Lessons Learned in Aligning Data and Model Evolution in Collaborative Information Systems (Extended Abstract)

Thomas Reschenhofer[1], Manoj Bhat[1], Adrian Hernandez-Mendez[1] und Florian Matthes[1]

Abstract: Today's enterprises have to align their information systems continuously with their dynamic business and IT environment. Collaborative information systems address this challenge by involving diverse users in managing the application's data as well as its conceptual model. In this sense, both the data and the model co-evolve. There are different approaches for aligning data and model evolution, wherein either the data is aligned to the model, or vice versa.

In this work, we present a hybrid approach supporting both strategies and elaborate on our experiences of applying the approach in projects for over five years. Thereby, we discuss challenges and issues faced in those projects. We formulate those issues and respective solutions as lessons learned, which not only hold for the concrete system which was applied in those projects, but which should guide the design and implementation of all software systems supporting the co-evolution of data and model.

The work summarized in this extended abstract has been published in [Re16].

Keywords: Lessons learned, best practices, model evolution, data evolution, collaborative information systems, semantic wiki

1 Introduction

The demand and requirements for information systems are changing continuously due to an increasingly turbulent business environment, technology innovations, and legal regulations. Adaptive information systems enable enterprises to adapt their software systems to meet the demands of such a dynamic business and IT environment.

One aspect of an information systems that is subject to frequent changes is its conceptual model – also referred to as the user-model [MK15]. The reasons for the user-model changes are manifold and range from the correction of mistakes to the adaption to new laws and regulations. If the information system is not able to adapt to the changing environment, the quality of the system's support for its business will decrease over time [vWv06]. Therefore, meta-model based information systems that allow users to dynamically update and evolve their user-models in order to meet the demands of the changing business needs are becoming popular. In a collaborative environment, this approach implies at least two different co-existing user roles for managing the user-model and its application data [SDW08] namely model designers who are responsible

[1] Technical University of Munich (TUM), Department of Informatics, Boltzmannstr 3, 85748 Garching, {thomas.reschenhofer, manoj.mahabaleshwar, adrian.hernandez}@tum.de, matthes@in.tum.de

for user-model changes, and end-users or data owners performing data changes.

Achieving such a collaborative environment that supports the evolution of both the user-model and its data in a coherent and consistent manner is a non-trivial task. Matthes et al. [MNS11] tackle this challenge with the so-called Hybrid Wiki approach. Thereby, the application data is initially represented by the unstructured wiki pages which can be structured incrementally and collaboratively by attaching types, attributes, and integrity rules. At the same time, model designers can define and adapt the user-model which imposes certain constraints on the underlying wiki pages and thus induces a schema on the application data.

Our experiences related to the application of a collaborative information system (CIS) that implements the Hybrid Wiki approach in a variety of use-cases and domains revealed a couple of challenges and issues which are not only related to the Hybrid Wiki approach in particular, but to collaborative approaches for the co-evolution of user-models and data in general. In this paper, we discuss our experiences of applying the Hybrid Wiki approach in industrial and research projects, and the consequences for the redesign of this approach.

2 Hybrid Wikis

The goal of the Hybrid Wiki approach is to empower non-expert users to collaboratively gather and consolidate information in a knowledge-based information system [MNS11]. It tries to reduce the complexities involved in using semantic wikis and their corresponding technologies including the markup language and the query language. The term "hybrid" refers to wiki pages which integrate a subset of semantic wiki features into classical wiki software.

The Hybrid Wiki approach enables data owners to iteratively structure initially unstructured data by adding *attributes* to *wiki pages*. Additionally, users can annotate wiki pages with *type tags* which enable the system to identify similarities between wiki pages. Furthermore, model designers can define *type tag definitions*, *attribute definitions*, and *validators* in order to specify constraints on the data. In this way, the model designer defines the user-model and urges the data owners to capture data corresponding to the user-model. It should be noted that in the Hybrid Wiki approach data owners are not restrained by strict integrity constraints while capturing information in wiki pages and their attributes, i.e., a value violating integrity constraints as defined in the user-model can still be stored in the CIS [MNS11].

The Hybrid Wiki approach was applied in several industrial and research projects in the domains Enterprise Architecture Management (EAM), Collaborative Product Development (CPD), and Collaborative Content Management (CCM) for more than five years [MN11], [RRS14].

3 Lessons Learned in Aligning Data and Model Evolution

Patton [Pa01] defines lessons learned as the knowledge which is derived from the screening of a situation and which can be applied in similar situations in the future. In the context of this paper, a lesson learned represents an issue we faced in the application of the Hybrid Wiki approach and the consequential redesign and reimplementation of our Hybrid Wiki system.

3.1 Relevance of Terminology

The starting point for defining the terminology of the Hybrid Wiki meta-model were wikis and wiki pages. However, these terms already refer to a certain form of representation and content creation, while the Hybrid Wiki approach was not only applied as a means for traditional knowledge management but also as a user-driven and model-based repository. Consequently, the stakeholders in the respective cases refer to their information objects using more general terms, e.g., *Entities* or *Workspaces*. In order to foster the adoption of the Hybrid Wiki approach in the future projects, we applied those implicitly proposed terminology changes to the Hybrid Wiki meta-model.

3.2 Simplicity vs. Expressiveness

Originally, the Hybrid Wiki meta-model allowed to assign multiple types (type tags) to one entity (wiki page). However, this seemed to be too complicated for the majority of users. As a consequence, we redesigned the meta-model accordingly, i.e., entities can only be assigned to a single type. On the other hand, the meta-model was extended by additional constraints to differentiate between additional types of attributes, e.g., dates or Booleans.

3.3 Configurability of Modeling Approach

Depending on the degree of maturity of the model, either a flexible data-first or a more restrictive model-first approach is desirable. Consequently, means for seamlessly changing the modeling approach in order to align it to the current needs are required, e.g., by activating or deactivating so-called free attributes (attributes which are not defined by the user model), or by configuring the strictness of constraints.

3.4 Searchable Inconsistencies

While inconsistencies between data and model are inevitable, users have to be supported in identifying and resolving them. This implies the need for facilities enabling the search for inconsistencies and to create data consolidation views.

4 Conclusion

There are three main conclusions which we draw from our experiences from the applications of the Hybrid Wiki approach. First, finding the right balance between data- and model-first approaches is decisive. The practical applications of the Hybrid Wiki approach revealed that in early stages of the user-model design, a focus on the data-first approach enables model designers to harness collective intelligence among the system's users and to utilize each individual's domain-specific knowledge. As soon as the user-model reaches a certain degree of maturity, the design space should be restricted in order to enforce a convergence of the user-model. Second, the co-evolution of both the user-model and its data yields to inconsistencies between them. One important success factor of software systems is the integration of adequate data consolidation tools and techniques. Third, a conceptual model enabling the co-evolution of user-model and data must have the right balance between simplicity and expressiveness. The basic concepts of a pragmatic approach to model and data co-evolution should be usable and understandable by a broad spectrum of both data owners and model designers.

5 Bibliography

[MK15] McGinnes, S.; Kapros, E.: Conceptual Independence: A Design Principle for the Construction of Adaptive Information Systems. In Information Systems, 2015, 47.

[MN11] Matthes, F.; Neubert, C.: Wiki4EAM - Using Hybrid Wikis for Enterprise Architecture Management. In Proceedings of the International Symposium on Wikis and Open Collaboration, 2011; p. 226.

[MNS11] Matthes, F.; Neubert, C.; Steinhoff, A.: Hybrid Wikis: Empowering Users to Collaboratively Structure Information. In Proceedings of the International Conference on Software and Data Technologies, 2011; pp. 250–259.

[Pa01] Patton, M. Q.: Evaluation, Knowledge Management, Best Practices, and High Quality Lessons Learned. In American Journal of Evaluation, 2001, 22.

[Re16] Reschenhofer, T. et al.: Lessons Learned in Aligning Data and Model Evolution in Collaborative Information Systems. In Proceedings of the International Conference on Software Engineering, 2016.

[RRS14] Rehm, S.; Reschenhofer, T.; Shumaiev, K.: IS Design Principles for Empowering Domain Experts in Innovation: Findings From Three Case Studies. In Proceedings of the International Conference on Information Systems, 2014.

[SDW08] Spahn, M.; Dörner, C.; Wulf, V.: End User Development: Approaches Towards a Flexible Software Design. In Proceedings of the European Conference on Information Systems, 2008; pp. 303–314.

[vWv06] van Oosterhout, M.; Waarts, E.; van Hillegersberg, J.: Change Factors Requiring Agility and Implications for IT. In European Journal of Information Systems, 2006, 15; pp. 132–145.