Process Mining for Business Process Standardization in ERP Implementation Projects – An SAP S/4 HANA Case Study from Manufacturing

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Abstract. Organizations increasingly build operations on enterprise resource planning (ERP) systems. However, ERP implementation projects require significant process transformation and standardization to successfully use ERP systems. This paper presents experiences from a case study in a manufacturing corporation to demonstrate how process mining can be used for process s decision-making in an SAP S/4 HANA ERP implementation project. In particular, the corporation tested process mining for the analysis of the SAP purchase-to-pay ("Purchasing") and the order-to-cash ("Sales") processes to determine whether the future to-be process should be standardized according to ERP standards, or to be individualized in a corporate-specific template. Further, process mining can be used to select suitable standard process specifications from process databases such as the SAP Best Practices Explorer, as well as to analyze the required process changes before the launch of the new ERP system.

Keywords: Process Mining, Process Standardization, ERP Implementation Projects, SAP S/4 HANA

1 Introduction

Organizations increasingly utilize information systems such as Enterprise Resource Planning (ERP) to support operations [1], and abundant practical experiences as well as academic contributions reveal significant potential of ERP systems for business process improvement and reengineering [2]–[4].

ERP systems are commercial information systems for the automation and integration of organizational business processes [5] to obtain a holistic overview of companies [6]. ERP systems enable companies to streamline business processes and to exchange information efficiently and effectively both within and across company boundaries [10]. Implementation goals range from reducing costs [9], increasing the overall organizational performance [11], or enabling new business models [11] to reengineering business processes in response to environmental change [12]. Organiza-

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tions further implement ERP systems to integrate and consolidate information and geographically [7] or functionally separate units (e.g., [8]-[9]). Further, ERP systems enable the integration and standardization of business processes by implementing them in a common underlying architecture [7].

However, implementation projects of ERP systems are frequently considered as failures (e.g., [13]). Although figures vary considerably, practitioners classify implementation projects in twenty-one [14] to seventy-five percent of cases [15] as failed. Even though both practitioners and academics have focused on researching and improving approaches for ERP implementation projects, the overall success rate of ERP implementation projects remains considerably low [16] due to the inherent complexity, resource intensity in terms of required financial investment, time, management challenges, risks, or the number of employees involved (e.g., [8], [9]).

In particular, research finds business process transformation and reengineering activities as necessary prerequisites before the actual ERP implementation project [17]–[20]. To contribute to the outlined problems in ERP implementations, this industry paper proposes to use process mining for improved transformation decision-making. Process mining is a technique for the discovery, monitoring, and the improvement of business processes through the extraction of process knowledge from event log data in information systems [21]. Process mining supports decision-making by allowing data-driven analyses of business processes, and to reduce the resources required for projects. Nevertheless, although process mining reached a state of maturity with numerous different solutions such as Celonis, Fluxicon, Lana Labs, QPR, or Signavio available in the market [22], the "post-mining" phase which is concerned with translating findings from process mining into actual decisions remains both a research gap as well as a significant challenge for organizations.

Thus, this paper demonstrates in the context of a large-scale SAP S/4 HANA ERP implementation project in a manufacturing corporation how process mining can be utilized to standardize business process across several companies. In particular, by applying process mining in the SAP S/4 HANA project to select suitable standard processes and to discover business-essential process variants which need to be implemented in the future process design in the new ERP system, this paper delivers an example of how process mining can effectively support process decision-making.

2 Project Background and Expectations to Process Mining

To explore how process mining can be used in ERP implementation projects, an industry cooperation with the IT service provider of a German small to medium-sized manufacturing corporation was formed to conduct the research in a real-life ERP implementation project. In 2017, the manufacturing corporation consisted of five companies operating globally with more than 8.200 employees and about 1,2bn Euro in turnover in 22 countries.

In the course of the standardization project, the group of companies wants to harmonize the existing, diversified SAP R/3 landscape to a uniform landscape under SAP S/4 HANA in order to support the goal of process standardization with an ERP plat-

form. The aim of the project is to develop a holistic approach for the introduction and use of the new SAP software for the entire group of companies, which standardizes as many processes as possible, provided this is economically and organizationally possible. At the same time, the project also regards the trade-off between standardization and business-critical individualization for the individual companies, and allows for individual non-standard process designs if these are decisive for business success.

Fig. 1 illustrates the standardization-individualization framework. At the one end of the spectrum, processes suitable for corporate-wide standardization such as administrative, support or service functions are located in a "shared services" sphere without any deviations from the corporate standard. At the other end of the spectrum, business-essential processes such as the production of individual products or sales processes which are part of the individual "DNA" of a company and which may not be standardized without threatening the ability of a company to serve markets are located in the individualization sphere. In between, processes which are neither suitable for perfect standardization, but which offer the potential for some degree of harmonization are located in the harmonization sphere between standardization and individualization.

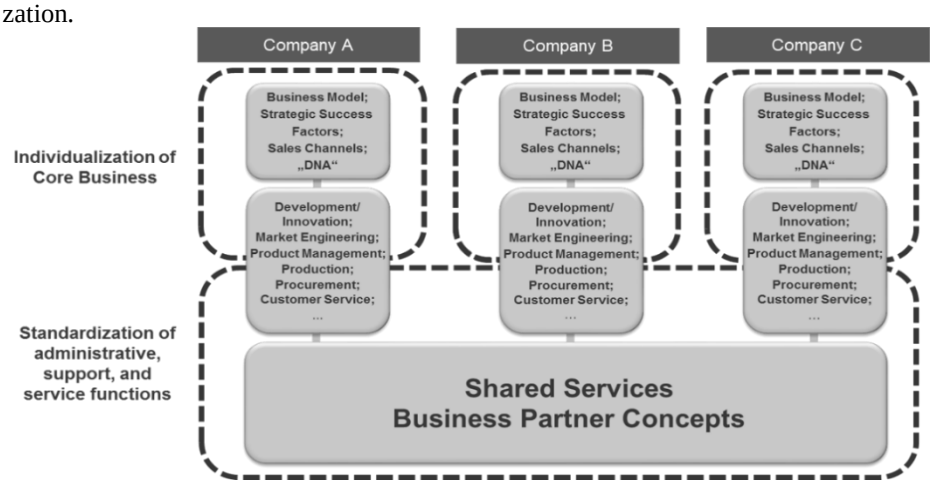

Fig. 1. Process Standardization vs. Individualization across Companies in the new ERP System

In particular, when making transformation decisions on standardization or individualization, the question arises as to where this makes economic sense and does not jeopardize competitiveness. Process Mining helps the process owners to identify necessary process variants and to consider them as an allowed deviation from the standard process specification when designing the future process design.

For process decision-making in this context, the process mining proof-of-concept was expected to deliver several data-driven inputs. First, the process mining approach was expected to support the project as it provides the possibility to explore all process variants as well as to drill-down to the individual case. Second, process mining was implemented to provide an analysis of whether the business processes contain variants critical for business success which need to be reflected in the future standard process specification in the S/4 HANA Business Suite. Third, process mining provides de-

tailed comparisons of the individual process specifications between the different companies, as well as performance indicators to compare which process specifications achieve the best result and should be taken as the future corporate standard in the SAP S/4 HANA landscape. Fourth, the ERP vendor provides different possible standard specifications for the S/4 HANA system, among which the corporation is required to select the most suitable design. Fifth, to contribute to the standard process selection, process mining further allows to compare business processes and their variants against the different standard specifications to decide which standard is a candidate for implementation, to implement required deviations from the standard, and to estimate changes and impacts on the organizations before the actual implementation.

However, due to limited IT budgets and the inability to implement all business processes in a process mining solution, the question of which business processes are suitable candidate processes for implementation becomes crucial. Thus, we implemented the decision support system "KeyPro" in the SAP ERP systems of the corporation. "KeyPro" provides analyses of log data and matches ERP transactions to business processes to automatically discover important processes along several importance dimensions such as the number of executions, process stakeholders, the involvement of customers or suppliers in the process, or the process being classified as a primary or secondary business process [23]. As a result of the KeyPro analysis, the SAP Purchase-to-Pay ("Purchasing") and the Order-to-Cash ("Sales") processes were selected for implementation in a process mining solution, as these are the business processes with the highest number of executions, a high number of employees involved in the processes, and a high degree of external partners involved.

However, to be able to compare business processes from different companies, the landscape of ERP-systems including their related systems and addons, as well as individual applications involved in the processes needs to be taken into account before implementing the process mining solution.

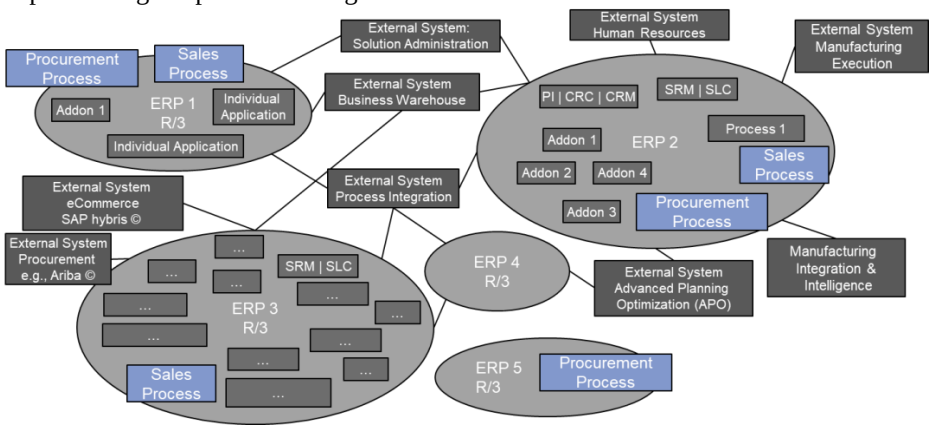

Fig. 2. ERP Systems Landscape as Boundary Conditions for Process Mining

For example, organizations frequently operate multi-ERP environments, such that business processes span several ERP systems with additional add-ons and self-developed "Z"-applications involved. These company-specific requirements impede

the out-of-the-box implementation of process mining solutions and increase required budgets both in terms of time and consulting capacities required. As experienced in the project, the major challenges in the implementation were different process designs and the requirement to adapt the solution to company specificities.

3 Process Mining Application in the SAP S/4 HANA Project

To mine and compare business processes and their variants, the manufacturing corporation implemented a process mining solution in a proof of concept project for the SAP Purchase-to-Pay ("Purchasing") and the Order-to-Cash ("Sales") processes.

To answer the outlined process decisions, the corporation envisioned the following procedure. Due to space restrictions, the following section describes the application for the procurement process. Process mining application for the sales process is performed analogously.

To determine whether the procurement process should be standardized or individualized, two process mining analyses are performed. First, procurement responsibles design several possible individual corporate-specific to-be procurement process templates (right hand-side of Fig. 3), which are to be compared against the individual as-is process variants of the different companies in the corporation.

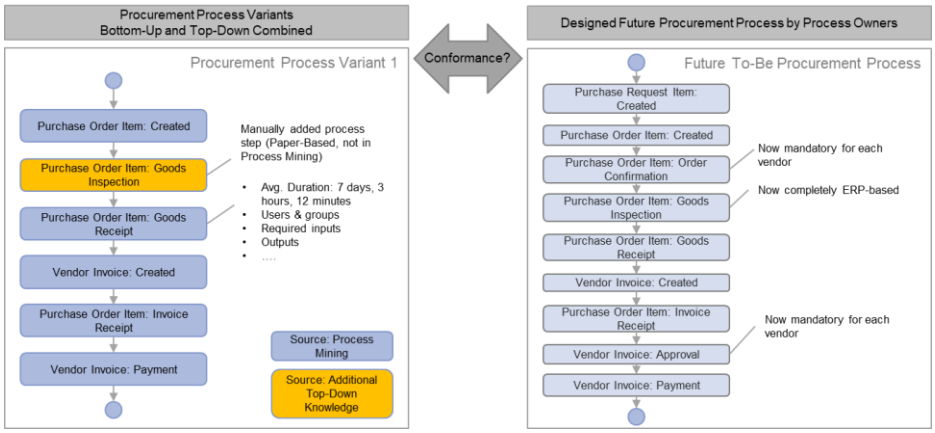

Fig. 3. Example for Variant-Level Comparison of As-Is Process against To-Be Process Designs

For the most important variants which cover at least 80% of cases, each variant of the as-is process is enriched with additional top-down process information such as shadow process steps and then compared against the to-be process to determine whether the variant is compatible with the to-be process in terms of completeness and desirability. In case the variant contains a critical characteristic which needs to be reflected in the template of the to-be process, the future to-be process designs are amended. As a result of this first step, a final "corporate procurement process template" with the highest degree of fit is selected for implementation in terms of expected performance and the degree of organizational change required.

Second, process mining results from the different companies are compared on the variant-level against the database of various possible standard processes by the ERP system vendor in the “SAP Best Practices Explorer” database. For example, for the procurement process, the ERP provider delivers 12 different standard process specifications in BPMN 2.0 notation in the “Operational Purchasing” domain for the on-premise version of SAP S/4 HANA.

As a final step, the two solutions should be compared in the future course of the project and evaluated in terms of whether the individual corporate-level template should be implemented, or whether the corporation should implement the SAP standard processes with local adaptations.

During application of the approach, several issues occurred. First, the expected number of variants to be analyzed was significantly higher than expected. Second, although the process mining solution provided the number of variant occurrences as a metric for which variant should be analyzed, it did not provide a more elaborate measure of the significance of a particular variant for the organizational value creation such as monetary impact, business criticality etc. In principle, the question of which variants need to be reflected in the future process design requires process owners to analyze each process variant. However, the effort to screen each variant in the pool of several thousand different variants and determine their business criticality is virtually impossible. Thus, the risk of “forgetting” a business-essential variant remains despite the use of process mining. Furthermore, a deeper analysis of results revealed issues concerning correctness and completeness of process models, which lead to a general discussion on trust and reliability of the process mining approach in the project team. For process mining research, a takeaway lies in the importance of trust among users in the technology. In particular for companies without previous experience in data-driven process analysis, failed process mining implementation projects might potentially “burn” the idea for the future due to missing trust into process mining results.

4 Conclusion

These experiences in the project reveal an important future research direction for process mining in terms of the “post-mining” phase to translate findings from process mining into organizational decisions to improve the value contribution. Data-driven process analyses offer the potential to significantly improve process decision-making. While typical top-down process documentation in companies is usually limited to the most common variants and the ideal flow of the process, the use of process mining allows all variants to be included in the decision to decide whether a process should be individualized or standardized. Traditional top-down transformation decisions unrelated to data in the ERP systems which usually neglect a high number of these variants are therefore highly likely to lead to a decision that is detrimental to the company. For example, ignoring vital process variants which the company needs to provide its competitive processes and products might lead to the "killing" of a competitive advantage. However, the applicability of the process mining approach with regard

to other business processes apart from sales and procurement might be limited by the availability of tools supporting other processes, as well as the number of (non-standard) tables in the ERP system involved in the respective process. Further, other process types such as Finance processes which occur in a rather transactional way instead of a process flow of several steps as it is the case in sales and procurement might be unsuitable for the presented approach.

In sum, although the implementation of the process mining solution required considerable monetary and managerial resources, managers reported confidence in the data-driven decision-making. In particular, managers highlighted the ability of process mining to support the selection of a suitable standard process and to allow for analyses of the required changes to the process before the implementation of the new standard process. Also, managers valued the identification of the most occurring variants and the determination of business-essential process variants such as customer- or supplier-specific process flows. Besides, process mining allows organizations to improve ERP implementation projects with the ability to perform a root cause analysis of deviations from to-be processes and to analyze process improvement potentials such as manual efforts or data issues. The assessment of these variants in terms of performance KPIs allows for improvement activities during the ERP project when the new to-be process is designed or selected. Finally, managers stated the process mining project helped them in advancing BPM as a core capability of the organization, and to increase the "process-oriented thinking" of their employees and themselves.

References

[1] M. Fischer, D. Heim, C. Janiesch, and A. Winkelmann, "Assessing process fit in ERP implementation projects: A methodological approach," in *Lecture Notes in Computer Science*, 2017, pp. 3–20.

[2] S. Finney and M. Corbett, "ERP implementation: a compilation and analysis of critical success factors," *Bus. Process Manag. J.*, vol. 13, no. 3, pp. 329–347, Jun. 2007.

[3] M. del R. Pérez-Salazar, I. Rivera, and I. M. Cristóbal-Vázquez, "ERP selection: a literature review," *Int. J. Ind. Syst. Eng.*, vol. 13, no. 3, pp. 309–324, Jan. 2013.

[4] A.-W. Scheer and F. Habermann, "Enterprise resource planning: making ERP a success," *Commun. ACM*, vol. 43, no. 4, pp. 57–61, Apr. 2000.

[5] T. F. Gattiker and D. L. Goodhue, "What Happens After ERP Implementation: Understanding the Impact of Interdependence and Differentiation on Plant-level Outcomes," *MIS Q.*, vol. 29, no. 3, pp. 559–585, Sep. 2005.

[6] I. C. Ehie and M. Madsen, "Identifying critical issues in enterprise resource planning (ERP) implementation," *Comput. Ind.*, vol. 56, no. 6, pp. 545–557, Aug. 2005.

[7] J. Benders, R. Batenburg, and H. van der Blonk, "Sticking to standards; technical and other isomorphic pressures in deploying ERP-systems," *Inf. Manag.*, vol. 43, no. 2, pp. 194–203, Mar. 2006.

[8] D. Hwang and H. Min, “Identifying the drivers of enterprise resource planning and assessing its impacts on supply chain performances,” *Ind. Manag. Data Syst.*, vol. 115, no. 3, pp. 541–569, Apr. 2015.

[9] S. P. Laughlin, “An ERP Game Plan,” *J. Bus. Strategy*, vol. 20, no. 1, pp. 32–37, Jan. 1999.

[10] J. Lee, K. Siau, and S. Hong, “Enterprise integration with ERP and EAI,” *Commun. ACM*, vol. 46, no. 2, pp. 54–60, Feb. 2003.

[11] R. Poston and S. Grabski, “Financial impacts of enterprise resource planning implementations,” *Int. J. Account. Inf. Syst.*, vol. 2, no. 4, pp. 271–294, Dec. 2001.

[12] P. Rajagopal, “An innovation—diffusion view of implementation of enterprise resource planning (ERP) systems and development of a research model,” *Inf. Manag.*, vol. 40, no. 2, pp. 87–114, Dec. 2002.

[13] CIO, “15 Famous ERP Disasters, Dustups, and Disappointments,” 2017. [Online]. Available: https://www.cio.com/article/2429865/enterprise-resource-planning/enterprise-resource-planning-10-famous-erp-disasters-dustups-and-disappointments.html.

[14] Panorama Consulting Solutions, “Key Findings From the 2015 ERP Report,” 2015. [Online]. Available: https://www.panorama-consulting.com/key-findings-from-the-2015-erp-report/.

[15] Deloitte, “Your guide to a successful ERP journey: Top 10 change management challenges for Enterprise Resource Planning Implementations,” 2015. [Online]. Available: https://www2.deloitte.com/content/dam/Deloitte/mx/Documents/human-capital/01_ERP_Top10_Challenges.pdf.

[16] A. Zhong Liu and P. B. Seddon, “Understanding how project critical success factors affect organizational benefits from enterprise systems,” *Bus. Process Manag. J.*, vol. 15, no. 5, pp. 716–743, Sep. 2009.

[17] V. Botta-Genoulaz, P.-A. Millet, and B. Grabot, “A survey on the recent research literature on ERP systems,” *Comput. Ind.*, vol. 56, no. 6, pp. 510–522, Aug. 2005.

[18] B. Kocaoglu and A. Z. Acar, “Developing an ERP Triggered Business Process Improvement Cycle from a Case Company,” *Procedia - Soc. Behav. Sci.*, vol. 181, pp. 107–114, May 2015.

[19] T. C. Loh and S. C. L. Koh *, “Critical elements for a successful enterprise resource planning implementation in small-and medium-sized enterprises,” *Int. J. Prod. Res.*, vol. 42, no. 17, pp. 3433–3455, Sep. 2004.

[20] E. J. Umble, R. R. Haft, and M. M. Umble, “Enterprise resource planning: Implementation procedures and critical success factors,” *Eur. J. Oper. Res.*, vol. 146, no. 2, pp. 241–257, Apr. 2003.

[21] W. van der Aalst *et al.*, “Process Mining Manifesto,” 2012, pp. 169–194.

[22] Gartner, “Gartner Market Guide Process Mining 2018,” 2018. [Online]. Available: https://www.gartner.com/doc/3870291/market-guide-process-mining. [Accessed: 26-May-2018].

[23] C. Fleig, D. Augenstein, and A. Maedche, “KeyPro - A Decision Support System for Discovering Important Business Processes in Information Systems,” in *CAiSE 2018 Forum and Doctoral Consortium Papers*, 2018.