Terravis – Large Scale Business Process Integration between Public and Private Partners

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Abstract: Supply Chain Management is a very popular and already mature topic between companies in which business processes are coordinated across company borders. However, there are also business processes that span not only companies but also public services. One example is the mortgage business in which banks and insurances are involved as private partners but interact with land registries and notaries which are public partners. Terravis is a platform that integrates the business processes between these parties and offers a high business value by being capable of doing end-to-end processing without media conversions. Such an effort is nevertheless complicated due to the number of interacting parties, different mindsets and different goals. Within this paper we discuss challenges integration projects face and describe experiences about how these challenges can be addressed.

1 Introduction

One long-term trend in the manufacturing industries is Supply Chain Management: Supply Chains are optimized between different companies. These networks of companies have become larger and more complex over time. They can be seen as the successor architectures for Large Scale Business Process Integration that build networks along business processes that span many organizations (both private and public) and in which typically no organization can dominate the other (in contrast to supply chains in which usually the OEM dominates.)

One example for the need of such an integration is the Swiss mortgage business spanning banks, notaries and land registries, from which Terravis[1] emerged. Terravis is a platform run by SIX Terravis Ltd.[2] that offers the following services:

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[1] Terravis is a registered product of SIX Terravis Ltd.
[2] SIX Terravis Ltd. is owned by SIX Group Ltd. and is supervised by the Swiss Federal Office of Justice

- Portal for land register and geographical data

- Electronic transactions with focus on the business between public administration (land register, commercial registers and notaries) and economy (mortgage institutes [banks, insurance companies, pension funds], geometers, institutions with high dependencies on land register data (e.g. telecom companies, Swiss Confederation, Swiss Railway SBB and others)

- Fiduciary management of register mortgages for banks

Within this paper, we want to explain the challenges, possible solutions and our experiences in Terravis as an example for a large-scale business process integration project. This paper is structured as follows: The next section explains the BPM Life-Cycle. In section 3, the Business Process Evaluation with the business motivation for Terravis is explained, followed by the Business Process Analysis with related experiences are presented in section 4. In section 5, the same is done for Business Process Design & Modeling. Section 6 will present the resulting solution architecture. In section 7 the main challenges and the counter-measures are summarized before a conclusion and outlook is given.

2 BPM Life-Cycle and Related Work

One way to optimize business processes is following the Business Process Management (BPM) approach. BPM is a cyclic approach that tries to continuously improve business processes. There are many different variations of this cycle, but we will use the one by Weske [We12] as shown in figure 1 within the context of this paper.
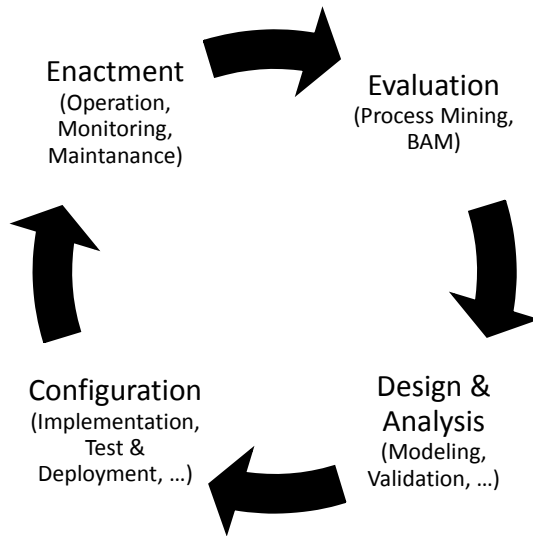
Figure 1: Business Process Lifecycle according to [We12]

The general approach is to find the potential for optimization in the currently executed business processes. Once found, attempt to improve them, implement the new business processes and analyze them further.

The following sections are structured according to this pattern: Section 3 starts with a short explanation of the evaluation of the old paper processes followed by the analysis of those processes. In section 4, the design is described and in section 5, we will present the configuration with some pieces that are related to enactment.

Terravis itself cannot endure the BPM Life-Cycle alone, because Terravis depends on the Business Process Evaluation of partners. Partners gain experience with the newly implemented business processes and forward their new requests to Terravis, who then change the business processes accordingly.

3 Business Process Evaluation

3.1 Mortgage Business before Terravis

Switzerland is organized as a federation[3]: The 26 cantons are responsible for the land registries and notaries within their area. With the introduction of the civil code [CC] in

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[3] Swiss political system, explained in the citizen portal by the Swiss Confederation
(https://www.ch.ch/de/politisches-system-schweiz/ - visited on 15 May 2014)

1912, a national legal foundation for the land registries and commercial registers were introduced and the associated competencies were transferred to the cantons.

3.1.1 Notary Systems in Switzerland

When the civil code was introduced, there was no need for harmonization of national laws for notaries. The consequences were:

- Each of the 26 cantons introduced a legal base for the notaries individually,

- In Switzerland three general types of organizations were established:

    o **Cantons with independent civil law notaries:** The notary is exclusively entitled to seal and stamp contracts of transfer of land ownership and to convey to the land register,

    o **Cantons with office notaries (Amtsnotariat):** The land register official is also notary with similar competences as a civil law notary

    o **Cantons with a mix of independent civil law notaries and office notaries:** Both systems can be present in one canton.

There is an exclusivity of the notaries in every canton for stamping land register contracts in the canton that appointed them. The consequence of that delimitation is a heterogeneous practice leading to different contracts, procedures, and forms.

Until 2012, there was no legal base in Switzerland that allowed

- electronic registration of notarial contracts
- electronic execution of notarial contracts

As a consequence, there was no industry IT solution or any standard other than Mac- or Windows-PCs using standard text processing (e.g. Microsoft Word), internet connection and accounting software.

3.1.2 Land Registry System in Switzerland

The civil code defines the constitutive law of the land register: parcel, ownership, legal rights and the dependency on the official survey. The mortgage notes are one of the rights to be registered with and only issued by the land register. The national regulation defined to a certain extent how a land register is organized, under which conditions a register entry can be accepted or has to be refused. The land register was kept in large heavy books where the inscriptions were done in proper structured form.

In Switzerland, the cantons began to digitize the land register data in the 1990s. Instead of setting up a nationwide project, the Swiss Confederation allowed any applying canton to realize its land registry solution as it saw fit, which resulted in five different software

solutions over the past 20 years. In 2007, the Swiss regulation defined a standard data model and interfaces for land registries for the first time.

3.1.3 Mortgage borrowing in Switzerland

Mortgage lending is one of the main pillars of the Swiss banking industry. Over decades, home owners and the economy have profited from low interest rates and steadily rising home prices when applying for hypothecary credits secured by mortgage notes. Even though the market volume exceeded 700 billion Swiss Francs by 2011[4] [SNB], the communication and business processes were never successfully standardized, nor digitized, throughout Swiss-wide between banks, notaries, and land registries. Because of the complexity of the business, the large number of involved partners, lack of standards and non-existing electronic interfaces, no one envisioned that a solution such as Terravis could be achieved.

4 Business Process Analysis

4.1 Project eGRIS

In 2001, the Swiss Confederation initiated a project called eGRIS with the aim of a nationwide portal for land register data for its citizens. As a result, in 2007, the Swiss government enacted the Technical Regulation for Land Registers in Switzerland [TGBV], which for the first time in Switzerland, defined the following aspects: a standard data model for land registers (eGRSIDM, eGRIS Data Model), a unique identifier for land (E-GRID, electronic Parcel ID), a unique identifier for right in the land register (EREID, electronic Rights ID), unique identifiers for persons registered in the land register (UID, AHVN13), a standard interface for geometers to land register (AVGBS) and a standard interface for exporting land register information (GBS).

In 2007, in response to budget cuts, the project management suggested to open the scope and invited the Swiss banks to join the eGRIS project. The aim of the project eGRIS was adjusted to the requirements of the banks (represented by the Commission for Financial Standardization[5]) and other authorized participants of the economy. This included the portal with integrated interfaces and the standardized, media-break-free electronic transactions between banks, land registry offices and notaries. In addition, the project management of the Swiss Confederation intended to setup a centralized data pool for land register data. The cantons refused the data pool and withdrew from eGRIS.

As a result, the Federal Department of Justice, SIX[6] (representing the Swiss banks) and the cantons agreed in 2009 that SIX was to take the lead of the project eGRIS, control the project finances and implement it together with the cantons. The new eGRIS steering

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[4] Schweizerische Nationalbank – Statistische Publikationen
(http://www.snb.ch/de/iabout/stat/statpub/bchpub/stats/bankench - visited on 15 May 2014)
[5] Swiss Commission for Financial Standardisation (www.sksf.ch - visited on 15 May 2014), a board of the Swiss Banks Association (www.swissbanking.ch - visited on 15 May 2014)
[6] SIX Group Ltd. is the main infrastructure for the Swiss financial industry

committee representing SIX, the banks and the cantons agreed on the following approach:

- Deliverables, time-line and milestones: the portal and electronic transactions to be realized by SIX in agreement with the cantons and the banks by end of 2014.
- SIX sets up an operating company.
- Every stakeholder (SIX, banks and cantons) carries their own project costs.
- A central data pool and the long term safeguarding of land register data are not part of the deliverables.

The Confederation withdrew from the project lead, but remained in the project organization without voting rights.

4.2 Stakeholders' Motivations

There were a large number of stakeholders involved in developing Terravis. Every group was involved in different stages of the development and therefore, the motivations were dynamic.

4.2.1 Banks

Banks are constantly looking for opportunities to increase the efficiency of their business operations. On one hand, there is a limited potential to improve the internal processes and one the other hand, the operations of the credit divisions is the less optimized in all Swiss banks.

The banks are looking to improve the integration between business processes of other stakeholders. With Terravis, there was the chance to increase efficiency, once all intended processes were implemented, by up to 50 percent.

4.2.2 Land Registry Offices/Cantons

The organizational integration of the land registries varies from canton to canton. The responsibilities are legally defined on the Confederation level in the land register regulations [GBV]. On a political level, the responsibilities are defined by the cantonal government (except cantons Lucerne and Zurich where the land register is incorporated in the Cantonal Court) and on the functional level, they are defined by the inspector.

Due to the fact that the cantons did not feel to be involved by the eGRIS project management headed by the Swiss Government between 2001 and 2009, they appreciated that SIX respected their requirements:

- Autonomy of the cantons regarding the land registries
- The data sovereignty still remains with the cantons
- No centralized data pool
- Decentralized solution regarding portal and electronic transactions

- Involving the cantons as equal partners in the project steering committee of eGRIS.

4.2.3 Notaries

Involving the notaries in project eGRIS was a demanding task. The notaries of the cantons, along with office notaries, were represented by their land registries and the respective notary inspector. The cantonal notary associations of 13 cantons are organized in the Swiss Notary Association (SNV)[7]. When SIX launched the eGRIS project together with the cantons in 2009, the SNV pursued its own project. The aim of that project was to develop an electronic notary register, a digital archive for notaries and electronic conveyance to the land register offices, based on a platform that the Federal Office of Justice promised to develop.

The motivation of the notaries was heterogeneous. In general, they wanted to ensure legal certainty and privacy, especially for notaries' customers. As stakeholders, the notaries could imagine to digitize the communication with the clients, the cantonal authorities (tribunal, land register offices and commercial register offices) and institutional partners (banks etc.), but they want to keep status quo, i.e. no change to the way the notary business was being done.

4.2.4 Raising Stakeholder Awareness

There were several key success factors in the eGRIS project. The project management convinced the opinion leaders by identifying the benefits and by disclosing the costs. Furthermore, it was important to raise the awareness of the legal departments of the cantons to check if the legal base exists and if not, to immediately establish a legal project.

4.2.4 Trust-building measures

There was no legal obligation of the land registers and the notaries to introduce Terravis; therefore, SIX could only succeed by taking several trust-building measures. The difficulties that the project management faced in the planning was that they didn't know most of the opinion leaders and all the dependencies; therefore, an interactive and intuitive proceeding was chosen.

The success of the project can be accredited to the communication of our own values from the very beginning, involving the stakeholders in the definition of the electronic processes and a fair requirement management. SIX led the project with transparency and honesty to all involved at all times.

4.3 Elicitation Techniques

Since the Swiss Confederation has no legal power to enforce a solution on all the cantons (autonomy of the cantons), the business process definitions and requirements needed to be elicited, verified, and agreed upon by a large number of stakeholders.

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[7] Swiss Notary Association represents the notaries of 13 cantons (www.schweizernotare.ch - visited on 15 May 2014)

The majority of the representatives in the project eGRIS are experts in the land register business and legal questions, but only a few have an IT background. This added the challenge of discussing the migration from paper-based processes to electronic ones at the same time.

A number of the canton representatives and notaries are retained in private companies such as SIX Terravis that are outside of the public administration and are offering services related to land registries and notaries.

While the measures described in section 3.2.4 address political problems, process elicitation was a huge problem, too. Every party only knew their "local" activities in the process, i.e. a notary knew how to draft a contract, but was unaware of the activities and dependencies before and after him. Establishing a global view of the business process was thus a challenging task like it is in other projects [Lü06]. In order to elicit the paper-based process and define the new electronic process, several elicitation techniques were used:

- **Stakeholder Workshops:** SIX organized several individual workshops with representatives of each stakeholder (banks, land register, notary). The aim and agenda of each workshop was proposed by the project management and adjusted if required by the participants. The definition of a process was discussed on drawings of business processes (very high level view, also called Level 0 or 1) to get an understanding of the discussed process and the business rules that apply to it.

- **Prototypes:** The results of the stakeholders' feedback were taken over into the next workshops. After a first common understanding was reached, SIX developed a prototype to visualize the results and to clarify additional details. The prototype was quickly developed as a BPEL [Jo07] process and used the BPMS' task facilities consisting of BPEL4People [Ag07] and the product's task manager. The user interfaces were not pretty, but contained all data to be changed or displayed. With this information, the standard cases of a business process could be conducted step by step and every party could give concrete feedback about the process flow and the necessary data.

5 Business Process Design & Modeling

The results of the workshops and the prototypes needed to be documented. While these two steps are interrelated in practice, the problems and solutions are distinct. The results related to modeling and documentation are discussed in this section.

Different stakeholders needed to be served by the process documentation. On the one hand, the people actually conducting or supervising the business needed to accept the new process definitions. On the other hand, implementers and IT departments needed to change their systems in order to interact with Terravis.

Right from the beginning, the decision was made to split the business aspects from the technical aspects into separate documents.

5.1 Process Documentation for Business Stakeholders

The main problem with the documentation for business stakeholders was understandability. The processes with many variants and differences due to differences in the notary systems are complex. In addition, the exchanged data structures are complex, too.

Most of the stakeholders from the public sector were not used for formal business process notations like BPMN [Ag11] or EPCs [NR02]. As a consequence, business process diagrams in those notations failed as a means of communication during workshops. High-level diagrams, which essentially are choreography diagrams but without a standard syntax, are used of the standard notations. While being very similar in expression, they could be understood easily by the non-technical stakeholders. All of these overview diagrams are followed by a free-text description of the process steps and business rules. Data structures are represented as lists of forms with placeholders.

5.2 Process Documentation for Technical Stakeholders

The technical documentation consists of service documentation and process documentation. Only the latter is relevant to the main topic of this paper.
Initially, the technical process documentation consisted of UML sequence diagrams depicting exactly one out of many scenarios of a process. The messages between the objects corresponded to SOAP messages that had to be exchanged between Terravis and a partner system. While this is helpful to get an introduction in to the process, complex processes were illustrated in dozens of diagrams that still could not cover all possible process variants. Especially when discussing processes with system implementers and IT departments, this view was missing. As a result, all processes were documented as BPMN diagrams that carry lot of technical details while still being abstract with regard to Terravis' internal implementation details like internal services.

6 Implementation & Execution

After having a coarse-grained specification, implementation work could be started. Because there are many non-functional properties in a large-scale business process integration system, a robust architecture is needed. Within this section we will explain the main architecture drivers of a large-scale business process integration platform like Terravis before explaining the high-level architecture.

6.1 Architecture Drivers

The main architectural drivers are derived from the environment consisting of many partner systems plus some additional business demands that are of cross-cutting concern:

- **Interoperability:** Banks, Notaries, and Land Registries deploy a variety of software solutions and operating systems. Thus, a central business process platform must be accessible in a platform-independent way.

- **Scalability to thousands of partner systems:** Terravis did not start with a big bang. Instead canton after canton and bank after bank was and is going to be connected. Nevertheless, the architecture needs to be prepared to deal with 1000+ partner systems in the final environment.

- **Fault Tolerance:** Besides performance and network aspects, the huge amount of partner systems also inflicts imminent failures. If all surrounding systems are available 99% of the time, the central business process platform can only expect all 1000 surrounding systems to be available only at 0.0043% of the time ($0.99\hat{ }1000^{1,}$) which is less than 23 minutes over a year. Failure tolerance and being able to resume processes after systems come back online are crucial.

- **Multi-Version Support:** Surrounding systems change and get updated. However, the business process platform also changes and delivers new features and will offer new service interfaces for added functionality. Because deployment windows are different between all partners, the central process platform needs to support a set of old service versions that allows partners to upgrade within a defined time-window and not in parallel with the central platform.

- **Short Time-to-Market:** Building a huge platform takes time, especially if requirements are not clear and evolve quickly. It is therefore a good idea to design an architecture that can be built iteratively and still address conceptually all necessary architecture drivers. Effort spend in architecture and implementation needs to be balanced and interleaved. Also a quick delivery of features allows the central platform to gain trust with its partners instead of letting them wait for a long period of time.

- **Process Monitoring/Data Integrity:** In eGovernment scenarios, the central platform needs to be able to demonstrate when and who has placed an offer/contract and when requests were sent to partners.

- **Confidentiality:** While most of the land register data is available publicly, business processes contain personal data and additional business-relevant information. Providing confidentiality for this information is crucial also with regard to building trust with partners.

- **Legally Binding Digital Signatures:** Very often when a business process platform is used to conduct business with administration offices, the question of legally binding signatures arise. In Switzerland, the law for digital signatures [ZertES] defines the requirements for digital signatures that are equivalent to hand-written ones.

6.2 Resulting Architecture

The Terravis Architecture is shown in figure 2. At the core, is a Business Process Management System (BPMS). It is responsible to coordinate the business processes and offers time-stamping of performed activities and resuming of faulting process instances due to service invocation errors. Also having this component that allows deployment of processes modeled in BPEL or BPMN, it provides a high abstraction of business process implementations and thus higher productivity and the ability to implement features faster.
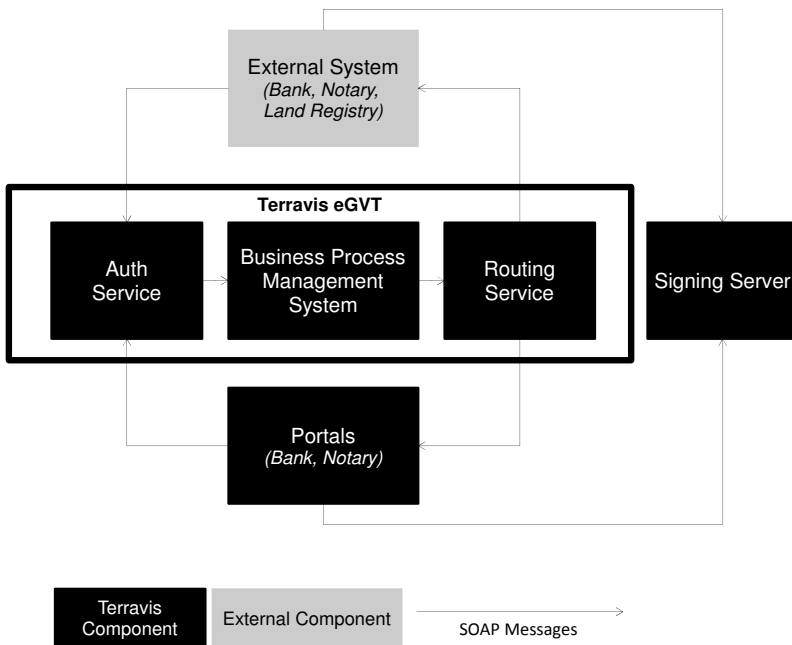

Figure 2: Terravis Architecture

SOAP/HTTPS was chosen as the integration technology. SOAP is platform-independent by using XML serialization and offers a good means of describing the service contract by using WSDL. In addition, most platforms can generate wrapper classes for the XML Schema. For confidentiality reasons, all SOAP connections from and to Terravis are secured by Two-Way-SSL. Both systems are authenticated by certificates and the communication channel is encrypted.

The BPMS does not manage all aspects of the SOAP messaging itself. Instead, it is surrounded by two Enterprise Service Bus (ESB) components: an incoming authorization service and an outgoing routing service. The incoming authorization service checks permissions of a partner to start a process instance or participate in an

already running process instance. If permission is granted, then the authorization service will route the incoming message to the correct process implementation. The routing service takes outgoing SOAP messages from process instances and checks their destinations. It then delivers the messages to the intended partner while using the correct proxies, SSL certificates etc.

Both ESB components can also convert messages between different service versions. All services are versioned and the version is indicated in their namespaces. By matching the version of the handled message with the supported version(s) of the target, the correct transformation is chosen. This functionality has been added after the second service version went productive and is one example of an already-planned, but later implemented, architecture decision of an important architecture driver.

The ESB components and the BPMS are supported with internal services for ID Generation, Document Generation etc. Together they build the eGVT (elektronischer Geschäftsverkehr Terravis), i.e. the core back-end for the business processes.

As the first institution to offer central digital signatures, Terravis offers a signature server that can be used for signing PDFs that are exchanged between banks, notaries, and land registries. The offered solution is completely ZertES-compliant, but will not be described in further detail as this is out of scope of this paper.

In the beginning, the envisioned architecture integrated directly with banking systems and notary systems. However, only land registries were able to change their systems and implement the necessary services quickly. To offer an intermediate solution, Terravis developed a portal that can be used by the banks and notaries to conduct their business as long as their systems are not ready. The portals use the same service interfaces like the external systems; there is no difference between the portal and a "real" external system from the process point-of-view. While this solution is good and allows the quick roll-out of the whole solution, it creates a new problem: At a certain point in time, banks will need to switch from the portal to their systems. This will make advanced routing necessary that is based on the process start date, the process type and the business partner.

Terravis has considerably grown in size (number of processes and process complexity) in a very short time-frame. A sample set of metrics that can be used to judge size and complexity is published [Lü13].

6.3 Development Process and Tooling

Besides the product/software itself, it is important to be able to roll out changes quickly after implementation. Besides basics like a central build server with a nightly build, automated deployments are one piece of the necessary infrastructure; however, no tool is good if used incorrectly. We have positive experiences with iterative development with short iterations and production releases. Terravis tries to deploy a new feature version every month.

7 Predominant Problems & Solutions

The project management of SIX had a complicated start due to the unusual constellation with SIX from the private sector setting up a new service in a public sector domain. As a consequence, a very high priority was to build up trust between SIX and the partners as well as between the partners themselves. Doing workshops and trying to moderate between parties and making sure to reach a common understanding was one part. Delivering quickly and without major hassles was the other part. Both parts, although one technical and one political and therefore not closely related, needed to go together to succeed.

This also included Change Management on all levels: Evangelizing end-to-end processing without papers and media transformations is a huge cultural shift from a 100% paper-driven business. SIX needed to educate and demonstrate feasibility of the envisioned solution. But by also being part of a huge organization with very established services, Terravis was a start-up in a huge organization that created friction and needed persuasion and introduction of new concepts, processes and tools.

Because Switzerland is divided in cantons and the business processes and conventions are very different across them, there are few if any people who understand the business processes end-to-end and can specify them. The result are many change request due to imperfect specifications and incorrect assumptions. The development process, the architecture and the development team needed to be able to deal with this. One solution is to support only the 80-90% cases, i.e. a certain process not with all variations but with the important and most frequently used ones. By doing this approach the costs-to-benefit ratio is much better and development can proceed much quicker because the remaining variants are usually very hard to specify and very complex. If such a variant arose, it could still be handled on paper. Also business mistakes are handled out of the process. This reduces complexity and allows quicker development and concentration on business benefits. Experiences with corner cases and frequent errors can be used to improve process models later.

A huge technical problem is quality assurance (QA). Efficient QA is necessary for doing quick deployments for fixes or frequent releases for new features. However, deployment speed is constrained by testing efforts that increase exponential with added features. Business processes are heavily tested with unit tests [Lü07] by using BPEL Unit [ML06]. However, whole system tests, including the portals, is still a manual and time-consuming task.

The data model of land registry data is also very complex because it needs to support history-versioning and the storage of historic, unstructured, or semi-structured data that have been valid under the different cantons legislature. Storing and parsing this data, as defined by the GBDBS Schema[8], is complicated and error-prone.

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[8] Grundbuchschnittstelle, (http://www.ejpd.admin.ch/content/dam/data/wirtschaft/ grundbuch___egris/tgbv_anhang3.pdf - visited on 15 May 2014)

As already discussed the sheer amount of partner systems creates a set of problems on its own: multi-versioning of services, routing of messages and fault tolerance are only the major ones. Consistently following the 'separation of concerns' paradigm is the only way to limit impact, isolate logic and reducing complexity in such a system.

8 Conclusions & Outlook

8.1 Conclusion

Terravis is one of the first platforms that offer large-scale integration of many partners across different domains. We expect those scenarios to increase, especially when both public and private parties participate in processes.

While such projects are technically challenging, they also have many non-technical success factors. Gaining trust and building concrete requirements engineering are two of them. On the technical side, a solid architecture and the development process with a supporting tool-chain to roll out new features quickly are crucial.

8.2. Outlook

Terravis has grown from its initial scope and now supports also integration into the Swiss Register of Commerce and the trustee functions of mortgages at SIX. Considering that current users are very pleased with Terravis, users and stakeholders with similar businesses (e.g. involving notaries or land registries) also want to benefit from the offered integration.

To keep the current development pace, new options for reducing testing efforts, while increasing test coverage, are continuously explored and implemented.

We expect Terravis to grow larger and other platforms for different domains to emerge. These platforms, support the exchange of structured information in contrast to emails and unstructured PDFs, which boost efficiency and allow all involved partners to integrate their processes tightly without media interruptions.

8.2. Relevance of other countries with Switzerland

Even though each country has developed its own legal framework for land ownership and conveying, Terravis is the sole provider of a straight through solution for the mortgage business and conveying.

Terravis is developed as a product that can be adapted to the needs of any jurisdiction by changing the parameters. Seeing that Switzerland provides one of the most complex structures, the platform can handle any business case as long as the process is standardized and structured. An implementation of the platform in all member states of the EU enables a single market for mortgages in Europe.

References

[Ag07]   Agrawal, A.; Amend, M.; Das, M.; Ford, M.; Keller, C.; Kloppmann, M.; König, D.; Leymann, F.; Müller, R.; Pfau, G.; Plösser, K.; Rangaswamy, R.; Rickayzen, A.; Rowley, M.; Schmidt, P.; Trickovic, I.; Yiu, A. & Zeller, M.: WS-BPEL Extension for People (BPEL4People), Version 1.0, 2007.

[Ag11]   Aggarwal, A.; Amend, M.; Astier, S.; Barros, A.; Bartel, R.; Benitez, M.; Bock, C.; Brown, G.; Brunt, J.; Bulles, J.; Chapman, M.; Cummins, F.; Day, R.; Elaasar, M.; Frankel, D.; Gagné, D.; Hall, J.; Hille-Doering, R.; Ings, D.; Irassar, P.; Kieselbach, O.; Kloppmann, M.; Koehler, J.; Kraft, F. M.; van Lessen, T.; Leymann, F.; Lonjon, A.; Malhotra, S.; Menge, F.; Jeff Mischkinsky, D. M.; Moffat, A.; Mueller, R.; Nijssen, S.; Ploesser, K.; Rivett, P.; Rowley, M.; Bernd Ruecker, T. R.; Samoojh, S.; Shapiro, R.; Saxena, V.; Schanel, S.; Scheithauer, A.; Silver, B.; Srinivasan, M.; Toulme, A.; Trickovic, I.; Voelzer, H.; Weber, F.; Westerinen, A. & White, S. A.: Business Process Model and Notation (BPMN), Version 2.0 Object Management Group (OMG), 2011.

[CC]   Schweizerisches Zivilgesetzbuch – SR 210 – Version of 1 July 2013

[GBV]   Grundbuchverordnung – SR 211.432.1 – Version of 1 January 2012

[Jo07]   Jordan, D.; Evdemon, J.; Alves, A.; Arkin, A.; Askary, S.; Barreto, C.; Bloch, B.; Curbera, F.; Ford, M.; Goland, Y.; Guízar, A.; Kartha, N.; Liu, C. K.; Khalaf, R.; König, D.; Marin, M.; Mehta, V.; Thatte, S.; van der Rijn, D.; Yendluri, P. & Yiu: A. Web Services Business Process Execution Language Version 2.0, 2007.

[Lü06]   Lübke, D.: Transformation of Use Cases to EPC Models Proceedings of the EPK 2006 Workshop, Vienna, Austria, 2006.

[Lü07]   Lübke, D.: Unit Testing BPEL Compositions in Baresi, L. & Nitto, E. D. (Eds.) Test and Analysis of Service-Oriented Systems Springer, 2007.

[Lü13]   Lübke, D.: BPEL Metrics in Large Scale Process Integration – A Time-Line, Technical Report available at http://www.daniel-luebke.de/files/20130601-BPEL_Metrics_in_Large_Scale_Process_Integration.pdf, 2013, last visited 2014-05-08

[ML06]   Mayer, P. & Lübke, D.: Towards a BPEL Unit Testing Framework TAV-WEB '06: Proceedings of the 2006 Workshop on Testing, Analysis, and Verification of Web Services and Applications, Portland, USA, ACM Press, 2006, 33-42.

[NR02]   Nüttgens, M. & Rump, F. J.: Syntax und Semantik Ereignisgesteuerter Prozessketten (EPK) Prozessorientierte Methoden und Werkzeuge für die Entwicklung von Informationssystemen – Promise 2002, Gesellschaft für Informatik, 2002, 64-77.

[We12]   Weske, M.: Business Process Management - Concepts, Languages, Architectures, Springer Verlag Berlin, 2012.

[TGBV]   Technische Verordnung des EJPD und des VBS über das Grundbuch– SR 211.432.11 – Version of 1 February 2013

[ZertES] Bundesgesetz über Zertifizierungsdienste im Bereich der elektronischen Signatur – SR 943.03 – Version of 1 August 2008