[εm] – Process Analysis using a Meta Modeling Tool

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Abstract. Increasing complexity in business processes and the resulting missing manageability are one of the main issues in business process management today. Process owners do not only have to keep track of one aspect of a process (e.g. the correct input and output, the efficiency or the compliance) but of combinations of these. In turn, these aspects are influenced by several possible factors throughout the whole process. Often occurring adjustments and fast changing regulations raise the complexity of monitoring even more. As the manual analysis becomes more and more infeasible, automatic analysis tools are required that support responsible persons in this task. Here, our meta modeling tool [εm] comes into play. For analysis, [εm] enables the user to define specific patterns that describe issues to be detected in business process models. [εm] can search these issues automatically by means of an included algorithm and present the detected parts. Currently existing tools often lack a wide applicability (i.e. only support one modeling language), only allow rather simple patterns or are too difficult to use. The demo presents the flexible applicability of the tool and how it can be used by modeling experts as well as domain experts to benefit from its wide-ranging functionality. Based on a continuous example, the support of arbitrary modeling languages, the creation of complex patterns by using the graphical user interface, and the search of these patterns in business process models are presented.

Keywords: Meta Modeling, Process Analysis, Compliance Checking

1 BPM and the Need of Tool Support

Business processes have indisputably risen from a side issue in companies to one of the key factors for a company's success, and the function perspective ("work in silos") gets more and more deprecated [1]. However, business processes are not self-propelling. Long-term efficiency and cost savings based on the process perspective are not raising out of nowhere. Quite the contrary: the appropriate management of business processes is the key to gain money in the long run and entails certain effort. Business process management (BPM) is not only the one-time documentation of real processes in a company. BPM includes the "design, enactment, management, and analysis of operational business processes" [2]. However, the increasing complexity of companies inevitably leads to a higher amount of more complex business processes. In turn, companies can

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only generate value from their business processes, if the business process management is qualified to handle this constantly raising effort. Besides the process documentation, in particular the analysis and governance of business processes gains complexity [3].

The approaches and tools that aim to enable and support the business process management in companies, as well as their application areas, are manifold. While tools for the modeling of business processes are widely available, the analysis segment is not so abundantly equipped. The tools that are equipped with an automated analysis support for business process models are often not flexible enough [4, 5]. While Business Process Model and Notation (BPMN) is the de facto standard for process modeling today, the reality is quite more diverse. The landscape of existing modeling languages is large and the applied language or language type often differs within companies (e.g., the usage of BPMN elements may even differ from modeler to modeler). Furthermore, most of the tools only detect very simple issues [5]. They enable the user to detect simple structures, such as predecessors or successors, splits and joins, or a label of a process step. But when it comes to longer paths, different labels and forbidden nodes, most tools do not live up to the challenge. Another important aspect for the practical applicability is the usability of these tools. Most of them require a certain knowledge of complex and mainly textual modeling notations [6].

Thus, our tool tries to address these issues to provide support for real-world business process management, not only for modeling experts but also for domain experts.

2 [εm] in Detail

[εm] has been developed over years according to the Design Science methodology of Peffers et al. [7]. Still, this is the first comprehensive presentation of the tool in academia, showing the whole workflow from meta modeling to process analysis. The initially mentioned problem of the growing complexity of business processes in combination with more and more aspects to prove, gave birth to the idea of [εm]. To not build "just another modeling tool", the wide applicability, the support of complex and flexible patterns as well as the ease of use has been a focus during the development.

[εm] exploits the advantages of meta modeling [8]. Due to this fact, all constructs in our tool follow a predefined "construction manual" that strictly constitutes, what is possible to model, and what is not. The clue: this construction manual can be freely defined by any user. This enables the user to use an arbitrary modeling language for creating process models. There are predefined common languages available, but one can also create new ones.

Once a modeling language is defined, not only models but also so-called patterns can be created. Patterns represent (real-world) issues, consisting of nodes and edges that are to be detected in the process models. For that, a powerful graphical pattern editor is integrated, which provides the user with a multitude of possibilities on how to represent the desired issue by a pattern. For both, the nodes and the edges, the editor provides a lot of adjustment options. The most important options for nodes are captions (to search particular terms like *print* or *invoice* in process models) and the typing (to search only for events, tasks etc.). A node can have an arbitrary number of captions and

types. It is also possible to define one pattern for more than one language. In that case, one would have to choose multiple languages (e.g., BPMN and the Event-driven Process Chain (EPC)), and select types of both languages (i.e., task and function) for a node. Nodes can also be set as forbidden, so that such a node must not exist within a process model. The most important options for edges are the direction and the "extension" of an edge to a path. While an edge only connects two adjacent nodes, a path denotes that several other nodes may be located in-between the two previously specified ones. Additionally, the path can be further particularized with several options (such as forbidding specific element like events on it). A main option here is the *pattern on path* setting. It enables the user to require or forbid other complete patterns that have been created within [εm]. More complex considerations such as calculations (*Are incoming probabilities 100 % in sum?*) or comparisons (*Is a document used twice within a process?*) are supported by global rules.

For the analysis of the process models (by means of detecting the constructed patterns), [εm] makes use of graph theory. Eventually, an implemented graph matching algorithm can detect the patterns within the process models [9].

In summary, [εm] aims to address the mentioned problems, by combining the constructs of meta modeling and graph theory. The tool itself and its documentation are freely available on the internet.[1]

3 [εm] in Use – Currently and in the Future

The development is a lively and ongoing process and design improvements are made continuously. The prototype has been used and evaluated in research projects and was part of several publications.

The usual procedure of analyzing process models comprises the language definition, the process model creation (or import), the pattern creation (or import) and, eventually, the search of patterns within the models. This procedure is exemplary shown in our 20-minute screencast describing the tool, which accompanies this paper.[2]

Due to its flexibility and its wide application possibilities, [εm] was used in several use cases in research projects and is subject to several publications. For business process improvement, it was used in a study to create over 100 patterns denoting improvement potential for business processes and to analyze process models of companies of different domains (retail, supply, consulting and logistics) with over 8000 single nodes. The results of the study are partly shown by Delfmann and Höhenberger [10].

Another use case is compliance checking. Within a study with a bank service provider, Becker et al. identified 49 potential compliance violations in its process models by analyzing a process model landscape consisting of over 21000 single nodes [11].

Another, completely different domain is form checking. In an experiment, Höhenberger and Scholta transformed governmental forms into a specially developed language in [εm] and searched for inconsistencies and legislation violations described by patterns [12].

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[1] See http://em.uni-muenster.de/ for software downloads and user guide

[2] Screencast available from http://em.uni-muenster.de/videos/

Currently, we are transforming an unstructured process landscape of an association for working safety into the model structures of [εm]. Within this project we also define potential weaknesses with experts and continuously analyze the process models. Automatic continuous analysis will enable organizations to prove they meet compliance regulations at any time.

In the near future, we will provide a freely accessible catalog of the developed process weakness patterns of the first study, as well as a catalog of the compliance patterns used in the second study. Furthermore, import modules for further standardized modeling languages, such as BPMN or EPC in its different types, are planned.

References

1. Weske, M.: Business Process Management - Concepts, Languages, Architectures. Springer, Berlin/Heidelberg, Germany (2012).
2. van der Aalst, W.M.P., ter Hofstede, A.H.M., Weske, M.: Business Process Management: A Survey. In: Business Process Management. pp. 1–12. Springer, Berlin/Heidelberg, Germany (2003).
3. Rinderle-Ma, S., Ly, L.T., Dadam, P.: Business Process Compliance (Aktuelles Schlagwort). In: Proceedings of the EMISA 2008. Sankt Augustin, Germany (2008).
4. Rosemann, M., Vessey, I.: Toward Improving the Relevance of Information Systems Research to Practice: The Role of Applicability Checks. MIS Q. 31, 1–22 (2008).
5. Becker, J., Delfmann, P., Eggert, M., Schwittay, S.: Generalizability and Applicability of Model-Based Business Process Compliance-Checking Approaches - A State-of-the-Art Analysis and Research Roadmap. BuR - Bus. Res. 5, 221–247 (2012).
6. Höhenberger, S., Riehle, D.M., Delfmann, P.: From Legislation to Potential Compliance Violations in Business Processes - Simplicity Matters. In: Proceedings of the 24th European Conference on Information Systems (ECIS). Istanbul, Turkey (2016).
7. Peffers, K., Tuunanen, T., Rothenberger, M.A., Chatterjee, S.: A Design Science Research Methodology for Information Systems Research. J. Manag. Inf. Syst. 24, 45–77 (2007).
8. Strahringer, S.: Metamodellierung als Instrument des Methodenvergleichs - Eine Evaluierung am Beispiel objektorientierter Analysemethoden. Shaker, Herzogenrath, Germany (1996).
9. Delfmann, P., Breuker, D., Matzner, M., Becker, J.: Supporting Information Systems Analysis Through Conceptual Model Query – The Diagramed Model Query Language (DMQL). Commun. Assoc. Inf. Syst. 37, 473-509 (2015).
10. Delfmann, P., Höhenberger, S.: Supporting Business Process Improvement through Business Process Weakness Pattern Collections. In: Proceedings of the WI 2015, pp. 378–392. Osnabrück, Germany (2015).
11. Becker, J., Bergener, P., Delfmann, P., Burkhard, W.: Modeling and Checking Business Process Compliance Rules in the Financial Sector. In: ICIS 2011 Proceedings, pp. 2291–2310. Shanghai, China (2011).
12. Höhenberger, S., Scholta, H.: Will Government Forms Ever be Consistent? Detecting Violations in Form Structures by Utilizing Graph Theory. In: Proceedings of the ECIS 2017. Guimarães, Portugal (2017).