(such as Process Model Intersection in [20]), where specialization or instantiation are appropriate design principles. To conclude, although aggregation/configuration is prominent, the pairwise combination of construction and application principle is not automatically given, but depends on the characteristics of the mining technique.

The analysis in Section 3.3 also shows that the instantiation principle is underrepresented in Reference Model Mining. Only if the reference model is constructed by means of process abstraction, the target models may be derived by means of instantiation. This is due to the fact that most existing approaches to Reference Model Mining are not capable of handling input models with varying degrees of abstraction. Hence, the abstraction level remains the same across all the input models and the reference model. The generic placeholder elements necessary for instantiation cannot be derived from differing, but more specific input models.

Our analysis also reveals that currently there exists no applicable technique for deriving the reference model by means of aggregation. That is because aggregation draws on several conceptual models covering different aspects of the situational context that are to be composed in the target model. None of the existing mining techniques is explicitly set out to mine several different reference models covering different aspects of the defined domain. However, such a scenario is realistic, for example when the reference model is supposed to cover a large domain, which should be divided into sub-domains to ensure the reference model applicability.

In this contribution we draw on the five principles configuration, instantiation, specialization, aggregation and analogy, as defined in [2]. However, these are not the only principles to be considered for reference model design. For example, Delfmann suggests modification as another design principle, allowing all changes to the reference model that do not result in erroneous or inconsistent models [7]. Besides that, principles like elimination or union might also be useful for reference model design. Elimination would allow designers to delete unnecessary elements from a reference model, whereas union would merge several models, without aggregating their contents.

Our analysis of existing mining techniques in Table 1 also acts as a gap analysis, identifying further research potentials and objectives and allowing for a more structural design of new mining techniques. The main motivation for this contribution is to increase the practical applicability of Reference Model Mining. Currently, there exist a number of publications that focus on technical and methodical aspects, as well as a few implementations, but few concrete suggestions for their application. By coining the term “Situational Reference Model Mining”, we emphasize that the choice of technique is relevant, i.e. they cannot always be interchangeably used. The procedure model, in combination with the analysis of existing techniques, is supposed to be a guideline for both reference modeling researchers and practitioners. However, it has not yet been evaluated by being applied in a large-scale context. Gaining more experience in practical applications of existing RMM techniques remains one of the major objectives of further reference modeling research. Our underlying assumptions, however, should be critically assessed. For example, in some cases it could make sense to develop situationally adequate target models instead of choosing an appropriate the mining technique.

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References

1. vom Brocke, J.: Referenzmodellierung – Gestaltung und Verteilung von Konstruktionsprozessen. Wirtschaftswissenschaftliche Fakultät. Universität Münster, Münster (2002)
2. vom Brocke, J.: Design Principles for Reference Modeling: Reusing Information Models by Means of Aggregation, Specialisation, Instantiation, and Analogy. In: Fettke, P., Loos, P. (eds.) Reference Modeling for Business Systems Analysis, pp. 47-75. Idea Group Publishing, Hershey (2007)
3. Fettke, P., Loos, P.: Perspectives on Reference Modeling. In: Fettke, P., Loos, P. (eds.) Reference Modeling for Business Systems Analysis, pp. 1-20. IGI Publishing, Hershey, PA (2007)
4. vom Brocke, J., Fettke, P.: Referenzmodellierung. In: Kurbel, K., Becker, J., Gronau, N., Sinz, E.J., Suhl, L. (eds.) Enzyklopädie der Wirtschaftsinformatik - Online-Lexikon, vol. 2015. Oldenbourg Wissenschaftsverlag, Munich, Germany (2013)
5. Rosemann, M., van der Aalst, W.M.P.: A Configurable Reference Modelling Language. Information Systems 32, 1-23 (2007)
6. Peffers, K., Tuunanen, T., Rothenberger, M.A., Chatterjee, S.: A design science research methodology for Information Systems Research. Journal of Management Information Systems 24, 45-77 (2007)
7. Delfmann, P.: Adaptive Referenzmodellierung. Methodische Konzepte zur Konstruktion und Anwendung wiederverwendungsorientierter Informationsmodelle. Logos Verlag, Berlin (2006)
8. Fettke, P.: Eine Methode zur induktiven Entwicklung von Referenzmodellen. In: Kundisch, D., Suhl, L., Beckmann, L. (eds.) Multikonferenz Wirtschaftsinformatik 2014 (MKWI), pp. 1034-1047. GITO-Verlag, Paderborn (2014)
9. Rehse, J.-R., Fettke, P., Loos, P.: An Execution-Semantic Approach to Inductive Reference Model Development. 24th European Conference on Information Systems (ECIS). Association for Information Systems (AIS), Istanbul, Turkey (2016)
10. Li, C., Reichert, M., Wombacher, A.: Mining business process variants: Challenges, scenarios, algorithm. Data Knowl. Eng. 70, 409-434 (2011)
11. Rehse, J.-R., Fettke, P., Loos, P.: A graph-theoretic method for the inductive development of reference process models. Software & Systems Modeling. Springer, Berlin et al. (2015)
12. Ardalani, P., Houy, C., Fettke, P., Loos, P.: Towards a Minimal Cost of Change Approach for Inductive Reference Model Development. 21st European Conference on Information Systems (ECIS 2013), vol. Paper 127. AIS, Utrecht, Netherlands (2013)
13. Gottschalk, F., van der Aalst, W.M.P., Jansen-Vullers, M.H.: Mining Reference Process Models and Their Configurations. In: Meersman, R., Tari, Z., Herrero, P. (eds.) On the Move to Meaningful Internet Systems: OTM 2008 Workshops, OTM Confederated International Workshops and Posters, ADI, AWeSoMe, COMBEK, EI2N, IWSSA,

MONET, OnToContent + QSI, ORM, PerSys, RDDS, SEMELS, and SWWS 2008, Monterrey, Mexico, November 9-14, 2008, pp. 263-272. Springer, Berlin et al. (2008)
14. Martens, A., Fettke, P., Loos, P.: A Genetic Algorithm for the Inductive Derivation of Reference Models Using Minimal Graph-Edit Distance Applied to Real-World Business Process Data. In: Kundisch, D., Suhl, L., Beckmann, L. (eds.) Multikonferenz Wirtschaftsinformatik 2014 (MKWI), pp. 1613-1626. GITO-Verlag, Paderborn (2014)
15. Yahya, B.N., Bae, H., Bae, J., Kim, D.: Generating Business Process Reference Model using Genetic Algorithm. Biomedical Fuzzy Systems Association, vol. BMFSA 2010, pp. 245-248, Kitakyushu, Japan (2010)
16. Rehse, J.-R., Fettke, P., Loos, P.: Eine Untersuchung der Potentiale automatisierter Abstraktionsansätze für Geschäftsprozessmodelle im Hinblick auf die induktive Entwicklung von Referenzprozessmodellen. In: Alt, R., Franczyk, B. (eds.) 11th International Conference on Wirtschaftsinformatik (WI2013), vol. 2, pp. 1277-1291, Leipzig (2013)
17. Gröger, S., Schumann, M.: Entwicklung eines Referenzmodells für die Gestaltung des Drittmittel-Prozesses einer Hochschule und Ableitung von Einsatzgebeiten für Dokumenten- und Workflow-Management-Systeme. Georg-August-Univeristät (2014)
18. Karow, M., Pfeiffer, D., Räckers, M.: Empirical-Based Construction of Reference Models in Public Administrations In: Bichler, M., Hess, T., Krcmar, H., Lechner, U., Matthes, F., Picot, A., Speitkamp, B., Wolf, P. (eds.) Proceedings of the Multikonferenz Wirtschaftsinformatik 2008. Referenzmodellierung, pp. 1613-1624. GITO-Verlag, München (2008)
19. Aier, S., Fichter, M., Fischer, C.: Referenzprozesse empirisch bestimmen − Von Vielfalt zu Standards. Wirtschaftsinformatik & Management 3, 14-22 (2011)
20. La Rosa, M., Dumas, M., Uba, R., Dijkman, R.M.: Business Process Model Merging: An Approach to Business Process Consolidation. ACM Transactions on Software Engineering and Methodology (TOSEM) 22, (2013)
21. Fettke, P.: Integration von Prozessmodellen im Großen: Konzept, Methode und experimentelle Anwendungen. In: Thomas, O., Teuteberg, F. (eds.) 12th Interntational Conference on Wirtschaftsinformatik, pp. 453-467, Osnabrück, Germany (2015)
22. Schunselaar, D.M., Verbeek, E., Reijers, H.A., van der Aalst, W.M.: Using Monotonicity to Find Optimal Process Configurations Faster. In: 4th International Symposium on Datadriven Process Discovery and Analysis, pp. 123-137. Citeseer, (Year)
23. Yahya, B.N., Bae, H., Bae, J., Kim, D.: Generating valid reference business process model using genetic algorithm. International Journal of Innovative Computing, Information and Control 8, 1463-1477 (2012)
24. Becker, J., Delfmann, P., Knackstedt, R., Kuropka, D.: Konfigurative Referenzmodellierung. In: Becker, J., Knackstedt, R. (eds.) Wissensmanagement mit Referenzmodellen. Konzepte für die Anwendungssystem- und Organisationsgestaltung, pp. 25-144. Springer, Berlin et al. (2002)