Tell Me What's My Business - Development of a Business Model Mining Software

Visionary Paper

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Abstract. Decision-making, innovation and transformation of business models require organizations to precisely understand their current status-quo business model. However, traditional top-down approaches to business model visualization are human-centric, "de jure", subjective, error-prone, and time-consuming. In contrast, bottom-up Business Model Mining collects and consolidates different sources of business model-related data and presents business models in predefined templates such as the Business Model Canvas. This paper employs a design science approach to develop a Business Model Mining Software to automatically mine business models bottom-up from enterprise resource planning systems. First, this paper discusses weaknesses of traditional top-down approaches to business model visualization and the potential by data-driven approaches. Second, this paper derives meta-requirements and design principles as theoretical foundations to conceptualize the business model mining software. Third, this paper instantiates the "Business Model Miner" in Microsoft PowerBI as a working software based on data from three real-life SAP R/3 ERP-systems of a manufacturing corporation.

Keywords: Business Model Mining · Business Model Canvas
Enterprise Resource Planning (ERP) Systems · Design science

1 Introduction

Organizations navigate in environments characterized by a multitude of changes in business, technologies, and individuals (e.g., [1]). Exemplary "megatrends" such as the "Big Data Era", Globalization, the "Internet of Things", Big Data, Social Media, Connectivity, the Sharing Economy, Individualization, or Mobility trends require organizations to continuously reinvent themselves and their business models through the provision of new products, services, or a combination of both. Besides competitive necessities to redefine the organizational value creation and to satisfy customer demands to remain competitive (e.g., [2]), organization science with the seminal contingency theory by Donaldson [3] highlights the need to adapt the organizational design including business models to match both internal and external variables in response to environmental change.

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However, decision-making in business model innovation and transformation requires a precise understanding of the current status-quo business model. This paper follows the definition proposed by Osterwalder and Pigneur [4] and defines a business model as a description of "the rationale of how an organization creates, delivers, and captures value". To visualize business models, academia and practice developed a rich pageant of different modelling methods, techniques, and tools to visualize business models (e.g., [5]). As a core obstacle in business model transformation, these traditional top-down approaches are subjective, human-centered, and "de jure" by relying on manual inputs and tacit knowledge of individual decision-makers. Thus, traditional top-down approaches to business model creation are expensive and time-consuming in their creation, error-prone, superficial, and potentially suffer from biases to the "system reality". In addition, the prevailing de jure approaches such as the widely accepted "Business Model Canvas" (BMC) by Osterwalder [6] provide rather high-level and strategic inputs, which are less focused on the actual operationalization of the business model [7] and thus only of limited use in business model innovation and transformation. Further, to increase the value of business modelling, strategic inputs need to be connected to the operational layer such as business processes (e.g., [7, 8]).

To overcome these outlined weaknesses, the "Big Data Era" provides significant potential for bottom-up and data-driven approaches to improve business modelling and decision-making. In his contribution, van der Aalst et al. in [9] coined the term "Mine Your Own Business" and proposed to use process mining and big data for decision making. As an extension, we aim to contribute to this proposal by using big data to mine business models of organizations. For example, new technologies such as data- or process mining allow to complement traditional top-down approaches to business modelling (e.g., [10]). Besides, enterprise resource planning (ERP) systems play a major role in organizations [11]. For example, ERP-systems such as the SAP Business Suite or Oracle are information systems are implemented by organizations to increase automation and to integrate business processes and information within one common infrastructure [12]. Organizational information systems including ERP-, Supply Chain Management (SCM), Customer Relation Management (CRM), or Workflow Management (WfM) systems generate large amounts of business-related data during operations (e.g., [13]), and cover the entire range of business processes in the organization [14]. Thus, such data can be used in business model mining [15] comparably to other data mining approaches such as process mining [16]. With the term "Business Model Mining" [15], we refer to approaches to mine business models from information systems and to visualize them in templates such as the BMC. Thereby, Business Model Mining has the potential to enrich and to supplement top-down, "de jure" business modelling approaches with bottom-up, data-driven and "de facto" knowledge on business models. In sum, the research question of this paper becomes:

RQ: "How to design a business model mining software to retrieve business models bottom-up from data stored in information systems?"

To answer the research question, this paper employs a design science approach to design the software artifact of the "Business Model Miner" to mine a BMC automatically from enterprise resource planning (ERP) systems such as the SAP R/3

Business Suite. To the best of our knowledge, the artifact in this paper is the first software being able to retrieve a BMC from ERP-systems.

The remainder of this paper is organized as follows. Section 2 briefly introduces the design science research methodology. Section 3 presents meta-requirements for business model mining and derives design principles to develop the conceptualization for business model mining. Section 4 presents the instantiation of the "Business Model Miner" in Microsoft SQL and Microsoft PowerBI for SAP R/3 ERP-systems. Section 5 concludes by presenting limitations and avenues for future research.

2 Research Methodology

Design science research aims to systematically conceptualize and develop artifacts in order to solve real-world problems [17]. To develop the "Business Model Miner", we employ a design science research (DSR) approach based on the methodology proposed by Kuechler and Vaishnavi [18] and consists of a problem awareness, suggestion, development, and an evaluation phase. In the initial problem awareness phase of design cycle one, we conduct a series of discovery workshops at the industry partner of this research to discover the weaknesses of de jure approaches to business modelling and the arising need for bottom-up business model mining. In the suggestion phase, we derive a set of preliminary meta-requirements for the business model mining concept in preceding research [15], which we refine in this paper with adjacent design principles and design decisions. In the development phase, we instantiate the conceptualization in a working prototype of the "Business Model Miner". Finally, as each of the approaches is associated with particular strengths and weaknesses, we hypothesize that the combination of both human, tacit knowledge on business models together with data-driven inputs from information systems significantly improves business modelling. However, design science requires at the forefront to solidly evaluate the Business Model Miner artifact in terms of whether the software actually provides superior or complementary inputs. Thus, we evaluate the Business Model Miner at three companies with a pool of thirty department managers by comparison of top-down, tool-based, and mixed workshops and individual sessions. Thus, in the evaluation phase, the prototype will be evaluated in terms of the ability to complement or outperform traditional approaches by comparison against "golden standard" business models derived in expert workshops with department responsibles at the industry partner.

3 Meta-Requirements and Design Principles

We derive three meta-requirements (MRs) and associated design principles (DPs) for business model mining in research preceding the development of the final "Business Model Miner" in this paper. This section refines these preliminary MRs and DPs identified in the previous contribution by Augenstein and Fleig [15]. We enhance the meta-requirements based on a series of workshops with IT and business model experts from the IT service provider of the industry partnership underlying this research.

First, business model mining requires data from information systems and the software artifact needs knowledge on which data provides the relevant inputs for which of the building blocks of the business model. Thus, MR1 demands:

MR1: "To mine business models bottom-up from information systems, business model-related data needs to be identified and retrieved".

Second, business model mining extracts large amounts of data from various sources such as multiple ERP-systems, which store business model-related data across numerous data tables. In addition, organizations frequently have more than one ERP-system in place. Thus, these different data sources need to be consolidated and prepared for later visualization of the business model in the Canvas and for analysis. Thus, MR2 imposes the following requirement on Business Model Mining:

MR2: "To mine business models from information systems, different sources of business model-related data need to be consolidated."

Third, the business model needs to be represented in a uniform template such as the BMC for the algorithms to be able to retrieve and visualize business models. Therefore, MR3 requires:

MR3: "To mine and analyze different business models from information systems, business models need to be visualized in a predefined template."

Based on these three meta-requirements, we introduce three associated design principles. First, to be able to retrieve the building blocks of the BMC, the relevant data tables in the ERP-system need to be identified, extracted, and connected via primary keys. Thus, business model-related data in one or more ERP systems is identified and extracted in individual files to account for MR1 in a "ERP-Systems Layer". We formulate the first design principle accordingly:

DP1: "Business Model Mining requires an ERP-systems layer to extract and identify relevant data"

Second, business model data needs to be merged in one central database and preparatory steps and scripting needs to be performed to account for MR2. Thus, the "Data Consolidation, Scripting, and Preparation Layer" merges for later visualization of the business models in the canvas. We formulate the second design principle as follows:

DP2: "Business Model Mining requires a database layer to consolidate and prepare business model-related data"

Third, MR3 requires the visualization in a predefined template. In particular, the BMC by Osterwalder [4] has gained significant popularity in both academia and practice. In general, the goal of business model tools is to provide a complete, transparent, and easy-to-understand representation of the business model [15, 19]. We formulate the final design principle as:

DP3: "Business Model Mining requires a presentation layer to present business models in a predefined business model template and provide additional analysis functionality"

Thus, the "Business Model Presentation Layer" visualizes the business model in the canvas template and provides additional functionality such as the calculation of indicators, time and company filters, or word clouds. The Canvas contains 9 building blocks which try to capture and structure the business model into a predefined template. Therefore, the Canvas serves as the template for the later surface of the Business Model Miner. For each of the building blocks, we introduce one or several proxies which reflects the definition of the building block and which can be computed from data stored in information systems in accordance with the contribution by Osterwalder and Pigneur [4]. "*Customers and Suppliers*" captures people and organizations targeted by the business model. Further, "*Value Propositions*" comprises the products and services through which the business model creates value for the customer segments. "*Channels*" collects the different ways of how organization communicates and how the value propositions are delivered to customers. "*Customer Relationships*" defines the type of customer relationships such as customer retention and acquisition. "*Revenue Streams*" gathers the different types of revenue generated by the business model. "*Key Resources*" represents the assets which are vital for the business model. "*Key Activities*" is the building block of the canvas which captures the "most important actions" which need to be done. "*Key Partnerships*" comprises the pool of suppliers and partners in the value chain of the organization to enable the business model through resource acquisition (e.g., purchasing materials). "*Cost Structure*" captures the most important expenditures incurred for carrying out the business model. Table 1 contains an overview over the proxies chosen for each building block.

Table 1. Proxies from information systems for building blocks of the BMC

BMC building block	Proxies ("design decisions")
Key activities	Matching of executed transactions in the ERP-system ("event log") to the APQC process framework [20] and counting number of executions, the number of human users related to process execution, the involvement of a customer or supplier in the transaction, or the value of sales or purchases linked to the transaction
Value proposition	Amount and value of products and services sold (product groups and hierarchies)
Customer relationships	Value generated with customers; repeat buying/single transactions; duration of customer relationships
Channels	Amount and value of products and services sold over distribution channels
Customer segments	Customer industries; customer classifications; geographic customer information
Revenue structure	Main revenues from balance sheets
Key resources	Most highly valued tangible and intangible assets
Cost structure	Main expenditures from balance sheets
Key partners	Supplier industries; geographic supplier information; duration of supplier relationships

In sum, these meta-requirements and design principles serve as the theoretical guidelines during the actual development of the Business Model Miner. The following paragraph presents results from the implementation of the Business Model Miner, which retrieves data from an SAP-ERP system (DP1), consolidates and prepares data in a Microsoft SQL Server database (DP2), and visualizes the BMC in Microsoft PowerBI (DP3). Figure 1 illustrates the blueprint of the technical implementation of the Business Model Miner based on the meta-requirements and design principles.

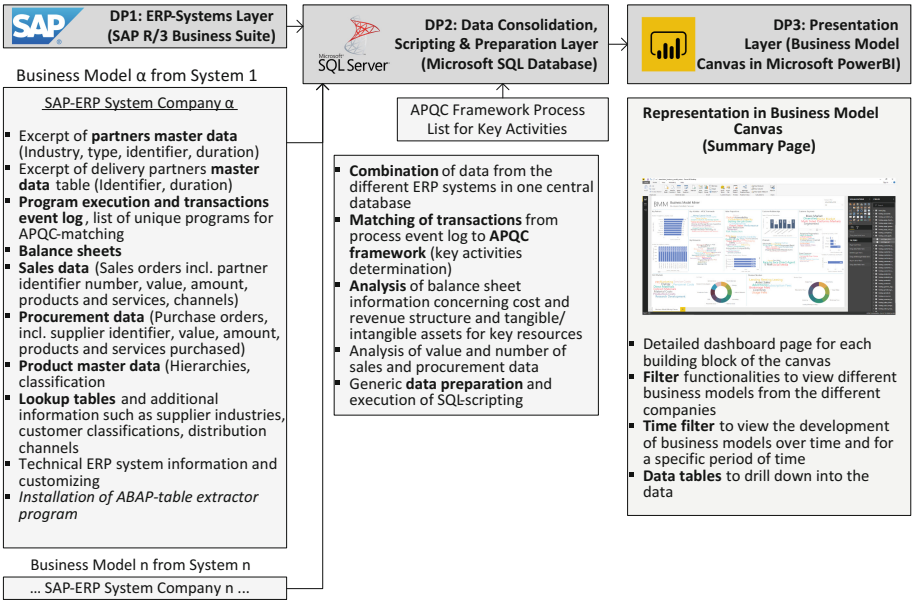

Fig. 1. Blueprint conceptualization and implementation of the business model miner for one or multiple SAP R/3 ERP systems and visualization of the BMC in Microsoft PowerBI

4 The Business Model Miner

We implement the instantiation of the Business Model Miner based on data from three real-world SAP R/3 ERP-systems from a German manufacturing corporation. The corporation consists of five individual companies with about 8,200 employees in 22 countries and 45 locations. The corporation is active in business-to-business and business-to-customer markets of various industrial areas and achieved a turnover of about 1.2 billion Euro in 2016. We retrieved business model mining data for three sub-companies for a period between 2010 and 2017. Each company is implemented on one SAP system, such that the business model of the particular company can be distinguished along the boundaries of the respective SAP systems.

For each building block of the Canvas, the tool presents word clouds and diagrams. The size of the tags in the word clouds is scaled according to values such as sales or

purchase values or numbers such as the volume of products sold or purchased. Users can adjust the level of details and specify the number of elements to be displayed in the word clouds and dashboards (e.g., the top N for each of the proxies). Besides, the screen contains a company to filter to select the business model of one or more individual companies. Further, the date filter allows to select business models over a specific period of time. Each of the visualization dashboards provides the ability of Microsoft PowerBI to filter distinct elements and associated data. For each of the building blocks, an additional detailed analysis dashboard page with further visualizations and drill-down possibilities is provided. Figure 2 contains the instantiation in Microsoft PowerBI based on a randomization of values for reasons of company compliance.

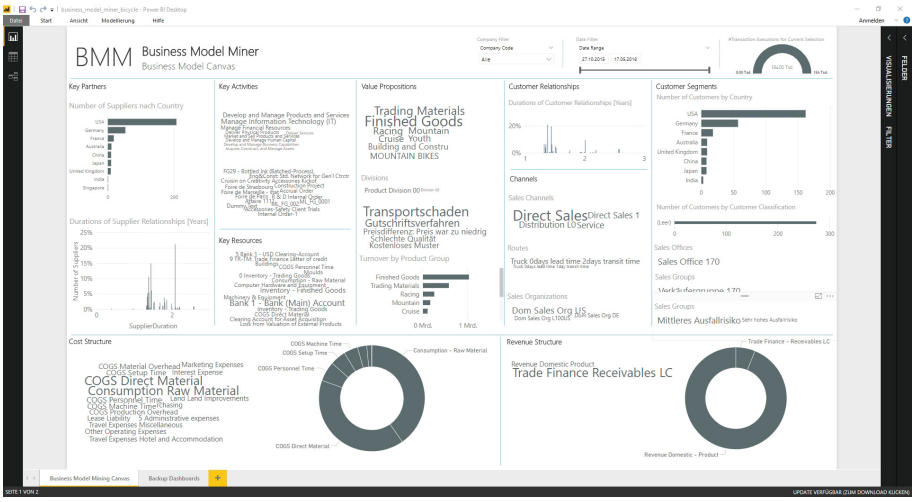

Fig. 2. Business model canvas dashboard of the business model miner *(randomized values)*

5 Conclusion and Outlook

This paper proposes the "Business Model Miner" to mine a BMC from SAP R/3 ERP-systems and to improve transformation decision-making in the "Big Data Era". However, the approach to derive business models bottom-up from data in ERP systems also encounters several limitations. First and comparable to "shadow processes" in process mining, business model mining captures only the elements of the business model which are stored or executed in information systems. Therefore, business model mining fails to include business model-related elements outside of systems such as paper-based processes, or intangible parts of the value proposition which are not documented in systems. Second, organizations might have more than one business model. In future research, we aim to explore how to distinguish among different business models in one ERP system. As a take-away from these limitations, we

position business model mining as a bottom-up "stimulus" to enrich and to complement the traditional top-down, human-centered approaches. Business Model Mining complements rather than replaces traditional "de jure" business modelling techniques with a "de facto" and data-driven approach to retrieve the business model automatically from information systems. Based on this Forum paper, we aim to provide the community with both an innovative Business Model Mining concept and the actual implementation in a working piece of software. The state of research of this paper also paves the way for future research avenues. The "mining" capabilities of the tool can be improved by means of artificial intelligence to replace some of "reporting" functionality with more elaborate business model discovery techniques. Finally, our SAP table extraction program allows to export data close to real-time. Thus, we aim to provide another version of the Business Model Miner to support "Real-Time Business Model Mining".

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