

Current State of Enterprise Architecture Management in SME Utilities

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Abstract. In the last decades numerous developments and legal changes moved the utility industry towards a liberalized market. Utility enterprises have to stay competitive and reduce costs while managing more complex IT systems. The authors of this work see special demand for aligning business and IT for small and medium-sized enterprises (SME) in this industry and identify Enterprise Architecture Management (EAM) as the key for this issue. Therefore a survey was conducted that analyzed the SMEs' awareness and experience with EAM and intended to capture recent initiatives in this topic. This work reveals a need for a reference enterprise architecture (EA) that tailors utility enterprises demands towards EAM and derives implications for the development of such a reference EA.

Keywords: Enterprise Architecture Management, Reference Modelling, Utility Industry, Energy Market, Small and Medium-Sized Enterprises, Reference Enterprise Architecture, Business-IT-Alignment, Survey

1 Introduction

Enterprises are complex and highly integrated systems comprised of processes, organizations, information and technologies, with interrelationships and dependencies in order to reach common goals [RSB11]. They need to be aware of the relations among strategy, business processes, applications, information infrastructures and roles to rapidly react on changing demands in the market and within their organization. Enterprise Architecture Management (EAM) contributes to this purpose by providing methods and tools to establish a more holistic perspective on enterprises [Ahl12, Lan13] which includes systematically capturing and developing the different architectural layers of an enterprise (e.g. business, application and technology architecture).

Recent developments like market liberalization and the diversification of energy sources caused significant changes in the European utility industry [JKK11]. Numerous new market roles and business opportunities created by changes in regulations resulted in an

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increased competition. Utility enterprises are forced to adapt their business models to the changing market situations which also requires adaptation in the enterprise architecture. In this context, EAM is expected to be an important tool for supporting change processes and developing competitive business capabilities [CWS13]. Especially small and medium-sized enterprises (SME) require support in EAM implementation, as they do not have a well-established tradition in this field [WTS15].

As a contribution to the above challenges, the objective of the ECLORA project is to develop a reference Enterprise Architecture for small and medium-sized enterprises in utility industry. This reference architecture can be applied in specific SMEs from the utility industry to help tailoring their actual enterprise architecture to their business demands depending on its characteristics like taken market roles. The focus of this paper is on utility enterprises' current awareness and knowledge of EAM concentrating on SMEs in Europe. Furthermore, the actual degree of EAM integration in these organizations is analyzed. For this purpose, an online survey was developed systematically questioning practitioners from the utility industry. The work is guided by three research questions (RQs):

RQ1: *To which extend are SME utility enterprises aware of EAM and its benefits?*

RQ2: *What is the current state of EAM initiatives in utility enterprises?*

RQ3: *Is there a demand for a reference Enterprise Architecture in Utility Industry?*

After clarifying the theoretical background regarding SMEs, EAM and the utility industry in section 2, the ECLORA project is introduced in section 3. Section 4 presents the survey design and evaluation of the responses, before in section 5 implications for ECLORA are derived. Section 6 finally concludes the contributions of this work and presents future actions to be taken for developing a reference EA.

2 Theoretical Background

Before presenting the survey's results, its theoretical foundation is clarified. The notion of SMEs is explained and how this work understands it. The field of research is EAM, whose current relevance for SMEs is elaborated. As the considered industry sector the SME utility industry is introduced and examined regarding EAM.

2.1 Small and Medium-Sized Enterprises (SME)

Depending on the context, enterprises can be classified by quantitative and qualitative criteria. According to [Cas02] more than 99% of European enterprises operate as an SME, which employ around 65 million people in total. Globally between 40% and 50%

of gross domestic product is accounted to SMEs. The European Commission defines enterprises up to 250 employees with a yearly business volume of up to 50 million Euro or a balance sheet total of up to 43 million Euro as SMEs [EU01]. This paper uses the less restrictive definition of medium-sized enterprises by the German institute for SME research. Here, enterprises are considered medium-sized with less than 500 employees [IfM01].

The entrepreneur and owner of a small enterprise is habitually working in his own company, therefore decision processes of SME are mostly highly centralized. They are often more focused on the operational planning and controlling than strategic aspects. The use of controlling instruments is usually limited. In addition, there is a big difference between the knowledge about the importance of such management models and the implementation of concrete measures [Kar11].

2.2 Enterprise Architecture Management and its Part in SMEs

Architecture is defined as a fundamental organization of a system embodied in its components, their relationships to each other, and to the environment, and the principle guiding the organizations design and evolution [Lan13]. EA is the formal declaration of the basic structures of an organization, its components and relations, as well as the processes used for development [WA12]. In this context, EAM provides a powerful approach for a systematic development of the organization in accordance with its strategic visions, yet its value depends on the organizational ability to perform EAM effectively [Ahl12].

The discussion and usage of EAM is focused on IT in practice, although there is knowledge about the importance of processes, strategies and organizational aspects as well [WA12]. EAM adopts various perspectives. As a *management philosophy*, it is a holistic way to understand, plan, develop control and adjust organizations architecture. As an *organizational function* it enables and improves existing strategic planning and implementation processes. As a *methodology and culture* it represents an open approach among the managers and proposes a set of management practices in order to reach a global optimum for the firm, free of egoism and opportunism [Ahl12].

Regarding EAM in SME there only has been few research so far [WA12]. In order to support the transition process of growing SMEs, [Jac11] developed the SME EA Growth Model (SMEAG) by dint of case study research. The model enhances existing growth stage models by combining EA principles for change management, EA frameworks and operational models for business execution. By mapping several areas of concern (e.g. organizational structure) to stages of growth, the work of [Jac11] reveals that EA facilitates growth triggered transition for SME. The need for standardizations and integration of processes in the several growth stages becomes more transparent. That motivates this work to contribute in research for EAM in SMEs.

2.3 The Utility Industry and Current State of EAM

Over the last two decades the European energy market has faced fundamental structural changes [JKK11]. Next to climate policies other regulations permanently changed the market utility enterprises operate in. In Germany within the EnWG (Energy Industry Act)⁵ law market functions were legally separated from each other through unbundling, e.g. separating energy production, energy trade or energy transmission and distribution. Next this, also technical improvements increased competition, which forced utility enterprises to improve their efficiency and effectiveness [AC07, GSA12]. Further the German energy market contains numerous market roles with different responsibilities and functionalities. The Germany Federal Association of the Energy and Water Industry categorizes nine market roles such as energy retailer, balance grid coordinator or metering service provider [BDE08]. Since several roles can be taken by one utility enterprise, the organizational structure of one enterprise is varying from another.

From IS perspective today's utility enterprises have more complex requirements towards its information systems. In [GSA12] the authors identified more than 80 different information sources that have to be used in order to develop an appropriate information system for the utility industry. The authors of this work determine EAM as an approach facilitating business and IT compliance on the one, and optimization of organizational structures on the other side. The emerging objectives to align business and IT, to overcome IT complexity, and to reduce costs for sustain competitiveness can be reached by implementing EAM [Ahl12].

There has been activity in IS research, which addressed this issue. For instance, [GSA12] identified 11 reference models for information systems development in utility industry and proposed a catalogue for reference models in order to agree on a common terminology [GA10]. As a summary the authors derive a lack of current research regarding EAM initiatives in the utility industry [CWS13]. Although stated literature and projects address the role of information systems in this industry, a holistic approach like EAM cannot be identified. Especially SME utilities seem to demand EAM integration in order to cope with the mentioned developments. Thus, the ECLORA project aims at developing a reference EA for SME utilities that can be tailored to the enterprise at hand by configuring the reference EA during its application.

3 The Joint Project ECLORA

The contribution of this work was elaborated in the frame of the ECLORA (German acronym for *Development of a Cloud based Reference Architecture*) project. In this joint project the academic partner collaborates with an industrial partner that provides software solutions for SME utilities. The objective of ECLORA is to develop a reference EA for SME utility enterprises such as energy providers of a municipality. This intention

⁵ cf. http://www.gesetze-im-internet.de/bundesrecht/enwg_2005/gesamt.pdf, accessed 2015-04-02

is facilitated by dint of reference modelling. Reference models are information models, developed for an abstract class of application and entitled to universality in this class. Thus, their purpose is to be reused by mechanisms of adjustment and extension according to a special application case. The reuse of a reference model is intended to increase both efficiency and effectivity of an enterprise's information systems and their change management [Bec02, FL04, Bro03].

ECLORA intends to develop a reference EA that uses the TOGAF framework as an EAM standard and thus will include all sub-architectures, namely business, information systems and technology architecture [TOG11].

From a methodical perspective the project utilizes the design science approach in order to develop the named artefact (i.e. the reference EA) by iteratively approximating it to a real world application and thereby enhancing it [Hev04]. For validation purposes technical action research is integrated in this iterative development process [WM12]. In Fig. 1 the instantiation of the applied regulative cycle in ECLORA is illustrated. As indicated, the survey presented in this work contributes both to the problem investigation and the solution design. Hence, the survey is intended to provide results conducing to an initial version of the reference EA, the focus of the work at hand is the analysis of the survey regarding the current state of EAM in utility industry.

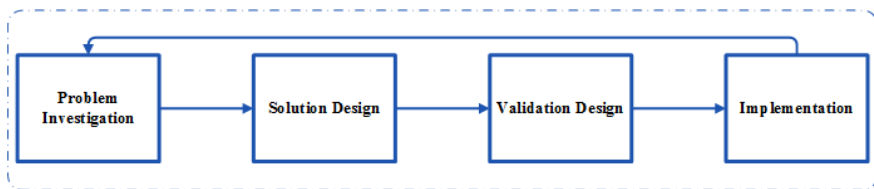


Fig. 1: Instantiating Design Science in ECLORA

4 Conducting a Survey in SME Utilities

In order to capture the current state of EAM in SME utilities a survey was conducted. The results are intended to answer the RQs of this work and reveal implications for the ECLORA project. Section 4.1 therefore explains the survey design before section 4.2 analyses its results and answers the RQs.

4.1 Survey Design

The scope of the survey was to collect information regarding EAM in SME utility enterprises. Therefore a questionnaire was designed and utilized by dint of an online survey. Surveys provide a simple approach to retrieve a high amount of information in a standardized way [Rob11]. In terms of design and conduction the steps carried out by [Rob11] guided the survey design. After revising the questionnaire a pre-test was

conducted with both partners of the joint project. The improved and condensed questionnaire was uploaded to the platform *SoSci Survey*⁶ and its link was published via the project partner SIV.AG to customers from the SME utility industry. In the end 53 completely answered questionnaires have been submitted. With the export functionality of *SoSci Survey* (in CSV-format), the data was analyzed using SPSS⁷ by IBM [Cam14].

Next to an introductory part providing basic information, the questionnaire contains six parts: *General Information (Part A)* focuses on the responding enterprise, its size, market role in the utility industry and the respondents' position within the enterprise. *Corporate Management and Organization (Part B)* focuses on knowledge and experiences in EAM as well as EAM's current integration and its general importance for the utility enterprise. *Strategy (Part C)* intends to capture the transparency of the enterprise's strategy, identifies core processes as well as Business Process Outsourcing (BPO) activities. *Operation (Part D)* enquires the enterprise's current IT landscape and its alignment to business and strategy. Further, the respondents' satisfaction of the current IT support is captured. *Monitoring (Part E)* addresses whether utilities implement processes for updating IT and business with operative and strategic changes and asks for utilized measuring methods. *Development and Forecast (Part F)* identifies future actions regarding EAM and asks for the expected value of implementing EAM.

4.2 Discussion of Results

This section presents the results after analyzing the 53 responded questionnaires. The discussion's structure is guided by the parts enumerated in section 4.1 and provides the foundation for deriving implications for ECLORA in section 5.

General Information (Part A): While SME are featured with 19 respondents, 15 employees from major enterprises answered the questionnaire. With 34% the majority of the respondents work in the management. The second big group of respondents (20.8%) came from the IT sector of their enterprise. Further respondents came from Marketing and Sales (13.2%), Accounting (7.5 %), Grid Operations and Services, Technics (both 5.7%), Procurement (3.8%), Corporate Development (1.9%) and Other (no exact statement, 5.7%).

The respondents were able to choose from nine different market roles in utility industry. These roles were derived from [BDE08] and adjusted to the target respondent group, i.e. end consumer or legislative institute were excluded. Since multiple answers were possible, 25 different combinations of market roles were identified in the pool of responding enterprises. Almost every second market role combination has less than 5% share of the total amount of combinations. This indicates a high degree of diversification in utility industry in terms of market role diversification. The diversification is illustrated by Fig. 2.

⁶ cf. <https://www.sosicisurvey.de/>

⁷ cf. <http://www-01.ibm.com/software/de/analytics/spss/>

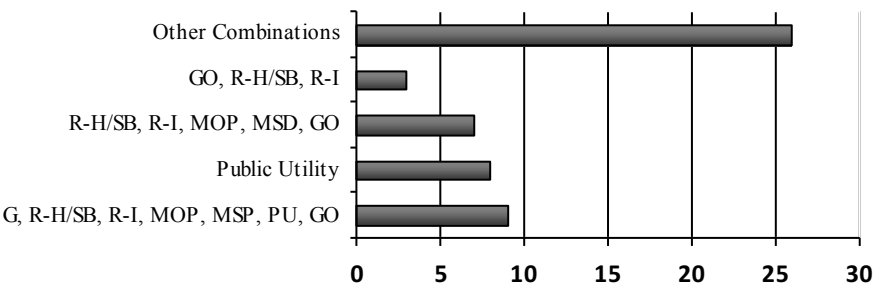


Fig. 2: Combination of Market Roles (G- Generator, GO - Grid Operator, MOP - Metering Point Operator, MSP - Metering Service Provider, PU - Public Utility, R-H/SB - Retailer for Households and Small Businesses, R-I - Retailer for Industry)

Corporate Management and Organization (Part B): Every respondent assessed his knowledge and experience with EAM as well as his opinion about EAM’s importance for an enterprise. None of the respondents rated himself as an expert in EAM practice. Based on all respondents the big majority (61%) is inexperienced with EAM. Still, 72% of the IT respondents are at least beginners. 43% of Marketing and Sales as well as 39% of the management respondents consider themselves as beginners. Considering the amount of respondents, it can be derived that management and IT are the two most EAM aware and experienced departments. 50% of the management rated EAM as important or very important for enterprise success, while 82% of the IT department answered the same. In contrast to the missing experience of EAM, one third of every identified department rated EAM as important. This result is remarkable when contrasting the level of experience to the assessment of EAMs importance, which is visualized in Fig. 3. The variable importance is scaled since the amount of respondents differs per level of experience. With increasing experience of EAM, respondents assess EAM as more important.

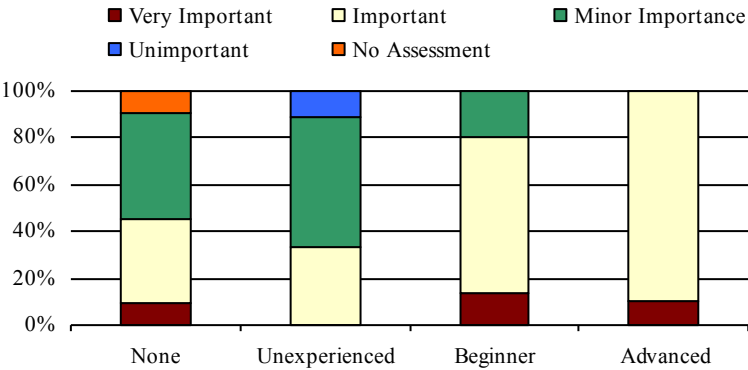


Fig. 3: Importance of EAM by Level of Experience

Only in 41% of the cases the respondents felt able to determine whether EAM has complete management support in their enterprise. While 28% declared they do have support, 13% said they do not. The following three reasons arose for the latter one: *EA Frameworks like TOGAF are too complex*, *EAM is too cost-intensive* and *EAM is too time-consuming*. This indicates, that research may lack in EAM solutions or frameworks tailored for SME. The statistic of EA Framework usage confirms this statement. 77% of the respondent did not make a declaration regarding used EA Frameworks. While COBIT or TOGAF only were mentioned by 5.7%, ITIL is used by 15.1%. Furthermore, this part of the questionnaire indicates what the respondents consider as the most promising benefits when implementing EAM in their enterprises. Especially overcoming complexity (45.3%) and tool support for business process management (41.5%) were mentioned. 35.8% stated that decision support for strategic projects and investments are promising benefits by EAM activities. Likewise advantages like quality management and the review of IT systems and applications were named by 32.1% resp. 30.2%. Further, the respondents had to state their feelings about the following three statements: (1) *Acquisitions and fusions force the harmonization of heterogeneous IT landscapes*, (2) *Movements like Cloud Computing, Offshoring or Outsourcing lead to a distributed IT landscape*. (3) *Regulations and laws cause an increasing IT complexity*. The agreements for these statements were measured using a Likert scale [Nor10]. The result revealed that the majority agreed to all three statements by choosing at least “agree”. In consequence, all these three aspects seem to characterize current developments in utility industry and could be addressed by dint of implementing EAM in SMEs.

Strategy (Part C): In part C the respondents answered questions regarding documentation strategies in their enterprises. 70% assessed their corporate strategy as documented, of which only 49% stated it as available for every employee. 17% named the corporate strategy as undocumented. Further, Business Goals [San14] were documented in 81% of the cases, of which only 58% had access to it. In 7.5% of the cases business goals were not documented at all. The third aspect was the documentation strategy of core processes. They are key activities that must be performed to ensure the enterprises continued competitiveness since it adds primary value to a certain outcome. From 84.9% of documented core processes 53.3% were accessible by the employees. This leads to the statement, that although most enterprises document their strategies, goals and processes, more efforts have to be made in order to provide a transparent strategy, the basis for successful EAM [Ahl12].

The questionnaire further investigated the aspect of core processes in the utility industry. Although 91% of the respondents said that the core processes are supported by information systems, only 22% stated to be delivered sufficiently by enough information and resources. It seems that there is a need for optimizing IT support of the core processes. This statement is supported when contrasting the degree of IT support and the provision of information and resources.

The last aspect was the development of Business Process Outsourcing (BPO). Each respondent was able to choose multiple from given business functions and their sub-

functions. Especially Energy Data Management (28%) and Billing Processes (20%) seem to be frequently outsourced processes in utility industry. Further, Grid Operations (16%) and end-consumer processes (11%) seem to be often outsourced. In general BPO can be stated as an important topic and need to be considered during the development of a reference EA in utility industry.

Operation (Part D): This part focused on Business and IT alignment in the respondents' enterprise. For the analysis of the responses also the results from part C were brought in here. The respondents had to assess to what extent IT and functional departments of their enterprises are collaborating. The in part C identified need for improvement of IT support was not verified at this point. 47.2% of the respondents stated a complete collaboration between IT and functional departments. 49.1% said the collaboration partially existed. Contrasting these results with the questions from part C did not provide an explanation why information and resources provision is lacking. A conclusion of these results could be that even with high collaboration of IT and business, the IT support and resource provision are not automatically satisfying. Thus, the practice of IT and business collaboration might not be optimal and need to be improved.

The central question was to name applications and software solutions related to the given business functions. This contributed especially for elaborating the interrelations among business and information architecture of the TOGAF Framework in ECLORA, which is out of the scope of this work. Generally it can be said that primarily commercial software suites and solutions were used as IT support. SAP, Neutrasoft and Schleupen were identified as the most utilized IT providers.

Monitoring (Part E): In order to capture changes in the enterprise architecture, monitoring is a vital part of EAM. Changes in business processes or responsibilities may have direct impact on operational business and thus need to be identified in order to adjust the EA [Ahl12]. Nevertheless, in 47% of the surveyed enterprises neither a single person nor a department is responsible for this interface activity between IT and business. Only 25% of the enterprises have a responsible role and 11% a department assigned for this.

Most of the enterprises update their corporate strategy, IT strategy and core processes in irregular time intervals. While 40% update their corporate strategy on demand, about 60% analyze their IT strategy and core processes if required. Only 28% of them update their corporate strategy annually. Almost every (96%) respondent stated that no particular measuring methods are used for monitoring. This allows the presumption that monitoring in current utility industry is very reactive instead of being proactive, which would be demanded by EAM.

Development and Forecast (Part F): The last part evaluated in which business functions the respondents ask for simpler IT support. More than 25% mentioned to be satisfied with the current situation. Still, 55% marked several business functions. Especially billing systems, customer relationship management systems as well as document management systems seem to be too complex. Further, it had to be stated which business

functions would get more efficient with better IT and business alignment. This intends to make expectations regarding EAM transparent. For each of the selectable business function multiple sub-functions could be chosen. It can be seen that especially billing processes (23%), end-consumer processes (20%) as well as controlling processes (15%) and energy data management (14%) seem to be expected to benefit most from EAM.

Next to the estimated impacts of EAM, respondents were asked to state which business functions tend to be outsourced in long-term. 86.8% assess current BPO initiatives as sufficient. There is no business area which tends to be generally outsourced in the future of utility industry additionally to the stated ones in Part C.

The last question intended to capture the expectations of utility industry regarding EAM. Again, multiple selections were possible. The following list summarizes the most marked expectations: *more effective utilization of resources* (53%), *detection of demand for action and optimization* (49%), *enhancement of business IT alignment* (43%), *analysis-tool to understand relationships and dependencies in the enterprise* (36%), *reduction of IT costs* (32%).

These results go along with the findings in Part B, where more than 45% said that overcoming IT complexity is enabled by implementing EAM in their enterprises. The results of this part indicate that especially in terms of billing and end-consumer processes EAM will facilitate an optimized resource provision, an enhanced Business-IT-Alignment and cost reduction. Likewise this could apply for Energy Data Management and Controlling Processes.

5 Implications for ECLORA

The analysis of the survey revealed seven major findings that are listed below. For each finding a consequence for the project is derived. The part of the questionnaire, where the finding occurred is indicated in brackets.

I. High Diversification of Market Roles in Utility Industry (Part A): In total, 25 different combinations of market roles were identified. This implies that a utility enterprise's EA partially depends on the market roles it takes. Thus, when identified a market role of the enterprise, configuration rules can be applied in order to tailor the reference architecture to the enterprise.

II. The assessment of EAM's importance for success increases with growing awareness and knowledge of the EAM discipline (Part B): This reveals that utility companies have to be made aware of EAM in order to convey its importance to the management level. Thus, when conducting workshops in ECLORA, knowledge of EAM has to be assessed and contingently imparted to the enterprise.

III. SME Utility Enterprises find EA Frameworks too complex and expensive for their business (Part B): Although there are numerous EA Frameworks available, SME utilities

do not feel supported by them since they address bigger business structure. Thus, there is a lack of EA frameworks that are tailored or can be scaled down to small and medium-sized enterprises. The reference architecture developed in ECLORA tries to address this issue and adjust the TOGAF Framework for SME utilities.

IV. Demand for a Reference EA was validated by the survey (Part B and D): The survey identified three factors that let utilities' EA grow complex. Next to fusions and outsourcing strategies, especially rules and regulations require an advanced flexibility from utilities (68% of the respondents). Further, almost the half of the EAM experienced respondents characterized EAM as a measure to overcome complexity. Together with finding (III) this underlines the demand of SME utilities for EAM.

V. Potential Optimization of IT Support and Communication between IT and other departments (Part C): Although in every case the identified core processes were supported by IT, the majority of respondents neither felt sufficiently delivered with information and resources nor are satisfied with the IT support. This reveals insufficient Business-IT-Alignment. This is addressed by ECLORA by mapping the business architecture with the other layers of the TOGAF Framework.

VI. Business Process Outsourcing is a relevant topic in Utility Industry (Part C): Especially in Energy Data Management and Billing the responding enterprises utilized outsourcing strategies. In order to provide a profound reference EA, mechanisms for configuration need to be developed, that address outsourcing strategies. Further, strategic changes regarding outsourcing have to be dealt with in a flexible manner applying the reference EA.

VII. Monitoring Processes need to be implemented in Utilities (Part E): In almost half of the cases Monitoring was conducted by not even a single person. Further, updating corporate and IT strategy as well as documentation of core processes were revealed as immature. The same applies for measuring methods. Thus, the reference EA also needs to address the implementation of monitoring in order to move utilities from a reactive towards a proactive manner.

6 Conclusion and Outlook

The aim of EAM is to master the complexity of IT and to align it to the enterprise's objectives, its business and also other aspects like laws or regulations [Ah12]. Especially utility industry is expected to be a beneficiary of the integration of EAM since laws such as market liberalization require utilities to act competitive. In the frame of the ECLORA project, a reference EA is developed, which applies reference modelling in order to provide a universal solution for EAM integration in utility industry [Ard13].

Therefore this work analyzed EAM's current state in the utility industry focusing on SMEs. A questionnaire was designed in order to capture utility enterprise's current

awareness of EAM and its benefits (RQ1), present EAM initiatives and resulting experiences (RQ2) and to reason whether there is a demand for a reference Enterprise Architecture in SME utility enterprises (RQ3).

The survey reached 53 respondents, which came from the utilities' management or IT department mainly. Facing RQ1 only respondents from IT can be considered as experienced with EAM. Apart from this, the majority ranked EAM as important for corporate success and named present issues like IT complexity as benefits when integrating EAM. Regarding RQ2 only few and no holistic EAM initiatives were identified. Only a minority of respondents felt sufficiently provided with resources and information and are satisfied with IT support. Further a lack of monitoring actions was captured since in the majority of cases no responsibilities are assigned for monitoring and updating the EA. Although these findings reveal the importance of EAM, common EA frameworks like TOGAF were stated as too complex and cost-intensive for SMEs to implement. Laws and regulations were assessed as IT complexity drivers as well as numerous BPO initiatives cause an increasing heterogeneity of IT. Further, the high diversification of market roles in utility industry accompanies variations of the utilities' corporate strategy and thus their EA. In consequence, a demand for a reference EA in SME utilities was identified (cf. RQ3).

The demanded reference EA needs to be configurable to its application context. Hence, ECLORA will develop the reference EA applying the approach for configurable reference modelling [Bec02]. The implications stated in section 5 will guide the next steps in the solution design phase (cf. section 3): The development of an initial reference EA, based on the results presented, and an additional literature review. This reference will then be validated and redesigned applying it to numerous utility enterprises by conducting multi-day workshops.

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