Frank Harmsen
Henderik A. Proper (Eds.)

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Practice-Driven Research on Enterprise Transformation

6th Working Conference, PRET 2013
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Preface

The PRET working conferences are set up as a one-day event to attract an audience from both industry and academia. PRET 2013, the sixth incarnation of PRET, was a continuation of the PRET working conferences that have been organized since 2009. To achieve its objective to confront and link practice with academia and vice versa, PRET is co-located with academic and practice-oriented conferences in related fields, such as information systems (PRET was co-located with CAiSE in 2009 and 2012) and enterprise architecture (co-location with TEAR/PoEM in 2010 and The Open Group conference in 2012). In 2013, PRET-6 was co-located with the Enterprise Transformation track of ECIS.

As early as 1996, Orlikowski noted that for decades, questions of transformation remained largely backstage as organizational thinking and practice engaged in a discourse dominated by questions of stability. As stated then, future research ought to address the question of how "precipitating" and "enabling dynamics" interact in response to pressures for change. Since then, the world has become even more dynamic. A turbulent economical situation, globalization, new technology, and new business models have changed the way we look at transforming enterprises, being (open and active) systems comprising a collective of actors, processes and technology that jointly engage in some purposeful activity. An enterprise can be divided into component systems (such as business units) as well as aspect systems (such as IT, business processes, etc.). Enterprises are no longer static organizations that change from one state to the other in a fairly discrete way, but are constantly in motion, in a much more continuous fashion. Enterprises change their purpose (for instance, the core business of a company), their customers and services, and their external and internal structure at a pace that is much higher and much less planned than it used to be. This is partly due to the dynamic environment in which they operate, but also, to a certain extent, a choice of their own. To handle this motion, the successful enterprises of today have well-defined managerial responsibilities and understandable project priorities while also enabling the processes to be agile enough, even improvisational and continuously changing. Hence, these enterprises do not rely solely on mechanistic or purely organic processes and structures. Enterprise transformation therefore comprises more than just planned change, initiated by people who think the organization is not agile enough to respond to its environment – it is a combination of deliberate and organic change.

We are pleased that the papers that were accepted to this year's conference represent this hybrid view. Moreover, most of them are based on practical cases, which will contribute to our understanding of enterprise transformation. This enables the PRET community to find better ways of dealing with the growing complexity of enterprise transformation, by providing models, reasoning about these models, and to eventually improve the practice.

This year we had a total of thirteen high quality submissions. This involved seven new submissions and six papers that were originally submitted (and reviewed) to the enterprise transformation track at ECIS 2013 and practice-driven research track at CEC 2012, but were found more suitable to be included in the PRET series. Finally, we accepted a total of eight papers, involving three from the seven new submissions.

Each paper was allocated to one of the following three tracks:

– Practical Experiences with Methods and techniques
– Cases in Enterprise Transformation
– Enterprise Architecture in Practice

The track themes, and allocated papers, reflect PRET's objective to bring together academia and practice.

The organizers would like to thank the authors and all paper reviewers. Without their work, this conference would not be possible.

For more information on the PRET series, see the website: www.pret-series.org.

April 2013

Frank Harmsen
Hend*erik* A. Proper

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An e-Government Project Case Study: Validation of DEMO's Qualities and Method/Tool Improvements

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Abstract. This paper reflects some useful outcomes of a practical enterprise change project where the Design and Engineering Methodology for Organizations (DEMO) was used in the initial stage as to give a neutral and concise but comprehensive view of the organization of a local government administration having the purpose to implement an e-government project. One of the main contributions of this paper is a case study on how applying DEMO we were able to confirm, in practice, its qualities of conciseness and comprehensiveness. Namely we specified a generic pattern that reflects the functioning of a local government Citizen Service Desk (CSD) and its integration with several other government agencies. The DEMO based specification of this CSD gave important insights to (1) perceive current operational constraints and (2) devise a strategical roadmap for the implementation phase of the e-government project. During our enterprise engineering project we were faced with some problems while applying current official DEMO Way of Working (DWoW), namely (1) the lack of a tool and method steps to quickly and collaboratively collect enterprise model data and (2) inability to efficiently and effectively propagate model changes in interdependent organizational artifacts. The other main contribution of this paper is a collaborative prototype tool which also implements some improvements to the DWoW as to solve the just mentioned problems.

Keywords: enterprise engineering, e-government, enterprise change, DEMO, case study, method, tool.

1 Introduction

This paper reflects some useful outcomes of a practical enterprise change project where the Design and Engineering Methodology for Organizations (DEMO) was used in the initial stage as to give a neutral and concise but comprehensive view of the organization of a local government administration having the purpose to implement an e-government project. By comprehensive we mean that all relevant original and

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human dependent actions are covered making the whole model of the organization complete. It is concise because no superfluous matters are contained in it. Although whole, the view is still compact and succinct. By neutral we mean that we abstract as much as possible from all realization and implementation issues, e.g., specific persons and/or IT systems/applications in place. This government administration is present in a small island of a European archipelago that is dependent on a main island that has its own autonomous regional government. The regional government has legislative autonomy in certain matters like health and education but it is ultimately under the authority of a national central government. This small local government administration – from now on referred to as SLGA – is a kind of "miniature" replica of almost all government functions from national to regional level and – thanks to having so many functions concentrated in a few persons – was chosen to be a test pilot for the e-government project, later to be extended to all government entities of the main island. This project has three main aspects: (1) the implementation of a workflow system to simplify and automate many operational processes currently paper based and/or – although using Word/Excel documents – lacking in structure and coherence; (2) the development of an online portal to automate as much as possible the interactions and services currently provided at a local physical Citizen Service Desk (CSD), so that the citizens can initiate such interactions in the comfort of their homes; and (3) the development of an IT integration layer with other regional and national government entities that end up executing most of the processes. In this context, our research team was assigned with the responsibility of applying DEMO to model the processes, interactions and information flows occurring in the SLGA. Our models are now being used as a base for the production of a strategic roadmap of organizational changes that will have to occur for several alternative scenarios of e-government implementations, according to the possible levels of integration and change in current government entities and/or their IT systems.

Our team comprised 4 DEMO experts, 2 working in the project full-time and 2 part-time – one 50% and the other 25% – totaling 55 man-days in a month of project execution. Many interviews were made to officials head of each of the SLGA's departments and also to most of the officials responsible for each unit of each department. Interviews were made both for information collection and model validation. A final global workshop with the presence of all interviewees – around 20 – was made for final validation where most models were deemed adequately correct and complete after some small corrections and additions. In the end we specified: 216 transactions – and their associated result types; and 232 fact types – these include classes/categories and fact types and exclude properties. We additionally specified 250 ontological transaction kinds that followed a certain repetitive pattern in certain departments and, because of that, were abstracted into a small subset of generic transactions of the above mentioned 216 transactions set. So, in fact, we specified almost 500 transaction kinds in this project. The huge complexity of the SLGA and the short time frame we had to completely model its organization lead to the need of having a very high throughput in model information collection, integration and validation. DEMO proved to indeed facilitate coherence, conciseness and comprehensiveness by making this enormous complexity intellectually manageable in a very short time frame. But we did face some problems in enabling these qualities of the method. The traditional official approaches to apply DEMO would not be feasible in the short time frame we had and current generally available DEMO supporting tools would not allow an effective and efficient propagation of model information and propagation of changes in individual model elements. We thus had to quickly create and apply new method steps and adequate tooling to support our needs. Wrapping up, the main contributions of our work are: (1) a practical validation of some of DEMO's qualities; (2) the specification of a generic and comprehensive DEMO based pattern that can be reused in other e-government transformation projects; and (3) the specification of more adequate method steps and tooling for the production of DEMO's Object Fact Diagram (OFD).

Section 2 presents our Research Method and Motivation. Next, in section 3, we do a brief Introduction to DEMO. In section 4 we present our case study: Applying DEMO to Model the Citizen Service Desk. Section 5 explores ways of Improving the DEMO WoW and Supporting Tools based on our experience. Section 6 wraps it up with a Results Analysis and Evaluation and finally, in section 7, we present our Conclusions.

2 Research Method and Motivation

In this section we present the applied research method as well as the motivation behind it. Enterprise Engineering Research borrows standards and methods from *Information Systems (IS) Research*. This research field deals with development, engineering and use of information systems. We find that some consider research on IS as a social science and not as an engineering discipline, [1] and [2]. On the other hand, both positivist and interpretive perspectives have been applied to study information systems [3]. In [4] two paradigms are pointed out that characterize much of the research in the IS discipline: behavioral science and design science. The behavioral-science paradigm seeks to develop and verify theories that explain or predict human or organizational behavior. The design-science paradigm seeks to extend the boundaries of human and organizational capabilities by creating new and innovative artifacts. A set of seven guidelines are proposed in [4] for understanding, executing, and evaluating the research. In order to assess how the design artifact presented in this paper meets IS research standards we use these guidelines, as described below.

Guideline 1: Design as an Artifact - This paper provides two viable artifacts in the form of methods. The first is the generalization of the solution for the citizen services desk transaction patterns in the scope of e-government initiative that can be applied in other similar projects. And the second is the method to propagate changes to derived facts and onto DEMO diagrams.

Guideline 2: Problem Relevance - The amount of processes that take place in organizations may be a huge problem when it comes to modeling, but they may not differ much in their pattern, still there is no defined method to generalize such processes. In our particular case of the CSD there was the need for a systematization of its functioning so we could identify the requirements for the online portal and the integration with other government agencies. Another problem that we faced was the lack of proper help from the modeling tools, and a lack of modeling guidelines when it comes to applying DEMO. The needs of shared knowledge between team elements, the centralization of names and descriptions and an easy way to propagate changes to diagrams from a central repository weren't met by any easily available tool.

Guideline 3: Design Evaluation - To evaluate the utility of the design artifact we apply the "*Case Study*" technique from Hevner's observational evaluation method. We intensively and dynamically developed and applied our artifacts in a real business environment as described in sections 4 – Applying DEMO to Model the Citizen Service Desk – and 5 – Improving the DEMO WoW and Supporting Tools. The huge amount of time saved in this real case, thanks to the use of our artifacts, validates their utility.

Guideline 4: Research Contributions - The first artifact we propose in our paper, the generalization of the solution for the citizen services desk transaction patterns in the scope of e-government initiative allowed us to generalize over 150 processes into around ten transactions and it was possible to validate in interviews with officers that their operational processes fit in our generalized pattern. The second artifact, the method – directly supported by a prototype of tool – to propagate changes in class names to derived result types and facts and then synchronize that data onto DEMO diagrams also proved to be an invaluable contribution in our work in both saving time in the production of diagrams and on keeping all the data coherent.

Guideline 5: Research Rigor - The devising of the design artifacts follow a rigorous step-by-step logical reasoning, using the solid theoretical foundations from DEMO as explained in the same sections referred in the above guideline.

Guideline 6: Design as a Search Process - This paper has the advantage of having DEMO as base, which provides a set of coherent and solid definitions for many organizational concepts which constitute "laws" that help direct the construction of the artifact. The artifacts themselves result from an interactive process with the organization and their development was meant to solve our needs as they presented themselves.

Guideline 7: Communication of Research - To communicate our research and conclusions we are using this paper, as well as providing a practical example of the method used in the form of a link to our study case spreadsheet.

3 Introduction to DEMO

3.1 Operation and Transaction Axioms

In the -theory [5] – on which DEMO is based – the operation axiom [6] states that, in organizations, subjects perform two kinds of acts: production acts that have an effect in the production world or P-world and coordination acts that have an effect on the coordination world or C-world. Subjects are actors performing an actor role responsible for the execution of these acts. At any moment, these worlds are in a particular state specified by the C-facts and P-facts respectively occurred until that moment in time. When active, actors take the current state of the P-world and the C-world into account. C-facts serve as agenda for actors, which they constantly try to deal with. In other words, actors interact by means of creating and dealing with C-facts. The production acts contribute towards the organization's objectives by bringing about or delivering products and/or services to the organization's environment and coordination acts are the way actors enter into and comply with commitments towards achieving a certain production fact [7].

According to the Ψ-theory's transaction axiom the coordination acts follow a certain path along a generic universal pattern called transaction. The transaction pattern has three phases: (1) the order phase, were the initiating actor role of the transaction expresses his wishes in the shape of a request, and the executing actor role promises to produce the desired result; (2) the execution phase where the executing actor role produces in fact the desired result; and (3) the result phase, where the executing actor role states the produced result and the initiating actor role accepts that result, thus effectively concluding the transaction. This sequence is known as the basic transaction pattern and only considers the “happy case” where everything happens according to the expected outcomes. All these five mandatory steps must happen so that a new production fact is realized. Inwe also find the universal transaction pattern that also considers many other coordination acts, including cancellations and rejections that may happen at every step of the “happy path” [7].

Even though all transactions go through the four – social commitment – coordination acts of request, promise, state and accept, these may be performed tacitly, i.e. without any kind of explicit communication happening. This may happen due to the traditional “no news is good news” rule or pure forgetfulness which can lead to severe business breakdown. Thus the importance of always considering the full transaction pattern when designing organizations. Transaction steps are the responsibility of two specific actor roles. The initiating actor role is responsible for the request and accept steps and the executing actor role is responsible for the promise, execution and state steps. These steps may not be performed by the responsible actor as the respective subjects, may delegate on another subject one or more of the transaction steps under their responsibility, although they remain ultimately responsible for such actions [7].

3.2 Distinction Axiom

The distinction axiom from the Ψ-theory states that three human abilities play a significant role in an organization's operation: (1) the *forma* ability that concerns datalogical actions; (2) the *informa* that concerns infological actions; and (3) the performa that concerns ontological actions [6]. Regarding coordination acts, the performa ability may be considered the essential human ability for doing any kind of business as it concerns being able to engage into commitments either as a performer or as an addressee of a coordination act. When it comes to production, the performa ability concerns the business actors. Those are the actors who perform production acts like deciding or judging or producing new and original (non derivable) things, thus realizing the organization's production facts. The informa ability on the other hand concerns the intellectual actors, the ones who perform infological acts like deriving or computing already existing facts. And finally the forma ability concerns the datalogical actors, the ones who perform datalogical acts like gathering, distributing or storing documents and or data. The organization theorem states that actors in each of these abilities form three kinds of systems whereas the D-organization supports the I-organization with datalogical services and the I-organization supports the B-organization (from Business=Ontological) with informational services [7].

4 Applying DEMO to Model the Citizen Service Desk

The SLGS's CSD works like a "government service store" where citizens can go to and initiate several processes, like renew a driver's license, make a passport or even ask for a tractor to plow their fields. The execution of most processes are of the responsibility of specific governmental entities. The CSD not only centralizes the initiation of these processes in a single physical interface but also makes them available in this secondary island, freeing its citizens of being forced to travel to the main island to deal with such matters. The CSD provides the initiation of around 150 processes, whose execution are of the responsibility of 12 different government entities, 10 of which are located in the main island, 1 in the mainland and 1 is local to the secondary island. In our project we applied the DEMO notion of transaction and modeled each of these processes as an individual transaction. Considering the transaction axiom, although most of the transactions are initiated in the CSD, their execution step does not take place there. The request act happens in the CSD, as well as the promise act. Then all processes are forwarded, in paper format, to the responsible entity that may or may not give some sort of direct response to the citizen – the state step of the transaction pattern – depending on the process in question. When there is direct response from the responsible entities it is usually in a form of a document that has to be delivered to the citizen either by postal mail or through the CSD. Before forwarding any process to the responsible entity, all documents associated must be scanned and archived in a local computer server, so that a digital record of all processes is kept. Payments related to processes, that have a cost associated, take place in the CSD. These payments are collected daily, grouped by entity and, at the end of the day, are forwarded to the responsible entities either by a bank deposit or by a direct delivery. Considering the large amount of transactions that take place in the CSD our first step while specifying them was to try to find a pattern to abstract this complexity that would cover all ontological acts taking place in the CSD. In Figure 1 we find Actor Transaction Diagram (ATD) of the CSD, where such pattern is specified.

In the identified transactions there are three that are not ontological. Scanning, archiving and forwarding are datalogical but we explicitly specified them already at this stage as they will be a central aspect of the future workflow system to implement. The five transactions with higher ids don't currently explicitly take place in the CSD in a structured way, but in a kind of ad-hoc way. Namely, a few times per year procedural orders come from some government entity informing of a new process or a change in

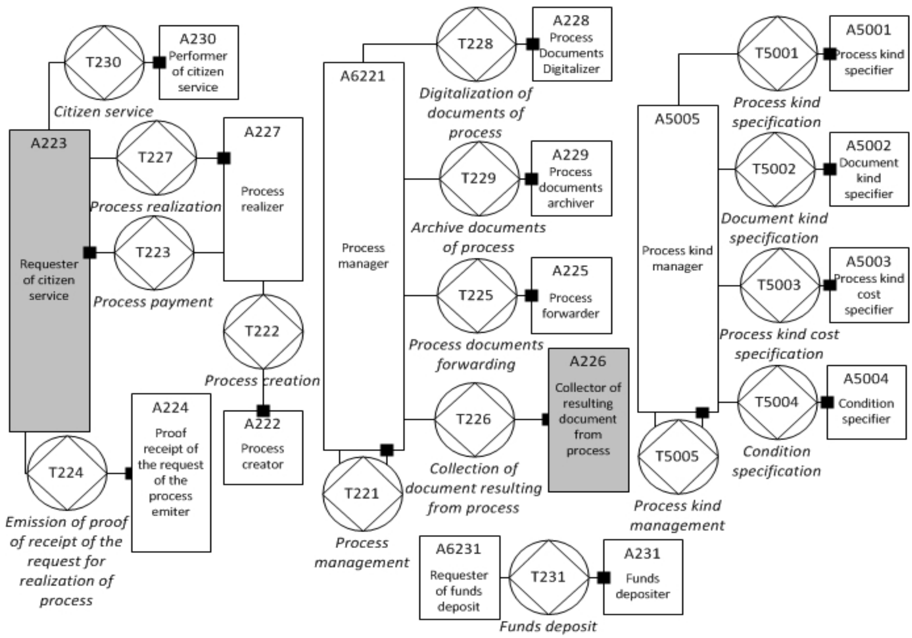


Fig. 1. CSD - Actor Transaction Diagram

an existing process. Examples are new mandatory documents needed to request to initiate a driver's license renewal, or new mandatory conditions to allow a process initiation like minimal age. So the (around 150) kinds of processes currently handled at the CSD, respective rules to follow and associated costs are currently dispersed in many unstructured documents, grouped by each entity. Our specification gives a needed structure to all this information and their specification. Future changes in the procedures and rules of the processes will be more easily integrated in the daily routine of the CSD workers thanks to the implementation of our specified pattern in the future workflow system.

We can notice five clear clusters in the ATD diagram, the first being the transactions initiated by the citizen; it starts with a citizen service that may or may not lead to a process realization – e.g. the case that what the citizen needs is not provided at this desk but in another specific government office. If indeed a process realization is requested then a process creation takes place. Process realization may have an associated cost communicated in the process payment transaction. But there are many processes with no costs associated that may be target of an emission of proof of receipt of the request for the realization of the process. That's why a step that usually would simply be the state act of a payment transaction deserves to be a transaction on its own. The second cluster is the funds deposit cluster, this one is isolated from the rest due to its nature. It is a daily transaction that can only be done by one CSD coordinator at the end of the day.

The third cluster is the process management cluster. Here we find the transactions related with the process that are executed in the back-office when the CSD collaborators are free from attending citizens. Two of the datalogical transactions, the scanning of documents of the process and archiving of these documents of the process take place whenever the CSD collaborators have free time. Forwarding process documents may vary depending on the process forwarding method. If it's sent by fax it takes place at the time of scanning. If it is sent by paper through the ferry boat it takes place every afternoon sometime before the ferry trip. The last transaction in this cluster also takes place when the CSD collaborators have free time, but it does not happen every day as many of the CSD processes have no returning documents, and in most that do, those documents are sent directly to the citizen by postal mail instead of returning to the CSD building. In the fourth cluster we have the process kind management and its related transactions that, as we previously stated, are meant to deal with the frequent changes in processes and their related documents and conditions.

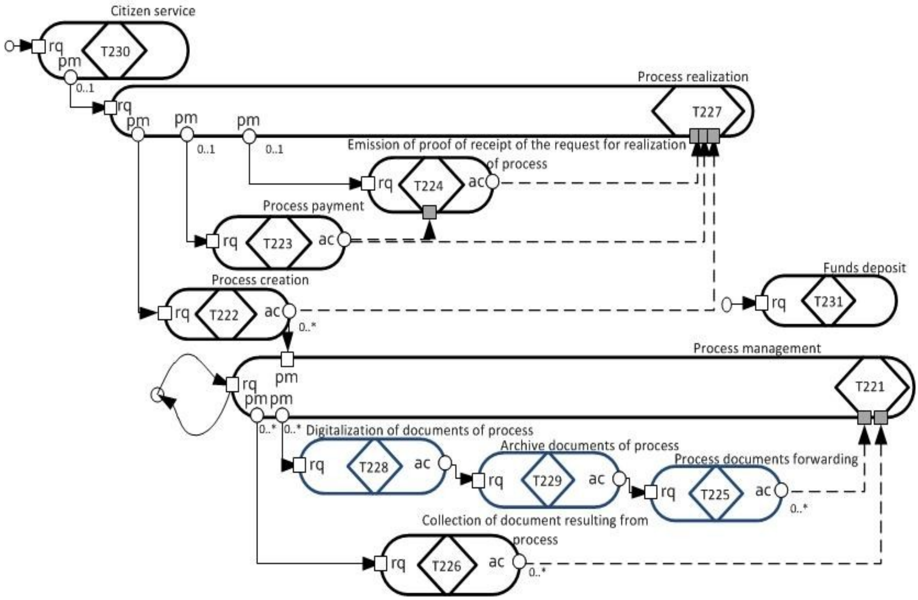


Fig. 2. CSD - Process Step Diagram Part 1

The CSD's Process Step Diagram (PSD) is found in Figure 2. As in the ATD, the same clusters are identifiable in the PSD, but not in a so clear fashion since there is a causal connection between process creation and process management. A process creation may or may not lead to an instant request of an instance of process management right away depending of the work load. But it will eventually lead to such an instance that may then handle many processes at the same time when a CSD collaborator has free time. As previously stated, a citizen service transaction does not always lead to a process realization transaction, for this reason the cardinality of that causal relation is zero or one. When there is in fact a process realization it is requested in the sequence of the promise act of the citizen service transaction. Process realization will always lead to the creation of a new process instance in the promise act. If that specific process has a cost associated, a payment process will also be requested after the promise step of the process realization transaction. There might be the need for an emission of proof of receipt of the request of the process. If a payment has been made the execution of this transaction must wait for the process payment accept act. The process realization transaction execution may have up to three waiting conditions, the creation of a process, that will always happen, the process payment, that will only be associated with a few and the emission of proof receipt of the request of the process that again will only happen in some cases.

The process management transaction is started when there is time and either processes to manage or documents waiting to be delivered. If there are processes to manage, the logical sequence of transactions is, first to scan the documents of the process, then archive those digital versions of the documents on a local server. If the document is meant to be sent by fax the forwarding of the process is done straight away otherwise at the end of the day the original documents in paper format are forwarded with a security firm to the main island using the ferry boat. When a process management is started only because there are documents that just arrived and need to be delivered to the citizen, the CSD collaborator uses the telephone to establish contact giving him or her the notice that the document is ready to be picked-up. The process management transaction has one or two waiting conditions depending on the processes that were started, it may need to wait for the forwarding of the process acceptance, the collection of documents resulting from a process or both.

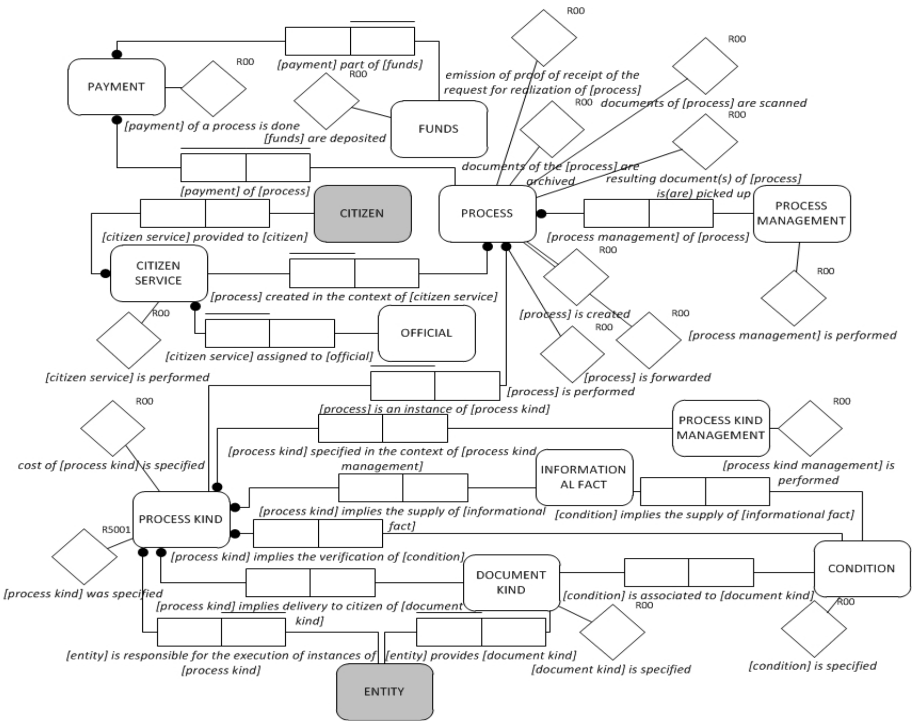


Fig. 3. CSD - Object Fact Diagram

In Figure 3, we find the OFD which, thanks to previous explanations should be mostly quite easy to understand. But for some classes we provide explanation here. Each PROCESS provided in the CSD isn't more than an instance of a PROCESS KIND that is the responsibility of some ENTITY. For each of those PROCESS KINDS, INFORMATIONAL FACTS are requested, and certain CONDITIONS must be verified. These CONDITIONS themselves – eventually a tree of chained conditions – may also imply the need to request INFORMATIONAL FACTS. Each of these will be associated to a specific DOCUMENT KIND. PROCESS KINDS and their related CONDITIONS and DOCUMENT KINDS are in constant change so PROCESS KIND MANAGEMENT deals with and describes such changes.

5 Improving the DEMO WoW and Supporting Tools

In the organizational units information gathering process we stored all collected information in a Google spreadsheet shared between team elements. When we were in the process of producing the State Model, one of the issues we faced was frequent changes in class names while validating diagrams with the organizations' collaborators, and subsequent need to change all related names of fact types and result types.

This would lead to a huge waste of time just in the renaming process. Taking advantage of the fact that we were working on a spreadsheet we developed a quick solution for our needs. We created a specific worksheet – named Facts – to store State Model elements. Excerpts of this worksheet – 3 main sets of columns – can be seen in Figures 4, 5 and 6.

Columns Class_1 and Class_2 contain the class name that each particular fact type relates to. In the case of the specification of a class or a result type, only Class_1 is filled (in bold). Class_2 is filled whenever we have binary fact types (that were the ones with the most occurrences in our project). Examples are visible in Figure 4. As one of our main goals was to facilitate name propagation, the only place that had the class name itself was the row containing the class definition. In all other cells we had that name passed by a reference to that cell, making all class name changes to

	A	B	C	D	E
1	**Kind**	**IDA**	**IDB**	**Class_1**	**Class_2**
2	CL	1	0	**CITIZEN**	
3	FT	2	0	CITIZEN	CITIZEN SERVICE
4	CL	3	0	**CITIZEN SERVICE**	
5	RT	3	1	CITIZEN SERVICE	

Fig. 4. Facts Worksheet Part 1 - Classes and ID's

F	G	H	I	J
ID_R	**Result_type**	**RT_prefix**	**RT_class**	**RT_sufix**
T230	[citizen service] is performed		[citizen service]	is performed

Fig. 5. Facts Worksheet Part 2 - Result Type and it's construction

K	L	M	N	O	P
Fact_type	**FT_prefix**	**FT_class_1**	**FT_infix**	**FT_class_2**	**FT_sufix**
[citizen service] provided to [citizen]		[citizen service]	provided to	[citizen]	

Fig. 6. Facts Worksheet Part 3 - Fact Type and it's construction

propagate automatically to all result types and fact types referring to the class having the name changed. Namely, the specification of result types was done in the four columns visible on Figure 5. The first column contained the result type formulation itself and it was automatically filled by a formula referring to the information in the other three columns containing, respectively, (1) the prefix (textual content before the referred class), (2) the class that the result type was related to and (3) the suffix. The column with the class name has a formula that fills the cells automatically when something was written in either the prefix or the suffix columns, and automatically changed the class name (referred in Class_1 column seen before) to lowercase adding the "["and"]" before and after the class name respectively.

For the binary fact types a similar solution was used, visible in Figure 6, but, instead of four columns, we had the need for six: the fact type formulation itself, the prefix, the first class, the infix (textual content between classes), the second class and the suffix. We decided to include in this spreadsheet only the classes, result types and binary fact types. But this solution could be scaled to include other elements of the SM like properties and ternary fact types, just adding more columns to the table and applying similar formulas to the ones we specified.

As there was no need to propagate changes in the name of properties these were added manually in the diagrams and, when part of a fact type, inserted also manually in the formulation on the spreadsheet. For a more streamlined manipulation of the data in this spreadsheet we added three more features: one new column with the kind of fact type(CL for class, TR for result type and TF for fact type), made all the original class names bold to facilitate finding the correct place to proceed with a name change of a class and added a result ID to relate each fact type with the transaction whose result leads to the creation of instances of that fact type. In [8] one can find the live worksheet referred in this paper with the examples and formulas mentioned, used to automatically fill the result type and fact type formulations and class names.

This spreadsheet tool is one of the main contributions of our work. With it we had most of the content specified for our OFD diagrams with automatic propagation of name changes. But considering the huge amount of model elements involved, it became essential to have automatic synchronizing between the spreadsheet we were working with, and our diagrams in Microsoft Visio, an idea adapted from [9]. To realize such synchronization one needs first to export the spreadsheet to Excel format. Then, by selecting the "data" tab and clicking on the Link Data to Shapes, a new window will appear were one can select the Excel file.

The data importing process is rather straightforward, one simply has to select the file path, worksheet to use, the columns and rows and an identifier field. When this importing process is over, one will have an external data tab at the bottom of the screen with the source data from the selected worksheet as you can see in Figure 7. To actually link the diagram shapes with the source data, one just places the shapes and fills them only with the unique row identifier. Then right clicking on the external data, using the "automatically link" option and matching the worksheet ID with the shape's label's ID. If done properly a chain symbol should appear in the left side of the linked rows as shown in Figure 7.

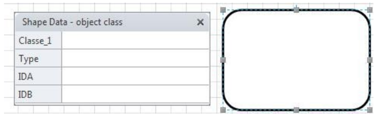


Fig. 8. Class Shape

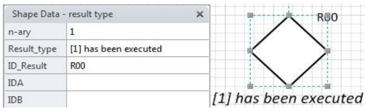
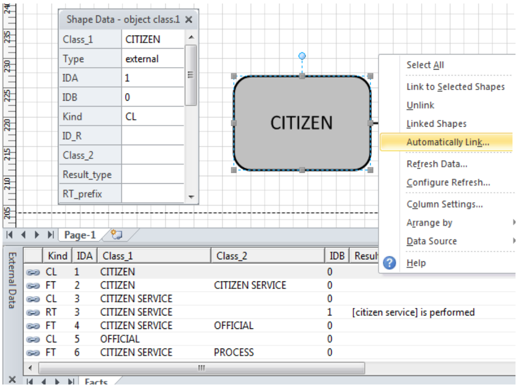


Fig. 9. Result Type Shape



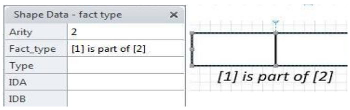


Fig. 7. Linking an Excel spreadsheet with Visio

Fig. 10. Fact Type Shape

For a proper synchronization of the spreadsheet with the Visio diagrams, we decided to use two ID's (IDA and IDB). This need existed due the direct matching between the column label in the spreadsheet and the corresponding Visio stencil shape label. We could not use the same row to synchronize classes and all their associated result types because we would need to have a huge stencil with many result type shapes that only differed in the shape's label name. We had the idea to give a new id for each result type, but, in this case we would lose the bond between the classes and related result types. So the solution we could come up with was to add a second ID column (IDB) used just for result types. In rows specifying result types related to the same class the first ID (IDA) is always the same – the same as the class it is related to – and only IDB changes. The changes done to the original Visio DEMO OFD stencil shapes to accommodate the new ID's can be seen in Figures 8, 9 and 10. This is an original and valuable contribution of our work as the Excel-Visio synchronizing solution presented in [9] was limited to ATD diagram data.

6 Results Analysis and Evaluation

While conducting our interviews and gathering organizational information we were able to witness the importance and relevance of the transaction axiom of the Ψ-theory. In most of the CSD transactions it was of the utmost importance to have a clear notion of each of the 5 basic transaction steps and clearly assess which organizational functions were responsible for fulfilling which actor roles and also important delegations that were in operation. It immediately got clear for the project team which government institutions were really responsible for which parts of the process. Also it became clear that several current process names should be changed as to more precisely reflect the real production or decision taking place in the execution of the process.

One example of this is also a quite interesting case we encountered. Citizens that become unemployed can apply for a subsidy given by the state. The name of the process was “applying for unemployment subsidy”. But in fact this is the name of the request coordination act of a complete transaction that should have a more precise name. Thus, this process was renamed to “decision on providing unemployment subsidy”, a much more precise name which also made more clear how the several responsibilities of each transaction step were and should be alloted and/or implemented in an e-government scenario. One thing we noted also in this case was a double delegation situation. The Social Security (SS) department is the one that ultimately decides on providing the subsidy and so, responsible for the promise step. In the main island this step is delegated to the Unemployment Institute (UI). This institute, in turn, delegates this responsibility, in the secondary island, to the CSD. Currently the unemployment processes are forwarded – paper based – first to the UI and then, by the UI to the SS. In this case and others, applying DEMO gave preciseness and coherence to the government processes that got better names while being modeled as DEMO transactions. Also bureaucratic infological and datalogical flows were easily identified providing clear input for process streamlining and automation for the next stages of this e-government project. In the end of the previously referred process the citizen receives, directly at his home a postal letter sent by the SS with the decision that declares if he or she is fit or not to receive unemployment subsidy. Then, with that letter in hand the citizen can initiate yet another paper based process in the CSD so he or she can start receiving the unemployment subsidy at some point in time.

In our OFD explanation we specified a class named INFORMATIONAL FACT. This is an example of a practical application of the distinction axiom of the Ψ-theory as to facilitate the gradual e-government implementation effort. Each instance of this class is supposed to be the specification of a kind of ontological fact whose information must be provided by the citizen for some process to initiate or to verify some process rule. For example, for many processes to initiate the latest tax declaration has to be delivered but it is not clearly specified, for that process, which facts on such tax declaration will be considered in the process execution. If a process requires the citizen's birth date, he is asked to provide his id card, but in that id card, besides the required informational fact there are many more that are not relevant, like the social id number, the fiscal identification id, amongst others. With this notion of informational fact we intend to enable government officials to precisely specify the elementary facts that are needed in each process, even though they are still paper and/or document based. This will allow a gradual learning process and a gradual implementation (process by process) of several e-government initiatives and/or process optimization by reducing the required conditions for process initiation and/or obtain required facts automatically by web-services provided by the appropriate entity.

Our improvised tooling solution to collect model data in a collaborative and integrated way was very useful to our DEMO practical project and it may also be to other colleagues. It saved us a huge amount of time in diagram editing and propagating model changes after validation rounds with officials from the SLGA. We estimate that we spent around 30% of our time in diagram creation and editing and that we would spend double of that time had we not used our method of collaboratively specifying transactions and facts and linking automatically all the data in the respective rows of a Google Spreadsheet to Visio diagrams. Such features were lacking in the modeling tools commonly used with DEMO. In our practical experience, a way to propagate changes done to certain model elements – like classes, our focus on this paper – is essential to maintain one of DEMO's proclaimed qualities: consistency. And this is currently not supported by the modeling tools we know to support DEMO, that we tested and analyzed. Neither Visio [10] (only diagrams), Xemod [11] and Model-World [12] have support to propagate a simple change in a class name to its related result and fact types. This could and should be easily implemented applying a similar method to the one we have presented here, and would be a relevant contribution for any project involving DEMO.

As a contribution to the practical method steps of DEMO, we find that while specifying fact types and result types any tool should provide a way to one easily just introduce the words of the formulations "surrounding" the referred classes and, for example, provide referral with auto-completion. We implemented such functionality in our collaborative spreadsheet with the automatically generated formulations based on string concatenation formulas provided by Google spreadsheet. We also contribute to the enterprise engineering community with method steps to integrate a spreadsheet with Visio diagrams allowing automatic synchronization between shapes and rows of the sheet. Just filling an ID in each shape instantiation in a diagram is sufficient so that, automatically, the DEMO id and the shape name or fact formulation of that shape automatically appear in the diagram in the next sync. Any slight change in names can be automatically reflected in several diagrams (e.g., a transaction name).

7 Conclusions

The analysis we did on the CSD models shows how Ψ-theory and DEMO's "lenses" of transaction and distinction axioms contributed in this case-study to a concise and comprehensive view of the essential dynamic and static aspects of the government's interaction with the citizen through the CSD. This concise view is now been very useful in the current stage of the project to structure and justify: (1) several organizational changes needed – information policies, establishment of common data semantics, etc.; and (2) the future implementation roadmap, taking in account critical points of interaction and responsibility distribution clearly pointed out in DEMO's construction model in a neutral way abstracted from implementation details. The CSD specification we provide here is one of the main contributions of this paper that may be useful to other DEMO and/or e-government projects.

Regarding the project method, we identified nearly five hundred fact types in the SLGA. Keeping consistency with such numbers in not an easy task, especially considering all the information is not concentrated in one place, but frequently spread, redundantly in diagrams and tables – e.g. class names, our focus in this paper. Therefore, change propagation solutions like the one we provide are essential and quite useful to save huge amounts of time. For space reasons in this paper we focus on the OFD diagram, but this solution is easily applied for all DEMO diagrams and that is what we have done in our project.

As a final remark we found that using DEMO as the central method to gather specifications for our e-government project allowed a much more effective and successful outcome than approaches of traditional requirements engineering and quality management. SLGA had used these 2 approaches before we started our project and, in a much longer time frame than ours, the produced documents were ambiguous, incomplete and some times excessively detailed without need. This leads us to corroborate that DEMO indeed provides a very high Return on Modeling Effort (RoME) as some other initiatives had already shown [13]. As future work we will validate our claims more thoroughly with qualitative and quantitative validations with team members and SLGA officials.

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Enabling Information Interoperability through Multi-domain Modeling

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Abstract. Flexible integration of information systems with heterogeneous data structures and interfaces has been an important IT research goal for decades. It is a fundamental requirement for enterprise transformation that the business knowledge captured in form of data and business processes can be integrated and adapted within and across enterprise boundaries. In this paper we present results of a model-driven interoperability approach in the asset management domain. The approach builds on multi-domain modeling principles and has been applied in three large use cases over the last 5 years. We show how information interoperability and enterprise transformation can benefit from multi-domain modeling and how it fits together with a design science approach.

Keywords: Domain modeling languages, model-driven engineering, meta modeling, information transformation, interoperability.

1 Introduction

The lack of semantic interoperability between information systems remains a big challenge in computer science and costs industry billions of dollars each year. In 2002, the National Institute of Standards and Technology estimated that the costs for inadequate interoperability in the US Capital Facilities Industry to be USD 15.8 billion per year [10]. This number was considered conservative by a report on interoperability in the construction industry in 2007 [25] and a recent Fiatech report on advancing interoperability [9].

Semantic interoperability is often a fundamental requirement to accomplish an enterprise transformation successfully. Many of drivers for enterprise transformation described by Harmsen et al. [13] such as mergers, acquisitions, introduction of novel technologies, new business models or compliance to corporate rules and policies require that existing information systems are interoperable at the time of the transformation and remain interoperable in the future. As pointed out in one use case in [13], lack of integration between the IT departments was a root cause of the lack of synergy between different business units.

Despite considerable progress made in the past, information integration remains challenging. Although first interoperability efforts were codified in the 1980s with standards such as EDIFACT or STEP APIs, the modeling of application data in terms of record structures and relational database schemas remained

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"too flexible" [2]. On the one hand, such flexibility increased the modeling power and incorporated more semantics (object or ontology-based methods) but on the other, it resulted in higher complexity and an increased likelihood that the data structures of independently developed systems would be mutually inconsistent and non-interoperable. The problem of low-level encoding and simple heterogeneous data types on the syntax level has mainly been solved with the acceptance of XML as the standard interchange format within and across enterprise boundaries. Data and application integration is therefore an ever-present issue and capabilities in this space are forcefully advertised by major information architecture vendors. To be strict, much of the emphasis lies on data transformation and interchange rather than wholesale migration. Systems such as IBM Websphere or SAP Netweaver present an XML-syntax, SOA based interface to the world, but the structure and meaning of data still needs to be adjusted by developers ensuring that the right data structures are exchanged and transformed at the right time [2].

We propose a multi-domain modeling approach to address some of the problems in semantic interoperability. In the context of three industry use cases we apply a meta modeling language to specify a set of executable domain specific languages (DSLs); one language for each data structure and interface that is required to be connected to the enterprise landscape. In a following step the developed domain models are integrated in two ways: (1) Behavior integration is achieved by composing some of their elements in another domain language that orchestrates the execution, and (2) static data and interface integration is achieved through bi-directional model transformation which is specified by another domain specific language within the same framework. By using the same meta modeling language for all DSLs, we achieve an integration on the language level that simplifies the integration of models while maintaining the benefits of domain-specific modeling. Specifically, this served the purpose of simplifying the semantic integration and addressed particular requirements which are explained in more detail in the next section.

The remaining paper is structured according to the STARR template: Section 2 describes the initial *situation* of the use cases which comes from the asset management sector, Section 3 provides an overview of the *tasks* including the requirements and goals, Section 4 covers the model-driven *approach* we took, Section 5 discusses the positive *results* of the approach, and Section 6 includes some *reflections* on the use case.

2 Interoperability in the Asset Management Sector

Gregory and Matthew [11,19] highlighted that the integration and data management of information systems are among the key challenges in Engineering Asset Management (EAM). Starting from the organization, planning, and controlling the acquisition of assets to the use, monitoring, maintenance, and disposal of physical assets, EAM incorporates multiple disciplines to manage the whole lifecycle of physical assets representing a unique interoperability challenge. In order to achieve an integrated EAM solution, information systems from different areas such as risk management, budget and costing estimation, condition monitoring, human resources, or facility management need to be integrated. In this section we discuss different aspects of integration that are relevant in the EAM domain. First we discuss Enterprise Application Integration (EAI) and Business-to-Business (B2) integration and then two dimensions of integration, horizontal and vertical integration. Lastly, we introduce three use cases to which we have applied our approach.

2.1 EAI and B2B Integration

The integration of software applications can be classified according to the enterprise boundaries: Enterprise Application Integration (EAI) and business-to-business integration (B2B integration). EAI is concerned with the integration of software applications within an enterprise and B2B integration is concerned with the exchange of electronic documents between organizations. Both share some commonalities [22,6,7]:

- Business processes are used for modeling the sequence of activity execution.
- Routing rules are applied for defining the data exchange between two systems.
- System interfaces provide the basis for data exchange.

However, EAI and B2B integration differ in their focus and requirements. EAI software provides the infrastructure to rapidly connect and interface between an organization's internal applications. B2B integration can be regarded as an extension of EAI by integrating organization's applications with the applications of its partners. The three use cases we are going to introduce in Section 2.3 cover both EAI and B2B integration situations.

The technical integration of systems is usually driven by a goal. Three possible goals on the technical level can be observed according to Eyal et al. [8,21]:

1. Systems with similar functionality may be merged: Merging systems with similar functionality is an important issue in preserving data quality. If duplicated information is distributed over several systems and an integration of those is not considered then there is a high risk that information becomes inconsistent over time. For example, duplicated data is changed in one system but not in the other.
2. Complementary systems may be composed to gain new functionality: Composing systems to gain new functionality, is the main reason for integrating existing systems in EAM. For example, a new decision support system is introduced that requires data from sensors and the ERP system. Without integration, prediction of asset health conditions cannot be achieved accurately.
3. Existing systems may be customized with new features: New functionality is introduced to the environment but in this case it affects only one system.

> The main reason for customizations is the ease of integration with other systems. For example, data extracted from sensor readings are filtered first and then transferred to an ERP system. Customization may be implemented within systems as an extension or as a separate component that can be re-used in combination with other systems.

An integration of two systems can be established in two dimensions depending on the relationship of the systems. The dimensions are referred to as horizontal and vertical integration known from organizational integration.

2.2 Horizontal and Vertical Integration

In order to achieve effective decision support the information needs to be integrated from different disciplines and integrated on a high level. These two goals refer to the integration in two dimensions: horizontal and vertical integration. The horizontal dimension integrates information from different disciplines whereas the vertical dimension integrates information within a discipline [12]:

Horizontal Integration: Horizontal integration incorporates different systems that provide complementary functionality required to reach a certain business goal. Horizontal integration can be established by implementing a distributed business process that orchestrates activities executed in different locations. It defines the specific order in which activities are executed to achieve a business goal.

Vertical Integration: Vertical integration handles the integration of systems within a certain domain, sometimes on different levels of abstraction. Depending on whether we are dealing with an EAI or B2B integration situation, the levels of abstraction and goal of the integration are different. In EAI, the systems in the same domain are usually on different levels of abstraction. For example, a system consists of sub-systems and a sub-system may consist again of sub-systems. Vertical integration in EAI allows to abstract information from a low level and lift it to a higher level that is appropriate for further processing and decision support. In this way unnecessary information is hidden and an overall view of the underlying data is accomplished [18,1]. An important feature of vertical integration is the direct access of information on different abstraction levels. A high level view has the advantage of identifying abnormal conditions quickly, but for finding the reasons why the condition is abnormal, an approach is required that allows to navigate to the sub-systems in order to localize the cause.

In B2B integration, the information systems in the vertical dimension also share the domain but are usually on the same level of abstraction. They are usually integrated by merging for a particular reason, for example, for comparing competing businesses in a market or for accessing them in a unified way.

Horizontal and vertical integration in EAI and B2B integration are illustrated in Figures 1 and 2. When we look at the order in which the dimensions are integrated, vertical integration is typically performed before horizontal integration.

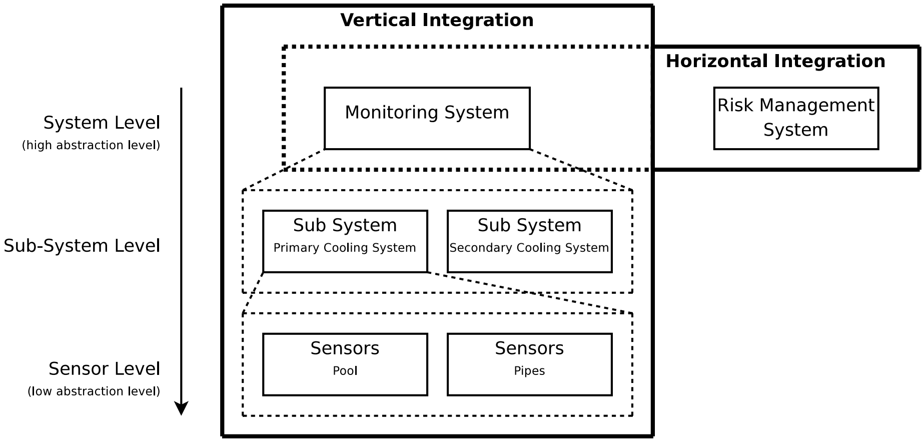

Fig. 1. Horizontal and vertical integration in EAI

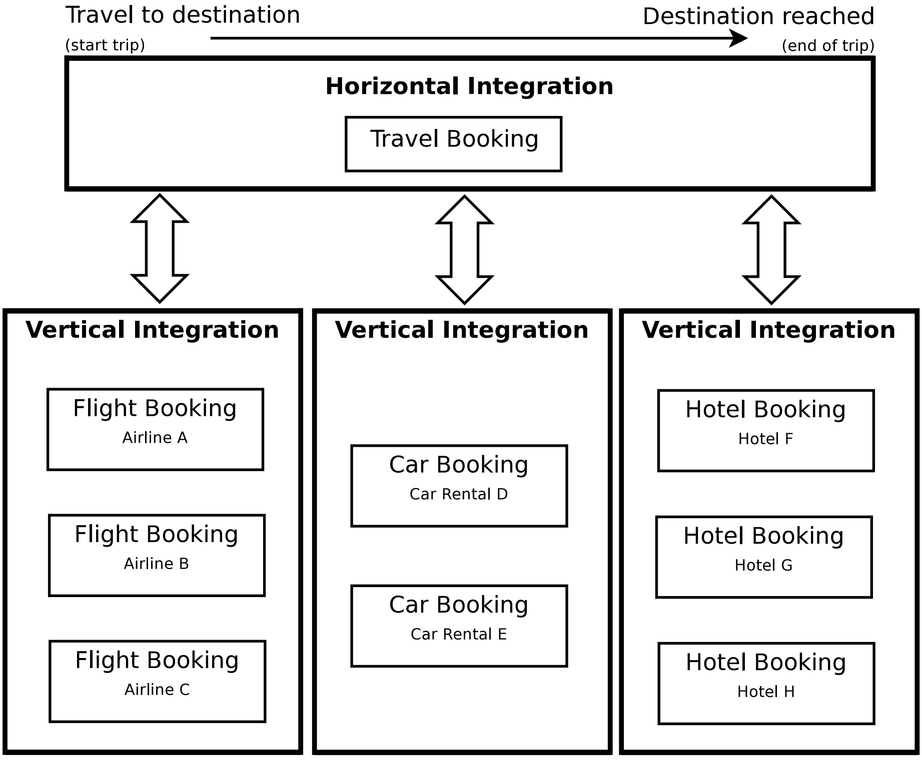

Fig. 2. Horizontal and vertical integration in B2B integration

The reason for this is that in the case of EAI systems, the more detailed data on a lower abstraction level needs to be aggregated first to a level where it can be integrated with other systems. In B2B integration, usually one or some systems are selected for integration on the horizontal level. In order to select a system, they must be vertically integrated first.

2.3 Use Cases

In this section we describe three use cases we have conducted in the asset management sector over the last 5 years. The first projects dealt with "plant monitoring and management" and has been conducted in collaboration with the CRC for Infrastructure Engineering Asset Management[1] (CIEAM) and the Australian Nuclear Science Technology Organization[2] (ANSTO). The second use case dealt with the automation of requirement engineering for interoperability and has been conducted with CIEAM and Mainpac Pty Ltd. [3]. The last use case investigated the digital handover of design documents to the operation and maintenance phase in the Oil & Gas industry and was conducted in collaboration with industry alliances and major CAD and software vendors in the Oil & Gas Interoperability area. In the context of the previous discussion on EAI/B2B and the integration dimensions, Use Case A covers horizontal and vertical integration in EAI, Use Case B covers horizontal integration in EAI and B2B and Use Case C covers the horizontal dimension in B2B integration.

Use Case A. Plant Monitoring and Management: In the first use case we considered a power plant management environment shown in Figure 3. It consists of five systems: The vertical dimension captured the "field data collection" which consisted of (1) an embedded sensor reading system, (2) a data filtering system, and (3) a field data collection system using personal digital assistants (PDAs). On the horizontal level, two systems were required to be integrated: (4) an enterprise resource planning system (ERP) and (5) a decision support system (DSS). The DSS was introduced later because it provided unique functionality that was required by the enterprise running the plant, functionality such as prediction of asset health and decision support in asset maintenance. Particular challenges in this use case were: how to interface with existing systems in a unified way, and how to deal with future changes that affect a new version of an existing software product or the introduction of new software to the enterprise landscape.

Use Case B. Capturing Interoperability Requirements: In the second use case, the problem was how to accurately capture and manage requirements for the interoperability of information systems within an enterprise (EAI) and between local and external systems at a business partner site (B2B integration). Requirements are negotiated in iterative sessions between an enterprise and its

[1] `http://www.cieam.com`
[2] `http://www.ansto.com`
[3] `http://www.mainpac.com.au`

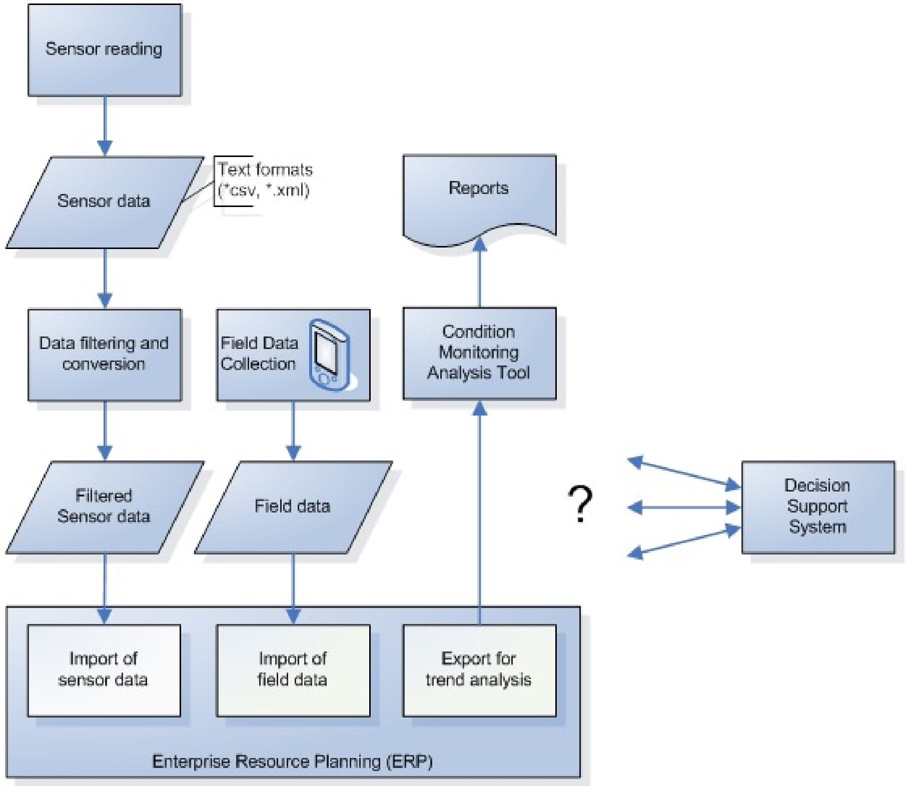

Fig. 3. Environment of Use Case A "Plant Monitoring and Management" [12]

partners and captured based on user input during meetings and on existing interfaces in the form of Web services definition files (WSDL) and C# code. From the requirements, a contract is formed in Microsoft Word documents and WSDL files and C# code are created which may be used as input for the next requirement capture cycle. Particular challenges in this use case were: how to capture requirements during interactive sessions with business partners, how to generate service contracts and interfaces automatically, and how to deal with changes and achieve consistency between interfaces, contracts, requirements and implemented code.

Use Case C. Standards-Based Interoperability in the Oil & Gas Industry: The third use case deals with the digital handover of documents from the design phase to the operation and maintenance phase. In the engineering space, interoperability is a major challenge in the information hand-over from one phase in the asset life-cycle to another [5]. To overcome the interoperability problem, considerable effort has been invested into the development of standards to serve as a *lingua franca* between computer systems. Two candidates of those standards are ISO 15926 and MIMOSA [20], which are currently applied

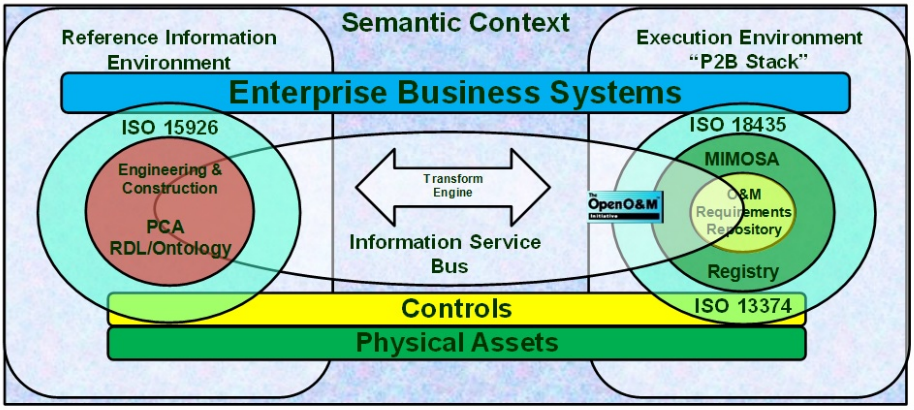

Fig. 4. Overview of Use Case C "Standards-Based Interoperability" (Figure provided by OpenO&M at ISA 2012 Exposition)

in the Oil & Gas Interoperability (OGI) Pilot in support of the ISO TC 184 OGI Technical Specification project. The particular challenge in this use case is how to map data in CAD tools into asset management tools using open standards and how to ensure that the mapping is correct according to the semantics of the underlying data model specifications [15]. An overview of the context is shown in Figure 4.

In the next section we discuss the common goals and objectives of the three use cases.

3 Requirements and Goals of a Sustainable Interoperability Solution

Although all three use cases cover a different type of integration and dimension, they share common requirements and goals. In this section we provide an overview of the key challenges and goals that have been defined in collaboration with the industry partners.

3.1 Requirements

Legacy Applications: Integrating systems that have been developed in the past remain one of the biggest challenges in interoperability. Because of limited human resources with necessary expertise the costs of changing and adapting legacy systems is usually so high that this option is often not considered as a solution. Alternatively, underlying data might be accessed directly, e.g., direct access of a relational database through SQL interface and bypassing the legacy application or developing a wrapper that maps an API of the legacy tool (if it exists) with state-of-the-art technologies.

Minimize Dependency on Existing Systems: Non-IT enterprises are often in the situation where they are locked into software support contracts, especially with large software vendors, and become dependent on particular systems that have been developed externally and dominate their tool landscape. Changing or adapting those systems usually requires high costs or is sometimes even impossible due to policy reasons. Software tools tend to be closed and only allow access through a limited API which becomes a challenge if no tools are acquired that need to access the same data. In some cases it might not only be necessary to access the data but also to feed data back into the systems, for example, a data quality tool performing data cleansing.

Comprehensive Integration: Since information can be integrated in different dimensions and within or across enterprise boundaries (see Section 2), a comprehensive solution is required that is able to support all different integration types in a single framework. Further to the already discussed integration types are the static and dynamic aspects of an information system that need to be considered, in particular *data integration* and *behavior-based integration* [23]. A fundamental requirement for a framework to handle data integration and behavior-based integration is the modeling language used. One of the first modeling approaches that combined behavior- and data modeling were Object/Behavior Diagrams [16]. More recently, the two modeling aspects received increased attention in artifact-centric business process modeling [4].

Security: An important issue in all three use cases, especially where critical infrastructure is involved, is security. Although integration always aims at a higher degree of automation where data is passed on automatically and information systems react automatically to events, it can be the case that data flow is limited because of security reasons. For example, supervisory control and data acquisition (SCADA) systems that control and monitor industrial processes in power plants are usually physically disconnected from the remaining enterprise systems for preventing the possibility of intruders accessing the system remotely and for restricting the access to critical infrastructure. The most prominent example for malicious software to exploit security holes in SCADA systems is the Stuxnet computer worm. Another security objective is that an integration solution should make use of the existing security infrastructure rather than try to bypass it, e.g., access data from an ERP system through the provided API rather than accessing the data directly.

Non-intrusive Solution: Today there exist many data integration solutions. About 60 tools are listed in a recent Gartner report on data integration tools published in October 2012 [24]. The drawback of a majority of those tools is that they require a lot of resources. They do not only require hardware and software resources but also human resources because people need to be trained to use, manage and maintain those tools. By introducing a new system to minimize the dependency, a new dependency might be created because of the complexity of the tool. Enterprises with limited resources are therefore looking for "non-intrusive solutions" that require a minimum impact on the existing infrastructure, a minimum requirement on hardware and software resources and minimum effort in learning to use the tool.

Sustainable Solution: Sustainability is not only an important aspect in energy production and consumption but also in software development. Especially in the asset management sector where physical assets usually operate much longer than software systems, it is crucial to consider future changes and even the whole replacement of a software system. An interoperability solution should therefore support changes on different levels: (1) changes made to the software landscape, e.g., adding or removing whole systems and interfaces, (2) changes on existing systems due to upgrades or changes in the business strategy and (3) changes to the integration solution itself, e.g., how to transfer the integration logic from one system to another.

Verification and Validation: This objective focuses on the correctness of an interoperability solution and is divided into syntax and semantic correctness. Whereas syntax correctness is usually fully automated by verifying data according to provided specifications, the semantic correctness still remains challenging and often involves domain experts. As there does not exist a fully automated solution for a semantically correct integration, functionality should be provided that supports domain experts in verifying the data (e.g. through query functionality), visualization and back-tracking transformed data to its original source.

Performance: The last objective is the performance of an integration solution which is often an issue in real-time integration scenarios. For example, the instant persistence of data across systems. Since we did not deal with real-time data in the three use cases mentioned above, this objective was not critical. However, performance was an issue for the transformation of very large amount of data and the requirement was to execute it in minutes.

3.2 Goals

Based on the requirements listed above the following goals were defined:

- **Seamless, non-intrusive integration of required systems**: The main goal was establishing bi-directional data integration of existing systems with minimal impact on the existing landscape. This goal included overcoming heterogeneous data interfaces and structure, e.g., SAP RFC, relational databases, and ontology-like specifications of standards.
- **Open transformation**: Internal change of systems and adding new systems must be supported. The integration solution must be open so it can be extended for support of new systems and must be able to export its own integration logic to an open standard, e.g., Query-View-Transformation (QVT) or XSLT languages that can be imported into another transformation engine.
- **Centralized integration**: The solution should centralize integration logic in a single system and replace integration components in existing systems. This offers the advantage of a centralized management of the integration and leads to a more flexible landscape.

– **Cover all dimensions in EAI and B2B integration**: A solution needs to support horizontal and vertical integration within and across the boundaries of the enterprise.
– **Easy usability:** It should be usable by domain engineers who do not have the background knowledge of the underlying IT technology. The domain experts should be able to: (a) design, simulate and execute an integration solution, and (b) verify the integration with the help of visual functionality.

In the next section we describe how we addressed the above mentioned goals in a model-driven interoperability approach using multi-domain modeling.

4 Model-Driven Interoperability Approach

In this section we describe a model-driven approach we have applied to Use Cases A–C introduced in Section 2.3. The approach builds on multi-domain modeling languages that are semi-automatically generated and coherently form an interoperability framework to achieve the goals mentioned in the previous section. Before this approach is discussed in more detail, the methodology applied in the use cases is described from a Design Science Research perspective in which the modeling languages specify the central design artifacts.

4.1 Design Science Research

We first discuss how the approach relates to the design science research cycles [14]. Figure 5 shows the *relevance-*, *design-* and *rigor cycle* between environment, design science research and knowledge base. The figure is annotated with the information from the three use cases.

Environment: All three use cases came from the asset management sector. The first use case, *plant monitoring and management*, involved *engineers* responsible for the maintenance of power plant and *external software consultants* responsible for the installed enterprise resource planning systems that supported the engineers with their regular tasks. The information systems to-be integrated were commercial SCADA and ERP and a decision support systems built in-house. On the technical side, heterogeneous interfaces in form of plain CSV, Web service like interfaces and a relational database had to be bridged. The main problem was a non-existing interoperability solution and high costs in performing a manual data exchange. However, the opportunity existed to implement and deploy a state-of-the-art solution that automates the data exchange and to demonstrate a new way of designing interoperability that can easily be handled by engineers and software consultants without any knowledge of the underlying implementation.

Use Case B, *capturing interoperability requirements*, involved internal and external *software consultants* and *software developers*. They met in regular meetings and needed a design tool to interactively capture requirements for negotiating service contracts. The problem was that capturing the requirements was performed manually, producing a Word document, and partly re-created existing

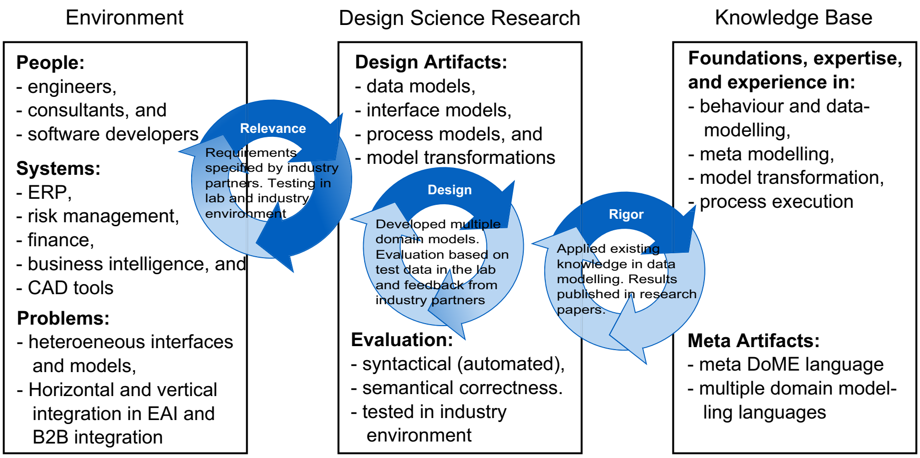

Fig. 5. Use cases in the context of Design Science Research according to the cycles by Hevner et al. [14]

interfaces rather than importing them automatically. The systems involved were a Business Intelligence software product with a relational database model in the background and various other systems, such as a finance system that can be accessed via Web service interface. There was an opportunity to introduce a model driven approach for human-computer interaction in capturing requirements interactively, re-engineering existing interfaces and generating documentation and code automatically.

Use Case C, *digital handover of design documents*, in the oil & gas sector involved CAD designers, engineers, owner & operators and large software vendors who built asset registries and enterprise resource planning systems for the operators. Systems considered in this use case were three different CAD software tools and one asset registry. On the technical side, the standards ISO 15926 and MIMOSA had to be used to specify the design and asset registry data, and an enterprise service bus specified by the OpenO&M Information Service Bus Model (ISBM) had to be used for the data exchange. The main challenge in this use case was identifying the overlaps and differences between ISO 15926 and MIMOSA and how the mapping could be specified and executed. This provided an opportunity to introduce a model-driven approach and model transformation techniques on a real-world scenario that involved complex standards.

Design Science Research: The design science research tasks consisted of developing design artifacts and processes as well as the evaluation. Artifacts were designed on two modeling levels: (1) On the meta model level a modeling language was constructed for each interface and data model and (2) on the model level artifacts were designed that represent a particular interface or data model. Further details on the artifacts and how they were designed and developed are explained in Section 4 below. The approach was evaluated in two stages, first within a test environment in the lab with a small data set and then a test environment at the industry partner's site with a larger set of data taken from real-world use cases. The tests included syntax verification which was fully automated by the modeling framework and semantic verification which was supervised by domain experts using visual feedback provided by the modeling framework.

Knowledge Base: The knowledge required to solve the problems in the use cases came from the research team who designed and implemented a solution and domain experts who provided feedback to the research team in regular meetings for the semantic correctness of the integration. Specific technical knowledge and experience from four areas in computer- and information science contributed to the use cases: (1) behavior- and data-modeling, (2) meta modeling, (3) model transformation and (4) process execution and consistency rules for data and behavior modeling.

Relevance Cycle: The cycle between environment and design science research was conducted by the research team in collaboration with the domain experts in regular face-to-face and online meetings. In the beginning, the research team had to become familiar with the environment and industry partners and their domain experts provided requirements and goals. Field testing was performed either collaboratively or independently by the industry partner in multiple cycles. In all three use cases a first prototype was deployed after successful testing in the lab environment. This prototype allowed industry partners to test in their environment and provide feedback either through meetings or log files. While the research team improved the design and implementation, the industry partner could perform further tests and feedback was incorporated in a next cycle.

Design Cycle: The development of the design languages and design artifacts were mainly performed by the research team. The design (or modeling) languages were semi-automatically generated by querying meta data from the required interfaces and data models. These languages were used to model design artifacts for the execution of the integration task. Depending on the results of the field, the artifacts were modified or new types of artifacts were added on the meta model level.

Rigor Cycle: The rigor cycle between design science research and knowledge base was also mainly conducted by the research team. It included the application of existing research outcomes and knowledge into multiple software prototypes deployed to industry partners. Feedback and evaluation results were captured in experience reports and led to the improvement of software prototypes and new scientific results that were published in multiple publications.

In the following section we describe the model-driven approach in more detail.

4.2 Multi-domain Language Approach

We decided to apply a model-driven development (MDD) approach because of the well-known benefits that come with it [17]. In particular the following benefits were relevant for the use cases: (a) fast prototype development to demonstrate benefits to industry partners in a shorter time, (b) separation of concerns and skills where design artifacts were used by domain experts to focus on the integration, and the research team focused on the implementation and execution of the artifacts, (c) bridging the gap between business (or engineers) and IT because IT systems are defined on a much higher-level using design artifacts, (d) results in software being less sensitive to changes, (e) design artifacts can be used for execution and for up-to-date documentation, and (f) platform independent modeling allowed to focus on the actual integration problem rather than implementation details.

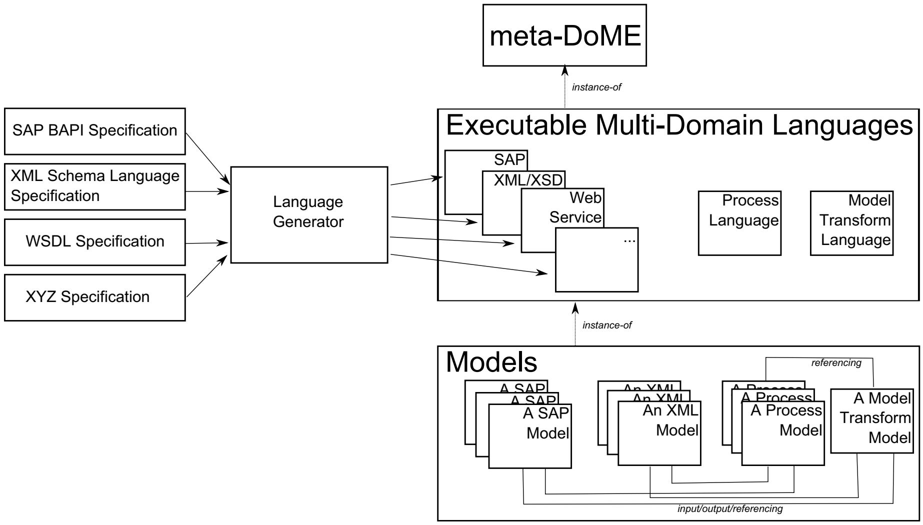

Fig. 6. Architecture overview of a multi-domain modeling approach for an interoperability solution in engineering asset management

One significant difference in our approach compared to existing MDD approaches in interoperability is the use of multi-domain modeling. Figure 6 shows an overview of the architecture. We created a domain modeling language with its own visual notation for each aspect of the framework: for each interface and data model specification, for the process-driven orchestration, and for the transformation of the data a separate modeling language was created. Through the use of multiple languages we maximized the benefits of MDD and allowed a domain expert in each aspect to focus on the problem with the help of a design tool. Each language has its own visual notation and constraints with which the domain experts are usually familiar. For example, an ERP system expert was able to verify an existing design in a fast and easy-to-understand way in our tool without knowing the tool and without the need to learn it beforehand.

Despite the advantage of this approach, we faced two challenges: First, how to develop a new modeling language for a model specification and second, how to integrate all languages and their models in a coherent way? For specifying a modeling language we used the open source meta modeling tool DoME (Domain Modeling Environment). DoME comes with a visual meta modeling language called meta-DoME and a modeling tool generator similar to the commercially available MetaEdit+[4], and is available as a contributed package in the VisualWorks[5] development environment. We addressed the first challenge by a text-to-model (T2M) transformation in order to lift existing specifications to the model level. Each specification language that was applied for data models and interfaces in the environment, was mapped to meta-DoME, the meta modeling language in DoME. This enabled us to generate a modeling language in DoME from each model and interface which have been specified in a language that has previously been mapped to meta-DoME. For example, we developed a mapping for the XML Schema language and this allowed us to generate a modeling language for each XML Schema specification automatically.

Meeting the second challenge, integrating languages in a coherent way, was possible by using DoME. All languages were created with the same meta modeling language *meta-DoME* and therefore integrated in the same framework. An important feature in DoME is that elements from one language can be referenced in another language. We made use of this feature in a simple process language to integrate other language elements, e.g., model transformation tasks for the orchestration of different data sources. This combined behavior- and data integration in a single framework.

5 Outcomes

For each of the three use case we developed a prototype using the same meta modeling framework DoME. In all cases the prototypes focused on bridging syntactical and structural differences between data sources and provided the following features:

Interface: Support for the required interfaces mentioned above and additional interface for XML, Web service and relational database servers such as Microsoft SQL Server, Oracle, SQLite, and MySQL. The support for Web services enables the continuing support for SAP in the case that ANSTO decides to upgrade to the new SAP version called NetWeaver which is based on Web service technology.

Flexibility: The prototypes provided a generic business process modeling editor with a basic notation that allowed creating new integration solutions. A clear separation between orchestration and data transformation supports various scenarios and enhanced re-usability and flexibility.

Adaptability: The prototypes used existing communication technologies and interfaces and did not require additional resources. In can be seen as a lightweight approach compared to existing tools. All prototypes were deployed as a single executable file with additional configuration information installed by copy

[4] `http://www.metacase.com`
[5] `http://www.cincomsmalltalk.com`

and paste. The prototypes can be executed in two different ways during the design phase: (1) executing the whole integration process at once or (2) executing the process stepwise and observing data flow and transformation between various applications. After a prototype is deployed, it can be executed in batch mode which allows the scheduled execution on a server.

Usability of Application: All prototypes provided a visual editor that was easy to use and understand by domain experts. For example, the editor for orchestrating an integration came with a simple process language that consisted only of activities with data in- and output and data flows between them. Designing a business processes is supported by wizards which insert new activities into a process. For each software application type that had to be integrated one wizard was implemented and provided.

With the deployment and application of the developed prototypes in an industry environment we could reduced the manual steps from an average of +15 to 3 single steps in all scenarios. Furthermore all scenarios were supported by a single integration tool and could be combined in different ways, e.g., features that were developed for one use case could be deployed in combination with features developed for another use case.

6 Discussion and Conclusion

A state-of-the-start software environment in asset management must be able to accommodate a dynamic environment to allow the introduction of new software applications and their integration to cope with Enterprise Transformation. We have pointed out that integration needs to be considered as a separate component to optimize re-usability of integration knowledge and provide flexibility to the environment. We have proposed an integration architecture that supports horizontal and vertical integration and have demonstrated its application in three use cases that involved multiple industry partners. We have developed a light-weight integration solution and implemented prototypes which are currently used in industry. They fulfilled the requirements identified in the use cases which are (1) support for various data interfaces, (2) flexibility in building future integration solutions, (3) highly adaptable to the running environment, (4) ease of use for non-IT users, and (5) a significant performance improvement through the automation of manual steps.

Open challenges we have identified are matching heterogeneous data models and interfaces, coherent modeling of processes and data, and modeling events with business processes. There exist many matching techniques and tools for matching heterogeneous data structures [3] but in the three use cases, especially for matching heterogeneous standards as in Use Case C, existing approaches were not sufficient to identify possible matches. On the modeling side, there is still a lack of standardized languages for modeling processes and data flow in a coherent way. Artifact-centric business processes try to overcome this gap but so far no standard has emerged. Similar problems can be found for modeling events in the context of processes. The Business Process Model and Notation (BPMN) language provides a set of events for modeling start, end and intermediate events in a business process but there is no guideline on how to use these events for orchestrating multiple systems in a correct way.

Future work includes addressing the challenges mentioned above, support for automated integration of service interfaces and the complex integration of engineering asset management standards. This includes the development of additional wizards which help to design and deploy integration solutions, the discovery and automated matching of services, and the complex mapping of data specified in standards such as MIMOSA and ISO 15926.

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Business Modeling in the Software Industry: Conceptual Design of an Assistance System

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Abstract. The choice of the right business model has proven to be a critical success factor for enterprises in the software industry. This paper presents the design of an assistance system for a standardized construction of business models for software producing companies. The system helps software companies to determine their business model by using predefined building blocks. The structured methodology enables companies to build their business model. Moreover, it enables them to estimate the impact of changes within one business model element on the other elements of the business model by following recommendations within the process of business model adaptations. The prototype aims at providing decision makers a tool which supports the design of business models and the consideration of existing interrelations between the elements of a business model. An interface to a process modelling tool allows considering implications of business model modifications on the business model's underlying business processes and value chains.

Keywords: Business models, decision support, software industry, business processes.

1 Introduction

Companies in the software industry continuously face peer pressure and a rapidly changing economy. Hence, companies are forced to continuously reconsider and readjust their current business model. To be able to prevail over competitors, the choice of the right business model is a critical success factor for the long-term success of a company. A business model explains how an enterprise works by providing an abstract view on aspects like the value chain of a specific product or the organizational structure within an enterprise [1–5]. Hence, a business model depicts relevant information about a company's underlying business processes, critical success factors and financial flows in a structured manner [4, 6]. Osterwalder et al. define a business model as "…a conceptual tool containing a set of objects, concepts and their relationships with the objective to express the business logic of a specific firm" [7].

By now, there has been considerable interest in business models in scientific research. In literature, as well as in organizational practice, there is still an identified

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need to explore further research issues [7–11]. Practice-oriented approaches, such as IBM's Component Business Model or the Business Motivation Model so far do not support a standardized construction and analysis of business models in a full extent [12, 13]. One further critical aspect about current business model research is the generality of the concepts. Although several research work about the constituent elements of business models exist, such as Linder and Cantrell's "Change Models" [14], Osterwalder's "Business Model Canvas" [15] or Morris' business model components [16], the derived concepts have no focus on a specific industry branch. As a result, these general business model concepts do not support a standardized description and evaluation of a business model's current quality [17]. Another critical aspect is the lack of software for an automated support for the construction and comparison of business models. So far, existing software has a strong focus on generic aspects about business modeling not taking into consideration a supported creation and adaptation of dynamic aspects of business models.

This article aims at developing an assistance tool that allows the easy creation and configuration of business models based on a priorly developed methodology for an automated creation and adaptation of business models with a particular focus on the software industry. By this means, software industry specific concepts are taken into consideration which goes along with the possibility for a detailed description and construction of business models. This methodology has already been prototypical implemented, which is going to be presented in this manuscript.

The derivation of the prototype is based on preliminary studies of Schief and Buxmann, who describe the derivation of morphological building blocks for business models in the software industry [18]. The assistance system supports decision makers of software producing companies to both compose new business models and to adapt already existing business models. The research work presented in this article follows a design oriented approach [19]. Based on a systematic literature review and on several expert interviews in the software industry, shortcomings about current business model concepts and software tools are collected as requirements. The derived requirements served as a basis for the conceptual design and the implementation of the business model assistance system based on a design-oriented research approach [20].

The outline of this document is as follows: Chapter 2 describes the state of the art in business model research by explaining the derivation of the constituent elements of business models and value chains in the software industry. In addition, the relationships between business models and business processes are presented in this chapter. Chapter 3 describes the conceptual and the technical design of the business model assistance system, whereas Chapter 4 focuses on its implementation and preliminary evaluations. The paper closes with a summary of the main research results, limitations an outlook on future research.

2 Requirements Analysis and Theoretical Background

This chapter explains the basic objects of recommendation. First, the constituent elements of business models in the software industry are going to be introduced, followed by an explanation of the software industry value chain.

2.1 Business Model Elements

To be able to design an assistance system for the construction and analysis of business models, first a conceptual and structured description of business models components has to be derived [9, 16, 21, 22]. Therefore, the specific elements of a business model within a specific industry branch have to be defined. Business model elements do not represent entire business models, but they describe the integral parts which make up a business model [14]. By decomposing a business model into its constituent parts, enterprises are offered a structured approach for a standardized description, analysis and comparison of their business model [5]. So far, extensive analysis in literature and practice has been carried out regarding the constituent elements of a business model [14, 16, 21]. However, they focused on generic aspects not taking into account specific industry branches.

The business model elements in this paper are focused on the software industry. Several literature studies and expert interviews with representatives from the software industry have been carried out to derive the constituent elements of business models in this industry (see corresponding publication by Schief and Buxmann [18]). The result are 20 morphological building blocks (business model elements) that have been classified into 5 business model categories [18].

Table 1. Business Model Categories and Business Model Elements in the Software Industry by Schief and Buxmann [18]

Category	Business Model Elements			
Strategy	unique selling proposition	product portfolio	value chain strategy	investment horizon
Revenue	license model	pricing model	sales volumes	operating margins
Upstream	technical platform	principles	localization	standardization degree
Downstream	sales channel types	target industries	target customer size	target customer type
Usage	operating model	support model	maintenance model	replacement strategy

After having derived the 20 business model elements, they have been classified into morphological building blocks, consisting of business model categories and business model elements. A business model category represents a structuring principle, grouping four business model elements each. The business model elements are optional variables that are assigned several specifications (e.g. the business model element *target customer size* can have as specification: "individual customer", "small organization", "medium organization" or "large organization"). The number of specifications for each business model element of which can be chosen is between 3 (minimum) and 11 (maximum). These morphological building blocks represent the conceptual basis for the prototype as they enable a standardized and comprehensive description and classification of software industry business models.

2.2 Business Models and Business Processes

Business models are often seen as a mediator between a company's strategy and its business processes:

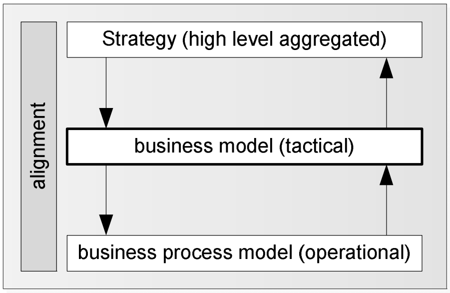


Fig. 1. Business Model in its mediating role [23]

Although business models and business processes are characterised by a close relationship, these terms however are often used interchangeably in practice [24]. Business models contain an abstract view on a company's core logic of creating value [7] whereas the business process model describes the implementation of a concrete scenario into executable process steps [6, 25, 26] which can be explained by the production of an output by the use of several input factors [27, 28]. Thus, a company's business model and strategic goals form the basis for the design of the underlying business processes. In doing so, a clear understanding about the scenario to be modelled can be gained as changes within a company's business model affect a company's business processes. Hence, business models explain why business processes are being executed in a specific manner [6].

For the developed prototype, the software industry specific value chain has been derived, based on several literature and practical studies by Pussep et al. [29]. Thereby, 10 characteristic activities that are typical for the software industry have been derived, which are depicted in Fig. 2:

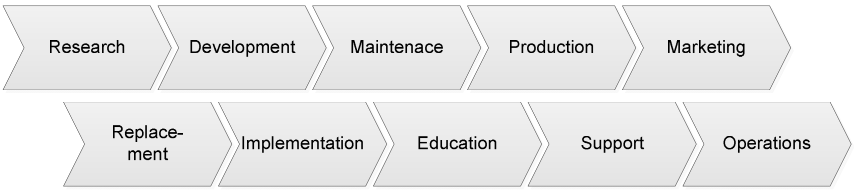


Fig. 2. Software Industry Value Chain [29]

Specific business processes are assigned to each activity in the value chain. Hence, modifications on specific business processes caused by external or internal influencing factors (e.g. outsourcing of certain procurement activities) come along with implications for the corresponding value chain activity. The following figure shows the existing interrelations between business models (including categories, elements as well as specifications) and business processes.

3 Conceptual Design of the Business Model Assistance System

This chapter explains the conceptual and technical design of the developed prototype. These explications are going to be enriched in the following chapter by the demonstration of several use case scenarios (s. section 4.1), which are supported by the prototype and have already been evaluated in practice.

In general, an assistance system represents a computer-based system that supports humans in decision making [30]. In our context, we define an assistance system as a recommendation system that enables several target groups in the software industry (company founders and companies that have been active in the marketplace for some time) to compose their business model from scratch and to carry out modifications on an existing business model by enabling users to configure their business model in a structured manner.

Based on the close relationship between business models and business processes, the prototype is also interfaced to business process level. By this means, the prototype supports *two different scenarios*: On the one hand it facilitates company founders to establish a business model from scratch. On the other hand it also indicates the effects of changes or components of a business model have on underlying business processes (e.g. an outsourcing of business processes, which is caused by changes on the business models is accompanied with changes on resource allocations and responsibilities in the underlying business processes). Fig. 3 depicts the design approach of the prototype which follows a three-tier architecture:

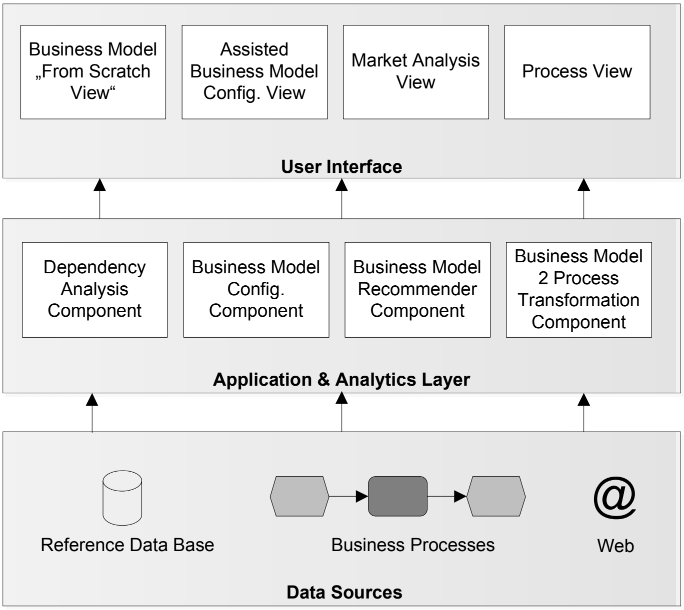


Fig. 3. Conceptual design of the business model assistance system

Data Source Level. The layer of data sources consists of the data sources that provide the operational data for the prototype. The reference database enables carrying out market analysis. It contains a large collection of reference business models for software producing companies. This data was elicited in the 100 largest software companies worldwide (based on the US classification scheme of SIC codes), by considering dimensions like annual accounts, transaction volumes, number of employees etc.). By this means, similar business models that are already on the market place can be used as a reference for the own business model. This data can be also used to compare and evaluate the own business model with those of competitors. An additional interface to the web allows taking into account current information when composing or modifying the underlying business model. Hence, current market data such as competitive analyses, forecasts or industry sales can be dynamically considered for the own business model.

Application and Analytics. The second layer comprises all major functionalities for analytic features and basic modifications for the business models. Based on the layer of data sources dependency analysis within the business model elements can be carried out among the business model elements to make statements about how modifications within one business model element influence other components of the business model. Hence, recommendations can be given within each step of business model modification (BM Recommender Component). An interface to the process modelling tool ARIS supports the process of business model transformation into executable business processes. Thereby, users are shown within each step of business model modification, how these changes affect the underlying business processes.

User Interface. The user interface represents the most aggregated level in which information about the evaluated data is provided to the end user (e.g. company founders or executive managers). The interface to the web and to the reference data base allows to carry out market analyses and to present current market development and / or the development of software companies along a timeline based on semantic knowledge networks. This helps company founders to get an overview about the specific market segment in which they plan to establish their business (Market Analysis View).

4 Prototypical Implementation

Within this chapter, the scenarios for the implementation of the prototype and first evaluations in form of expert interviews with representatives in the software industry are going to be described.

4.1 Application Examples

The prototype supports two scenarios: “Personal Business Modeling” and “Business Modeling Example”. The first scenario focuses on company founders in the software industry who intend to start their own business to implement their business idea into practice. Before company founders can transfer a concrete business plan into practice, they first have to get an overview about the key business model inclusive its constituent elements. Hence, company founders get informed about which components are most important for their business idea. Within this scenario the prototype supports company founders to derive their business model from scratch. Company founders can compose their own business model by clicking through the 20 business model elements derived in Chapter 2 and selecting several specifications for each business model element. For each business model category and business model element users are shown several specifications to select from (see Figure 4).

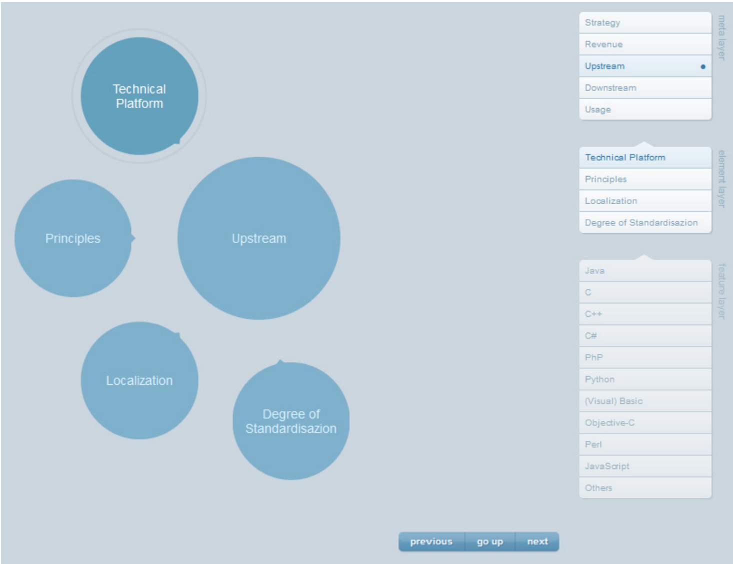
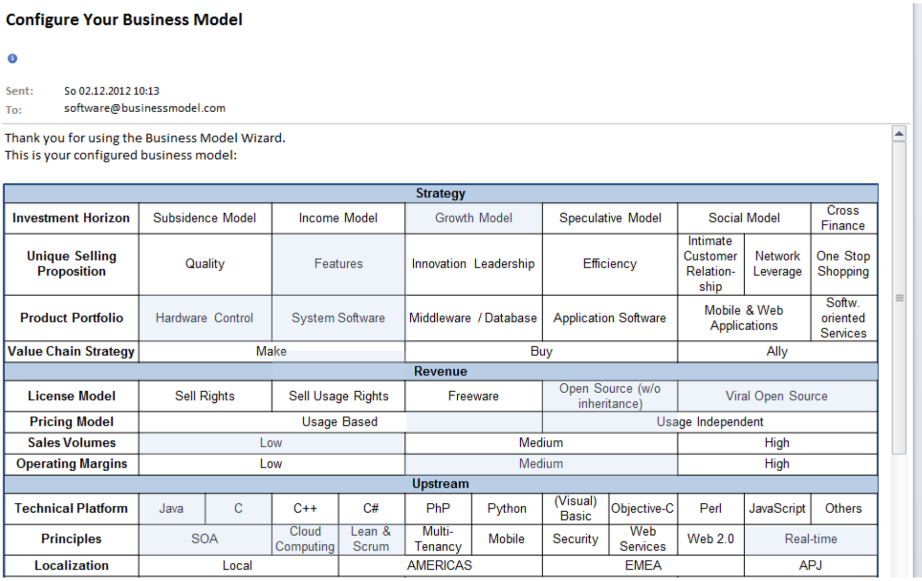


Fig. 4. Business model element with its specifications

The figure above shows the business model element category "Upstream", which consists of the business model elements "Technical Platform", "Principles", "Localization" and "Degree of Standardization"(Schief & Buxmann 2012).

After having configured the business model, users receive an e-mail with a comprehensive overview of their configured business model by presenting the constituent parts of the business model in a structured manner which is based on the morphological building blocks (see Figure 5). Based on the connected business model reference data base several analyses are being carried out to recommend users investors that are convenient in supporting the specific business idea. Furthermore, users are shown in the configured overview a list of competing enterprises that pursue a similar business idea and could be a potential rivals once the business is running. Subsequently, this aggregated information can be used as a basis for consultation interviews with potential investors that are needed to start the business. Further target groups of the scenario "Personal Business Modeling" are analysts, scientists or business developers.



Configure Your Business Model

Sent: So 02.12.2012 10:13
To: software@businessmodel.com

Thank you for using the Business Model Wizard.
This is your configured business model:

<table>
<tr><th colspan="12">Strategy</th></tr>
<tr><td>Investment Horizon</td><td colspan="2">Subsidence Model</td><td colspan="2">Income Model</td><td colspan="2">Growth Model</td><td colspan="2">Speculative Model</td><td colspan="2">Social Model</td><td>Cross Finance</td></tr>
<tr><td>Unique Selling Proposition</td><td colspan="2">Quality</td><td colspan="2">Features</td><td colspan="2">Innovation Leadership</td><td colspan="2">Efficiency</td><td>Intimate Customer Relation-ship</td><td>Network Leverage</td><td>One Stop Shopping</td></tr>
<tr><td>Product Portfolio</td><td colspan="2">Hardware Control</td><td colspan="2">System Software</td><td colspan="2">Middleware / Database</td><td colspan="2">Application Software</td><td colspan="2">Mobile & Web Applications</td><td>Softw. oriented Services</td></tr>
<tr><td>Value Chain Strategy</td><td colspan="4">Make</td><td colspan="4">Buy</td><td colspan="3">Ally</td></tr>
<tr><th colspan="12">Revenue</th></tr>
<tr><td>License Model</td><td colspan="2">Sell Rights</td><td colspan="2">Sell Usage Rights</td><td colspan="2">Freeware</td><td colspan="2">Open Source (w/o inheritance)</td><td colspan="3">Viral Open Source</td></tr>
<tr><td>Pricing Model</td><td colspan="6">Usage Based</td><td colspan="5">Usage Independent</td></tr>
<tr><td>Sales Volumes</td><td colspan="4">Low</td><td colspan="4">Medium</td><td colspan="3">High</td></tr>
<tr><td>Operating Margins</td><td colspan="4">Low</td><td colspan="4">Medium</td><td colspan="3">High</td></tr>
<tr><th colspan="12">Upstream</th></tr>
<tr><td>Technical Platform</td><td>Java</td><td>C</td><td>C++</td><td>C#</td><td>PhP</td><td>Python</td><td>(Visual) Basic</td><td>Objective-C</td><td>Perl</td><td>JavaScript</td><td>Others</td></tr>
<tr><td>Principles</td><td colspan="2">SOA</td><td>Cloud Computing</td><td>Lean & Scrum</td><td>Multi-Tenancy</td><td>Mobile</td><td>Security</td><td>Web Services</td><td>Web 2.0</td><td colspan="2">Real-time</td></tr>
<tr><td>Localization</td><td colspan="3">Local</td><td colspan="3">AMERICAS</td><td colspan="3">EMEA</td><td colspan="2">APJ</td></tr>
</table>

Fig. 5. Overview of selected business model elements of the composed business model

The second scenario focuses on enterprises that have been active in the market place for some time and intend to change several aspects about their current business model ("Business Modeling Example"). In this scenario, the prototype provides recommendations about business model adaptations for specific business model elements. An interface to the process modeling tool ARIS shows how changes within single business model elements influence a company's business processes. If users change one element of their business model, effects on the other elements of the business model are displayed in form of recommendations. Figure 6 shows an example for a recommendation process. In this case, users get informed that changes within a company's business model in terms of a switch from national distribution to a pan-European distribution has an influence on the current business model element "sales volumes".

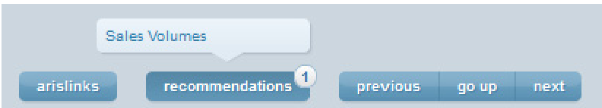


Fig. 6. Recommendations for business model modifications

In addition, to each step within business model modification, the underlying value chains and business processes are indicated through an interface to ARIS. Thereby, for each step in business model transformation, the value chain of the software industry with its 10 activities is deposit. By clicking on an activity of this value chain, an EPC diagram in the process modeling tool ARIS is displayed which indicates all

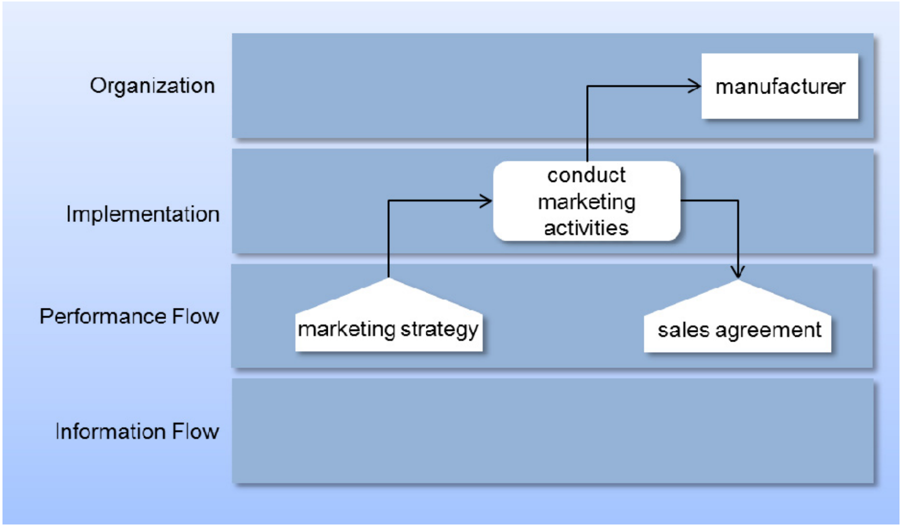


Fig. 7. Interface to business processes

related organizational units, functions, information flows and material and resource objects within the specific value chain activity. Figure 7 shows the process view of the prototype.

The figure above demonstrates how conducting marketing activities enables users to gain insight about several related aspects / views of this step in the business process. Hence, users gain insight in the effects of business model changes on the underlying business processes including all related views on a business process such as involved organizational units, performance flows and information flows. Thus, if specific aspects about a business model change, users are informed which artifacts within a specific process step are affected and should be considered in terms of business model transformation [32].

4.2 Preliminary Evaluation

For the prototype presented first evaluations have already been carried out in practice in from of expert interviews with 13 representatives in the software industry. The practitioners were either CEOs or employees with strategic and managerial responsibilities. In the following, a brief summary of the evaluation results will be shown. For a full listing of the results and the applied research methodology cf. [33].

To gain results which can be applied to the entire software industry, the composition of the selected software companies was as broad as possible. Therefore, the expert interviews have been carried out with software companies that are established in several market segments such as e-learning software producers, enterprise software producers or providers of media asset management systems. In total, 7 large enterprises and 6 small and medium sized enterprises have been interviewed. First, interviewees had to compose their business model based on the scenario “Personal Business Modelling”. In a next step, the interviewees had to carry out modifications on a fictive, already existing business model according to the scenario “Business Modelling Example”. Therefore, the interviewees were shown recommendations for adaptations on the current business model. In addition, interviewees had to check influences of business model adaptations at the underlying business processes.

First evaluation results have demonstrated that most interviewees estimate the research work as highly relevant (85 %), whereas 15 % claimed that the implemented concept is too academic as it tries to convey the derived research results into a holistic construct. 68 % stated that aspects about the relationships between business models and business processes, as supported within the scenario “Business Modelling Example” are already taken into consideration in practice. However, there is still a lack of a conceptual method for considering these interrelations and monitoring the quality of the underlying business model. In the most interviewees’ point of view, the evaluated prototype is most useful for start-up companies establishing their business model from scratch. Hence, the majority of the interviewees estimate the scenario “Personal Business Modelling” as highly relevant.

5 Conclusions, Limitations and Outlook

This paper presented a tool for the assisted and standardized description and composition of business model. First, software industry-specific business model elements have been derived and grouped into categories. As a business model often acts as mediator between a company’s strategy and its business processes, an analysis of the relationships between the business model and its underlying business processes has been carried out. Based on the presented research results, a prototype has been developed which supports start-up companies to compose their own business model. In addition, it also supports companies that are already active in the marketplace by offering the possibility to change specific aspects of their business model.

In the scenario “Personal Business Modelling” enterprises so far do not receive recommendations within business model composition from scratch. Current research work focuses on an integration of (proactive) recommendations for each step in the process of business model composition. Therefore, existing interrelations between the business model elements have to be analysed and taken into consideration. According to the carried out expert interviews we found out, that the questioned software companies estimate the use of control parameters (key performance indicators) as highly relevant to determine the quality of a business model. For this reason the prototype is currently extended to integrate software industry specific KPIs as feedback parameters for the quality of the current business model. If specific thresholds are reached on business process level, the information is sent to the prototype in form of a warning message. By this means, users will be shown which aspects about the current business model should be changed.

So far, the focus of the prototype has been on the software industry. In future research work, further industry branches (e.g. automotive industry) should also be taken into consideration to derive a structured framework for a standardized description of business models. Hence, business model components and value chain activities of further industry branches have to be carried out and transferred into a conceptual framework. A fundamental research question for future work is how business strategy and business process KPIs can be monitored in a consistent and continuous manner, in order to propose proactive business model changes. The current prototype provides interfaces to business process level are implemented in ARIS. In future research, further process modelling tools will be integrated with the prototype to enable broader application potentials of the assistance system. The vision for future business model adaptation is a roundtrip-like engineering and management of business models based on current environmental business data.

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The Role of Value-Oriented IT Demand Management on Business/IT Alignment: The Case of ZON Multimedia

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Abstract. More than ever, enterprises aim at assuring their structure and initiative portfolio are aligned and support value-creation. However, essential, explicit and cross-cutting models that allow keeping bottom-line in sight over the whole initiative lifecycle are generally absent.

The role of IT Demand Management is instrumental in addressing this issue due to its unique positioning between business and IT. We advocate that the classical Business/IT alignment should primarily be reformulated as a more general Business/Business alignment. Furthermore, we analyze its contribution to making a new organizational capability emerge - the instruments through which interactions and alignments are made using a common value referential.

In this paper, we present the case of the IT Demand Management of ZON Multimedia and report on its transformation in the last 3 years - a journey of increasing maturity and transformation towards value-orientation.

Keywords: IT Demand Management, Benefits Management, Value Management, Business/IT alignment, Enterprise Engineering.

1 Introduction

More than ever, enterprises aim at assuring their structure and initiative portfolio are aligned and support value-creation. Cost reduction through effective reuse, reengineering and innovation being heavily demanded features from enterprises and their supporting systems.

Laudon notes that *enterprise performance is optimized when both technology and the organization mutually adjust to one another until a satisfactory fit is obtained* [1]. However, studies indicate as much as 90 percent of organizations fail in applying their strategies [2]. However, essential, explicit and cross-cutting models that allow keeping bottom-line in sight over the whole initiative lifecycle are generally absent.

Misalignment between the *business* and its *support systems* is frequently appointed as a reason of these failures [1, 3]. Aligning Business and IT is a widely known

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challenge in enterprises as the developer of a system is mostly concerned with its function and construction, while its sponsor is concerned about its purpose, i.e., the system's contribution.

The role of IT Demand Management is instrumental in addressing this issue due to its unique positioning between business and IT. We advocate that the classical Business/IT alignment should primarily be reformulated as a more general Business/Business alignment. The main implication is to abstract from the implementation and model the alignment problem as the relation between two systems, one supporting the other. This is mainly a relativity issue, as one organization's support processes are the core processes of the (sub)organization providing them [4]. Particularly, in the case of IT-enabled supporting systems, this implies modeling the business behind the IT organization as a pre-condition to co-developing those systems.

In this paper, we present the case of the IT Demand Management of ZON Multimedia and report on its transformation in the last 3 years - a journey of increasing maturity and transformation towards value-orientation. This approach is based on Enterprise Engineering (DEMO) [5], Value Modeling (e3Value) [6] and Enterprise Architecture (Archimate) [7]. Furthermore, we analyze their contribution to making a new organizational capability emerge - the instruments through which interactions and alignments are made using a common value referential.

The paper follows the STARR template, describing Situation, Task, Approach, Results and Reflection and closes with a contribution summary and conclusion.

2 Situation

2.1 ZON Multimedia Group

The ZON Multimedia business group leads the market in pay TV in Portugal and is the second largest internet provider. Nationally, it is also leader of the cinema market.

The origins and development of ZON are intertwined with the genesis and growth of the mass entertainment and telecommunications industries in Portugal.

From 1999 onwards, TV Cabo, became the leading distributor of television to the home and later the first internet operator to offer a broadband service. In 2008, after TV Cabo had split off from the incumbent operator, ZON Multimedia first appeared as an independent brand. With new business and engineering processes, ZON transformed itself into a provider of high quality integrated services, both inside and outside the home and for businesses.

Today, ZON Multimedia has around 1.6 million customers. ZON operates the largest New Generation Network in Portugal, reaching over three million homes. ZON is also the second largest provider of internet and fixed voice with 790 thousand customers and 976 thousand, respectively. Its digital satellite platform allows it to offer coverage to the whole country. Its 210 cinemas make up the largest network in the country and attract almost ten million cinema-goers a year. Today, ZON Multimedia and its affiliates have approximately 1,600 employees.

This solid operating base, internationally recognized for its know-how and ability to adapt across a range of markets, is the foundation stone for ZON's internationalization strategy. In 2010, its expansion plans were given a hefty boost with the setting up of its ZAP joint venture for providing subscription TV services via satellite to the Angolan market, recently extended to include Mozambique.

For confidentially reasons, only a selected set of information is available for the purpose of this paper. Particularly, the monetary rates were withheld and, whenever possible, relative values were provided.

2.2 ZON Multimedia's IT Demand Management

The IT Demand Management area is responsible for analyzing business needs and using the available resources to provide feasible solutions.

ZON's IT Demand Management unit includes the Service Strategy and Service Design processes of the ITIL v3 framework. The managed platforms included those typical of a Telco, e.g. CRM, Integration, Billing, Provisioning, ERP, public and internal Portals to name a few. A standard IT Demand Management process that mapped to a classical Software Development LifeCycle (SDLC) was in place, as pictured in Figure 1.

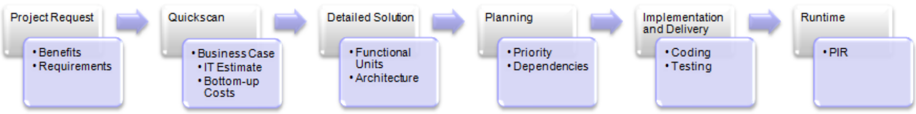

Fig. 1. IT Demand Management process

A set of Telco traditional IT client units (business and support) jointly created over a thousand project requests per year through this process, ranging from simple changes to full-scale product launches and IT transformations with development effort that amount to hundreds of staff-days. The Information Systems support services annual investment was 18,9 M€ in 2011 [8].

The demand component of this process had fundamental issues:

- Problems/opportunities were not clear and direct implementation of solutions was requested from IT;
- Prioritization of projects was casuistic and used criteria were opaque;
- A large number of projects went through detailed and time-consuming specification and only after an estimate by the development team was it possible to evaluate the merit of the project;
- A project backlog amounting to half the new project requests placed every year;
- The capacity issue led to ageing and dated solution specifications;
- Investment control and visibility: IT was mostly seen as a cost center;
- Solution design: ROI imbalances were found at solution component level, i.e., the contribution to the benefits was unknown or unjustifiable.

3 Task

This paper addresses a 3 year period of continuous changes to the IT organization and, particularly, to the IT Demand Management process. The main goal of the transformation is to provide improvement of IT Management maturity, particularly in the Value Management area and addressing the previously stated issues.

The idea of introducing a Benefits Management process is not new [9], with known promises of increasing portfolio control, particularly prioritization, and establish a clear rationale for allocating delivery capacity. However, as maturity increases, diminishing returns were experienced and deeper approaches were called for.

The stakeholders of such process are the Business Units, split into the sponsors – empowered to approve business changes and budget – and the users, which specify and operate the system. From the IT side, the process stakeholders are the IT Director, IT Demand Management (Business Account & Requirements Manager, Business Analyst and Architect), Delivery Management and Operations Management.

The task at hand was result-oriented and specific indicators for each of the phases of the process have been defined: project backlog reduction (includes demand shaping and project consolidation), value-driven project cancellations and scope reduction (€) based on cost/benefit of solution components.

4 Approach

A Design Science Research (DSR) based approach was followed in alignment with ongoing PhD work. The Environment component of the Relevance Cycle (cf. Figure 2) was presented in the previous sections. Regarding scientific Foundations used in the Rigor Cycle, a combination of Benefits Management [9], Enterprise Engineering [5, 10] and Value Modeling [6] was used, both presented in section 4.1.

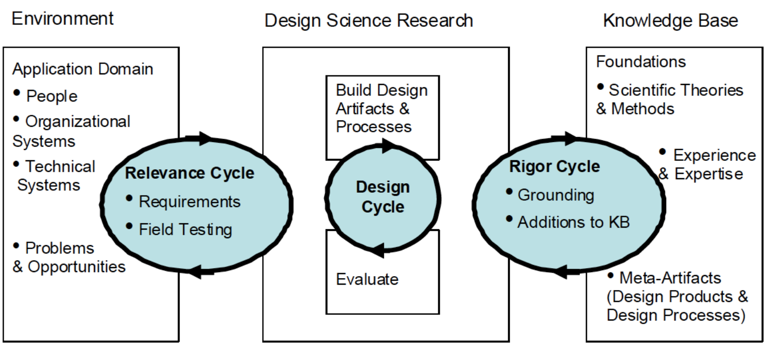

Fig. 2. Design Science Research reference model [11]

The resulting artifacts belong to three distinct types:

- **Concepts** – used for business analysis and creating relevant questions for project qualification and requirements elicitation.
- **Deliverables** – tangible changes to project request forms, quickscan (as presented in section 4) and project prioritization and planning;
- **Method** – mostly resulting of adding value structuring and engineering capabilities to a general SDLC process with Benefits Management;

As stated, the improvement process of the IT Demand area has been a continuous effort during last three years. Nevertheless, we can break down the overall approach taken in this time period in three distinct, but connected, phases presented in the following sections:

- Phase I. Benefits oriented Lifecycle
- Phase II. Quickscan and Investment Appraisal
- Phase III. Value-oriented Solution Development

Before presenting each of these phases, we will briefly review the foundations of the Rigor cycle.

4.1 Scientific Foundations

Enterprise Engineering - DEMO. Formally integrating the notion of purpose into system development activities requires addressing both the teleological and ontological perspectives in an integrated, bidirectional way [12]. However, Engineering approaches are generally focused solely on the ontological perspective [13]. By Enterprise Engineering is meant the whole body of knowledge regarding the development, implementation, and operation of enterprises [5]. DEMO has a particularly relevant role in this area both as ontology and as a method. Enterprise ontology [5] includes a sound theory and a method for supporting enterprise engineering. It goes beyond traditional function (black-box) perspective aiming at changing organizations based on the construction (white-box) perspective. Organizations are considered as systems composed of social actors and their interactions in terms of social commitments regarding the production of business facts.

From the Transaction Axiom of Enterprise Ontology, we find that actors perform two kinds of acts. By performing production acts (P-acts), the actors contribute to bringing about and delivering services to the environment. By performing coordination acts (C-acts), actors enter into and comply with commitments. P-acts and C-acts occur in generic recurrent patterns, called transactions. Every transaction process is some path through this complete pattern, and every business process in every organization is a connected collection of such transaction processes [5].

The Distinction Axiom of Enterprise Ontology's PSI-theory, states we can divide all acts of an organization in 3 categories - ontological, infological and datalogical, respectively related with the 3 human abilities: performa (deciding, judging, etc.), informa (deducing, reasoning, computing, etc.) and forma (storing, transmitting, etc.). By applying both axioms, DEMO is able to produce concise, coherent and complete models with dramatic reduction of complexity. This feature is particularly relevant for quickscan efforts as it assists in creating and checking essential transactional models.

Additionally, unlike other approaches, DEMO makes a very strict distinction between teleology, concerning system function and behaviour – the black-box perspective – and ontology, about its construction and operation – the white-box perspective [14]. These perspectives are embodied in the Generic System Development Process (GSDP), which is specified in DEMO's TAO-theory as the process by which a system is designed and implemented from the specifications of its using systems. The GSDP is systematically defined, clarifying normally ambiguous concepts like architecture, design, engineering and implementation. The GSDP is directly relatable to a software development process and is an abstraction that clearly positions the construction and function perspectives. In order to systematically address the teleological part, a new perspective – contribution – was introduced in [12]. This perspective directly addresses the origin of the functional requirements as means of obtaining certain results and the valuation of their contribution by some stakeholder.

Value Modelling – e3Value. A formal business model [15] is necessary to create a founded integration with constructional models. Value Modelling is increasingly recognized that the concept of value assists in improving stakeholder communication, particularly Business and IT [16]. All organizations have in common bringing about *value* to their *environment*, either directly or indirectly, so *value* is an unifying concept to consider in business modeling. For our case, we elected e3Value [6] because of its formal ontology, practical application, coverage financial evaluation coverage and tool support.

e3Value is part of e3family, a set of ontological approaches for modelling networked value constellations. It is directed towards e-commerce and analyses the creation, exchange and consumption of economically valuable objects in a multi-actor network [15]. In e3Value, an Actor is perceived by his or her environment as an economically independent entity, exchanging Value Objects. An enterprise is modelled as an actor in a value network, where the demand and offer market concepts are a natural consequence of the economic context of Value Objects. This is a natural way of capturing, structuring and expressing the components of a business case. Our approach implies specifying the value system of the opportunity at hand for each project request. Only upon stakeholder agreement about the model of the value system does the supporting system design process begin. The fact that these are two formal systems allows checking them for coherence and alignment Further, we applied e3Value to improve system and subsystem value modelling: inside the boundaries of organizations, as opposed to applying it solely to e-commerce relations between formal organizations.

4.2 A 3-Phase Approach

Phase I – Benefits Specification. The project portfolio benefits management essentially aligned with the Benefits Management approach [9]. In our approach, it began by introducing a mandatory qualification step for each and every project that is requested from IT. The Qualification step consists in validating the Project Request form. Particularly, it includes checking the presented investment rationale.

For this purpose, a new version of the project request form was produced, with the following added/revised sections:

- The proposed benefits, by type, value, owner, timing and evidences;
- Impact of "doing nothing" and deferring the project in specific amounts of time.

Positioning each system in a GSDP referential allowed clarifying their relations. Moreover, specifying the production facts and their contribution, differentiating this perspective from functional and constructional perspectives, as defined in [12, 13], enabled increased assertion capabilities during project request qualification.

Collecting benefits and working on their specification allowed for increased insight into motivation, which is especially relevant for solution building and case-by-case decisions. However, it fell short of expectations as the whole IT development process did not formally consider this information, and the project qualification that follows, as a main driver for the whole process.

Phase II – Quickscan and Investment Appraisal. In mid-2011, a new step – the *quickscan* – was introduced in the process. The outcomes from project qualification, particularly benefits specification, were leveraged as inputs for formal appraisal.

The main reason for introducing the quickscan was that significant time was consumed by doing detailed solution design for all projects before they were formally evaluated against the potential benefits. Many projects were canceled after detailed development estimates or, at least, lost priority and many never saw the light of day. In these cases, significant effort had already been consumed and relevant capacity was used for detailed estimation. The quickscan involves business accounting, architecture and business analysis functions and aims to provide a high-level solution, identified impacted platforms and estimate of the project cost. The quickscan happens, by definition, very early in the process. This makes it challenging as several solution scenarios may be designed, and solution scope is not yet closed in depth, only in breadth. For this reason, complexity reduction techniques are sought-after, which is a relevant entry point for techniques and methodologies that aim at making Enterprise Engineering intellectually manageable, such as DEMO.

The introduction of a quickscan phase, that includes the production of a High-level Estimate as deliverable, was decisive to boost efficiency and effectiveness of the process. On one hand, less work was done to reach a decision on whether to continue with the project, i.e., deciding on its funding. On the other hand, the work anticipates detailed solution design effort, so it does not involve inefficient allocation of effort.

Building on Phase I, validation of benefits since the early stages of the project became a norm and was made a mandatory component of the project request.

The budget remained under the IT department but now the business units had to compete and justify its allocation to projects before a wider audience. According to the project cost range, different approval levels (and forums) are required for project appraisal. Further, prioritization of projects for portfolio composition became driven by the stated benefits. The result is a project portfolio with increased visibility and buy-in by the business units and board.

Additionally, some incursions into detailed benefits analysis were carried through. For instance, a seemingly simple mechanism for aligning requirements with benefits is to build a two-dimensional matrix with the benefits proposed for the project and the Functional Units (FU) that contribute to achieving those benefits. This matrix supports the following coherency checks:

- Ensure functional units contribute to at least one benefit
- Ensure the production of each benefit is grounded on at least a functional unit

Moreover, it became possible to identify and analyze imbalances in expected return at the FU level. Combined with cost information from the quickscan, it allows applying an analogy of the Pareto rule, i.e., aiming at 80% of the benefit with 20% of the effort. For instance, automation of very specific and seldom occurring exception scenarios is likely to be complex to build *versus* the benefit is provides.

Furthermore, an e3Value model was produced for selected projects. This value model was instrumental in checking completeness of the scenario and its structure contributed to identifying gaps in stakeholders (economic actors), value exchanges (transactions) and the value objects themselves. Using the value model for formal and structured teleological representation is part of a more elaborated roadmap which is presented in section 4.4. These constructs, the benefits matrix and value model, have not been explicitly included in the deliverable. They are used as instruments to identify the relevant questions and only in selected projects.

Phase III – Value-oriented Solution Development. Phase III of the transformation began in mid-2012 and is currently ongoing for research validation completion. It entails using value specification to guide solution development on a project-by-project basis, i.e., it consists in ensuring alignment between the value and construction models of the project. It is a more detailed approach, working inside the construction of the system, and has been performed selectively for research validation purposes. It consists in creating the e3Value models, the DEMO models, and aligning them [17]. This approach, named Value-oriented Solution Development Process (cf. Figure 3), is further detailed and analyzed in [18].

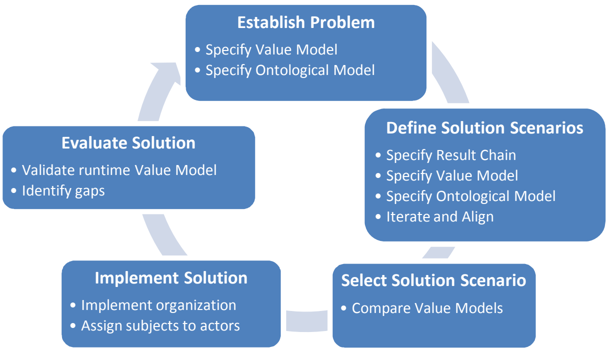

Fig. 3. VoSDP - Method for practical application

The existence of an overall value model to commit project-specific value model changes incrementally in deltas is comparable to architecture deltas on a project-by-project basis being committed to an overall architecture model. This assists in having a more systematic and complete analysis capability over the business model part of the overall solution, while keeping alignment with the construction. A single, simple, value model would give a high-level, but accurate idea of the context of the value proposal. For instance, a simplified generic value model of a private, for-profit enterprise is presented in Figure 4.

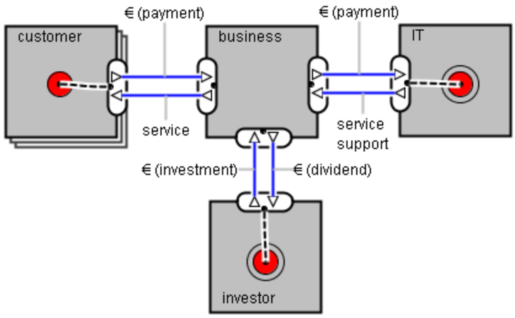

Fig. 4. Generic value model of IT-enabled for-profit enterprise

Considering the value model in Figure 4, the equation for considering the development of business support initiatives for an annual period would be:

$$dividend = customer\ revenue - business\ OPEX - IT\ OPEX - investment$$

It is noteworthy that the result can be attained by reducing the expenditure or by finding alternative ways of generating value, such as increasing revenue (relating with the customer actor) or decreasing support costs (relating with the IT actor). For instance, a business requirement such as allowing the customer to configure the features of his phone service (such as confidentiality, 3-way conferencing, voicemail, etc.) via selfcare channels can have many concurring initiatives through different stakeholders and at different timings. This was the case with different project requests: one for configuring features via set-top box interface and another for the same request over automated dial-in IVR (Interactive Voice Response). Technologically, they consist in simple service reuse but, from a business perspective, there are overlapping benefits that should be aligned by the business areas in an overall value model in order to accurately specify the worthiness of the initiatives.

The creation of a project-specific value model, exemplified in Figure 5, is a step forward by itself, fostering consensus among stakeholders and improving objectivity. Further, in order to rationally select solution scenarios, objective criteria must be defined. To this end, using e3Value it is possible to assign valuation formulas and specifying value model components using specific attributes that make the profitability sheets directly derivable from the model.

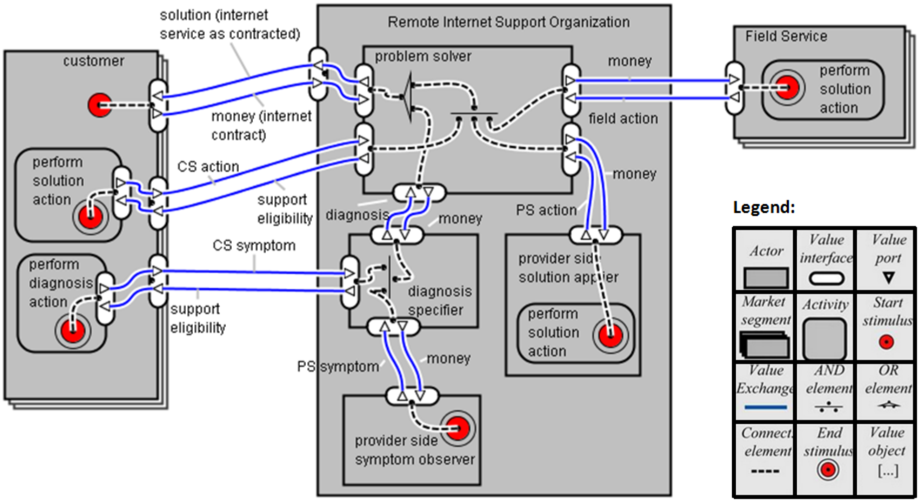

Fig. 5. Internet Support Example - Value Model

The process of alignment with the construction model is described in [17]. While it exceeds the scope of this paper, it must be mentioned as it is a cornerstone of the approach and allows checking coherency between ontological and teleological models. The advantage of having a business case integrated with the ontological and implementation models is that it makes possible to estimate the critical values that put economic viability at stake and monitor them in anticipation via trend analysis.

5 Results

The main quantitative improvements to the IT Demand process found over the three year period are summarized in Table 1. The IN column establishes the number of projects of whichever category that entered the process each year. The terminal states of the process, Cancelled and Implemented, come next and its sum equals the projects leaving the process, represented in the OUT column. Finally, δ backlog refers to the backlog variation, or project flux through the IT DM process.

Table 1. IT Demand Management process volumes 2010-2012

Year	IN	Cancelled	Implemented	OUT (C+I)	δ backlog
2010	100%	33%	65%	98%	2%
2011	55%	29%	30%	59%	-4%
2012	45%	28%	29%	58%	-13%
Total	**200%**	**90%**	**124%**	**215%**	**-15%**

The values presented are a percentage of the total of projects that were input to the process in the first of the 3 years. In Figure 6, a yearly referential is taken to portrait process improvements: the outputs are considered as a percentage of the inputs of the corresponding year. As it can be seen, 9% and 29% backlog reduction were achieved in the second and third years, respectively.

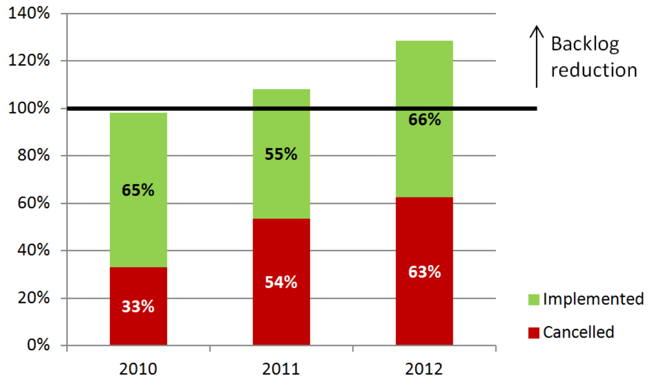

Fig. 6. Process outputs (implementations and cancellations) *versus* yearly inputs

As it can be seen, the project backlog has faced a significant and increasing reduction, led by a major cut in project creation and implementation. We should point out that the decrease in the number of implemented projects does not imply a strict proportional IT investment reduction. In this case, consolidation of initiatives played a major role in this indicator. Furthermore, some decrease in IT Demand may be partially explained by the overall economical context and the pressing need for more rigor and justification in its allocation – the approach we have presented serves as a means for doing just so.

The yearly contribution of the Demand Management process due to 1) project cancellation and 2) scope reduction based on value balancing, represented 6% of the yearly Information Systems service spending. In the remainder of the section, we detail the origin of these quantifiable improvements.

Phase I led to a massive cancellation due to missing benefits specification and ageing. In spite of this, the project backlog grew as there was a very large number of new projects, more than half of which found the way through production.

The application of Phase II mounted a large obstacle to project creation, which dropped by almost 50% in 2011 and kept the tendency for 2012. Additionally, as main result, the input to solution development process had a quality increase, resulting from better problem elicitation. For instance, applying the presented method allowed improving the definition of the set of stakeholders, scoping and value proposal. Additionally, business case clarity yielded important gains, particularly enhancing GO/NOGO decisions, prioritization criteria and scrutiny between peers. As a positive side effect, the relation with the IT Delivery also improved as planning and priority volatility has been greatly reduced.

As for the outcome of Phase III, there are still no results that allow for complete validation as not enough projects have completed the new process. Interesting metrics will be, for instance, stakeholder identification gaps, the number of times the construction model is not compliant with the value model (differentiate incompleteness and violation), average number of alignment iterations, etc. It is noteworthy, though, that applying the transactional pattern to value exchanges supports the identification of relevant scenarios. Also, by building the value models of functional units that had no explicit contribution, it became possible to integrate them in the overall business case and to decide if they should be a part of the recommended scenario or not. The now structured business case enables tracing benefits to implementation components. In turn, validation is improved by using a structured and traceable value proposal as reference during Post-Implementation Review.

6 Reflection

Looking back at the last three years, it is possible to identify clear advances in the maturity of the IT Demand Management organization and process from the Value Management perspective, including:

- **Increase of justified and mature project requests**
- **Improved specification of benefits and value generation mechanisms**
- **Project Appraisal based on IT DM inputs**
- **Stakeholder visibility and buy-in**
- **Prioritization based on known and systematic criteria**
- **Value models that can be checked at runtime**
- **Reduction of planning volatility**

The simple fact that the expected benefits are made explicit has a two-fold contribution: 1) there is a justification for the project that rests on the benefits to the company, which are now open to scrutiny; 2) the solution provider is now aware of the intended benefits and must question or commit, never ignore them.

It is worth noting that there were no specially created IT artifacts or tools. Current portfolio management tools, spreadsheets and process control mechanisms were used with minimum adjustments.

As a main challenge, we have to point out the early commitment to a high-level estimate during quickscan, as it is a demanding exercise in terms of working with a high-level solution and predicting scope, impact and costs. In addition, an adaptation period was needed for the business areas to engage in the new process as an opportunity rather than a threat – and adjusting their way of working, namely benefit forecasting and matching with their own yearly objectives and plans.

Leveraging the new deliverables produced we can now map the artifacts regarding value-orientation through the process, as represented in Figure 7. Particularly, each Project Request (1) entails a value model (2) that must be made explicit. This value model specifies the exchanges of value objects between stakeholders, representing expected benefits. The quickscan produces a high-level solution that honors the value model. The fact that the components of the value model are matched to ontological components, e.g. from a DEMO model (3), allows constructive estimates that complement the value model with the cost dimension. The result is a formal, integrated, problem/solution value model that provides structure to the business case (4). After investment appraisal, the detailed implementation models are produced (5). Following, implementation planning (6) can now be performed based on the project value proposals across the portfolio.

More importantly, the mentioned artifacts are aligned and represent a value proposal along the three perspectives – contribution, function and construction – and have significance during operation (7). This marks a significant difference from traditional business case approaches, which are used solely for decision making during early design stages. The value proposal can effectively be used during operation of the solution for justification of each component in the runtime environment and for change analysis.

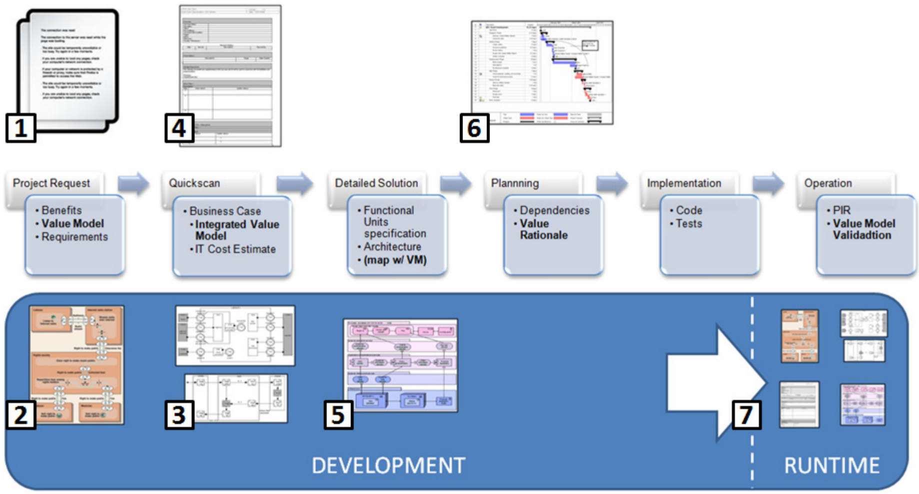

Fig. 7. IT Demand Management Process - Value-oriented

From this reflection, we have devised a value management maturity matrix that summarizes our experience. The matrix is presented in Table 2.

Table 2. IT Demand Maturity Matrix regarding Value-orientation

#	Level	Description
0	No Value Awareness	No portfolio management based on explicit value
1	Value Awareness	Common language and casuistic value decisions
2	Benefits Specification	High-level rationale is captured systematically
3	Value-oriented Portfolio Management	Process steps (i.e., qualification, quickscan, detailed solution design, estimates and planning) is systematically value-driven (*black-box*)
4	Value-oriented Solution Design	Value of solution components is defined in detail and traceable through the whole process (*white-box*)
5	Continuous Improvement	Patterns are captured, trends are anticipated and proactive Demand is created

The maturity of the process has increased as a result from the transformation. Coupled with enabling political and management changes (particularly the formal appraisal step introduced in Phase II), the maturity has increased from level 0 to 3 and is now entering level 4 at the time of writing.

IT Demand Management is now adequately positioned to promoting business-business alignment while maintaining neutrality, which includes rationally handling OPEX increases *et al* by promoting IT and making itself explicit as a business.

7 Conclusion and Future Work

In this paper we report on the transformation of an IT Demand Management organization of a Telco. Such transformation was grounded on: 1) Benefits Management, 2) Integration of theoretical models, in this case an ontology for matching e3Value and DEMO, and 3) a value-oriented solution development method.

The ability to establish relevant perspectives by stakeholder group and present an integration ontology to act as a Rosetta Stone for the Business and IT parties. By employing a separation of concerns enabled by differentiating Construction, Function, Value and Purpose perspectives, problem elicitation improved. Jointly, the inclusion of mandatory benefits statement and their validation during project request phase was instrumental in controlling demand volume and quality.

The main contributions from Value Modeling to integrating Teleological and Ontological perspectives were: value structure and coherence, economic reciprocity and value object explicitation; from the Enterprise Engineering side, the provision of complexity reduction mechanisms, a transactional context and construction support.

We found Enterprise Engineering and Value Modeling to be compatible and complementary and that their combination results in an essential capability to increase the maturity level and business IT alignment. As future work we hope to fully implement and evaluate Phase 3 for more detailed and grounded Business/IT alignment and Value Management maturity.

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Adoption and Use of Social Media in Small and Medium-Sized Enterprises

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Abstract. In recent years, social media have been increasingly adopted in enterprises. Enterprises use social media as an additional way to get in contact with their customers and support internal communication and collaboration. However, little research is devoted to the adoption and internal usage of social media in small and medium-sized enterprises (SMEs), which are of high social and economic importance. The purpose of this paper is to examine the adoption, usage, and benefits of social media in SMEs as well as potential concerns that may prevent a wider adoption of social media in SMEs. Therefore, a survey of decision-makers in German SMEs was conducted. Findings based on 190 responses indicate that SMEs started to use internal social media (e.g., wikis, blogs) in order to support collaboration among employees and to improve knowledge management. However, SMEs still face problems to manage adoption and to identify relevant business values. Based on our results, we derive several implications for SMEs, in particular how to overcome the obstacles to a wider adoption of social media.

Keywords: social media, SMEs, adoption, usage.

1 Introduction

In the last few years, web 2.0 technologies and associated social media applications such as social network sites (SNSs), microblogging, weblogs, content communities, and wikis have been increasingly making their way into organizational environments [1], [2]. While the use of internal social media applications is believed to improve communication and collaboration among employees, knowledge management, and product/service innovation, companies started to establish social media based networks with business partners and engage in public social media for purposes of marketing, customer relationship and reputation management, recruitment, and product/service innovation [3]. According to recent studies, 72% of large enterprises have already deployed at least one social media tool. 40% say that social networking tools as well as blogs were in use [4].

Not only social media have proven to play an important role for larger corporations, it also becomes increasingly relevant for small and medium-sized enterprises (SMEs). According to research by US-based marketer Constant Contact,

F. Harmsen and H.A. Proper (Eds.): PRET 2013, LNBIP 151, pp. 61–75, 2013.

24% of small businesses use social media in a structured way, and a further 20% use it in an informal way, with slightly higher percentages for medium-sized businesses [5]. In Germany, 47% of all companies use social media [6]. In particular, SMEs can benefit greatly from easy-to-use and easy-to-implement social media applications [7]. Moreover, the adoption of social media applications is rather less complicated and less costly due to its wide diffusion and technological advances [8]. Furthermore, it is even argued that SMEs should proactively embrace social media technologies and (re)-design their core business processes in order to maximize their efficiency. The widespread adoption of social media by SMEs might help to "level the playing ground" with large firms [8]. However, many small businesses that use social media may fail to understand how to use them correctly. The Business Network International addresses this by surveying 1,000 business owners. They found that three quarters of the surveyed owners have been "put off" a company because of improper use [9].

There is a growing body of academic literature on social media use in corporate context. However, most of the studies focus on larger enterprises and there is little research on social media in the context of SMEs explicitly. As SMEs are a vital component of all economies representing 99% of all companies in the European Union and employing half of the total workforce in the EU [10], they are of high social and economic importance. However, SMEs often are behind larger companies regarding the adoption of innovative technologies. Reasons for this are, for example, a limited ability to realize risky investments and a stronger focus on core business activities, which are directly aiming on increasing the company's profit. Given their typical limited resources and capacities, SMEs have to make well-conceived decisions regarding the adoption of new technologies such as social media applications. In this regard, knowledge of key success factors as well as potential impediments may significantly improve their ability to make informed decisions on whether or not to adopt social media. In particular, it is important to identify factors behind the reluctance of SMEs to introduce social media in their organization despite its potential benefits.

The main purposes of this paper are therefore

(1) to investigate the adoption, management, goals and added values of internal social media platforms in SMEs, as well as
(2) to explore factors that may prevent a wider adoption of social media in SMEs.

To address these research purposes, we surveyed decision-makers in German SMEs. In order to be able to compare the social media adoption in SMEs with adoption in large scaled companies (LSEs), we additionally surveyed a smaller sample of German LSEs. We do so to search for significant differences and to explain their reasons. Moreover, we validated our results by comparing it with findings of other studies. Finally, based on our results we derive several implications for SMEs, in particular with respect to how to overcome obstacles to a wider adoption of social media.

The paper is structured as follows. In the next section, an extensive literature review concerning social media use in corporate context and especially for SMEs is provided. Section 3 outlines the applied methodology for the survey. Following, we present the results of the survey in section 4. In the subsequent section 5, the findings are discussed and the implications deducted. Finally, we conclude by summarizing the results, outlining limitations, and by proposing potential future research.

2 Literature Review

Recently, social media use in corporate context has been subject to considerable attention. There are a growing number of studies focusing on the use of social media by companies. In this section, we review relevant literature on the internal use in corporate context. In addition, we present several recent works on web 2.0/social media and SMEs. We used the keywords (isolated as well as in combinations) displayed in Table 1 in the mentioned search engines and searched for publications from 2003-2012.

Table 1. Search parameters

Keywords	Social media, enterprise 2.0, web 2.0, small and medium enterprises, large scale enterprises, technology, adoption, deployment, dissemination, implementation, goals, obstacles, problems, added value, wiki, blogs, social network, microblog, RSS, social bookmarking, podcast
Search Engines	ACM Digital Library, AISeL, EBSCO, Google Scholar, Jstor, ScienceDirect, Taylor & Francis Online

2.1 Adoption and Use of Internal Social Media Applications

The adoption and use of internal social media applications in corporate context, widely termed as "Enterprise 2.0", has recently generated a lot of research interest. Several case studies on social media adoption and use in enterprises show a diverse area of application in Enterprise 2.0 implementations (e.g., [11], [12], [13], [14]). However, the majority of previous works, focused on studying specific social media applications in enterprise context.

Among others, enterprise microblogging has attracted a lot of research attention recently. In a case study about the early adoption and use of Yammer - an enterprise microblogging platform - in a Fortune 500 company, Zhang et al. [14] found that users vary in their posting activities, reading behaviors, and perceived benefits. The study also identified barriers for adoption, such as the noise-to-value ratio paradoxes. Other studies such as by Riemer et al. [12] also confirmed the potential benefits of enterprise microblogging but still pointed out that there are striking differences in usage patterns and enterprise microblogging is highly dependent on the particular organizational context shared by users.

Companies have recently started to use internal social networking platforms. Richter and Riemer [15] studied three cases of large, knowledge-intensive organizations, which introduced corporate social networking sites. They identified three modes of use of corporate SNS including identifying experts, building personal context and fostering existing relationships.

Another important social media application, which has been adopted by an increasing number of companies are enterprise weblogs. For example, enterprise weblogs are often used as project logs or for communication between the CEO or head of marketing and the company's customers (e.g., [16]). Efimova and Grudin [17] examined the use of blogs as personal communication and knowledge management tools within Microsoft and identified the benefits to both individuals and organizations. In a recent paper, Wattal et al. [18] examined the role of network externalities on the use of blogs in an organization and showed that such usage within an individual's network is associated with an increase in one's own usage. Furthermore, they also found that network effects are stronger for younger generations and women.

Recent literature has also paid attention to enterprise wikis, which can be used by knowledge workers to create a shared knowledge base of common term [13], [19]. Recent empirical studies show that wiki technology was used to support a wide range of work activities within a corporation, including project team collaboration, information dissemination within communities of practice, idea generation, e-learning, technical support, customer relationship management, and resource management (e.g., [20], [21], [22], [23]).

Despite the potential benefits social media offers for organizations, companies are challenged managing the adoption and use process of social media [4]. In a comparative study, Fuchs-Kittowski et al. [24] summarized findings about a whole range of economic, cultural, and technical factors that can be seen as great obstacles to the use of web 2.0 in enterprises. The most important of them is the fact that cost-benefit analyses yield unclear results. Similarly, further studies by Kaske et al. [25] as well as Steinhüser and Smolnik [26] also emphasized the problems of measurement of social media success. We addressed this issue by proposing various measurement models and frameworks. In a recent work, Kuikka and Äkkinen [27] aimed at identifying internal and external challenges related to the adoption and use of social media in a large case company. Results of their study revealed that companies might face internal challenges such as resources, ownership, authorization, attitudes and economic issues as well as external challenges associated with company reputation, legal issues and public/private network identity.

2.2 SMEs and Social Media

Kim et al. [8] presented a conceptual model of web 2.0 applications and analyzed the usage of these platforms in 100 U.S. SMEs (50 "best SMEs" to work for in America in 2009 and 50 SMEs randomly chosen from manta.com, an online source of SMEs). Their results show that while most of the 50 "best SMEs" adopted web 2.0 to some degree, other SMEs need to increase their efforts to improve their performances, to connect with consumers, and to remain competitive. Stockdale et al. [28] found that the business value of social media, for SMEs, lies primarily in customer engagement. Out of the five case organizations they examined, only the largest one with about 300 employees reported using social media internally. Based on six case studies of the application of social media in SMEs, Zeiller and Schauer [7] analyzed the adoption and implementation, the motivation of team members and their benefit, and success factors of the use of social media for team collaboration. They found that top-down adoption strategies based on an initiative by management dominate in the case companies. Furthermore, two success factors were identified: support of the social media activities by the company's management as well as technical and operational support for users. On the other hand, Li et al. [29] investigated that many SMEs simply can not afford to establish a dedicated collaborative portal. Subsequently, they present a platform that includes weblogs, microblogging, and project management.

A few number of studies focused on specific social media platforms. For example, Stocker et al. [30] studied weblog adoption practices for knowledge transfer purposes in a case SMEs. Results of their study indicated that weblogs in SMEs also suffer from the knowledge sharing dilemma although through their simplicity, they will significantly reduce the cost of contributing knowledge. Moreover, weblogs have to be actively and professionally promoted, even in SMEs where the number of employees is lower and group identity may be higher. Another example is a work by Fuchs-Kittowski and Hüttemann [31], which presented a new web 2.0-related approach towards an integrated collaboration and knowledge environment for SMEs. More specifically, we proposed a new conception for quality assurance in enterprise wikis including different methods to measure the structure of the wiki and user behavior. Chang and Chou [32] argued that IT-enabled collaboration between SMEs will help companies develop their proactivity, which they define as the ability to anticipate change. Recent literature addressed the adoption of web 2.0 in SMEs networks ([33], [34], [35]). As SMEs face new challenges in a complex and dynamic competitive environment, they need to cooperate due to their restricted resources and limited capacities.

As shown above, most of the existing studies each focus on certain web 2.0 technologies but do not provide a comprehensive overview regarding the adoption and internal usage of social media in SMEs in general. With our research paper we therefore attempt to contribute in this field to get broader insights by analysing the status quo of internal social media usage in German SMEs, without focussing on single technologies or platforms.

3 Methodology

To address our research purposes, we follow a quantitative research approach by conducting an extensive survey of German SMEs. In the period from July 12 to August 27, 2012, we contacted (via mail) about 500 companies across different industries mostly from the North Rhine-Westphalia region in Germany asking them to participate in an online survey. Contact data were provided by the local chamber of industry and commerce. Furthermore, about 200 companies were contacted nationwide via Xing, which is a social network platform for business purposes similarly to LinkedIn. We contacted enterprises, which match the definition of being a small and medium-sized enterprise according to EU-law [36]. Following this definition for SMEs, the number of employees does not exceed 250 and the annual turnover does not exceed 50 million Euros. Furthermore, we contacted large companies with more than 250 employees to allow a comparative analysis.

Based on our research goals and the findings from the literature review, the survey was structured as follows. First, we explained the differences between externally and internally used social media as we did in the first paragraph of chapter 2 (literature review). That was to ensure that participants have the same understanding of the matter they will be dealing with in the survey. In a second step, we asked participants to provide information about number of employees, sales, geographical affiliation, and industries of their firm, as well as information about the position of the participant within his/her organization. Subsequently, we asked participants whether their company has already adopted social media platforms in their organization. Depending on their answer, respondents were assigned a corresponding subset of follow-up questions. On the one hand, respondents of firms that have already adopted social media platforms were asked to answer questions about the status quo in their organization, process of adoption, areas and benefits of social media use, as well as evaluation and plans for the future regarding adoption of additional platforms. Moreover, participants were asked to report factors that may impede a wider adoption of social media in their firms.

On the other hand, organizations that have not adopted or used social media were asked whether they are planning or considering using social media in the future. Finally, we asked a number of questions to companies that have explicitly rejected the use of social media to elicit the reasons for that reluctance. In total, the survey comprises 30 questions of different types including yes-no and multiple-choice questions, rating scales as well as open-ended questions supporting the exploratory approach. We closed the survey after having obtained responses from 190 companies in total. This yielded a response rate of about 27%.

4 Results

4.1 Descriptive Data of the Respondents

Overall, we contacted 700 companies, of which 190 managers (27%) responed. Only one manager per company participated. This data set included 147 (77%) SMEs with up to 250 employees and 43 (23%) LSEs which each employ more than 250 employees. In our analysis, we focus on 80 companies, 64 SMEs (44%) and 16 LSEs (37%), which stated to use social media for internal purposes. For the other companies (83 SMEs, 27 LSEs), we analyse the reasons for not adopting internal social media, as far as they provided such information.

The diversity of industries in which the sample firms are engaging is high covering manufacturing, services, retailing, IT/telecommunication as well as other services. Most of the responding enterprises belong to the IT/Telecommunications industry (SMEs: 55%, LSEs: 31%) or are service companies (SMEs: 28%, LSEs: 31%). 13% of the participants of our survey classified themselves as “other”. However, they provided more information by means of an open-text answer revealing that they are, for example, energy suppliers, tourism or construction companies.

More than half of the SMEs (59%) stated that their employees are between 31 and 40 years of *age* (LSEs 50%) while 16% stated an average age of between 41 and 50 years (LSEs: 44%). 59% of the SMEs have only one *single headquarter* (LSEs: 12%) while 41% (LSEs: 88%) operate *several branches*, 35% of them with at least one branch outside of Germany (LSEs: 63%). 50% (LSE: 37%) of all companies with more than one branch use social media.

4.2 Adoption and Management of Social Media

In 36% of the SMEs, social media *adaption was organized* as a top-down process (LSEs: 25%) and therefore essentially initiated and controlled by the higher management. Only 14% of the participants described their social media adoption as a bottom-up process (LSEs: 23%) while 50% specified that social media has been introduced in a mix of both approaches (LSEs: 63%). The introduction of social media was mainly *initiated* by the top management of the company (66%; LSEs: 32%) or the IT-department (25%; LSEs: 25%). Therefore, *the responsibility for the management* and control of social media in SMEs is mostly located with the CEO (44%; LSEs: 19%) while, within LSEs, mainly the IT-, marketing- or corporate communication-department performs this task (each 25%).

Participants reported that wikis are the most frequently used *type of social media* for internal usage, followed by blogs and internal social networks (see Table 2). 61% of the SMEs companies have been using internal social media no longer than three years (LSEs: 56%). Concerning the LSEs, our result is backed up by the survey of Bughin et al. [4], which described social networks, blogs, and wikis as the three most used social media platforms.

Table 2. Adopted types of social media

Type of Social Media	SMEs (in %; n=64)	LSEs (in %; n=16)
Wiki	81.25	75.00
Blogs	60.94	62.50
Internal Social Network	39.06	37.50
RSS	32.81	18.75
Social Bookmarking	29.69	12.50
Microblog	29.69	12.50
Podcast	9.38	0.00

In most cases, the *board supports* the internal social media use, by active participation (70%; LSEs: 50%) and/or a regular call to use the appropriate tools (42%; LSEs: 25%). 53% of the companies offered *trainings* to their employees (LSEs: 37%). According to the interviewees, the *acceptance* of social media was never classified as low or very low (LSEs: 25%). 71% of the SMEs reported a high or very high level of acceptance (LSEs: 25%). Social media *guidelines* exist in 45% of the SMEs (LSEs: 57%), which adopted internal social media.

4.3 Goals and Added Values of Social Media Usage

The respondents mentioned the need to improve communication structures (58%; LSEs: 38%) and collaboration processes (60%; LSEs: 44%) as most important reasons for SMEs to adopt social media. 28% of the SMEs stated that they had implemented social media primarily because of the current social media trend in IT (among LSEs even 38%). In only 3% of the companies, social media were adopted without certain goals (LSEs: 25%). The most quoted goals (multiple choice) were improved communication (84%; LSEs: 56%), improved information and knowledge management (83%; LSEs: 50%), and improved collaboration (78%; LSEs: 50%). A rapid detection of in-house experts and the change or opening of the corporate culture has been quoted in 30% (LSEs: 19%) and 24% (LSEs: 6%) of the cases, respectively. The results for LSEs are in line with the survey of Clearswift [37] and Bughin et al. [4], which points out that increasing speed of access to knowledge, reducing communication costs, and increasing speed of access to internal experts are the top-3-purposes for internal social media usage. When asked to what extent social media has already set a value for the company, improved communication were mentioned most frequently, followed by faster access to in-house information and knowledge, improved cooperation, and a positive change and opening of the corporate culture (see Table 3).

Table 3. Objectives and value added through implementation of social media (n=80, multiple choice)

Goals of social media usage	**SME expected**	**SME achieved**	*LSE expected*	*LSE achieved*
Improved communication	**84.38%**	**79.69%**	*56.25%*	*56.25%*
Faster access to in-house information and knowledge	**82.81%**	**70.31%**	*50.00%*	*56.25%*
Improved collaboration	**78.12%**	**59.38%**	*50.00%*	*37.50%*
Positive influence on corporate culture	**23.44%**	**28.12%**	*6.25%*	*18.75%*
Faster access to in-house experts	**29.69%**	**21.88%**	*18.75%*	*25.00%*
Reduction of travel costs	**14.06%**	**12.50%**	*0.00%*	*0.00%*
No goal / no added value	**3.12%**	**4.69%**	*25.00%*	*18.75%*

Furthermore, we asked the participants to assess the added value and intensity of use of the implemented social media platforms in the company (scale from 0=very low to 5=very high). The results are displayed in Figure 1. The size of the circles in the chart represent the amount of companies that use the corresponding social media platform. Regarding the intensity of use and added value, since none of the platforms were rated less than 1.5, the chart has been adjusted to provide a better overview. Grey filled circles represent SMEs, black filled LSEs. As the figure shows, SMEs considered social bookmarking, RSS and podcasts as with a low added value and intensity of use while LSEs rate wikis, blogs, and microblogs as low. In contrast to

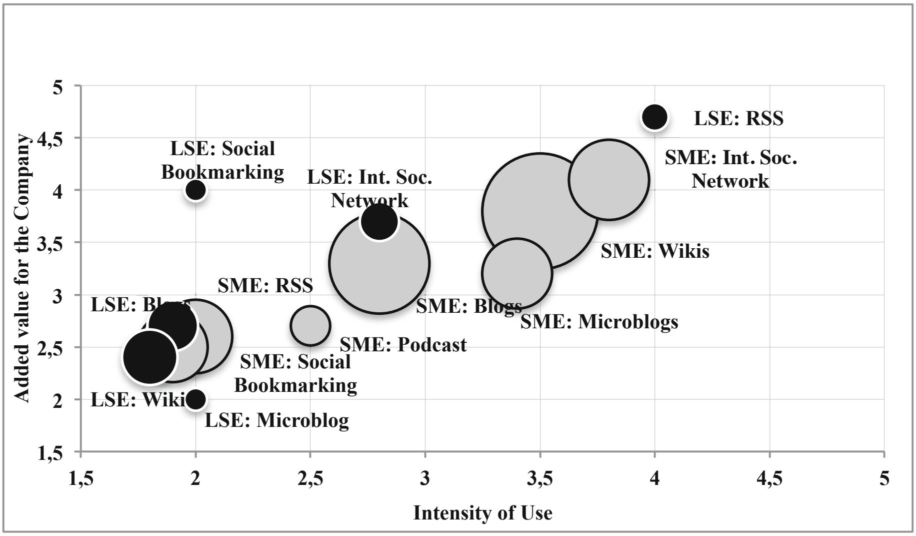

Fig. 1. Intensity of use and added value of different social media platforms

that, Internal Social Networks (ISN) as well as wikis and microblogs seem to contribute a higher value with significantly higher usage intensity in SMEs while for LSEs this is only true for RSS and Internal Social Networks.

With regards to the *overall importance* of social media for the companies' production and/or service provision, 56% rated importance as with "high" or "very high" (LSEs: 31%), while 20% classified importance as with "low", "very low" or "no" (LSEs: 57%).With regards to the *overall importance* of social media for the companies' production and/or service provision, 56% rated importance as with "high" or "very high" (LSEs: 31%), while 20% classified importance as with "low", "very low" or "no" (LSEs: 57%).

4.4 Obstacles to Social Media Usage

When asked about occurring *problems related to the implementation and operation* of social media, SMEs mostly mentioned aspects of lacking support by employees, effectiveness, efficiency, issues of corporate culture and the lack of resources (see Table 4). To get more information about factors that prevent social media adoption we provided an open-ended text question. However, only a small amount of 19 SMEs answered to that optional question.

Table 4. Preventing classification and frequencies

	Total (19)	Percentage (n=19)
Insufficient support of SM by employees	6	32%
Poor Effectiveness and Efficiency	4	21%
Lack of Resources	3	16%
Issues of Corporate Culture	3	16%
Others	3	16%

Of the 83 SMEs (LSEs: 27) that specified not to use any social media within the company, 44% reported to have not yet adopted that technology because they have generally just not considered it (LSEs: 31%). The lack of expected value added due to social media has been mentioned in 23% (LSEs: 42%) of the cases as a major reason for not implementing social media internally. Only 6% (LSEs: 0%) respectively 1% (LSEs: 5%) said that the technical implementation or high implementation costs led to a rejection. When asked whether the companies plan to use social media in the future, 10% said yes (LSEs: 37%), while 48% (LSEs: 37%) of companies were undecided. 42% (LSEs: 26) reject any future corporate social media use.

5 Discussion and Implications

5.1 Adoption and Management of Social Media

Distributed structures are often seen as a driver for the adoption of internal social media because of the accompanied difficulty of communication and cooperation within the organization. However, we could not find a direct link between distributed enterprise structures in SMEs and the corporate use of social media. Of all SMEs with more than one branch 50% (LSE: 37%) deployed social media, which is not significantly higher than the overall adoption rate of social media (44%; LSE: 37%).

As other studies have shown, decision-making processes regarding the adoption of social media are difficult because costs of the adoption process may be estimated precisely while benefits can be hardly measured. In this sense, literature has shown that the personality of firm owners and their attitude to do business considerably influence decision-making processes in SMEs (e.g., [38]). Therefore, it can be assumed that in SMEs the affinity of the CEO has a significant impact on the initiated social media activities. Our data confirm that assumption and show that those companies with a CEO, who owns a public social media account, apply social media for internal usage in 55% of the cases. In those cases where the CEO does not own such a user account, only 13% of the SMEs adopted internal social media. Additionally, a much larger share (44%) of managers in SMEs than in LSEs (19%) stated that the CEO is directly responsible for social media activities and that he is highly involved and one of the most active users. Furthermore, the CEO has been mentioned as being the initiator of social media activities by most of the managers in our survey (66%). In contrast, in LSEs usually the IT department (37%) or the internal communication department (25%) initiates the usage of social media.

Moreover, we found that adoption processes in SMEs often follow a social media strategy (e.g. SMEs provide social media guidelines and organize trainings in order to enable employees to effectively use social media). The importance of such procedures becomes obvious in a statement of one manager which company did not provide a social media guideline: *"Because we have no guidelines and no allocated social media responsibilities, the communication on non-private topics has stopped. Nobody feels responsible for the next step anymore."* It also turned out that employees in

SMEs seem to be very open to the adoption of social media (84% support social media usage), especially in those cases where the average age of employees is between 21-40 years. Regarding the adoption of different types of social media, wikis and blogs are most frequently used. However, about one third of the SMEs already implemented social networks sites (often based on the Yammer software) to better connect employees among each other. Surprisingly, social networking sites have been mentioned as the most value adding and most intensively used platform in SMEs. A reason for this might be that SMEs often have a "right" size to profit from social network functionalities: they are big enough to gain value from a higher transparency of skills and contact information of the work force but on the other hand they are small enough in the way that people are aware of each other and generally interested in the activities of their colleagues.

Based on our results, it can be stated that a successful adoption of social media depends on the support of the CEO and a well-structured adoption process. SMEs are well advised to perform trainings and develop enterprise specific social media guidelines [39].

5.2 Goals and Added Values of Social Media

Our findings suggest that SMEs follow specific goals such as to improve knowledge management and collaboration. Although the current social media trend might be an important driver of social media adoption in corporate context, adoption rarely took place without concrete goals. Basically, social media are still associated with improved communication within the company. Most of the managers in our survey stated that this goal has been achieved. 78% of the managers also stated that they had high expectations on social media as an enabler for better collaboration. However, only 59% said that collaboration became more efficient based on social media (see Table 3). One participant noted that *"within the company, collaboration is not supported in general"*.

Surprisingly, managers come to the conclusion that social media positively influenced the *corporate culture* in a stronger way than they had expected it when rolling-out social media. Regarding aspects of corporate culture, for one of the participant of our survey it is essential that *"one has to know each other better, to grant other colleagues their space and freedom, to admit mistakes, to develop a sense of confidence and to accept each other."* This seems to be in line with our finding that SNS are one of the most beneficial types of social media for SMEs because SNS are more focused on social interaction and social relations than e.g. wikis.

Based on these results, SMEs should always consider the enterprise culture and mindset of the employees. Strict policies may decrease the potential values. The highest value could be reached throughout the support of the communication via SNS, but the employees should feel "free" to use the SNS and although be allowed to discuss private topics. The adoption always follows clear goals, which ought to be continuously monitored and if necessary adjusted.

5.3 Obstacles to Social Media Usage

Compared to LSEs, a much lower number of SMEs already adopted social media. This is not surprising since SMEs usually have only very limited resources and focus their knowledge on their specific field of business. The adoption of internal social media needs more resources and demands a comprehensive managerial strategy, which can not be easily provided by SMEs. Five SME managers mentioned aspects of resources such as “high maintenance efforts”, “someone has to keep it running” or “keeping everything tidy, keeping information up to date”.

The high number of undecided companies and the fact that this technology has just not been considered shows a great potential for appropriate software vendors. Furthermore, when asked what value social media has brought to the companies in our survey which already use social media in total, 62% quoted a high or very high value. 16% felt that the benefits of social media are low or very low.

SMEs are well advised to keep risk low when adopting social media. Reducing cost und keeping efforts as low as possible are important challenges SMEs face. SMEs can address this by choosing open source solutions and hark back to specialized social media cloud services. Additionally, SMEs are supposed to invest more in the adoption stage and to buy knowledge from external consultancies instead of amortize investments in case of a failed adoption.

6 Conclusion

This paper sheds light on the adoption of social media in SMEs, which has so far received little research attention. In order to provide first results, we conducted a survey of a number of German SMEs. In particular, the contribution of this paper is two-fold. First, we identified benefits of social media use, impediments to a wider adoption, and factors behind the reluctance to adopt social media for a majority of SMEs. Second, based on our results, we derived several implications for SMEs to overcome obstacles to social media adoption as well as impediments to social media diffusion.

In summary, our findings suggest that social media adoption is associated with primarily non-technical barriers and challenges (also in line with [20], [40, [41]. In particular, these include “soft” factors such as management attitude and employee acceptance, rather than “hard” ones involving cost aspects and technical issues (e.g., system integration). Hence, in general, it is important for SMEs to take these “soft” factors into account when considering a social media adoption. The contribution of our article is twofold. We contribute to the academic world by providing new and up-to-date insights into the adoption of social media in SMEs. Based on these findings other researchers will be able to conduct further investigations on certain aspects we highlighted. Furthermore, our work has practical implications because managers are enabled to benchmark their own business and to learn from our results.

One limitation of our study is that we have focused only on German SMEs, which are mostly based in the North Rhine-Westphalia region. As future research, we will attempt to validate our findings based on an even larger sample by recruiting more

SMEs as well as larger firms to compare our results. Moreover, we seek to conduct a number of personal interviews to deepen our understanding of the adoption and use of social media in SMEs, as well as barriers to social media adoption and diffusion on a larger scale. In addition, we aim to increase the geographical diversity of firms to be recruited (e.g., SMEs from other European countries and/or the U.S.) in order to conduct comparative analyses.

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Engineering an Enterprise: Practical Issues of Two Case Studies from the Luxembourgish Beverage and Tobacco Industry

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Abstract. This study is a contribution to the discussion of practical issues in engineering enterprises that do not embrace classical enterprise architecture frameworks. It analyses two case studies within the beverage and tobacco industry in Luxembourg. The research settings provided an interesting context in an industry sector with high compliance regulations. In those case settings, no classical enterprise architecture framework was applied, so that the companies followed a rather pragmatic approach to cope with challenges. The research adopts an interpretive case study approach and explores qualitative data of work perspectives from higher along with lower hierarchy levels of IT and business people. The paper identifies three main motifs of practitioners that drive the engineering of their enterprise: standardization, financial aspects and organizational culture. The findings of this research suggest that contemporary EA frameworks are too rigid to be applied or appropriately tailored in some business environments. This paper suggests, that break from routine and training in EA frameworks should provoke more sophisticated approaches by the practitioners during enterprise engineering, but reflexive actions may substitute EA frameworks to some extent.

Keywords: enterprise engineering, enterprise architecture.

1 Introduction

Engineering enterprises involves the purposeful design of an entire organization that is a socio-technical artifact. This enterprise wide perspective becomes in a turbulent environment increasingly important, hence modern enterprises can be regarded as dynamic and vibrant systems that have to continuously adapt to a changing situation (e.g. [1]). Those changes usually affect several aspects within one enterprise, so that the adaption process may nurture conflicting goals. Organizations with the capability to respond quickly enough to the changing environment achieve competitive advantage. This capability involves the restructuring of fundamental processes and approaches in order to answer to various challenges. The discipline of Enterprise Engineering (EE) is an emerging discipline and it describes an engineering based

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approach to design or transform enterprises. EE is providing guidance in practice and matured from various research foci such as enterprise application integration [2] or alignment of business strategy and information systems and technology [3].

Authors have devoted considerable emphasis to the rise of methodological literature in the field of EE, which included different drivers for their approaches. From the organization perspective this involve internal drivers [4] such as business-IT alignment, cost reduction, standardization, and management / governance. External drivers [4] include various compliance regulations such as Clinger-Cohan Act, Sarbanes-Oxley Act, and Basel II [5,6]. However, to the best of our knowledge, a review about the drivers that is motivating the practitioners to engineer their enterprise is not available for organizations, which apply no classical enterprise architecture (EA) framework. A classical EA framework (such as TOGAF [7]) is a holistic and structured approach, which helps practitioners to govern and administer the architecture of an enterprise.

Particularly with regard to what motifs practitioners that engineer their enterprise have is relatively difficult to find in the literature. However, this would be interesting, because EE approaches could be designed accordingly. This paper presents in the following section (section 2) a brief overview about the drivers for using EE and prescriptive approaches of EE. This research is designed to identify what happens in practice concerning engineering enterprises in organizations without a classical EA framework. A classical EA framework can be part of engineering an enterprise, whereas it is not a necessity for EE. So, the enterprise is engineered also without the use of a classical EA framework. In particular, descriptions of real stories and detailed analysis may help practitioners to improve their activities in the field of enterprise engineering. In addition, as we will show in section 2, there is a lack of insight of real stories in the field of EE, which do not apply classical EA frameworks. Descriptions of what are driving them to engineer their enterprise and the way they do it would be helpful, because this improves our understanding of the "muddy" aspects of engineering enterprises. As such, this research tries to provide rich descriptions of engineering enterprises without a classical EA framework and to answer following research questions:

- What are driving motifs for practitioners to engineer their enterprise, which do not apply a classical EA framework?
- What is the difference between engineering enterprises without and with a classical EA framework?
- What are the potential practical and theoretical implications of the findings?

This in-depth research includes two case studies from the field of beverage and tobacco industry in Luxembourg. This field is of high interest to study enterprise engineering, because it involves great need for regulatory compliance with various standards (e.g. national and international beverage and tobacco laws). So, answering the research questions may involve a distinctive view to an industry field that includes those needs. Moreover, an investigation about what is happening in practice requires the collection of qualitative data, which requires an appropriate analysis approach.

This article is structured as follows. In the next section we present our literature review, and the third section outlines our research approach. The fourth and fifth sections present our case descriptions and analysis. This paper concludes with a discussion and implications of our findings for engineering enterprises in practice.

2 Literature Study

The purpose of this research is to obtain a theoretical interpretation from empirical data [8]; we also draw on available literature to develop our theoretical interpretation. We considered two streams as most helpful to gain insight to answer our research questions. One stream involves the drivers for practicing EE, which includes internal and external drivers that drive the establishment and improvement of EA (e.g. [4,9]). The other stream is a brief overview of the classical EA framework literature (e.g. [10,7]). In addition to those two streams we draw on work from social sciences, more in particular Giddens' work [11]. Insight from the social sciences may enrich the discussion and implications, since enterprises are inherently social constructs.

2.1 Drivers for Applying EA Frameworks

In previous literature studies there is a growing understanding that organizations have common reasons why they seek to gain advantages from EA approaches [4]. The motivations can be differentiated into internal and external drivers [4]. Internal motives involve:

- Business – IT alignment [12-15],
- cost reduction [16,17,15],
- standardization [18,15],
- governance [14,15],
- agility [1,12] and
- others like risk management [19-21].

Business – IT alignment is a continuous concern for information systems executives and according to Schönherr's [4] literature analysis an intensive object of EA research by academic and pragmatic sources. Cost reduction is another main object of EA research [4] and involves financial efficiency and business effectiveness [17]. Standardization is another important factor why organizations try to apply EA approaches to increase for example maintainability, reliability and security of processes and/or technology [15]. Governance mechanisms through e.g. technology and/or processes establish and monitor EA approaches [15]. Agility of organizations is another reason why EA approaches get applied in order to increase speed and flexibility that is required in turbulent environments [1]. Since modern enterprises have a growing dependence on IT, a frequent motive in EA literature is its focus on e.g. technology-related risks [20]. In addition to those internal motives, Schönherr [4] cites several external motives that include various compliance regulations such as Clinger-Cohan Act, Sarbanes-Oxley Act, and Basel II [5,6]. Those compliance regulations place increased challenges on businesses' internal control systems and IT [6] and are required to fulfill in order to stay in competition. This literature strand is insightful to grasp the various motifs of organizations that are engineering their enterprise.

2.2 Prescriptive Approaches for Enterprise Architecture

Classical EA is considered as an instrument to communicate an enterprise's future direction and this involves activities such as coordinating and steering that help to transform an enterprise [22]. Those activities necessitates a more holistic view on an enterprise and not only technical issues, such as IT [22]. Therefore, no universal perspective can be used in EA, which is illustrated by the wide variety of EA frameworks that were published [22], such as [7,23]. Because of this variety, principles were also differently positioned in EA literature. Architecture principles are described as the bridge from strategy to design [22]. Some frameworks consider principles from a technical perspective (e.g. [7]) other frameworks have a more business like point of view (e.g. [24]). Accordingly, EA literature involves multiplicity in methods and techniques that correspond to the respective ontology of its frameworks [25]. For example, TOGAF's Architecture Development Method (ADM) [7] provides an explicit description that is centered on requirement management and includes a cyclical and iterative understanding of architecture development (e.g. best practices for architecture procedures, organizational structures and responsibilities). This literature strand is helpful for comparing of what is done in practice and what could be done in theory with the help of EA frameworks.

2.3 Using Insights of Structuration Theory to Derive Implications

As earlier indicated, we identified a lack of research, which describes the driving motifs of practitioners that engineer an enterprise without a classical EA framework. Literature about the drivers for applying EA frameworks is insightful to grasp the various motifs of organizations to apply EA that is engineering their enterprise. And the second main literature strand is helpful for comparing of what is done in practice and what could be done in theory with the help of EA frameworks. In addition, insight from the social sciences may enrich the discussion and implications, since enterprises are socio-technical artifacts. In this research we draw on Giddens' work [11] as "sensitizing device" in order to view the world from a certain perspective, such as context, process or the context-process linkage [26]. In the realm of system sciences research, interpretive researchers tend to generalize with the help of social theories such as Structuration Theory [11,27]. Structuration theory deals with social phenomena at an abstract level rather than their particular instantiation in a specific context [28]. Structuration theory presents various concepts (stratification model, reflexivity, etc.) and in this research we draw on the stratification model to derive implications for practitioners.

3 Research Approach

We used an interpretive case study approach to study the driving motifs and activities how to engineer an enterprise without a classical EA framework in practice. This involves an in-depth understanding of motifs and practices from research participants, a filtering of individual differences, a contextually grounded study of the activities from research participants and a sophisticated abstraction and generalization that is based on a social theory. We acquired this understanding through the collection of detailed, qualitative data from two case studies. Both case studies involved companies that are involved in the beverage and tobacco industry within Luxembourg. Company A produces at one site whereas company B has several sites within Europe, however, both are large enough to provide moderate data for the study. Narratives about company A and B are given in section 4.

This is a well suited research approach for exploring a phenomenon [29], when there are interactions between people and the organization [30]. In addition, it has several advantages for research of an exploratory nature, since it generates insights and rich descriptions [31]. This fully corresponds to our needs to explore the driving motifs and activities how to engineer an enterprise without a classical EA framework in practice.

3.1 Data Collection

We understand that organizations purposefully design their enterprise that may experience business turbulences and transformations. By doing so, the organizations also engineer their enterprise. The goal was to collect data from practitioners that participate in engineering the enterprise, in order to explore their driving motifs and activities how they engineer their enterprise without a classical EA framework, such as TOGAF. To accomplish this goal, the researchers visited headquarters of both organizations and presented the research idea. The head of the companies and the researchers decided upon the people to interview. The researchers met at least two persons from the business as well as two persons from the IT departments. Those people covering various work perspectives from higher along with lower hierarchy levels. In Company A five persons were interviewed during visits from November 2011 and December 2011. The interviewed persons were responsible for legal and human resources, quality control, production planning, IT administration and new production site. Company B is rather complex compared to company A and we interviewed 8 persons to accommodate the research needs. The interviews with individuals from company B were during visits from March 2012 to April 2012. We interviewed persons that were responsible for logistics, distribution department, financial director, IT director, application development manager, CEO, supply chain manager and administration. We recorded and transcribed the interviews, each lasting approximately 80 minutes and held within a relaxed atmosphere. Although we collected a lot of data, we used the indirect speech in this paper. This is because both companies operate in a multi-lingual environment and all interviews were held either in French or German. As a result, we tried to avoid any misperception through translation of quotes.

To encourage the interviewees', we ensured that their statements remain confidential. In addition, we collected detailed information about the companies. However, we needed to limit the detail of information, since otherwise it would be relatively easy to track the origin of data in a considerably small country like Luxembourg. Therefore, we provide only data that are most relevant to this research about EA issues in practice.

3.2 Analysis of Interview Data

We filed the data sets of qualitative material in order to simplify and accelerate further research progress. For data analysis we used an approach that is referred to as distinctive types of coding and was based on Miles and Huberman [32]. The progress of data analysis is conducted in three steps:

- With the help of spread-sheets we sorted the data sets, and transcriptions were read and reread to familiarize researchers with the information. The data was deposited with some meaning in order to expose the various activities, events, and incidents.
- Through short descriptions in table form we developed a better understanding by looking at the driving motifs and activities when practitioners engineer an enterprise without a classical EA framework in practice.
- Finally, we identified tendencies and patterns in the data collection by comparing the data with the reviewed literature streams that we identified to support this explorative research. In addition, we draw on work from Giddens' [11] to enrich the discussion and draw implications from this study. These implications provide the basis for the potential transferability of the gathered results of this study.

By applying this coding procedure to the collected data we were able to conceive various aspects of the theme of this research (what are driving motifs for practitioners to engineer their enterprise which do not apply a classical EA framework). With the help of this explorative approach, we were able to build a bottom-up conceptualization of the collected data sets while using the reviewed literature (first literature stream: drivers for applying EA frameworks; second literature stream: prescriptive approaches for EA) as guidelines what aspects are of interest for studying EE in practice.

4 Two Case Studies from the Luxembourgish Beverage and Tobacco Industry

In this section, we provide narratives about company A and B, to get a coherent understanding about the "story of company" A and B. In addition, both narratives provide rich insight about driving motifs and activities how to engineer an enterprise without a classical EA framework in practice.

4.1 Company A

Company A operates independently and is export oriented with a diversified product range. Although the company witnessed some changes that involved the relocation to newer production sites, the business remained relatively stable. Research participants stated that dominant attributes: high cost control intensity, high market driven attitude, top-down strategy and the organizations intensive usage of revenue data for their decision making process.

People mentioned that various food standards and the fact that the business model is export oriented, influences the company most. Although the European Union tends to have more common standards, the market regulations within the beverage and tobacco industry are still nationally governed and the interviewees' stated this as dominant means. In addition, interviewees' stated new or altered means are communicated through various committees within the company. However, interviewees' affirmed the desire to formalize and automate communication at company A.

On specifically asking how the management of the organization could be improved we obtained various stories: people expressed that it seems to be difficult to find the right contact person; executive committees' team player attitude is improvable; there seems to be an overload of production data, whereas meaningful management data is missing. In addition to those prevalent difficulties, we asked about changes within the business-IT infrastructure of company A and found out that interviewees' experienced that newly adopted software could hardly be adapted afterwards. This seemed to be a great concern within company A and was adjusted through small modifications of the applications and staff training. Furthermore, we found it interesting that interviewees' stated language barriers as a problem during work within the multi-lingual environment of Luxembourg. Additional issues are continuous updates of European Union directives, which seem to challenge the beverage and tobacco industry; and some legacy that provides a double flow of information for production and quality. However, interviewees' felt not restricted in their work freedom through means, and understand standards as providing opportunities as well as challenges.

4.2 Company B

Company B, in contrast to company A, is a complex network of entities within the beverage and tobacco industry. Interviewees claim, that activities of the single entities are very independent and smaller projects likely suffer from a lack of appropriate data exchange within the organizations network. In addition to the independence or embeddedness in a network of organizational entities and the cultural variations, the researchers found additional contrasts that reflect the prevalent differences between company A and B. Research participants at company B stated that average attributes regarding cost control and market driven attitude.

Asking the interviewees' how to improve the management of company B they mentioned to be worried about not being asked during various decision processes when new means and IT related affairs were implemented. Especially the people from lower hierarchy levels and those who not worked for the core entity mentioned that they were informed only at the end for doing the actual implementation. This is at odds with the statement of the CEO, who said the main improvement should be their supply chain project. This is similar to the interviewee's experiences during the introduction of new means, which were necessary because of mergers and the growing internationalization. They reported multiple difficulties when company B acquired another organization or new IT tools were integrated. In order to overcome those difficulties company B followed a hybrid approach, which involved the training of their employees and the tailoring of means as well as the advice of external consultants. Various regular meetings within the different entities should further support the communication and utilization of news and means. In addition, whereas the CEO negated to use additional instruments, other interviewees' stated to use in their day-to-day business additional means and tools that by-pass proposed instruments. Those interviewees' even stated that those by-pass instruments are too important to eliminate the tools.

5 Case Study Analysis

This section highlights what happens in practice in the field EE through analysis of two case studies within the beverage and tobacco industry. For this reason, we created analytical tables (Table 1 and Table 2) to get a clear view of the companies' organizational and cultural contexts, transition approaches, practiced processes and identified challenges.

5.1 Differences between Company A and B

This compendium of what happens in practice in the field of engineering an enterprise shows the various features of two different companies within the beverage and tobacco industry in Luxembourg. Although both companies are engaged in the same industry sector, they are dissimilar in a number of issues (Table 1).

Organizational context: Their organizational context is contrasting, since company A operates as one independent entity whereas company B is rather a network of entities. This is an example how organizations may organize differently, so that they may need to follow different fundamental processes and approaches for EE.

People / cultural context: Company A follows a top-down strategy and this is contrary to company B, which adheres a bottom-up strategy. Those findings are interesting, since many classical EA frameworks involve a balanced, holistic and integrated view of the business and IT.

Transition approaches: Likewise, the companies' transition approaches varied, because company B also sought external consultancy compared to company A. However, both quested training of employees and tailoring of means. Based on the collected data during interviews we interpret the different transition approaches by means of the varying organizational and cultural contexts.

Practiced Processes: According to the answers of interviewees in company B they used also additional by-passing of proposed means. This information about what interviewees' do in practice is interesting, since the beverage and tobacco industry involves great requirement of regulatory compliance with various standards (e.g. national and international beverage and tobacco laws). So, it is rather surprising that they admit to by-pass some of their "standard-procedures".

Table 1. Analytical table: differences between company A and B

	Company A	Company B
Organizational context	• independent • export oriented • relative stable business	• network of entities with support function of the main production • multiple changes through acquisitions and internal developments
People / cultural context	• top-down strategy • high cost control intensity • intensive usage of revenue data for their decision making process	• bottom-up strategy (e.g. team decisions) • average use of financial data
Transition approaches	• adopted software could hardly be adapted • adjustments through training • small adjustments of the application	• training of employees • tailoring of means • seeking advice from external consultants
Practiced processes	• organizational means	• organizational means • additional by-passing of proposed means

5.2 Similarities between Company A and B

Despite those dissimilarities, the analytical table showed similar challenges, based on the answers that where given by interviewees' from both companies. Those common challenges involve two issues: too weak involvement of lower hierarchies during the decision-making processes and language barriers (Table 2).

We found it thought provoking, that interviewees' from both companies mentioned a too weak involvement of people from lower hierarchies, because those people stated that one organization follows a top-down strategy and the other one applies a bottom-up approach. Although the two organizations have a different organizational context, interviewees' still perceive the too weak involvement of lower hierarchies as a challenge to improve on.

In addition, we found it interesting that the interviewees' from both companies stated that the variety of languages is a challenge in practice within business and their related enterprise engineering. Besides Luxembourgish, French and German, English is another important business language. Nevertheless, information and communication technologies are usually described in one language and the users do not necessarily comprehend this language. Likewise it is unavoidable to meet colleagues and / or external contacts that do not speak your language.

Table 2. Analytical table: similarities between company A and B

	Company A	Company B
Identified challenges	• executive committee is lacking team spirit • production data overload • some meaningful data is missing • language barriers	• improvement project on their supply chain • lower hierarchies are hardly consulted during the decision making process • language barriers

The next section discusses the driving motifs for EE practitioners, who do not apply classical EA frameworks. In addition, we draw on work from Giddens' [11] to enrich the discussion and implications.

6 Discussion

The literature study of this research provided two streams to gain insight in engineering an enterprise without a classical EA framework in practice. The first literature stream involves the drivers for practicing EE, which includes motifs that drive the establishment and improvement of EA (e.g. [4,9]). This is useful to identify the motifs of practitioners (Table 3) and the two case studies of this research provide additional insight.

6.1 Driving Motifs for EE Practitioners, Who Do Not Apply Classical EA Frameworks

Standardization is in the literature (e.g. [18,15]) discussed as an important factor why organizations apply EA approaches. We need to differentiate between internal and external standardization (compliance) motifs. External compliance regulations are very important motifs in the realm of practitioners, because they are well recognized by interviewees' as dominant means that influence their business and EE. In addition, the researchers know that many (external) compliance regulations are holistic approaches, so that they may influence many internal standards as well. However, this research cannot confirm that internal standardization measures are an important factor, because the data analysis has not highlighted this.

Table 3. Motifs of practitioners

Strand	Literature	Company A	Company B
Internal and external standardization	[18,15,5,6]	external compliance regulations are dominant means	
Financial aspects	[16,17,15,14]	• high cost control intensity • intensive usage of revenue	average use of financial data
Organizational culture	[14,15]	top-down strategy	• bottom-up strategy • social focus, team orientation, flat hierarchy

Another main object in the literature involves financial aspects (e.g. [16,17,15]) and for company A is this apparently also an important issue. Interviewees' of company A stated high cost control intensity and intensive usage of business figures for their decision making process that are part of their cultural context. However, interviewees' of company B claimed only average use of financial data.

That interviewees' draw less attention to this aspect may be also reasoned in the company's organizational culture, which is another important motif of engineering enterprises [14,15]. The analysis highlights two different approaches of management and leadership, such as top-down vs. bottom-up strategy with company A and B. The applied bottom-up strategy is supplemented by companies B's strong social focus, team orientation and flat hierarchy.

Although agility is acknowledged as another reason for applying EA approaches (e.g. [1,12]), the beverage and tobacco industry is a relative stable business sector, compared to other environments that necessitates speed and flexibility. Similar reasons are relevant concerning risk management in EA [19-21]. Therefore, the analysis derived no further insight of these potential influence factors of business and EE.

6.2 Comparison of Engineering Enterprises with and without a Classical EA Framework

The second literature stream about a brief overview of the classical EA framework literature (e.g. [10,7]) helped to gather insight about the differences what *is done* and what practitioners *could do*, if they would apply e.g. TOGAF (Table 4).

The discussion about the motifs of practitioners found three main strands: standardization, financial aspects, and organizational culture. Those motifs are covered by TOGAF in a sophisticated way. Altogether, TOGAF presents an in-depth method, which should practitioners help to apply EA successfully. In comparison with what practitioners in the analyzed case studies do, it is apparent that practitioners follow a far less structured method, compared to the TOGAF approach.

The main motif of practitioners for engineering their enterprise is compliance regulations that influence their business and EE. The core of TOGAF's ADM [7] is requirement management, so that it is clear that business requirements like external compliance regulations are eminent important. Financial aspects are another main motif of practitioners, who engineer their enterprise. The TOGAF approach involves for example control criteria, and internal and external requirements of all architecture governance-related information. Finally, the organizational culture is another main motif that drives engineering of an enterprise. TOGAF includes best practices for architecture procedures, organizational structures and responsibilities, and integration thereof procedurally and culturally.

Therefore, TOGAF [7] provides multiple instruments to communicate and steer an enterprise (e.g.: future direction, coordinating and steering, help to transform the enterprise) with a certain holistic view on an enterprise. Apparently, the case study analysis could not provide any information regarding the application of TOGAF (or other EA frameworks), by the investigated companies. However, the analyzed case studies provided insight about the differences what is done and what practitioners could do, if they would apply e.g. TOGAF.

Table 4. Comparison of what is important in EE by practicing it without a classical EA framework and what TOGAF is suggesting

	Engineering an enterprise without a classical EA framework in practice.		**What practitioners could do, by applying TOGAF.**
	Company A	Company B	TOGAF [7]
Standard-ization	External compliance regulations are dominant means		Core of TOGAF's ADM is requirement management
Financial aspects	• High cost control intensity • intensive usage of revenue	Average use of financial data	Control criteria, and internal and external requirements of all architecture and governance-related information
Organiza-tional culture	Top-down strategy	• Bottom-up strategy • social focus, team orientation, flat hierarchy	Best practices for architecture procedures, organizational structures and responsibilities, integration thereof procedurally and culturally,

The comparison of what is important in EE by practicing it without a classical EA framework and what TOGAF is suggesting is insightful, but its similarity is not necessarily a surprise. This is reasoned in the long lasting EA framework development of TOGAF by academics and practitioners. However, it is interesting, because practitioners that do not apply a classical EA framework do not necessarily something completely different in their day-to-day activities. Rather they apply actions that are meaningful enough to cope with their issues concerning standardizations, financial aspects, and organizational culture.

7 Implications

The previous section compared the sophisticated descriptions of TOGAF [7] and what practitioners do in relation to the identified main motifs from the case study analysis. Based in these findings, a number of practical implications become apparent, which should help practitioners to perform better.

7.1 Lesson for EE Practitioners: Break from Routine and Training in EA Frameworks

First of all, training upon EA related issues should provoke a more structured EE approach by the practitioners we interviewed. Currently, their business and EE approach is rather confined when responding to processes and challenges. There is certainly a lack of thinking more holistic by practitioners, which would allow them to approach transitions proactive. Obviously, practitioners remained to a great extent within their routines, which provided a safe environment to them. However, the collected data of company B indicate that multiple changes occur also within a relative stable business sector. Consequently, practitioners need a break from routine to improve upon their capability in engineering enterprises and training in EA frameworks would provide some help in doing so. However, participating in this research, which identified practitioners' motifs that drive their enterprise engineering activities, can be the trigger of change. As Giddens [11] states, motivation of action refers more to the potential for actions and motives appear most often only in special situations where, for example, routines are breached (such as the activities during this research with the participating companies). Then, Giddens [11] claims, change occurs and the previously safe environment is scrutinized.

The various approaches of EA frameworks, which involve various methods and techniques of steering an enterprise, may be contradictory to the findings of what the practitioners in the two case studies do. However, practitioners' success shows more or less an inherently intrinsic approach, which serves them enough to cope with business challenges (e.g. company B, fluctuation through mergers). Obviously, the sufficient tacit understanding of fundamental processes and approaches of their organization helps them to engineer their enterprise to some extend. This is not necessarily structured, but in practice their reflexive actions upon enterprise engineering are adequate enough. According to Giddens [11], reflexive monitoring is dependent on the competence of social agents, in terms of their capacity to rationalize ongoing social life and we imply that does include enterprise engineering. This supports our practical implications to call for training upon EE related issues. So, we imply that reflexive actions may substitute EA frameworks to some extent. The findings of this research suggest that organizations may prosper also with a rather simple and confined approach when responding to challenges.

7.2 Lesson for EE Theory: Rigidity in EA Frameworks

Furthermore, the differences of what is important in EE by practicing it without a classical EA framework and what TOGAF is suggesting, showed some overlap (cf. section 6). This is not necessarily a surprise, because the insight of TOGAF is rather the product of long lasting EA framework development since the mid-1990s [7]. However, it is apparent – and TOGAF is only one example of many EA frameworks – that specified EA frameworks seem to be too rigid and complex, to be applied by organizations, such as company A and B of this research. It seems that this rigidness and complexity of contemporary EA frameworks shows that those frameworks are not designed appropriate enough to allow manageable tailoring. Uncomplicated tailoring would allow more organizations to benefit from sophisticated enterprise architecting. Therefore, we imply that current EA frameworks are too rigid and complex that they could be easily applied for novice enterprise architects.

8 Concluding Remarks

This study is a contribution to the discussion of practical issues in engineering enterprises. The research settings provided an interesting context in an industry sector with high compliance regulations. Hence, its originality is the rich description of the practical issues in engineering enterprises without a classical enterprise framework. We found contrasts in the organizational and cultural contexts, transition approaches and practiced processes (cf. section 5). In addition, we found also similar challenges despite the dissimilarities of the investigated companies. The driving motifs for practitioners that engineer their enterprise and do not apply a classical enterprise architecture framework were explored. We discovered three main motifs of EE practitioners: standardization, financial aspects, and organizational culture (cf. Table 3). In addition, we compared of what is important in EE by practicing it without a classical EA framework and what TOGAF is suggesting. Hence, the findings of this research yield practical and theoretical implications for further research (section 7). We suggest that practitioners may break from routines and get training about EA frameworks. We imply that contemporary EA frameworks are too rigid to be of much help for organizations like in this research setting.

Although this thorough investigation seeks to give a comprehensive answer to the research questions, there is space for future research. The paper concentrates on only one EA framework (TOGAF), which is a fraction of the available EA literature and future research could involve other EA frameworks. Whereas two case studies provided insight into the driving motifs for practitioners to engineer their enterprise, more case studies are necessitated to get a better overview of what is happening in this field.

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Realization of Enterprise Architecture (EA) Benefits

A Meta Study on Control and Controllability

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Abstract. Realization of Enterprise Architecture (EA) benefits is a topic not well researched, despite the fact that EA has been in focus among both practitioners and researchers for many years. Based on a literature review and nine semi-structured interviews, this research investigates control and controllability in terms of measurability and traceability. The findings reveal that there are evident challenges in reality and the reason for such reality varies from one situation to another. The interviews suggest that hard ways/approaches, in terms of concrete technical ROI-related metrics, to measure and trace realization of EA benefits convincingly, quantitatively and effectively is still absent. It could be concluded that control and controllability concern not only technical issues, but also socio-political-cultural issues. This research contributes by revealing the many challenges in control of realization of EA benefits and by analyzing the 'what and why' of the reality.

Keywords: Enterprise Architecture, Enterprise Architecture Benefits, Control, Controllability, Measurability, Traceability, Enterprise Transformation.

1 Introduction

Enterprise Architecture (EA) has been emerging since late 1980s and early 1990s. With an increasing number of professionals noticing the importance and significance of EA in improving business performance and IT investment, and to facilitate enterprise transformation, more and more researchers and practitioners have joined the "EA community". There is a variety of definitions for the term EA. EA as a description of (an) enterprise not only provides stakeholders in organizations a holistic understanding of the enterprise, but also as an instrument enabling an organization to move towards a status within aligned, balanced integration within business, IT as well as that between business and IT.

In this paper, *EA benefits* represent the benefits induced by EA implementation in organizations. Since EA as a term was coined, the value and benefits has been discussed. Initially, EA was considered as a means to achieve benefits in the IT field,

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such as improved interoperability [1], reduced duplicated components and interfaces and reduced information silos [2]. Gradually and later, some practitioners stated that, EA is important and helpful because it could also facilitate in achieving business benefits such as integrated and holistic understanding of (an) enterprise [3], better institutionalization [4], better business-IT alignment [5, 6], improved business structures [7], better decision making [8], and increased business performance [3, 9].

In general, EA is somewhat costly. In order to manage, control and decrease the cost and risk; we need to know more about controllability in relation to realization of EA benefits. "*Projects are crucial means by which enterprise-level benefits can be achieved, […] organizations should therefore try and increase the EA-related benefits obtained by projects*" [10]. So in EA implementation, because of uncertainties [11], "*the organization tracks and measures EA benefits or return on investment, and adjustments are continuously made to both the architecture management process and the enterprise architecture products*" [12, p9].

In relation to realization of EA benefits, control (and controllability) is not well addressed. The purpose of this paper is not to scrutinize claimed EA benefits. Instead, we will question *how well realization of EA benefits is controlled*, *the extent to which suggested EA benefits could be controlled in EA practice* and *the possibility for realization of EA benefits to be well controlled?* The controllability reflects the extent to which the realization of EA benefits could be controlled. The research concerns the reality, especially the professionals' considerations. We will address controllability through two dimensions (abilities), measurability and traceability, since in practice, these two abilities together could more or less determine the controllability and these two abilities are relatively doable.

Measurability refers to the extent to which EA benefits realized in an EA implementation could be measured. Traceability refers to the extent to which EA benefits realized in an EA implementation could be traced. Measurability determines the extent to which the outcome in an EA implementation could be measured, calculated and distilled qualitatively and quantitatively. Traceability determines the extent to which the corresponding outcome could be linked, connected and related to EA as an exclusive factor. These two dimensions are tightly connected to each other, and generally, we will discuss the two dimensions simultaneously. We do discuss measure (and measurability) and trace (and traceability) separately at a few places in the text.

In relation to the realization of EA benefits, this research aims to improve the understanding towards the realizability of EA benefits based on experienced professionals' knowledge. In this paper, we develop a shared conception about controllability and thereby a better operationalization regarding realization of EA benefits. Further, we also explain why there would be such a low or high controllability.

This paper is structured as follows. Next section briefly presents the research approach. Then, we present a literature review focusing on control (and controllability) in realization of EA benefits. The following section presents the main findings. Finally, in Section 5, comments on the contribution, limitation and future work are presented.

2 Research Approach

The research approach consists of two parts: an extensive literature review and an empirical study among EA professionals.

A Literature Review, on the realization of EA benefits are charted with a concentration on the perspectives, approaches and models to analyze, measure, and evaluate EA benefits. First, a combinative search based on Google Scholar with keywords "enterprise architecture benefits" and "EA benefits" provided us with 142 results. Second, we excluded some irrelevant ones and duplicates, and 62 results were left. However, it is *out of the scope of this paper to make any complete and exhaustive list of EA benefits*. Detailed information from the literature review will be presented in Section 3.

An Empirical Study, including nine semi-structured interviews on control and controllability of realization of EA benefits were conducted in September and October 2012. The qualitative empirical data was collected from nine EA professionals in Chinese companies. The major part of interviewees has been engaged in business departments, or IT departments, or both for more than 10 years (7 out of 9 interviewees), and some of them more than 15 years (6 out of 9 interviewees), and even more than 20 years (2 out of 9 interviewees). They have all witnessed the increasingly widely deployment of IT systems in business and the emerging comprehension, adoption and implementation of EA as a well-accepted discipline in industry (i.e., EA were accepted by both business and IT professionals to solve their enterprise-wide problems). They were deeply aware of problems related to the misalignments between business and IT in organizations, and essentially, they were depressed by the existing misalignment in their organizations. The interviews were done through Skype and recorded. Each interview took about one hour. The main questions asked are shown in Fig. 1. From the answers, some narrative, inductive findings based on the analysis of the data will be presented in Section 4.

Q1-1: Is it possible and practical to measure the potential EA benefits? If so, how to measure them? If no, why?
Q1-2: Is it possible and practical to connect the realization of business outcome to EA initiatives? If so, how to trace them? If no, why?
Q1-3: If you were in charge of EA initiatives, how would you measure and trace the benefits and the value added by EA initiatives?

Fig. 1. Questions applied in the interviews

3 Analyzing Control and Controllability of Realization of EA Benefits in literature

This review emphasizes how EA benefits are presented, how realization of EA benefits is presented and how control and controllability are discussed in the literature.

Most publications found in the search are theory-intensive. For instance, in order to explain how EA could add value to organizations, based on a systematic literature review and **theoretical** analysis, Tamm [13] generalized about benefit enablers and inductively summarized the findings in four points: organizational alignment, information availability, resource portfolio optimization, resource complementarity. Also, some research are conducted in order to collect **empirical** evidence of relations between EA techniques used and EA benefits such as Salmans and Kappelman [14] and van Steenburgen et al. [15]. Based on 21 interviews and a case study, van der Raadt [16] explored the relation between EA effectiveness and stakeholder satisfaction and explained why there is a gap between organizational benefits and individual understanding in EA practice. Based on a survey with approximate 68 valid respondents, Lagerstrom et al. [17] tested the relations between enterprise architecture management and organizations' success with information technology. Based on an online survey (including 293 respondents), Foorthuis et al.[18] tried to connect EA benefits with the corresponding technique in order to achieve and realize EA benefits.

When analyzing the literature it is found that EA benefits are often claimed differently, from different perspectives, by researchers and professionals according to their own experiences and understandings. From this there are many **perspectives** claiming EA benefits. For instance, Buchanan [19] proposed to analyze EA benefits from *Financial* and *Business effectiveness*. Considering the same, Buchanan et al. [20] presented that EA benefits could be researched from *financial* perspective, *customer* perspective, *internal* perspective, and *learning and growth* perspective. In [21] a framework was introduced to understand the organizational impact of EA: based on three categories of benefits (i.e. *Data management*, *application development* and *IT infrastructure*), via the business process benefits, EA could shape the organizational impact such as *productivity*, *agility*, etc. Contrarily, Rico [22] developed a framework for measuring EA from the aspects of Return on Investment (ROI). In order to reflect the multitude of benefits, Niemi [23] categorized EA benefits into four types: *Indirect, Strategic, Hard*, and *Intangible*. As a brief conclusion, the report presented by Boucharas *et al.* [3] could be regarded as a summary of the many aspects of EA benefits. Similarly, in [18], the benefits are categorized into two main types, i.e. the benefits for *organization as a whole* and these for the organization from the *individual projects* point of view.

It is also found that there exist many **models** applied to study EA benefits. Niemi and Pekkola [24] used the *DeLone and McLean IS success model* to measure and analyze EA benefits. Further, Lange et al. [25] customized and developed a new model called EA benefit realization model. Cane [26] applied the Technology-to-Performance Chain model which was proposed in [27]. Regarding the fact that both EA itself and EA benefits are multi-dimensional, some socio-technical mixed quantitative and qualitative **approaches** are also used to study EA benefits, for example, balanced scorecard approach (with the four perspectives, i.e. *Service, Processes, Assets and Financial*) to measure and trace the value of EA [28].

Regarding the aims or goals of EA to be adopted, as stated by [29], [30] and [14], EA are often used to enable integration, to do IT planning [31], to facilitate business process improvement and reengineering, to provide a blueprint of an organization's business, data, applications and technology, to make descriptions and prescriptions, to align business objectives with IT initiatives, and to use EA as a tool for decision making. Also, some other considerations such as to enable integration, agility and change [32], transparency, complexity management, innovation and regulatory compliance [33] are also prevalent. The real value of EA is conveyed and reflected through the utilization of EA deliveries, such as descriptions about the As-Is architecture, prescriptions about the To-Be architecture, and the roadmaps for transition plan.

Clearly, it is argued in [34, 35] that maturity matters in the realization of EA benefits. The relation between EA maturity and the realization of EA benefits through the distinctive success factors in the various stages of EA maturity is illustrated. In [36], the value of EA is addressed with comparisons of ROI (of EA initiatives in different organizations) and some principles (to facilitate a successful EA initiative). One problem is that all the ROI data used in that report are actually estimated data rather than real statistics data, and ROI is actually just one of the many aspects of EA benefits. In [15] it is stated that EA techniques have a moderate effect on realization of EA benefits. Assessment and measurement of EA projects are often subjective, "*objective compliance testing cannot be taken for granted*" [37]. Grigoriu [38] developed a relatively comprehensive mapping table of EA benefits and the corresponding financial indicators. In [33], it is pointed out that in practice EA benefits are normally not assessed due to the points such as their (i.e. organization) current low maturity stage, missing metrics, no data at hand, too complex and unique decision making situations, too long term consequences, and being too academic. In order to close the gap between the perceived importance of EA and the current practice of the assessment of EA benefits, three different areas of EA assessment are also given, i.e. EA processes, EA scenarios, and EA success.

Rodrigues and Amaral [39] summarized that the considered view/views, in relation to identification of stakeholders, would affect the value assessment and measurement. Additionally, they stated that there still were needs to assess EA benefits and value since some difficulties and challenging problems still exist, i.e., (1) the lack of a clear definition of what is meant by value; (2) the different stakeholders' value views; (3) the lack of a clear understanding of what is important for value assessment and how value can be measured; (4) the need to quickly demonstrate the value of EA. Aiming at delivering an effective EA practice, three shared characteristics (i.e. greater senior management involvement, architecture built into project methodology, and greater architecture maturity) and five key management mechanisms (including enterprise architecture guiding principles, business cases for architecture investments, IT steering committee, one page graphic descriptions, technology research and adoption process are identifies) are important. Correlatively, to enable a success of EA, some potential success factors for EA as a whole governance process are formulated in [40].

From the literature review, it could be stated that control and controllability is currently a central topic in both theoretical and practical research. Various researchers contribute to the community by improving the understanding towards three research questions, including what the various potential EA benefits are, how EA benefits could be realized, and how realization of EA benefits could be perceived, measured and controlled, as shown in Fig. 2.

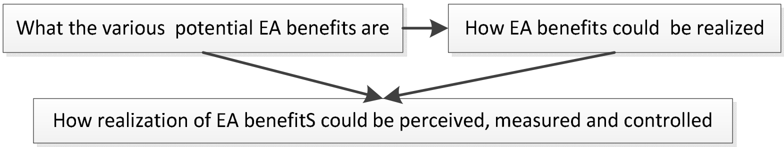

Fig. 2. Research related to EA benefits in literature

4 Findings from the Empirical Data about Control and Controllability

In this section findings from the interviews will be presented in the following way: first statements about "state-of-the-art" are presented and discussed, followed by some "thoughts about control of realization of EA benefits" and then ending with a discussion around 'what and why' about control and controllability regarding realization of EA benefits. Empirical findings are summarized in Fig. 3. The arrows (from Section 4.1 to Section 4.2 and Section 4.3; from Section 4.2 to Section 4.3) denote the sequence of findings and the process of reasoning in the analysis. The findings are numbered in order to link the figure with the detailed explanations in the following sections. It is noteworthy that in Section 4.3, we link the available literature with empirical findings, which means that the findings of Section 4.3 are based on both empirical data and literature.

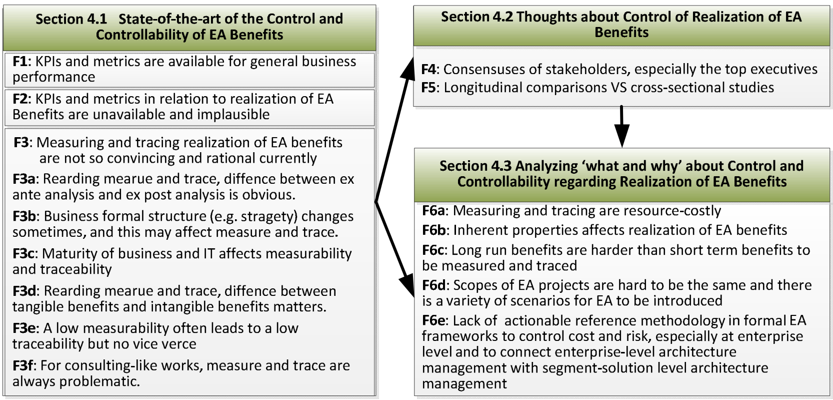

Fig. 3. The findings construction

4.1 State-of-the-Art of Control and Controllability of EA Benefits

All the interviewees stated that in organizations there would normally be metrics and economic statistics about investments and business outcomes, and data on ROI (*F1* in Fig. 3). There would be mechanics to control risk. Sometimes the risk control is very strict. Usually, the metrics and indicator systems appear to be hierarchical. A Sales

Manager described this as follows: "There are metrics in enterprises for them to calculate the business outcome. And the CEOs emphasize money-related statistics very much." [Interviewee3, Sales Manager].

However, metrics and KPIs are problematic for EA practice (*F2* in Fig. 3). There seems to be a lack of shared metrics and corresponding KPIs for common use in EA implementation. Metrics with hard indicators like financial oriented measurements seem to be impractical. Metrics with soft indicators seem to be more feasible. The Deputy Director of the information centre stated: "*Measure, trace and possible improvement of the realization of EA benefits seem to be not so easy and doable. That is why efficiency and effectiveness are not so easy to be measured, traced and why we professionals are still confused and always involved in the debates of KPIs for IT*". He continues to give the following EA example: "*One example is the impact of EA on Human Resource. Based on shared knowledge about the organization and communication, Human Resource may be improved, however, such improvement is neither measurable nor traceable*" [Interviewee5, Deputy Director of information centre].

In relation to measuring and tracing realization of EA benefits, there is a minor difference between *ex ante* analysis and *ex post* analysis (*F3a* in Fig. 3). In *ex ante* analysis, financial benefits are not so persuasive and might lead to a misconception with too many expectations. *Ex ante* analysis is to provide a description and statement on the desirability of EA benefits. In contrast, financial benefits seem to be more useful and accessible to confirm EA benefits and to convince, persuade the top executives in *ex post* analysis. Measuring and tracing could be related to the architecture principle of business-driven methodology, business formal structures, such as strategy and vision, etc. and this might influence measurement of EA benefits (*F3b* in Fig. 3). As stated by a consultant, "*With the change of strategy, the measuring system of business performance will also change*" [Interviewee1, consultant]. For example, the strategy could change from *monetary-related ROI improvement* to *market-share-rate improvement*. Such a change may inevitably lead to lots of change of desirability towards various EA benefits as well as the measurability, traceability.

It is also found that measurability and in particular, traceability of EA benefits depends, to some extent, on the maturity of business and IT (*F3c* in Fig. 3). EA is thought to be able to help improve the maturity of business and IT. In contrast, the maturity of business and IT more or less determines the extent to which realization of EA benefits could be measurable and traceable. Capability maturity models are often used as a qualitative way to measure and trace realization of EA benefits. In addition, the interviewees agreed that to some extent, EA helps to make it easier to evaluate and measure the business outcome. The reason could be that better standardization at a higher maturity level makes the process, performance, and services more measurable, quantifiable and traceable.

All the interviewees argued that it is very hard to relate real tangible benefits to changes of business outcome (*F3d* in Fig. 3). Still worse, besides tangible benefits, intangible benefits are even harder to be convincing. It is very hard to define, find, and shape dependences between benefits and outcomes. It was confirmed that tangible benefits (e.g. better business performance) are relatively more measurable than intangible benefits (e.g. better understanding of an enterprise). Similarly, at solution level, tangible benefits are relatively more traceable than intangible benefits. For instance, the cost reduction in investment and planning in EA projects is very visible and easy to be detected. However, at enterprise level, intangible benefits are actually more traceable than tangible benefits. For instance, the employees and the top executives may agree that EA could considerably improve their understanding of enterprise business and IT, but they could hardly agree that EA as a tool could necessarily help them improve their business performance.

In general, long-term oriented benefits (e.g. better decision making) are less traceable than short-term oriented benefits (e.g. business-IT alignment). For EA to be an interdisciplinary socio-technical methodology, it is somewhat difficult and to a certain extent impossible, impractical to connect the outcome change of business performance (in terms of accounting and statistics) with EA initiatives directly, explicitly, convincingly and sometime intuitively. It was stated by the Deputy Director (Interviewee5) that the impact of EA on business and IT in organizations could be divided into two parts, i.e. *direct impacts* and *indirect impacts*. Just addressed as in most literature, EA benefits are claimed as potential, hard to be justified clearly in reality. The following statements describe this situation: *"It is very difficult and practically impractical for* supervisors *to do supervision management in EA initiatives."* [Interviewee6, IS supervisor]. "*The traceability of the change of cost and ROI, etc. is sometimes too weak in the sense of justification. It is not so convincing. Therefore, in most cases, enterprises emphasize heavily best practices*" [Interviewee4, strategist and planning scientist]. *"(Cost) accounting is certainly very common in projects, practice and even science research. [...] However, EA frameworks like TOGAF do not concern any strict accounting or auditing affairs. The realization of EA benefits could be experienced but could not be audited. KPIs are difficult because some other factors (for example the global economy status, the local implementation of some specific enterprise systems, etc.) are very difficult to be excluded in the final and overall business outcome*" [Interviewee4, strategist and planning scientist].

In addition, it is found that, a low measurability of EA benefits often leads to a low traceability (*F3e* in Fig. 3). However, a high measurability of EA benefits does not necessarily imply a high traceability. Neither does a high (or low) traceability of EA benefits necessarily mean a high (or low) measurability of EA benefits.

Another interesting finding is that realization of EA benefits is similar to consulting-like works regarding the process to measure and trace the benefits (*F3f* in Fig. 3). "*It is similar for all consulting-like works. It is very hard to relate the work with digital money improved or cost reduced*". [Interviewee5, Deputy Director of information centre]. The Senior IT Manager (Interviewee8) stated that to measure and trace realization of benefits when introducing IT systems is a hard task. This is exemplified by the Deputy Director in the following way: "Implementation of an ERP system does not necessarily produce a better Inventory Turnover Rate, similarly, EA initiatives do not necessarily make a better business performance" [Interviewee5, deputy director of information centre].

From the interviews, it was found that it would take time for a complex organization to decide whether or not to introduce EA practice to guide the enterprise governance. On example was provided by the CIO, who said, "*I was always worried about* *the potential risk of EA. Actually the impacts of EA on organization will be determined by how EA is grounded, but in my opinion, the statistics result wouldn't be direct*" [Interviewee7, CIO].

4.2 Thoughts About Control of Realization of EA Benefits in Practice

The input of IT could be measured and traced directly; nevertheless, the ultimate output of IT needs to be measured and traced indirectly through business output change. Similarly, the measurement and tracing of realization of EA benefits could be conducted via the measurement and tracing of business performance, implicitly, indirectly and qualitatively. However, clearly, as stated by the Consultant, "*most often, EA will improve the overall productivity through a sacrifice of local productivity*" [Interviewee8, consultant]. This is also supported by the Deputy Director, claiming: *"It is more feasible from a qualitative perspective to make CEOs, CIOs etc., through projects, to know what they do not before and to behavior better than before (e.g. better decisions), and ultimately make them realize the value of EA initiatives*" [Interviewee5, deputy director of information centre]. From this to measure and trace the realization of EA benefits, there is a need for qualitative and soft indicators, as described by the Consultant: "*qualitative and soft indicators will be more feasible. […]If EA is introduced and grounded well, the enterprise business will become better, but you could never say that 'if without EA, the enterprise business will die' or 'if without EA, the enterprise business is destined to be a failure'"* [Interviewee9, consultant].

It is suggested by interviews that soft qualitative indicators are more applicable than hard quantitative ones. Instead of direct measuring and tracing, aggregation of mixed qualitative and quantitative indicators to measure and trace benefits indirectly may be more suitable in reality. In fact there is a consensuses among EA stakeholders that supports from top managers and their active involvements are the two most important success factors in realizing EA benefits (with a low level of traceability).

EA initiatives are expensive and costly; and it is costly to spell out the outcome (benefits) of EA projects (programs). It would be even more costly to trace the realization of EA benefits. This is supported by one Consultant who said, *"EA is costly, and calculating the outcome of EA is also costly. They can feel and approximate change in the sense of cost and revenue"* [Interviewee1, consultant]. It is very hard for EA consultants to make the financial outcome of EA explicit and convincing; also, it is difficult to persuade CEOs to make decisions. Instead, best practice, i.e. benchmarking, turns out to be their choice.

In order to promote the consensuses, it was said that two alternatives might be useful. (1) *Longitudinal comparisons* (*F4* in Fig. 3), i.e. the comparisons in the same organization (between scenario within EA implemented and that without EA implemented). (2) *Cross-sectional studies* (*F5* in Fig. 3), i.e. the comparisons in different organizations (between the object company and another similar company). The first one is often used to illustrate the gap between AS-IS architecture and TO-BE architecture, and together with the roadmaps for transitions. The second comparison is often called methodology of best practice or benchmarking. Usually, the two comparisons are used together in order to formulate a combinative solution.

4.3 Analyzing 'What and Why' about Control and Controllability Regarding Realization of EA Benefits

Exactly as an old saying goes, "*truth is not always palatable*". Very early, Zachman [41] stated that "*you could not cost justify enterprise architecture, […] architecture is an Information Age idea. 'Cost-justification was an Industrial Age* idea". But, as suggested by the Consultant (interview 9), the ROI of EA is actually project-quantitatively measurable; this could then be compared with statements in [10] and [37], EA is actually project-compliance assessable; in EA implementation, though there is no taken-for-granted benefit, nevertheless, there exist controls in three different levels (i.e. enterprise, collective, and individual) to better realize EA benefits. Certainly, for EA success, "*having sound EA frameworks and programs are necessary but insufficient conditions*" [42], and even effective coordination and governance of the EA practice is also insufficient.

The reasons for the controllability of the realization of EA benefits could be studied from various perspectives. Firstly controllability of the realization of EA benefits would be resource costly (*F6a* in Fig. 3). It takes time and money to manage, measure, and trace realization of EA benefits. Secondly, we should understand the inherent properties of EA benefits (*F6b* in Fig. 3). Not all EA benefits could be reflected through quantifiable metrics. It is easier and more feasible for enterprises to get and collect qualitative data about realization of EA benefits. Some benefits can be managed and felt only through qualitative analysis. In addition, quantitative data sometimes are also hard to be connected to EA benefits directly, and explicitly. Thirdly, EA sometimes concerns long-time benefits (*F6c* in Fig. 3), which means that some benefits could only be realized in the long run and even sometimes implicitly. In the long run, many uncertain factors might affect business outcome and further the final result of measuring and tracing of the realization of EA benefits.

Additionally, in view of EA applications in reality, just as addressed in Bucher et al. [43], the scenarios in which to introduce and implement EA vary considerably. In different scenarios, the emphasis of the realization of EA benefits should vary, too. Worse, in EA implementation, there is a lack of clearness in the definition of EA scope while discussing the realization of EA benefits (*F6c* in Fig. 3). "*It is very difficult to strictly define a limited boundary and scope, and stick to it in the consulting-like projects*" [Interviewee5, deputy director of information centre]. In such a consideration, for example, *improved (better) understanding of an enterprise* relies mainly on EA modeling and communications between stakeholders, in contrast, improved business and IT structure and capabilities reply more on the actions taken after enterprise-wide decisions involved in EA governance. It is questionable for the actions taken after enterprise-wide decisions to be included in EA implementation. The extent to which these actions could be included in EA implementation is discussable and negotiable.

Last but not least, as addressed in a previous quote, the *lack of reference model or* mechanics in EA frameworks to control the realization of EA benefits is also objective and evident (*F6d* in Fig. 3). We understand that the existence of 5 different kinds of misalignment of business and IT [44] is objective and promotes organizations to introduce EA in history. The incomprehension and lack of understanding how to apply EA are also objective, so EA frameworks and methodology are important. In the process of using EA methodology and frameworks, best practices are required in order for enterprises to use it as references. Overall, EA implementation is very hard, EA benefits are not necessary. *Until now, there is no usable reference model or method to help control the cost and risk. Either, there is no financial cost or risk mechanics in any formal EA frameworks.* Such a work heavily relies on project management. Unfortunately, in real projects, it is not doable. Moreover, inherently, the existing mainstream of EA frameworks (for instance, TOGAF, DODAF, etc.) is applicable in management at solution or segment level; however, there is no explicit method or means to do enterprise-level management. The lack of means to manage the enterprise-level EA affairs which is increasingly synonymous with the portfolio of projects, i.e. the gap between enterprise-wide management and project/program level portfolio management, may be one of the reasons why there would be a low controllability in realization of EA benefits.

5 Conclusions

Our aim was not to propose any new theory or metric to control realization of EA benefits. Our aim was to contribute to the EA field by revealing the many challenges in control of realization of EA benefits in reality and by analyzing the 'what and why' of the real practice. This research highlights the real practice and potential reasons for the real practice. With our findings, EA professionals could become more realistic in their EA initiatives.

The research presented in this paper explores control of realization of EA benefits using two dimensions, i.e. measure and trace. Potentially, controllability is weaker than either measurability or traceability. Definitely, traceability is tightly connected to measurability. For any kind of EA benefits to be traceable, the specific kind of EA benefits should first be measurable.

This research reveals that both intangible and tangible EA benefits are not easy to trace or measure. The practitioners tend to keep weak control in order to reduce the potential cost and risk in EA practice.

Reflectively, it could be concluded as: In technical terms, regarding control and controllability in realization of EA benefits, effective ways/approaches/model/metrics to control (in the sense of measure and trace) realization of EA benefits is currently absent. However, controllability is not only a technical issue but also a socio-political-cultural one. Control turn out to be actionable in socio-political-cultural ways (which are doomed to be soft). Technical support is necessary, but socio-political-cultural managerial issues are determinant.

In this sense, regarding the *separation* of *top executives* and *owners of enterprise business (process)*, especially in private complex enterprises, real (and continuous) commitment (as well as engagement) of top executives seems to be insufficient, but further the real (and continuous) commitment (as well as engagement) of the ***owners of the enterprise business (process)*** is needed.

The main strength of this research is that the main items, in terms of challenges and 'what and why', are tracked in the findings based upon analysis of empirical data gained from interviews with EA experienced respondents. Future work will incorporate systematic success factors that affect the realization of EA benefits and the achievement of EA success. In addition, based on our main findings, we plan to do a survey-based study on measurability and traceability in relation to realization of EA benefits.

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The Architects' Perspective on Enterprise Transformation: An Explorative Study

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Abstract. Enterprise architecture management (EAM) is considered to be a valuable means in order to support large-scale changes, called enterprise transformations (ET). In the study at hand we apply an explorative qualitative approach in order to investigate the potentials of EAM to support ETs by discussing the topic with highly knowledgeable informants that deal with EAM on a daily basis in nine different companies. The results reveal six propositions about the current and future state of EAM as an ET supporting discipline. The propositions reveal a distinction between IT and business focused EAM, means and activities taken by EAM to support ET, major pitfalls that need to be avoided as much as perceptions about the future of the discipline.

Keywords: enterprise transformation, enterprise architecture management, empirical study.

1 Introduction

Enterprise architecture (EA) is the definition and representation of a high-level view of an enterprise's (company, governmental body, etc.) business processes and IT systems, their interrelationships, and the extent to which these processes and systems are shared by different parts of this enterprise [1]. Enterprise architecture management (EAM) is a tool to establish an EA by describing the current state of the organizations' structure and developing a strategy, and thus a desired future state of the enterprise [2]. The transition between these two states is called enterprise transformation (ET) [3, 4]. ET is an "extensive, fundamental modification of the company, which is generally initiated by strategic decisions made by the management" [5].

The activities that are necessary in such transformation processes need to be coordinated in an organized manner [6]. Coordination is considered as the management of dependencies between activities [7]. The involved activities will typically consider several additional aspects of the enterprise, such as human resourcing, finance, or reporting structures [4].

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EAM is seen by many scholars as a means to support the coordination of transformation [8, 9, 10, 11]. However, in many transformations, architects are not involved or limited to a support of IT matters [12]. Therefore, we are interested in the reasons for such limitations – how do architects see their role in transformations, which perspective do they take, what is the scope they consider? Summarized the following research question guides our explorative study:

RQ: How do enterprise architects perceive enterprise transformations and how do they contribute to the successful management of these.

In the following section we present related work concerning the topic area. We continue with presenting our research approach. In section four we describe the results by providing the qualitative data that we collected. We go on with a discussion and provide summary and limitations in the last section.

2 Related Work

2.1 Enterprise Transformation

ET is a company's response to the dynamics of their environment or to internal crisis. Because of this oftentimes radical and fast moving environment, organizations need to establish the ability to react even faster to these sometimes fundamental changes [13]. ET does not focus the minor changes a company undergoes in their strategic considerations or processes every day, but describes the fundamental changes that substantially modify its relationships to internal and external stakeholders [14].

According to Rouse [14] four main causes for transformations exist: First, the revenue opportunities of emerging markets or new technologies are initiators of transformations. For example the rise of mobile applications has completely changed some businesses and value proposition of companies, which made it necessary to transform their processes, technologies and strategy [15]. Second, threats of the market or technology changes are causing ETs [14]. Third, transformation initiatives by main competitors drive ETs. Sometimes changes in the environment become only visible if a major competitor adapts itself and suddenly performs better or attracts more or different customers [14]. Finally, internal crisis within the enterprise fosters ETs. Examples are a decrease of key performance indicators such as cash flow or market performance [14].

Management of ET includes manifold activities that need to be coordinated. Kotnour et al. [16] identify four major management steps: (1) recognizing the change, (2) establishing an overall philosophy, (3) deciding on future environments and (4) defining the interconnected accountabilities. Uhl & Gollenia [17] provide an approach that integrates existing disciplines like business process management, IT management, value management, strategy management, project management and others by a newly introduced discipline called meta-management. This discipline deals with the coordination and general setup of the transformation [18].

2.2 Architectural Support of Enterprise Transformation

The management of EA is a "continuous and iterative management function" [19], meaning that planning and executing EAM is not a one-time effort but requires constant support [20].

One of the main goals of EAM is the continuous alignment of business and IT [13, 19, 21] in order to improve the performance of the organization. Alignment is supported by creating a holistic and integrated view of the strategy, processes, technology resources and information flows often represented in the different layers of an EA framework [22]. It is a key objective to reduce organizational complexity by codifying and understanding its structures [23]. Ross et al. [9] found that the introduction of EAM enables the reduction of IT costs. This is possible because of a consistent, strategic IT planning [21] which can reduce costs of IT operations as well as application maintenance [24]. Beyond cost reduction, IT responsiveness and flexibility can be increased with a reduced development time of applications, minimized overhead and the ability to reuse IT-components [25].

On the business side, enterprise architecture is supposed to improve risk management, optimize business processes and support decisions [9]. This is possible because EAM is considered to combine and integrate the strategy, business and technology perspective in order to model different future operation scenarios [22].

The type of information that EAM can provide is documented and formalized in manifold meta-models [26, 27, 28, 29]. In [30] we consolidated concepts of those meta-models in order to get an overview about information that is potentially provided by current EAM approaches. Figure 1 illustrates common information objects of EAM.

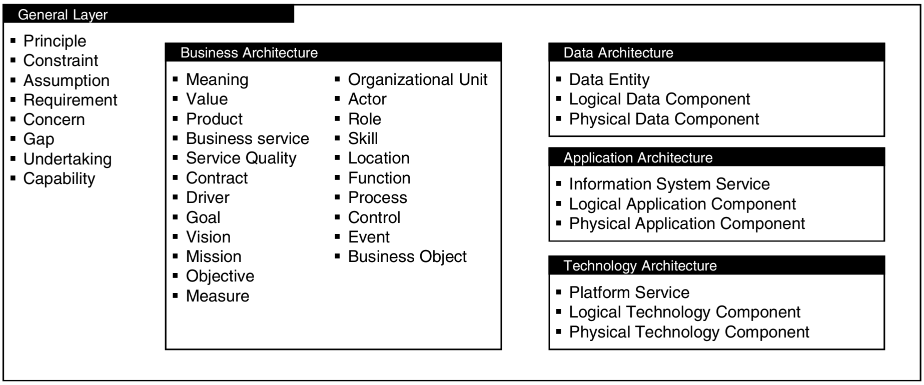

Fig. 1. Information provided by EAM [30]

Asfaw et al. [12] provide a discussion about how EAM is supporting ETs. They identify success factors like communications, stakeholder involvement and guided application development. However, the authors conclude that architecture cannot deal with all occurring challenges. Additional disciplines like change management are needed. Winter et al. [31] illustrate how EAM and ET management differ and what both have in common. Especially the to-be designs and change project roadmaps that EAM creates, are seen as an integrated implementation component and input for ET.

However, almost none of the current literature provides an overview of the architects' perception and opinion about the future support of transformation. Thus, we aim at discussing the current transformation support of EAM and its future evolution.

3 Research Approach

We conducted a multiple case study approach guided by the one described by Eisenhardt [32]. Such an approach usually yields more robust and generalizable findings than single case discussions [33].

3.1 Data Collection

In order to gain insight to the context of ET and EAM, we conducted a literature search by following guidelines provided by vom Brocke et al. [34] and Webster & Watson [35]. Since on the one hand we wanted to understand the relation of ET and EAM ahead of the interview phase but on the other hand needed to deal with a huge amount of available sources in the topic area, we concentrated on major journals (Jourqual ranking [36]) and conferences (ECIS, ICIS) by applying the keywords "Enterprise Architecture" OR "Enterprise Architecture Management" on the title. For the ET part we applied the keywords "Enterprise Transformation" OR "change" OR "strategic transformation" OR "IT transformation".

In addition to the structured search, we conducted reverse searches by surveying the references of articles we found during the first search steps. We further added sources that were already known in the research group in order to provide a rich foundation for the preparation of the interviews.

Based on the surveyed literature, we developed the questionnaire for the interviews. The questionnaire consists of four major sections. In Section A we intended to "break the ice" by starting with biographical questions like the informant's job description or company. We move on with questions that aim at understanding the role of EA for the company. The third part deals with ET as such by asking the informant about transformations where he or she was involved in. We related the subsequent questions to these examples. We asked primarily about the extent, the scope and the success of the transformation. In the fourth part of the questionnaire, we asked about the EAM involvement in the described ET example.

In general, we adopted the research approach described in [37]. Thus, we conducted the interviews face-to-face or on the telephone, depending on the availability of the interviewees or the local distance. For the phone interviews we incorporated guidelines given by Burke & Miller [38] like providing the questionnaire upfront or being aware of the difficulties of the communication channel. We relied on additional data sources like reports offered by the companies (e.g. the annual reports), publically available information about the interviewees (e.g. social network profiles), press releases, websites, field notes etc. The triangulation of such sources increases the robustness of the resulting findings [39]. Our informants were all experienced enterprise architects or employed in similar positions like data architect or business architect. We identified the informants by applying the search terms “Enterprise Architect” or “Transformation Architect” in social business networks (Xing and LinkedIn). Our search revealed 86 potential informants in the German speaking area; we could make appointments for interviews with nine of them. All interviews were recorded and transcribed in order to allow for further processing in the research team. We transcribed the interview in the language we discussed with participants. Extracts presented in this paper are translated for understandability reasons. We asked the informants to focus on their own experiences and tried to find examples that are not located too far away in the past. Whenever possible we used court-room questioning in order to avoid questioning that allows informants to speculate [40]. We further promised our informants to keep their and their company’s anonymity in order to allow them for providing honest answers.

3.2 Informants and Data Analysis

Our informants were working with nine European companies in different industries. All companies have more than 5000 employees and dedicated EA departments. In Total we recorded and transcribed more than seven hours of interview material. Table 1 provides an overview of the companies and informants.

Table 1. Interview Partners

Company	Industry	Informant
A	Telecom	Head of IT Strategy & Architecture
B	Automotive	Enterprise Architect
C	Consulting	Enterprise Business Architect
D	Consumer	Enterprise Architect BI and Data
E	Banking	Transformation Manager
F	Consumer	Lead Enterprise Architect
G	Telecom	Enterprise Architect
H	Banking	Enterprise Architect
I	Banking	Director Integration Architecture

We followed recommendations for multiple case studies by Eisenhardt [32] and used within-case and cross case analysis. This implies to understand the interviews and cases conducted in one Company first and afterwards identify commonalities and differences. We used the software ATLAS.ti in order to conduct a first open coding. We used the graphical functions of ATLAS.ti in order to cluster the codes in a purposeful way based on semantic similarity [41] to get an overview concerning emerging constructs.

4 Results

We identified six major constructs that are influencing the current and future support of EAM for ET. These are the ET scenario, EAM activities, EAM artifacts, knowledge about the establishment of EAM as an ET support discipline, pitfalls and perceptions about the future.

4.1 Enterprise Transformation Scenarios

We discussed with our informants what they perceive as an ET scenario and ask them to provide concrete examples from their point of view. In Table 2 we summarize the examples given during the study.

Table 2. Transformations Described in the Cases

Company	Scenario	Goal	Cause	Success
A	Replacement of IT	Develop a complete new IT Stack	Merging of mobile and fixed phone	Yes
A	Partnerships	Partnership with external companies	Changed customer demand	Yes
A	Business process reengineering	Designing of Services	Competitor situation demand more flexible products	Yes
B	Post-merger integration	Integration of an Asian Development Facility	Step into Asian market	No
B	Compliance policies enforcement	Roll out of Enterprise Application Management.	N/A	No
C	Replacement of IT	Companywide auditing standard	International customers and stronger competitors	Yes
D	Compliance policies enforcement	Restructuring of IT demand process	Number of unnecessary projects	Yes
D	IS consolidation	Customer support services	Old systems and new SAP system for other areas	Yes
E	IS consolidation	Reduce number of systems	Personal changes	Yes

Table 2. (*continued*)

E	Replacement of IT	One core banking system for the group	Need to decrease costs	No
E	Post-merger integration	Acquisition of another bank	---	Yes
F	New business development	Establishment of an online channel	Competitor situation	Yes
G	Post-merger integration	Integration of the two IS stacks	Merging of mobile and fixed phone	Yes
H	Replacement of IT	New Access and Identity Management	Regulatory	Yes
I	Replacement of IT	New System for Investment banking	Need to reduce costs	No
I	IS consolidation	Consolidation in Investment banking	Organizational restructuring	Yes

Thus, our informants provided experiences from 16 ETs. Certain scenarios are more similar to each other than other ones. A pretty common scenario is the *post-merger integration*. Mergers and acquisitions (M&A) are strategic moves to enhance the growth of the company [42]. The goal is to create synergy effects by "integrating two separate business entities" [43]. Two-third of all mergers fail or do not deliver the expected operational improvements. One of the reasons is the missing integration of the technical architecture, organizational infrastructure and cultural aspects, besides the financial components [43].

An example is Company E (retail bank) that acquired another bank in Eastern Europe. The goal was to integrate the new company on the organizational and the technical side as well as possible. The chosen method of IT integration was a mix between a standardization and coexistence approach [44]. Company E already had negative experiences with failed standardizations and this time took the approach to standardize some processes where possible but still kept two co-existing systems. The EAM department in this case took a consulting role and provided experiences from past projects. Thus, the transformation is considered a success as of today.

Another scenario often mentioned by the architects is the *replacement of information technology* or legacy systems. These are replaced for several reasons rooted either in the business or the IT side of the enterprise [45]. On the business side, typical causes are for example: "Changes in accounting practices and policies", "financial drivers", i.e. in terms of productivity, "requirement of new system capabilities" and many more [45]. The technical side can also provide reasons for a replacement: "System not compatible with newer technologies", "costs of upgrading are too high", "technology that is no longer supported" or that the necessary staff is unique and expensive [45]. Often the cost driver is and most of the technical problems arise from a lack of documentation in the legacy systems [46]. The replacement of technical components is often accompanied by large transformations in other areas of the organization, such as personal or cultural changes. However, in such large scale transformations a significant degree in planning is necessary in order to prevent disruption of the operational business [47]. This is important because in most cases, such transformations fail because of their complexity and changing business objectives [48].

An example for this scenario is Company H. The transformation project conducted established a new access and identity management (AIM) system. An AIM system is used to control the responsibilities and permissions of the employees in the different applications and databases. The scope of this transformation is enterprise-wide, since it affects every user. The driver for this project was not primarily cost reduction or the replacement of an old mainframe system but to meet regulatory requirements.

The third major scenario that we identified during the study is the *consolidation of systems.* While it is similar to the previous scenario, the difference is the focus on consolidation of small systems rather than replacing core legacy systems. Companies introduce massive transformation initiatives to reduce the number of applications. Typical processes are to research what kinds of applications are necessary to carry out the different business processes [49]. Afterwards, obsolete systems are discovered and eliminated. However in general the goals are similar to the replacement of IS: cutting costs and reducing complexity, which results in a more competitive IS structure.

As an example, Company D is a global developer and manufacturer of consumer goods. Their strategic goal is to conduct a transformation from a production based company to a consumer driven company. This transformation has an effect on the IS landscape as well. Some years ago they started a huge initiative to introduce an ERP system for the finance and sales department. The most important reason, for not introducing this system for all departments was the fear of failure of a too large program. The area of customer service was, for example, not part of this ERP initiative. The customer service is mainly based on in-house-developed systems for each region. The problem is that the system and the knowledge holding employees are too old. The different systems produce costs and are difficult to maintain in the global data center. The goal is to bring all regions into one system, with some exceptions allowed. Additionally, the compatibility with the new ERP system must be ensured.

The other cases are further business oriented transformations like business process reengineering or the development of a new business model.

Proposition 1: Most ETs that would benefit from EAM occur in the areas of mergers and acquisitions, replacement of IT, consolidation of systems and further business-related ones.

4.2 EAM Activities of Transformation Support

At first we were interested in activities that architects conduct in order to support ETs. Very often EAM has a moderator role and tries to bring different partners together. Like our informant from Company G stated:

"We try to bring all the princedoms together at one table in order to figure out, which solution makes sense. If no agreement is possible the head of architecture or IT Manager decides – but that is always the last resort, because than it's not jointly supported by all participants" (Company G).

The business support for a transformation can be even more direct; EAM here can take the role of an internal intelligence service. While in certain transformations architects are members of the governance boards, in other cases EAM acts rather as a decision supporter. Our informant from Company D provides an example from a business model affecting transformation:

"If the e.g. business would like to reduce prices for certain spare parts and redefines a strategy according to which in order to foster a stronger customer commitment, we try to structure the relevant information by using questionnaires and catalogues" (Company D).

In the case of Company F, the holistic character of EAM becomes evident. Here the task of EAM is having the overview of the manifold programs, projects and demands that are currently affecting the company. Further, the EAM department is the one, were all the target states are known and interferences easily can be identified. The informant from Company B further considers a globally understood EA method as a helpful means in order to support transformations, especially to have a common understanding of certain techniques and thus increase the probability of consistent outcomes. EA also helps to utilize external providers by identifying necessary capabilities that these must provide (Company C).

If the architects are located in the IT department and are rather dealing with IT issues, further mechanisms become apparent. A major one is providing IT-related decision information to the transformation management team. But the job is not about information provision only – EAM is valuable for the CIO to communicate the IT part of the transformation and to strengthen his role. Our informant from Company C pointed out:

"If you consider which artifacts, results or intermediate results the CIO needs in order to communicate further up, e.g. to the CFO in order to allow for information about how well the IT support for certain business functions is." (Company C).

The results show that the term EAM covers two different areas of activity: On the one hand the planning and strategy about IT related issues (e.g. application landscapes) on the other hand rather qualitative additions to the overall transformation initiative – not necessarily about IT-related issues. This finding is in line with other studies like [50], thus we summarize:

Proposition 2: The term EAM covers two related but different approaches of transformation support – one focusing on business/IT alignment and one rather oriented towards pure business issues.

4.3 Means to Support Enterprise Transformations

Even if from our perception, architects like to talk about the rather abstract mechanisms like described above, EAM is able to provide some very concrete means to support the transformation. Our participant from Company A outlines that it is very important to provide concrete advice and not being too theoretical.

Traditionally, EAM is very keen on planning target states, that are expressed e.g. in target process maps, target capability maps or application landscapes [31]. Another very important means are standards. However, standards can occur in very different shades. Traditionally standards are defined concerning applications or other specific EA artifacts. An artifact that supports the standardization of business-related aspects and helps to avoid misunderstandings during a transformation is a common language. Here the concept of logic object models is seen as a valuable means (Company B):

> *"If I ask five people, I get ten opinions about the used terms. That is, why we try to identify a common language at the moment, our means for that is the logic object model." (Company B)*

However, since such standards are hard or sometimes even impossible to establish due to manifold reasons, some organizations rather standardize their methods than their results. In the case of Company E this increased the success of the transformation initiatives:

> *"In the past we had the strategy to introduce one certain system for the whole company. However, that did not work due to manifold requirements in the single national units. Thus, now we are rather working with standardized methods and concepts instead of concrete systems that we standardize".*

Another means is the standardization of governance processes and thus the establishment of transformation-relevant boards and committees – enriched by additional discussions with specific stakeholders in IT and business away from the regular meetings (Company I).

Again, it is important that the architects are directly involved in the partial transformation projects and provide the necessary guidance. A means that architects seem to be very capable to provide is methodological guidance:

> *"We had multiple phases where a target organization was defined and it was clearly defined on a roadmap, when which organization should be transformed. We supported this with the architecture, mostly by providing methodological guidance" (Company E).*

Artifacts that were further mentioned pretty often are application landscapes or capability maps. Thus summarized:

Proposition 3: Artifacts that are very often used to support transformations are standards, roadmaps, capability maps or application landscapes.

4.4 Establishing Transformational EAM

While EAM is a well-established to support business-IT alignment, its establishment as an ET supporting discipline needs further efforts. Therefore, we discussed with the participants of our study about success factors of transformational EAM.

Overall the business side needs to trust in EAM and needs to consider the architects as appropriate to talk to (Company F). How can this be achieved? One major point is communicating in a way that the partner from the business side is directly able to understand. This means to use language and tools that are well-known on the business side. The experiences from Company G and Company I reflect this experience:

> *"I do no longer describe solutions with component- or flow-charts. I take the most important from the solutions that architects' draw and invest more time in communicating those extracts with the management. My goal is not to get a great picture of the architecture but having slides that help to convince the management – based on arguments, figures and cost-ratios." (Company G)*

> *"We need to find the right tools in order to communicate with the business side. We used many tools that worked well for IT matters, but were not understood by the business. As an example: We have a domain model that aggregates our applications in a business-related manner. […] That all worked very well for IT purposes but the business never really understood the model." (Company I)*

Thus, the transformational EAM does not only draw architecture maps but goes the extra mile to already interpret and translate them into the relevant information that business departments need. It seems a good idea to concentrate on a few EA artifacts and provide these in a value-adding way instead of offering to much at the same time (Company D). These key artifacts are different in each enterprise and need to be identified by analysis and discussions. When such artifacts are in place, architects are needed, that are able to communicate also with top-management stakeholders.

> *"You need people who are able to communicate with the higher top-management. You need to know that these managers provide only brief meetings and you need to be able to hit the bottom line within this time." (Company C)*

Furthermore, EAM needs to be explained to other stakeholders during the transformation. These are project managers or other involved employees. Since EAM in many cases is not able to put pressure on the stakeholders, it needs to convince them:

> *"I am 80% of my time in meetings […]. We are not like kings that put thumbs up or down but instead discuss appropriate solutions with experts or stakeholders." (Company G)*

> *"In general people are no fools, they are not more chuckleheaded than others." (Company B)*

It is especially necessary to be able to explain the use on the local level – and not just what it means for the whole. That also includes to leave certain degrees of freedom on the local level and not to think that a central function can manage everything better.

> *"It's important to discuss what really needs to be synchronized. Do I really have to work in the same way everywhere? Or, where is the lowest common denominator? Where actually is it? That is the important point one has to think about and which you have to focus on afterwards." (Company B)*

The experience of our informants shows that it is very valuable to be involved early in the projects and help to bring the necessary experts together or ensure that standards are kept. After that step, the architecture efforts can become lower and "people can do their work" (Company H). EAM usually can provide methodological guidance and best practices, especially in the beginning of projects – even if that often requires serious convincing efforts (Company D).

Proposition 4: In order to establish an EAM that supports transformations, communication and a focus on key artifacts is necessary.

4.5 Pitfalls in ET Support by EAM

In the interviews with our informants, we could identify three major pitfalls that challenge architects when ET support is important. The first major point are cultural issues. Especially in global transformations these become very important like many informants mention:

> *"We tried it at a foreign location, Japan. We tried to translate it in the language of the colleagues over there; we even provided the process as a Manga comic. […] However, let's say, it was read …" (Company B)*

> *"I think that is a tendency in Germany. We are all artists. We want to have as much freedom as possible. When I do process management or use methods I reduce that freedom. […] That does not comply with our culture and our feeling." (Company B)*

"If they [Chinese locations] are starting to introduce a central ERP system for their location at a certain point of time, they have a look at how it was done in Germany or the US. […] But, they are not that far when it comes to establishing the transparency that we do here – that's also about the mentality." (Company C)

The second critical point is the measurement of transformation success. Success measurement is very often perceived as a difficult job and often not conducted at all. Similar to others, our informant in Company B reflects:

"If I introduce a software system it is easy to measure, e.g. by how often someone logs on. With a process change that is not possible" (Company B)

However, in the end the transformation efforts need to prove their success. While some prefer trying to establish financial figures since these are well established in the management, others focus on qualitative measurements:

"We are in contact with market research companies that provide information about the brand perception of our customers. Our success was measured by the feedback of our consumers" (Company D).

The third important pitfall is EA's tendency to become an end in itself or not to consider the question of how much EAM is enough. The informants almost agreed upon the fact that EAM for transformations needs to set the overall frame but should not become too detailed.

"I think it [EAM] should provide the rough frame and processes. Very brought, not in detail – since the details change too often" (Company B).

"That is the problem. Many architects prefer to work very clean. Build clear architectures, start by the low layers. However, they forget that this does not create a business value. Finding the right balance is important" (Company I).

Proposition 5: Pitfalls that need to be avoided are disregarding cultural issues, inadequate success measurement and an EAM that becomes an end in itself.

4.6 The Future of Transformational EAM

During the discussions some implications came up on how EAM will or should develop in the future as a transformation supporting discipline. So far, EAM is usually considered as an IT matter [31] – which in itself is not a problem since IT nowadays is a major part of many transformations, especially in industries like insurance or banking:

> *"IT is the shop floor of the bank. Where other industries have their factories to produce their products we have the IT to fulfill the task." (Company I).*

According to our informants, EAM is able to provide a view on the global IT possibilities and allows for further information about existing processes or applications (Company C). The job of business-IT alignment will become more and more ensured without further efforts, while new business requirements are implemented (Company F). IT can even be the pioneer concerning transformation experiences (Company C). The reason is that in the IT area transformations like outsourcing [51] are conducted often at the moment. Other areas will follow and experiences made once can be used.

Overall an evolution of EAM towards a more business-centric transformation supporting discipline can be recognized but requires additional efforts and fosters new challenges. This already starts with wording issues. While the term "enterprise architecture" is considered to be a very technical term [12] and thus will change, e.g. to "enterprise transformation management" (Company F). The whole process will take time (comparable to the establishment of process management as a single discipline in enterprises) (Company B). EAM needs not to be established as a single department but rather should be in the minds of the company's kind of organizational intelligence (Company B).

Furthermore, the trend seems to be a shift from documentation towards governance [11] as a main EAM task:

> *"During the last three years we moved away from documentation to governance. During restructuration last year, we moved from the development department to a specific governance and compliance department. Because of that we got more visible recently." (Company H)*

In parallel to the shift in tasks, many EAM departments strive after more business orientation. While this is a very well-known trend [50] one of the informants claimed that EAM needs to be careful of not to lose its connection to the IT:

> *"If we use too many IT terms that could cause denial at the business side. But, if we use too much business language, our influence within our own organization [IT] will slowly diminish, which means, the acceptance could diminish". (Company D)*

Thus, the future of EAM as a transformation supporting discipline stays multifaceted and manifold development pathways are thinkable. Summarized:

Proposition 6: EAM as a transformation discipline will move away from a pure documentation of IT-related matters but architects need to be careful, not to lose the focus with its respective stakeholders.

5 Discussion

EAM is often involved in ETs and contributes in a valuable way. However, there seems not to be one possible way for EAM`s contribution. We explored the perspective of the architects on ETs and collected their practices and experiences. In Table 3 we summarize the propositions we derived within the findings section.

Table 3. Propositions Summary

	Proposition
1	Most ETs that would benefit from EAM occur in the areas of mergers and acquisitions, replacement of IT, consolidation of systems and further business-related ones.
2	The term EAM covers two related but different approaches of transformation support – one focusing on business/IT alignment and one rather oriented towards pure business issues.
3	Artifacts that are very often used to support transformations are standards, roadmaps, capability maps or application landscapes.
4	In order to establish an EAM that supports transformations, communication and a focus on key artifacts is necessary.
5	Pitfalls that need to be avoided are disregarding cultural issues, inadequate success measurement and an EAM that becomes an end in itself.
6	EAM as a transformation discipline will move away from a pure documentation of IT-related matters but architects need to be careful, not to lose the focus with its respective stakeholders.

The identified transformation scenarios show that defining scenarios is a lot depending on the perspective taken. While in our exploration IT-driven and business-driven scenarios are occurring almost half by half, other authors (e.g. [52, 53]) would not explicitly consider IT-driven scenarios as transformation but rather differentiate the business-driven scenarios more in detail.

The second proposition became very clear during the study – EAM covers many very different activities and tasks which foster serious problems on explaining, what the discipline actually does – this seems to be very different depending on the company talked to. Our impression is that we can find a "traditional" type of EAM that is very strongly rooted in the IT departments and deals with handling the IT complexity. These activities are very important in almost all transformations since IT is always affected. The role of these "traditional" architects however differs depending on the transformation scenario that occurs. While they can and should take a strong role in the IT-related scenarios (e.g. by providing detailed plans about IT dependencies), their transformation support might be more passive in the business-oriented ones. The other "extreme" that we find is the business-oriented EAM approach. This one often occurs in industries were IT is a major part of the value creation (banking, finance, etc.). It is also rooted in the IT but emancipated itself towards a more business-related position (and thus can contribute by providing dependencies between capabilities or within those). Architects who conduct this style of EAM are much more involved in strategic discussions or business related decisions than those dealing with pure IT issues.

However, proposition three shows that EAM has the potential to further establish itself as a discipline that supports the ET. When we compare the mentioned artifacts and provided services by current EAM with the theoretical potential based on the EAM meta-model (see figure 1 in the related work section), it becomes apparent that EAM could provide more guidance than it currently does in many cases. How could EAM emerge in that direction? Proposition four shows that the key lesson learned is fostering an appropriate communication and establishing a focus on key deliverables that are related to the transformation. Therefore, it seems to be better to concentrate on the provision of not too many but meaningful artifacts instead of being too broad or getting lost in the details.

In addition, major pitfalls need to be avoided. These are cultural issues – may those occur while applying certain EA standards in other countries or even subunits of the enterprise. Furthermore the goals and the success of transformations and EA use need to be measured – or at least regularly assessed on a qualitative basis. That is necessary especially to know what the demands are and not to become an end in itself. That goes along with proposition six, which includes the perception that EAM will more and more develop away from a discipline that mostly does documentation towards one that is involved and respected as a strategic advisor.

Our propositions should guide the development and design of new EAM approaches in the future. While we explored the perceptions of the architects about how EAM supports transformations, new EAM frameworks or design theories [54] could especially focus this point. Such approaches need to consider the role that the EAM department has within the concrete enterprise – is it supposed to add information about IT issues or is it able (and allowed) to add support to additional, more business and strategy related issues? Depending on the answer, EAM approaches would be different and would support different activities that are taken when managing transformations. We see great potentials for design oriented researchers to provide artifacts in this area.

6 Summary and Conclusion

In the paper at hand we provided an empirical exploration about the EAM support of ETs. Based on interviews with highly knowledgeable informants from nine enterprises we explored the transformation support and potentials of EAM concerning this purpose. Our findings reveal IT-driven as much as business-driven scenarios of transformation were EAM can be effective. We further investigated what the major pitfalls are and how a transformational EAM in the future could look like.

Some limitations occur. We conducted a qualitative study based on a relatively small number of participating companies and interviews. However, we consider this very suitable for the given purpose of field exploration. Especially since we discussed with highly knowledgeable informants [33] the chosen method provides empirically sound propositions for further research [32]. Since the topic is complex, we were only able to cover a broad rather than a deep perspective in this paper. However, this broad perspective helps to develop more concrete research designs (e.g. qualitative questionnaires) or artifacts (e.g. EAM capabilities) in the future.

In consequence, we plan further research in the topic area. First, we need to gain clarity about the inputs that EAM can provide to the management of ET. Second, we need to understand, which kind of EAM is suitable for which ET scenario. Finally, such findings should be consolidated in an integrated approach, aiming at the architectural support of enterprise transformations.

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