

Enterprise Architecture for Small and Medium Sized Enterprises

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Abstract. Enterprise architecture (EA) is used as a holistic approach to keep things aligned in a company. Some emphasize the use of EA to align IT with the business, others see it broader and use it to also keep the processes aligned with the strategy. Although a lot of research is being done on EA, still hardly anything is known about its use in the context of a small and medium sized enterprise (SME). Because of some specific characteristics of SMEs, it is interesting to look how EA can be applied in a SME. In this PhD, we present an approach for EA for SMEs, which combines four dimensions to get a holistic overview, while keeping things aligned. The approach is developed with special attention towards the characteristics of SMEs. Case studies are used to refine the metamodel and develop an adequate method, while tool support is being developed to enable the validation rounds.

Keywords: Enterprise architecture, Small and medium sized enterprises, Business architecture, CHOOSE

1. Context

1.1. Problem/Application Area

1.1.1. Enterprise Architecture

Enterprise architecture (EA) is a key instrument in controlling the complexity of the enterprise and its processes and systems. The most important characteristic of an EA is that it provides a holistic overview of the enterprise. This enables optimization of the company as a whole instead of doing local optimization within individual domains. EA facilitates the

translation from corporate strategy to daily operations. To achieve this quality, it is necessary to use an approach that is understood by all those involved from these different domains. (Lankhorst 2009)

1.1.2. Small and Medium Sized Enterprises

In the U.S., the Office of Advocacy defines a small business as an independent business having fewer than 500 employees (Small Business Administration 2012). Small and medium sized enterprises (SMEs) are important to the U.S. economy. Small firms represent 99.7 percent of all employer firms, employ about half of all private-sector employees, pay 43 percent of total U.S. private payroll, and have generated 65 percent of net new jobs over the past 17 years from 1993 till 2009 (Small Business Administration 2011). Further, SMEs play a critical role in nurturing industrial innovation, constituting 40 percent of highly innovative firms in 2002 (CHI Research Inc. 2004). SMEs also play a significant role in enhancing the competitiveness of an economy through the process of economic renewal by creation, elimination, and restructuring of economic sectors.

Micro, small and medium-sized enterprises are often referred to as the backbone of the European economy. There were close to 20.8 million SMEs in Europe, which accounts for 99.8 percent of all companies. Furthermore the lion's share of those SMEs are micro enterprises with a total of 19.2 million. Around 70 percent of European jobs are provided by the SMEs in the private sector and they account for 58.4 percent of total gross-value added production. (European Commission 2010)

We further use the definition of SMEs as stated by the European Commission: SMEs are companies which employ less than 250 employees and of which the annual turnover is less than 50 million euros or of which the total assets are less than 43 million euros. (European Commission 2003)

1.2. Main Previous Research

Research on EA has primarily focused on integrating business with IT, often referred to as business-IT alignment (Henderson and Venkatraman 1993). Some well-known approaches are: Zachman's Framework (Zachman 1987), The Open Group Architecture Framework (TOGAF) (The Open Group 2009), ArchiMate (Lankhorst 2009), Capgemini's Integrated Architecture Framework (IAF), Enterprise modelling (Bubenko 1993), and CARP (Zur Muehlen 2011).

A summary of the IS literature regarding SMEs is given in the literature study of Jan Devos ((Devos 2011), pp. 41-87). Most of the articles are about E-business, Internet, E-mail, and ERP systems in SMEs. However, articles about EA for SMEs are very scarce. In fact, in this literature study of A1 papers found from 1979 to 2008 about SMEs and IT, no single paper discussed EA for SMEs.

Recently, a paper has been published on a cross-sectional empirical study of information system architectures within 143 small to medium sized enterprises in France. This study provides an empirically derived taxonomy of enterprise architectural variants of the types often described in the literature for large firms. The authors found three kinds of IT architectures for MIS in SMEs in France and the greater the size of the firm, the greater the IT Architecture integration was in SMEs. They conclude that standardization of the processes through the company and industry is more important than the deployment of technology (ERP systems) to get improvement in organizational performance. (Bidan et al. 2012) This indicates the need for SMEs to get a structured view on their company.

In Belgium, an exploratory case study research by students of the University of Ghent in 27 SMEs delivered interesting insight in which factors determine whether an SME documents its processes, its strategy, and whether there is a link between both. While some companies have a link between their processes and strategy, none of them uses an EA or business architecture method. (De Nil et al. 2012)

1.3. How the Research Relates to the Research Group

The expertise of our research group is in conceptual modelling, and more specifically in business modelling (see Fig. 1). This research is situated in the part of business and enterprise architecture and has a strong link with the research done at our department. A lot of knowledge and support is available regarding the development of metamodels and methods.

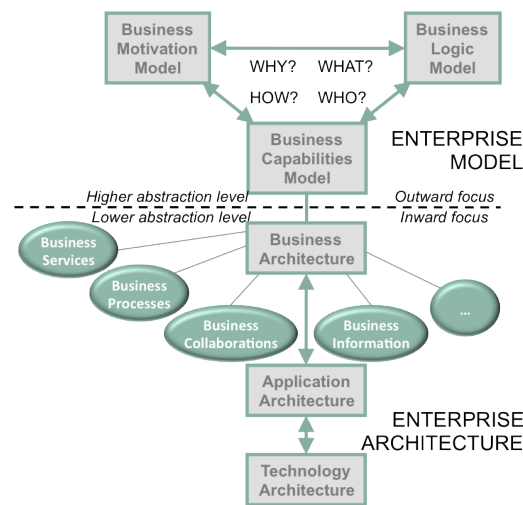


Fig. 1: Research at our department of the University of Ghent

2. Problem Statement and Goal of the Research

2.1. Specific Research Problem

The main research question is how to enhance the business overview in SMEs.

In a SME, the entrepreneur (CEO) controls the enterprise. However, while most entrepreneurs have a good knowledge about their company, the overview tends to stay unspoken. This can cause some problems to occur:

- For ERP adoption, the most important criterion used by European SMEs in selecting an information system is the best fit with current business procedures (van Everdingen et al. 2000). This is also confirmed in an interview with Jeroen Persyn, responsible for guiding East-Flemish Belgian SMEs in their choice for an ERP system. In nearly all SMEs he has assisted, a clear overview of the business was lacking.
- In an enterprise, employees tend to know less about the structure of the company and why things are done. Although the entrepreneur knows the overview of the company, it is difficult for him to communicate with its employees about strategic issues without having an explicit overview (Kamsties et al. 1998).

- A concrete job description and overview of tasks and responsibilities of employees is difficult to keep track of, especially in a changing environment and enterprise (Kamsties et al. 1998).
- A strategy is not static, neither are processes. Keeping processes at all time in line with the strategy is difficult to achieve (Dougherty 1992).
- In an ever-changing environment, assessing the impact of changes can help prevent problems to occur. What if the economy changes? What if the strategy has to be adapted? What if an employee leaves the company? (Porter 1998)
- A SME has different stakeholders with different desires and goals. Balancing these goals as good as possible is not a simple assignment. (Heyse et al. 2012)
- If the CEO leaves the company for some reason (e.g., he sells the company or a child takes over), his overview of the company has to be transferred to the new CEO.
- It is difficult to track all decisions made on different meetings. In the best case, reports of the meetings are made and stored at the same place, but most of the time this is not done. Transforming decisions towards real changes in how the company is organized and implementing these changes consistently is hard to achieve.

It seems obvious that EA could help to reduce these problems, however, EA is generally an unknown concept in SMEs. This is confirmed by the previous mentioned case study research of De Nil and Deprost (De Nil et al. 2012) and by the literature study of Devos (Devos 2011).

2.2. Importance from a Scientific/Practical Point of View

As already mentioned, SMEs are important for economy (cf. “1.1.2 Small and Medium Sized Enterprises”). However, not all new SMEs make it through the first years. 70 percent survive at least 2 years, 50 percent at least 5 years, a third at least 10 years, and only a quarter stay in business 15 years or more (Census Bureau 2011; Bureau of Labor Statistics 2011). EA could help SMEs in overcoming the problems mentioned in “2.1 Specific Research Problem” and increase the survival rate.

2.3. How and to What Extent Will the Research Provide a Solution to the Problem

Our approach differs from the previously mentioned EA approaches in that the approach is specifically designed taking into account the characteristics of SMEs and their CEO. As

Lankhorst (Lankhorst 2009) mentioned, it is necessary to use an EA approach that is understood by all those involved from the different domains. SMEs have characteristics, some which are indeed different from larger companies. (Bernaert and Poels 2011b)

2.4. The Intended Scientific Contribution and its Originality/Novelty

In this research, the authors propose an EA approach that can be used by SMEs to develop their EA models and manage their EA. The approach differs from the EA approaches above in that the approach is specifically designed taking into account the characteristics of SMEs and their CEO. A crucial element that was missing for SMEs to be able to use EA was simplicity in the existing approaches. (Bernaert and Poels 2011b)

3. Solution Approach and Related Research

3.1. Alternative Solutions to the Problem

As previously mentioned, it is a novel idea to develop an EA approach specifically for SMEs. Nevertheless, to develop a metamodel for our approach, existing EA approaches are analysed. Either ArchiMate 2.0 (The Open Group 2012), REA with goal modelling (Andersson et al. 2009), CARP (Zur Muehlen 2011), Capgemini's IAF (van't Wout et al. 2010), enterprise modelling (Bubenko 1993), and EKD (Stirna and Persson 2007) include a strategic dimension, an active actor, an operation, and a resource. These four dimensions (why, who, how, what) will become the basis of our approach for EA in SMEs. Zachman's Framework also includes two additional dimensions: when and where. We presume that these dimensions are attributes of an operation in our approach.

3.2. Solution Approach

To have both an approach specifically developed for SMEs starting with EA, and to give SMEs the opportunity to fully benefit from the existing elaborated standard EA approach (ArchiMate (Lankhorst 2009)), two stages in the research are performed.

First, a metamodel is created, combining the essential dimensions and characteristics of EA with the characteristics of SMEs. (Bernaert and Poels 2013) This metamodel is called the CHOOSE metamodel.

Second, this CHOOSE metamodel will be mapped to Archimate's metamodel, to be able to switch to the standard EA metamodel (The Open Group 2012). (Roose et al. 2012)

4. Methodology

The methodology of our research is summarized in Fig. 2. First, criteria are extracted from the characteristics of SMEs and EA approaches. Second, a first version of the CHOOSE metamodel is being developed, based on these criteria. Further, during case studies in SMEs, the metamodel is being refined and a method is being developed and refined. Third, the CHOOSE metamodel and method, in combination with criteria for developing tool support, are being used to develop tool support. This tool support enables both the validation in the case studies, as the validation by SMEs themselves that can use the tools.

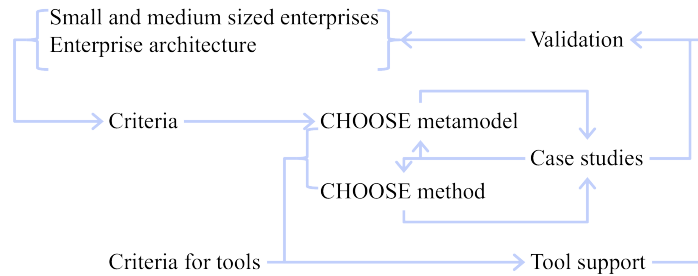


Fig. 2: Summary of the methodology

The different steps of design science are used (see Fig. 3). (Hevner et al. 2004) The development and refinement of the CHOOSE metamodel and method are part of the build step. The case studies are part of the evaluate step, while the tool support enables the evaluate step. The goal of design science is not the truth, but utility. Utility is found in the search for usability of EA in the context of an SME. We are not pretending to develop the only perfect EA approach for SMEs. The link to existing EA approaches enhances the rigor of our research, while the link to and case studies in SMEs enhances the relevance of the research.

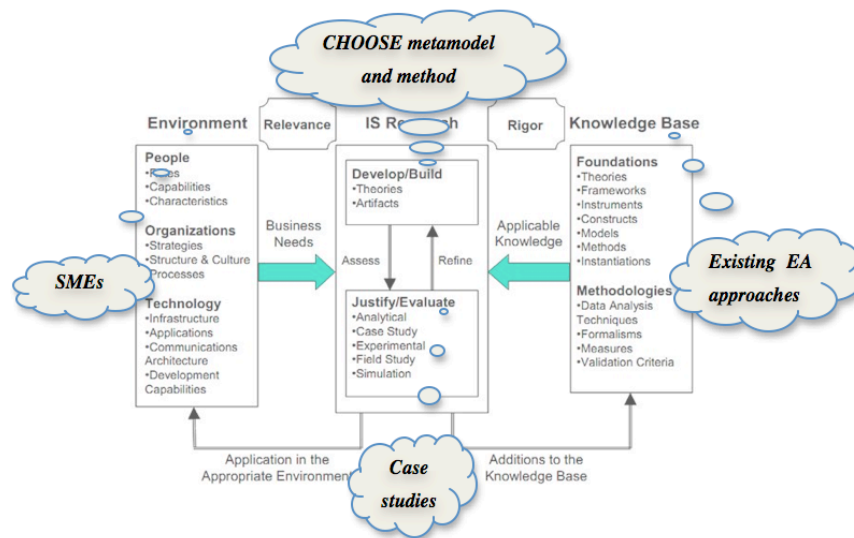


Fig. 3: Information Systems Research Framework according to our research (from (Hevner et al. 2004))

The seven guidelines presented in (Hevner et al. 2004) can be applied to our research. The CHOOSE metamodel and method are created (guideline 1: creation of an artefact) for SMEs (guideline 2: for a specified problem domain). The CHOOSE approach is evaluated in case studies (guideline 3: thorough evaluation of the artefact). No specific EA approach for SMEs exists (guideline 4: innovative, novelty). The metamodel will be formalized (guideline 5: the artefact must be rigorously defined, formally represented, coherent, and internally consistent). The case studies are used to refine the metamodel and develop and refine the method (guideline 6: search process). Finally, articles are written about the approach, both in academic journals as in journals for practitioners (guideline 7: communication both to a technical and managerial audience).

According to the engineering cycle for world problems (Wieringa and Heerkens 2006), during a PhD three steps can be done. First, in the problem investigation step we investigate SMEs, their characteristics, and problems. Second, in the solution design step, the CHOOSE metamodel and method are created, looking at existing EA metamodels and methods and according to the characteristics of SMEs. Third, case study research (Yin 2003) in SMEs, where the CHOOSE metamodel and method are being evaluated against the criteria we derived from the characteristics of SMEs, is used for the design validation step.

5. Results so far

The investigation started from the analysis of existing goal-oriented requirements engineering methods, i.e. methods that start from organizational goals to elicit requirements. This analysis showed that methods such as KAOS pay a lot of attention to precision and consistency in modelling requirements, but spend insufficient attention to supporting the use of the method by the actual target group of users, namely the people who possess the knowledge about the business goals (i.e. not the IT-people, but the managers). When used by SMEs in particular, goal-oriented requirements engineering methods fall short because of the specific characteristics of these organizations, for example the large amount of implicit knowledge shared by only a few people (often even only the manager or owner of the company), the little amount of IT knowledge (e.g., because of the absence of an IT department or IT specialist within the company), and the lack of resources to hire (expensive) external IT-consultants. These findings are based on an in-depth case study trying to apply a simplified version of KAOS for the development of the EA of a SME (a tire central). (Bernaert and Poels 2011b)

From this problem analysis and a study on the specific characteristics of SMEs with regard to the deployment of IT, we started to develop an approach for EA that uses four dimensions (goal, actor, operation, object) for the structuring of business architectures. The key points of this new approach, called CHOOSE (which stands for "keep Control, by means of a Holistic Overview, based on Objectives and kept Simple, of your Enterprise") were reported in the November 2011 issue of the Dutch/Belgian magazine "Informatie". (Bernaert and Poels 2011a) Meanwhile a number of steps were taken to start the development of tool support targeting different platforms: PC, Apple, tablets/smartphones (iPad, iPhone, and Android). Additionally, a case study was developed to test and evaluate the main principles of CHOOSE. A refined version of the metamodel and a first version of the method were presented (paper submitted to Information Systems and e-Business Management, which also presents the underlying meta-model of CHOOSE). (Bernaert and Poels 2013)

6. Planning and Timing

- *July 2012*: Writing of a book section on EA in SMEs for a new book on IS in SMEs.
- *September – October 2012*: Formalising the CHOOSE metamodel.
- *November – December 2012*: Further elaborate the metamodel and method.

- *September – December 2012*: Helping thesis students to make the mapping of the CHOOSE metamodel on Archimate's metamodel.
- *January – February 2013*: Performing case studies, analyse the case study results, and refine the metamodel and method.
- *March – May 2013*: Write an article on the formalised metamodel, write an article on the case studies, and write an article on the link between the CHOOSE metamodel and Archimate's metamodel.
- *July 2012 – June 2013*: Supervise thesis students (1 programming in Access/Java, 1 programming in Eclipse, 2 programming for Android tablets, 2 programming for Apple iPad, 1 programming for Apple iPhone, 1 executing case studies).
- *June – September 2013*: Writing and defending PhD.

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