set "running example"[2] is provided for testing purposes. The mentioned data set was chosen to allow comparison with other approaches, such as [1]. The OCPM feature was also tested with SAP Order-to-Cash and Purchase-to-Pay, as well as Oracle Invoice-to-Cash processes and several ready-to-use event logs. The scalability for OCPM proved to be the same as for traditional process mining.

II. OCPM for MPM - Why and How

Following the idea of OCPM, it is no longer necessary to determine one case ID for several objects that interact in a process instance. In a traditional event log, each event is related to one activity, one timestamp, and one case (i.e., a process instance). Taking a look at the example of a customer order given by van der Aalst [1], the concept of OCPM becomes clear: The process can be analyzed from different perspectives - orders, items or packages. These objects are interlinked, for example some items can be sent together in one package, others separately or even with another order. The traditional process mining approach would only focus on one perspective which can lead to certain disadvantages:

1) Loops in the process graph that lead to huge complexity. Taking the order as case ID, the process step of "picking the item" will occur for every item in the order.
2) Duplicated events lead to skewed process performance indicators such as the number of process steps or automation rates, if not carefully modeled. If the item is picked as case ID, the process step "place order" would occur for every item-case and thus suggesting a much higher number of order creations.
3) The need to aggregate information. One order with multiple packages only has an aggregated delivery time (traditional) instead of having multiple delivery cases with their respective time (OCPM).

The discovered object-centric directly-follows graph (DFG) is shown in figure 1. The order to cash process displayed consists of three colored objects: orders - *golden*, items - *blue* and packages - *dark grey*. Activities are colored like the object that causes them, arcs like the interacting object. When objects interact they make use of the same activity as can be seen at the blue node "pick item" which obviously originates from the item object but also is part of the package process, since a not-picked item cannot be put into a package. The object-centric DFG is more comprehensive than the traditional spaghetti-like DFG on the same event log. This underlines the large advantage and is the main reason for developing OCPM for MPM. Through OCPM the number of process variants is significantly reduced, since loops are largely eliminated and no events from other object types can interfere. Thus, the need to drill down into process data and analyzing only reduced subsets is obsolete. This unlocks important information that was previously hidden and could not be used to generate actionable insights. Additionally, the frequencies shown on the

[1]https://mpm-processmining.com/en/casestudy-access-en/

[2]https://github.com/Javert899/pm4py-mdl/blob/master/example_logs/mdl/mdl-running-example.mdl

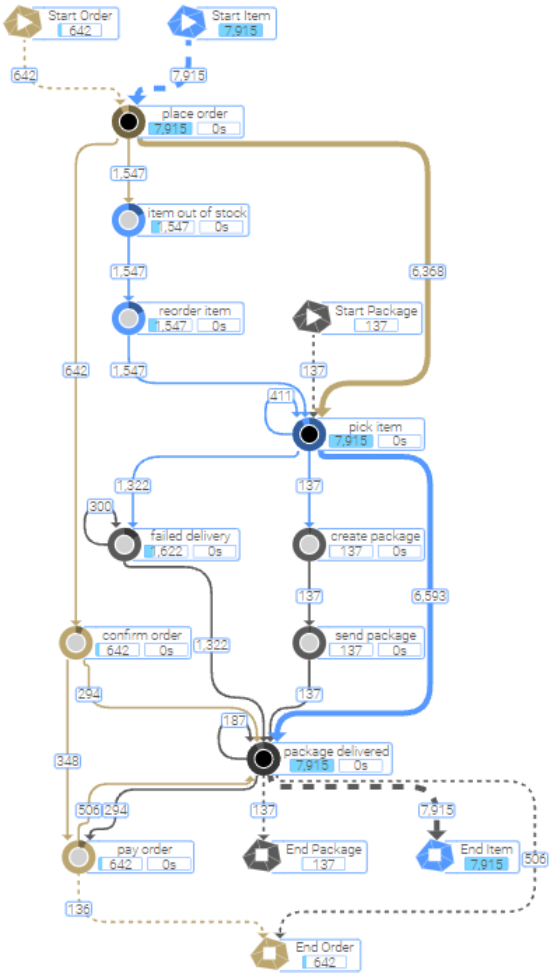

Fig. 1. MPM's object-centric process graph for three process objects

graph are correct.

III. Innovation and Main Features

Besides the fully interactive and customizable object-centric process graph - which is an adaption of existing research results - the innovations intended to broaden the topic of OCPM in the process mining community are the application of conformance checking on object-centric event logs, the provision and use of object attributes for analysis, and the investigation of the influence between the object types.

The MPM Conformance Checking module [3] integrates seamlessly with OCPM, as it is able to consider different case-properties when aligning the process model. Every object type can be "conformance checked" against its own or a global/traditional process model. The interaction of object types can be taken into account by including the specific process steps in both objects. The influence of one object type's conformance to another one's is related by the linkage of these objects. An object-centric conformance checking approach derives more precise results because the process deviations can be allocated directly to single objects and not to a consortium of objects bundled into a case. In the demo application this becomes clear as the overall process governance would have been 91.6% whilst the process governance for the order objects is 77.0%, 73.4% for the item and 90.5% for the package objects. Thus, it is shown that the traditional approach would not have detected the root cause of process deviations in item- and order-processing.

As MPM is using its synergies with Qlik©, the other two objectives can be reached. Issues regarding data modelling such as the linkage of different objects can be easily tackled [4]. With the Qlik© Associative Engine it is possible to discover relations in even vast amounts of data due to a patented in-memory technology [5]. Following this, context information can be used unaggregated per object type. Until now developers had to decide whether to provide information per event (not necessarily available for entire case analysis and the filtering influenced the process graph) or as a fuzzy assignment to the traditional case ID. MPM-based OCPM gives the freedom to attach such information to an object case, whereas it can be available not only to the object itself but also to the other related objects. The demo video[3] demonstrates how each object's attributes are available for analysis and how the influence between the object types is assessed by only using the power of the associative engine for OCPM.

Since certain analysis is dependent on the modelling of object interaction, MPM overcomes the downside of insufficient modelling by calculating the traditional model as well, e.g., to identify maverick buying (invoice posted before order) the invoice activity has to be defined in the order object, otherwise the pattern can't be found easily.

IV. Conclusion

The motivation for OCPM-based MPM is a more comprehensive, less complex process analysis with simpler data and event modeling and thus, better quality. It simplifies process mining projects and increases the acceptance of process mining in organizations. To make OCPM enterprise-ready, traditional functionalities like conformance checking, the use of object attributes for analysis and the investigation of inter-object relations have to be included which is presented in this demo. Further research and development is still required, like simple information representation of the different objects to reduce the entry-barrier for OCPM-based process mining.

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