# A Reference Enterprise Architecture for Holistic Compliance Management in the Financial Sector

*Completed Research Paper*

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## Abstract

*Since the global financial crisis from 2007, an increasing number of regulatory requirements has forced financial institutions to implement a holistic and efficient approach for regulatory compliance management (RCM). The state of practice in financial institutions is characterized by various and segregated compliance programs. Research and practice identify an absence of a holistic RCM approach that captures the impact of legal requirements on financial institutions from organizational and information systems (IS) perspectives. Using a design science research (DSR) approach, we develop a reference compliance organization (R-CO) that uses enterprise architecture concepts to provide such a holistic solution. The contributions of our work are (i) a problem investigation of industrial needs, (ii) the R-CO model that proposes a solution for such needs, (iii) the application of the R-CO in two use cases, and (iv) the R-CO's evolution during evaluation episodes according to the Framework for Evaluation in DSR (FEDS).*

**Keywords:** Reference Enterprise Architecture, Reference Model, Regulatory Compliance Management, Reference Compliance Organization, Enterprise Architecture

## Introduction

Due to the increased number of regulations on national, European and international level in the financial sector, financial institutions are forced to implement a coherent Governance, Risk and Compliance (GRC) program (Abdullah et al. 2010). Racz et al. (2010) define GRC as an "*integrated, holistic approach [...] ensuring that an organization acts ethically correct and in accordance with its risk appetite, internal policies and external regulations through the alignment of strategy, processes, technology and people*". The compliance function of an institution herein has the objective to identify relevant regulatory requirements and to facilitate adherence to these obligations (Mills 2008). As this task is termed as regulatory compliance management (RCM), Kharbili (2012) defines it as the management "*...of ensuring that enterprises (data, processes, organization, etc.) are structured and behave in accordance with the regulations that apply, i.e., with the guidelines specified in the regulations*".

Practitioners and researchers agree that financial institutions currently do not approach RCM in a holistic manner and rather implement isolated compliance solutions due to the plethora of short-term deadlines (Cleven and Winter 2009; Gozman and Currie 2015). Such compliance solutions typically consist of organizational structures and processes supported by IS and IT-based instruments (Cleven and Winter 2009). A potential way for moving towards more integrated or holistic compliance solutions is to provide a reference model (RM) for the financial industry as a normative guide. Experiences from other industrial areas show that RMs can provide an accepted guideline that further supports adaptation to future regulatory changes.

Research work reported in this paper had the ambition not to start "top-down" from existing regulations and their "translation" into actable compliance solutions but to analyze established practices in financial institutions and a "bottom-up" distillation of a RM from these practices. Such a "bottom-up" approach not only circumvents the obstacle to interpret opaque legal texts, but also reveals insights based on experiences from practice as demanded by the literature (Akhigbe et al. 2015). However, this approach leads to numerous challenges. This includes the method for developing the RM, the kind and quantity of financial institutions to analyze, the method for capturing best practices, and the approach to structure and document the resulting RM. As a holistic RCM is required to capture both organizational structures and an IS perspective, we employ insights from the enterprise architecture (EA) research domain. The EA community provides methods and tools to establish a holistic perspective on organizations (Ahlemann et al. 2012). EA models represent different architectural layers of an enterprise, such as business, application and technology architecture (Lankhorst 2017). Since EA projects are highly time- and resource-consuming, financial institutions would benefit from such a RM that incorporates EA structures. Consequently, the artifact presented in this work is a domain-specific Reference Enterprise Architecture (R-EA), which is defined as a generic EA for a class of enterprises that is used as a foundation in the design and realization of a concrete EA (van der Beek, Wijke ten Harmsen et al. 2012).

In the remainder of this article, we present a Reference Compliance Organization (R-CO) that represents an R-EA in the RCM domain of financial institutions. The R-CO is developed using design science research (DSR), as documented in the next section. Afterwards, we explicate the problem addressed by the R-CO and elicit a set of functional and non-functional requirements. In the main part, we document the construction process of the R-CO, in which we applied and adjusted methods from the RM research domain. Then, we present the resulting artefact in detail and provide a framework for its application. Before concluding our work with general implications on practice and research as well as future research potential, we report on the evaluation strategy that was applied throughout the DSR process.

## Research Method

The main objective of this research is to design a RM for IT-based compliance in financial industries that supports organizational and technological implementation of regulatory compliance and fulfils industry needs. We decomposed this objective into four research questions (RQ) to structure and guide the research activities required:

- **RQ1**. What are the current problems in RCM for institutions in financial industries and the requirements to a potential solution?
- **RQ2.** Which methods are available for developing the R-CO and how should they be adjusted in order to meet the identified requirements?
- **RQ3.** How should a stable and standardized R-CO be shaped?
- **RQ4.** What benefits and drawbacks does the R-CO possess?

Our research work addresses the above RQs by structuring it in terms of the DSR methodology proposed by Peffers et al. (2007) since it aims at designing a complex new artefact (i.e. the R-CO model) and at acquiring new knowledge (e.g. discovering established practices in financial industries as a basis for the R-CO; demonstrating the use of the architecture to assess its strengths and limitations). Peffers et al. (2007) propose a process for DSR projects consisting of five activities, which we performed as follows.

The first activity is *problem identification and motivation.* We performed a literature study to investigate the existing body of knowledge in the field of RCM in financial industries (see next section). The results of this study indicated the need for the R-CO, spanning both organizational and information technological aspects. The business relevance was confirmed in the interview study performed as part of identifying objectives (activity 2) and designing the R-CO (activity 3). Activity 2 is to *define the objectives for a solution.* Objectives for the design of the R-CO originated in our case from using three instruments: focus group, interview study and literature review. Our research was funded by a group of 9 companies organized in a committee of a German IT-association. The companies' representatives are experienced in the field of IT-based compliance and contributed objectives of the solution, which were captured in a focus group-like setting. The interview study consisted so far of 64 phone interviews (each interview between 60 and 110 minutes) with compliance officers and other experts of financial institutions about their practices and their view on missing elements in IT-based compliance. The "missing elements" are

input to the objectives; practices are a basis for activity 3 of the DSR process, the *design and development* of the actual artefact. The fourth activity is the *demonstration*, that the artifact actually solves the problem. We performed expert interviews with consultants from enterprises providing IT-based compliance solutions. Activity 5, *evaluation*, has the intention to observe and measure how well the artifact supports the solution to the given problem. Therefore, we conducted validation workshops with the industrial partners funding the project. Moreover, the R-CO was applied and then evaluated by both an independent IS vendor (ISV) as well as a German savings bank.

# Problem Investigation

One of the most important aims of problem investigation in a DSR project is to establish relevance of the problem for research and industrial practice and to identify the root causes of the problem. Therefore, we analyzed literature for relevant approaches and research gaps mentioned by other authors. On this basis and with insights from industrial settings, we then explicate this work's problem statement and define requirements towards its solution. Thus, this section contributes to RQ1.

### *Related Work: Information Systems in Regulatory Compliance Management*

In order to identify relevant related literature we used the Scopus and Google Scholar databases to search for two kinds of peer-reviewed articles. First, we identified meta-reviews or literature analyses in the field of RCM from an IS perspective. We analyzed the results, such as Akhigbe et al. (2015) or Cleven and Winter (2009), to get an overview of current research activities and identified first articles that are closely related to our research objective. Second, we used the same databases to expand related work by searching for "*regulatory compliance*", "*compliance management*" and "*finance\**" in combination with "*information system\**" and "*enterprise architecture*". We analyzed these results and further conducted for- and backward search on relevant articles, according to Webster and Watson (2002). We only selected literature that approached RCM topics from an IS point of view. The remainder of this section summarizes our findings and concludes requirements research stated in terms of holistic RCM.

There exist numerous systematic literature reviews and meta-analyses in IS research on RCM. Akhigbe et al. (2015) analyze the results of fourteen literature reviews that focus on RCM of business processes. As a result, they require future IS research to focus on real-life regulatory compliance scenarios and compliance enactment tasks, i.e. mechanisms to dynamically react to violation occurrences to re-establish compliance. Cleven and Winter (2009) focus on a broader and more aggregated perspective by including articles beyond business process management. Using the concept of EAM for their theoretical framework, they map the identified articles to the several EA layers. Their work reveals that there exists no holistic approach covering all EA layers. Abdullah et al. (2010) use expert interviews and a literature review to identify gaps between industry challenges and research solutions in RCM. They derive the need for benchmark studies, RMs and knowledge of appropriate IT support. Volonino et al. (2004) highlight that holistic RCM has to be considered enterprise-wide and is beyond simply complying with certain rules. In contrast, it was about developing an integrated approach by identifying all relevant organizational elements and the relationships among them. In reality, financial institutions tend to implement isolated compliance solutions due to short-term deadlines set by regulators (Gozman and Currie 2015). The question arises, how to realize such a holistic and enterprise-wide RCM.

Concrete contributions are made in the field of legal requirements engineering, where methods are suggested (Boella et al. 2014) and modeling language are developed (Ghanavati et al. 2014) to systematically capture regulatory requirements. Other authors investigate the regulatory impact on organizational and operational structures. For instance, researchers and practitioners map different legal interpretations to processes and rules on the web-based knowledge management system *Eunomos* (Boella et al. 2013). Further, Kharbili (2012) introduces a conceptual framework for RCM in the domain of business process management. Some research investigates RM in the RCM domain. Becker et al. (2010) provide a first methodological sketch how RMs may be used by financial institutions to meet legal requirements. Timm et al. (2016) go further and develop a reference process model for customer identification in the context of anti-money laundering directives but lack the integration of practical knowledge. Schlosser et al. (2014) present a functional RM for better business-IT alignment by defining requirements for rule-based IS solution in the regulatory context. On a more global perspective, Foorthuis and Bos (2011) provide a strategical framework for implementing compliance means in an organization.

However, their high-level approach lacks concrete means of implementations. In contrast to the prior mentioned literature, Gozman and Currie (2015) focus on the perspective of financial institutions. By conducting a long-term study with several institutions they derive eight IS capabilities, which are necessary to implement a holistic GRC initiative. Their capability framework agrees with the need for a holistic RCM. Likewise, it emphasizes the vital role of IS in the context of RCM.

We identified the following core requirements mentioned by IS research in the RCM domain: the need to include practical knowledge from financial institutions in RCM solutions (Abdullah et al. 2010; Akhigbe et al. 2015); a more holistic approach for RCM realization (Cleven and Winter 2009); the need for RMs that support the implementation of such a solution (Akhigbe et al. 2015; Cleven and Winter 2009); and more transparency on sufficient IT support in RCM scenarios (Abdullah et al. 2010).

## *Problem Statement and Requirements Elicitation*

After the review on IS literature, we performed two industry-related activities as part of problem investigation: evaluation of an earlier project with financial institutions and a focus group with ISVs.

The earlier project had the aim to develop a best practice description for performing case management for anti-money laundry (AML) programs in large banks. The project partners were the German bank association and a private university in the field of GRC. The project resulted in a best practice recommendation certified by the supervision authority in Germany and covering organizational roles, process descriptions and aids, such as lists of embargo countries. When evaluating these results, we had access to the documentation and contact to the developers. Two researchers independently of each other scanned the documents for relevant information the problem at hand. The results were compared and verified in discussions with the developers. The core insights were that it was feasible to develop the best practice descriptions based on established practices in the domain, the financial institutions were willing to apply the results and found them beneficial, and there is a need for integrating an IT perspective into the best practices to ease the implementation and for continuous updates of the descriptions. Although this was the view of only one association of financial institutions, we consider it as support for the overall problem relevance from an institution's perspective. In summary, this activity revealed the following requirements: the R-CO needs to rely on practical insights rather than regulatory texts; it needs to reveal the potential of appropriate IT support; and the R-CO's distribution must integrate with the agendas of banking federations for successful application on institutional level.

The focus group consisted of 9 ISVs, which were members in a working group (WG) for compliance in the financial sector in a German IT-association. One WG meeting in early 2016 was dedicated to discuss integration between different IT solutions in the compliance field, the effects of changed or new regulations on these solutions and how the ISVs perceive the demand of their clients (i.e., the financial institutions). The participating researchers took notes during the meeting, captured flipchart and whiteboard content, and collected slide decks the participants contributed to the meeting. The main conclusions were that the vendors look for mechanisms to make their products more robust against changing regulations, expect new business opportunities in the regulatory technology domain by integrating different tools along the value chain, and want to use existing data for learning. Further, the ISVs felt a substantial demand from their clients for better integration of RCM processes and tools. We identified the following requirements for R-CO development: the R-CO must be resilient towards regulatory changes; it must reveal synergies of different RCM domains and support exploitation of synergy potential; and the R-CO must consist of a profound data perspective.

In summary, these results confirmed the view of the scientific literature that there is a need for a holistic perspective (organization and IT) on compliance, a lack of robustness in current solutions and a need for implementation of regulatory changes. Furthermore, it confirmed our conjecture that financial institutions as well as ISVs consider this a highly relevant problem. Consequently, we argue that both would benefit from a RM for financial compliance, which captures a holistic RCM from organizational and IS perspectives. Therefore, we suggest the R-CO as a solution for this problem.

Based on the initial list of requirements towards the R-CO we conducted several focus group meetings within the WG to identify and validate the industrial requirements towards the R-CO. To further capture the perspective of financial institutions, we conducted interviews with representatives from four different German banking federations. Afterwards, mapped the requirements identified in the literature with the

insights from practitioners. Table 1 illustrates resulting list of consolidated requirements. It shows each requirement's source and defines its type. Therefore, we use the types of requirements defined by Johannesson and Perjons (2014) who distinguish between functional, environmental and structural requirements.

| # | REQ Description | Source | Requirement Type |
|---|---|---|---|
| **REQ1** | R-CO must reveal interrelations among RCM processes, data structures and IT systems. | ISVs, Federations, Literature | Functional |
| **REQ2** | R-CO needs to combine regulatory requirements with knowledge from their actual practical implementations. | ISVs, Federations, Literature | Functional |
| **REQ3** | R-CO has to be representative for the German legal sphere regarding financial regulations. | ISVs | environmental (generality) |
| **REQ4** | The application contexts of the R-CO needs to be investigated. | ISVs, Federations, | environmental (usability, customizability) |
| **REQ5** | The R-CO model has to provide a logical and consistent structure. Its content has to correspond with regulatory requirements. | ISVs | Structural (consistence), environmental (correctness) |

**Table 1. Functional and Environmental Requirements towards the R-CO**

## Constructing the R-CO

The reference modeling research domain investigates RM methods for construction and application. Although this discipline is widely established in IS research and provides numerous approaches for RM construction, there is a lack of a commonly accepted definition of the RM term. As depicted by Fettke and Loos (2006), there exist several definitions. Thomas (2005) understands a RM as "an information model used for supporting the construction of other models." In general, it addresses a problem of a certain application class (e.g. a group of enterprises) and provides an applicable solution. The purpose of its development is to be reused in by its application class to improve effectiveness and efficiency of IS development (Fettke and Loos 2006). In order to define the notion of RMs more precisely, IS research discusses the characteristics universality, recommendation and reusability (Fettke and Loos 2006; Schütte 1998; Vom Brocke 2006). While these three characteristics sharpen the concept of RM, the former two are neither measurable nor can they be verified by objective reasoning. Consequently, Thomas (2005) and Vom Brocke (2006) argue that only the actual application of a RM to an enterprise-specific model and its acceptance within the problem domain defines the essence of a RM. Although this is in line with our understanding of the developed R-CO, we still consider universality and recommendation as important aspects of the R-CO. From a life cycle perspective, IS research distinguishes between the phases of RM construction and RM application (Fettke and Loos 2006). During RM construction, the RM is developed and prepared for its application by the RM designer. Afterwards, the RM user applies the model to his or her concrete use case in the application phase. The IS research domain provides numerous methods for RM construction. While some approaches are tailored to the development of certain RM types—such as configurable reference process models (Becker et al. 2002)—we used the more generic construction method from Schütte (1998). He defines a cyclic procedure model, which comprises of five phases: *(i) problem definition, (ii) model frame construction, (iii) model structure construction, (iv) model completion,* and *(v) application.*

The remainder of this section documents how we adjusted these phases for developing the R-CO. Further, we discuss the characteristics universality and recommendation. In doing so, the subsequent two sections contribute to RQ2. The R-CO's reusability is elaborated in the next section.

## Addressed Problem and Model Frame of the R-CO

In phase *(i) problem definition* the RM's problem domain and application class is defined (Schütte 1998). During *(ii) model frame construction,* one has to identify the aspects the RM needs to integrate to properly address the problem. An appropriate modeling language is chosen. The objective of the R-CO is to provide a stable and standardized information model that represents holistic RCM. The model has to

address the need of financial institutions and ISVs in the German legal sphere to provide recommendation from both organizational and IT perspectives and to reveal their interplay with each other. In concrete, the R-CO's objective is based on the functional requirements delineated in the previous section. RMs can be composed of different model structures (Fettke and Loos 2006). From the work of Cleven and Winter (2009) we draw the conclusion that EA management (EAM) provides necessary means to meet the requirements towards the R-CO. In general, EAM aims to maintain flexibility, cost efficiency and transparency within an enterprise. It addresses effective and efficient business-IT-alignment (Ahlemann et al. 2012). In this context, an EA model provides a holistic view on an organization capturing business related elements, information structures, IT landscape, and the relations among these concepts (Lankhorst 2017). In consequence, we identify EA modeling languages appropriate to capture the RCM holistically. This is further supported since EAM addresses the different dimensions of IS capabilities mentioned by Gozman and Currie (2015) like the alignment among business, regulation and IT, data management, IT sourcing management, and which are in line with EAM related objectives (Ahlemann et al. 2012; Lankhorst 2017). There exist a plethora of EA frameworks (Bui 2017). Constructing the R-CO, we followed The Open Group Architecture Framework (TOGAF) because it is widely accepted (The Open Group 2010). In concrete, we utilize the well-established ArchiMate modeling language in version 3.0.1 that is based on TOGAF (The Open Group 2016). From a modeling perspective, EAM looks at an enterprise from difference angles. TOGAF differentiates between business, data, application, and technology layer. In consultation with the compliance experts from the focus group, we decided to exclude the technology layer. This is argued with the fact that it mainly covers infrastructural elements (e.g. hardware or system software) and, thus, is highly specific for each financial institution and therefore out of scope of a holistic compliance organization.

## Structure Forming and Knowledge Elicitation for R-CO Construction

Schütte (1998) defines the phase of *(iii) model structure construction* to gather and structure the necessary RM content based on the prior described RM frame. He mainly describes reference process models and reference data models as results of this phase. Thereafter, the phase of *(iv) model completion* interrelates them with each other. At this point, we adjusted Schütte's method for several reasons. First, the method does not provide concrete means to elicit the necessary R-CO content. Thus, we consulted other related work to develop an appropriate strategy for knowledge elicitation. Second, we already interrelated business, data and application layer with each other in ArchiMate, while we gathered the information. Third, we conducted separate elicitation rounds for various RCM domains covered by the R-CO. Last, each elicitation round resulted in a single iteration loop that was followed by each other (see *Activity (B)* in Figure 1). We integrated these independent R-CO parts with each other afterwards.

For knowledge elicitation, research discusses two generic strategies. While deductive reference modeling derives RMs from generally accepted knowledge, the inductive approach abstracts from individual models to agree on a common understanding within the RM. Most established RMs have been developed based on deductive approaches (Ardalani et al. 2013). However, inductive reference modeling offers higher validity since it analyzes a higher amount of data from practice—e.g. in terms of process logs or concrete enterprise information models. Further, inductively developed RMs have a higher degree of detail, are more mature, and seem to be more accepted when it comes to RM application (Rehse et al. 2016). Recent research in the reference modeling domain provides first methodological support for inductive RM construction and proposes approaches to abstract from a set of individual models to a RM (Fettke 2014; Martens et al. 2015; Rehse et al. 2016; Rehse and Fettke 2017; Yahya et al. 2012). After acquiring data from a representative sample of enterprises from the problem domain, the models are harmonized in terms of syntax and semantics. Subsequently, a RM is derived from the set of individual models.

The construction process of the R-CO deployed both deductive and inductive methods. After deductively developing a first R-CO model structure in ArchiMate, we applied inductive techniques to include practical compliance knowledge from the perspective of financial institutions. We argue that using such in-depth information from practitioners enhances the R-CO's universality and recommendatory character. Using a representative sample of participants from the German financial sector, the final R-CO offers more generally valid information than deriving it from regulatory texts or expert knowledge. Further, a sufficient sample size improves the significance of the R-CO's recommendatory character, such as representing best practices.

Figure 1 illustrates the concrete construction process. It has its foundation in a prior developed method for R-EA development (Timm et al. 2017). The procedure is divided into the three activities *(A) R-CO structure development, (B) R-CO reference elicitation* and *(C) R-CO model integration.* During activity (A), we deductively constructed the R-CO model structure. Therefore, we used three different sources. First, we analyzed RCM related literature and legislative texts. Second, we conducted expert interviews with the ISVs from the focus group. Third, we conducted interviews with employees of four German banking federations. As displayed in Table 2, we interviewed three federations from German credit institutions and one federation from the financial services domain. This resulted in an initial R-CO containing an overview on the general organizational structure of a compliance department and high-level compliance functions. Moreover, we identified RCM related demands perceived in practice that were mentioned by the interviewees. The core findings were that German banking federations demanded more support in the regulative topics of Anti-Money Laundering (AML), Customer Identification (also "Know Your Customer", abbr. KYC) and Fraud Prevention. In concrete, we identified an absence of systematic implementations of these regulatory topics and a lack in appropriate IT support.

In activity (B), we inductively developed the R-CO. Based on identified demands from practice, the focus group decided to capture the three regulatory topics of AML, KYC and Fraud. Implementing an AML program, financial institutions are obliged to identify and report money-laundering activities in their customer base. Fraud prevention addresses the detection of other criminal activities, such as corruption or treason. Furthermore, institutions are required to identify their clients thoroughly (KYC—Know Your Customer). This becomes a complex and time-consuming task, especially considering complex organizational structures of business clients. For each of these three topics we conducted an iterative loop of inductive reference modeling. An iteration consisted of the same procedure. First, an interview study with German financial institutions was conducted, in which we interviewed compliance officers and AML officers. Second, we developed an individual EA model for each interview using ArchiMate. Third, we applied RM abstraction techniques to derive an R-EA for each of the domains. These three steps align with the seven stages of the method for inductive reference modeling proposed in (Rehse et al. 2016). While the preparation and data collection are performed during the interview study, the stage of preprocessing relates to our step of individual model construction. The acquisition of the reference model and its post-processing is conducting in the third step of reference abstraction. Further, both R-CO's evaluation and enhancement is part of activity (C).
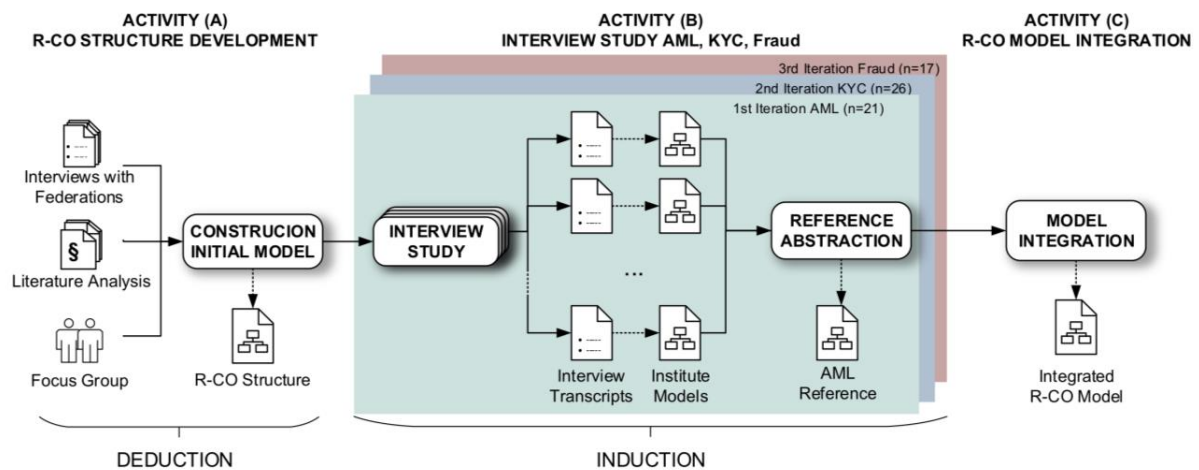


**Figure 1. Combining deductive and inductive methods for R-CO construction**

During these three iterations, we conducted 64 interviews. For each we collected qualitative data that revealed how the institutions implemented the respective regulatory requirements in their daily practice. Questions addressed all relevant EA layers, i.e. business, data and application perspective. We used standardized questionnaires that contained open, multiple and single choice questions. The questionnaires were developed consulting the domain knowledge of the focus group. Pre-tests were conducted with one domain expert for all three questionnaires. Table 2 summarizes the sample sizes of the three studies. It reveals the representativeness of interviewed institutions for the German financial

sector. For structuring the sector, we referred to the definitions from §1 of the German Banking Act (KWG). Credit institutions were further divided by their federations based on the directory of the German Central Bank (2018). We deliberately excluded financial holding institutions, payment service provider and insurances from the sample because the focus group decided to focus on classic institutions.

| Type by Regulation | Type by Federation | Activity (A) | Activity (B) | | |
|---|---|---|---|---|---|
| | | Federations | AML | KYC | Fraud |
| **Credit Institutions** | Credit Banks | 3 | 6 | 10 | 3 |
| | Savings Banks | | 5 | 8 | 3 |
| | Mutual Banks | | 5 | 3 | 6 |
| | Mortgage Banks | | 0 | 1 | 0 |
| | Building Society | | 1 | 0 | 0 |
| **Financial Services Institution** | | 1 | 4 | 4 | 5 |
| | Σ | **4** | **21** | **26** | **17** |

**Table 2. Sample of the Interview Studies by Type of Financial Institution**

Two researchers conducted the development of the individual models. Based on the interviews' transcripts, potential model elements were identified and first models emerged. During several modeling sessions, the researchers defined modeling conventions and agreed on a universal EA structure for each AML, KYC and Fraud models. We used the ArchiMate viewpoint concept to define these structures. Relating to a certain stakeholder's concern, a viewpoint is a certain perspective on an EA model and projects relevant EA model elements and relations with regard to the concern (Lankhorst 2017). For instance, one viewpoint illustrates used data for the monitoring of a customer's transactions in terms of AML. The researchers reviewed the models among each other. Afterwards, the individual models were harmonized. In doing so, elements with the same semantics were labeled identically and corresponding model parts used the same level of granularity. For RM abstraction, we applied two approaches. On the one hand, the minimal cost of change approach by Ardalani et al. (2013) was adjusted to identify common practices among the individual models. On the other hand, we modified the method proposed by Scholta (2016) for identifying best practices (Timm et al. 2018). Consequently, the R-CO's recommendatory character provides both industry's common and best RCM practices. While R-CO's common practices primarily become apparent in essential compliance tasks and vital data for risk calculation, it consists of additional data fields and software applications that embody identified best practices.

After conducting the three inductive iteration loops, we integrated all three R-EA models into the initial R-CO structure during activity (C). Again, during several modeling sessions the two researchers identified similarities of the sub-models. Inter alia, this process revealed mutual data objects used by the different domains. Especially most data objects from KYC processes form the basis to monitor customers' behavior to identify AML patterns. Not only were each of the sub-models validated but also the resulting R-CO model. The concrete evaluation documented in the evaluation section.

## A Reference Compliance Organization

### *Structure and Model Presentation*

The previous section outlined how we used EA concepts to construct the R-CO. This section aims to explain the overall R-CO structure and presents a certain extract of it. Thus, it contributes to RQ3. The model was developed using ArchiMate meta-model in version 3.0.1. The R-CO uses the following ArchiMate elements: involved business roles, business functions and processes, compliance-related data objects, supporting application components, and relations among those elements. As visualized by Figure 2, the R-CO uses ArchiMate's viewpoint concept for its overall structure. Each rectangle represents a certain model view, which addresses a certain concern of the R-CO.
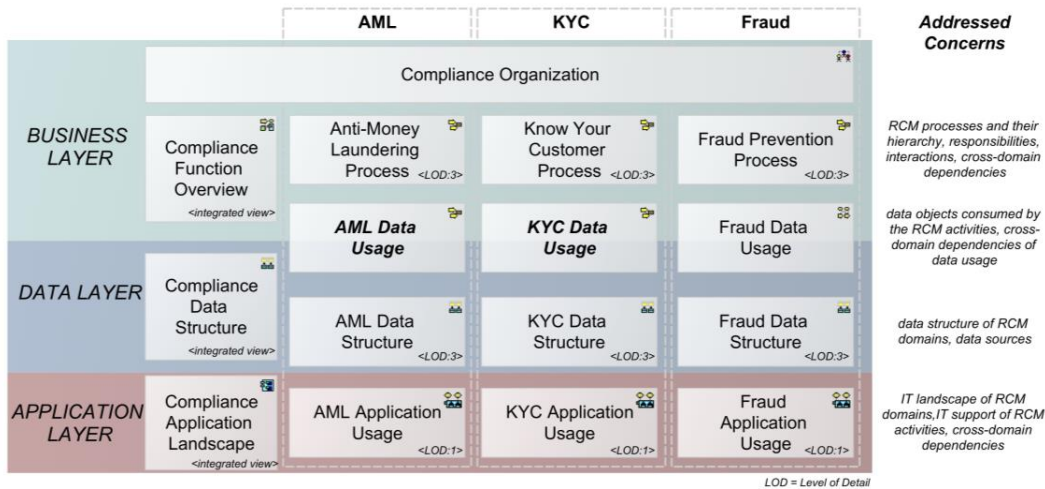
**Figure 2. Overview of the R-CO Model Structure**

For means of coherence, each RCM domain uses the similar set of model views. For instance, the R-CO defines a data usage view for AML, KYC and Fraud. It reveals the data processed for the completion of certain business functions and processes. Vertically read, Figure 2 illustrates the different TOGAF layers. Horizontally read, it shows the several regulatory domains AML, KYC and Fraud. Some R-CO views address concerns related to a single ArchiMate layer (e.g. information structure), while some reveal interrelations between two layers (e.g. data usage). The right column summarizes general concerns addressed by the R-CO. Next to these domain-specific views, the R-CO provides integrated views (e.g. "compliance organization"). These aggregate the R-CO elements across all RCM domains in order to generate the demanded holistic overview on RCM. One view may consist of up to three different layers of detail (indicated by *"LOD"* of each view). For example, the "AML information structure" view contains over 200 data objects with three levels of detail. Moreover, the "Fraud Prevention Process" view structures 243 business function in three levels of detail. While this structure origins in ArchiMate's core framework, other perspectives on the R-CO are provided. For instance, the R-CO business layer can be structure by dint of the Three Lines of Defense model. It distinguishes between risk mitigating activities at the front office, the back office and processes for internal auditing. Although its effectiveness for risk management is not yet proven, it is widely used by compliance organizations of financial institutions (Davies and Zhivitskaya 2018). In additional ArchiMate views, the R-CO provides such an overview for each regulatory domain.

To present the R-CO in more detail, we visualize an integrated view of the R-CO in Figure 3. As indicated in Figure 2 (bold italic views), we integrated the AML Data Usage and KYC Data Usage view into an integrated data usage view. For clarity reasons, this is just an extract from the view. It does not concentrate on a certain control flow but reveals data objects (green) created or read by business functions (yellow). Further, it shows responsible business roles (blue). On the top of the figure, the view indicates the domain (KYC or AML) of displayed business functions. On the one handy, two main tasks of an AML program are to conduct a hazard analysis and to monitor operational activities for AML case identification (upper right). On the other hand, part of the KYC program is to identify business clients by its legal and natural persons, and to assess each client to a risk profile based on the institution's risk model (upper left). Each function accesses or writes several data objects. The figure highlights some of these access relations. This example reveals dependencies among different RCM domains from an IS perspective. For instance, the *risk classification* relies on an updated and correct *risk model from the hazard analysis (a)* in order to *assess the client's risk* properly *(b)*. Furthermore, the subsequently defined *client's risk profile (c)* is essential for a thorough *monitoring of the client's transaction (d)* activities because monitoring rules are sensible to the client's current risk level. For instance, political exposed persons, such as diplomats, are high-risk clients by default. Up to now, the R-CO can further identify what IT systems are related to this dependencies and an R-CO user may identify that this dependency is considered in his RCM.
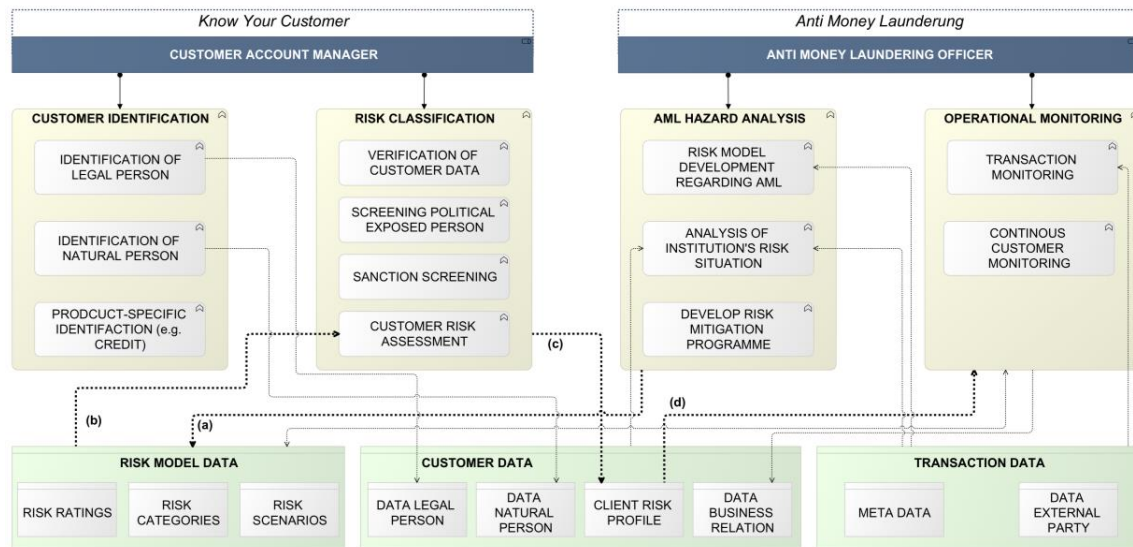
**Figure 3. Integrated Data Usage View between KYC and AML domains (extract)**

## A Framework for R-CO Reuse

Although IS research distinguishes between RM construction and RM application, these phases are closely interconnected. The RM designer may have concrete beliefs how the RM has to be applied. Meanwhile, the user of the RM can have a different perception of the model's value (Vom Brocke 2006). This problem is explicated by Fettke (2008), Höhnel et al. (2006) and Wolf (2001). All authors highlight that the application of a RM to a specific use case is highly context-dependent and requires implicit knowledge. In order to explicate this R-CO application knowledge, we define a framework that supports communication among RM designer and RM users. We argue that such a framework systemizes the reusability of the R-CO. As a foundation, we identify the following aspects for RM reusability in IS literature:

- **Explication of RM stakeholders.** The communication task between RM designer and user can be enhanced, when the RM directly addresses a certain set of stakeholders, who can be derived from the RM's application class (Vom Brocke 2006).
- **The RM value perceived by the RM user.** In order to justify the application effort, the RM has to provide a certain value to its user. Although there is a lack of empirical evidence to determine the value of RM, research agrees that is RM usage increases IS development effectivity and efficiency (Fettke and Loos 2006). The following economic effects are discussed: a decrease in costs; a decrease of modeling time for enterprise-specific models; an increase of model quality; a competitive advantage; and a decrease in modeling risks (Becker et al. 2002; Fettke and Loos 2006; Schütte 1998).
- **Different application scenarios of the RM**. Within its problem domain, there may exist various RM application scenarios, which should be made explicit (Höhnel et al. 2006).

Based on these aspects, we provide a framework for the R-CO's reuse. While the R-CO's stakeholders were identified in the phase of problem definition, the other two aspects emerged in remaining construction activities. The R-CO addresses four stakeholders: (i) financial institutions; (ii) independent software vendors (ISVs) that develop on compliance-related solutions; (iii) business consultancies active in the financial sector; and (iv) accountancy firms. While the former two stakeholders actually used the R-CO in their context, the latter two emerged as potential R-CO stakeholders, but did not act as R-CO users so far.

The R-CO value perceived by these R-CO stakeholders may vary depending on the concrete application context. Concerning the above-mentioned economic effects, we claim the following advantages when applying the R-CO:

- **Cost reduction:** Applying the R-CO helps institutions to avoid penalty charges as well as a reduction of development costs for regulation-specific software development.

- **Quality Improvement:** Transforming isolated RCM solutions into an integrated and IS supported state by applying best practice approaches enhances the RCM's quality.
- **Risk mitigation**: The application of the R-CO mitigates the risk of the institution's reputational and financial damage in case of an unidentified case of money laundering or fraud.
- **Time/ Effort reduction:** Applying the R-CO saves the time and effort to build a holistic RCM from scratch or to implement regulatory changes manually.

We argue that comprehensive application scenarios need to relate to addressed stakeholders and provided RM values. Therefore, we define five R-CO application scenarios. They are designed based on the problem statement, the three interview studies during the construction process, and discussions observed during focus group meetings. Table 3 relates them to addressed stakeholders and a value proposition. The first three scenarios directly relate to the R-CO objective and result from problem investigation at the beginning of this RM project. In scenario (I), a financial institution can improve its RCM by investigating differences between its individual approach and recommendations of the R-CO. From a more general perspective, the R-CO further can be used to (II) build or extend a RCM approach. In this case, the R-CO serves as a blueprint for building a coherent RCM approach or the implementation of a new regulatory topic. From the perspective of ISVs, the content of the R-CO can be used to (III) improve existing or develop new compliance software. For instance, the data layer may be used to improve the software's maturity. Further, integrated views reveal potential new markets for ISVs. The latter two application scenarios (IV) and (V) emerged during the R-CO development. During sessions of the focus groups, the high-level views of the R-CO were used to discuss implications of new regulations for the RCM of the financial sector—even though these were not captured by the R-CO yet. Further, the interviewed compliance officers and ISVs were interested to use the R-CO as a tool for training their employees.

Since the R-CO captures multiple EA layers and RCM topics, the extent to which it is actually applied may also vary. Fettke (2008) defines five dimensions of RM application, which can be transferred to the R-CO: breadth, detail, depth, volume and use of language. The R-CO covers different regulations like AML or Fraud. They can be applied altogether or separately as R-CO modules (breadth). Further, the R-CO consists of several levels of detail. While in one application context an aggregated model may be sufficient, another may require the detailed R-CO application (detail). Then, financial institutions or other RM users may intend to extend the application to their business partners in order to trigger some synergy effects (depth). Still, the RM user could also just realize certain segments of the R-CO (volume) or use another terminology for the phenomena described in the R-CO (use of language).

| # | Application Scenario | Stakeholder | Related RM Value |
|---|---|---|---|
| **(I)** | GAP Analysis with Individual Models | Financial institution | • risk mitigation<br>• RCM quality improvement |
| **(II)** | Building/ Extending a coherent RCM | Financial institution | • cost and time reduction<br>• risk mitigation<br>• RCM quality improvement |
| **(III)** | Improvement/ Development of Compliance Software | ISV | • decrease of development time<br>• product quality improvement |
| **(IV)** | Analysis of new regulations | Financial institution, ISV, consultancy, auditing | • decrease time of implementation<br>• improve integration quality |
| **(V)** | Personnel Training | institutions, ISV, consultancies, auditing | • knowledge transfer<br>• risk mitigation |

**Table 3. Application Scenarios of R-CO**

To date, we applied the R-CO model in two distinct uses cases. In the first use case, application scenario (I) was applied by a German savings bank. The overall objective of the R-CO application was to identify gaps between the bank's as-is situation and the R-CO regarding two specific segments of the model: the identification of business clients from the KYC module and the processing of suspected cases from the AML module. For the actual application, two members of the research team conducted a two-day workshop at the bank. The bank's long-standing compliance officer and AML manager, as well as his deputy represented the R-CO user. In essence, the first day captured the bank's current practice of the two processes, while the second day's purpose was to conduct the gap analysis with the R-CO. We recorded

the bank's situation using participative modeling sessions with the help of a bulletin board and facilitator's toolbox (Stirna et al. 2007). Afterwards, these materials were translated into an ArchiMate model following R-CO structure. Then, a professional modeling tool was used to conduct a gap analysis between the bank's as-is model with the R-CO's respective views. The tool helped to visualize the similarities and differences of the models and proofed to be a very conducive approach to trigger reasoning about them. In short, the R-CO user assessed the possibility to compare a bank's current state with the R-CO as very valuable. Most parts of the R-CO user's AML and KYC program proofed to be valid. Still, the gap analysis revealed potential weaknesses. Most of all, the user stated that the holistic but still detailed R-CO model improved understanding interrelations among the different RCM domains.

In the second use case, an ISV used application scenario (III) in order to develop a new compliance software product. The ISV provides IT solutions for payment transaction to financial institutions from the German financial sector. The initial idea to use the R-CO was to identify potential new markets by analyzing the common practice of AML. Therefore, the ISV especially consulted the business and data layer of the R-CO's AML module with the help of one member of the research team. Various ideas were generated during a workshop day, from which one specific product idea was concretized. This idea was based on a lack of IT support in a certain part of the AML reporting process (another main task of the AML program). The R-CO was further consulted for data, which needs to be processed in this activity. In the end, the ISV applied the R-CO to develop a new product for AML case management. The tool supports banks to document AML case investigation thoroughly, which, hitherto, was mainly conducted manually.

## Model Evaluation

During the construction process of the R-CO, we implemented various evaluation activities at certain points in time, which validated the chosen activities, the R-CO's structural foundation as well as its scope and content. The following documentation of these activities contributes to RQ4. For evaluating these aspects, we applied the Framework for Evaluation in DSR (FEDS) by Venable et al. (2016). The framework distinguishes between two orthogonal dimensions of DSR evaluations. First, with regard to its functional purpose, an evaluation can be formative or summative. Second, the framework identifies the underlying paradigm of an evaluation to be either artificial or naturalistic. According to Venable et al. (2016), a thorough DSR evaluation originates from a state of formative and artificial evaluation methods to a more fully and realistic evaluation scenario using summative and naturalistic methods. The transition from one state to the other is defined by a corresponding evaluation strategy. Our DSR project constructs a RM, which aims to capture best practices RCM from organizational and IS perspective. Thus, the main goals of evaluating the R-CO were to ensure its rigor (i.e. its efficacy and effectiveness in the financial sector) and to reduce the design uncertainties related to the R-CO construction process. We defined four evaluation episodes. We first conducted a formative evaluation in an artificial setting before scaling up to naturalistic settings with a summative purpose. Table 4 summarizes them.

| # | Functional Purpose | Paradigm of Study | Method | Focus | Addressed REQ |
|---|---|---|---|---|---|
| 1 | Formative | Artificial | Criteria-based analysis | R-CO Structure | REQ1, REQ3, REQ5 |
| 2 | Formative | Naturalistic | Focus Group | Construction Process, Interview Sample | REQ1, REQ2, REQ3, REQ5 |
| 3 | Formative | Naturalistic | Expert Interviews (8x) | Correctness of AML, KYC and Fraud module | REQ1, REQ4, REQ5 |
| 4 | Summative | Naturalistic | Action Research | Reusability (Bank Perspective) | REQ1, REQ2, REQ3, REQ4, REQ5 |
| | | | Case Study | Reusability (ISV Perspective) | |

**Table 4. Evaluation Episodes during the development of the R-CO**

**Episode 1**. The initial R-CO structure was deduced using literature from the RCM domain, expert knowledge and interview transcripts, as depicted in Figure 1. In a formative-artificial setting compliance experts from outside the project's working group checked, whether the initial R-CO's structure fulfilled REQ1, REQ3 and REQ5. During this episode, the experts examined the appropriateness of high-level elements from the initial R-CO, which represented overall compliance functions of a financial institution,

a general compliance data structure, and prior identified IT solutions. While the general R-CO structure was assessed to be appropriate to the regulatory landscape in terms of compliance functions (REQ1), the results of this episode helped to revise the initial R-CO's data layer and improved the organizational model of a compliance department of a financial institution. In the experts' understanding, this resulted in a revised R-CO structure, which represented a high-level German compliance organization (REQ3). Moreover, the general approach to use EA models to capture both organizational and IS aspects was considered adequate (REQ5).

**Episode 2**. One of the highest design risks originated from the construction process of the R-CO since it combined deductive and inductive reference modeling methods and required a long time span. Therefore, we integrated an evaluation after developing the first R-CO module for AML. In a formative-naturalistic setting, the IS vendors evaluated the resulting AML module of the R-CO within a meeting of the focus group, in which we participated. REQ1, REQ2, REQ3 and REQ5 were evaluated. While the ISVs concluded that the model consistently captured all architectural layers (REQ1 and REQ5) and adequately represented both regulatory requirements and practical knowledge (REQ2), they judged the sample of interviewed institutions as too narrow. Thus, we extended the pool of interviewed practitioners (REQ3).

**Episode 3.** After finalizing the three rounds of induction (see Figure 1), we evaluated the resulting R-CO's structural coherence and consistence as well as its correctness (REQ5). Further, it was investigated, whether all necessary interrelations among organizational and IS perspectives were integrated in the R-CO (REQ1). Therefore, we conducted eight validation workshops with 18 experts from seven ISVs. The participants ranged from compliance software product managers to IT developers and IT consultants as well as chief executives. Based on a standardized questionnaire, we discussed each element of the R-CO and their meaning, relevance and relation to other elements. One workshop lasted one day, whereby each module of AML, KYC and Fraud was evaluated at least four times in total. As a result, R-CO's level of detail was assessed sufficient. Further, the participants estimated the model to be coherent across the different modules. The core result of this episodes was an improved R-CO model, since the experts' knowledge was used to answer open modeling questions (e.g. the relations among elements) and corrected mistakes, which emerged during the modeling process (e.g. misunderstood answers during the interview study). Moreover, a first application design of the R-CO was discussed at the end of each workshop (REQ4). This resulted in an advanced list of potential application contexts of the R-CO as summarized in Table 3.

**Episode 4.** The final R-CO model was applied in two separate summative-naturalistic settings. The main goal of this evaluation was to evaluate the R-CO's effectiveness, i.e. that it works in a real situation, where it is used in an application scenario addressed by the R-CO (as defined by Table 3). Thus, all requirements were evaluated in this episode. In a first application case, we conducted action research at a German savings bank. On a two-day workshop with focus on AML and KYC related processes and IT solutions, a gap analyses between the R-CO and the current situation of the savings bank was conducted. After the workshop, we interviewed the participants about the R-CO's reusability (REQ4) and correctness (REQ5). They stated that the gap analysis helped them to identify room for improvement in their RCM approach. Even though their compliance processes—namely customer identification and AML case management— were thoroughly implemented, the detailed data layer and its relations with the different domains of the business layer helped them to structure their RCM from a more holistic perspective (REQ1 and REQ3). The compliance officer especially named the R-CO's expressive power and the visualized gap analysis as a reason to apply it. In the second application case, a case study was conducted. An ISV applied the R-CO to develop a new compliance software product for AML case documentation. In the application case, the R-CO was used to identify potential new markets in the field of RCM. The R-CO revealed that a prior developed IT solution of the ISV may cover a certain need for IS support in the process of AML case management. The identified need was validated by the ISV's customer base. Afterwards, the ISV emphasized the advantage of the R-CO to discover synergies using the integrated perspective of different RCM domains that expands the legal demands by practical experience (REQ2).

All in all, both the ISVs involved in the focus group and the financial institutions we consulted during and after the R-CO construction stated that the developed R-CO provides a solution for holistic and robust RCM, which incorporates and interrelates organizational and IS concepts. Based on the evaluation's insights presented above, we argue that the R-CO not only seems to be a universally valid RM with a recommendatory character, but also was already reused by two different stakeholders. Thus, according to

Thomas (2005) and Vom Brocke (2006) we are legitimated to call the R-CO a RM. Further, the initially defined requirements REQ1-REQ5 have been meet. However, some drawbacks have been identified, too. So far, our research did not cover the economic perspective on the R-CO, i.e. how costly the application of the R-CO in certain application scenarios is and how to assess the effort to maintain the R-CO. Further, not all scenarios mentioned in Table 3 have been evaluated yet. Thus, scenarios (II), (IV) and (V) are still open for discussion. In addition, in both application cases at least one R-CO designer was involved. This leads to the question, whether the R-CO is expressive enough to be applied by the R-CO user alone.

## Conclusion & Implications

Research work presented in this paper addressed the construction of a Reference Enterprise Architecture for the domain of IT-based compliance in the financial sector in a research process following the Design Science Research paradigm. By conducting a problem investigation based on related literature and insights from a focus group of domain experts, we define a set of requirements towards a reference model (RM) for holistic regulatory compliance management (RCM) in the financial sector (RQ1). Subsequently, we investigate and adjust methods from the reference modeling research discipline to develop a Reference Compliance Organization (R-CO). The essential empirical basis for R-CO construction were enterprise architecture (EA) models of 64 financial institutions developed from individual interviews capturing the practices in the field and 8 expert statements from ISVs about IS in the field (RQ2). After presenting the R-CO's structure, we discuss and exemplify the benefits of using EA structures and provide a framework that systemizes the R-CO's application (RQ3). The results of the four evaluation episodes performed give reason to believe that the artefact developed in the research process, i.e. the actual R-CO, solves the business problems from both target groups, which motivated the research (RQ4). From an ISV perspective, support was required to position their existing products in the compliance landscape and identify innovation potential and possibilities for new products. From a financial institution perspective, best practices integrating organizational and IS aspects were required as support for implementing and maintaining compliance solutions. Success in both application scenarios makes us think that the R-CO is an important tool to overcome challenges of the financial service RCM, in which several stakeholders operate that differ in their intentions and expectation regarding regulatory compliance practice.

Two obvious conclusions from our work are that it is not possible to rely solely on regulatory texts or domain requirements for developing an efficient R-CO, but that it is possible to develop a valid R-CO by induction from practice. Regulatory text does not provide sufficient guidance how to implement an adequate R-CO. In particular, the distribution and operationalization of organizational responsibilities, avoiding costly media manual data collection and adapting processes with too high efficiency losses is difficult. This was confirmed in the interviews with financial institutions. The established practice in institutions turned out to be similar enough to allow for finding a common denominator on a sufficiently detailed refinement level, which makes the reference an actual "best practice", and at the same time clearly different from each other when considering the actual details to require an abstraction. Using the R-CO as a basis, we also showed that dependencies among the distinct RCM domains can be derived by generating new model views based on such concerns ("What data does both KYC and AML process/share with each other and where is it stored?", cf. Figure 3). The R-CO also proved to support cooperation among the different focus group's members (ISVs and consultancies).

The advantage of the R-CO not only covering the business layer but also the data and application layers comes on first sight with the disadvantage of higher efforts caused by higher complexity (as compared to a RM covering the business layer only), both for its development and maintenance. Only if a sufficient number of financial institutions applies and the R-CO contributes to its maintenance and shares experiences, the higher efforts will pay back. Although the participating ISVs and financial institutions were convinced of the viability of this approach, this economic perspective stills leads to the implication that either a community-based approach or a business model for R-CO distribution and maintenance is required. For the R-EA developed in our project, a cluster organization is expected to take this role.

Although there are a few developments addressing general architectures of IS in banking, such as BIAN (BIAN 2018), there seems to be an absence of a holistic solution for RCM in the financial sector on an international level: Thorough analysis of related work and numerous discussions with experts from ISV and financial institutions did not reveal such an international RCM or standardization effort. Thus, in the following we discuss generalizability of our results beyond our empirical basis Germany. With exception

of REQ3, we consider all requirements identified to be relevant for any holistic RCM approach. Consequently, the methodological approach we present with this work is transferable to similar problems. Prior research shows that the used method can be applied to other domains like the utility industry with some alterations (Timm et al. 2017). Nevertheless, it has to be observed that the R-CO's empirical basis is limited to qualitative data from German institutions. While this is arguably the main limitation of our research, we understand the R-CO to be still of significant value for the implementation of a holistic RCM outside Europe. From several consultations with the focus group's experts, we conclude that the R-CO's overall structure is valid to institutions beyond the European legal sphere. While the high-level business, data and application layers of the R-CO structure were evaluated to be transferable to other regulatory spheres, R-CO models of higher granularity presumably need to be adjusted to local specifics. This especially applies to the business and data layer. Of course, such an application of the R-CO is not a trivial task and therefore needs to be investigated in future research.

Moreover, the implications for research in other compliance contexts can be discussed. The need for implementing RCM may originate from different sources, such as regulatory bodies, standards and codes of practice, or contractual agreements with business partners, defining different compliance contexts. Regulatory compliance in the financial sector forms a different compliance context than regulatory compliance in the energy sector or healthcare industries, as the objectives of the regulation, the control objectives and usually also the domain and subject of regulation are different. Despite these differences, it can be observed that most compliance contexts require the implementation of management systems with defined processes, organizational roles and instruments. Our work in the compliance context of financial regulation showed that an EA is a suitable way to capture the different elements of such a management system including the mutual dependencies, and that a R-CO has the potential to serve as best practice for the domain. Other compliance contexts might benefit from this experience and explore the suitability of the EA approach and the feasibility of creating a RM. Problems observed in focusing on process-compliance only, such as difficulties to capture dependencies between different roles or processes, are addressed by our work. Furthermore, such crimes that are as wide-ranging as money laundering and fraud do not solely relate to the financial sector. For instance, money-laundering cases often relate to other industries such as real estate or trade in goods. Thus, European regulation equally demands organization of other industries to implement means for AML. While we understand high-level content of the R-CO to be applicable to such industries, further investigation is necessary to evaluate this assumption. Nevertheless, the current R-CO will serve as a useful starting point for such an endeavor.

Future work in this field can take different directions, including the investigation of cost-benefit aspects, potential business models or transferability to other compliance contexts, as discussed above. However, two observations from our research and hypotheses derived from these observations are from our opinion the most interesting ones. First, the usage of R-CO enhances the resilience against future changes in regulation from the perspective of financial institutions. Our conjecture is that design principles from software architectures or RMs are helpful for making architectures more robust against changes by, e.g., designing the data layer in a way that dependencies of elements in other layers on the data layer are minimized. As an effect, regulatory changes leading to changed data collection requirements would affect less parts of the R-CO. Second, the usage of R-CO improves the interaction among the different stakeholder groups in the financial regulatory domain (i.e. institutions, regulator, ISVs, consultancies, domain syndicates, and auditing companies) which shortens the timeframe required until a new regulation can be in effect and the efforts required for implementation. Improved interaction and some degree of cooperation would open for "co-design" of regulations and their implementation.

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