Enterprise Risk Management: insights on emerging risks from the German banking sector

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Abstract

IT innovations have reshaped banking and will continue to do so. They are a manifestation of indispensable progress, yet risks emerge from IT innovations. Historic data and accounts of emerging risk experiences are rather scarce. Hence, they present a special challenge to risk management as they are hard to identify. Moreover, traditional risk management practices, relying on historic data, may not be fully adequate.

What solutions can be offered by risk management to manage these risks? When is an uncertainty understood as an emerging risk? Who needs to be involved in the risk management process?

The research asks the seemingly obvious question, yet this important topic has been regularly neglected in academics as well as in practice. Both literature and theoretical basis have only recently developed so as of yet there is little availability of varying viewpoints and reliable theories. 70% of the banks interviewed do not actively consider emerging risks in their risk management process. The banks take a reluctant position in general, waiting to see how things develop. Only three banks have a proactive approach and manage emerging risks from IT innovation in using an enterprise-wide approach such as Enterprise Risk Management (ERM).

Therefore, this work develops a conceptual framework which aims to fill the research gap between ERM as an approach to holistic portfolio risk management and the lack of academic and practical work on emerging risks. The conceptual framework explores how banks can apply ERM to manage emerging risks in the future. Researching this topical phenomenon, extending today's common application and understanding of emerging risks and ERM in practice and academia is one of the most challenging tasks confronting future risk management (Bromiley *et al*., 2015). To the author’s knowledge, this project is one of the first to take this challenge.

Acknowledgment

Thank you to my advisory committee, Prof Trevor Buck, Prof Thomas Peisl, and Dr Matthew Bonnett, for their guidance. Their hard work and commitment to my growth as a scholar enabled me to complete my dissertation and grow intellectually.

Thank you, to the staff at the Napier Doctorate of Business Management Program for their help on my research and ensuring that my doctoral studies were enjoyable.

Thank you to the participants of the study for their time and input.

Thank you to my husband and my parents for supporting this journey all the way.

I dedicate this research to our son Nathan, who turns one year old as I am writing this. I hope he will enjoy learning and academic studies as much as I do.

I enjoyed every second of this academical journey.

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Abbreviation

API	Application Programming Interface
BaFin	Bundesanstalt für Finanzdienstleistungsaufsicht
BCBS	Basel Committee on Banking Supervision
BilMoG	Bilanzrechtsmodernisierungsgesetz, Accounting Law Modernization Act
C	Consultant
CAQDAS	Computer-Assisted Qualitative Data Analysis Software
CAS	Casualty Actuarial Society
CEO	Chief Executive Officer
CFO	Chief Information Officer
CobiT	Control Objectives for IT and related Technology
COSO	Committee of Sponsoring Organizations of the Treadway Commission
CRO	Chief Risk Officer
EBA	European Banking Authority
ECB	European Central Bank
ERM	Enterprise Risk Management
ETA	Event tree analysis
FFSA	Federal Financial Supervisory Authority
FSB	Financial Stability Board
GCC	German Commercial Code
G-SIBs	Global Systemically Important Banks
IAA	International Actuarial Association
IEC	International Electrotechnical Commission
IIA	Institute of Internal Auditors
IM	IT Manager
iNTeg-Risk	Early Recognition, Monitoring and Integrated Management of Emerging, New Technology related Risks
IRGC	International Risk Governance Council
ISACA	Information Systems Audit and Control
ISO	International Organization for Standardization

IT.....	Information Technology
MaRisk	Minimum Requirements for Risk Management for Banks and Financial Services Institutions (Mindestanforderungen an das Risikomanagement von Banken und Finanzdienstleistungs-instituten – MaRisk).
Quali.	Qualitative
RBS	Royal Bank of Scotland
RIMS.....	Risk and Insurance Management Society
RM	Risk Manager
SandP/ASX 200.....	Standard and Poor's Australian Securities Exchange 200 Index

1 Introduction

Appearances are a glimpse of the unseen.
Das Sichtbare der Welt eröffnet uns die Schau ins Unsichtbare.
Anaxagoras, 500–428 B.C.[1]

IT innovation is a manifestation of the imperative progress in banks, but it is also prone to risks (Ali *et al*., 2014; Bhargava, 2014; Roland Berger, 2015). IT innovation is not a new phenomenon, but its current scale and potential impact on banks certainly is (Price and Adams, 2015). Historic data and accounts of experience are rather rare, which leave its emerging risks as largely unknown (Häckel *et al.,* 2015; RIMS, 2010). Such emerging risks present a special challenge to risk management as they are hard to identify. Moreover, traditional risk management practices, relying on historic data, may not be adequate (Bjerga and Aven, 2015; IAA, 2008; RIMS, 2010).

In organisational and risk management literature, the attention towards emerging risks from IT innovation is gradually increasing (Aven, 2016; Feduzi and Runde, 2014; Flage and Aven, 2015; Lampel *et al.,* 2009; Loch *et al.,* 2006; McGrath and McMillan, 2009; Weick and Sutcliffe, 2007). Some literature even went on arguing that current IT innovations are just a glimpse of what is possible in the future. The development of IT in the last twenty years has reshaped the banking sector and will continue to do so (Aichinger and Bruch, 2012; Dombret, 2015b; Fiordelisi *et al.*, 2011). The recent examples of its potential are new payment services like Google Wallet, peer-to-peer lending, crowd-sourced equity funding or digital currencies (Ekekwe and Islam, 2012; Medcraft, 2015a). Even other industries, that were until recently perceived as relatively stable and safe, now show an increasing interest in IT innovation – for example the taxi industry (which has been disrupted by Uber) and hospitality (disrupted by Airbnb). Therefore, the interest in IT innovation and the risks emerging from it is more than understandable. Some academics even argue that the

[1] Curd, 2015.

domain of emerging risk is one ‘‘to which much of contemporary business has shifted’’ (Snowden and Boone, 2007, p.5). Scholars maintain that an organisation’s success is largely influenced by its capability to predict future states of affairs and effectively build a strategy to confront emerging risks (Bates *et al.*, 2012).

Considering that risk management is one of its primary business activities, the banking industry cannot afford to be oblivious to the potential threat posed by IT innovations (Lam, 2014; Rodriguez and Edwards, 2014; Walker, 2009). A member of the Executive Board of the Deutsche Bundesbank, Andreas Dombret, asserts that IT will be the genesis of the next financial crisis (Dombret, 2015b). In fact, this statement could not be more apt in that it signals a need for timely awareness which such a threat poses if overlooked any longer.

The survival and prosperity of a bank depends on its ability to identify, quantify, price, and manage risks better than its competitors (Lam, 2014). Risks which can affect the entire bank and its underlying business model, such as emerging risks from IT innovations, must be managed in a holistic, enterprise-wide approach. Hence, ERM[2] is seen as the main risk management approach capable of integrating risks with the achievement of firm objectives (Anginer *et al.*, 2014; RIMS, 2010). ERM is understood as a label for a system which includes methods and processes by which firms manage risks “… from across the enterprise with the goal of identifying underlying correlations and thus optimising the risk-taking behaviour in a portfolio context” (Farrell and Gallagher, 2015, p.625).

Such a holistic risk management program presents the linkage between strategic objectives and risk management, especially aiming to include risks that are hard to quantify (Zhao *et al.*, 2015). Consequently, ERM has gained considerable attention as a means of dealing with complex business risks as corporate environments become increasingly volatile and uncertain (Arena *et al.*, 2010; Subramaniam *et al.*, 2015). Yet, scholars argue that banks only recently have started to manage risks in such an integrated fashion as proposed by the ERM concept (Lam, 2014). With the

[2] ERM in this work is understood as an ERM framework (COSO, 2004) as well as the verb in form of *enterprise-wide risk management.*

given importance of IT innovations for banks, it is of significance to investigate how banks handle emerging risks from IT innovations utilising an ERM perspective (Anginer *et al.*, 2014; pwc, 2015b). Therefore, this research aims to understand how risk management for emerging risks caused by IT can be enhanced by the application of ERM.

This study is driven by the main research question: *Which ERM components are critical to the ERM of emerging risks resulting from IT innovations?*

The research problem is explored by means of a qualitative case-study methodology centred on semi-structured interviews and is carried out in a two-stage process, as summarised in Figure 1-1. The first research stage concerned a literature review that identified the research gap and the four focus areas of the research. From this, the research questions were identified, which in turn resulted in the interview questions. In addition, the research gap and the interview questions were further refined through a pilot case study. Stage 2 concerned the collection of the field data and its within-case and cross-case analysis. Both stages added to the conceptual framework. In the first stage, the conceptual framework was developed from the findings of the academic literature review. In the second stage, this conceptual framework was reviewed and discussed based on the field data from the case studies.

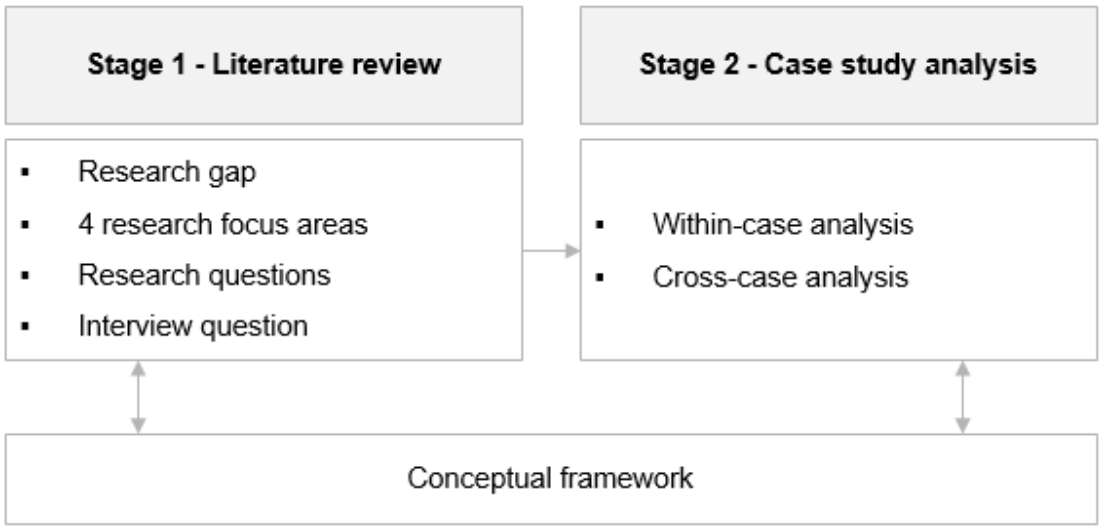

Figure 1-1: Two-stage research process

Both stages are grounded in an inductive reasoning and case study methodology in which data is collected to explore a phenomenon and to identify themes and patterns (Saunders *et al.*, 2016; Whetten, 1989). The philosophical understanding of the research is best described as critical realist, proposing that scientific work must go beyond pure identification of regularities and also focus on the analysis of mechanisms, processes and structures that account for the patterns that are observed (Briar-Lawson, 2012; Denzin and Lincoln, 2011). The social world is, in the critical realists' view, an extremely complex, open system, which can only be partially known (Grote, 2009). It is important to recognise that, in the context of risk management, human knowledge is always incomplete and selective, and, hence, reliant upon assumptions (Renn, 2005).

The researcher's profession as a risk management consultant inspire the motivation for this research. In various projects over the last ten years, the researcher experienced the growing importance of risks emerging from IT innovations. Yet, banks seem to lack appropriate risk management solutions. Before the start of this endeavour, the researcher performed a pre-study in which she discovered that academia is also in a search for ways to treat those emerging risks using an ERM approach.

1.1 Research questions, aim and objectives

The central aim of this research thesis is to explore which ERM components are of special importance for the ERM of emerging risks from IT innovations.

To achieve the above aim, the researcher has defined specific objectives:

1. To conduct a critical contextual literature review of academic and industry-based literature in order to detect central themes and theoretical issues that underlie the current ERM practice within the banking sector in the context of emerging risks, which should lead to identifying the research gaps.
2. To explore the processes and procedures for managing risks across an enterprise, by recognising in the literature review the current debate in ERM research and identifying the common ERM components.
3. To select a research methodology and method appropriate to exploring the research gaps and answering the research questions, derived from the research problem.
4. To develop, based on the literature review and field data findings, a conceptual framework integrating key dimensions geared towards improving the overall applicability of ERM for emerging risks from IT innovations.

The research addresses the following questions to achieve its aim and objectives:

1. Which ERM components are critical to the ERM of emerging risks from IT innovations?
2. What key meanings are currently attached to emerging risks from IT innovations within the German banking sector?
3. How does uncertainty influence the ERM of emerging risks from IT innovations?
4. Who should be involved in the ERM of emerging risks from IT innovations?

1.2 Background of the German banking sector

The research field is German banks who participated in the European Central Bank (ECB) and European Banking Authority (EBA) stress test of 2014 (EBA, 2014). This section thus describes the sector in the context of the research interest and the rationale for its selection.

Banks operate in an unstable environment exacerbated by increased market competition and new technologies which minimise the comparative advantages of banks. Especially the competition from non-banks is threatening, as banks are losing market share to firms that so far have not been the focus of finance regulators (Deutsche Bundesbank 2014a; Greenham *et al.*, 2014). Fiordelisi *et al.* (2011) argue that technological change has greatly added to the progressive development of enlarged competition. Hence, the ability of banks to handle technology innovations has become a prime factor for competitive advantage (García-Granero *et al.*, 2015; Häckel *et al.*, 2015).

Figure 1-2 displays possible IT innovations, or innovation enabled by IT, which will have a low, medium, or high impact on the banks' internal processes as well as the business model in the next four years (Johansson *et al.*, 2014; Kauffman *et al.*, 2015; Mariotto and Verdier, 2015). These developments affect banks in numerous ways. For example, mobile payment services, like Google Wallet, are posing a significant challenge as incomes from such services are at stake. Furthermore, this leads to loss of customer contact and data.

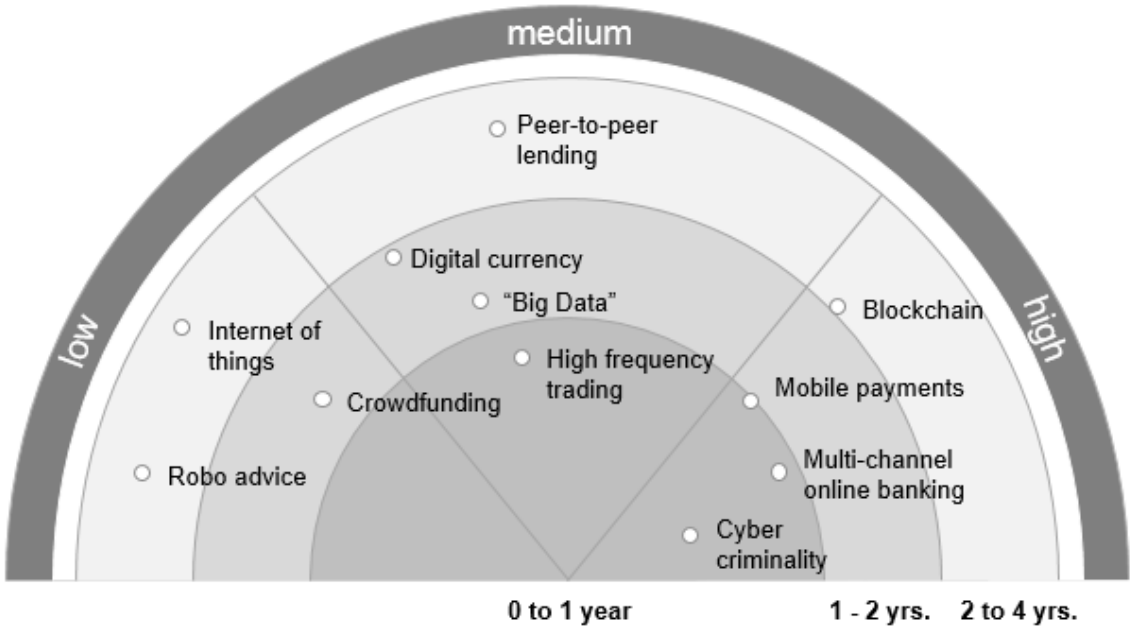

Figure 1-2: IT innovations and developments from IT innovations affecting German banks

Simultaneously, banks recognise the urgent need to improve the alignment of IT risks with the rest of the organisation (Valentine, 2008). Consequently, it is vital that banks understand the relationships between emerging risks and their risk management capabilities. Nevertheless, up to today the focuses of risk management activities in banks have centred on financial risks such as credit, market, or liquidity risks (Aebi *et al.*, 2012).

The first generation of financial risk management arose in the 1970s and 1980s which focused on quantitative models calculating pricing risks. The second generation progressed from measuring to advanced reporting and controlling of risks. An increased trading volume positioned risk managers to align a bank's risk appetite with its trading positions (Bhimani, 2009). Up to this day for most banks, the management of risks remains greatly fragmented across risk types (Aebi *et al.*, 2012; COSO, 2004). This results in individual business units managing different types of risk and taking risk-based decisions in their respective silos, sometimes without taking into account the holistic nature of risks or interrelationship between risk types (Moch, 2013). The third generation of risk management is now in search of a more proactive risk management (Beasley *et al.*, 2016; Ludwig, 2012).

In the post-crisis period, a debate has evolved concerning whether current risk management in banks depends too much on quantitative models, theorising that the shift from the first to the second period placed excessive reliance on quantification (Diamond and Rajan, 2001; Ludwig, 2012). Some critics even argue that the growing interest in financial risk management processes “should be attributed primarily to their communicative and organisational usefulness and less to the accuracy of the results they produced” (Millo and MacKenzie, 2009, p.638). However, this stands in marked contradiction to the large strand of scholars who see a clear need for quantitative risk management (Bhimani, 2009; Moch, 2013). Nevertheless, scholars and practitioners call for enhanced risk management which also covers IT risks, and especially for a focus on emerging risks from IT innovations (Bromiley *et al.*, 2015; Olson *et al.*, 2014). In response to this, companies have introduced ERM as a holistic approach to risks.

German banks have been chosen as the research focus for two reasons. First, banks need to comply with several regulations, e.g. those set by the Federal Financial Supervisory Authority, which coerces them to fulfil minimum requirements for risk management. Thus, due to the business model of a bank and the compliance with those regulations, it is ensured that risk management can be investigated in every bank (Bebenroth *et al.*, 2009; Hall *et al.*, 2015). Second, the banking industry faces tremendous changes triggered by IT (Fiordelisi *et al.*, 2011). On the one hand, IT innovations affect the internal processes of a bank, e.g. customers want to handle their banking activities online. On the other hand, IT innovations affect the business model of banks, e.g. not only traditional banks offer loans, but also crowdsourcing platforms or peer-to-peer lending services.

1.3 Justification for the research

While a substantial amount of work has been conducted by looking at the impact of the adoption of new information technologies, to the knowledge of the researcher, no study has yet researched how emerging risks from IT innovations are handled by applying ERM (Wilson *et al.*, 2010). Thus, this research combines aspects in a unique way which previous research has neglected.

A bank is understood as an intermediary between agents who need to borrow and those who are willing to lend or invest (Diamond and Rajan, 2001). Therefore, in an economic system like Germany's, banks play a vital role (Moch, 2013). The financial crisis has painfully demonstrated the effects of banks and their risk management practices on the economic prosperity of a country (FFSA, 2014; Nanda and Nicholas, 2014; Ross and Crossan, 2012; Stiglbauer *et al.*, 2012; Vaubel, 2010). Hence, an economy has a high interest in smoothly operating banking system, including sound risk management (Bessis, 2010; Bhargava, 2014). For this reason, the focus on risk management by regulators and policy makers in charge of controlling banks' risk management is continuously growing. Even though the supervisors have acknowledged the importance of IT innovations, they are urgently searching for a better comprehension of the required risk management procedures.

IT innovations in the banking sector are recognised as a double-edged sword. On the one hand, they are an engine of economic growth, creating market gains for the innovators and adopters, increasing society's welfare and leading to changes in the banking industry. On the other hand, they are related to catastrophic events like the recent financial crisis (Kauffman *et al.*, 2015; Liu *et al.*, 2015). Grounded on this understanding, related questions arise such as the following. How can IT-enabled crowdfunding or peer-to-peer-lending support an economy? Which systemic risks can occur when algorithms are used to make (automatic) credit decisions? Answering these questions implies that emerging risks should be identified and evaluated for whether they present a threat or a chance to a bank. As a result, scholars and practitioners urgently demand an advancement of risk management practices (Huber and Scheytt, 2013; pwc, 2015a; Subramaniam *et al.*, 2015).

Furthermore, these IT developments justify the growing interest in how banks handle such risks (Klüppelberg *et al.,* 2014). As IT affects all parts of a bank, a broader question has to investigate how emerging risks are handled enterprise-wide. An analysis of current literature has showed the gap in ERM for emerging risks (Aven, 2016; Bharathy and McShane, 2015). Most ERM research has focused on defining what ERM is, organisational factors associated with ERM and effectiveness of ERM.

Although work from these three areas has significantly advanced ERM, what remains to be fully explored is how a specific risk is treated in the context of ERM.

Furthermore, until today for most banks, the management of risks remains greatly fragmented across risk types (Aebi *et al.*, 2012; COSO, 2004; Keith, 2014). Banks struggle to identify emerging risks and to apply knowledge and procedures efficiently in unravelling risk management issues (Keith, 2014). As a result, both scholars and practitioners demand a new management approach to handle emerging risks outside the traditional silos of market, credit, and operational risk (Aebi *et al.*, 2012; Bromiley *et al.*, 2015; Dombret, 2015b; pwc, 2015b; Roland Berger, 2015).

This research proposes to explore a contemporary, real-world phenomenon (Doh, 2015), which has to the knowledge of the author, has not been studied before.

1.4 Outline of the report

This thesis is built on the suggested structure of Perry (2002) and is divided into 8 chapters.

Chapter 1 introduces the research topic to the reader. The research questions and the research aim and objectives are presented, followed by a justification of the importance of the research. This initial understanding provided to the reader will be then furthered by the literature review.

The literature review in Chapter 2 summarises the relevant academic literature and hence allows the identification of the research gap and the respective research questions. The literature review is clustered into four research areas:

1. **Procedures** – explores practices and procedures for the management of emerging risks (Arena *et al.*, 2010).
2. **Risk field** – discusses emerging risks and the respective definitions (Aven, 2012; Jäger, 2009).
3. **Risk rationalities** – explores how companies conceptualise uncertainty into risks (Emblemsvåg, 2010).
4. **Uncertainty experts** – investigates employees of an organisation involved in the management of risks.

These four areas, moreover, present a structure that is recurrently applied to systematically guide the reader through the research.

An important aim of the research is the development of a conceptual framework that integrates key dimensions geared towards improving the overall applicability of ERM for emerging risks from IT innovations. This conceptual framework is presented in Chapter 3, right after the literature review and before the analysis and discussion of the findings. The researcher has intentionally decided to present the conceptual framework early in the thesis, to allow the reader to follow the conceptual framework development.

The presentation of the conceptual framework is followed by Chapter 4, which lays out the research philosophy. As philosophy shapes how research problems are formulated, and how the researcher seeks information to answer these questions, an explicit statement is deemed necessary for the reader.

Chapter 5 discusses in detail the chosen research methodology and the applied data collection method, including how the data is analysed and interpreted. The methodology chapter serves as the basis for the subsequent presentation of the findings from the data in Chapter 6.

The findings (Chapter 6) and the analysis of the findings (Chapter 7) are divided into two distinct chapters. This allows a clear distinction between presentation of the findings and the analysis of the cross-case interpretations in Chapter 7. Thus, the reader can observe in a better way how the data lead to the interpretation. Chapter 7 presents a discussion of the analysis across the four research areas to connect the areas into a coherent picture that underlies the conceptual framework. As suggested by Whetten (2002), the conceptual framework was initially developed from the understanding achieved via the literature review and was then furthered by the data analysis to continuously allow new observations (Corley and Gioia 2011; Weick, 1989; Whetten, 2002).

The work concludes with Chapter 8, which presents a summary of the implications and the conclusion which can be drawn from the thesis. It will demonstrate how the

research aim and objectives have been met and recapitulate the answers to the research questions.

1.5 Understanding of key research terms

This section discusses terms frequently used in the research and introduces some useful distinctions which facilitate the overall understanding of the research.

In 1992 itself, Kloman described risk management, as "… the art of making alternative choices, an art that properly should be concerned with anticipation of future events rather than reaction to past events" (p.302). Risk management is understood as a pro-active process by which risks are identified, analysed and managed. Yet, risk management is frequently criticised for not identifying, assessing, and responding to the growing array of risks across a complex enterprise.

ERM has grown out of the conviction that traditional risk management approaches, which decompose systems into isolated subsystems, are not sufficient (Allan *et al.*, 2011). An enterprise-wide approach to risk management was introduced by Haubenstock (1999), who consolidated all the risks into an overall risk portfolio. This portfolio management technique is the core principle of the ERM concept (Bates *et al.*, 2012; Farrell and Gallagher, 2015). ERM is not a conceptually and operationally single thing, neither in academia nor in practice (Choi *et al.*, 2015; Power, 2009). Yet, in this research, ERM is understood as a label for a system which comprises risk management methods and procedures addressing risks in a portfolio approach and aims to support the achievement of organisational goals (Bates *et al.*, 2012; Lam, 2014; Wu *et al.*, 2015).

Furthermore, emerging risks are conceptualised as risks which are evolving in the sense that experience and data are just starting to develop. Yet, this concept contains beliefs that a new type of event, new in the context of that risk, could have an impact on something that banks value (Flage and Aven, 2015). In the banking sector, risk management frequently concentrates on quantitative risk management of silo risks such as liquidity risk, credit risk, and market risk (Aebi *et al.*, 2012; Liebenberg and Hoyt, 2003). However, it is assumed that emerging risks from IT

innovations do not directly affect financial risks, such as a client failing to pay back his loan. Rather, it is expected that IT innovations allow non-banks to offer loans, for instance peer-to-peer lending platforms, and hence banks are at risk of losing income from loan interest (Aebi *et al.*, 2012; Bromiley *et al.*, 2015; Dombret, 2015b; pwc, 2015b; Roland Berger, 2015). Therefore, IT innovations in the banking sector are understood as a force enabling new products and services, as well as new business models and operating structures affecting the entire bank (Dombret, 2015b).

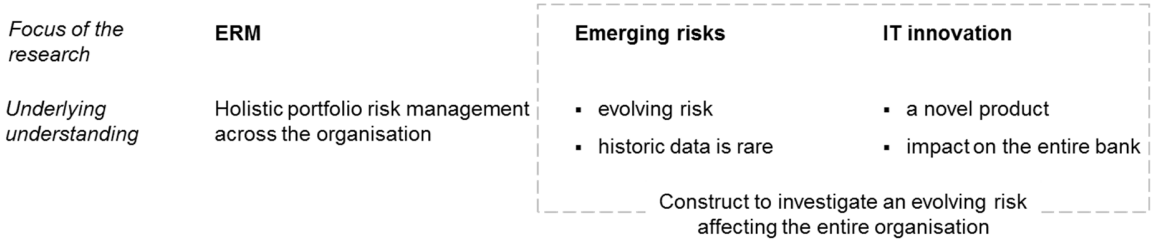

Figure 1-3: Understanding of research topics

Overall, emerging risks from IT innovations are understood as a construct to investigate ERM for a risk which affects the entire organisation. Thus, the research does not deal with the exploration of the specific and detailed risks resulting from IT innovations.

IT risks are classified as operational risks (BCBS, 2005). Operational risk management has been criticised for a limited view of risks and as only a means to fulfil regulatory requirements (Jarrow, 2008; Power, 2009). Power (2004a) excoriates operational risk management as: “the burden of managing unknowable risks ... is replaced by an easier task which can be successfully reported …” (p.30). Current rules and principles in this domain centre on the estimation of operational risk losses and the application of these estimates to calculate economic capital (Jarrow, 2008). For emerging risks, the underlying data are often missing, and hence those risks are frequently overlooked in operational risk management practices. Therefore, this research concentrates on how emerging risks are managed via ERM practices and does not focus on operational risk management. It is suggested that,

once a fundamental understanding of emerging risks in context of ERM is achieved, further research in combination with operational risk management is sensible.

By introducing the research problem, justifying the need for this research, and presenting the writer's understanding of key terms, this chapter has laid the foundation of this research. On these bases, the work can proceed with the review of current literature.

2 Literature Review

This section essentially concerns itself with the scope and focus of the literature review which is of pertinent significance in association with the present study. Therefore, under this section numerous themes are integrated into a literature review framework, focusing on risk field, risk rationalities, uncertainty experts, and procedures. With regard to each of the sub-sections, the respective research gap is identified and a resulting research question is derived (Eisenhardt and Graebner, 2007).

2.1 Scope of literature review

The purpose of the literature review is to offer an interpretation that reflects the claims of knowledge (Cooper, 1982). To achieve this, and in order to reflect the research project, only publications meeting the following criteria was included in the literature review. Certain poignant measures have been adopted by the researcher in order to operate a pertinent and critical literature review:

- The academic literature is written in English or German.
- The focus of the literature is primarily on Germany, the UK, North America, Australia, and New Zealand, this is because these countries have made the most progress in ERM (Bebenroth *et al.*, 2009).
- With respect to separate studies which used the same data (e.g. a dissertation and a journal article based on the same dataset), only the study with the most comprehensive reporting was included, in order to avoid the overrepresentation of a particular set of data.
- Searches were conducted using numerous key terms such as ‘enterprise-wide risk management’, ‘enterprise risk management’, ‘integrated risk management’, ‘emerging risk’, ‘emergent risk’, ‘IT innovation risk’, ‘new risk’ and ‘risk management’.

Risk management in banks is well established and the number of empirical studies is vast (Bhimani, 2009; Moch, 2013). However, in the banking sector, risk management frequently concentrates on quantitative risk management of silo risks

such as liquidity risk, credit risk, and market risk (Aebi *et al.*, 2012; Liebenberg and Hoyt, 2003). Further, academic work on banks and enterprise-spanning risk management is limited (Bromiley *et al.*, 2015). Hence, studies of other industries have been included in this review. It is possible that not all results are directly transferable to the German banking sector due to different legal and regulatory compliance requirements.

2.2 Structure and focus of literature review

The literature review draws on Arena *et al.* (2010) and focuses on four key areas (Giovannoni *et al.*, 2015; Mikes, 2005; Tacke, 2006; Tekathen and Dechow, 2013) which are preponderantly significant in the investigation of the research aim. The following are the four key areas which the researcher takes into account:

1. **Procedures** – investigates practices and procedures for the management of emerging risks (Arena *et al.*, 2010).
2. **Risk field** – discusses emerging risks and the respective definitions (Aven, 2012; Jäger, 2009).
3. **Risk rationalities** – explores how companies conceptualise uncertainty into risks (Emblemsvåg, 2010).
4. **Uncertainty experts** – investigates which employees of an organisation are involved in the management of risks.

Figure 2-1 illustrates the literature review framework and the respective focus areas.

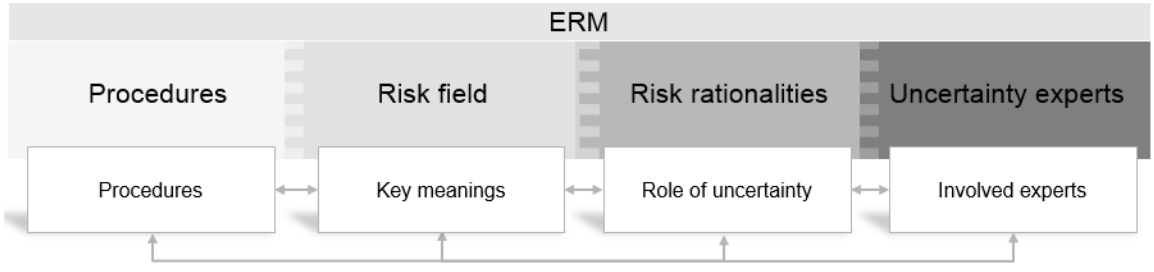

Figure 2-1: The four central aspects of the literature review and their focus

ERM research is often criticised for not taking a multifaceted view of risk management in practice (Power, 2009). Analysing the present research area from

the aforementioned four perspectives aids in avoiding the antecedent realm of criticism, and not only ensures that ERM procedures are taken into consideration, but also subsequently determines the members of the organisation who designs and executes them in accordance with the designated conceptualisation of risk (Jäger, 2009).

2.3 Procedures: ERM in practice

The manner in which professionals work together in the management of uncertainties and risks is highly influenced by the procedures applied in practice (Arena *et al.*, 2010; Aven *et al.*, 2011). For this reason, the ERM procedures applied in practice are discussed. Procedures in this context are defined as processes as well as applied concepts and the ERM COSO components (Section 2.3.1).

The idea of integrated risk management, versus silo risk management, can be traced back to Kloman (1976). A review of ERM history delineates that most ERM methods were established in the insurance and finance sector, where data from the past was taken to estimate for the future as an evaluative method (Renn *et al.*, 2011). Numerous experts have recognised amplified strictness of regulatory oversight as one of the key drivers for ERM (Liebenberg and Hoyt, 2003; Zhao *et al.*, 2015). ERM as we know it today was motivated by corporate scandals and subsequent changes pertaining to the corporate governance requirements, such as the Sarbanes-Oxley Act of 2002. Debt-rating agencies such as Standard and Poor's, Moody's, and Fitch in the present ages examine ERM practices as part of their overall rating assessment. Internal factors concentrate on the maximisation of shareholder wealth (Beasley, 2005; Liebenberg and Hoyt, 2003) and corporate governance (Lundqvist, 2015). The European banking literature prior to the recent crisis identified a broader range of risks arising from globalisation, regulation and increased competitiveness (BaFin, 2012), as a force for ERM. In the past, different terms were used to describe risk management practices, focusing on the enterprise as a whole. Table 2-1 summarises those terms and the main authors who applied them.

Term	Author
Traditional risk management	Stulz (1996)
Coordinated risk management	Schrand and Unal (1998)
Integrated risk management	Colquitt *et al.* (1999)
Enterprise risk management	Dickinson (2001)

Table 2-1: Terms for risk management spanning the entire enterprise

In the past twenty years, the term most applied in academic and business publications has been ‘enterprise risk management’. However, until now various ERM definitions have existed simultaneously (see Table 2-2, in author alphabetical order).

ERM definition	Source
“The process by which organizations in all industries assess, control, exploit, finance and monitor risks from all sources for the purpose of increasing the organization's short and long-term value to its stakeholders.”	Casualty Actuarial Society (CAS) (2003)
“… a process, effected by an entity’s board of directors, management and other personnel, applied in strategy setting and across the enterprise, designed to identify potential events that may affect the entity, and manage risk to be within its risk appetite, to provide reasonable assurance regarding the achievement of entity objectives.”	COSO (2004), p.2
ERM differs from traditional risk management in its enterprise-wide approach, in which strategic, operational and compliance risks are managed concurrently rather than separately.	Liebenberg and Hoyt, (2003); Paape and Speklé (2012)
“ERM is a strategic business discipline that supports the achievement of an organization’s objectives by addressing the full spectrum of its risks and managing the combined impact of those risks as an interrelated risk portfolio.”	Risk and Insurance Management Society (RIMS) (2016)
ERM is an approach to assure that the firm is attending to all risks: a set of expectations among management, shareholders, and the board about which risks the firm will and will not take; a set of methods for avoiding situations that might result in losses that would be outside the firm's tolerance; a method to shift focus from "cost/benefit" to "risk/reward"; a way to help fulfil a fundamental responsibility of a company's board and senior management; and a language for communicating the firm's efforts to maintain a manageable risk profile.	Dreyer and Ingram for Standards & Poor’s (2008)

ERM definition	Source
"… a structured, consistent and continuous process across the whole organisation for identifying, assessing, deciding on responses to and reporting on opportunities and threats that affect the achievement of its objectives."	The Institute of Internal Auditors (IIA) (2009)

Table 2-2: Overview of ERM definitions

As Table 2-2 indicates, there is no common definition of ERM. One strand of scholars sees risk as independent of a firm`s objectives (e.g. Dreyer and Ingram, 2008) and the other group defines risks in terms of achievement of organisational objectives (e.g. COSO, 2004; IIA, 2009). An additional major difference is between those who define risk only as a problem (RIMS, 2016) and those who argue that risk can also be a potential competitive advantage (CAS, 2003). However, all definitions have in common that risks should not be managed in silos, but integrated across an organisation, and that risks should be managed in a portfolio approach (Brustbauer, 2015; Choi *et al.*, 2015; Lam, 2014; Meulbroek, 2002; Power, 2004a).

2.3.1 ERM components

To further clarify what constitutes ERM and to provide an overview of the current academic debate, Table 2-3 lists the ERM components considered across various academic studies. The seven ERM components listed at the top of the table are derived from the most cited ERM framework in academia and practice, the ERM Committee of Sponsoring Organizations of the Treadway Commission (COSO) framework (Choi *et al.*, 2015; Ridley *et al.*, 2008; Zhao *et al.*, 2015). Although COSO is often criticised for only providing only broad guidance, leaving the details to the adopting organisations (Hayne and Free, 2014; Wu and Olson, 2008), Paape and Speklé (2012) found that 43% of ERM adopters actually apply the COSO ERM.

In addition, the table shows whether the ERM researchers mention emerging risk and/or IT innovation (the two columns on the right-hand side of the table). An 'x' indicates that the research explicitly mentions the ERM component, whereas a '-' shows that it is not mentioned.

Author	Comments	ERM components (adopted from COSO, 2004)							
		Establish context strategy	Identify risks	Risk assessment	Risk response	Communicate	Monitor and review	Emerging risk	IT innovation
Aven (2008)	Built on ISO/IEC Guide 73, 2002.	X	X	X	X	X	X	-	-
Emblemsvåg (2010)	Enhance qualitative risk management based on knowledge management.	X	X	X	X	X	X	-	-
Kmec (2011)	Focus on risk identification.	-	X	X	-	-	-	-	-
Mafrolla *et al.* (2016)	ERM in private firms differs according to ownership structure.	X	X	X	X	X	X	-	-

Table 2-3: ERM components

As Table 2-3 indicates, scholars seem to agree on which high-level components should constitute ERM. Yet, the understanding of the exact content of the single components differs (Lundqvist, 2014). For example, knowledge management is slowly gaining attention (Schiller and Prpich, 2013) and is only indirectly reflected in the ERM components. Nevertheless, Neef (2005) takes the stance that “a company cannot manage its risk effectively if it cannot manage its knowledge” (p.112). Aven *et al.* (2011) take a similar stance by proposing an ontological clarification of the risk definitions. A strand of scholars which is in line with this suggestion adds that it is indispensable to recognise the context of risk and that knowledge is always incomplete and selective (reductionist), and liable to assumptions, claims, and predictions (Locke, 2007; Renn, 2005; Renn *et al.*, 2011; White, 1995). Standard risk management techniques have been frequently disparaged for assuming a complete state space and hence excluding future states with a high degree of uncertainty ab

initio (Feduzi and Runde, 2014; Lampel *et al.*, 2009; Loch *et al.*, 2006; Snowden and Boone, 2007).

None of the reviewed research has mentioned emerging risk and/or IT innovations. In line with Beasley *et al.* (2015) who demand research on the handling of specific risks in the context of ERM, the first research question asks:

Which ERM components are critical to the ERM of emerging risks from IT innovations?

This research question is in line with a recent study by Lundqvist (2014), who stresses the need for further investigation of ERM components. "… it is important to take a step back and first determine what ERM really is and what the principal components are" (p.394).

2.3.2 ERM studies

In addition to the academic literature, this section reviews the empirical evidence resulting from academic surveys and case studies. The studies published between 2009 and 2015 which are of relevance to the present research are summarised in Table 2-4.

Despite the wide range of ERM definitions, there is no doubt that academic research on this topic is still in its early stages (Beasley *et al.*, 2015; Bromiley *et al.*, 2015; Lundqvist, 2015). A large share of the existing evidence is drawn from case studies and surveys (Kleffner *et al.*, 2003; Moch, 2013). Studies of the last 15 years have focused predominantly on (A) organisational factors associated with ERM, (B) defining what ERM is, and (C) effectiveness of ERM. Table 2-4 lists these ERM studies by alphabetical order of the author name. Each ERM study has been allocated to a research classification and research area. In addition, each is specified as a quantitative or qualitative research approach; in addition, the research topic and main findings are summarised.

Author	Research classification and area	Quantitative, qualitative	Research topic	Main findings
Aebi *et al.* (2012)	(A) Banks in North America during the financial crisis from 2007 to 2008	Quantitative study	Investigate if ERM related corporate governance mechanisms are related to better performance during financial crisis.	Banks should improve the ERM quality; embed risk governance by CEO and CRO at the same level; CRO reporting to the board rises performance.
Arena *et al.* (2010)	(A), (B) Three Italian non-financial firms from 2002 to 2008	Qualitative longitudinal multiple-case study, 41 interviews	Investigate organisational variations of ERM.	ERM is different in all firms due to pre-existing practices; ERM success depends on experts and their power.
Beasley *et al.* (2015)	(A), (C) 645 members of the American Institute of Certified Public Accountants	Quantitative descriptive statistics analysis	Explore how boards and management effect ERM adoption and maturity.	ERM maturity is positively related to the involvement of the board and ERM training for senior management.
Eckles *et al.* (2014)	(C) 69 firms adopting ERM between 1995–2008	Quantitative desk-top analysis	Test the hypothesis that ERM reduces firms' cost of reducing risk.	ERM firms have lower stock return volatility; operating profits per unit of risk increase post ERM adoption.
Farrell and Gallagher (2015)	(C) 225 cross industry firms, which took the RIMS ERM maturity assessment between 2006–2011	Quantitative desk-top analysis	Analyse the valuation implications of ERM maturity.	Firms with a mature ERM have a higher firm value (Tobin's Q of 25%); most important aspects are top down executive engagement and ERM culture.
Grace *et al.* (2015)	(C) Insurance companies in the USA	Desk-top analysis	Investigates which aspects of ERM add value.	ERM aspects adding value are economic capital models and risk managers reporting to CEO.

Author	Research classification and area	Quantitative, qualitative	Research topic	Main findings
Halliday (2013)	(A) Executives from the SandP/ASX 200 index in Australia	Mixed method research; Desk-top analysis and survey	Examines organisational structure in risk management.	Board audit committee for oversight of ERM ERM should report to CFO or CRO.
Hoyt and Liebenberg (2011)	(C) 275 publicly-traded insurers in the USA	Quantitative desktop research, data from 1998 to 2005	Measure the extent of ERM and the value implications.	ERM is associated with higher firm value, indicated by a Tobin's Q premium of 20%.
Kmec (2011)	(B) Single case study, energy company	Not further specified	Identify risk.	Proposes a risk identification method which is a synthesis of existing tools.
Mikes (2009)	(B) Two financial institutions	Qualitative research, field study with 75 interviews	Classify ERM types and how they achieve organisational significance.	Suggests two types of ERM models: 1. driven by strong shareholder value, 2. corresponding to risk-based internal control imperative.
Paape and Speklé (2012)	(A), (C) 825 firms headquartered in the Netherlands	Empirical work; secondary data; quantitative	Sows the extent of ERM implementation and effect on risk management effectiveness.	ERM is influenced by regulations, internal factors, ownership structure, and frequency of risk assessment; no evidence that COSO improves ERM.
Tekathen and Dechow (2013)	(B), (C) One German firm, industry and time range not specified	Qualitative research, singular case site, semi-structured interviews	Explores how ERM and accountability are related.	Implementation of ERM does not ensure organisational risk management ERM does not help to reduce uncertainty.

Table 2-4: Summary of recent ERM studies

To identify whether a firm has implemented ERM, most researchers have relied on data from surveys (Farrell and Gallagher, 2015; Halliday, 2013; Kleffner *et al.*, 2003; Mikes, 2009) or the announcement of a Chief Risk Officer (CRO) (Pagach and Warr, 2011). This is challenged by Paape and Speklé (2012) who criticise the current

literature for studying ERM by use of date that may not be appropriate. The reliance on a signal variable to draw the conclusion that the firm has adopted ERM is problematic, e.g. hiring an individual cannot be a guarantee for ERM. Lundqvist (2014) even argues that the announcement of a CRO can simply be a signal to shareholders, nothing more. On the other hand, it is possible that companies which have implemented ERM do not necessarily have a CRO. In the banking sector, however it is very common that banks have a CRO in place (Aebi *et al.*, 2012; Lam, 2014), but that is not necessarily an indication of ERM implementation.

Furthermore, the inconclusive results presented in Table 2-3 regarding ERM effectiveness can be assigned to the missing consensus on what exactly constitutes ERM and agreement on how to measure ERM (Lundqvist, 2014; Lundqvist, 2015). Critics argue that the main roadblock to ERM research is the difficulty in developing a valid and reliable measure for the ERM construct (McShane *et al.*, 2011; Mikes and Kaplan, 2015). Although numerous different ERM frameworks (e.g. Casualty Actuarial Society Framework, COSO ERM Integrated Framework, International Association of Insurance Supervisors Framework, ISO 31000-2009, Sarbanes-Oxley Act of 2002, Joint Australia/New Zealand 4360-2004 Standards, Turnbull Guidance, etc.) exist which indicate how ERM should be realised in organisations, they seldom discuss how to measure the effectiveness of an ERM framework.

Even though no common measure for the implementation of ERM exists, academia has presented different findings of ERM value. A consensus found in the literature is that ERM can improve firm performance (Beasley *et al.*, 2005; Farrell and Gallagher, 2015; Gordon *et al.*, 2009; Grace *et al.*, 2015; Hoyt and Liebenberg, 2011; Keith, 2014). Just recently, Eckles *et al.* (2014) found that, after adopting ERM, firm risk decreased and accounting performance increased for a given unit of risk. A similar opinion is expressed by Farrell and Gallagher (2015) and Hoyt and Liebenberg (2011), who ascertain a valuation premium (as measured by Tobin's Q) for ERM adopters. This has been challenged by Beasley *et al.* (2008), who find insignificant or negative announcement returns for ERM adoption.

That no measure of ERM success is shared by academia and practice raises doubt about the data used in these research studies. For example, Beasley *et al.* (2005)

utilise a scale extending from ‘no plans exist to implement ERM’ to ‘complete ERM is in place’ to measure the extent of ERM implementation. Liebenberg and Hoyt (2003) and Beasley *et al.* (2008) depend on data on CRO appointments as their single indicator for ERM adoption. Their results indicate firm-specific benefits of ERM. Pagach and Warr (2011) are in line with these findings. For nonfinancial firms, Beasley *et al.* (2008) find that market reactions to CRO appointments are positively related to firm size and volatility of previous earnings. For financial firms, Beasley *et al.* (2008) exclude those findings, arguing that these firms may be more driven by other demands for risk management, such as regulations. Gordon *et al.* (2009) measure the success of ERM in an organisation by rating the realisation of a number of generic strategic, operational and compliance objectives. Yet, it is doubtful that simple proxies of implementation for ERM can sufficiently capture ERM complexity (Lundqvist, 2014).

Most of these studies do not address the specifics of various ERM practices, nor are the differences of ERM design between companies taken into consideration. An exception is the study by Paape and Speklé (2012), who have analysed data from 825 organisations. They find that factors associated with ERM adoption are similar across countries. Yet scholars agree that, in practice, ERM differs from organisation to organisation (Arena *et al.*, 2010; Bromiley *et al.*, 2015; Mikes, 2009, Tekathen and Dechow, 2013). In some firms ERM is implemented as a unified practice that aims to cover various risks, whereas in others ERM is more of an umbrella term (Power, 2008) under which different functional departments carry out separate risk management practices (Arena *et al.*, 2010). The case study of three Italian companies by Arena *et al.* (2010) provides indication that ERM can mean very different things to different organisations.

Critics find that the corporate application of ERM can vary in its calculative practices (Mikes, 2009; Mikes, 2011) and degree of embeddedness (Power, 2009). The result is a wide discrepancy in ERM even within comparable industries (Arena *et al.*, 2010). According to Mikes (2009) even within the banking industry systematic variations in ERM exist (Mikes, 2008; Mikes, 2009). In the financial services sector ERM is understood to represent a set of risk practices, yet they include such wide-ranging

techniques as Value-at-Risk and Economic Capital models, as well as qualitative methods for non-financial risks. The normative-practitioner literature suggests that these risk management approaches increasingly constitute ‘best practices’ that a growing number of organisations seek to implement (e.g. Mikes, 2005; Lam, 2014). Among scholars, it is often argued that firms in the financial industry are particularly likely to implement ERM (Beasley *et al.*, 2005; Kleffner *et al.*, 2003; Liebenberg and Hoyt, 2003).

A stream of literature debates whether banks have had a strong incentive to implement ERM since Basel II became effective, as ERM could reduce capital requirements (Liebenberg and Hoyt, 2003; Mikes, 2009). One view, expressed by Paape and Speklé (2012), is that ERM enables enhanced risk disclosure, which could result in the opportunity to reduce the cost of capital. In addition, the consolidation trend in the German banking sector in the last ten years (Deutsche Bundesbank, 2013) has resulted in more complex financial institutions, leading to more multifaceted risk profiles. Many commentators have found that financial conglomerates tend to offer a wide product range that entail risks that are increasingly interdependent (Fiordelisi *et al.*, 2011). In addition, since the post-era of the financial crisis of 2008, banks report increased pressure from regulators to include a broader range of risks in their analysis (BaFin, 2012). Hence, it could be argued that banks should have an even higher interest in ERM. However, others contend that as long as academic research on ERM in banks is limited and empirical evidence is lacking, a cautions view should be taken (Haubenstock, 1999; Meulbroek, 2002).

Almost absent in academic literatures is an explicit examination of how IT risk should be treated by ERM. A strongly practice oriented piece of work was issued in 2013 by the Information Systems Audit and Control Association (ISACA) and the IT Governance Institute. The “CobiT 5 for Risk” framework is primarily designed for IT and audit practitioners (Babb, 2013). CobiT (Control Objectives for IT and related Technology) aims to control IT related strategies and operations and supports legal compliance with regulative requirements. Yet, very few academic studies have been published which evaluate the effectiveness of CobiT or investigate where or how it

has been adopted (Ridley *et al.*, 2008). The existing research has been published primarily in association with ISACA or the IT Governance Institute, neither of which is considered to be independent (Ridley *et al.*, 2008). In addition, the "iNTeg-Risk ERMF" (Early Recognition, Monitoring and Integrated Management of Emerging, New Technology related Risks Emerging Risk Management Framework) focuses on the early recognition and management of emerging technology risks, in which technology is not limited to IT. The iNTeg-Risk project of 2009 to 2013 is funded by the seventh framework programme of the European Union. The basis for this framework is the ISO 31000 and IRGC framework (Jovanovi and Löscher, 2013). Yet, this framework so far has received very little attention in academic publications.

Another area, in which academic work is inconclusive, is research on organisational factors associated with ERM. The findings of the studies listed in Table 2-4 and which are classified as "A – organisational factors associated with ERM" are very homogeneous, yet they have been conducted in different industries and countries. A multitude of scholars in their poignant research works, namely, Aebi *et al.* (2012), Beasley *et al.* (2005), Halliday (2013) and Liebenberg, and Hoyt (2003) highlight that a strong CRO has a positive effect on ERM. Literature describes ERM often as highly dependent on the experts in charge and their possibility to integrate and create a meaningful position, moving ERM away from "being a black box … to a process of confrontation potentially able to prepare … for a black swan" (Arena *et al.*, 2010, p.673). According to a view expressed by Arena *et al.* (2010) and Mikes (2009), ERM is often seen as an internal control compliance device that does not translate easily into business processes and culture (Ashby *et al.*, 2012a). Scholars agree that research on conditions which enforce ERM is rare. "Virtually all literature is silent on how to deal with the myriad cultural, logistical, historical challenges that exist and are unique to all organisations" (Fraser *et al*., 2010, p.79). In addition, none of the revised pieces of research focused on a specific risk, such as emerging risks from IT innovations. All studies focus on ERM and enterprise risks in general.

The preceding section has put forth a mixed picture of ERM. On the one hand, scholars argue that ERM is a good approach to managing risks enterprise-wide and help to create positive effects for firms, such as improving capital efficiency and

reducing the expected costs of external capital and regulatory examination (Liebenberg and Hoyt, 2003; Wu *et al.*, 2015). On the other hand, academia in the present field of interest is lacking in evidence pertinent to the effectiveness of ERM. One reason for this can be that ERM is a framework which can take many forms and is influenced by many factors. Accordingly, comparison across organisations is difficult, and defining common criteria for the measurement of ERM effectiveness is a task yet to be mastered by academia and practice (Bromiley *et al.*, 2015; Choi *et al.*, 2015). Kaplan (2011) supports this view and questions whether the efforts to standardise and codify risk management on an enterprise-wide level are still premature. Despite academic attention and growing application of ERM by organisations, Power (2009) cautions that the last twenty years have not led to a superior control of risk. The academic field is fragmented (Verbano and Tura, 2010). Scholars like Power (2009) even argue that risk management practices have taken too many forms, resulting in the "risk management of nothing" (p.849).

2.4 Risk field: IT innovation and emerging risks

The way in which risk is defined has a substantial influence on risk management practice (Aven, 2012; Aven, 2016; Flage and Aven, 2015; Renn, 1998; Renn *et al.*, 2011). "Attempts to manage risk must confront the question: 'What is risk?'" (Slovic, 1999, p.690). Consequently, this section on risk field explores academic publication of IT innovations and the emerging risks from this.

The term IT innovation is a widely applied term in multiple disciplines. IT innovation is understood as a multi-stage process by which organisations transform ideas into new or improved outcomes which rely on IT. An outcome can present an IT based process, service or product which advances the company from its competition (Baregheh *et al.*, 2009). Medcraft (2015b) summarises the key drivers for IT innovations for banks as robo-advice[3], crowd-sourced equity funding, digital currencies, cyber resilience, and blockchain. Especially blockchain is a recent

[3] Robo-advice is understood as the usage of algorithms to assist the automated suggestions of options for asset allocation based on the customer parameters, such as risk preference, holding period, etc., without the use of human financial planners (Estrada, 2016).

development that is frequently and exuberantly discussed, particularly by practice, whereas academia is lacking in publications. Many proclaim that it can disrupt the financial market (Ali *et al.*, 2014; Giaglis and Kypriotaki, 2014; Price and Adams, 2015; Shin, 2015). A blockchain is described as a public transaction ledger for a digital currency transaction; it detects any changes, and stores them, decentralised, on many computers. Thus, the information is comparatively more tedious to manipulate and the underlying data is verifiable (Shin, 2015; Swan, 2015). Risk management literature on such innovations is rare; the majority of the reviewed literature currently focuses on the understanding of how to commercially explore this innovation (Eckenrode, 2014; Kostoff *et al.,* 2004).

The reviewed literature characterises emerging risks from IT innovations as complicated, as the risk can develop and emerge quickly over time (Beasley *et al.*, 2016; Köhler and Som, 2014). The International Risk Governance Council (IRGC) (2010) describes emerging risk as: “a risk that is new or, a familiar risk that becomes apparent in new or unfamiliar conditions” (p.5). A similar view is shared by IAA (2008): “developing or already known risks which are subject to uncertainty and ambiguity and are therefore difficult to quantify using traditional risk assessment techniques” (p.37).

The term emerging risk has been shaped primarily by the insurance sector in the last ten years (IAA, 2008; Jäger, 2009; Munich Re, 2016). Yet, the insurance literature on emerging risks generally relates it to the concept of low probability and high impact. For that reason, emerging risks are of special interest for an insurer, as emerging risk can lead to claims with a high loss potential but may also represent a new business opportunity (IAA, 2008). The last five years have shown a slow trend toward other industries, like banks, starting to pay more attention to emerging risks and IT innovations, as the chances for loss or win from those instances are closely connected (Beasley *et al*., 2016; Diaz-Rainey *et al*., 2015; RBS, 2014).

The academic literature frequently reports that changes in IT can lead to innovations (Adomavicius *et al.*, 2008; Sambharya and Rasheed, 2012; Wilson *et al.*, 2010). Recent research in the area suggests that innovations are interlocked in mutually influencing relationships and are susceptible to network effects (Anderson and Felici,

2012). For that reason, some IT innovations can grow to be disruptive, their effects being transformative, which also influences future IT innovations (Beasley *et al.*, 2016). As a result of this evolution of IT, academic literature has recognised a new generation of business risks (Wilson *et al.*, 2010). Sambharya and Rasheed (2012) describe IT risk as a supranational risk that, due to its interdependencies, also has an international effect. Interconnectivity is described as leading to risk contagion, spreading the effects of risk well beyond those initially expected (Sambharya and Rasheed, 2012). An interesting recent development in the literature relates to the discussion of the fundamental challenge arising from this. Ripple effects and the possibility of coexistent risk events relating to one another intensify their individual and combined effects (Renn *et al.*, 2011), thus causing greater, unforeseen consequences and reducing the ability to respond effectively.

Even though academia agrees on the newly generated interconnectivity of emerging risks, the literature on those risks is very limited. Research on IT innovations and their impact on the banking industry have been widely discussed in academia over the past twenty years (Wilson *et al.*, 2010), yet research on IT innovation and the related emerging risks is rare (Diaz-Rainey *et al.,* 2015; Häckel *et al.*, 2015). Furthermore, from the literature review it can be concluded that no commonly agreed meanings are assigned to emerging risks from IT innovations (Flage and Aven, 2015). Following the calls of March and Shapira (1987), Bromiley *et al.* (2015) and Aven (2016), researchers need to develop deeper comprehension of what managers understand by emerging risk. Further research in this area is warranted, therefore research question two asks:

What key meanings are currently attached to emerging risks from IT innovation within the German banking sector?

The literature review indicated that one of the most salient features of innovation is uncertainty (García-Granero *et al.*, 2015). The connections among innovation, uncertainty, and risk are recurrently discussed in various streams of literature (Bowers and Khorakian, 2014; Klüppelberg *et al.*, 2014; Köhler and Som, 2014; Maynard, 2016; Praeg, 2014). Hence, as a next step the following section explores the impact of uncertainty on the conceptualisation of risks.

2.5 Risk rationalities: understanding of uncertainty and risk

Risk rationalities represent how companies conceptualise uncertainty and risk (Emblemsvåg, 2010). The evolving discussion about ERM owes its lack of information from academic work to strategy and organisational change and culture (Bromiley *et al.*, 2015; Fraser *et al.*, 2008). Very little literature exists that analyses the understanding of risk and uncertainty in the context of ERM. Therefore, this section presents a review of the literature on uncertainty and risk and the linkage between the two terms.

The definition of uncertainty and risk is a source of ongoing debate in academia (Aven, 2012; Aven and Renn, 2009; Aven *et al.*, 2011; Lam, 2014; Tietje and Scholz, 2002). Neither academia nor business has agreed on a single definition of the terms (Aven and Renn, 2009; Henschel, 2007; March and Shapira, 1987). Nevertheless, uncertainty and risk are generally presented as two different, not synonymous, occurrences. Some scholars suggest that uncertainty and risk can be described as cause and consequence (Aven, 2010a; Perminova *et al.,* 2008).

Many academics discuss Knight's distinction between risk and uncertainty (Gollier *et al.*, 2013; Mikes, 2011; Power, 2009; Zhao *et al.*, 2015), suggesting that "pure" uncertainty implies that no information about possible future circumstances and their probabilities exists, while risk implies at least a partial knowledge of such probabilities (Holzer and Millo, 2005; Krane *et al.*, 2014). Moreover, Knight defines risk as the form of incomplete knowledge for which the future can be predicted through the laws of chance (Perminova *et al.,* 2008), including the possibility to express future events in probability distributions (Aven, 2010a; Bjerga and Aven, 2015). This view of risk and uncertainty is also often found in banking literature on risk management. This literature chiefly discusses risks as occurring from an imaginable situation, which consequently entails a certain state of knowledge, while uncertainty infers that there is no certainty about the state of things (Perminova *et al.,* 2008). Perminova *et al.* (2008) argue that: "Whereas risk concerns itself with the calculation of probabilities based on certain facts, uncertainty concerns itself with epistemology, i.e. are we certain of the facts" (p.76).

In academic literature, uncertainty is often reflected in the concept of probability and probability assessment (Feduzi and Runde, 2014). Aven (2010b) agrees with this view yet warns that the assignment of probability could even lead to camouflaging uncertainties, which could leave important uncertainties unconsidered. Consequently, large strands of scholars have criticised risk managers for not specifically considering uncertainty as an important aspect of risk (Aven, 2010a; Bromiley and Rau, 2014; March, 1987). Klüppelberg *et al.* (2014) suggest that further research on uncertainty is warranted to move the attention "… from risk exposure as a basis of decision making to situations where the probability distribution of a random outcome is unknown" (p.402). So far, it seems that empirical research on the influence of uncertainty and risk on risk management practice is yet to emerge (Gollier *et al.*, 2013).

Not only in traditional risk management literature but also in ERM literature, the understanding of risk and uncertainty are rarely debated. It is left to the individual organisation to define uncertainty and risk, depending on the objectives of the company (Hayne and Free, 2014). So far, the concept of uncertainty, and especially the question of when uncertainty turns into a risk, has seldom been mentioned in ERM research (Bromiley and Rau, 2014). Contradicting this view is a large strand of scholars who point out that the concept of risk and uncertainty can be of special importance in areas which are rather new, like IT innovations, where experience and knowledge about future states and risks are rare (Anderson and Felici, 2012; Dombret, 2015b; Maynard, 2016).

A large body of banking literature examines the determinants of future risk, postulating that the future, to a certain extent, will be a reproduction of the past, allowing the use of past information about risk to be applied to future risk. Holzer and Millo (2005) take this argument even further, proposing that risk management is a series of experiments which can be repeated. Especially after the financial crisis, a strand of scholars emerged which criticised existing risk management models as tending to be primarily additive, analysing only a number of selected factors, and then assessing risk along each of these factors (Aven *et al.*, 2011; Sambharya and Rasheed, 2012). Therefore, Lam (2014) and others further call for risk management

rationalities which discuss uncertainty and risk and how risks can be managed without assuming that historic data can predict the future (Liebenberg and Hoyt, 2003).

Other than this, academic literatures rarely explores the case when no or only limited knowledge claims exist about a potential risk (Anderson and Felici, 2012; Aven *et al.*, 2011). As previously argued, uncertainty relates to the absence of scientific knowledge, which makes it difficult to assess the probability and possible outcomes of undesired effects (Renn *et al.*, 2011). However, when does uncertainty become a risk for an organisation? This is of special interest when considering emerging risks for which rather little risk data exists (Olsen and Wu, 2008). Scholars agree that this is largely the case in IT, where the innovation cycle has decreased dramatically in recent years (Köhler and Som, 2014; Peisl *et al.*, 2014). This leads to the third research question:

How does uncertainty influence the ERM of emerging risks from IT innovations?

The following section will explore who is involved in the management of uncertainty in the context of ERM.

2.6 Uncertainty experts: organisational roles

Closely linked to the discussion on uncertainty and risk are studies that explore how risk rationalities are dealt with in practice. Therefore, the organisational roles involved in conceptualising and controlling uncertainty and risk will be explored in this section. Uncertainty experts are understood as employees of an organisation involved in the management of uncertainties and risks.

Based on a typology traditionally employed in the management of risks developed by Mikes (2009), the roles established in current academic literature are further elaborated. First, risk management experts deal with specific risk categories (e.g. credit risks). Academia describes them as being responsible for the traditional silo risk analysis and management, usually focusing on the reliable quantification of probabilities and impacts (Arena *et al.*, 2010; Silva *et al.*, 2014). The ERM literature

hardly mentioned which departments require risk managers or the exact responsibility of a risk manager (Aven *et al.*, 2011).

Second, senior management is a common subject in ERM literature. While some academics research the role of the CRO (Mikes, 2009; Paape and Speklé 2012), others focus more broadly on investigating the role of senior management and risk oversight (Beasley *et al.*, 2015). For example, Liebenberg and Hoyt (2003) see the support of senior management as vital for the ongoing development of ERM, for establishing risk committees and a CRO. Academia describes the CRO as an advisor for managers on questions of risk (Power, 2004a; Power, 2009). The study carried out by Mikes in international banks suggests that the role of the CROs has expanded, with more than half of them frequently involved in firm-level strategic decisions (Mikes, 2008). Mikes found that some CROs aspired to an expert role in key business decisions (strategic advisor), while others attempted to integrate the job roles of risk and performance management, i.e. strategic controller (Mikes, 2008). Power (2005) describes the CRO as an important role in positioning risk management in the management hierarchy. Despite the emerging importance of this role, Mikes and Kaplan (2015) maintain that the existence of a CRO does not guarantee any kind of quality in the risk management process per se. This may be due to the evolving definition of the exact duties and responsibilities of senior management in ERM (Keith, 2014).

Third, the academic literature identifies the professional group of internal auditors as having a central role in the conceptualisation of uncertainty and of how risks are defined and further managed. The IIA defines the core role of internal audit with regard to ERM as giving an objective assertion to boards that business risks are being managed properly (IIA, 2009). Outside the UK, a less uniform picture tends to appear. Data for Germany describes the role of internal auditors less prominently, calling for a clear segregation of duties between internal audit and risk management (BaFin, 2012).

Fourth, Arena *et al.* (2010) argue that accountants have traditionally played a key role in controlling uncertainty through the analysis of the variances in performance. Yet, Bromiley *et al.* (2015) criticise those studies for concentrating on risks for which

well-defined statistical properties can be assigned. It is striking that ERM publications in English-speaking countries are concentrated in accounting and finance journals (Jäger, 2009); while German publications on ERM, are less often found in accounting journals.

In addition to those five roles in risk management, a growing emphasis on the role of audit committees in ERM can be perceived in the UK and the USA. Although academia is in doubt about the prevalence of audit committees in practice (Turley and Zaman, 2004), there is little evidence that tangible benefits exist (Spira and Page, 2003). Especially the question of what can be expected from such a committee – which is supposed to be independent, comprising non-executives reporting to an executive board – remains so far unanswered (Fraser and Henry, 2007). Stiglbauer *et al.* (2012) compare the audit committees in Germany and Anglo-Saxon countries, finding that the authority of a German audit committee is more limited than that of Anglo-Saxon audit committee. This is despite the fact that in 2009 Germany passed the Accounting Law Modernization Act (BilMoG) and emphasised the economic benefit of audit committees (§ § 324 and 264d German Commercial Code (GCC)).

It can be concluded that academia and business are lacking in consensus about the structure, including the application of human resources, which best supports ERM (Liebenberg and Hoyt, 2003). Furthermore, ERM is frequently described as a response to a broader demand for societal accountability (Giovannoni *et al.*, 2015; Power, 2004a; Power, 2009). A conflicting view is expressed by Spira and Page (2003), who criticise ERM for obstructing the diffusion of responsibilities and encouraging resistance to accountability in the event of problems. Despite this discussion, academia is rather silent on who in particular should be involved in ERM. Yet, Bromiley and Rau (2014) call for ERM tools which support the different conceptualisations of risk and are tailored for the different groups using the ERM tools. Further understanding is required and hence research question four asks:

Who should be involved in the ERM of emerging risks from IT innovations?

The reciprocal entanglement of ERM actors, alongside their embedded conceptualising of uncertainty and risk, are key aspects for understanding the ERM on two levels (Wilden *et al.*, 2016). First, these actors can all be translators of ERM in the organisation (Mikes, 2008). To assign responsibility for ERM, e.g. to a CRO, will influence the organisational meaning of ERM and its internal direction (Arena *et al.*, 2010). Second, the overlapping of different actors, all involved in managing uncertainties, could result in rivalry and hoarding control over information (Mikes, 2008). Recognising emerging risks from IT as a topic which affects various departments in the organisation may lead to the identification of additional actors during the data collection phase of the proposed research.

2.7 Research gaps and research questions

The research questions are derived from the research gaps identified during the literature review. While employing ERM to manage various risks, the research gaps show that emerging risks from IT innovations have hardly been reflected in ERM research. Figure 2-2**:** recaps the proposed research questions by assigning them to the focus areas of the literature review. The following questions are addressed to achieve the research aim and objectives:

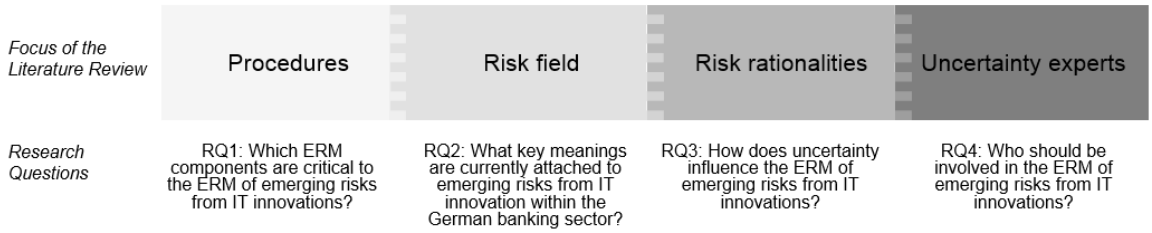

Figure 2-2: Research questions derived from literature review gap

The aim of this research project is to develop a conceptual framework which explores how German banks can apply ERM to manage emerging risks from IT innovations in the future. The first research question explores the ERM components required for the management of emerging risk. As research on emerging risk in IT innovations is limited, research questions two and three ask rather fundamental questions about the meanings attached to emerging risk from IT innovations and the role of

uncertainty. Research question four is the connector between risk field, risk rationalities, and risk procedures, searching for enterprise-wide functions in a bank involved in the management of emerging risk.

2.8 Conclusion

This chapter has critically analysed the ERM literature of the last two decades. ERM is still in a developing stage and important knowledge gaps remain – in practice and academia (Power, 2009).

The literature review has identified a need for further research in banks by revealing that most published research addresses ERM from a theoretical viewpoint, lacking empirical data (Keith, 2014; Liebenberg and Hoyt 2003). It has been indicated that during the last decades of ERM research, no single theory has evolved to serve as a holistic explanatory framework (Bromiley *et al.*, 2015; Choi *et al.*, 2015). This conclusion is applicable to all four areas of the literature review: procedures, risk field, risk rationalities, and uncertainty experts. As established by the literature review, several gaps exist that this research seeks to fill. The gaps can be summarised as:

1. Insufficient knowledge about the ERM components which are especially critical to the management of emerging risks;
2. Lack of understanding of how banks comprehend the concept of emerging risks from IT innovation;
3. Lack of knowledge about the impact of uncertainty on the management of emerging risks;
4. Necessity of further insight into who should be involved in ERM.

Seeking to adapt to increasing expectations from regulators and stakeholders, firms struggle with the design of their ERM (Paape and Speklé, 2012). Various academics holding this view have called for further research on ERM, especially in the financial industry. “Financial institutions have pioneered the development of risk management systems and it would be interesting to explore the specific approaches that they have

adopted to risk management" (*comment by author: risk management in this context is understood as ERM*) (Fraser and Henry, 2007, p.407).

The literature review has taken a somewhat cautious view of the benefits of ERM. A sceptical view is justified as long as consistent research on the benefits on ERM is absent, and thus further research is required in extending the ERM practice. Therefore, the next section presents the conceptual framework which aims to improve the practice of ERM for emerging risks from IT innovations.

3 A conceptual framework of emerging risks for ERM

As discussed in the literature review the theoretical basis of ERM, indeed of emerging risks in general, has only developed recently and has not yet progressed for enough to make available varying viewpoints and reliable theories. Therefore, in this section a conceptual framework is developed, from the review of academic literature, which aims to close the research gap between ERM as an approach to holistic risk management (Aven and Aven, 2015; RIMS, 2016) and the lack of academic and practical work on emerging risks. The conceptual framework explores how banks can apply ERM to manage emerging risks from IT innovations in the future, and thereby extend today's common application and understanding of ERM.

The conceptual framework is developed in an iterative process to allow new observations and simultaneously call for self-critical analysis, in which unsatisfactory theories are discarded (Corley and Gioia 2011; Weick, 1989; Whetten, 2002). This is guided by the understanding that the early process of theorising entails abstracting and selecting factors that are deemed as important (Locke, 2007; Storberg-Walker and Chermack, 2007). The outcome is a future oriented conceptual framework, which is perceived as a pre-theory, a nascent theory (Meredith, 1993). Nascent theory offers tentative answers to novel questions (Edmondson and McManus, 2007). Therefore, in this work, a conceptual framework is conceived as a system of interlinked concepts that may subsequently lead to an initial ample understanding of a phenomenon (Jabareen, 2009). Concepts refer to a collective of meanings or characteristics associated with certain objects (Meredith, 1993). Furthermore, it is suggested that a conceptual framework presents an abstraction and simplification of multiple realities in order to aid in understanding a complex system that exists in the real world (Rossel, 2009; Schepers *et al.*, 2014). Hence, the focus is on providing an adequate understanding, rather than offering a full theoretical explanation (Ramasesh *et al.*, 2014).

Yet, the difficulty in using models to present situations is that of “obtaining adequate simplification, while maintaining sufficient realism” (Meredith, 1993, p.5). As a result, the conceptual framework focuses on three ERM concepts (research question one).

The ERM components provide insight into the key meanings that are currently attached to emerging risks from IT innovations (research question two) and depict the effect of uncertainty (research question three). Furthermore, the conceptual framework provides understanding of the involvement of stakeholders (research question four).

Figure 3-1 is a pictorial representation of the conceptual framework.

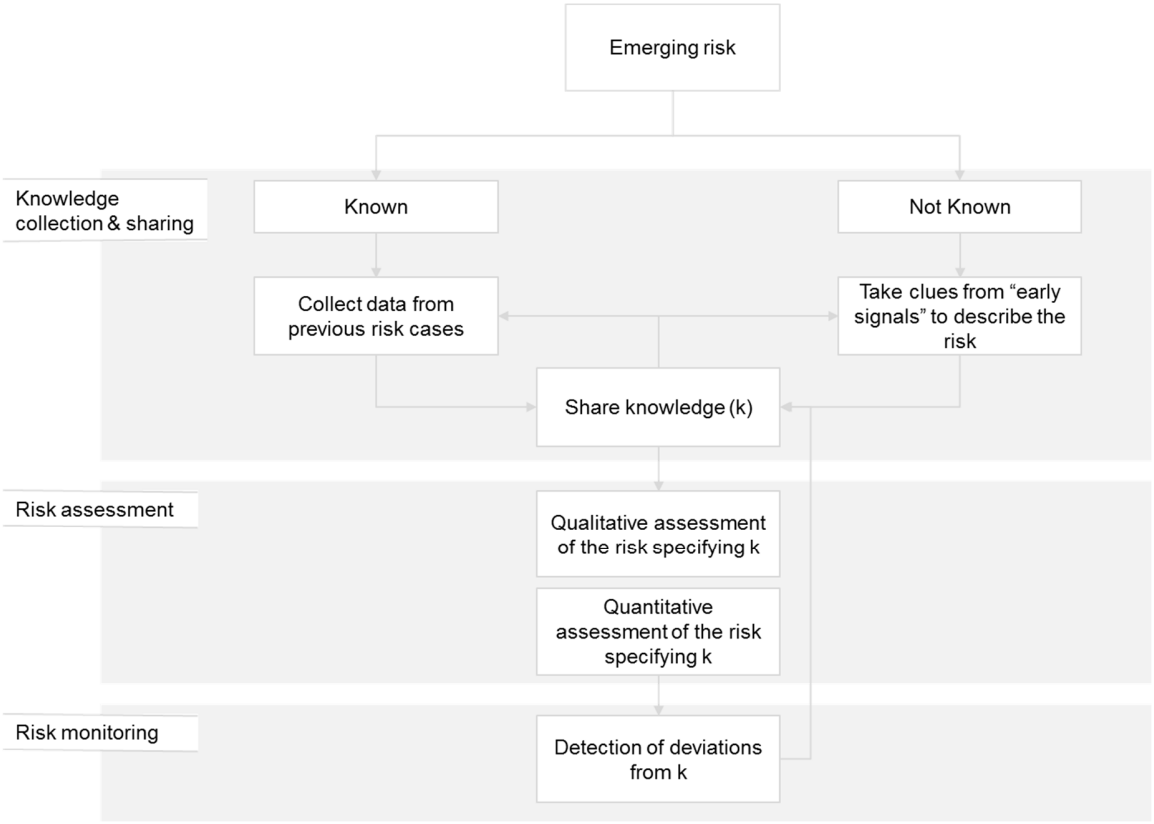

Figure 3-1: Conceptual framework for ERM for emerging risks from IT Innovations

Before the detailed discussion of the framework, Table 3-1 provides an overview of the concepts and the underlying understanding.

ERM components	Underlying understanding of the concepts	
(1) Knowledge collection and sharing	Emerging risks are either known risks, which become apparent in an unfamiliar context or entirely new risks that are not known. It is a relative concept, depending on the knowledge which changes over time.	At the start of the ERM process, the input from various stakeholders is required (IRGC, 2011); the number of stakeholders' decreases with the increase of knowledge over time. The knowledge about risk grows in relation to the time a risk is known.
(2) Risk assessment	Risk assessment which is revised as new knowledge is available over time.	
(3) Risk monitoring	As knowledge changes, risk monitoring allows updating of existing knowledge and inclusion of new knowledge (Flage and Aven, 2015).	

Table 3-1: Annotation to conceptual framework

Three ERM components have been identified as particularly vital; therefore, they will be explored in more detail in the following sections.

3.1 Knowledge collection and sharing (1)

Academia generally discusses four types of emerging risk concepts. Hence, Figure 3-2 was developed as a matrix for the four emerging risk concepts as related to knowledge, in relation to risk and to context.

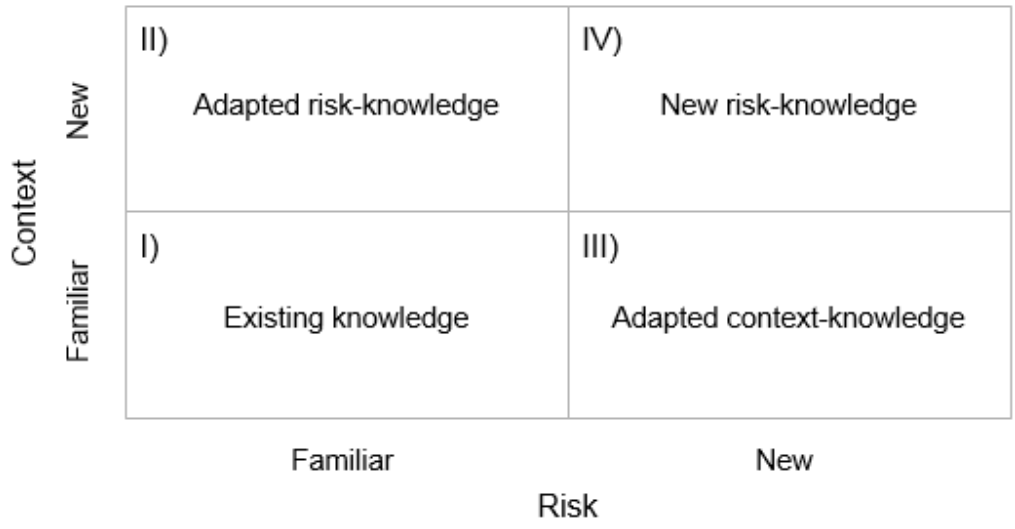

Figure 3-2: Emerging risk concepts based on IRGC (2011)

Quadrant I) presents a familiar risk in a familiar context. According to IRCG (2011), existing knowledge enables organisations to finally identify a long-standing issue as a risk. Quadrant II) symbolises a familiar risk in a new context. Quadrant III) stands for a new risk in a familiar context; an issue in a familiar context is conceptualised as a risk due to adaptation of knowledge (IRGC, 2011). Quadrant IV) offers a new risk in a new context and therefore maximum uncertainty with the lowest available level of data and knowledge.

The most frequently described concepts in academic publications are emerging risks that have been known yet in a different context (quadrant III). Moreover, academia recurrently discusses emerging risks, which are entirely new (quadrant IV). Then, the banks have to take early signals and include these clues to start describing the risk. Early signals are essentially understood as clues, which can point toward a risk, yet require interpretation to verify whether those signals indeed point towards an emerging risk.

In classical ERM concepts knowledge collection and sharing do not constitute a key element, and it is assumed to be part of numerous other risk activities. However, knowledge collection and sharing for emerging risks may differ from regular risk management data collection processes, which tend to focus on the collection of quantitative data (Wu and Olson, 2008). First, qualitative data is required to describe the risk as in the first phase of the data collection (Aven, 2010b). Therefore, a range of stakeholders needs to be involved to collect and share knowledge about emerging risks (Wu and Olson, 2008). The stakeholders can be internal as well as external to the bank. The underlying assumption is that information asymmetry exists; it is supposed that some stakeholders have knowledge, which is not yet available to other stakeholders (Florin, 2013). This information asymmetry may exist intentionally or accidentally.

Knowledge collection and sharing is crucial for the management of emerging risks for two reasons. First, it helps to conceptualise an uncertainty and thus allows detection of a risk (Bjerga and Aven, 2015; Gollier *et al.*, 2013). Second, knowledge collection and sharing can help to establish a knowledge base and hence provide the basis for the second step – risk assessment (Flage and Aven, 2015).

3.2 Risk assessment (2)

The concept of uncertainty is reflected in the notion of probability and probability which is further reflected in the ambit of risk assessment (Flage and Aven, 2015). Risk assessment is frequently understood as an evaluation of risks in terms of its likelihood and impact (COSO, 2004; Wu and Olson, 2008). Academia has ad nauseam asserted that it is necessary to assess the risk in order to facilitate a pertinent decision on the manner in which the risk should be treated (Bessis, 2010). Numerous banks strive to reduce uncertainty and at the same time endeavour to exploit opportunities arising from the same. The assessment of emerging risks should go "… beyond what seems to be the most logical development path … and also consider other development paths that are possible … even if they seem extremely remote" (RIMS, 2010, p.6).

At the initial stage, a qualitative risk assessment is suggested, which mainly helps to describe the risk (Aven, 2010b). Aven (2016) further argues that risk assessments should specify the degree of knowledge, meaning that the person who assesses the risk should indicate the degree of knowledge upon this assessment is based. Such a scheme of action should allow other stakeholders to rate the degree of validity of such claims. Such a risk assessment implies a belief that probability is not perfect and that uncertainty and risk cannot be fully transformed into a quantitative format (Flage *et al.*, 2014). However, once more data and knowledge about the risk is available, a quantitative evaluation of the risk may be completed.

This two-phase approach to risk assessment serves two functions. First, when little knowledge exists about a risk, a qualitative assessment helps to determine the risk and furthers the understanding of it amongst various stakeholders (Aven, 2015a). Furthermore, based on the qualitative assessment, it can be detected whether the risk is already known in a different context, yet possibly has been labelled differently. Second, the quantitative risk assessment specifies the impact and probability and therefore gives some indication about the subsequent actions that need to be taken.

3.3 Risk monitoring (3)

The risk assessment is the basis for the monitoring of the risk. The result of the risk assessment will determine which emerging risk needs to be monitored and in which frequency and intensity. High impact and high probability need relatively more action than a risk that has been assessed as low impact and low probability. Risk monitoring in this sense is understood as the constant observation of the risk and its development, relying mostly on early warning signals (RIMS, 2010). In case of a change detected in the state of a risk, the information is fed back to the risk assessment (Wu and Olson, 2008).

Banks have reported that, once a risk has been identified and mitigating actions have been defined, the development of the risk is not further watched (Jovanovi and Löscher, 2013). Therefore, risk monitoring for emerging risks is critical for two reasons. Primarily, risk is rapidly susceptible to change, and monitoring is required to detect the change. Second, monitoring a risk can also provide new knowledge about the risk, which then can serve as an input to step (1), the collection and sharing of knowledge, and step (2), the assessment of the risk. As knowledge changes, risk monitoring is incumbently required which allows the update of existing knowledge and the inclusion of new knowledge (Flage and Aven, 2015).

3.4 Summary

The preceding section has presented the conceptual framework which provides an increased understanding of how academia currently perceives and theorises the ERM of emerging risks, and at the same time, it is future-oriented in describing imminent ERM practices. The concerned chapter has challenged the predominant assumption that ERM frameworks are designed for every type of risk. The conceptual framework is based on the view that ERM is understood as a holistic risk management methodology, which manages risks in a portfolio approach across the firm with the purpose to exploit risk and chances (Choi *et al.*, 2015). Yet, these emerging risks are easy to overlook as they are hard to quantify due to a lacking data basis (Bjerga and Aven, 2015) and are characterised by a high amount of change. For this reason, it is easy to have them not included in ERM. These

characteristics of emerging risks are the reason for the proposal of the conceptual framework, which proposes that emerging risks require an adaptation of ERM.

The proposed conceptual framework will be furthered by the field data and the cross-case analysis as presented in Chapter 7.

4 Critical realism philosophy

This section discusses the philosophical paradigm which underpins this research endeavour. First, the philosophical paradigm in risk management is explored (Section 4.1), followed by a discussion of the philosophy adopted for the research – critical realism. Section 4.2 investigates the impact of the research philosophy on methodology and Section 4.3 explores the limitations of critical realism.

Philosophy in the anterior context can be delineated as "… the use of abstract ideas and beliefs that inform our research" (Bessis, 2013, p.16). It shapes how problems and research questions are formulated, and how the researcher seeks information to answer these questions. The actions of researchers are directed by the systems of belief, the paradigm, by which knowledge claims are generated and interpreted (Guba and Lincoln, 1994). From an ontological point of view, the author accepts reality as real, acknowledging thereby the imperfectness of reality. The epistemological orientation is described as modified objectivist, where findings are seen as true; nevertheless, it is appreciated that knowledge is value laden and fallible (Danermark *et al.*, 2002; Welch *et al.*, 2015). Ontology is not reducible to epistemology; human knowledge captures only a small portion of an infinite reality (Crotty, 1998; Fletcher, 2016). The ontological principle, that social reality is to a substantial degree external to individuals and affects social actions, is elementary to critical realism (Buchanan and Bryman, 2012).

To justify the appropriateness of the chosen philosophical stance, a short analysis of the predominant stance in risk management is discussed, then the relationship of particular characteristics of the philosophical point of view to the research aim is shown.

4.1 Research philosophy in the context of risk management in banks

Risk management in banks predominantly focuses on management of financial risks, applying mathematical models to identify and evaluate those risks. However, recurrent valuation problems in the recent past have raised the question of the

appropriateness of financial models and risk management practices (Crotty, 2009). In the case of the financial crisis of 2008, the quantitative models did not fully anticipate a fundamental shock in the financial system that the same models had helped engineer (RIMS, 2010). Common risk management practice is to explain a phenomenon by deducing it from a law (e.g. whenever event x then event y), taking a number of boundary conditions into account (da Graca Moura and Martins, 2007). The explanatory enactment of those models is seen as problematic and can be assigned to the "ontological acceptance of constant conjunctions of events in financial markets and the deduction of laws based on these conjunctions" (Andrikopoulos, 2013, p.35).

Nonetheless, the response of risk managers towards the financial crisis has not been one of far-reaching modification of the dominant way of theorising risk management (Crotty, 2009). Motivated by the explanatory problems that are rooted in this conception of risk, an alternative way to research risk is proposed. It is suggested that a solely positivist approach to manifold analyses and assessments of risk is claimed to be deficient in predicting emerging risks (da Graca Moura and Martins, 2007). It is put forward that risks are multidimensional, meaning different things to different people, depending on a multitude of factors, e.g., upon their underlying value system. "Risk perception cannot be reduced to a single subjective correlate of a particular mathematical model of risk, such as the product of probabilities and consequences, because this imposes unduly restrictive assumptions" (Newby, 1997, p.133). Certain scholars argue that risks can exist independently of our perceptions and knowledge, another strata of scholars claim that risks are implicative of mental construction (Renn *et al.*, 2011), and are not real but originate in the human mind (Beck, 1992). Both views can influence ERM in association with emerging risks. The researcher therefore justifies the need for an ontological realism that must specify the manner in which and how a risk is conceptualised.

It is suggested that an epistemological shift may be vital in order for risk managers to pose fundamental questions about the nature of knowledge used to make predictions about emerging risks. While the author suggests that reality exits independently of a single persons knowledge, it is also evident that the nature of

knowledge that is produced depends on what problems exist and what questions are asked in relation to the world around us (Danermark *et al.*, 2002). As an alternative to asking more positivist questions of how many or how much, a qualitative approach to field risk research would stress upon the importance of more reflective questions. The aforementioned nature of questions can include: “how do I (as the risk manager) know what I know”, “why do I only know what I know”, “what is it that I do not know (about emerging risks, etc.)” (Donnell *et al.*, 2013). However, it does not imply that all forms of measurement are thereby excluded (da Graca Moura and Martins, 2007). The philosophical stance which is closest to fore stated manner of proposed thinking has been identified as critical realism.

4.2 Critical realism in the present research

There exists a plethora of divergent views and approaches to the domain of critical realism. Consequently, the researcher deems it necessary to discuss the relevant understanding with pertinence to critical realism adopted for the present research endeavour.

Critical realism can be reffered to as a movement shifting away from positivism, as closely associated with the works of Bhaskar and Harré (Archer *et al.*, 2015; Bhaskar, 1978; Danermark *et al.*, 2002). The term critical can then be understood as a “transcendental realism that rejects methodological individualism and universal claims to truth” (Denzin and Lincoln, 2011, p.11). In other words, critical realism is critical of the ability to know reality with certainty (Wynn and Williams, 2012). Critical realism shares the interest of positivism in the objective world, in patterns, and in finding causalities. Nevertheless, it also departs from it by claiming that the study of the observable does not go far enough, as it neglects the mechanisms that created the phenomena that positivists seek to measure (Archer *et al.,* 2015; Danermark *et al.,* 2002).

It is argued that scientific expeditions must go beyond pure identification of regularities to the analysis of mechanisms, processes and structures that account for the patterns that are observed (Briar-Lawson, 2012; Denzin and Lincoln, 2011). The social world is, in the critical realists’ view, an extremely complex, open system,

which can only be known partially (Grote, 2009). It is of pertinent significance to recognise in the context of risk management that human knowledge is in the majority of contexts incomplete and selective, and, hence, reliant upon assumptions and anticipations (Renn, 2005).

For critical realists the social world is real in the sense that it exists independent of its identification (Fletcher, 2016). The social world can be stratified into three levels of reality (Bhaskar, 1978; Christie *et al.*, 2000; Roberts, 2014). It is proposed that these different levels allow a differentiated view of emerging risks, as explored in Figure 4-1.

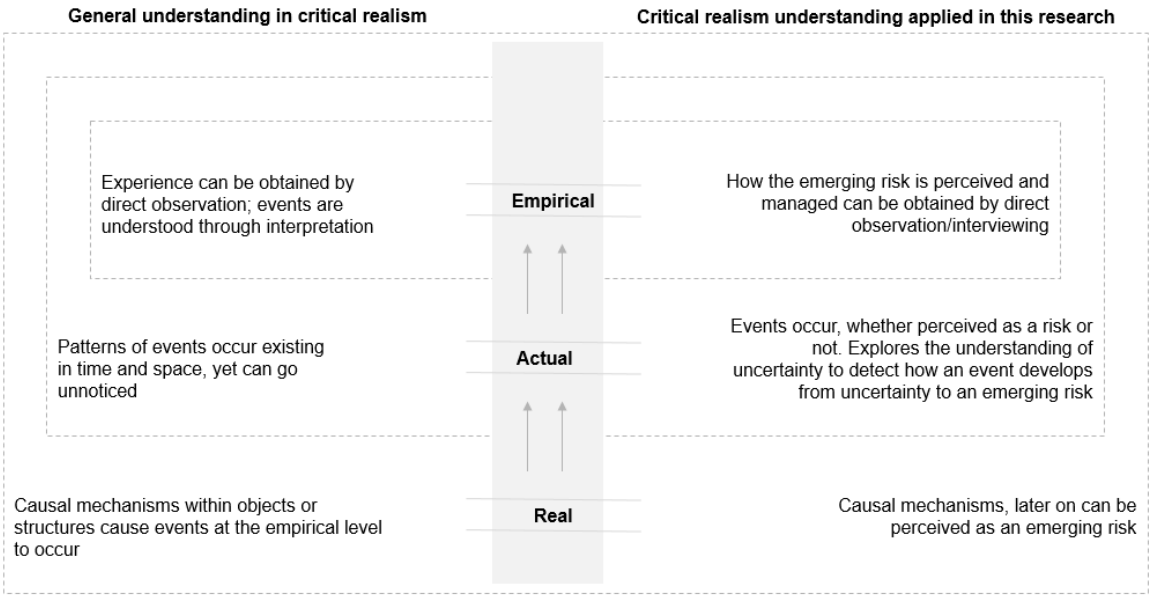

Figure 4-1: The three levels of reality in critical realism and their understanding in this research

Layder (1993) argues that a key aspect of critical realism is “a concern with causality and the identification of the causal mechanisms in social phenomena … recognizing the importance of actors’ meanings” (p.16). Underneath this view, lies the inherent understanding that no difference exists without a cause (Byrne, 2013). The author proposes that risk events are caused by mechanisms that are discoverable and are distinct from the perception and the actions of individuals or the risk manager who studies them.

It is suggested that the theoretical underpinning of critical realism as a basis for this research could help to understand the practice used by individuals to conceptualise

and detect risks, and to further manage those risks by considering all three levels of reality.

The previous section has discussed the linkage between the philosophical stance and the ontological and epistemological view. Moreover, philosophy not only shapes what to search, but also influences how to perform the research from a methodology point of view. For the purposes of the present study, case study methodology was identified as the most suitable manner in order to achieve the aim and objectives. A primary reason is that case study is on the same tangent with the critical realist view that closed conditions are rarely found in the social sciences (Perry, 1998; Tsang, 2014). Researching a case in its natural context allows exploring the conditions under which the presumed mechanisms function and correlate in the real (Huberman and Miles, 2012a; Tsang, 2014). In consonance with the same, Wynn and Williams (2012) describe case study methodology as an appropriate approach to exploring the interaction of structures, human actions, and contexts in order to identify and explain generative mechanisms (Sayer, 1984). Chapter 5 will discuss the research methodology in more detail.

4.3 Limitation of critical realism

Choosing an appropriate philosophical underpinning also requires a sound understanding of its limitations.

A constratint of critical realism is that it relies to some extent on interpretation, level one to three adapted from Bhaskar (1978). Critical realists acknowledge the fallibility of knowledge and therefore suggest cross-case analysis to increase credibility of findings. With respect to critical realism, perception can be seen as a window of reality which should be then compared to other perceptions. Non objective knowledge of the world is belived to exist, hence the research proposes to accept alternative accounts of a research phenomenon (Bhaskar and Hartwig, 2010). All knowledge is seen as partial and imperfect. If nother research concludes a different outcome on the same research subject in a different outcome, it is not seen as proof that the underlying mechanisms have been misinterpreted, as the different result may be due to a change in the context (Perry, 2002).

4.4 Summary

The antecedent chapter suggests and implies an engagement of an in-depth dialogue in association with the risk management studies, thereby focusing on the mechanisms and context, and subsequently suggesting a critical realist view. It has been argued that critical realism offers a fresh perspective to the risk researcher by delineating apparent causes and effects, and by identifying underlying generative mechanisms (Briar-Lawson, 2012). It is proposed that this understanding can advance the less explored field of ERM and emerging risks.

The circumstances to be researched (Eisenhardt, 1989; Yin, 1989), and the research philosophy adopted by the researcher, point towards the research methodology (Guba and Lincoln, 1994). Therefore, the next section will take this argumentation further and provide viewpoints for the chosen methodology.

5 Methodology

The present chapter details out the overall approach which was adopted for answering the research questions and attaining the research objectives. Edmondson and McManus (2007) stress that good research results from asking the right questions and then choosing the right method, not the other way around. To appraise the chosen case-study methodology (Section 5.1), the data collection (Section 5.2) and data analysis procedures (Section 5.3) will be discussed.

5.1 Overview of research methodology and method

This section addresses key conceptual issues and offers a rationale for selecting the qualitative case study strategy.

There are several research strategies applicable to business and management research; the predominant are experiment, survey, action research and case study (Carter and Little, 2007; Creswell 2013; Miles *et al.*, 2013; Yin, 2014). Since both qualitative and quantitative research can be used to seek a description of social reality, Table 5-1 summarises the key advantages and disadvantages of both approaches (Bryman, 2006; Bryman and Bell, 2015; Merriam and Tisdell, 2015, Yin, 1989).

	Qualitative research	**Quantitative research**
Advantage	▪ Allows deeper understanding ▪ Focuses on participants view ▪ Explores subjective dimensions ▪ Makes analytical generalisation ▪ Flexible ▪ Interpretive	▪ Measures variables ▪ Is structured and standardised ▪ Provides statistical methods for data analysis ▪ Allows statistical generalisation
Drawback	▪ Subjective ▪ Researchers deep involvement may lead to bias ▪ Provides only a small sample ▪ Statistical generalisation is limited to lacking similar conditions and context	▪ Is inflexible ▪ Is deterministic ▪ Includes important factors which cannot be expressed in numbers may be disregarded ▪ Excludes subjective aspects ▪ Assumes an objective reality

Table 5-1: Advantages and drawbacks of qualitative and quantitative research

According to Eisenhardt and Graebner (2007), the complexity of the causal relationship of the research subject, the meaning of subjective meanings, and the requirement for openness and reflexivity, do not allow for a quantitative research approach at this point in time. Yet, this constraint of the research approach does not have to be permanent. As soon as the understandings of emerging risks are further explored and the risk management procedures are described in more detail, a quantitative approach could add important knowledge. The benefit of a quantitative research approach will be further elaborated in the outlook for further research in Section 8.6.

The research questions, which have been derived from the research gap identified during the literature review (Cooper, 1982; Tranfield *et al.*, 2003), focus on understanding and explorative aspects (Bryman, 2012; Gläser and Laudel, 2010). The methodology which allows providing answers to explorative research questions and resonates with the critical realist view is identified as qualitative case study research (Caelli *et al.*, 2003; Carter and Little, 2007; Donnell *et al.*, 2013; Flick, 2007; Maxwell *et al.*, 2013; Seawright and Gerring, 2008).

Stake (2005) states that case study research is not a methodology but a choice of what is actually studied. Other scholars describe it as a strategy of inquiry and methodology (Eisenhardt, 1989; Yin, 2013; Yin, 2014). In line with Creswell (2013), a case study is seen as a methodology as well as a product of the inquiry. Eisenhardt (1989) defines the case study approach as “a research strategy which focuses on understanding the dynamics underlying the research phenomenon” (p.534). This is particularly suitable when the boundaries of the research phenomenon are not obviously apparent, classically due to a lack of a priori knowledge and a strong theoretical base (Benbasat *et al.*, 1987).

Case study research is especially suitable when the research area calls for theory building rather than theory testing (Buck, 2011; Eisenhardt 1989; Eisenhardt and Graebner, 2007; Singh, 2015). This research approach may allow a more informed foundation for nascent theory development in a newly developing area of research (Edmondson and McManus, 2007; Eisenhardt 1989; Yin 1989), such as risk management for emerging risks from IT innovations. Furthermore, case study is

aimed at exploring contemporary complex phenomenon within their real-life context (Runeson and Höst, 2009; Yin, 2014). The case study involves interventions having multiple causes and effects and is meant to detect interventions in their totality, not only in terms of their single aspects (Byrne, 2013; Yin, 2013). This is in line with the research area, which explores a contemporary and complex issue (emerging risk) in a specific context (ERM in German banks) (Doh, 2015). In support of this view, academia has recently called for more case study research in risk management in banks (Giovannoni *et al.*, 2015).

Multiple-case studies are conducted to examine several perspectives and to understand the similarities and differences between the approaches adopted by German banks (Creswell, 2013; Donnell *et al.*, 2013; Eisenhardt and Graebner, 2007; Yin, 2012). The research adopts an embedded design that includes IT managers and risk managers from the respective banks, as well as risk management consultants. Each bank is one separate case, and the risk consultants present another case. Even though an embedded design is complex, it allows induction of richer and more reliable results (Yin, 2013). Multiple-case studies allow a more rigourous research exploration than a single case study, as they are more generalisable (Christie *et al.*, 2000).

A review of common criticism of the case study methodology indicates that this methodology also requires careful consideration of the possible drawbacks. Case studies have been criticised for a lack of generalisability (Bryman, 2012). A strand of researchers forcefully argues that this critique can be met by applying appropriate research methodology practices (Flyvbjerg, 2006; Runeson and Höst, 2009). Another topic of concern is the inherent subjectivity in case study research. Subjectivity can be mitigated through careful selection of interviewees, a structured interview process, and a well-designed procedure for recording and interpreting the data (Christie *et al.*, 2000; Creswell, 2013; Meuser and Nagel, 2002). On the other hand, it is worth noting that qualitative research aims to discover meaning and understanding, rather than to verify facts or predict outcomes. Meaning, however, is subjective. Nevertheless, due to making the research process explicit, the reader can follow the development of the research argumentation.

The research instrument was verified by a pilot research (Denzin and Lincoln, 2011; Tracy, 2010) with two interviews conducted in one bank. A pilot study is understood as a small-scale feasibility study of the major study (Chenail, 2011). The purpose of the pilot study was to evaluate the feasibility of the proposed research project (Miles and Huberman, 1994) and to verify the interview protocol and possibly detect potential researcher biases (Chenail, 2011). Conducting a pilot study does not guarantee success in the main study, but it does increase the likelihood of success (Baxter and Jack, 2008). The pilot affected several decisions related to carrying out the main study, which will be further discussed in Sections 5.2.2 to 5.2.4.

In this section a brief overview of the research design was given. The next section deals with the description of the applied data method and the implication of this method for data collection and data analysis.

5.2 Data collection

This section discusses the sample from which the data have been collected. The parameters selection of interview partners is described, as well as why further organisational documents were omitted from the case study.

5.2.1 Sample design

In case studies, the units of analysis should be selected intentionally. This is in contrast to surveys or experiments where subjects are sampled from a population to allow generalisability (Runeson and Höst, 2009).

Consistent with critical realist philosophy, the author argues for a purposeful sampling strategy, which aims for cases with high information richness through which sets of ideas can be evaluated on the basis of interpretation and explanation (Emmel, 2013; O'Reilly and Parker, 2013; Welch *et al.*, 2015). Hence, samples should consist of cases which best present a research topic and substantiate meaningful and significant claims (Eisenhardt and Graebner, 2007; Perry, 2002; Yin, 1994).

The research aims to explore how emerging risks from IT innovations are managed in the enterprise-wide risk management process of German banks. This calls for

large banks, where “large” is understood relative to the average size of a German bank (Hauner, 2005), as with the size of the bank, the risk management process implemented usually increases in complexity (Bessis, 2010). These principles were found in the banking population of the ECB and EBA stress test of 2014 (EBA, 2014). The stress test of 2014 is designed to evaluate the resilience of the largest banks to hypothetical shocks, such as an economic downturn (Acharya *et al.*, 2014). The intention is to detect weaknesses and respective risks in the European banking sector so that mitigation actions can be taken (Deutsche Bundesbank, 2014b). Consequently, this large bank group has been selected as the members provide the required size and complexity (EBA, 2014; Yin, 2013) to investigate risk management practices across the entire organisation (Olson and Wu, 2008; Seawright and Gerring, 2008). In 2015, the stress test was not carried out, and data for 2016 were not available by the time the research was completed.

The eight banks from which data have been collected are part of the population of 25 German banks (Deutsche Bundesbank, 2014c). In addition, two more banks have been included. Those two banks have a representation in Germany and are classified as global systemically important banks by the Financial Stability Board (FSB) and the Basel Committee on Banking Supervision (BCBS). Those two banks have been included in the sample due to their size, as the size of the bank affects the extent and scope of ERM (Bessis, 2010).

Even though differences in the business models of all interviewed banks exist, all banks must comply with the Minimum Requirements for Risk Management (Mindestanforderungen an das Risikomanagement – MaRisk), and hence comparable risk management structures can be found (BaFin, 2012; Deutsche Bundesbank, 2014a). Concentration on one sector means its specific characteristics can be observed in more depth. In addition, a single sector study also limits the range of extraneous variations in the data, which might influence the constructs of interest (García-Granero *et al.*, 2015).

An ongoing debate in academia is the question of how many cases are required (Creswell, 2013; Guest, 2006; Siggelkow, 2007; Tracy, 2010). However, consistent with Francis *et al.* (2010) and Uprichard (2013), the sample size was not predefined

at the start of the research, rather determined at the point of data saturation. In the context of achieving an appropriate level of research validity, the researcher aimed for purposeful sampling. It is suggested that the sample size should be established inductively and sampling should continue until saturation is reached (Guest, 2006). It is argued that the adequacy of the sample cannot be solely determined on the number of participants but rather on the appropriateness of the data (Caelli *et al.*, 2003).

Purposeful sampling is the most commonly used sample approach in applied research (Miles *et al.,* 2013). Despite of this dominance, the concept of saturation has been criticised, as many works in qualitative research do not make explicit what saturation implies in the context of the research (Caelli *et al.,* 2003; O'Reilly and Parker, 2013). In this research, data saturation refers to the point in data collection when no additional relevant data is found (Francis *et al.,* 2010). In this study, this implied that no new codes had to be created in order to code the interviews. Data from summary tables were used to construct a cumulative frequency graph and were useful in determining the development of saturation in the data (see Appendix 4: Data saturation).

By interview 14, the two globally systemically important banks (G-SIBs) and the risk manager of the largest German bank from the sample had been interviewed. For the next seven interviews, only six more codes emerged. Therefore, it was decided as a next step to carry out the missing interview with the IT manager of the largest German bank. The researcher intentionally chose to conduct this interview to a point where very few codes emerged, as the interview with the G-SIBs supported Bessis' view that the size of the bank affects the extent and scope of ERM (Bessis, 2010). Interview number 22 did not require a new code. Since the next interview also did not require further new codes, the data collection was stopped (O'Reilly and Parker, 2013).

5.2.2 Semi-structured interviews

Data collection with semi-structured interviews is favoured as the research questions demand an explorative approach. In a research area for which current literature and

research is limited, it is likely that a qualitative approach will be given preference (Bryman, 2012; Creswell, 2013).

Various qualitative methods for data collection were reviewed, yet not all were considered suitable for this thesis. An extract of approaches considered are given in Table 5-2 including the reasons for their rejection.

Data collection method	Reason for rejection
Closed Survey	Rejected for not providing deep insights and flexibility (Singh, 2015); no ability to integrate emerging themes.
Focus groups and interviews	Not applied as answers can be influenced by the conversation with others and possible difference in status; could be applied after in-depth interviews (Ritchie *et al.*, 2013).
Direct observation	Excluded as the pilot study showed that emerging risks are not part of the regular ERM processes, and hence observation could be difficult.

Table 5-2: Qualitative data collections methods considered and reasons for rejection

Semi-structured interviews have been selected as they provide direct human interaction and encourage the interviewee to expand and to discuss attitudes as well as facts (Campbell *et al.*, 2013; Gioia *et al.*, 2013). Interviewing has become the predominant method of data collection in qualitative research (St. Pierre and Jackson, 2014), where it is appropriate to gain in-depth exploration into ideas and relationships not previously considered (Schwandt, 2007). Another reason for the selection of semi-structured interviews was that the researcher was able to derive interview questions from the research questions. However, inductive research also needs to allow for emerging themes that arise during the interviews (Edmondson and McManus, 2007; Thomas, 2006). Key questions were constructed in the form of general statements, then sub-questions for further probing followed (Bryman and Bell, 2015; Saunders *et al.*, 2012). The questions seek to provoke responses that allow participants to recount a wealth of information and to explore and unravel issues in a nondirective and unbiased way (Harris, 2000; Huberman and Miles, 2002a; Yin 2009). The interview questions are divided into four main categories. The first set of questions focuses on new risks induced by IT innovations, the second set of questions deals with uncertainty, and the third set concentrates on the ERM

procedures and the actors involved. Hence, the interview questions reflect the focus of the literature review and the derived research questions.

The data collection took place in February 2015 for the pilot study, and between June 2015 and June 2016 for the main study. To the best knowledge of the researcher, during this time span no changes to German compliance and regulation rules were made which could have an impact on the ERM for emerging risks from IT innovations of German banks. Interviews lasted between about 60 minutes and 120 minutes. If permission was granted, the interviews were audio-recorded. Only one expert did not allow such audio recording, as he generally does not feel comfortable in being audiotaped. All interviews were anonymised and if necessary translated from German to English. Extensive field notes were employed during and directly (no longer than 12 hours) after the interview.

5.2.3 Interviewees

The key informant technique was applied as the research topic is new and hence not statistically representative, but knowledge about the research issues is more important (Eisenhardt and Graebner, 2007; Faifua, 2014; Kumar *et al.*, 1993). The focus is not on the expert as an individual, but on the expert in his/her organisational and institutional context (Meuser and Nagel, 2002). An expert is understood as someone having privileged access to relevant information and who can shape reality through his institutional context (Hitzler *et al.*, 1994; Meuser and Nagel, 2009).

The pilot interviews provided guidance in identifying the most knowledgeable experts. Since the ERM process for emerging risks from IT innovations is explored, IT and risk managers as well as risk management consultants have been identified as experts, as it is their responsibility to define and manage the ERM processes (Gläser and Laudel, 2010). Knowledge and skills makes them suitable to represent their community. Therefore, a representativeness based on content is possible.

Whenever possible two experts from each bank were interviewed. This should allow presenting the reality of described procedures as it is assumed that informants likely would provide more precise answers if they knew another person form their organisation would be interviewed (Meuser and Nagel, 2002). A total of twenty-three

individuals have been interviewed, of which fifteen hold a senior position in risk management or IT. In addition, also risk management consultants were interviewed. Anand *et al.* (2007) suggest that consultants are especially knowledgeable about areas in business which are rather new as they have a high influence on the set-up of new procedures. Consultants were chosen based on their working experience in the banking sector. A review of documents and articles accessible through the internet was conducted to identify consultants who are knowledgeable in the banking sector and risk management area. Thirty-five consultants were contacted, resulting in six interviews.

5.2.4 Field analysis of organisational documents

The data collection in case study research is typically drawn from multiple sources of information (Creswell, 2013; Yin, 2013). For that reason, during the pilot the researcher sought further data sources. The bank of the pilot study had provided access to their intranet to look for secondary data. This opportunity led to a comprehensive documentary analysis of around 150 documents and 48 process charts. However, no document was identified which provided further details to the risk management process of emerging risks. Nevertheless, the non-availability of further documents has no influence on the chosen research methodology. Since case study methodology does not rest only on multiple data sources, it is likewise important to include multiple separate cases. Hence, in the main research, the focus was put on collecting data from the banks and the risk consultants via semi-structured interviews.

5.3 Data analysis

Qualitative analysis is understood as the process of reviewing, synthesising, and interpreting data in order to describe and explain the phenomenon studied (Fossey *et al.*, 2002). As qualitative data can have various meanings, rigourous data analysis includes an explanation of the process by which the raw data are transformed and organised (Mårtensson *et al.*, 2016; Meuser and Nagel, 2002). As a result, this

section discusses how the collected data from the semi-structured interviews are processed in order to answer the research questions.

The research is grounded on an inductive approach applying within-case and cross-case analysis as suggested by Eisenhardt (1989). The analysis process, which is described in Table 5-3, comprises five main steps. Each step was chosen due to a different analytical focus and resulting product.

Analysis step	**Analytical focus and product**	**Focus on**
1. Writing down the interviews	Translation into English (if required)	Within-case analysis of each single bank and the risk consultants
2. Paraphrasing	Case summary which synthesises the case Detection of emerging themes	
3. Coding	Essence of key attributes of verbal information	
4. Thematic sorting of concepts	Identification of similar products and relationships across multiple-cases Exploration for additional themes based on identified groups	Cross-case analysis across the different types of banks and the risk consultants
5. Comparison of concepts	Similarities and differences conceptually organised (with recourse to theoretical knowledge)	

Table 5-3: Analysis steps in within-case and cross-case analysis

The qualitative researcher must develop an interpretation of the data in the specific context of each case (Ayres *et al.*, 2003; Meuser and Nagel, 2002). Therefore, the analytical approach involved multiple inductive-coding cycles to create holistic single-case studies. The result is a summary of the case as well as a first set of coding categories. The case studies were then analysed in a multi-case study approach in order to understand underlying structures and mechanisms (Yin, 1989). Creation and comparison of individual cases lends external validity to findings observed across multiple cases. Though important findings in one case may be context bound, the emergence of similar findings across cases can begin to confirm that the observation is credible (Miles and Huberman, 1994; Yin, 2012). It is assumed that if themes have an explanatory force in individual cases and across multiple-cases, they are more likely to apply beyond the sample (Ayres *et al.*, 2003).

In the last step, similar cases are grouped together to seek for similarities and differences (Miles *et al.*, 2013). The analysis process was iterative lasting eleven months.

This section has given a broad overview of the data analysis step. The next section on data management will argue for the data quality process applied to this research and be followed by a discussion of the reduction of data and the data interpretation against the backdrop of inductive case research.

5.3.1 Data management

The focus of data management is considered to be the assurance of data quality. The cornucopia of literature on qualitative research methodology stands in marked contrast to the relatively low consensus of the qualitative community on what constitutes good qualitative research (Tracy, 2010). Prominent qualitative scholars lead an ongoing discussion of whether qualitative research can and should even adhere to predefined quality criteria (Denzin and Lincoln, 2011). Yet, in line with Mårtensson *et al.* (2016) and Tracy (2010), it is suggested that guidelines for best practices can advance every undertaking. Hence, to ensure rigour in the data quality, suggestions for qualitative research by Beverland and Lindgreen (2010), Miles *et al.* (2013), Yin (2013), and Yin (2014), have been followed. These academics have identified four forces as especially critical to qualitative case study research.

First is construct validity, in which it has to be ensured that the correct operational measures have been established for the concepts that are being studied (Yin, 2014). Validity in this research is obtained by developing its constructs from the literature review. Furthermore, the reader will be provided with a chain of evidence using cross-case tables or quotes from informants to safeguard this quality criterion. The Computer-Assisted Qualitative Data Analysis Software (CAQDAS), NVivo 10, has been chosen to organise the interviews as it allowed the sorting of data with the help of various key words and indices (Hutchison *et al.*, 2010). This assisted in managing the interviews, coding the data and with support of visual graphs, and it helped to detect similarities and differences across the cases. Secondly, internal validity requires that a causal relationship, where certain conditions lead to other conditions,

has been established (Huberman and Miles, 2002b; Yin, 2012). This aspect is incorporated into the research by matching patterns through cross-case analysis. In addition, to increase the internal validity it was necessary to verify whether the findings are internally coherent and if concepts are systematically related. To facilitate this process, the researcher continuously went back to the findings of the literature and mapped them to the themes emerging during the data analysis (Meyer, 2001). This is in accordance with critical realism, which argues that an external reality exists, and others most likely have researched aspects of that reality (Perry, 2002). Thirdly, external validity aims to establish that the domain to which a case study's findings belong can be generalised (Meyer, 2001; Yin, 2012). External validity is achieved by specifying the population of interest, as in Section 5.2.1. In contrast, positivist research carries out statistical generalisation. Case study research seeks analytical generalisation in which findings can be generalised into a broader theory (Yin, 2013). This is realised by investigating multiple-case studies to develop analytic generalisation through replication logic. Research design for multiple-cases is generally more difficult than a single-case design; however, the resultant data allows greater confidence in the research findings than would a single case study (Yin, 2012). Fourth, reliability is constructed by applying standardised interview protocol, to ensure that constructs are well defined and grounded in extant literature (Miles *et al.*, 2013; Yin, 2012).

5.3.2 Data reduction and interpretation

Data reduction refers to the overall process of breaking down and transforming data into manageable, meaningful units of information (St. Pierre and Jackson, 2014). The data reduction process began with coding (Campbell, *et al.*, 2013).

Based on previous risk management research (Arena *et al.,* 2010; Jäger, 2009; Tekathen and Dechow, 2013) and the interview questions, an initial set of codes and sub-codes were derived to allow an initial coding (Gioia *et al.*, 2013; Hutchison *et al.*, 2010; Saldaña, 2013). Codes represent the essence or key attribute of verbal information. A codebook was developed as a means to document the development

and evolution of the coding system (Baxter and Jack, 2008). This codebook was valuable in ensuring the reliability of the codes (DeCuir-Gunby *et al.*, 2011).

Garrison *et al.* (2006) suggest verifying codes with an expert in the research field, to serve as a sounding board for evolving propositions. Hence, the researcher asked a risk management expert from her company and a risk management scholar to review the suggested codes and provide feedback (Campbell *et al.*, 2013). This helped to ensure the reproducibility of inter-coder reliability, in which the aim is that different coders would code the same data in the same way (Saunders *et al.*, 2016; Yin, 2012). Yet, it is argued that in an interpretative research, different researchers would not derive the exact same codes.

The data analysis was performed manually on paper as well as in NVivo. Even though this was a time-consuming task, it helped greatly in learning the method and in becoming familiar with the data. An additional advantage was that the results, derived from the paper work and the usage of the software, could be compared. The coding obtained was almost identical. Nevertheless, coding in NVivo was found to be much faster and allowed documenting the thinking process through the application of diaries and time stamps in a better way.

The researcher recognises data analysis and data interpretation as an iterative task in which continuous understanding and learning about the data can help to discover new themes and relations between them (Alvesson and Kärreman, 2007; Meuser and Nagel, 2002). Data interpretation in critical realism research wishes to identify and deepen explanation, although recognising the implications of fallibility in constructing multiple, plausible explanations (Jennings, 2015). By mapping various, sometimes conflicting, interview statement to research questions, the field data is used to find relationships between the object of study and the research questions posed (Creswell, 2013).

5.4 Limitations and constraints of the research methodology

Even though steps are taken to minimise researcher bias, it is difficult to be entirely neutral regardless of how theoretically sensitive and methodically prudent the

researcher is (Bryman and Bell, 2015; Miles *et al.*, 2013). The researcher's subjective influence on this interpretive project is thereby acknowledged. In realism research, conceivably the best a researcher can aim for is the awareness of values rather than the removal of all existing values (Bhaskar and Hartwig, 2010). Furthermore, qualitative data as such are multi-layered and can be interpreted in different, nonetheless plausible, ways (Gibbs, 2007). Likewise, the self-reported nature of the data should be highlighted, given that the informants report on a subjective topic.

Moreover, the use of the key informant technique implies that the possibility of common method bias cannot be ruled out. Data from interviews can be judged as a "… retrospective sensemaking by image-conscious informants" (Eisenhardt und Graebner, 2007, p.28). To limit this possibility, suggestions from Eisenhardt und Graebner (2007) were followed by selecting key informants who view the research phenomenon from diverse perspectives.

5.5 Ethical issues

An important aspect of good research is the consideration of ethical issues. "Naiveté [about ethics] itself is unethical" (Mirvis and Seashore, 1982, p.100). The university's Research Ethics Committee reviewed the research endeavour prior to its application in the field. Furthermore, the following steps are taken to assure research ethics and probity:

- The research design, methods, and purpose were fully disclosed to informants prior to the data collection. With the request for an interview, a document was included which clarified the aim and objectives of the study and how the data would be collected, analysed and protected. Before the start of the interviews, the informants were reminded of the voluntary nature of their participation and given opportunity to withdraw and to seek clarification of unclear aspects. Informants gave informed consent before data collection commences.
- Previous scandals in the German banking sector have made banks fearful of disclosing information. Therefore, gaining access to institutions was difficult

and was only achieved after multiple reassurances of confidentiality. All the interview partners agreed to co-operate solely on the basis of personal and institutional anonymity. As informants disclosed sensitive information pertaining to their organisations, an identification-coding scheme is used to safeguard informant's identity. It was made sure that no names or identifying characteristics of informants or their organisations are used. During the interpretation of the data, several relationships could be drawn based on characteristics that banks share. Nonetheless, such relations were excluded as it could have been possible to identify the bank based on these characteristics.

- Key ethical factors also include the careful handling of sensitive results (Runeson and Höst, 2009). The guiding principles for the data storage and deletion are the Edinburgh Napier University's Data Protection Code of Practice and associated guidance in combination with the German Federal Data Protection Act (Bundesdatenschutzgesetz, Gesetz zum Schutz vor Mißbrauch personenbezogener Daten bei der Datenverarbeitung). Hence, all electronic equipment, data files, and support materials, including handwritten notes and diagrams, either are secured by an encryption program or are locked in the researcher's office. Moreover, all electronic and physical data files will be destroyed five years from the date of the submission of the thesis for examination.

5.6 Summary

This chapter has presented a detailed discussion of the research methodology. Having explored potential methods of data collection and analysis, the researcher determined that a single method is most suitable for this research.

Table 5-4 demonstrates for the methodological fit applied in this research, which is understood as consistency among elements of a research project (Edmondson and McManus, 2007).

Element	Adaptation in this research
Nature of the research question	Exploration of an open-ended inquiry about the phenomenon
Data collection	Semi-structured interviews from multiple cases; qualitative data which needs to be interpreted for meaning
Goal of data analysis	Pattern identification and emerging themes
Data analysis method	Inductive, iterative, thematic content analysis, coding for evidence of constructs
Philosophical stance	Critical realism in trying to observe the real, the actual, and the empirical; exploring conditions under which the presumed mechanism functions and correlate in the real; no universal claims for truth
Theoretical contributions	Nascent theory, inviting for further work on the issue

Table 5-4: Methodological fit in nascent theory building research

Although qualitative research is not dominant in risk management research, at least in terms of methodological rigour, this chapter has argued that qualitative case study research is fully appropriate for this research situation and can be applied with careful attention to methodological integrity.

6 Findings

Following the discussion of methodology presented in Chapter 5, the present chapter engages with a pure presentation of the findings, without any interpretation or reference to the literature.

Qualitative research is often questioned as to how field research on the same phenomenon can result in different findings (Mårtensson *et al.*, 2016). Therefore, the data must be presented in sufficient depth to allow for a linkage between data and theory. It also stresses the meaning of the uses of verbatim quotes from the interviews to provide credibility to the study (Tracy, 2010), as it allows the reader to distinguish between the researcher's own opinions from the informant's verbatim ideas (Gioia *et al.*, 2013). However, interview quotes will not be provided for all themes that emerged. Instead, interview quotes have been selected which are considered information rich and express the theme within a few sentences.

The research questions and the research gap identified have influenced the unit of analysis and resulted in a multiple-case study research design. The bank's IT manager and the risk manager make up the "case" of each bank. In summary, ten banks have been interviewed. To deepen the insights from the case bank and get an outside view, the six risk consultants are defined as another separate case. In total, twenty-three individuals have been interviewed.

To ensure anonymity, the interview partners are all referred to as "he", even when the interlocutor is a female. The use of "his" in the thesis is defined as a gender-neutral pronoun and interchangeable with "her." Furthermore, interview partners are labelled by the abbreviation RM for risk manager or IM for IT manager or C for consultants, followed by a letter or number for the respective case. The banks are marked with the letters A to J, and the consultants bear the numbers 1 to 6 (e.g. RM-A for risk manager of case bank A and C-1 for risk consultant number 1).

To allow a comprehensible overview of the emerging themes, the findings are reported by total number of informants discussing the topic and the number of times the topic has been raised. The findings are presented by the structure identified from

the literature review, which focuses on the four research fields – procedures, risk field, risk rationalities, and uncertainty experts.

6.1 Findings on procedures

The research area procedures is concerned with research question number one: *Which ERM components are critical to the ERM of emerging risks from IT innovations?*

The interviewees stated different components which they deemed as being important to the ERM for emerging risks from IT innovations. Table 6-1 lists components according to the density coverage in the interviews, from the most to the least mentioned theme.

	Code	# informants mentioning (n=23)	# of mentions
Procedures	Risk assessment	16	39
	Knowledge collection	16	35
	Decision-making	7	34
	Operational risk management	14	31
	Risk monitoring	15	27
	Knowledge creation	17	25
	Risk identification	6	17
	Lack of procedures	6	16
	Risk classification based on risk inventory	5	13
	Ineffective ERM	4	11

Table 6-1: Emerging themes in procedures

Sixteen informants mentioned risk assessment as a vital part of the ERM process. RM-H describes his view on risk assessment as:

> *"It is part of the DNA of our business. It means that we have to assess a risk on a day-to-day basis very rigorously and analyse emerging risks. We look at the regulatory landscape. We look at the competitive landscape, and we do very regular reviews of emerging risks, emerging competitive risk, emerging*

> *regulatory risk, and consider what that means against our current business model …" (RM-H).*

He furthermore combines risk assessment with knowledge in the following way:

> *"Banks think they are sort of … we know everything. But the community we work in is very open to admitting: "You know what? We don't know everything." We learn, we are constantly in a review of risk and our view of emerging threats and our view of what is going on. Yes, we make mistakes, yes, our systems may suffer what we call degradation, but we immediately look at it, we assess it, we learn and we improve. And I think that is the ongoing risk management model we need to aim at. I have worked in a few places and I know that this is the approach everybody needs to take. Again, it depends very much on the learning methodology the bank operates in" (RM-H).*

C-6 stresses the importance that not only regular risk assessment as typically known in banks is required, but in fact a broadening of the present scenario of risk assessment is needed:

> *"… they cannot be reactive, they need to have proactive rules" (C-6).*

Informants frequently were concerned about how to receive knowledge about emerging risks. C-3 summarises his experience as:

> *"You can never kind of lay back and say: Now I kind of, I'm 100 percent sure everything is running smoothly, I did this kind of testing, this kind … could never happen. Because there is always something, something new that could appear …" (C-3).*

Informants from bank IM-A, RM-A, RM-D, and IM-G also highlighted that emerging risks must be reported to operational risk management. They discussed that a reporting process must be set-up so that operational risk management can be informed. RM-C raised the idea that operational risk management must provide a scheme for risk assessment and further guidance on how to proceed with the risk after its identification.

A frequently raised topic, with fifteen informants, is risk monitoring. Interview partners postulated that more actions are required to monitor the development of a risk and

furthermore to observe whether the actions that were defined, are sufficient once the emerging risks materialises.

> *"What I think is important as well, and where we are not good at, is to understand and validate measures and to validate whether the defined actions really would help if the risk actually occurs" (RM-F).*

RM-H shares this view and adds:

> *"It is something we now realise as one of the highest risks on areas of due diligence when we are voting new IT products. Four, five years ago, we did not know the word cyber risk or system protection. It was not top of our key risks landscape, but what happens in our bank and I think this is where a new risk emerges we then retrofit that back into our framework. The cyber risk is now officially a key risk. We have a framework for it, which has only been there in the last three years. When we have an emerging risk, we assess that risk and then absolutely go do something that we believe is going to be an ongoing consistent … which is sort of then a monitoring framework and we sort of promote it to be part of our framework" (RM-H).*

RM-J described the current set-up of risk monitoring as:

> *"We have the 110 risk types and we have assigned the three Line of Defence model. And we have 13-14 control functions within the group, and each of these risks is clearly assigned to a control function. And for each risk, there is a risk task controller; he is responsible for defining and monitoring the risk, for the definition of controls and all procedures related to the overall risk management process" (RM-J).*

Four informants raised serious doubts about whether ERM is reaching its objectives.

> *"The bank claims to have an enterprise-wide risk management, however, I doubt that it works" (IM-E).*

C-3, C-4, and RM-J share the same view and report that most banks treat the risks on the ERM-level, and only risks specific to a certain product are managed on product-level by the respective department.

> *"It is a combination of both, there is a department level but there are also cross organisation groups. We try to get it at a department level because the products are so different and the customers also. One year ago, we were trying to come closer to ERM, but now we are going down a different angle. ERM moves much closer to the business unit" (C-4).*

RM-B described that further risk management processes exist outside of the risk management department.

> *"There is a digitalization campaign, and in this context also new risks are analysed with the help of IT, and new strategic directions are set" (RM-B).*

He described this initiative as an example that his bank treats emerging risks in various departments across the entire organisation.

6.2 Findings on risk field

In the research area of risk field, research question two is explored: *What key meanings are currently attached to emerging risks from IT innovations within the German banking sector?*

The findings from the interview highlight that German banks attach various meanings to emerging risks from IT innovations. Common opinions, understood as characteristics of emerging risks, discussed during the interviews are:

- Emerging risks are characterised by a lack of knowledge
- Emerging risks are characterised by a fast development and change of the risk
- Emerging risk are dependent; they depend on the underlying IT innovation
- Emerging risks are comprehended as risk with a high uncertainty.

Table 6-2 lists the themes emerging from the interviews according to the density coverage in the interviews, from the most to the least mentioned theme.

	Code	# informants mentioning (n=23)	# of mentions
Risk field	Lack of knowledge	21	45
	Fast development	23	34
	Context specific	17	33
	High uncertainty	15	29
	Decision-making	14	27
	Chance	12	24
	Known risk	16	20
	Threat	15	19

Table 6-2: Emerging themes in risk field

RM-B, IM-B, RM-C, and IM-C attach uncertainty as a key meaning to emerging risks and describe that uncertainty makes it very complex to arrive at a common understanding. RM-B is concerned, commenting that managing risks to which various meanings are attached is problematic, and sometimes impossible, as people do not understand the underlying issue.

Arguing in the same direction, IM-A, IM-F, C-3, C-4, C-5, and C-6 highlight the problem, that some decision makers are not up-to-date with technological developments and hence do not have the knowledge to define and to identify those risks or create awareness for possible risks.

> *"Key decision makers currently do not know enough, they lack the knowledge; that is the biggest problem" (IM-A).*

C-1 is concerned that decision-makers will only consider aspects they know of; he summarises his view as:

> *"A human is limited in his knowledge and will only move in this field" (C-1).*

A similar view is shared by RM-C who describes emerging risks as a lack of knowledge and furthermore relates it to the corporate culture of a bank. He says:

> *"Well, the corporate culture sets a certain way of thinking. Especially when new risks arise, I should approach them unbiasedly and eventually not even consider the status quo. And of course it is difficult to do so if I am anchored*

> *in the company and its philosophy and culture. A certain distance would be useful when working on this topic. But at the same time this topic cannot be outsourced, because it is a strategic subject and such subjects should stay in the company" (RM-C).*

C-6 described a situation in which a new IT-based product should be launched and the IT department proposed a solution for it, which he reviewed and found many risks to it. He reported that he had "*to literally fight*" (C-6) for the business experts, as well as the IT experts to sit together and actually understand the new product in order to select the best IT solution for this product.

RM-H described a similar situation in which his department struggled to accumulate knowledge to ensure that the products are safe and the customers of the banks are satisfied with. He states:

> *"We only know what we know. No one of us has a crystal ball. The key things for us at the moment is trying to outsmart these cybercriminals and to try to understand where the market is going and get ahead of the risks, so to speak. It is a significant threat to our business model. If our customers feel that our products are not secure, then our customer will go away" (RM-H).*

A common refrain from the banks is the relationship between the understanding of emerging risks and decision-making.

> *"I find knowledge important, but at a certain point, you need to take a decision and you need to go for it. You cannot always wait until you have absolute certainty" (IM-C).*

RM-B describes emerging risks from IT innovations as strategic risk, and hence sees risk management as an important input to effective decision-making. Fourteen of the interview partners discussed decision-making in the context of emerging risks. C-6 acknowledges:

> *"The technology is going to enable running the model, not making the decision…" (C-6).*

C-4 expresses his concern regarding decision-making and lack of knowledge as:

> *"Let's say we have the best process to manage a risk in a process. If people do not understand the underlying technology like artificial intelligent or*

> *blockchain, even closer things like APIs [application programming interface] or mobile apps, they will end up making the wrong decision. They will object to things, which they do not understand. They will allocate money to projects which are already obsolete" (C-4).*

RM-B, IM-B, IM-H, IM-I, RM-I, and RM-J declared that they collaborate with fintech[4] companies to evaluate and test new IT products and work with them in defining the risks. Bank D and F have outsourced the IT and see the definition of the risk as the prime responsibility of the outsourcer.

Three informants say that emerging risks are changing all the time; hence, a shared definition will be hard to achieve.

> *"I think if you try and define it, you spend more time in doing the definition than you do actually trying to manage the risk which is pretty invasive" (IM-H).*

At the same time, they acknowledge the importance of a definition as a means to communicate the risk to other stakeholders and collect further information about the risk. Yet, RM-F raised another topic by expressing his concern that a common definition set by the supervisor could present a disadvantage to smaller banks with a relatively small IT.

> *"If you specify a certain raster or definition, you would privilege large, complex institutions and overwhelm small institutions" (RM-F).*

Furthermore, informants generally agreed that most emerging risks are already known, yet in a different context and that those risks are already included in the banks risk inventory. Ten respondents argue that most of the risks from IT innovation have been present in other situations (e.g. data breach).

RM-D and RM-E find that the main characteristics of emerging risks from IT innovations are already included in their risk inventory and hence attaching further meaning is not required.

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[4] The term "fintech" is an abbreviation of the words "financial services" and "technology" and describes technologies that enable or provide financial services.

> *"It is more important to sit down from time to and think about what risks should be incorporated. Risk identification is more important than a general definition" (RM-E).*

One key meaning attached to emerging risk is uncertainty. The understanding of uncertainty expressed in the interviews will be explored in the next section.

6.3 Findings on risk rationalities

Risk rationalities explore answers to: *How does uncertainty influence the ERM of emerging risks from IT innovations* (research question three)? In the interviews, various aspects of uncertainty have been discussed, as expressed in Table 6-3.

	Code	**# informants mentioning (n=23)**	**# of mentions**
Risk rationalities	Uncertainty as a lack of knowledge	17	44
	Uncertainty as an engine for change	8	26
	Uncertainty ignorance	4	23
	Uncertainty as an obstacle to risk assessment	7	19
	Uncertainty as a competitive advantage	8	12
	Uncertainty impact on ERM processes	5	18

Table 6-3: Emerging themes in risk rationalities

Seventeen informants related the concept of uncertainty to a lack of knowledge about emerging risks. This view is shared by RM-H, who further describes his role as aiming to reduce uncertainty:

> *"I am not a technical expert, I am not tech support, but I make sure that the right people with the right expertise are at the right table and do the right analysis… If I do not know what kind of new innovations currently exist, I can overlook the innovations – this means you may overlook the risk completely. I would call this know-how risk" (RM-H).*

Furthermore, how the IT innovation and the risks will develop in the future is uncertain for a lot of the informants. RM-J expresses this concern as:

> *"Yet, we are all aware of it, and we know it can happen to us as well. That is why everybody is so alert. That is the subject of uncertainty, because you have examples from other industries in your mind and you are extremely careful that you do not get yourself into such a situation, which is the first step. And the next step is that we are trying to move to the head of this movement and lead this game" (RM-J).*

C-2 has discussed whether data about uncertain states exist in order to assess the risk or if banks actually do not make the effort to identify the data to overcome the uncertainty. He expresses his critical view about banks collecting data and creating knowledge as:

> *"There is therefore a clear line between uncertainty and ignorance … Face uncertainty and do not ignore it" (C-2).*

This opinion is furthered by C-5 who summarises:

> *"I face so many uncertainties throughout my role at work. Not everything is black and white. The world is changing too rapidly to be black and white" (C-5).*

RM-C, RM-D, RM-E, and RM-F see uncertainty as an obstacle to determining the probability and impact of the risk. Five out of ten banks are concerned about how to reflect uncertainty in a risk assessment. IM-F reports:

> *"Uncertainty plays a major role; the more uncertain you are during your estimation, the more uncertain is the result you are working with. Therefore, sometimes a good-case, worst-case and best-case scenario is created" (IM-F).*

> *"The uncertainty of what those products look like or how they going to impact the bank's business model is significant. In terms of how we deal with that internally, we can only tread what we know" (RM-H).*

> *"We have very good people who are sort of predicting the future because we can only then manage our risks by prediction of where we think the market is going. And it is a very definitive science, the science of uncertainty I would call it. … That is where we see the uncertainty is driving our business model" (RM-H).*

Eight informants see also an advantage in uncertainty as it allows competitive advantage if you can manage it properly.

> *"Uncertainty is not a disadvantage. If uncertainty did not exist, then you would not need risk management. Uncertainty is the raison d'être of risk management" (RM-J).*

RM-B describes IT innovation and the early detection of risks as a means to gaining competitive advantage. C-1, C-2, and C-5 comprehend in uncertainty a driver for creativity and to finding new solutions to a problem. This view is also shared by C-3 who states:

> *"It is almost an advantage as it keeps us on our toes and it ensures that we constantly innovate and that our systems are evolving over time. I would treat it as an advantage" (C-3).*

C-5 describes his experience with uncertainty as:

> *"I feel it is an advantage because in certain times, that is actually when the best organisations can work. It is not an easy process but I think I have seen uncertainties creating opportunities" (C-5).*

Five informants report uncertainty as something negative; they perceive it as a threat and an obstacle to managing a risk. IM-B expresses his opinion:

> *"Uncertainty is bad. To ignore innovations is dangerous as innovations affect the whole banking business" (IM-B).*

RM-E does not attach a lot of uncertainty to emerging risks; he says:

> *"A risk per se contains uncertainty, and for a new risk the uncertainty is just a bit higher" (RM-E).*

Informants report that uncertainty makes it hard to manage a risk. IM-C says that in cases where a lot of uncertainty exists the IT innovation will not be implemented. C-4 argues:

> *"Even if the IT has a potential impact, the processes are not designed for uncertainty. A certain level of knowledge is required before the processes can get started" (C-4).*

C-4 relates the concept uncertainty to processes he has observed in the bank:

> *"So then the question needs to be … in this world where uncertainty is going to increase and the rewards to those who make the right bets are far higher than for those who are not making the bet. … The risks of not making the right*

investment are much higher, therefore the questions need to be: can traditional companies like banks adapt their processes, adapt how we work to deal better with uncertainty? I think that is the real question. How do you deal with uncertainty better, how do you evolve as an organisation? How do you evolve your processes? How do you do more on your leadership?" (C-4).

6.4 Findings on uncertainty experts

The research area uncertainty experts is concerned with research question four: *Who should be involved in the ERM of emerging risks from IT innovations*?

Interview partners focused on six emerging themes (Table 6-4) concerning experts handling emerging risks.

	Code	**# informants mentioning (n=23)**	**# of mentions**
Uncertainty experts	Occupational roles	25	45
	Required skills	8	32
	Group composition	16	30
	Banking cooperation	17	23
	Outside experts	9	23
	Collaboration	7	21

Table 6-4: Emerging themes among uncertainty experts

The interviewees identified fifteen internal stakeholders who should be involved in the management of emerging risks (see Table 6-5, stakeholders are listed in alphabetical order).

Proposed internal stakeholder to be involved	**Informant**
Board of directors	C-5; IM-B; IM-F; RM-F; IM-H; RM-H; RM-I;
Business department	C-1; C-2; C-3; C-5; RM-E; IM-F; RM-F; RM-I
Business process owner	C-1; C-5; RM-F; RM-H; IM-G;
Chief Executive Officer	C-5; C-6; IM-B; RM-B; IM-H; RM-H; RM-I; RM-J
Chief Risk Officer	C-2; C-3; C-6; RM-B; RM-J
Digital Officer	RM-B

Proposed internal stakeholder to be involved	Informant
Group Security	IM-A; RM-A; RM-J, IM-J
IT expert	C-1; C-2; C-3; RM-E; RM-D; IM-G; IM-H
IT risk manager	C-1; C-3; RM-F; IM-E
Legal department	C-5; RM-D
Marketing department	C-3; RM-H
Operational risk manager	C-3; IM-B; IM-C; RM-A; RM-C; RM-E
Project manager	C-3; IM-A; IM-B; IM-E; IM-F; IM-J; RM-A; RM-D; RM-F
Purchasing department	IM-F
“Three Line of Defence”	IM-A; RM-A; RM-J

Table 6-5: Internal stakeholders involved in the risk management process

Another actor, highlighted by bank B, C, F, and C-5, is the regulator. RM-B described the importance of the regulators as gatekeepers and rule setters for banks and other financial institutions.

> *“The regulators play an important role; they have to establish common ground so it is possible that German banks can compete on the same ground as banks outside of Germany” (RM-B).*

Furthermore, informants report the operational risk management department as being responsible for the risk management methods. Eight informants named the CEO as being ultimately responsible for the management of emerging risks. C-6 states his view as:

> *“It is a classic trade-off between risk taking and reward; the business needs to decide. It sits within the business …” (C-6).*

C-4 stresses, in general, on the importance of having the right people in place:

> *“Oh yes, it is fundamentally all about the people. It is actually not about the IT or the industry. How fast paced the industry is has a role. But it is all about the skill set, the mind-set and the culture of the people. … it is all about the skill set and the mind-set of the people and the culture of the organisation. That is far more important than anything else” (C-4).*

C-2 sketches the skills of the involved people thus:

> *"You have to understand the world as an interconnected system, but within their team those experts also must take the role of a specialist. They must be able to link their area of expertise with other issues; they must be able to anticipate the future" (C-2).*

The importance of the composition of the group handling emerging risks was a concern to C-1:

> *"The group composition has a crucial influence on whether and how risks are identified and treated" (C-1).*

Banks B and F also rely on experts outside of their organisation to collect knowledge on emerging risks. RM-B finds outside knowledge important as the corporate culture automatically influences how risks are seen and treated; therefore, he appreciates an outside view "*to think out of the box*" (RM-B).

Bank D and F lament that the collaboration between various actors could be improved. Yet, various reasons have been mentioned for a lack of cooperation. First, stakeholders do not work together because of lack of time (bank C, D, F). Second, actors have no incentive to work together (bank D, F). Third, the involved stakeholders lack the skills and procedures to work together (bank D). This view is also shared by C-4 who suggests:

> *"I think enough people are already involved, yet some people need to be upskilled; not increasing the number of people but upskilling people is required. Leadership needs to make real effort."*

6.5 Summary

This chapter focused on the presentation of the findings supported by verbatim quotes of the informants (Tracy, 2010). The coding of the interview data helped to identify emerging themes, such as a lack of knowledge, risk assessment, risk monitoring, understanding of uncertainty, and occupational roles involved in ERM. These important topics will be further analysed in the next chapter, focusing on cross-case analysis to verify whether certain themes are dominant with a certain group of informants. Moreover, findings from academic literature will be included to allow a discussion of the findings from multiples views.

7 Analysis of findings

The aim of this research project is to develop a conceptual framework which explores how German banks in the future can apply ERM to manage emerging risks from IT innovations. For this purpose the conceptual framework is developed in an iterative process from academic literature and field data. The presentation of findings has been incorporated in another chapter (Chapter 6), while this chapter caters to the interpretation of the qualitative data analysis.

The aim of the qualitative analysis is to detect patterns, coherent themes, meaningful categories, and emerging ideas which assists in comprehending the identified phenomenon. The challenge is to identify valuable connections and to offer reflective analysis. Qualitative analysis aligns with the critical realist position that analysis refers to a layered ontology which should not be reduced to the empirical (Runde, 1998). This ontological position also underlies this chapter, in which multi-faced analysis of the interview data along with the current academic work results in multi-faced interpretations are demonstrated. Hereby, the focus is on the cross-case comparison to allow the investigation of several perspectives and to understand the similarities and differences between the approaches adopted (Yin, 2013). The outcomes of the analyses are again presented by the four research topics.

Furthermore, the findings have been compared to literature with conflicting as well with similar viewpoints (Eisenhardt, 1989) to offer interpretations of the results in order to propose answers for the underlying research questions. As introduced in the methodology chapter, the focus in this chapter will be on step four and step five of the analysis steps presented in Table 7-1.

Analysis step	Analytical focus and product	Focus on
1. Writing down the interviews	Translation into English (if required)	Within-case analysis of each single bank and the risk consultants
2. Paraphrasing	Case summary which synthesises the case Detection of emerging themes	
3. Coding	Essence of key attributes of verbal information	
4. Thematic sorting of concepts	**Identification of similar products and relationships across multiple-cases** **Exploration for additional themes based on identified groups**	**Cross-case analysis across the different types of banks and risk consultants**
5. Comparison of concepts	**Similarities and differences (with recourse to theoretical knowledge) conceptually organised**	

Table 7-1: Cross-case analysis steps

The research questions and the identified research gaps influenced the unit of analysis and resulted in a multiple-case study research design. The interviews with the bank's IT manager and the risk manager make up the case of a bank. In summary, ten banks were interviewed. Table 7-2 lists the case banks and provides characteristics (Bundesverband deutscher Banken e.V., 2015) identified as relevant in adding explanatory power to the cross-case analysis, yet not comprising anonymity.

Bank	Total assets	Internationalisation	Systemic importance	Interviews Risk Manager	IT Manager
A	Large	Multi-national	High	Yes	Yes
B	Large	Global	G-SIB	Yes	Yes
C	Medium	National	Medium	Yes	Yes
D	Small	National	Low	Yes	No
E	Medium	Multi-national	Medium	Yes	Yes
F	Medium	National	Low	Yes	Yes
G	Small	National	Low	Yes	No
H	Large	Global	G-SIB	Yes	Yes
I	Large	Multi-national	High	Yes	No
J	Large	Global	High	Yes	Yes

Table 7-2: Characteristics of case banks

Bank D has outsourced the entire IT department and did not give approval to interview the IT provider for non-specified reasons. In banks G and I a second interview was not possible as both banks reported a serve risk-related incident, therefore the banks decided to not give any further interviews at the point of investigation. Nevertheless, as the interviews from banks D, G, and I were comprehensive and the researcher was allowed to raise additional questions after the initial interview, it was decided to include those banks in the case studies.

To deepen the insights from each case bank and get an outside view, the six risk consultants are defined as another separate case. The cross-case analysis focuses on the banks, yet to further the understanding of the case banks and obtain a separate view, the risk consultant's interpretation is taken to support or challenge the view of the banks.

The analysis of the banks has presented a homogenous picture *within* the banks. The IT managers and risk managers were mostly found to share the same view towards emerging risks from IT innovations, with little deviations between the two occupational groups. This is in line with prior research which found that managers tend to share the overall firm culture, rather than a specific occupational culture (Jacks and Palvia, 2014). Yet, the cross-case analysis revealed that various banks

have differing views of emerging risks from IT innovations and ERM practices. To capture these important differences between banks, the researcher developed a classification system for the interviewed banks, which will be presented in the next section.

7.1 Classification of banks

Prior literature has identified IT innovation as a central source for value creation in organisations (Davis and Eisenhardt, 2011), while acknowledging the need for sound risk management. In contrast, the empirical data revealed that managers have a wide variety of attitudes toward IT innovations and the treatment of the impending risks, ranging from ignorance and avoidance to acceptance of exploring IT innovations. Since this research is grounded in critical realism understanding, all explanations of reality are treated as fallible (Bhaskar, 1978). This view is particularly applicable for change-oriented research in which participants offer different views and "some must be taken as more accurate than others" (Fletcher, 2016, p.8). Thus, to capture banks' current risk management approaches and attitudes towards future ERM for emerging risk, the researcher developed a construct termed *emerging risk management concern*.

This construct and the assigned capabilities emerged from the collected data and from academic as well as practitioner literature on ERM and emerging risks (Beasley *et al.*, 2015; COSO, 2004; Deutsche Bundesbank, 2014a; FFSA, 2014; IRGC, 2011; Kleffner *et al.*, 2003; Teece, 2012; Wilson *et al.*, 2010). Specific actions adopted by managers to promote or discourage risk management for emerging risks were measured. Each action taken to encourage the risk management process, such as management board oversight for emerging risks, was coded and measured as plus one point. Conversely, the researcher coded each action taken to discourage risk management, such as lack of ownership for emerging risks, as minus one point. Then the points were summed into a total score, which designated each bank as proactive, neutral, or discouraging (Graebner and Eisenhardt, 2004).

Bank	Activity	Points	Category
A	▪ Management lacks knowledge about IT innovations (-) ▪ Lack of ownership for emerging risks (-) ▪ Uncertainty only seen as negative (-) ▪ Risk assessment important (+) ▪ Risk management and IT innovation process linked (+) ▪ ERM in place (+) ▪ Risk management focused mainly on the fulfilment of regulatory requirements (-)	-1	Discouraging
B	▪ Difference between threat and risk (+) ▪ Uncertainty seen as a chance (+) ▪ Risk oversight by management board (+) ▪ ERM in place (+) ▪ Strategic decision-making allowed by ERM (+) ▪ Risk management and IT innovation process linked (+)	+6	Proactive
C	▪ ERM in place (+) ▪ Risk management mainly focuses on the fulfilment of regulatory requirements (-) ▪ Uncertainty is only seen as negative (-) ▪ ERM must allow strategic decision-making (+) ▪ Lack of ownership for emerging risks (-) ▪ Work with other banks to share knowledge (+)	0	Neutral
D	▪ Uncertainty only seen as negative (-) ▪ Silo risk management for emerging risks (-) ▪ Risk oversight by management board (+) ▪ Risk assessment important (+)	0	Neutral
E	▪ Work with other banks to share knowledge (+) ▪ Uncertainty seen as a chance (+) ▪ Risk assessment important (+) ▪ Risk oversight by management board (+) ▪ ERM in place (+) ▪ Risk management focused mainly on the fulfilment of regulatory requirements (-)	+4	Neutral
F	▪ Risk management focused mainly on the fulfilment of regulatory requirements (-) ▪ Silo risk management for emerging risks (-) ▪ Lack of ownership for emerging risks (-) ▪ Management lacks knowledge about IT innovations (-)	-4	Discouraging
G	▪ Uncertainty only seen as negative (-) ▪ Risk oversight by management board (+) ▪ Silo risk management for emerging risks (-)	-1	Discouraging

Bank	Activity	Points	Category
H	▪ Uncertainty seen as a chance (+) ▪ Risk oversight by management board (+) ▪ ERM in place (+) ▪ ERM must allow strategic decision-making (+) ▪ Risk management and IT innovation process is linked (+) ▪ Continuous activities to increase knowledge about emerging risks (+)	+6	Proactive
I	▪ Uncertainty seen as a chance (+) ▪ Risk oversight by management board (+) ▪ ERM in place (+) ▪ ERM must allow strategic decision-making (+) ▪ Risk management and IT innovation process linked (+) ▪ Continuous activities to increase knowledge about emerging risks (+)	+6	Proactive
J	▪ Risk oversight by management board (+) ▪ ERM in place (+) ▪ Continuous activities to increase knowledge about emerging risks (+)	+3	Neutral

Table 7-3: Emerging risk management concern of case banks

Managers at proactive banks had taken steps to promote risk management for emerging risks. For example, the managers of bank I made a formal decision to collaborate with fintech companies to develop and test new IT innovations. The managers of bank B made a similar decision, creating an internal digital lab for designing, testing, and assessing IT innovations and their related risks. Managers at neutral banks had not proactively managed emerging risks so far but were willing to consider it. As one manager said, "IT becomes more and more important. Data is a production factor" (IM-C). Managers at discouraging banks actively avoided risk management activities for emerging risks. For example, the management of bank D decided to delegate the entire responsibility of IT innovations and their risks within the responsibility of the IT outsourcee.

Table 7-4 summarises the number of the case banks that were either discouraging, neutral or proactive towards ERM for emerging risks.

Discouraging	**Neutral**	**Proactive**	**Total (%)**
-4 to -1 points	0 to 4 points	5 points and more	
3 – (30%)	4 – (40%)	3 – (30%)	10 – (100%)

Table 7-4: Number of banks per classification category

The following sections will present the cross-case analysis by contrasting the views of the discouraging, neutral, and proactive banks. While analysing the views expressed by the risk consultants, it was found that their descriptions of future ERM procedures for emerging risks are very similar to the views shared by the proactive banks. Therefore, interview quotes from the risk consultants are included mainly to support the view of the proactive banks. In cases where the views deviate, it is explicitly stated.

7.2 Analysis of procedures

This section explores the ERM procedures for emerging risk by focusing on answering research question one: *Which ERM components are critical to the ERM of emerging risks from IT innovations?*

In the literature review in Chapter 2, risk management was criticised for the constant conjunction of event-regularities (Runde, 1998) and the deduction of laws (Andrikopoulos, 2013). To overcome this criticism, the next section discusses causal factors which were raised in the interviews and deemed important to understanding ERM for emerging risks. Causal factors are understood as contributing to a particular way in which an event is seen or realised (Runde, 1998).

7.2.1 Causal factors to ERM for emerging risks

This section discusses five causal factors that are derived from the collected data that were interpreted as influencing the firm's view of ERM.

Understanding of innovation and customer satisfaction

A topic emerging from the interviews is the relation between ERM and innovations. Banks which comprehend innovations as a feature critical to their success seem to have a more active ERM in place. The proactive banks highlighted that ERM must go beyond risk avoidance activities and recognise the possible value in pursuing an IT innovation from which a competitive advantage can be gained.

> *"Because as a bank we sometimes get a little too focused on do we have the right systems, do we have a backup, do we have continuity in place, that sort of the stuff. What we need to focus more on as a bank going forward and what is more important for us now, is to make sure that we are innovating and changing products and changing IT services. … To make sure that we are not just thinking about how we can meet our needs now" (RM-H).*

This revelation is supported by Farrell and Gallagher (2015), who discovered that firms which integrated ERM in strategic activities had a superior ability to discover chances and risks. Bank H reported that when they consider an IT innovation, a lot of risk management activities are part of the product approval process. Yet,

> *"…we try to launch things too quickly, and we launch them badly – what I would call sticking plasters. And we launch them in such a way that there is a high risk of them failing in the future, which is almost something that we see day to day" (RM-H).*

Even though bank F in the summary has been classified as a discouraging institution, its IT manager summarised the view on IT innovations as:

> *"… but innovation would not exist if we would know all the risks. … It always requires a little innovation spirit and pioneering spirit" (IM-F).*

A recurring theme in the interviews was the remark that IT innovation is deemed necessary to improve the experience and the satisfaction of the customers. The discouraging and neutral banks raised this topic eight times, while the proactive banks discussed it twenty-three times.

> *"For example, we have no appetite for underlying customer services to ever be unavailable for the obvious reasons. If a customer cannot make a payment or buy something or go to whatever store and buy something, if that service is not available, that service is over. Our risk appetite would be that we have*

> *110 percent of a 24/7 service. And so anything that we look out for in a new service, a new system, developing new products, changing underlying systems is assessed by the risk that our service may become unavailable" (RM-H).*

All of the proactive banks and all consultants highlighted IT innovations as a mean to increase customer satisfaction, yet at the same time they acknowledged the possible risks which could emerge and requires handling by ERM. Striking is that all of the consultants discussed IT innovation and customer satisfaction. C-5 made a thought-provoking point in stating that banks treat their customer as per:

> *"… the mind-set of the organisation" (C-5).*

Hence, there may be a link between enforcement of IT innovation, customer satisfaction, and higher interest in ERM for emerging risks. However, the existence of this relation is ambiguous.

Triggered by the above statement of C-5, the aspect of corporate culture is worth discussing.

Corporate culture and risk appetite

Kasperson *et al.* (1988) describe risk management as a science as well as a manifestation of culture in which "… culture affects action" (Jacks and Plavia, 2014, p.20). Only the proactive banks and four out of six consultants named corporate culture as being vital to risk management. On the other hand, the discouraging and neutral banks did not raise this topic. C-4 postulates:

> *"The most important thing is the skill set, human capital as well as the culture of the organisation. Yet human capital itself is not enough, if we move thousands of Google employees to the banking sector I guarantee the productivity will increase, however if we do not change the culture within a year, half of the people would have left, because they cannot work in this banking culture" (C-4).*

Moreover, the proactive banks and four of the risk consultants report risk appetite as a critical concept in helping to identify which risks need to be assessed and reported.

> *"… the risks we take on a day to day business level is in line with the risk appetite of the bank" (C-6).*

RM-H describes risk appetite as a framework for action:

> *"But we all do it in the same way, across the bank, but we all do it slightly differently, and that is the mantra. Everyone needs the same guidebook, to translate that rulebook and apply it to our businesses. It gives us the autonomy to do what we think we need to do and manage it in our respective area" (RM-H).*

Ai *et al.* (2012) express that incorporation of risk appetite into the strategic decision process is a key piece of ERM. Contradicting this view are Farrell and Gallagher (2015), who have found no evidence that application of risk appetite increases ERM performance. However, C-5 and RM-J both describe risk appetite as a way for the operational management to decide if an opportunity should be pursued or not for meeting the goals of the bank.

The statement of the informants points towards the importance of culture in the management of emerging risks. Based on the interviews, the researcher shares the view expressed by Ashby *et al.* (2012b) that "… risk culture is a way of framing issues of risk and culture in organisations and not a separate object" (Ashby *et al.*, 2012b, p.4). Emerging risks are not a singular thing, and it is currently up to the organisation to define what an emerging risk is and how to treat it, and the corporate and risk culture seem to influence how banks do this.

Supervisor and regulator

The role of the supervisor and regulator has been described as a control function and high source of pressure, and as a source which needs to help define future risk management processes. This resonates with a recent article by Diaz-Rainey *et al.* (2015), who describe a close linkage between regulations, technology, and processes. Furthermore, three discouraging banks (bank A, F, G) and three neutral banks (bank C, D, E) complained that they are so busy complying with the current rules and regulations that they have no time to develop their ERM and are reluctant to consider IT innovations.

Projects

The extant literature acknowledges projects as a means to develop, introduce, and implement IT innovations (Zhang, 2013). This view is extended by the data from the case studies. Not only are the IT innovations implemented via projects, but the operative management of emerging risks are also the responsibility of the respective project, as determined by five of the interviewed banks. However, the discussion of ERM in project management literature is limited (Taylor *et al.*, 2011). Although it may sound contradictory to include an enterprise-wide risk approach in a single initiative, many IT projects are complex enough and affect large parts, if not the entire organisation (Häckel *et al.*, 2015). Schiller and Prpich (2013) describe the relationship between projects and ERM as a response to organisational complexity. All of the proactive banks support this view, managing projects as a portfolio which encompasses ERM.

Decision-making

Decision-making was a recurrent theme discussed by three banks and two consultants. Support for the relation between ERM and decision-making is also evident throughout the literature. Aven (2012) suggests a relationship between risk assessment and various stakeholders involved in decision-making. He proposes that the more stakeholders are involved in the decision process, the higher is the importance of not only expressing the risk in terms of probability but also providing a risk description to allow better understanding and communication of the risk. This view is supported by Hall *et al.* (2015), who found that communication is essential for risks with low a priori knowledge and that risk communication can facilitate innovation, the accumulation of knowledge, and organisational learning. Power (2005) describes information and communication procedures as an essential element of ERM, with special concern for appropriateness of the communication to the various involved stakeholders across the firm (Aven, 2015a). Seven cases raised the topic that information provided by ERM must allow decision-making. Pasanisi *et al.* (2012) describe the relationship between information and decision-making as a complex process in which only providing probabilistic data is insufficient. They further insist that, in cases of high uncertainty, a wider analysis process is required in order

to identify the required information. This view is explicitly shared by five of the consultants, however only by three banks.

This section has argued that, before the ERM components are discussed, it is necessary to explore some causal factors which frequently have been raised in the interviews. These causal factors seem to have an influence on the standpoint on the future set-up of ERM. Unfortunately, it is beyond the scope of this research to comprehensively investigate the relationship of these factors. Nevertheless, the identification of the causal factors allowed the detection of two ERM concepts, which will be further explored in the next section.

7.2.2 Rule-based and principle-based ERM

In the interviews, the informants described an ERM which they deemed necessary in the future to manage emerging risks from IT innovations. From the collected data, two ERM concepts emerged, referred as rule-based and principle-based ERM (Power, 2009). Table 7-5 describes the main characteristics of the two concepts and provides the most relevant statements from the informants.

Rule-based ERM has been defined as a linear process that is structured by rules which explicitly define what one has to do. According to the informants, it is crucial to gain a common understanding amongst all stakeholders of what the emerging risk is. Furthermore, they put forward that it is best to utilise the existing risk inventory and that quantification of the emerging risks is very important. The rule-based ERM has exclusively been discussed by the discouraging and neutral banks and is depicted in Table 7-5.

ERM	Important aspects	Key quote
Rule-based	Commensuration of risk (Schiller and Prpich, 2013)	*"… whenever something is clearly defined, you have a common language" (*IM-E).
	Utilising existing risk inventory	*"A lot of risks are not reported because they do not fit in the predefined risk inventory"* (IM-C).
	Focus on risk quantification	*"We see risks more from the operational risk side, where it is important to report risks based on their probability and impact"* (RM-A).

Table 7-5: Rule-based ERM

Primarily the proactive banks and the risk management consultants sketched a different picture of future ERM for emerging risks. They focused on principles instead of rules. Principles are understood as guidelines for a special area in which the employee can act within the given boundaries, take actions, and make decisions on his own. The same is demonstrated in Table 7-6.

ERM	Important aspects	Key quote
Principle-based	Risk culture and risk appetite	*"… if someone is operating outside of the risk appetite, the machine needs to raise it. It is a matter of having a very robust risk framework which is understood by everybody … But people confuse responsibility with risk taking and responsibility of risk allocation. You can do certain things, but it has to stay within a certain band, they have to stay within that threshold"* (C-6).
	Customer satisfaction	*"… if you don't have any customers, obviously you don't have a bank. It is quite simple"* (C-5).
	Importance of IT innovation	*"And the only way you can make more money is by reducing the overall overheads, and you can only do that by massive automation typically, through technology"* (IM-H).
	Decision-making	*"The technology [understood as risk management models] is going to enable running the model, not making the decision"* (C-6).

Table 7-6: Principle-based ERM

The principle-based ERM was informed by four main aspects recurrently raised in the interviews. First, risk culture and risk appetite are described as a guideline to determine which risks are acceptable to the organisation. Second, the focus should be on customer satisfaction and ensuring that risk management helps to achieve the best customer service possible. Third, informants highlighted the importance of IT innovation as a critical success factor in the future survival of banks. Yet, not every IT innovation can be rated according to deterministic rules; again, flexibility is required in judging whether an IT innovation is of value to the bank. Fourth, risk management was frequently described as allowing making informed decisions by the senior management. Hence, it is central to fully understand a matter, analyse it

from different viewpoints and then arrive at possible scenarios which can be presented for decision-making.

It is beyond the scope of this research to provide a discussion and empirical data concerning whether either of the two presented ERM concepts is superior to the other. Yet, in the past, academics like Power (2009) or Schiller and Prpich (2013) criticised ERM for replacing principle-based risk management with rule-based ERM, which has developed into a “performance management system rather than strategic risk management system” (p.1011). This points in the direction of the ongoing debate on what ERM actually is. It also points towards the fact that empirical research about emerging risks and ERM is limited. Currently it can only be concluded that the banks who already proactively manage emerging risks seem to follow a principle-based approach.

7.2.3 ERM components

Besides the rule-based and principle-based interpretations of ERM, the informants highlighted several ERM components which they deemed especially important in the management of emerging risks.

Figure 7-1summarises the ERM components (adopted from COSO, 2004) and which case mentioned it.

	Case / ERM components	A	F	G	C	D	E	J	B	H	I	Consult.	Sum
		Discouraging			Neutral				Proactive				
ERM components adapted from COS (2004)	Establish context strategy	○	○	○	○	○	○	○	●	●	●	●	4
	Identify risks	○	○	○	●	○	○	○	●	●	○	●	4
	Risk assessment	●	○	○	○	●	●	●	○	●	○	●	6
	Risk response	○	○	○	○	○	○	○	●	●	●	●	4
	Communicate	○	○	○	●	○	○	○	●	○	●	●	4
	Monitor and review	●	○	○	●	●	●	○	●	●	●	●	8
	Knowledge creation and sharing	○	●	○	○	●	●	●	●	●	●	●	8

○ Not mentioned ● Mentioned by at least one informant

Figure 7-1: ERM components resulting from the interview analysis

Establish context, identify risk, risk response, and communicate risk are concepts which were not discussed very extensively during the interviews. Therefore, the next sections will focus on knowledge collection and sharing, risk assessment, and risk monitoring.

7.2.3.1 Knowledge harvesting and sharing

Across all the cases, knowledge collection and sharing is a frequent discussed topic (eight of ten cases). Yet, ERM literature is rather silent regarding this aspect. However, research on risk management in general highlights that managing risks is about managing knowledge. Scholars put forward that risks exist independently of human knowledge but that the way they are perceived and conceptualised is very much dependent on prior knowledge (Aven, 2010b; Khoo, 2012). Perminova *et al.* (2008) describe risk management as a means to discover unknown information. Christiansen and Thrane (2014) support this view by describing risk management as a vehicle to transfer information across different levels in an organisation. Power (2004a) recommends that in case of little knowledge about the risk, risk management should act as "an information-gathering process" (p.54).

The consultants are consistent in their views and all see a strong need for continuous knowledge harvesting and sharing. None of the discouraging banks or neutral banks mentioned this. Whereas academic risk research has strongly focused on the examination of risk identification, assessment, response planning, and monitoring (Taylor *et al.*, 2011), knowledge harvesting and sharing has been seldom covered.

Seventeen informants discussed collaboration with other banks as a means to identify and understand more about IT innovations. Furthermore, they reported that participation in IT events and outside expertise are important in assessing new knowledge. Knowledge and expertise come from experience with a wide variety of cues and stimuli (O'Connor *et al.*, 2008). The IRCG (2011) argues that emerging risks have various sources and possibly can affect multiple organisations; therefore, they strongly suggest collaborating with other organisations to build up knowledge.

7.2.3.2 Risk assessment

With 39 mentions in the case studies, risk assessment is a frequently raised topic. Respondents said that a risk assessment is a prerequisite to trigger further actions, such as the identification of mitigating actions. Even though seventeen informants reasoned for a risk assessment, out of this group, seven informants found that the assigned probabilities do not necessarily reflect the origin and amount of knowledge underlying the risk assessment.

This latter view is also shared by Aven (2012), who argues that probabilities can always be assigned to an uncertainty or a risk, yet he puts forward that the probability numbers do not show how much valid information underlies the assessment. For emerging risks, RIMS (2010) suggest that the assessment should go beyond the pure assignment of quantifiable numbers and include a qualitative assessment of the risk, in which alternative scenarios for the development of the risks are evaluated.

The topic of risk assessment was discussed by one discouraging bank, three neutral banks, one proactive bank, and the risk consultants. Yet no details were provided for what exactly this ERM procedure should look like.

7.2.3.3 Risk monitoring

In the ERM COSO framework, risk monitoring is described as a control process that ensures the efficient performance of all the components (COSO, 2004; Moeller, 2007). Interview partners did not share this view. Instead, they understood risk monitoring as the requirement to oversee the development of emerging risks. However, whilst conceptually appealing, to date there is little guidance on how to monitor emerging risks (Conforti *et al.*, 2013). Interview partners reflect this opinion by vaguely describing the concept and implications of risk monitoring.

A concept discussed by five informants in relation to risk monitoring is the risk inventory. Two neutral banks described it as a portfolio of risks and respective risk description, which helps to identify and classify risks. Two banks and two consultants find such an inventory essential as it helps to set a common language and defines a shared procedure. Aven (2012) even claims that how risks are defined theoretically

can be neglected as long as there is precision in the risk assessment and stakeholders are aware of the limitations of the perspective adopted.

7.3 Analysis of risk field

The analysis of the risk field explores the key meanings attached to emerging risks from IT innovations, as expressed in the interviews. The underlying research question number two is: *What key meanings are currently attached to emerging risks from IT innovations within the German banking sector?*

To discuss the key meanings attached to emerging risks, the matrix with the emerging risk concepts already introduced in Section 3.1 will be applied.

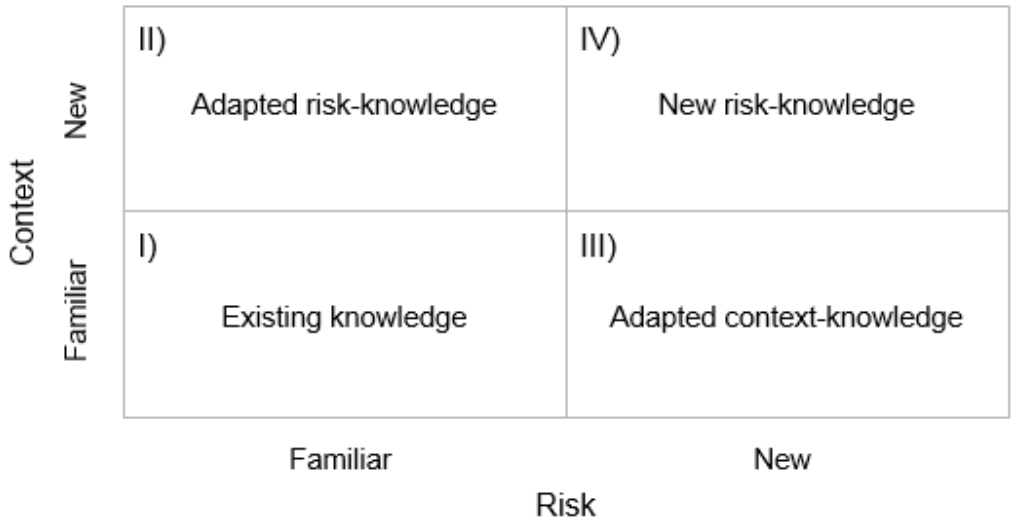

Figure 7-2: Emerging risks concepts based on IRGC (2011)

Figure 7-2 displays the four emerging risks concepts related to knowledge in relation to risk and context.

Table 7-7 shows the frequency of the emerging risk concepts (I, II, III, and IV) occurring in different cases.

Quadrant	Discouraging			Neutral				Proactive			Consultant					
	A	F	G	C	D	E	J	B	H	J	1	2	3	4	5	6
I)	X	X	X	-	-	-	-	-	-	-	-	-	-	X	-	-
II)	-	-	-	X	-	X	-	X	X	X	X	X	-	X	-	-
III)	-	-	-	X	X	X	X	X	X	X	-	X	X	X	-	X
IV)	-	-	-	X	-	-	-	X	X	X	X	X	X	X	X	X

Table 7-7: Emerging risk concepts per case

A familiar risk in a familiar context (quadrant I) was discussed by the neutral and proactive banks and risk consultants. This concept was frequently mentioned to describe a situation in which, due to a change in knowledge it was possible to detect a state and conceptualise it as a risk.

One neutral and two discouraging banks reported that emerging risks are familiar risk but in a different context (quadrant II). In their view, knowledge about such a risk exists, but it must be adapted to the new context of the IT innovation. Data breach was a frequently mentioned example of this type of emerging risk. Allan *et al.* (2011) support this view: "… when people input incorrect data into a newly established IT system, this operational risk may cause serious problems in other fields, such as financial reporting or reputational risks through poor servicing. The combined symptom can be understood as an emerging risk but in fact it is deeply rooted in existing risks" (Allan *et al.*, 2011, p.189).

The most often identified concept describes emerging risks as a new risk in a familiar context (quadrant III). Across all the banks, this concept was discussed the most. However, none of the informants was able to provide an example of an emerging risk for an IT innovation.

It is striking to note that only the proactive banks, one neutral bank and the consultants discussed emerging risks as a new risk in a new context (quadrant IV). The other banks did not contribute to the concept.

Furthermore, the bundling of meanings in concepts, as presented in Figure 7-2, allows the discussion of several evolving aspects. *First*, a shared understanding of

the concept of emerging risks across the banks and consultants does not exist. This is in accordance with the few academic publications on emerging risks. Flage and Aven (2015), who classify emerging risks as a relative concept, agree with this view. *Second*, discouraging banks conceptualise emerging risks unilaterally, whereas proactive banks and risk consultants characterise emerging risks according to various aspects. Academia agrees that how risk experts understand risks will highly influence the practices and procedures applied to the management of risks (Arena *et al.*, 2010; Aven *et al.*, 2011). The proactive banks have been identified as using multiple procedures to manage emerging risks, whereas the neutral banks and discouraging banks do not apply as many processes. *Third*, even though a common understanding about emerging risks does not exist, a recurring theme in the interviews is knowledge. Knowledge is the shared topic in all four quadrants. Furthermore, six out of all informants highlight that the decision-makers lack knowledge about IT innovations and emerging risks. Therefore, respondents reported that IT innovations are not implemented due to a high degree of uncertainty. This discussion draws from the work of Power (2004b), who relates the concept of uncertainty to the management of knowledge. Power (2004b) argues that quantitative risk management is appropriate where large data sets are available and the organisation has a common understanding about the risk. In cases where knowledge is rare, risk management has to take another role such as knowledge creation and gathering (Power, 2004b). A similar view is held by Rodriguez and Edwards (2014) who assert that missing information is not an issue, but rather a lack of knowledge on how to interpret the existing information.

In addition, the perception of emerging risks expressed by the informants, which was then translated into the four quadrants focusing on knowledge, led to a review of literature regarding unknown unknowns. Yet, it was found that the academic literature on unknown unknowns and black swans is in its early stages and very theoretical, and includes high controversy discoursing on what exactly is understood by an unknown unknown (Aven, 2015b; Feduzi and Runde, 2014; Haugen and Vinnem, 2015). It is put forward that this concept currently does not add to the understanding of emerging risks discussed by the informants and the practice-

oriented results this research aims for. For this reason, the topic of unknown unknowns is not further explored.

7.4 Analysis of risk rationalities

Effective and efficient risk management requires an appropriate problem framing (Yeo, 1995). This view expresses the importance of risk conceptualisation. The research subject risk rationalities is hence concerned with answering research question three: *How does uncertainty influence the ERM of emerging risks from IT innovations?*

Nine managers of the banks testified that the daily risk management procedures do not consider the aspect of uncertainty. Possible clarifications are provided by Bromiley *et al.* (20014), who found that managers tend to have a greater confidence in their decision and perceive less uncertainty. March and Shapira (1987) claim that managers downplay risks because of their self-confidence in influencing the situation. An alternative account could be that the banks perceive uncertainty as an underlying concept of knowledge and, hence, do not actively consider it. A further imaginable explanation could be that the informants perceive uncertainty as an inherent concept of probability assessments. This is in accordance with the large strand of risk management literature which describes uncertainty as a concept of probability (Flage *et al.*, 2014).

Especially in theory-based academic literature, uncertainty is frequently debated, whereas practice oriented ERM literature rarely discusses the concept of uncertainty. Only recently, have academics started to relate the concept of uncertainty in practice oriented inquiries. For example, Bjerga and Aven (2015) argue that, in a frequently changing risk landscape, uncertainty is a critical factor. However, in their seminal works, Kasperson *et al.* (1988) propose that individuals cannot deal with the full complexity and multitude of risks. As a result, simplifying mechanisms to evaluate risks are applied, hence downplaying uncertainty.

In summary, academia segregates uncertainty into two concepts:

1. Uncertainty understood as a lack of knowledge, which makes it hard to describe the risk (Rodriguez and Edwards, 2014).
2. Uncertainty about the future development of the risk, which makes it impossible to judge probability (Aven, 2011; Flage *et al.*, 2014).

This is in accordance with the interview findings. Ten informants related the concept of uncertainty to probability frequencies, and nine discussed uncertainty in the light of lacking knowledge and hence not being able to qualitatively describe the risk. Striking is that the discouraging and neutral bank are more concerned about concept 2, whereas the proactive banks report they first have to understand and gain knowledge about an emerging risk before they can quantify it (concept 1). In the academic literature, both concepts are described as having an impact on the risk management practice (Aven, 2013; Perminova *et al.*, 2008; Renn *et al.*, 2011).

A major strand of scholars discusses uncertainty in the context of innovation, mainly with regard to the economic success of the innovation (Häckel *et al.*, 2015). However, in the interviews, the source of uncertainty was not brought up by any of the interviewees.

Bank H described uncertainty as a positive concept which allowed creating opportunities. Yet, IM-H also acknowledges that he has a large number of employees who work to clear up that uncertainty:

> *"I think that is headed to take advantage of … we are an incredibly large company with a large number of resources devoted to its management, which increases the ability to anticipate, plan, and get ready for new technologies, and therefore we can use them more quickly than some other firms" (IM-H).*

Academia frequently relates the concept of uncertainty to the system view, in which uncertainty is seen as a result of complex systems where knowledge is lacking about the variables and their interaction in the system. White (1995) argues that, when risk management fails, it is usually accountable to the failure to detect emergent traits arising out of the system. In those cases, risk management malfunctions in recognising risks and in underestimating their interaction in the system. Blockley

(2013) adds to this view, suggesting that the more we understand about a system, the more likely false assumptions can be detected. None of the interviewed banks raised this topic. A possible explanation may lie in the lack of resources. A recurring theme amongst the banks is the high pressure to ensure smooth and reliable operations and comply with current rules and regulations. These two objectives take up all of the banks' resources and do not allow for any further activities in relation to IT innovations. However, it was a frequently discussed concept with the consultants. They recommended that emerging risk experts need to adapt a system view in order to understand the location and reason behind the emergence of a risk.

> *"Enterprise-wide means that it must be an enterprise system wide, as a look outside of the bank is therefore very important. And that means I must increasingly look into the risks of my business partners and customers, and the more I understand the risks, the sooner I see when something arises which may affect me" (C-2).*

Wu and Olson (2008) propose an interesting aspect by classifying ERM as a framework that allows the structured management of uncertainty in a sense that every risk, with its underlying uncertainty, can present an opportunity for the firm. Fifteen experts perceived emerging risks as a threat, but twelve also saw an opportunity in emerging risks. Noticeable is that only the proactive banks and the risk management consultants see emerging risks as a chance. This could link to their interpretation of IT innovations as a source of competitive advantage.

Emphasising the importance of risk communication to include various stakeholder of the organisation and facilitate further risk management procedures (IRCG, 2011), the next section will discuss who should be involved in the ERM process.

7.5 Analysis of uncertainty experts

ERM is a human resource based process. Mikes and Kaplan (2015) argue that the effectiveness of risk management depends on the people who organise and contribute to the risk management processes. The underlying research question number four explores: W*ho should be involved in the ERM of emerging risks from IT innovations*?

Interviewees mentioned fifteen different organisational roles, which should be involved in the ERM of emerging risks from IT innovations. Furthermore, the discouraging and neutral banks reported that the group compositions were static, whereas the proactive banks and the risk consultants revealed that the composition of the group depended on the respective risk.

Academic literature distinguishes between two types of actors handling uncertainties: managers taking strategic decisions and operative employees making decisions as part of their day-to-day work processes (Grote, 2009). Adding to this view C-6 expresses:

> *"The people who are the closets to the customer must take the ownership of the risks. When there are 10,000 people taking day-to-day decisions, they must be responsible for taking the responsibility. If they feel a process is not working, they must raise the issue" (C-6).*

Hitherto, based on the interview data it was infeasible to identify who should be involved in terms of the identification of professional roles. On the one hand, this presents a surprise, as banking risk management is usually described as a formal, well-established process with static involvement of resources (BCBS, 2014). On the other hand, it can point to the circumstance that ERM for emerging risks is a very new, evolving process that has not yet been established.

Interesting is that interview partners not only mentioned the occupational roles which should be involved, but also they described the characteristics of the resources. Especially the interview partners from the proactive banks and the consultants frequently highlighted the skills and mind-set of the required people. They demand staff who are very eager to learn new things, are well connected within the organisation, and are able to share their knowledge to allow decision-makers to make an informed judgement.

Another frequent topic is the debate about who has the required knowledge. This is in line with findings by Perminova *et al.* (2008), who report that managers view risk management as a procedure to assemble previously unknown information as well as a means to share knowledge.

The proactive banks reported that they highly rely on outside expertise, also working with fintech companies, to explore IT innovations. Furthermore, bank H emphasised that the group handling uncertainty and risks depends on the individual situation and the amount of knowledge the individuals have. Bank H described a flexible process, in which experts work together to solve a problem and then return to their individual teams. The proactive banks share the view that the required knowledge determines who should be involved in the ERM process, not necessarily the occupational role. This view is furthered by the IRCG (2011), which professes that ERM for emerging risks is within the responsibility of everyone in an organisation. Yet the IRGC concedes: "… but having the responsibility is not the same as having skills to exercise that responsibility" (IRCG, 2011).

Moreover, the findings from the interviews stress the importance of including senior management in the ERM process. Bank H described the overall responsibility of senior management as setting boundaries in which the employees can work independently and ensuring accountability:

> *"When they feel they can break the rules and get away with it, are they going to be held accountable? So accountability has had a big impact on us …" (IM-H).*

These findings are supported by previous studies in which senior management played a crucial role in successful ERM (Beasley *et al.*, 2015; Subramaniam *et al.*, 2015). Dombret (2015b) maintains that it is the responsibility of top management to understand risks associated with IT innovations, as it is crucial for the business success.

The case banks who consider IT innovations as a key driver for success relate emerging risks to strategic decisions and therefore pointed to the CEO as the ultimate person responsible (bank B, H, I, J). Banks, who classified emerging risks from IT innovations as a regular operational risk, did see the responsibility more within the middle management or the project manager (bank A, C). Bank E and F report that senior management has delegated risk management activities to the project managers. Bank H comments that IT risk managers in their organisation are more and more seen as advisory partners to the management. In their recent study,

Hall *et al.* (2015) and pwc (2015b) also acknowledge the important relationship between risk managers and executive management.

Scholars like Klüppelberg *et al.* (2014) argue that the challenge of risk identification and assessment lies in the subjectivity of the risk. The stakeholders' views determine the identification and impact of the risks (Hall *et al.*, 2014). Stakeholder in this context is understood as an individual that directly influences or is influenced by a risk. He is an actor who may have knowledge about the risk and can help to clarify the uncertainty. None of the interviewed banks has supported this view. Only consultants and banks B and H pointed to the importance of the stakeholders' understanding of a risk and its impact on ERM.

However, bank D and F raises the issue that their organisation is lacking the willingness to work together to resolve risks. This is supported by Rodriguez and Edwards (2014), who find that further efforts in financial organisations are required to move from silo mentality to enterprise-wide risk management. Furthermore, the IRGC risk governance framework stresses the significance of dialogue among the key stakeholders (IRGC, 2011). They argue that one person seldom has all the required knowledge about an emerging risk, and therefore the responsibility for risk management should be shared by those who may have important risk-relevant information and others who are potentially impacted.

At a minimum, this discussion of the findings so far shows that it is infeasible to identify the precise occupational roles. Instead, it is important to focus on the characteristics of stakeholders and their willingness to cooperate to collectively manage the risk. Furthermore, it is critical to include various stakeholders depending on their knowledge.

7.6 Validation of the conceptual framework after the data analysis

In Chapter 3 the conceptual framework developed from the literature review was presented. In addition, the conceptual framework was validated by the collected field data, as presented in Section 7.1 to 7.5. The interpretation of emerging themes resulting from the cross-case analysis have been laid out, supported and challenged

by recent academic publications. To allow the reader to perceive the impact of the emerging themes on the conceptual framework, this section will discuss the emerging themes across the aforementioned four research areas.

The development of the classification scheme of the banks allowed clustering them into discouraging, neutral, and proactive banks. The emerging risk management concern captures the banks' risk management approach and attitude towards future risk management processes for emerging risk. As expressed in the emerging risk concern, seven of the ten banks do not take conclusive actions to confront future emerging risks. Yet, remarkably consistent patterns emerged from the interviews with the proactive banks and the risk consultants. While some perceptions about ERM for emerging risks were specific to certain informants, commonalities prevailed. A common theme that has been found in all the four research areas and across all cases is knowledge. Hence, the following discussion takes knowledge as an anchor to propose possible explanations and different points of view.

First, it is proposed that knowledge informs the design of the ERM procedures which are applicable for emerging risks. The discouraging and neutral banks described risk management as a strict, descriptive process in which deviations from the regular ERM process are rare. They sketched the picture of a rule-based ERM, while the consultants and the proactive banks described a principle-based ERM. This is in alignment with Power (2009), where it is proposed that the rule-based ERM falls short and does not reflect the complexity of the risk. On the other hand, the principle-based ERM considers alternative choices and aims at identifying future events that could result in emerging risks. The proactive banks have outlined that the ERM components are realised depending on the knowledge about the emerging risk. This implies that less knowledge about a risk requires more actions in the different ERM components.

Second, interview partners attach various meanings to emerging risks. It has been found that banks mainly apprehend emerging risks as a risk they have encountered before, yet in a different context. A recurrently discussed example is the risk of data breaches in existing and new IT solutions. This understanding of emerging risks is a surprise. It deviates from the current theory-driven definitions for emerging risks

mainly characterised by low probability and high impact (Florin, 2013; IRGC, 2010). Yet, the context and the familiarity of the risk and the resulting level of knowledge were frequently mentioned in all interviews. Moreover, informants across all cases agreed that emerging risks from IT innovations are difficult to perceive as they can be dissonant with the dominant mode of thinking and can imply a deviation from current mind-set (Rossel, 2009). Hence, this study sides with the position voiced by Bromiley *et al.* (2015), who urge that, in order to contribute to the ongoing ERM discussion mainly driven by finance and accounting, management scholars should take a more prescriptive stance. Likewise, they should aim to understand how different individuals define risk.

Third, in the context of emerging risks, banks refer to uncertainty as a lack of knowledge. Therefore, they differ from the prevailing academic research that frequently discusses uncertainty as a concept that is reflected in probability (Feduzi and Runde, 2014). However, in recent works, scholars like Aven (2016) share the view of the informants. Emblemsvåg (2010) express it as: “Separating uncertainties from risks may seem of academic interest, but uncertainty has to do with information management and hence improvement of model quality … while risks is the very objective of the model” (Emblemsvåg, 2010, p.253).

Fourth, experts should be involved in the risk management of emerging risks depending on their knowledge. The informants urged to include inside and outside specialists and to collaborate with other banks for knowledge collection and sharing. Schiller and Prpich (2013) support this, arguing: “What is limiting organisational risk management is the lack of a concept of risk knowledge generation, with current incarnations of ERM assuming risk information arises from within the organisation like a deus ex machine” (p.1010).

Fifth, the prevalence of the concept of knowledge across all cases can be understood as two sides of a coin. On the one hand, the banks lack knowledge about emerging risks from IT innovations. On the other hand, as per definition, innovations describe something new and, therefore, general knowledge about this innovation is rare. Both sides point out that risk management is not a deterministic science; it calls for sense making, to be able to see the emergence of risks in various contexts and

to detect connections which have not been noticed before. Therefore, informants described risk assessment and risk monitoring as an essential part of ERM for emerging risks. However, they refrained from describing exact procedures. Instead, they highlighted that risk assessment as well as risk monitoring need to enable the creation and validation of knowledge, to allow a better understanding of emerging risks.

Surprisingly, even though the data analysis has confirmed that most of the banks lack an ERM for emerging risks, in their outlook for future ERM practices the interviewees confirmed the conceptual framework as presented in Chapter 3. As discussed in Sections 7.2 to 7.5, a recurring theme from the interviews is the importance of knowledge creation and sharing, risk assessment and risk monitoring. The informants confirmed the view that uncertainty is predominantly understood as a lack of knowledge and that a large number of inside and outside experts should be involved, depending on their knowledge about the emerging risk.

Hence, it is proposed that the conceptual framework, at this point in time, does not require an adaptation. However, the informants highlighted practical aspects of the set-up and adaptation of ERM which allow the proposal of guidelines that are presented in the subsequent section.

7.6.1 Guidelines for the conceptual framework

The data analysis has exhibited that practitioners lack guidance on how to apply ERM to emerging risks. Therefore, the framework guidelines have been developed to provide direction to decision-makers. The recommendations summarise aspects deemed important for consideration while adapting the existing ERM framework, to allow a greater focus on emerging risks. The framework guidelines have been developed from suggestions by the informants and exploration of the academic literature.

(A1) Banks may consider involving several stakeholders from various fields of expertise and different departments as well as experts from outside the bank. This would allow including different viewpoints and various knowledge sources about an emerging risk (Hall *et al.*, 2014), and therefore improving the legitimacy of the knowledge base (Wilden *et al.*, 2016).

(A2) Stakeholders should be willing to challenge current assumptions and should be prepared "… to overcome cognitive barriers to imagine that events outside expected paradigms are possible" (Florin, 2013, p.318). Yet, it is not proposed that all decision-makers should acquire in-depth knowledge about each risk, rather it is based on the idea "… that in-depth substantive knowledge must be usefully coupled with a broad understanding of the generic factors that contribute to the emergence of risk" (Florin, 2013, p.321).

(A3) The knowledge should be collected and shared amongst the stakeholders for gaining a substantial edge over the creation of the emerging risk and can further be extended as the knowledge develops. Furthermore, this would allow stakeholders to understand, add to it, and detect possible biases and selective views. Moreover, relationships and impacts on other areas from which a risk can develop could be detected (IRCG, 2011). The emerging risk should be well understood before a quantification of the risk is performed. Yet, it is argued that risk commensuration amongst stakeholders is not necessarily required (RIMS, 2010; Schiller and Prpich, 2013), as long as the source of the risk and its possible impact is understood.

(A4) The risk assessment should specify the amount of knowledge the assessment is based on, to allow an informed judgement of how valid the assessment is. Scholars such as Flage *et al.* (2014) claim that probability is not always an adequate representation of epistemological uncertainty. Hence, the risk assessment should in addition cover the assumptions and background knowledge of the emerging risk (Aven, 2016).

(A5) Banks should develop a routine in which assumptions and beliefs are tested to facilitate thinking outside the comfort zone and to avoid a tendency to focus on known risks. RIMS (2010) suggest simulations and scenario analysis or the usage of tools like the Bayesian Belief Network as a means to develop the understanding about an emerging risk (Blockley, 2013).

(A6) It is deemed especially important that the conceptual framework should allow for reactive as well as proactive management of emerging risks (Beasley *et al.*, 2016). Reactive implies that knowledge about a risk is used to reflect on the past and then derive actions to improve in the future. Proactive has the sense of future-oriented, managing emerging risks as early as possible, even when not exactly knowing whether it will affect the bank in the future. The risk should be monitored and special focus should be laid on the identification of an opportunity that could develop from the emerging risk.

(A7) To save resources, banks are advised to cooperate with other banks in detecting emerging risks and sharing knowledge about them. This is an aspect not very frequently discussed in academic literature, yet this topic was raised main times in the interviews (see Section 6.4) and is described as a chance to comprehend the large field of emerging risks from IT innovations.

7.6.2 Benefits of the conceptual framework

To further gain academic and practical understanding, it is deemed essential to discuss the benefits of the conceptual framework (Tsang, 2013; Tsang, 2014). The benefits have been identified based on the findings from the field data.

The first benefit is that the framework can form a foundation for a retrospective analysis, to study the ERM strategies for emerging risks, locating the limitations and areas for improvement of existing ERM mechanisms. Furthermore, the framework can be applied prospectively, as a managerial tool supporting decisions on how to adapt ERM for emerging risks (Arena *et al.*, 2014). The second benefit is potentially

reducing exposure to emerging risks by bringing to attention states of the world that might have not been uncovered otherwise (Bjerka and Aven, 2015). A third benefit is counteracting the tendency to handle only risks that confirm presumptions and existing knowledge (Feduzi and Runde, 2014; RIMS, 2010). Therefore, increasing the chances of discovering evidence that bears significance for banks and which, so far, has not been under consideration by risk management procedures for well-defined risks (Arena *et al.*, 2014, RIMS, 2010).

7.7 Discussion

The development of the classification scheme of the banks allowed the clustering into discouraging, neutral, and proactive banks. Kloman (1992) defined risk management, as "… the art of making alternative choices, an art that properly should be concerned with anticipation of future events rather than reaction to past events" (Kloman, 1992, p.302). Seven of the ten interviewed banks are classified as neutral or discouraging and do not take definite actions to confront future emerging risks.

However, remarkably consistent patterns emerged from the interviews with the proactive banks and the risk consultants. While some perceptions about ERM for emerging risks were specific to certain informants, commonalities prevailed. This allowed the validation of the conceptual framework. The views expressed by the informants and the resulting cross-case analysis confirmed the conceptual framework as presented in Chapter 3. Hence, the conceptual framework was not further adopted after the interviews. Yet, the field data allowed the identification of guidelines that provide directions for the adaptation of ERM to better manage emerging risks from IT innovations.

8 Conclusion and implications

The last seven chapters have presented the reader with a line of reasoning which put forward what the research area covers, why it is of importance, how it was researched, and which findings can be drawn from the data.

Before the next section, which provides a summary to the research questions, Table 8-1 recapitulates the structure of the work and how this set-up allowed a logical and coherent research project.

Chapter	Action	Purpose
Literature Review	▪ Evaluation of academic and industry contributions ▪ Development of a literature review framework and a structure which was used throughout the research	The creation of the literature review framework allowed the framing of the research field, set boundaries to it and served as a structure for the presentation of the further research claims. Identified the research gap and, based on that, formed the research questions.
Conceptual framework	▪ Conceptual framework derived from the literature review and furthered by the field data ▪ Presentation of the model guidelines	The conceptual framework is the first effort to structure ERM for emerging risks and includes the collected data as well as findings from previous academic researches. The model guidelines help to detect how ERM needs to be adapted to better reflect emerging risks.
Philosophy	▪ Description of critical realism and presentation of reasons that this understanding of philosophy is applicable to this research	Make the system of belief explicit as it informs how knowledge claims are generated and interpreted (Guba and Lincoln, 1994; Wynn and Williams, 2012). Searched for multiples views including aspects of mechanisms and context (Briar-Lawson, 2012)
Methodology	▪ Identification of multiple-case studies ▪ Exploration of the phenomenon through semi-structured interviews	Identified research methodology that allowed exploring a research field in which little previous research had been done and hence demanded theory building instead of theory testing.

Chapter	Action	Purpose
Findings and analysis	▪ Presentation of findings based on verbatim quotes and coding ▪ Cross-case analysis including reference to other academic research ▪ Classification scheme for banks, clustering multiple views and furthering the understanding in the comparison of themes across cases ▪ Review of the conceptual framework based on the field data	Informed by critical realism, it was deemed necessary to explore the research issues from various perspectives and allow for various causal explanations (Subramaniam *et al.*, 2015). It was especially important to expand the sample of banks to also include G-SIBs to encompass a broader range of views.
Implications	Contribution to knowledge: ▪ Conceptual framework organising and describing the different concepts and phenomenon concerned (Tsang, 2013) ▪ Addition to the rare literature of ERM and especially ERM in the banking industry Contribution to practice: ▪ Conceptual framework and model guidelines to enhance ERM for emerging risks in practice	In line with a DBA, this research presents a contribution to research as well as to practice.

Table 8-1: Research structure and demonstration of coherence and logic

This structure is seen as an indicator of a coherent research project, in which the components of the research are consecutively assembled.

Furthermore, the next paragraph will argue that the research is not only coherent, but also of good quality. To achieve this, research quality criteria and their reflections in this research are presented. Nonetheless, it is acknowledged that there is an ongoing debate whether qualitative critical realist research can be judged based on conventional research evaluation criteria, the criteria which are often assigned to quantitative, positivistic informed research (Jennings, 2015). The researcher understands these criteria as a presentation of thoroughness, which she argues can and should be established in any kind of research.

Quality strategy	Adoption in the present research
Construct validity	Concepts are defined and grounded in extant literature (Yin, 2012). A chain of evidence using quotes from informants and cross-case tables is provided to readers.
Internal validity	Within-case analysis is followed by cross-case pattern patching (Riege, 2003).
External validity	The population of interest is specified. Cases are purposefully selected to allow information richness (Meyer, 2001). Analytical generalisation, not statistical generalisation, is targeted (Yin, 2012). Results are compared with extant literature.
Reliability	A case study protocol was developed and was continually refined (Riege, 2003). Data are recorded in a case study database (NVivo) to keep an audit trail with time stamps. A standardised interview protocol was used. Constructs are defined and grounded in extant literature.

Table 8-2: Quality criteria and their adaptation in this research

Furthermore, another criterion for research evaluation is the questions of how generalisable the findings are. The proposed interpretation of the research phenomenon is built on current academic literature and on the interview data from 61%[5] of all German banks participating in the banking stress test of 2014 and of two globally systemically important banks (EBA, 2014; FSB, 2015). However, the primary goal is not the statistical generalisation of findings but rich descriptions of phenomenon by those who have experienced them, to allow an ample understanding of the research issue. Therefore, the research aimed at analytical generalisation (Easton, 2010; Yin, 1989).

8.1 Research aim and objectives

The study's central aim is to identify which ERM components are important for the ERM of emerging risks from IT innovations. In order to achieve this aim, four

[5] Based on income before tax in 2014.

research objectives were identified. Table 8-3 reviews the research questions with their corresponding results.

Research objectives	Research result
To conduct a critical contextual literature review of academic and industry-based literature in order to identify central themes and theoretical issues that underlie the current ERM practice within the banking sector in the context of emerging risks, which should lead to identifying the research gaps.	An extensive literature review was conducted of 657 peer-reviewed articles, 50 industry reports and surveys, and 81 books which allowed: ▪ the identification of the research gaps and concluded in: ▪ the development of a literature review framework focusing on risk field, risk rationalities, uncertainty experts and procedures.
To explore the processes and procedures for managing risks across an enterprise, by recognising in the literature review the current debate in ERM research and identifying the common ERM components.	A clear gap exists between ERM as an approach to all risks affecting firm objectives and the neglect of emerging risks from IT innovations in ERM approaches. The common ERM components were identified and informed the data analysis, to explore if these components were found in the interview data.
To select a research methodology and method appropriate to exploring the research gaps and answering the research questions, derived from the research problem.	Due to the novelty of this research, an explorative qualitative case study methodology based on semi-structured interviews was assessed to be a suitable approach for this research endeavour and the researcher's interpretation of philosophy.
To develop, based on the literature review and field data findings, a conceptual framework integrating key dimensions geared towards improving the overall applicability of ERM for emerging risks from IT innovations.	The conceptual framework organises the ERM components which are of special importance for the ERM of emerging risks from IT innovations. It is developed from the findings of the literature review and furthered by the understanding of emerging risks and ERM expressed by the informants. Furthermore, model guidelines for the implementation of ERM for emerging risks were proposed.

Table 8-3: Research objectives and their achievement in the research

The collected data revealed that banks rated as discouraging or neutral are lacking ERM procedures for emerging risks from IT innovations. Hence, primarily the future

requirements were explored instead of the current ERM practices. With this established, it was crucial that the semi-structured interview set-up would allow asking further questions. The chosen research approach allowed investigation of an emerging subject, which called for theory building rather than theory testing (Eisenhardt and Graebner, 2007; Singh, 2015). In line with critical realist philosophy, it was important to explore the phenomenon from the different viewpoints found in the opinions shared by the IT and risk managers as well as the risk management consultants (Donnell *et al.*, 2013). Furthermore, interviewing ten banks helped to obviate the similarities and differences between banks, which allowed presenting multiple views of the phenomenon (Christie *et al.*, 2000).

8.2 Responses to research questions

Chapter 7 considered the research questions in detail. However, it is important to present concise answers to each within this conclusion chapter. Hence, the responses to the research questions are summarised in this section to allow the discussion of implications for knowledge and practice.

The research questions were derived from the research gaps identified in the literature review, which recognised the importance of exploring four key areas (risk field, risk rationalities, uncertainty experts, and procedures) to fulfil the research aim. The answers are syntheses of the findings of the literature review and the analysis of the primary data (Bryman and Bell, 2015).

Research field and research question	Findings	Interpretation
Procedures – *Which ERM components are critical to the ERM of emerging risks from IT innovations?*	Knowledge collection and sharing, risk assessment and risk monitoring are crucial in the ERM of emerging risks from IT innovations.	Collect and share knowledge to allow an initial understanding and description of the emerging risks. Risk assessment should be able to incorporate new knowledge as it is available over time. As knowledge is changing, risk monitoring allows the update existing knowledge and inclusion new knowledge (Flage and Aven, 2015).
Risk field – *What key meanings are currently attached to emerging risks from IT innovations within the German banking sector?*	Various meanings are attached to emerging risks; no common understanding exists amongst banks and risk consultants.	Emerging risks are familiar risks which become apparent in an unfamiliar context; it is a relative concept depending on the background knowledge that changes over time.
Risk rationalities – *How does uncertainty influence the ERM of emerging risks from IT innovations?*	Uncertainty is understood as a lack of knowledge.	As the risk emerges from a novelty (IT innovation), the focus is not on uncertainty expressed by impact and probability, as is dominant in risk management. Rather, the focus is on reducing uncertainty by collecting knowledge.
Uncertainty experts – *Who should be involved in the ERM of emerging risks from IT innovations?*	Involvement of experts depends on their knowledge.	Seldom does one single person have all the knowledge about an IT innovation. Hence, various stakeholders should be involved, depending on their expert knowledge.

Table 8-4: Responses to the research questions

The first research question addresses the ERM components deemed especially important to managing emerging risks in the future. The pilot study indicated that banks currently do not have special procedures for emerging risks; the informants confirmed this for the discouraging and neutral banks. The proactive banks and the risk consultants highlighted knowledge collection and sharing as a critical aspect. Moreover, vital in the management of emerging risks is the assessment and monitoring of the risk.

To address the second question, which concerns banks key meanings attached to emerging risks from IT innovations, the researcher first reviewed the existing literature, as reported in Chapter 2. The theoretical investigation shows emerging risks as characterised by low probability yet high impact. The analysis of the empirical data reveals that the majority of interviewees do not share this view, but instead focus on the familiarity of the risk and the context in which the risk occurs.

The third research question addresses the influences of uncertainty on ERM. The research has linked uncertainty to the concept of lack of knowledge. Informants see knowledge as a means to decrease uncertainty. This finding again deviates from that dominant in risk management literature, which mainly discusses uncertainty as a concept of probability.

Research question number four explores the stakeholders involved in the ERM. Academic ERM research has been rather silent on that aspect, leaving it to the individual organisation to assign the stakeholders. The informants enhanced this view and listed a number of organisational roles which should participate. A common theme was that they argued that the choice of experts to be involved should depend on the risk and the required knowledge.

8.3 Research contributions

The discussion of the coherence of the research, the presentation of the quality criterion and its application in this research, as well as the answers to the research questions, aim to serve as a basis for the reader to evaluate the research contributions. The contribution to practice and knowledge are discussed in the preceding section.

The key findings from this research can be summarised as:

- The classification scheme developed to specify the *emerging risk management concern* in German banks indicated that banks adopt different mechanisms and processes to confront emerging risks.

- Knowledge is the conjunctive element of the ERM components. The level of knowledge determine the actions taken in the assessment and monitoring of the emerging risks.
- Emerging risks are conceptualised as risks for which little historic data exists and for which there is a high uncertainty about the future development. The informants did not share the view expressed by academic literature, which predominantly describes emerging risks as high impact and low probability.
- Uncertainty is understood as a lack of knowledge, which again differs from the theoretical discussion of academic publications.
- No shared view exists of who exactly needs to be involved in the ERM of emerging risks. However, it was found that different individuals inside and outside of the banks should be involved, depending on their expert knowledge.

A DBA thesis is meant to contribute to knowledge as well as to practice. This research supports this requirement by providing theoretical as well as practical insights on ERM and emerging risks from IT innovations. The contributions to practice as well as to knowledge are summarised in the next two sections.

8.3.1 Contribution to practice

The conceptual framework offers a contribution to practice as it helps developing a wider view of ERM. Therefore, the framework can be the basis for a retrospective analysis, to study the ERM strategies for emerging risks, to locate the limitations and areas for improvement of existing ERM mechanisms (Arena *et al.*, 2014).

It can potentially reduce exposure to emerging risks by bringing to attention states of the world that otherwise might have not been uncovered otherwise (Bjerka and Aven, 2015). Decision makers, such as IT and risk managers, might underrate the possibilities of emerging events and their consequences because they have never experienced them (Fiskel *et al.*, 2015). The conceptual framework aims to counteract the tendency to handle only risks that confirm presumptions and existing knowledge (Feduzi and Runde, 2014; RIMS, 2010), therefore, increasing the chances of discovering evidence that bears significance to banks but which so far has not been

considered by risk management procedures for well-defined risks (Arena *et al.*, 2014; RIMS, 2010).

The conceptual framework puts forward the framework guidelines. They should provide practical guidance and point to aspects that require special attention in the ERM for emerging risks.

Therefore, the conceptual framework and the framework guidelines can be of value to a number of stakeholders (Hall *et al.*, 2014). First, they can be significant for the bank's decision-makers, as they are in charge of handling risks (Lu *et al.*, 2012). The conceptual framework and the model guidelines provide them with an initial step by allowing them to identify how ERM should be adapted. Second, the supervisors, and regulators of the banking system can benefit. They would like to understand how sound risk management for emerging risks should be set-up, so they can judge and advice on the appropriateness of current practices (Dombret, 2015b). They can apply the conceptual framework as a baseline and as a point for discussion with German banks. Third, consultants looking for solutions to assist their clients building a sufficient ERM can use the conceptual framework as a guideline.

Furthermore, the interview findings indicate how emerging risks are currently conceptualised. This research has followed calls from scholars such as Arena *et al.* (2014), Aven (2016), and Weick *et al.* (2005) who urge risk management to make sense of uncertainties as this affects strategic decisions and company performance. The research found that various meanings are attached to emerging risks from IT innovations, with no shared view amongst banks. Yet, often emerging risks have been discussed as known risks but emerging in a different context. This understanding of emerging risks points to the importance that banks, regulators, and supervisors need to challenge existing views to also discover entirely new emerging risks (Dombret, 2015b).

8.3.2 Contribution to knowledge

While the concept of risk in general has been well documented, the underlying theoretical drivers of emerging risk are less well understood (Jäger, 2009). This topic has so far been widely neglected by the ERM literature, where most work discusses

ERM in the light of the corporate governance debate, stressing its role as a tool for accountability (Power, 2004a; Power, 2005; Spira and Page, 2003). Most of the ERM literature has appeared in the business media, whereas academic research on ERM is scarce (Bromiley *et al*., 2015). Literature on ERM has focused on defining in general what the ERM concept entails, organisational factors associated with ERM and effectiveness of ERM. To the knowledge of the author, no research has investigated how a particular risk is handled by ERM. Therefore, this research contributes to knowledge by adding to the empirical ERM literature. Moreover, it adds to the rare ERM research in the banking industry.

The conceptual framework also presents a contribution to knowledge as it is a representation of a complex and highly dynamic phenomenon. It draws attention to the mismatch of the dominant backward-oriented directives and theories which presently prevail in ERM research (Bjerga and Aven, 2015) and helps to organise a complex, under-researched topic. It alters the understanding of how ERM can be understood by academia in order to manage emerging risks. The conceptual framework creates a frame that identifies the crucial ERM components for emerging risks.

Furthermore, the methodological approach underlying this research demonstrates the use of qualitative data collection and analysis. So far, risk management research has been dominated by quantitative methods. Qualitative research in risk management just has lately evolved, nevertheless has been recognised as providing valuable findings for practice as well as academia (Millo and MacKenzie, 2009; Moch, 2013 Subramaniam *et al.*, 2015). The approach to this study may shed a new light on research in this field. For that reason, this study contributes to knowledge by suggesting that a qualitative method is appropriate for such a highly heterogeneous field as ERM.

This section has outlined the contributions of the research on the level of knowledge and practice. The next section will take forward the presented arguments and will present the implications for policy and practice.

8.4 Implications for policy and practice

While conceptual frameworks will not serve all purposes, the process of conceptual modelling can help scientists, policy makers, and managers to discuss applied problems and theory among themselves, irrespective of their research areas. Especially in the banking sector, implications for policy play a crucial role due to the eminent role of the banking regulators and supervisors.

Overall, the major challenge of regulation is to stimulate technological innovation, while ensuring economic development as well as societal benefits from it (BaFin, 2014; Medcraft, 2015a). For this reason, the Deutsche Bundesbank recently urged German banks to consider the whole range of risks from IT innovations, not only the income or loss side of an IT innovation (Dombret, 2015a). However, the Deutsche Bundesbank cannot provide clear guidance on how this call can be fulfilled. The regulators are in search of guidelines and further insight. “We need … to ‘think outside the box’, to go beyond our experience and think in entirely new dimensions” (Dombret, 2015b). Yet, the fast development of IT innovations and resulting increased competition leave policy-makers with a complex task. Therefore, research on ERM and emerging risks from IT innovations provides critical understanding in three areas.

First, this research has shed light on how banks conceptualise emerging risks from IT innovations and the respective ERM procedures. Hence, it can serve as a building block to evaluate whether existing regulations can be used or adapted to the complexity and uncertainties of IT innovations. Second, providing critical insights on how banks currently manage those risks can help to determine how future policies need to be adapted. Regulators have to be forward-looking and understand both realised and potential IT innovations (Greenham *et al.*, 2014). Third, interview partners have highlighted the importance that policy needs to set common ground with other nations to allow equal competition. For example, the European regulators and supervisors should not be stricter (on risk management procedures) than, for example, those in the USA, as this could create a competitive advantage for countries outside of the control of European regulation.

8.5 Limitations of the study

The present research attempts to make new contributions with the intent to further ERM for emerging risks from IT innovations. However, given the novelty of the research field, this research has limitations that require consideration.

Firstly, in line with its critical realism research philosophy, the explanations conveyed in this study are a portion of a possibly large number of interpretations, and reflect the particular reading of the researcher. The research project is exploratory, and the cases are selected because of their supposed information richness. Research conclusions are consequently contextual, rather than aiming at universal statistical generalisations (European Commission, 2010; Singh, 2015). One reason for this is that research findings may be affected by the way that interviews were conducted. For example, different levels of rapport with different interviewees may provide findings that similar levels of rapport would not have. To guard against this possibility, Perry (2002) suggests that, as a second stage, a realism project needs to verify the research results by using the same interview protocol.

Another constraint is that this is a single industry study. This implies that the presented results must be transferred to other sectors with great caution. Yet, restricting the analysis to one industry has the advantage that the findings are grounded on information from homogeneous firms, and allows for contributing to the scant literature on ERM in banking.

Furthermore, it was not possible to investigate the underlying reasons why the discouraging, neutral, and proactive banks differ in their ERM practices, as this was beyond the scope of the research and could be seen as problematic in the sense of anonymity. For example, based on constructs of the size and the business model, it would have been easy to identify the banks, as the overall population is only 25 banks.

8.6 Directions for further research

The consideration of the research limitations provides, at the same time, an interesting avenue for future research. The claims made in this thesis are context-

sensitive and require additional qualifications (Edmondson and McManus, 2007; Locke, 2007).

First, the present study can be considered as an initial step in a systematic effort to explore emerging risk management in German banks. A comprehensive testing of the proposed conceptual framework would be desirable for the next stage of theory construction (Buck, 2011; Meredith, 1993; Sobh and Perry, 2006), as opportunities exist to extend the conceptual framework to other business areas. Whilst the qualitative data identified the key ERM components, quantitative data could provide further insight regarding their importance (Keith, 2014) and their exact design. The testing of the conceptual framework could also add important insights into the causal factors discussed in Section 7.2.1.

A second avenue for further research would be to examine the link between banks and regulators in the context of ERM for emerging risks from IT innovations. The interviewed banks and risk management consultants frequently raised the role of the supervisor. The Australian Security and Investment Commission maintains that IT innovations are fundamental in providing better and cheaper banking services to customers. Nevertheless, Medcraft (2015b) sees the urgent need for regulator and banks to work together to harvest the opportunities. Therefore, future inquiries could investigate on how banks and regulators could work together to ensure that future risk management in covering emerging risks from IT innovations.

Furthermore, the role of operational risk management in emerging risks should be investigated. Many interview partners raised this topic. Since operational risk management is a stand-alone research field, it was excluded from the scope of the current project. Yet, further research could provide deeper insight into the integration of emerging risks and operational risk management.

Last, how the conceptual framework can be applied in practice has to be verified. It can be debated whether the downside of emerging risks is high enough to justify the proposed risk management actions. This is an argument, which warrants further research to evaluate the economic impact of emerging risks from IT innovations.

8.7 Conclusion

This work began with the quote: “Appearances are a glimpse of the unseen” (Anaxagoras, 500–428 B.C.; Curd, 2015). It resonates with the author’s critical realist view that there are multiple views of reality and it resounds with the research field: ERM for emerging risks from IT innovations. Innovations always bring a new sight and risks emerge from those innovations. Yet, as one interview partner summarised it: “We know it is out there, yet we do not know the implications and how to take care of it” (RM-B). Blockchain, big data, crowdfunding, etc., are IT based innovations affecting banks are just a glimpse of what IT innovations will bring about in the future. Academic publications on IT innovations and their risks are numerous, yet lacking answers for how banks can manage those risks in an ERM context. In the recent times, Aven (2016) has called for risk management approaches to emerging risks and point to the fact that developing these may be the main challenge for the risk field. This research has taken a first step to address this challenge.

The present study has provided the first empirical evidence for ERM for emerging risks from IT innovations. It draws attention to an area, which has been acknowledged to have significant impact on the banking industry (Medcraft, 2015a), hitherto has not found adequate attention in academia. The theoretical advances and empirical results from this study provide a useful step towards a more nuanced view on ERM and emerging risks from IT innovations. Overall, the research outcomes lend to the interpretation that ERM in German banks is still backward-oriented, lacking the pro-active management of emerging risks from IT innovations. Only one German bank and the two G-SIBs have been identified as actively managing emerging risks from IT innovations. The question remains open whether the other banks have the time to wait for the unseen, yet known, to become apparent.

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Appendices

Appendix 1: Interview guide

The appendix includes the semi-structured interview guide to provide a better understanding of the data from the interviews.

Research question: What key meanings are currently attached to emerging risks from IT innovations within the German banking sector?

1.1 How would you define emerging risks from IT innovations?

1.1.1 Does your organisation have a common definition?

1.2 Can you give me an example of an emerging risk from IT innovation that your organisation is currently facing?

Research question: How does uncertainty influence the ERM of emerging risks from IT innovations?

2.1 What roles does uncertainty play in the management of emerging risks from IT innovations?

2.1.1 Do you have an example where uncertainty had an impact on the management of emerging risks from IT innovations?

2.2 Do you see uncertainty as an advantage or disadvantage in the management of emerging risks from IT innovations?

2.2.1 Can you please elaborate why you see it as an advantage/disadvantage?

Research question: Who should be involved in the ERM of emerging risks from IT innovations?

3.1 Who in your organisation is involved in the management of emerging risks from IT innovations?

3.2 Is this a static group of people or can the people involved vary?

3.2.1 If the groups vary, what factors cause variations?

3.2.2 Should further people/departments be involved in the management of emerging risks?

3.2.3 Who has the overall responsibility for the management of emerging risks?

Research question: Which ERM components are critical to the ERM of emerging risks from IT innovations?

4.1 Does your organisation manage emerging risks from IT innovations?

4.1.1 If it is managed, can you please explain in detail how?

4.2 Does your organisation manage emerging risks per department or throughout the entire organisation?

4.3 Which risk management aspects and components do you find especially important in the management of emerging risks?

4.3.1 Why do you find them important?

4.3.2 Is your view shared among your organisation members?

Closing questions:

Do you have any further questions?

Is there anything you want to add?

Is there anything that could be improved in the interview process?

Would you like to receive a summary of the research findings?

Appendix 2: Example of interview record

Below is an extract of the interview with a risk manager of bank H. Bank H was classified as proactive. The interview was conducted in English and transcribed. Hence, not all sentences may be complete or grammatically correct, as they have been written down the way the informant has said them in the interview.

Interviewer: How would you define emerging risks from IT innovations? What characteristics are important from your point of view to be mentioned in a definition of emerging risks?

Informant: What I think about IT innovation and what I immediately worry about, I worry about the level of due diligence and testing that the business would do. Because from the world we live in now IT innovation is happening so quickly ... Sometimes we transform it for 48 hours. The fact that we are a bank means we are held up to a huge amount ... We innovate but we have to do it in an incredibly managed, measured way. So, we can never bring products or innovate technology quickly. The worry for me is that the business is, when they are innovating and developing great products and new services for customers they do not do the relevant risk checks so to speak. And they launch these products or launch these services in a way there will be no absolutely certainty as to the protection of customer data but protection … against cyber risk, so external parties being able to hack and take customer data or to use it fraudulently. We very much worry about, how does this leap take innovation link in prior existing infrastructure? Because for the risk we have here is that we create and develop a new IT innovation or any tool, or any system, but the issue we have is that it does not necessary speak to or link to our existing infrastructure. That we have customer data flowing through that particular system or tool. What we tend to do is that we have to manually reconcile that data or pick it out from one system, our existing system and load it into the new systems. What we found is that our IT infrastructure has become so complex we all reconcile the data ... So instead of something being really managed well and automated what we tend to do is we produce another system or a tool and then bolt it up without really thinking about how is this sustainable. And we find six to twelve months down

the line after we have launched the particular tool is the manual nature of making sure that information is complete, protected, is accurate. And we start having issues with data not being complete, reconciliation pulling over … starting to back up etc. And that is one of the key risks that we would say that we have is that we do not necessarily think strategically … We try to launch things too quickly, and we launch them badly – what I would call sticking plasters. And we launch them in such a way that there is a high risk of them failing in the future, which is almost something that we see day to day. What we try and do and I run what we call the new and amended product approval process, we call it NAPAP. More about those it is not just about new products, it is about new technology, new customer services. And so we have to work through quite a detailed process to make sure that the business comes to a particular gateway, that they have done the relevant due diligence for those picking at the gateways. And they only get loans approval when they are only allowed to go to market once we are comfortable that the business has assessed the risk of operational resilience and that product is going to stand up to high-level abusage, that it is not going to fall over, but it is going to be available 24/7. And it is going to be protected so any information that the customer is having that they can feel absolutely secure in the knowledge that it is not going to be hacked. Equally, we make sure what we are trying to do now in the current market is adding more layers of tech and challenge to ask that question, is this particular service, this IT innovation, the product sustainable? Are you implementing manual controls to be able to maintain this service, if so from my perspective it is not sustainable and so it is an interesting position at the moment that we are actively slowing our business down? Because in their desperate need quite rightly in the competitive landscape to bring great products to market to strike to be in competitiveness. And that is sort of a challenge that I have currently is making sure that we can work with our businesses to help them understand the risk they are taking and how going forward we need our system to be ready sustainable and for us to design products and services that are going to stand the test of time. That are sets of key things that we look at. It is very much from a customer perspective, I would say. All the nuts and bolts have to be absolutely right in the back end and we do look across our services landscape. We look at the operational risk of launching and innovating around what you would

expect technology, managing, and any supplier risk so if you are using third party supplier that we showed that we have the right contracts and the right oversight by the supplier. We also look at our customer data protection information risk of equally what is even more important for us is the customer service going to be absolutely right. Are the customers going to see a seamless service between what they see as the new product or service and what they are used to? But from our perspective as well we are also looking from a regulatory perspective. Are we comfortable that these products meet our regulatory requirements?

Interviewer: The next question is does your organisation have a common definition for emerging risks?

Informant: It does. Our bank operates a very, very rigourous risk management framework. It … is pretty much what governs my day job, my team's day job. ... So if we do not manage operational risk our services go down and our reputation is tarnished. Everything we do, every process that we have whether it will be launching a new product, launching a new service, launching a new app, launching a new customer service, internet site or anything is very much governed around how we can prove that we can manage those six principle risk. For me in my role, the critical ones that I am responsible for is operational risk, conduct risk, and reputation risk. But you can imagine the other risks are the more financial based risks around credit quality of customers around credit practices. And that is very, very technical and I am not a necessary part of that focus. When we look at emerging risks whether it will be new market regulation, I would say the competitive landscape and new payments providers we all see some of the starter emerging companies in the market which as I mentioned before drives them afterwards, it is going to stick to bring products to market or bring new services to market. We always consider emerging risk ... And each key risk has a very, very detailed framework … what should be considered against those key risks and how we should be certain at managing risk appetite, for example, operational risk in our bank is split into certain individual key risks one of them being technology. Now, technology in itself that has its own detailed key risk framework and we set high-risk appetite. For example, we have no appetite

for underlying customer services to ever be unavailable for the obvious reasons. If a customer cannot make a payment or buy something or go to whatever store and buy something, if that service is not available, that service is over. Our risk appetite would be that we have 110 percent of a 24/7 service. And so anything that we look out for in a new service, a new system, developing new products, changing underlying systems is assessed by the risk that our service may become unavailable. So if you can imagine what we are looking at emerging risk we are always looking out how is that particular new product service is going to impact our risk appetite. If you think about it we go through that process all of those thirteen key risks and when we develop the product on the developing services we look across the low key risks to make sure that how we are managing emerging risks and that it does not cause us to have any problem. The emerging risk would be considered again, are we able to launch that new product? Is that new product going to cause any legal constraints than any of the other at jurisdictions, which we operate? It is part of sort of the DNA of our business, it means that we have on a day-to-day basis very rigorously analysis of emerging risks. We look at the regulatory landscape. We look at the competitive landscape and we do very regularly reviews of emerging risk, emerging competitive risk, emerging regulatory risk, and consider what that means against our current business model.

Interviewer: And do you think that such a common definition is helpful or hindering in the risk management process? Is it good to have?

Informant: Yes, and No. As a bank we have four individual business units. Now, it is absolutely right that to demonstrate, to make sure that we are consistently managing risk across the bank whether it will be Africa, or the US, or the European banking system. You have to have a consistent way of managing risk because that is what our regulators expect. … There needs to be consistency that is an absolute given. But what it does do it provides me and my team with a framework, with an approach. Every bank, every business will have its own way of doing things and its own approach to risk, and its own risk appetite approach. We are given what I call, a

spine, so we are given the framework, we are given the principles, and we are given guidance as to how this particular risk should be managed in your business.

Appendix 3: Concept map

Coding was a valuable step in the data analysis. Yet, coding was seen as an initial step. “It leads you from the data to the idea, and from the idea to all the data pertaining to that idea” (Richards and Morse, 2007, p.137). Therefore, concept maps were identified as a meaningful tool to helping bridging the gap between codes and further meanings behind the data. Figure A-1 is an example of a concept map developed in parallel to the interview coding.

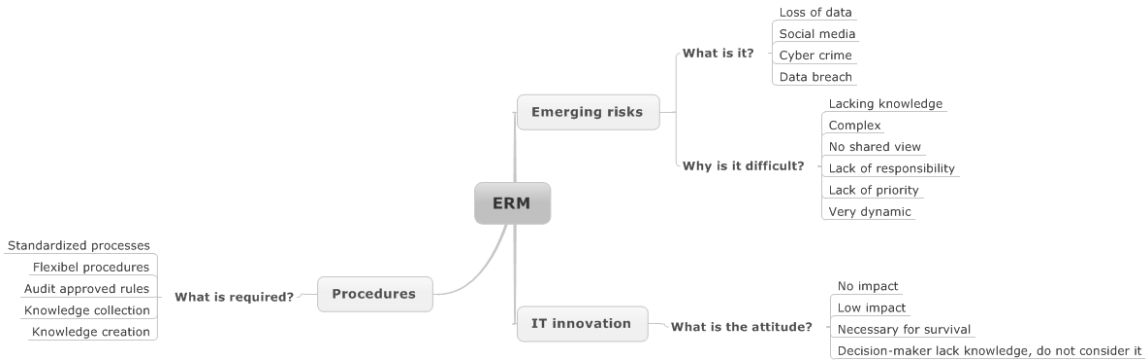


Figure A-1: Example of a concept map

Appendix 4: Data saturation

In qualitative research, data saturation refers to the point in data collection when no additional, relevant data is found (Francis *et al.,* 2010). Relevant data is data which needs to be coded. In this study, no new codes were required for interview numbers 8, 15, 17, 19, 21, 22, and 23. For interview 20, one additional code was necessary, therefore an additional three interviews were conducted, yet did not result in further codes within the next three interviews. Hence, the data collection was stopped.

The codes were continuously refined; at the point when the data collection stopped, 101 codes were defined, which were reduced to 48 codes at the end.

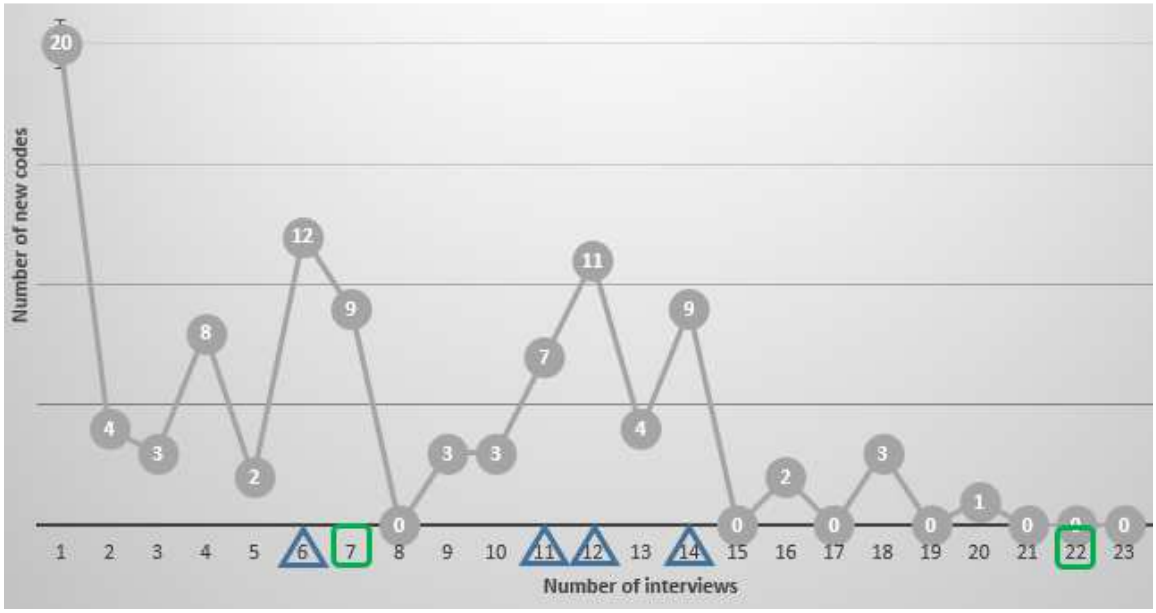


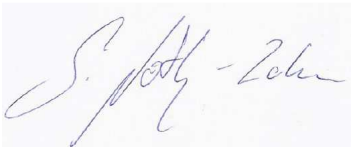
Figure A-2: Realisation of data saturation

The interviews marked with a blue triangle are the interviews with the G-SIBs. The interviews marked with a green quadrat are the two interviews with the biggest bank after the G-SIBs. In total, 61%[6] of all German banks participating in the banking stress test of 2014 and two globally systemically important banks were interviewed (EBA, 2014; FSB, 2015).

[6] Based on income before tax in 2014.

Declaration

I declare that this Doctorate of Business Administration thesis is my own work and that all sources literary and electronic have been properly acknowledged as and when they occur in the body of the text.



Stephanie Nöth-Zahn
Date: 16 September 2016