dant definitions of semantically equivalent concepts in the ICM had to be avoided. Furthermore, we always tried to relate new concepts to existing ones in case of similarity (by “composedBy”, “isGeneralizationOf” or “definedBy” relations). However, the manual modeling was not always easy and sometimes it was difficult to model concepts consistently.

Because the manual modeling of RMs is a time consuming and error-prone process, a dedicated tool box is needed to cope with the consistency problem and to model the fine grained conceptual elements. A semiautomatic tool that is performing a syntactical and linguistic analysis of the RM documents may generate recommendations to model the conceptual elements properly. For example, prepositions like “based on” or “in line with” may require modeling a respective artifact. Because the RM documents are written very differently, modeling recommendations can not only rely on syntactic rules. For example, in some RM documents the activities of procedures are written by nouns while in others verbs are used. Hence, a plain syntactical analysis of the documents is not sufficient. Further rules are needed to transform the language used in the original documents in a “normalized” language. We will investigate if rules used to precisely write requirements [10] could be adopted to transform the original text in a “normalized” language (e.g. the passive or noun form of a verb is transformed in its active form). This may allow a semiautomatic extraction of conceptual elements and their modeling in the ISM and ICM. Furthermore, the tool box should be able to adapt and improve its generated recommendations according to modeling decisions done by RM experts.

Furthermore, we want to offer the organizations a tool for an efficient comparison of RMs that automatically compare RMs and extract the essence of similar procedures.

7. CONLUSION

In this paper we have presented MoSaIC, a model based approach to integrate reference models. The core idea is to represent each RM in a dedicated Integration Structure Model (ISM) and the common concepts in one central Integration Concept Model (ICM). The created ISMs and the ICM allow a semantic integration of RMs. As each RM-ISM contains the most important RM information, it provides a condensed overview for organizations. Furthermore, the integration of RMs eases the understanding and avoids misinterpretations of terms and concepts used in RMs (Q21), because the concepts are associated with their synonyms and contexts in the RM-ISMs. Every new RM may enrich the description of a concept and ease its comprehension. Therefore, the more RMs are integrated, the smarter the ICM will become.

The fine granularity of the models (ISMs and ICM) enables to model RMs on different levels of abstraction: abstract, concrete RMs and even internal processes can be easily integrated in the MoSaIC Integration Model. Furthermore, the integration of abstract and concrete RMs supports a better understanding of a certain area that is addressed by both of them (Q21).

Our approach allows a detailed and efficient comparison of RM procedures (Q22). The fine grained model elements, the concepts connecting the procedures, and the semantic concept relations allow identifying automatically similarities between procedures and process areas. The essence can also be identified to efficiently adopt multiple RMs. The organizations do not have to worry any more about the redundancies between the adopted parts of RMs.

Finally, changes on existing RMs or new RMs can be integrated in the MoSaIC Integration Model (Q23). This is done by creating or updating the respective ISM and adding or updating the connections between the changed or newly created ISM and the central mediator, the ICM. The integration of a new RM implies adding new concepts to the ICM if they are not already defined.

First experience and results with the presented approach are promising; we were able to effectively model the integration of some process areas of the RMs COBIT, CMMI and Functional Safety. We expect that the results of our future work will make the integration of RMs more accurate and comfortable to offer a better support to organizations for the adoption of multiple RMs.

8. REFERENCES

[1] Armstrong, R. (2008) Sox compliance: Eleven essential controls for the sme, Sarbanes-Oxley Compliance Journal 2008. http://www.s-ox.com/dsp_getFeaturesDetails.cfm?CID=2106.

[2] CMMI (2010): CMMI for Development, Version 1.3. CMU/SEI 2010-TR-033, ESC-TR-2010-033, SEI, Carnegie Mellon University, Pittsburgh, PA.

[3] COBIT(2007): Control Objectives for Information and Related Technology Version 4.1. ISACA (Information Systems Audit and Control Association).

[4] Favre, J.-M. (2006): Megamodelling and Etymology. In J.-R. Cordy, R. Lämmel, and A. Winter, editors, Transformation Techniques in Software Engineering, Dagstuhl Seminar Proceedings, No. 05161, ISSN 1862-4405.

[5] Ferchichi, A., Bigand, M. (2008): An Ontology for Quality Standards Integration in Software Collaborative Projects. Proceedings of MDISIS’08 (Model Driven Interoperability for Sustainable Information Systems), Montpellier, FRANCE, 14.

[6] Ferreira, A. L., Machado, R. J., Paulk, M. C. (2010): Quantitative Analysis of Best Practices Models in the Software Domain. Proceedings of the 17th Asia Pacific Software Engineering Conference, 433-442.

[7] IEC 61508 (2010): IEC 61608 or Functional safety of electrical/electronic/programmable electronic safety-related systems, Edition 2.0, 30 April 2010, DKE-Gremium 914.

[8] Liao, L., Qu, Y., Leung, H. K. N. (2005): A Software Process Ontology and Its Application. Proceedings of the IWFST-2005 (International Workshop on Future Software Technology, Shanghai, 1-10.

[9] Malzahn, D. (2009): Assessing - Learning - Improving, an Integrated Approach for Self Assessment and Process Improvement Systems. Proceedings of ICONS ’09, the Fourth International Conference on Systems, Gosier, Guadeloupe, France, 126-130. Ieee. doi: 10.1109/ICONS.2009.31.

[10] Pohl, K., C. Rupp (2011): Requirements Engineering Fundamentals – A study Guide for the Certified Professional Requirements Engineering Exam – Foundation Level – IREB compliant. Rocky Nook, Inc, Santa Barbara.

[11] Siviy, J., Kirwan, P., Marino, L., Morley, J. (2008): Process Architecture in a Multimodel Environment. SEI White Paper, http://www.sei.cmu.edu/library/assets/multimodelSeries_wp4_processArch_052008_v1.pdf.

[12] The Standish Group International (2009): CHAOS Summary 2009. Chaos (pp. 1-4). Retrieved from http://www.statelibrary.state.pa.us/portal/server.pt/document/690719/chaos_summary_2009_pdf.

12th International Conference on Product Focused Software Development and Process Improvement (Profes '11). ACM, New York, NY, USA, 6-9.
doi: 10.1145/2181101.2181103