Metamodel of the Artifact-Centric Approach to Event Log Extraction from ERP Systems

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ABSTRACT

Enterprise Resource Planning (ERP) systems handle a huge amount of data related to the actual execution of business processes and the goal is to discover from transaction log a model of how the business processes are actually carried out. The authors’ work captures the knowledge of existing approaches and tools in converting the data from transaction logs to event logs for process mining techniques. They conduct a detailed analysis of the artifact-centric approach concepts and describe its constructs by the ontological metamodel. The underlying logical and semantically rich structure of the approach is presented through the model definition. The paper specifies how concepts of the data source are mapped onto the concept of the event log. Dynamics NAV ERP system is used as an example to illustrate the data-oriented structure of ERP system.

KEYWORDS

Data Conversion, Dynamics NAV, ERP System, Event Log, Metamodel, Process Mining

1. INTRODUCTION

Organizations adopt information systems to manage the everyday large volume of operations and information. Enterprise Resource Planning (ERP), Customer Relation Management (CRM) and Workflow Management systems (WfMS) are some of the best known and most widely used systems. ERP systems handle a huge amount of data related to the actual execution of business processes and have a particular way of recording activities. Analyzing this data helps us to gain insights into process execution and to identify the gaps between how the systems are planned to be used and how the employees actually carry out the operations. To truly understand these end-to-end processes, a solution is needed that can pull information from ERP systems and other enterprise information systems event logs.

Process mining refers to techniques that go over event log structures to discover the real business flows in a company. It provides the ability to view critical process milestones, link detailed information to them and to understand deviations (Ingvaldsen & Gulla, 2006). Researches have applied process mining on event logs from real-life workflow information systems, where processes are automatically stored (Goedertier, De Weerdt, Martens, Vanthienen, & Baesens, 2011; Rebuge & Ferreira, 2012). However, ERP systems provide transaction logs where business processes are not exposed. In ERP systems, data related to a particular business process is stored across multiple tables and tables are connected through key relationships. As van der Aalst (2015) pointed out there are no explicit references to events and process instances. The challenge is to translate the existing raw data from the table structure of ERP system to event log structures. Extracting ERP data requires in-depth knowledge of complex table structure and understanding of ERP tables, fields, and table joins. Little
research has been conducted on transaction logs in ERP systems, and most of the publications taking on this issue describe ERP system as a promising domain for process mining (Jansen-Vullers, van der Aalst, & Rosemann, 2006; Ingvaldsen, 2011).

In this paper, we focus on the definition of the extraction as a first step in data extraction process. The extraction definition specifies how concepts of the data source are mapped onto the concept of the event log. The decisions made in the mapping phase influence on the resulting event log to a large extend. The paper discusses how business objects, events, and their relations can be defined for the extraction process of raw data from ERP systems into event log structures for process mining project. Description of constructs will be presented by the ontological metamodel. We first describe characteristics of Microsoft Dynamics NAV ERP transaction data and address the challenges related to applying process mining on transaction logs. In ERP systems, like Microsoft Dynamics NAV system, the central elements in logs are transactions and a transaction can be applied in the context of multiple business processes. There are potential many-to-many relationships between transaction and business process definition. The artifact-centric approach assumes that a process is driven by multiple collaborative artifacts (Fahland, De Leoni, Van Dongen, & van der Aalst, 2011). Each artifact (data objects) has its own execution and can be related to other artifacts. The artifact-centric approach is more suitable for ERP systems since ERP systems generally comprise many complex business processes of an entire organization. Section 3 presents different approaches to the log extraction problem found in the literature. In section 4, we introduce an ontological metamodel for supporting the artifact-centric approach of log extraction in pre-processing phase, with rich logical structure and semantics of its relationships. The resulting metamodel captures information about the concepts, constraints, and rules used in transforming the raw data from ERP systems into event log structures. Section 5 follows with a discussion of results and ideas for future work.

2. ERP TRANSACTION DATA AND PROCESS MINING

ERP systems are integrated software solutions that help companies manage important backbone operations. Operations areas are provided as customizable modules in ERP systems that reflect best practice for common business processes (Mesbahi, Kazar, Benharzallah, Zoubeidi, & Bourekka, 2015). Such best practices of business processes can be presented by ERP- specific process reference models. The function richness of ERP systems makes its reference process model complex and hard to understand.

A few large vendors dominate the global ERP market. SAP is the most widely used ERP system with the total market share of 25 percent in 2014. Microsoft Dynamics NAV is on the fifth position with 5 percent of market share (Columbus, 2014). Microsoft Dynamics NAV is an ERP system for small and medium-sized enterprises. It is globally present, and more than 100,000 organizations use Microsoft Dynamics NAV to support daily operations. Even though the ERP system Microsoft Dynamics NAV is widely used, an overall reference model for Microsoft Dynamics NAV has not yet been published by Microsoft. Pajk (2012) described a purchase reference model on two levels. The design is based on Dynamics NAV system educational material and the author’s personal experiences in ERP solution implementation projects. A general overview of purchase processes is presented on the first level. The second level describes purchase posting transactions.

Recent research has shown that ERP implementation rate of success is quite low and initial problems occur in the utilization of information systems after their implementation (Pantelić, Pajić, Bečejski-Vujaklija, & Vujosević, 2013). Companies use ERP systems to support their business processes and they need to verify that systems are configured appropriately. The actual business
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