

# Impact of Solvency II on the Enterprise Architecture of Insurances: A Qualitative Study in Germany

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## Abstract

In 2007, the European commission suggested a new framework directive for insurance companies, called Solvency II. This directive defines a three-Pillar approach regarding Solvency- / Minimum Capital requirements (Pillar I), requirements regarding governance and risk management (Pillar II) and disclosure and transparency requirements (Pillar III). This scientific paper gives an overview of the major challenges and the general impact of Solvency II on the Enterprise Architecture (EA) management of insurance companies. Furthermore, we discover general strategies that were defined for implementing the Solvency II requirements from an IT-perspective. We conduct expert interviews with participants from the insurance sector to discover impacts of Solvency II on the EA. The results can be used to prepare more effective for upcoming projects that refer to regulatory requirements within insurance and related industries.

## 1 An Introduction to Solvency II and Federated EA Model Management

In the 1990s, the European Economic Community defined the “four freedoms” as part of the Internal Movement [2]. These regulations exerted strong pressure on insurance companies concerning shrinking profit and rising underwriting risks [21]. To ensure the solvency of insurance companies by holding a minimum solvency capital, the European commission suggested a new framework directive regarding the solvency of insurance companies [14]. This directive is called Solvency II. Adapted from the Basel II regulations in the banking industry, Solvency II is also built upon a three-Pillar construction [5]. Pillar I deals with the calculation of Solvency / Minimum Capital Requirements (SCR / MCR), which can be interpreted as minimum limits of equity capital that insurer need to have available [19]. Pillar II deals with the controlling of the internal risk management and Pillar III with requirements regarding the reporting [21]. To handle these requirements and regulations, complex calculations based on information distributed in the entire Enterprise Architecture (EA) are required.

An EA embraces business capabilities, processes, applications, and infrastructure, but also cross-cutting aspects like visions, projects, and goals as well as the organizational structure [4]. EA information seeks to describe the relationship between objects within an EA; this information is stored in an EA repository using a coherent model. Information that refers to the running business are stored in databases and Data Warehouses. Recent research describes the challenges that arise in the course of EA model maintenance [23] and propose automation mechanisms that utilize existing information sources within the operative IT environment [4], [8], [24], [25] to enhance the data quality as well as to decrease costs for collecting the information. Once gathered, EA information should serve various

stakeholders as a foundation for decision making. Against these considerations, we advocate that EA management functions are intended to provide means to carry out successful Solvency II projects. Data that needs to be reported to the supervision, e.g. in form of Quantitative Reporting Templates (QRTs), must be identified within the source systems, extracted to calculation / validation tools, and reported to several stakeholders within and outside the company (board members and supervision). EA management may help to fulfill the requirements of Solvency II by providing the required information in an adequate quality, defining organizational processes, data flows and best practices for the selection of Solvency II software and their implementation. Hence, we investigate ongoing Solvency II projects in this paper and provide an overview of major challenges as well as the impact of Solvency II on the EA of German insurance companies. We state the following research questions:

- What are the major EA management challenges when implementing Solvency II?
- What are requirements regarding an EA and its management function?
- What kinds of strategies were defined within the industry for implementing Solvency II requirements from an IT perspective?

The remainder of the paper is structured as follows. Within the next chapter, we outline our research approach taken followed by a brief overview of Solvency II requirements for IT. Subsequently, we report results of an interview series carried out in the German insurance sector. We give an aggregated overview of the impact of Solvency II on EA management and reveal details of two concrete cases. The final part of the paper sums up the impacts and gives an outlook on further research.

## 2 Research Approach

To address above research questions, we apply qualitative research methods [13], [16] in terms of expert interviews carried out in industry. Figure 1 gives an overview of the conducted research approach: First of all we define the scope of research by analyzing current IT-topics in the insurance sector. After that we identify the IT-requirements of Solvency II by analyzing state-of-the-art literature and publications from the industry. Based on this information we write an interview guideline, which will be used to conduct the interviews with the participated experts from the insurance sector. Major issues and findings from the conducted interviews will be evaluated in the last step to identify further research areas in regard of EA in the insurance sector.

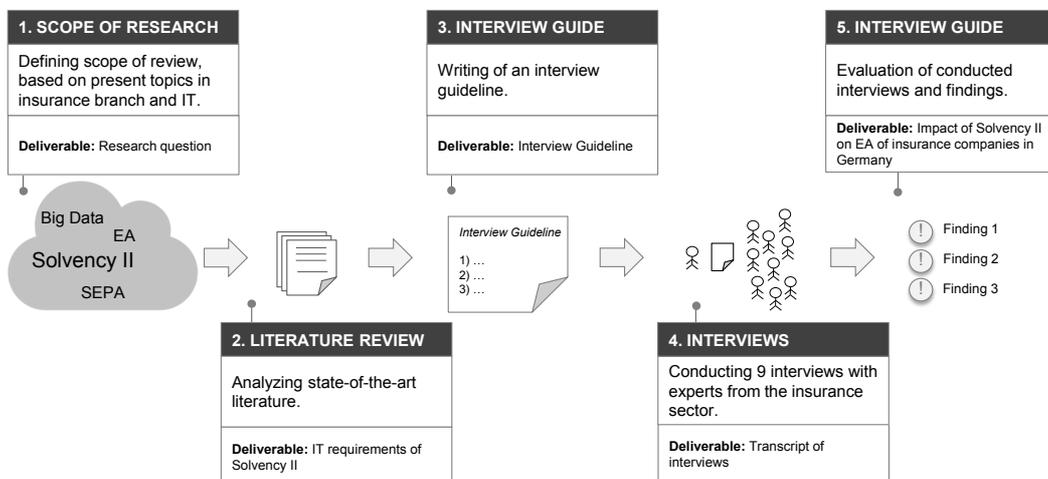


Figure 1: Research approach

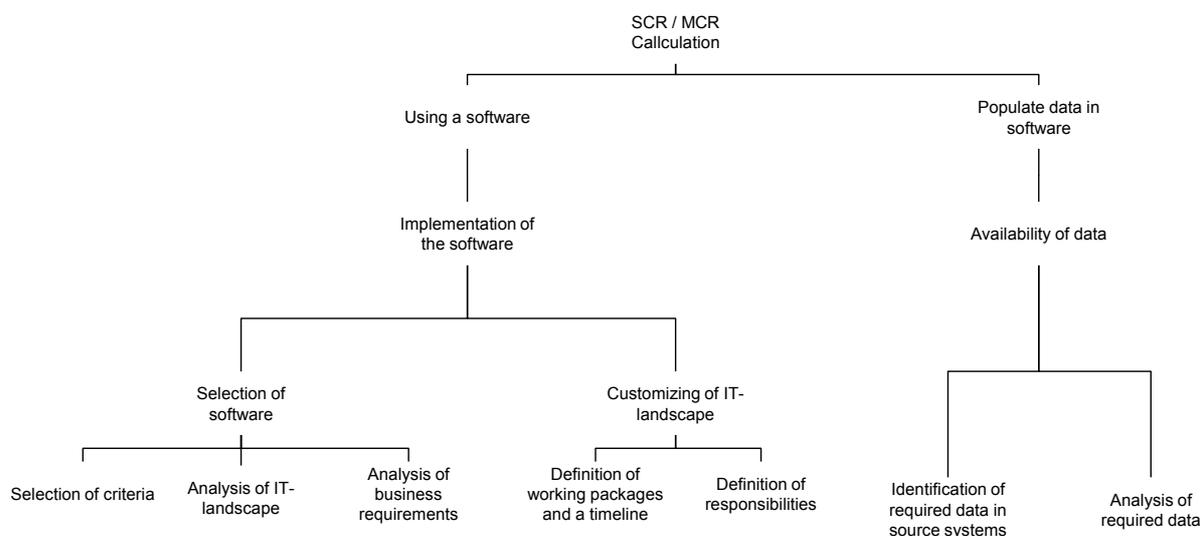
The interviews follows a semi-structured approach to identify new aspects and decisions regarding the implementation of regulatory requirements [16]. The collected information will be analyzed by detecting common behaviour and decisions taken by the participated insurance companies. After we had conducted our interviews, we were able to identify patterns regarding the defined strategies and occurred problems referring to the implementation of the Solvency II requirements [17].

### 3 IT Requirements of Solvency II

In order to meet the business requirements of Solvency II, specific IT requirements have to be fulfilled by the EA. In addition to organizational requirements (e.g. internal data quality processes), the selection and implementation of a Solvency II software and the provision of Solvency II specific information need to be performed by IT and claim the largest expense of the IT requirements.

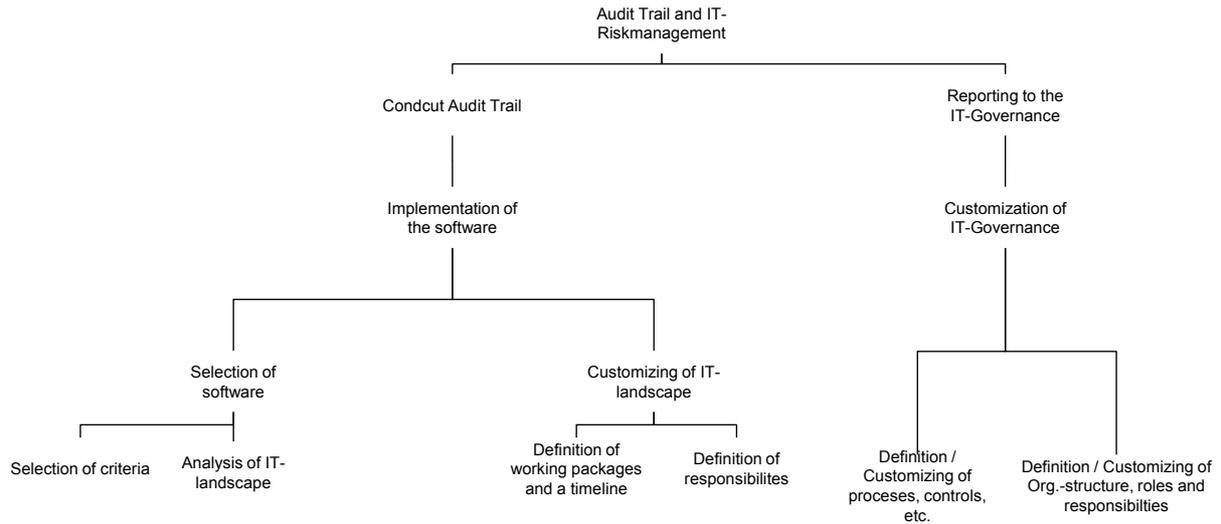
Several experts from the insurance industry have defined the IT-requirements of Solvency II in white papers and other publications [1], [7], [9], [15], [18], [26], [20]. As of today the IT-requirements of Solvency II have not been analyzed in research yet. Figure 2, 3 and 4 show the IT-requirements for Pillar I, I and III in a hierarchic structure.

Pillar I deals with the calculation of the Solvency / Minimum Capital requirements. The calculation of these values will be conducted by using specific Solvency II software and the population of required data into this tool. Figure 2 gives an overview of the sub-requirements, to meet the calculation issue.



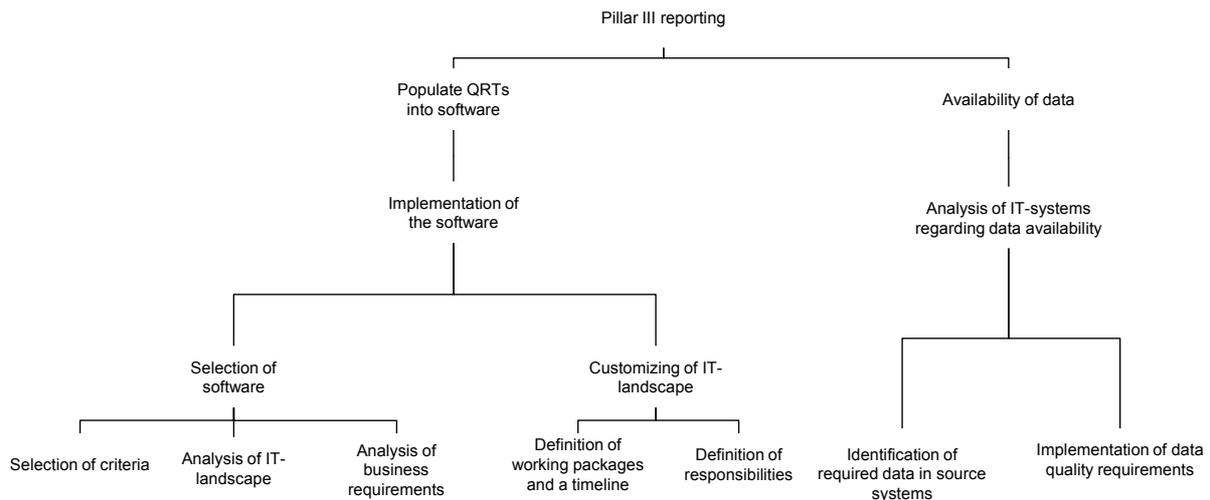
**Figure 2: IT requirements Pillar I**

Risk management issues regarding Solvency II are summed up in the Pillar II. As of today, IT components and processes have a significant impact on the risk management of insurance companies. Thus changes of the IT-environment are required as well. Figure 3 illustrates the IT-requirements of Solvency II in terms of Pillar II.



**Figure 3: IT requirements Pillar II**

Disclosure requirements are summed up in Pillar III and includes the reporting of the QRTs. Insurance companies have to ensure that all required data is available for reporting issues and run several validation actions in specific Solvency II software. Sub-requirements (e.g. Populating QRTs into software, availability of data, etc.) are illustrated in Figure 4.



**Figure 4: IT requirements Pillar III**

Regardless of the differences in terms of business requirements within Pillar I, II or III, the implementation of a software solution is one of the key activities of insurance companies dealing with Solvency II. Furthermore, the availability of data is a mandatory requirement for Pillar I and Pillar III.

## 4 Impact of Solvency II on EA Management in the German Insurance Sector

Table 1 gives an overview of the interviewed participants. We consider persons with different job positions and different types of companies that deal with Solvency II to get various experiences and opinions regarding the implementation of the Solvency II IT-requirements. Furthermore, the field of

activity and the size of the company may impact the complexity of the requirements, particularly data quality requirements.

<i>Job title</i>	<i>Role</i>	<i>Size of company (number of employees)</i>	<i>Field of activity</i>
IT-Architect	Insurance company	~ 3.000	International
Controller, Risk Manager	Insurance company	~ 6.000	National
IT-Architect, IT-Architect	Insurance company	~ 9.000	National
Lead IT-Organization, Executive Assistant	Insurance company	~ 23.000	International
IT-Architect	Insurance company	~ 10.000	International
Project-Lead, Solutions-Architect, Business-Architect, Lead IT-Architecture	Insurance company	~ 4.000	National
Senior Management Consultant	External Service provider	~ 71.000	International
General Manager	Internal Service provider	--	National
Technical Lead Solvency II	Insurance company	~ 14.000	International

**Table 1: Participants of the narrative interviews**

#### 4.1 Data Quality (DQ) problem

In line with [8], [11], [12], [25] our conducted interviews show that data quality is not sufficient in industry and is one of the most challenging issues in case of Solvency II projects.

*7 out of 9 companies have issues with the data quality requirements.* Common problems are:

- *Lack of understanding the business requirements:* Solvency II demands for new information from insurance companies, that were not asked before Solvency II and these requirements were underestimated regarding range and complexity. Furthermore, while proceeding integration tests and validations of the implemented requirements on their testing systems, insurance companies face the problem, that the requirements were not implemented correctly (from a business perspective). So further rectifications are required.
- *Missing data:* Recent work by Grunow et al. [10] and our conducted interviews have shown that companies have to manage the problem of missing data in their enterprise, which is necessary to meet specific requirements: Due to the fact that the required data from the supervision data include information, that were not documented completely by insurance companies, further effort is needed to obtain these information (for instance historical data within the QRTs). Furthermore some information will be estimated by actuarial employees, which could affect the quality of the information.
- *Different data structure:* Buschle et al. show [24] the issue of the defined structure of the QRTs has a data structure (for instance regarding the Line-of-Business structure), which could differ from the current data structure of the insurance companies. These differences could also lead to problems regarding the reporting ability of insurance companies.

#### 4.2 Standard-Software as a leading solution

Insurance companies have the following possibilities to make use of software to fulfill the Pillar I and Pillar III requirements: Standard-software, self-developed software, Microsoft Excel, and a combination thereof. As analyzed by Rands [21], it would be advisable to make use of a self-developed software, when standard solutions cannot be purchased. Each insurance company have its

own data structure and is operating in different business lines with different Line-of-Business structures. The development of an own solution could be more efficient, due to reductions in customizing activities.

*During the conducted interviews it turned out that only 1 out of 9 insurance companies also make use of Microsoft Excel (in addition to a standard software). The other interviewed insurance companies only use standard software to fulfill the Solvency II requirements.* Most of the insurance companies are using standard solutions for Pillar I and Pillar III requirements, mainly established solutions on the market (for instance Steria Mummert SOLVARA or SAS RIMF). Common criteria for the decision of these solutions were the recommendation by business partners, the experience of the software-developers and the huge amount of functionality. Furthermore, automated software-updates, which include changed business requirements, save effort in comparison to a self-development. The software has to fulfill the business requirements of Solvency II and fit into the EA of the organization from an IT-perspective (e.g. interfaces to source systems); technical or business criteria didn't have a significant impact on the choice of the used software.

### **4.3 Communication between business and IT**

To implement the business requirements of Solvency II within the existing EA, IT employees need profound knowledge about the business requirements of Solvency II. A collaboration working between business and IT is needed. *During the interviews, 5 out of 9 companies pointed out problems with the communication between IT and business employees.* On the one hand, IT employees often do not understand how to implement the demanded requirements of the business correctly. On the other hand, business employees do not understand the complexity of changing implemented requirements within the solution regarding the effort (for instance intensive test activities are required). This circumstances lead to implementation failures and errors in the requirements elicitation from a business perspective. At worst the rising amount of failures and errors could lead to a "show stopper" in the project and postpone the timeline of these.

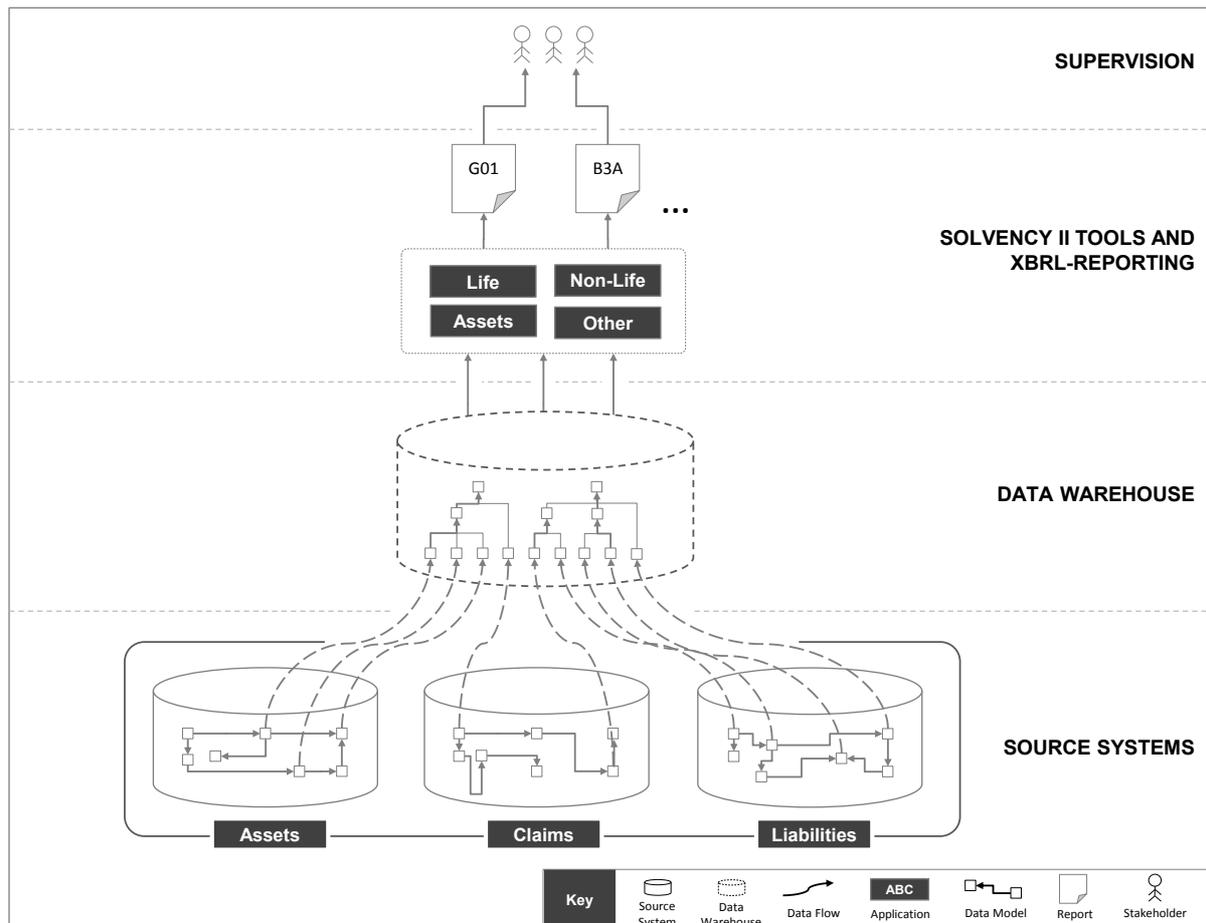
### **4.4 "Moving-Target-Problem" of the defined requirements**

To optimize the defined QRTs, the supervision asks for comments by insurance companies and external service providers [6] and changed the QRTs over time. However, these changes were challenging for insurance companies due to the fact that the changes have to be integrated in already running implemented functions, which lead to further effort. *3 out of 9 interviewed companies had further unplanned effort in fixing implemented IT-requirements due to changes in the business requirements.* Furthermore, the interviewed companies complain about issues within the used software-solutions: The software-developers have to update their software solutions regarding the changed requirements and publish these updates as soon as possible. As a matter of fact the tight time slot has an impact on the correct development of their software (for instance on testing-activities). The gap between the release of changed regulatory requirements and an update of the software solution has an impact on the progress of the project: Insurance companies have to wait for the software updates to continue implementation activities and tests. This also could lead to a postpone timeline of the Solvency II project.

### **4.5 Technical changes within the EA and target IT-landscape**

The implementation of the software solutions and the delivery of the required data to these tools come with technical changes within the EA of insurance companies.

7 out of 9 companies want to make use of a federated approach in their target IT-landscape. Figure 5 illustrates a typical structure for a federated approach to maintain an EA repository [23]. In the context of Solvency II, specific reports have to be generated and presented to the supervision. Typically the calculations are processed by actuarial tools to provide an adequate reporting to the supervision. Depending on the offered products, various tools for different divisions (life, non-life, etc.) are required. To calculate the reporting-values, data from different source systems have to be transferred and transformed for the calculation tools. To provide the information in sufficient quality, the maintenance of an EA repository solution could reduce further effort.



**Figure 4: Future IT-environment in context of Solvency II**

4 out of 9 companies already implemented or started to implement new interfaces from their source systems to extract the required data from these. 3 out of 9 companies are still using a manual delivery of data to their software-solution, either due to the fact that they are still waiting for the finalized data requirements or because they are implementing a group or Solvency II specific Data Warehouse solution.

## 5 Case Studies

The following cases reveal in depth 2 out of the 9 conducted interview surveys in regard of the strategy of implementation, data quality, the role of the IT-architect and the current project status. COMPANY A and COMPANY B illustrate two different strategies regarding the IT-implementation.

	<i>COMPANY A</i>	<i>COMPANY B</i>
<b>General Information</b>	COMPANY A is a insurance company with approx. 6.000 employees and mainly operates in national locations (Germany). The company offers insurance services over several lines of businesses (liability, health, life, etc.).	COMPANY B is a insurance company with approx. 9.000 employees and only operates in Germany. The focus of their business is insurance services for public sector and services in the private sector (all line of businesses).
<b>General Strategy of Implementation</b>	The company starts at an early stage with Solvency II. In 2003 the company started to analyze and participate in surveys and studies regarding Solvency II from the supervision, but did not rush into implementation activities. The strategy focuses more on knowledge creation and preparation of requirements. For instance, the decision for a Solvency II - tool was made later than 80% of industry partners. IT was involved during the tool selection process and analysis activities of the EA.	The company initiated a Solvency II project in 2012. The project was divided into several (approx. 7) sub-projects with different business issues (life, non-life, etc.) IT did not possess any responsibility role. All issues regarding IT were allocated to finance. Furthermore every business department decided for implementing own software-solution. In the end, four different solutions were being planned in order to deal with the business requirements of Solvency II. Every sub-project mainly worked on its own goals.
<b>Data Quality Issue</b>	Due to the fact, that COMPANY A started to deal with Solvency II requirements on an early stage, it got enough time preparing for upcoming business requirements. Furthermore the company is implementing a Data Warehouse solution at the time of writing in order to simplify reporting preparation in the future.	The case of COMPANY B described, that some data was not available at this time. Furthermore, using four different software solutions to deal with the requirements lead to a higher effort in regard to the implementation and data validation. The implementation of a Data Warehouse solution is on discussion now.
<b>Role of IT-Architects</b>	IT-Architects have a characteristic role within the Solvency II project: They are wholly responsible for analyzing and planning the future state of the EA (the future IT-landscape) and recommend appropriate software solutions to fulfill the requirements of the business regarding Pillar I and Pillar III.	IT-Architects have weak responsibility within the Solvency II project: All activities, which have to strongly be coordinated with IT-Architects or IT-employees, were proceeded by every line of business on its own. For instance, the decision to implement different software solution and the definition of appropriate interfaces to guarantee the correct data extraction from the source and feeder systems were made by business responsibilities.

<b>Current Project-Status</b>	COMPANY A is on a good way to have the ability to report Solvency II data to the supervisory body in future. Most of the data quality issues are solved in appropriate manners and the future IT-landscape has successfully been defined. Only little adjustments are planned to be executed within the next months.	COMPANY B has major problems with implementing Solvency II requirements. Experience has shown that the chosen strategy – to implement the Solvency II requirements without IT support – may lead to major problems within the EA regarding data quality issues and further effort (e.g. implementing different types of software solutions). The project is currently “on hold”.
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COMPANY A starts at a very early stage with analyzing the requirements of Solvency II to avoid data quality issues. IT-Architects constitute a significant role in terms of planning and designing the future state of the EA. The project has a satisfactory status. In contrast, COMPANY B starts a Solvency II project at a much later stage. The availability of all required information, which needs to be reported to the supervision, is not given at current stage. It turns out that the exclusion of IT-Architects in strategic decisions – for instance the choice of Solvency II software – leads to significant issues regarding project success: COMPANY B chooses several Solvency II software solutions, whereas each Business Unit selects its own. Major issues were identified during the aggregation of the software results. IT responsibilities mentioned that the choice of only one software solution as a Single Point of Truth reduce the effort (for instance data cleansing).

## 6 Discussion

The conducted interviews show different strategies in the implementation of the Solvency II requirements. On one hand, some insurance companies start early with implementing the Solvency II requirements in the EA. But on the other hand, some insurance companies decided to wait with the implementation of the requirements, until the supervision publishes the final requirements.

Insurance companies are discussing on implementing a new Data Warehouse solution for Solvency II issues. The implementation of a Data Warehouse solution could reduce effort of data availability and validation in context of Solvency II. The defined data structure could be used to implement further regulatory requirements, for instance IFRS 4 Phase 2. Most insurance companies decided to work with a new Data Warehouse initiative (on group level or Solvency II specific) to improve the enterprise data quality; other insurance companies are still in discussion regarding this topic. Nevertheless the majority of the participants agree that the implementation of Data Warehouse solution is a mandatory within the setup of the EA of insurance companies: It represents the best solution regarding a central repository with integrated information from all departments within an organization.

Furthermore the results show that insurance companies mainly use standard software solutions for the data extraction, risk calculations, and validations and reporting purposes. But technical criteria (e.g. functionality of the software) are not the main driver of this decision: The implementation of the Solvency II requirements is a complex challenge and needs a lot of effort from an IT-perspective. Insurance companies don't use individual software or only Microsoft Excel based solutions for Solvency II purposes, because they don't want to take the risk of software failures (e.g. missing updates, performance issues) and spend more money for the market leaders with more experience and competence on this area.

## 7 Conclusion and Further Work

This paper provides a qualitative analysis of EA challenges in today's insurance companies regarding regulatory requirements in the specific context of Solvency II. The information gathered from the interview emphasized that data quality is one of the most challenging issues for insurance companies referring to EA: The huge amount of required data and its complexity challenges insurance companies in terms of data provision and reporting ability. Most of the interviewed insurance companies consider the possibility to introduce a group Data Warehouse solution with high quality and granular data in order to reduce further efforts for implementation (e.g. IFRS 4 Phase 2). The implementation of a group Data Warehouse would demand major changes referring to the EA (e.g. introduction of new interfaces, mapping tables, data models, etc.).

Regarding the defined strategic direction of implementing the Solvency II requirements, the findings illustrate that continuous employment with upcoming regulatory requirements is necessary to fully understand the business requirements and to prepare the implementation thereof. Nevertheless, without implementing these from the beginning and considering changes of the requirements that already have been implemented, this could lead to unplanned and high effort regarding the implementation.

Additionally, the communication between business and IT also needs to be improved to guarantee a successful implementation. The setup of a project glossary and a specific process model in implementing regulatory requirements could considerably support the project outcome. Our results are limited on 9 cases. To consolidate the results, further analyses are required.

It turns out that Solvency II requirements come along with common IT – requirements (e.g. selection and implementation of software solution, data quality analysis, definition of target EA).

Further research could examine best practices for knowledge creation regarding business requirements by IT and business (e.g. data quality aspect) and analysis solutions for Data Warehouses regarding regulatory requirements. Thereby, the efforts should account for different organizational factors like the size of the business, the structure of the business, EA management experience, availability of data and the underlying source- and feeder-systems.

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