

RANKING OF CURRENT INFORMATION TECHNOLOGIES BY RISK AND REGULATORY COMPLIANCE OFFICERS AT FINANCIAL INSTITUTIONS – A GERMAN PERSPECTIVE

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ABSTRACT. This paper provides new insights on the relevance of new information technologies for the risk and regulatory compliance management of financial institutions in Germany. For this purpose, 62 executive risk managers and compliance officers have been surveyed with respect to risk categories, regulatory requirements as well as new technologies with an emphasis on artificial intelligence. The results of this survey are compared to the scientific literature and to four existing studies of 2016 and 2017, respectively. This research shows that artificial intelligence, big data and cybersecurity technologies are on top of the agenda of financial institutions in Germany. Moreover, the majority of participants are convinced that artificial intelligence solutions will widely be implemented and used in the risk and regulatory compliance environment by the end of 2022.

1. INTRODUCTION

Banks and other financial institutions (FIs) are required to regularly disclose their financials and risk situation to public supervisory agencies (BaFin Federal Financial Supervisory Authority, 2011). These disclosure requirements represent a key element of today's financial regulation policies (Mishkin & Eakins, 2016, p. 470 f.). Since the world-wide financial and economic crisis of 2007-2008, banks and other FIs are struggling with the exponential increase of these regulatory requirements. According to the Tech and Finance magazine (2016), more than 20,000 new regulations for FIs were created in the year 2015 alone. By the year 2020, the catalogue of regulations is expected to exceed 300 million pages. This large extent makes it nearly impossible for FIs to keep up to date with the implementation of new regulatory requirements (Eggert, 2014, p. 84). Furthermore, not only the total number of new regulations increases steadily, but also its degree of complexity (Eggert, 2014, p. 7). One of the main reasons for the massive increase in regulations related to FIs is that governments throughout the world want to ensure stability for the financial sector. A reliable financial system is critical for a healthy economy. Another reason for the increasing amount and complexity of regulations might be due to the fact that in the past decades, the whole financial sector became significantly more complex as well, with products and globally integrated structures that are difficult to understand and to regulate. One major reason for this development is the innovation of financial products that are getting more sophisticated (Cao, 2012, p. 78). Detailed and extensive regulatory requirements are essential to ensure that the probability of a FI to experience financial difficulties gets minimized. The bankruptcy of a single FI can have a negative impact on other organisations and on the overall

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economy (Hull, 2015, p. 16). Being out of date with respect to regulatory requirements is a high risk for FIs, especially for banks (Deutsche Bundesbank, 2017a). If an institution does not comply with current regulatory requirements, it will endure a financial penalty through national supervisory agencies or it could even lose its banking license in the worst case. Consequently, there is a rapidly increasing demand to implement new technological solutions that can assist in dealing with this fast-growing number and increasing complexity of regulatory requirements in a more efficient manner (Goltz & Mayo, 2017). Without the use of new technologies, FIs may not be able to stay up-to-date with respect to permanent changes of regulations (Boella et al., 2013). A large proportion of these requirements addresses risk management. Therefore, it appears to be one of the most critical tasks regarding regulatory compliance. In terms of risk management activities of FIs, it must be recognized that the management of non-financial risks like operational risk and issues concerning cybersecurity became significantly more demanding in recent years. For several institutions, the management of non-financial risks has become even more important than the management of traditional financial risks like liquidity risk and credit risk. Operational risks and issues with cybersecurity are mainly driven by human errors, misbehavior or lack of information (Lemieux, 2012, p. 47 f.). In order to manage these types of risks efficiently, FIs have to deal with an increasing amount of unstructured data that is difficult to manually measure and to evaluate. For these reasons, it is a strategic priority for risk management departments of banks and other FIs to introduce new technological solutions (van Liebergen, 2017).

Therefore, the research question arises which new technologies need to be considered to improve the effectiveness and efficiency of the risk and regulatory compliance management of FIs in the future.

This research article presents the results of a survey with respect to future planning of risk and regulatory compliance management at banks and other FIs in Germany. The study has been carried out in November and December 2017. The aim of this survey has been to provide on-the-job expert assessments on the subject. The content of our survey covers four main thematic fields and a set of questions (Q) to obtain statistical information about the participants. The results of this research are compared to four existing studies and scientific articles that cover similar topics in order to discover similarities and possible discrepancies in the presentation of the research results.

2. RELATED STUDIES

The survey presented in this research article is mainly based on and compared to four selected existing surveys that cover similar thematic fields and were carried out in 2016 and 2017, respectively. Besides, the results of this survey have been put into the context of scientific articles that deal with the subject matter. An overview of the evaluated comparable surveys is presented in table 1.

The survey entitled "AI and you: Perceptions of Artificial Intelligence from the EMEA financial services industry" has been carried out by Deloitte in cooperation with Efma1 and focuses on AI and other cognitive technologies in the financial industry. The survey provides expert assessments of more than 3,000 business and technical executives of FIs on the current and future relevance of AI for institutions in the geographic regions Europe, Middle-East & Africa (EMEA). Besides, the major fields of interest with respect to the implementation of AI technologies are presented (Deloitte, 2017). The second survey has the title "Restore, rationalize and reinvent: A fundamental shift in the way banks manage risk". It is a global study that has been carried out by Ernst & Young in cooperation with the Institute of International Finance2. This survey presents the relevance of selected risk categories and the estimated future impact of new technologies on risk functions and possible challenges involved in implementing the presented technologies. For this purpose, Ernst & Young (2017) interviewed risk managers of 77 firms across 35 different countries. Another survey with the title "The future of risk management in the digital era", that has been carried out by McKinsey & Company and the

Institute of International Finance, deals with a similar subject. Moreover, the McKinsey survey also focuses on digital risks in general and its possible impact on FIs. For this reason, McKinsey & Company surveyed experts of 30 selected FIs on various topics of interest. The target audience mainly consisted of CEOs and risk managers (McKinsey & Company, 2017). The fourth survey is entitled "European Banking Barometer - 2016: Seeking stability in an uncertain world". It has been carried out in the European Union by Ernst & Young in cooperation with the Institute of International Finance. This survey deals with the business outlook and focus areas of 250 selected institutions in Europe. The study shows that risk and regulatory compliance management are major topics of interest for a vast majority of participants. Besides, this survey presents strategic priorities and an outlook on the financial market (Ernst & Young, 2016).

Title	Relevant topics	Geographic region(s)	Publisher(s)	Year
AI and you: Perceptions of Artificial Intelligence from the EMEA financial services industry	Artificial Intelligence and other cognitive technologies in the financial industry	Europe, Middle East and Africa (EMEA)	Deloitte in cooperation with Efma	2017
Restore, rationalize and reinvent: A fundamental shift in the way banks manage risk	Digital transformation of risk management in the financial industry	World	Ernst & Young in cooperation with the Institute of International Finance	2017
The future of risk management in the digital era	New technological solutions for the risk management in the financial industry	World	McKinsey in cooperation with the Institute of International Finance	2017
European Banking Barometer - 2016: Seeking stability in an uncertain world	Risk and regulatory compliance management are the focus areas in the financial industry	Europe	Ernst & Young	2016

In the results section of this article (see chapter 4), the outcomes of our survey are compared to the content of these four surveys as well as to the findings in selected scientific articles. The aim of this approach is to discover similarities and possible discrepancies in the presentation of the research results.

3. RESEARCH DESIGN

The creation of the survey format is based on three different subsequent steps. The first step is characterized by a comprehensive scientific literature research on the subject matter. The resulting insights are used to build a theoretical foundation to create survey questions. Furthermore, four selected existing surveys (see chapter 2) have been analyzed to specify the content of our survey. The third influencing factor are results from expert interviews with both risk managers and compliance officers of selected FIs in Germany. The experts have been requested to give an estimation about strategic priorities with respect to the digitalization of the

risk and regulatory compliance management in Germany. These approaches are interconnected and built on one another. Therefore, the procedure to create the questionnaire of this survey can be illustrated through the pyramid scheme in figure 1.



Figure 1: Procedure to create the survey form

In order to ensure high quality of defined questions, the survey has been tested by three selected risk and regulatory compliance experts from different German FIs. The questions and response options were analyzed regarding completeness, comprehensibility, uniqueness and significance (Atteslander, 2010, p. 295 f.). Afterwards, the survey has been reviewed based on the feedback of the three experts.

The survey contains 17 questions with predominantly defined response options. At some points, the participants are invited to write an additional comment in text boxes. The reply options for each question are presented in the chapter research results (see chapter 4). The evaluation of the survey and the presentation of the results are in the form of aggregated statistical data to ensure the anonymity of the individual participants.

In order to ensure a high quality of responses, the participants had to meet the following criteria:

- job role: risk manager or compliance officer
- more than 5 years of professional experience in this role
- middle level management (executive) or higher
- business operations in Germany

The survey has been distributed in two different ways. On the one hand, the survey has been sent directly to 164 selected recipients via E-Mail in English and in German versions. Only one risk manager or compliance officer of each selected institution has been contacted. The primary sources of information for the contact data of the recipients have been gathered from the network of contacts from IBM Germany (ger. IBM Deutschland GmbH), as well from websites of institutions and related job descriptions at the professional social network XING. On the other hand, the German banking association Bankenfachverband e.V.³ helped to distribute the survey via E-Mail to 54 selected executive officers in Germany. The reason for selecting this second approach is that the distribution through an established association might increase the acceptance and the willingness of the recipients to participate in the survey. It was ensured that each institution has been contacted only through one of the two mentioned distribution approaches. In total, 218 persons have been contacted individually and have been invited to participate in this survey.

The proportional share of the target audience of this survey is based on the report of bank branches in Germany in 2016, published by the German Federal Bank (Deutsche Bundesbank, 2017b). In order to define a target proportional distribution of participants for the banking

sectors in Germany, the total number of institutions and the total branches of each sector are taken as a benchmark. The predefined target audience is illustrated in table 2.

Target audience	Total number of institutions	Total branches	Participants (%) target
Cooperative banks	976	11,145	39.1 %
Private banks	381	9,825	26.0 %
Public savings banks	412	11,351	29.6 %
Other financial institutions	119	1,593	5.2 %
Total	1,888	33,914	100.0 %

The target proportional distribution of participants for each banking sector is calculated based on the percentage distribution of the total number of institutions and the total branches. For the first part of the calculation, the total number of institutions of each sector is divided by the total number of all institutions (1,888). The result for each sector is then multiplied by one third. For the second part of the calculation, the total number of branches of each sector is divided by the total number of all branches (33,914). The result is then multiplied by two thirds. As a last step, the two partial results are added up. In summary, the following formula describes the calculation for each sector:

$$Participants (\%) = \frac{number\ of\ institutions}{\sum\ number\ of\ institutions} * \frac{1}{3} + \frac{number\ of\ branches}{\sum\ number\ of\ branches} * \frac{2}{3}$$

For this calculation, the proportion of the number of branches is weighted by a factor of two compared to the proportion of the number of institutions. The major reason for this approach is that the number of branches is a better indicator for the proportional share of the banking sector in Germany than the total number of institutions (Deutsche Bundesbank, 2017b). Therefore, various proportional splits of these two components were tested. In an additional step, the overall distribution list for the survey was based on the proportional distribution of participants. The survey was distributed via E-Mail with a personalized cover letter including objectives of the survey in the period from November 15th to November 17th, 2017. The E-Mail contained both links to an online version as well as the PDF version of the survey in English and in German. On November 28th, the German banking association Bankenfachverband e.V. distributed the survey as well via E-Mail to selected executive risk managers and compliance officers in Germany. The submission deadline for both the online survey and the PDF documents was the 22nd December 2017.

4. RESEARCH RESULTS

4.1. Survey participants. In total, 71 survey forms have been returned. This is equivalent to a rate of 32.6 %. Each survey form was reviewed individually and anonymously to ensure a high quality of data. Therefore, survey forms that did not meet the presented criteria (see chapter 3) were sorted out. As an adjusted result, 62 survey forms were considered for the evaluation of the survey and the statement of results. Compared to the total number of contacted persons, this equals a quota of 28.4 %. The percentage proportion of the participants based on the banking sector in Germany (Q2) is illustrated in table 3. This table shows a comparison of the target and the actual survey audience.

Target audience	Total number of institutions	Total branches		Participants (%) target	Participants (%) actual
Cooperative banks	976	11,145		39.1 %	27.4 %
Private banks	381	9,825		26.0 %	32.3 %
Public savings banks	412	11,351		29.6 %	29.0 %
Other financial institutions	119	1,593		5.2 %	11.3 %
Total	1,888	33,914		100.0 %	100.0 %

It must be considered that the actual proportion of cooperative banks (27.4 %) is significantly lower than the target proportion of 39.1 %. Otherwise, the actual quota of private banks (32.3 %) is remarkably higher than the target quota of 26.0 %. The actual proportion of public savings banks (29.0 %) only has minor discrepancies from the target (29.6 %). Due to the relatively small total number of participants, this deviation is considered insignificant. However, the discrepancy between the actual proportion of other FIs (11.3 %) and the target proportion (5.2 %) is considerable. In general, the deviations are caused by different return quotas for each banking sector. One possible explanation for the outstanding quotas of private banks and other FIs is that these institutions were predominantly contacted by the German bank association Bankenfachverband e.V. The acceptance and willingness to submit the survey might have been higher since the invitation came from an official association.

With regard to the profession of the participants, it must be considered that more than two thirds (68.0 %) work as risk managers and about one third (32.0 %) as compliance officers (Q3). The aim of this research is to present aggregated results from both, risk managers and compliance officers. For this reason, the results are not presented individually for each job role in the following sections. The average professional experience of the survey participants at their mentioned occupation is 11.1 years (Q5). This shows that the participants provide a sufficient practical experience. In terms of the management level, 59 participants (95.0 %) specified that they are executives and three participants (5.0 %) indicated that they are chief executives.

One major limitation of the following research results is the sample group size. Due to the large number of 1,888 institutions in Germany, it is nearly impossible to include all possible participants in a survey. Therefore, it is required to create a small group that aims to reflect the statistical population. However, this approach bears the risk that the sample group does not represent all possible participants correctly, which may lead to a certain error margin (Atteslander, 2010, p. 163). In consequence, the results of this survey do not allow to draw universal conclusions for all FIs in Germany. This aspect must be considered at the interpretation of the research results.

4.2. Risk categories. The first thematic field of the survey is called "risk categories". The participants are requested to create both, rating and ranking of the current relevance of selected types of risk. In the context of this survey, the term relevance describes to what extent an institution is affected by a certain risk category. Furthermore, the recipients are invited to give an estimation of the future relevance of the chosen risk categories by the end of the year 2022.

At first, the participants rate the current relevance of selected risk categories on a scale from "very low" to "very high". The scale of ratings is based on the descriptions of Atteslander (2010, pp. 227-243). For the visualization of the results in figure 2, the terms of the scale are defined by a numeric value. In this context, "very high" is defined as the numeric value one, "high" is defined as two, "middle" is defined as three, "low" is defined as four and "very low" is defined as five. Therefore, a risk category with a low average rating is considered to be more

relevant than a category with a high average rating. The evaluation shows the average rating of each risk category in ascending order.

Q6: How would you rate the current relevance of the following risk categories for the risk management of your institution?

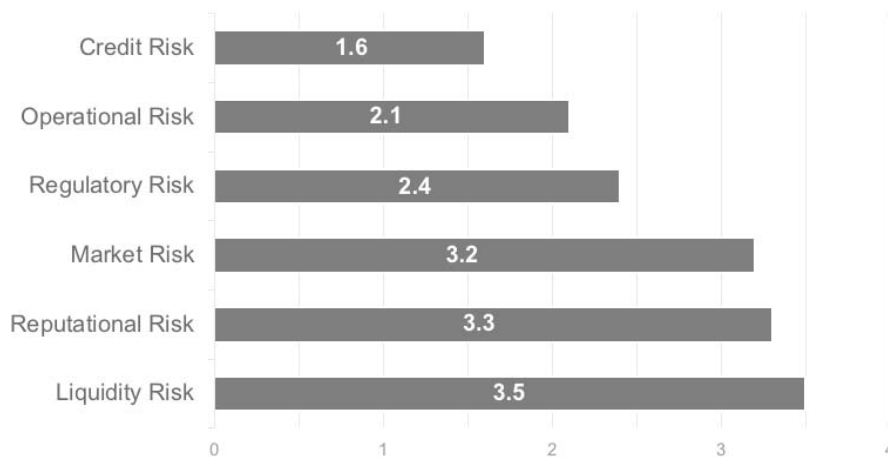


Figure 2: Rating of the current relevance of selected risk categories

The selection of the six different risk categories is mainly based on Hull (2015). Since the single risk categories can be defined in different ways depending on the context of the definition, a common description of each term is provided as an orientation for the survey recipients.

Figure 2 shows that Credit Risk is rated as the most relevant risk category for the risk management of FIs in Germany with an average rating of 1.6. The second position is held by Operational Risk (2.1) with a gap of 0.5 points to the first position. Regulatory Risk is rated with an average of 2.4 and is the third most relevant risk category. The three remaining categories Market Risk (3.2), Reputational Risk (3.3) and Liquidity Risk (3.5) are rated significantly less relevant for the risk management of FIs in Germany. In the following, the results of question six are compared to the results of question seven. The difference between these two questions is that on the one hand, a rating of the individual categories is created and on the other hand, a defined ranking on a scale of one to six is created. In question six, the participants are given the chance to evaluate more than one category with the same rating. In contrast to that, the participating persons must decide which categories are more relevant than others in question seven and therefore cannot rank two or more categories as equally important.

Figure 3 illustrates the current ranking of the relevance of selected risk categories for the risk management of the institutions on a scale from one to six. For this purpose, one represents the most relevant risk category and six represents the least relevant category. The evaluation shows the average ranking of each risk category in ascending order.

Q7: Please create a ranking of the current relevance of selected risk categories for the risk management of your institution on a scale from one to six.

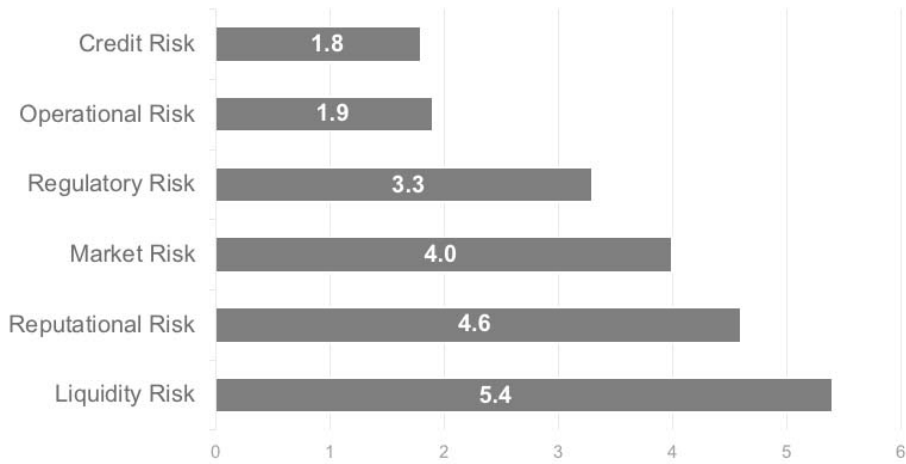


Figure 3: Ranking of the current relevance of selected risk categories

It must be considered that the ascending order of risk categories is equal in both question six and in question seven. However, the gaps between the individual categories differ significantly. Both questions show that Credit Risk is currently the most relevant risk category for the risk management of FIs in Germany. It has an average ranking of 1.8. In accordance to Azzollini and Pacelli (2011), Credit Risk has traditionally been the most relevant risk category for a majority of FIs in the past decades. In a short distance behind, Operational Risk is ranked on second position with an average ranking of 1.9. Power (2005) and Jobst (2007) discovered the increasing importance of Operational Risk and regarded it as a key factor for the regulation of FIs since the introduction of the International Convergence of Capital Measurement and Capital Standards document, known as Basel II, in the year 2004. When the Basel II reforms were extended by the current regulatory framework Basel III in December 2010, the management of Operational Risk gained further relevance for FIs in the European Union (Bank for International Settlements, 2017; Ames et al., 2015). The gap between the first two categories and the remaining four categories shows that Credit Risk and Operational Risk are currently the major topics of interest for the risk managers and compliance officers in Germany.

On position three, Regulatory Risk has received an average ranking of 3.3. It is noteworthy that Regulatory Risk is ranked above traditional risk categories like Market risk (4.0), Reputational Risk (4.6) and Liquidity Risk (5.4). The poor ranking of Liquidity Risk in both questions can be explained by the current loose monetary policy of the European Central Bank. At the time when the survey has been carried out, banks and other FIs were able to borrow money at a comparatively low interest rate. Therefore, the risk of being unable to meet liabilities is relatively small. These results are in accordance with the European Banking Barometer of 2016, which was carried out by Ernst & Young in cooperation with the Institute of International Finance. Their study also determines that FIs focus more on non-financial risks like Operational Risk than on traditional banking risks like Market Risk and Liquidity Risk (Ernst & Young, 2016). Besides, Lemieux (2012, p. 47 f.) also recognized a shift from focusing on financial risks towards non-financial risks since the economic crisis of 2007-2008.

The third question of this thematic field focuses on the estimated future relevance of the above-mentioned risk categories by the end of the year 2022. The results are illustrated in figure 4.

Q8: In your opinion, how will the ranking of the above-mentioned risk categories look like in five years from now? Please create a ranking of the estimated relevance of the risk categories for the risk management of your institution in five years from now on a scale from one to six.

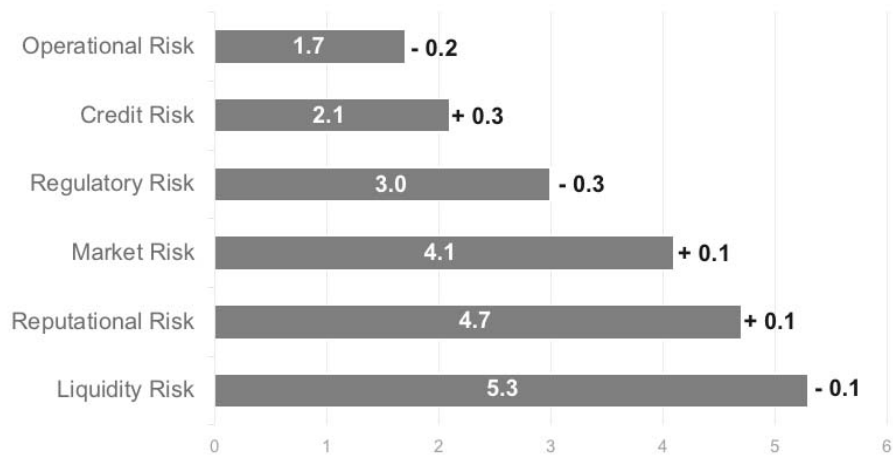


Figure 4: Ranking of the estimated future relevance of selected risk categories

The figures behind each bar illustrate the deviation of the results from the ranking of the current relevance of the risk categories. As a result, it must be considered that Operational Risk is ranked as the most relevant risk category in five years from the moment the survey was carried out with an average ranking of 1.7. Compared to the results of the previous question (Q7), this equals a reduction of 0.2 points. On the contrary, the average ranking of Credit Risk is 0.3 points higher (2.1). This shift between the first and the second position shows that the surveyed risk managers and compliance officers expect Operational Risk to be more relevant than Credit Risk by the end of the year 2022. This statement is in accordance with the Ernst & Young study of 2016. The participating institutions of this reference study also estimated that Operational Risk will become significantly more important for FIs in Europe (Ernst & Young, 2016). Lemieux (2012, p. 47 f.) also predicted that Operational Risk is expected to be the most relevant risk category for FIs in the future. Compared to the results of the previous question, Regulatory Risk is estimated to become significantly more relevant for the risk management of FIs in Germany. Its ranking is reduced by 0.3 points to an average rank of 3.0. Cohn (2016) explained this development by the complex relationship between risk and regulation. Cohn discovered that the regulation of known and estimated risks reshapes and creates new risks for FIs. Therefore, an increasing extent of regulatory requirements leads to an increase in Regulatory Risk. The results of the three remaining risk categories Market Risk (4.1), Reputational Risk (4.7) and Liquidity Risk (5.3) each vary by 0.1 points compared to the results of the previous question.

4.3. Regulatory requirements. The following set of questions deals with the current extent and degree of complexity of regulatory requirements for FIs. The aim of this section is to evaluate whether the current regulatory framework is regarded as a burden for risk managers and compliance officers in Germany. The response options have also been developed in accordance to Atteslander (2010, pp. 227-243).

Q9: How would you rate the current extent of regulatory requirements for your institution?

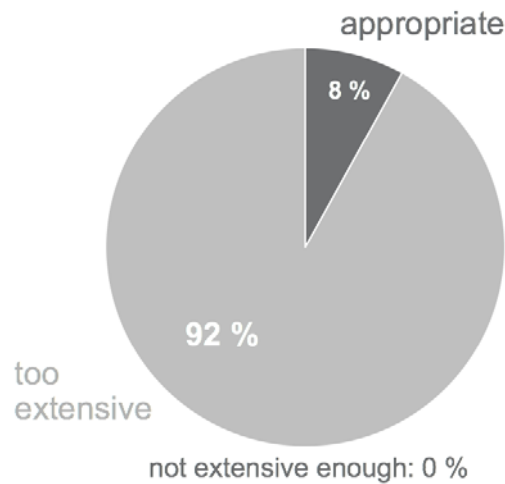


Figure 5: The current extent of regulatory requirements for FIs in Germany

The results presented in figure 5 show that 92 % of the participating officers say that the current framework of regulatory requirements is too extensive. This statement is a first indication that FIs might feel overburdened by the large number of regulatory requirements. The remaining 8 % of the participants reply that the extent of regulations is appropriate. It is noteworthy that none of the 62 participants claims that the extent of requirements is not extensive enough. The insights provided by this question are analyzed and compared to the answers of the two following questions of this thematic field. The following pie chart (figure 6) illustrates the results of question ten regarding the degree of complexity of the current regulatory framework.

Q10: How would you rate the degree of complexity of the current regulatory requirements for your institution?

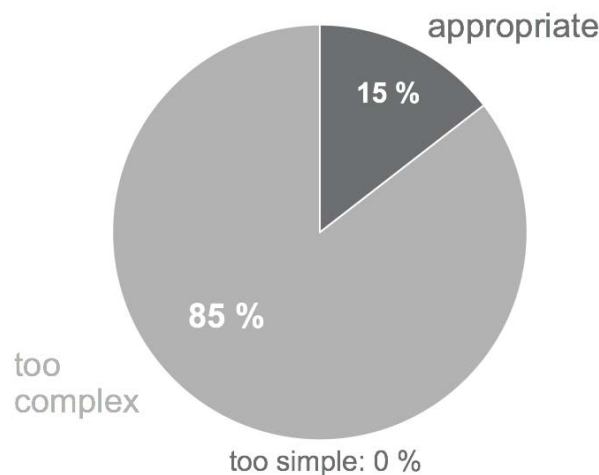


Figure 6: The degree of complexity of the current regulatory requirements

Figure 6 shows that 85 % of the participants think that the current framework of regulatory requirements for FIs in Germany is too complex. This result is a further indicator that FIs

feel overloaded by the regulations in the financial sector. The remaining 15 % say that the complexity of the current regulatory framework is appropriate. None of the participants claims that the regulations are too simple.

The following question combines the two aspects regulatory requirements and new technologies. The participants are requested to evaluate whether their institution will need to implement new technological solutions to manage the increasing amount of regulations in the next five years (figure 7).

Q11: Since the world-wide financial and economic crisis of 2008, the number of regulatory requirements for financial institutions increases steadily. Do you think that your institution will need to implement new technological solutions in order to manage the increasing number of regulatory requirements in the next five years?

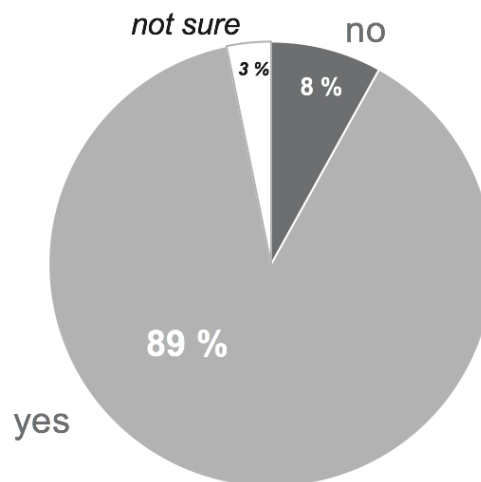


Figure 7: The need of technical solutions to manage regulatory requirements

In this survey, 89 % of the participants say that their institutions will need to implement new technological solutions to deal with the increasing amount of regulations by the end of 2022. This result is another indicator that FIs in Germany feel overburdened by the regulatory framework. Only 8 % think that their institution will not need to implement new technologies to deal with the subject matter. The remaining 3 % are not sure about this issue. The insights of these three questions are in accordance with the results of the study by McKinsey & Company (2017). 97 % of the overall participants of the McKinsey survey are convinced that digitization and new technological solutions are critical tools for an increasing regulatory burden. With regard to European respondents, 100 % regard new technologies as essential to deal with the subject matter. The minor discrepancies between the results of this survey and the McKinsey study might result from different target audiences. McKinsey focuses mainly on global systemically important banks (G-SIBs), whereas this study provides no limitation and evaluation of the size of the participating institutions. Large banks that operate globally tend to rate the importance of new technological solutions higher than small regional banks because the business activities and structures of G-SIBs are generally more complicated than those of regional banks (McKinsey & Company, 2017). Scientific literature also identifies an increasing need of new technologies to deal with the extensive regulatory framework. For instance, Agarwal et al. (2017) present a cognitive platform that combines new technologies like AI and machine learning to achieve and ensure regulatory compliance of financial regulations. Besides, Arner et al. (2016) and Weber (2017) identify an enormous potential of regulatory technology, referred to as "RegTech". Arner et al. define RegTech as the use of technology

for regulatory monitoring, reporting and compliance purposes. The authors are convinced that RegTech solutions have the potential to enable a real-time regulatory system that is capable of addressing risks while ensuring regulatory compliance. In conclusion, the analysis of the results of the three questions of this thematic field shows that the current regulatory framework for FIs in Germany is regarded as being too extensive and too complex. For this reason, a large majority of participants is convinced that their institutions will need the support of new technologies in order to deal with the subject matter in the future.

4.4. New technologies. The conclusion of the previous section (chapter 4.3) leads to the thematic field of new technologies. In this part of the survey, the participants are invited to create both a rating and a ranking of the estimated relevance of new technological solutions for the risk and regulatory compliance management of their institutions by the end of 2022. Besides, they are requested to name the main reason for investing in new technologies for FIs in Germany.

Figure 8 illustrates the responses to the first question of this thematic field. The participants rate the relevance of each new technology on a scale from "very low" to "very high". The visualization of the results is created in accordance to the methodology presented for question six and shows an average rating of each technology (see chapter 4.2). A technology with a lower average rating is regarded as more relevant than a technology with a higher average rating.

Q12: How would you rate the relevance of the following new technologies for the risk and regulatory compliance management of your institution in the next five years?

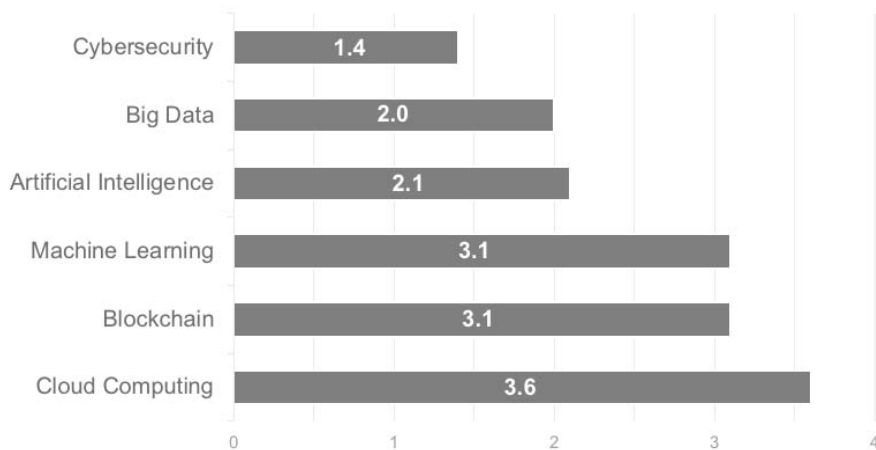


Figure 8: Rating of the estimated future relevance of selected new technologies

The selection of the six new technologies is based on the study "Regtech in Financial Services: Technology solutions for Compliance and Reporting", that was carried out by the Institute of International Finance (2016). Since the above mentioned new technologies are defined in various different ways in the literature, each technology is defined in a specific manner for the purpose of this survey. The aim of this approach is to ensure a common understanding of the technologies.

With respect to responses towards this question (figure 8) it shows that Cybersecurity is rated as the most relevant new technology aspect for the future risk and regulatory compliance management of FIs in Germany with an average rating of 1.4. Big Data is on the second position with a rating of 2.0 and Artificial Intelligence technologies are a little bit behind with an average rating of 2.1. The remaining three technologies Machine Learning (3.1), Blockchain (3.1) and Cloud Computing (3.6) are considered significantly less relevant than the first three technologies. In the following section, the results of question twelve are compared to the results of question

13. The differences between these two questions are similar to the evaluated questions six and seven (see chapter 4.2).

Therefore, figure 9 visualizes the ranking of the relevance of investigated new technologies on a scale from one to six. As in the previous section, "one" represents the most relevant new technology and "six" represents the least relevant new technology. The evaluation shows the average ranking of each technology in ascending order.

Q13: Please create a ranking of the estimated relevance of the above mentioned new technologies for the risk and regulatory compliance management of your institution in the next five years on a scale from one to six.

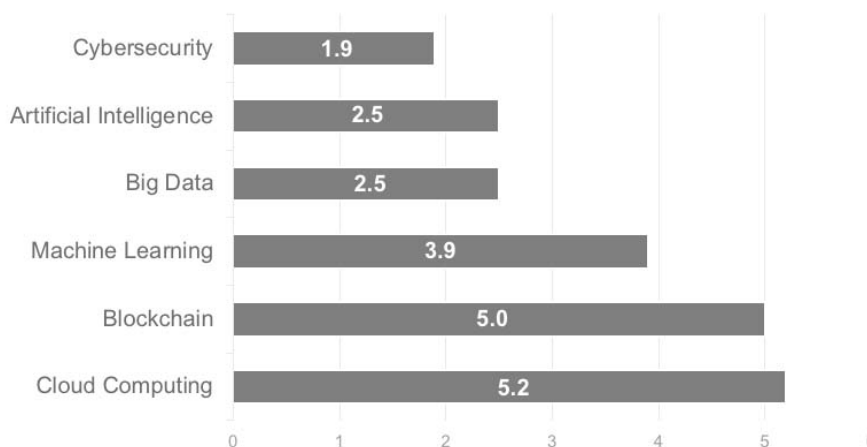


Figure 9: Ranking of the estimated future relevance of selected new technologies

In figure 9, the ascending order of technologies slightly differs from the one in question twelve. In this case, Artificial Intelligence technologies are ranked slightly better than Big Data. The order of remaining technologies did not change. The gap between individual technologies also differs from the results of question twelve. Both questions show that Cybersecurity is ranked the most relevant technology for risk and regulatory compliance management of FIs in Germany with an average ranking of 1.9. One possible reason for this result is that issues concerning Cybersecurity represent not only cost-intensive aspects, but also a high risk for the reputation of an institution (Lemieux, 2012, p. 47 f.). Johnson (2016) pointed out as well that risk management concerns regarding Cybersecurity for FIs are arising. Johnson analyzed that issues regarding Cybersecurity of systemically important FIs could result in a shock or debilitation of the financial sector and even for the global economy. Therefore, Cybersecurity technologies are essential to prevent such a negative scenario from occurring. These insights are comparable to the results presented in the study by Ernst & Young and the Institute of International Finance (2017). According to the Ernst & Young study, 77 % of the participating Risk Managers voted Cybersecurity as the top priority for the current risk management of their institutions. The following two technologies Artificial Intelligence and Big Data are ranked almost equally important with an average rank of 2.5. With respect to the evaluation of the survey by Ernst & Young, 45 % of the participants estimate that Artificial Intelligence will have a significant impact on risk functions of FIs in the following three years. These two statements are indicators for the future business demand for AI solutions regarding risk and regulatory compliance purposes. In a broader context, Stone et al. (2016) estimate that AI technologies in combination with Cybersecurity will represent a significant factor to ensure the overall public and corporate security by the year 2030. The fourth position is held by Machine Learning (3.9). The remaining two technologies Blockchain (5.0) and Cloud Computing (5.2)

are estimated to be less relevant than other technologies in the future. The poor ranking of Cloud Computing is in accordance to the positive ranking of Cybersecurity. Data that is stored in a cloud environment that is hosted by an external party appears to be more likely to be concerned by Cyber threats than data that is stored at the personal servers of an institution. According to the McKinsey & Company study (2017), 83 % of the European respondents say that a possible shift from local to cloud technologies is hindered by security concerns. Besides, 50 % of the surveyed people also regard heavy regulations of the banking sector as a reason for preferring local systems rather than cloud-based solutions (Mc Kinsey & Company, 2017). Aich et al. (2015) and Kulkarni et al. (2012) provide an overview of security concerns regarding cloud computing technologies.

Question 14 deals with the main reason for investing in new technologies for FIs in Germany. This question is not limited to the risk and regulatory compliance management of the institutions. Therefore, other aspects that may be relevant for risk managers and compliance officers can be taken into consideration.

Q14: In your opinion, what is currently the main reason for investing in new technologies for financial institutions in Germany?

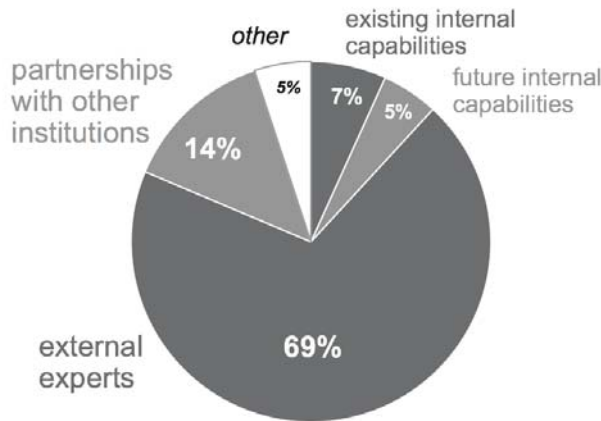


Figure 10: The main reasons for investing in new technologies

The response options of this question are based on the study on AI at the financial services industry that was carried out by Deloitte in cooperation with Efma (2017). The pie chart in figure 10 shows that risk reduction is the main reason for investing in new technologies with a proportion of 29 %. An explanation for this result is that the participants of this survey are exclusively risk managers and compliance officers. For them, the reduction of risk is likely to be regarded as a priority. 24 % of the participants regard long term cost savings as the main reason for investing. Compliance with regulatory requirements is for 23 % of the surveyed the major reason. Furthermore, 18 % say that competitive advantage has the highest relevance. The remaining 6 % provide different answers by using the additional text box for this question. In detail, the following additional answers are given:

- creation of new products
- usage of online distribution channels
- strategic digitalization
- changing customer behaviour

All four additional answers have been submitted by one participant. Regarding the scientific literature, Gabor and Brooks (2016) provided an examination of the digitalization in the financial industry and in particular the international development of financial technologies, referred to as "FinTech", with regard to financial inclusion.

4.5. Artificial Intelligence. The last set of questions deals with Artificial Intelligence technologies in particular. The aim of this approach is to evaluate to what extent the risk and regulatory compliance management departments are already engaged in this field of action. Furthermore, the participants are requested to estimate when AI technologies will be in operation in the future. The last question of this survey aims to evaluate how these institutions will mainly develop AI solutions in the next years. This set of questions and the corresponding response options have been developed in accordance with the survey "AI and you: Perceptions of Artificial Intelligence from the EMEA financial services industry" that was carried out by Deloitte in cooperation with Efma (2017). However, it must be considered that the target audience of the Deloitte study were business and technical executives at FIs in the EMEA region, whereas this study focuses on risk managers and compliance officers in Germany.

At first, the participants are requested to evaluate when the risk and compliance management departments have officially started to deal with AI technologies. In this context, it must be considered that the specification refers to the time the survey was carried out in December 2017. The bar chart in figure 11 illustrates the corresponding results to this question.

Q15: When did the risk and regulatory compliance management department(s) of your institution officially start to deal with the field of Artificial Intelligence?

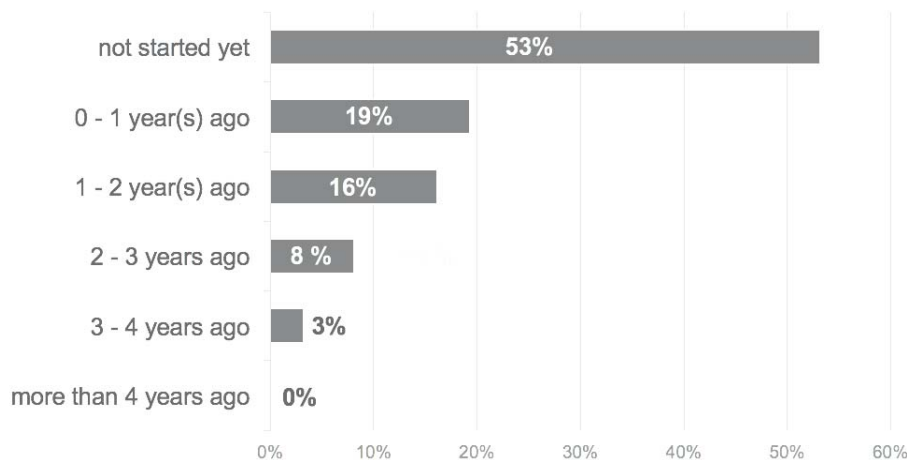


Figure 11: Starting point for Artificial Intelligence technologies

The evaluation in figure 11 points out that more than every second risk and compliance management department of the surveyed FIs in Germany has not started to deal with AI technologies yet (53 %). Another 19 % respond that they have started to engage in this field of action in the last twelve months. Furthermore, 16 % of the participants answer that they have started one to two years ago. 8 % of the surveyed say that their risk and compliance management departments have already started two to three years ago and the remaining 3 % answer that they have started three to four years ago. None of the surveyed persons says that they have started to deal with this topic more than four years ago. The evaluation of this question shows that AI is a comparatively young research field that has not been on the agenda of several risk and compliance management departments of FIs in Germany yet. There are significant deviations between the results of this survey and the study that has been performed

by Deloitte and Efma (2017). According to the Deloitte study, only 11 % of the interviewed executives of FIs have not started to deal with AI technologies yet, compared to 53 % of the participants of this study. This discrepancy can be explained by the different target groups of the surveys. As discussed, the Deloitte study interviewed business and technical executives of FIs in the EMEA region, whereas this study is restricted to risk managers and compliance officers in Germany. In several areas of banking activities, AI technologies are already developed much further than in the fields of risk and compliance management. Therefore, executives of other departments might evaluate the situation differently. Moro et al. (2015) analyzed the literature on business intelligence (BI) in banking from 2002 to 2013 by using text mining approaches in order to identify the main fields of interest of BI technologies in the financial industry. In 1989, BI has been defined as an umbrella term for a variety of concepts and methods for the improvement of business decision making through the use of fact-based computerized systems by Howard Dresner (Nylund, 1999). Therefore, BI is regarded as related to AI. The results of the research of Moro et al. show that credit business was on top of the BI agenda for the banking industry between 2002 and 2013. Moreover, Moro et al. also discovered that risk management tasks like prediction of bankruptcy and fraud prevention were also highly relevant topics for BI applications. These insights confirm the relevance of new technological solutions like BI and AI for the risk management activities of FIs. In the following question, the participants are invited to estimate when AI technologies will be implemented and used for an improvement of the risk and regulatory compliance management processes of their institutions. It must be considered that the time specification references to the time the survey was carried out at the end of the year 2017. The results are illustrated in figure 12.

Q16: When do you think Artificial Intelligence solutions will be implemented and used to improve the risk and regulatory compliance management processes of your institution?

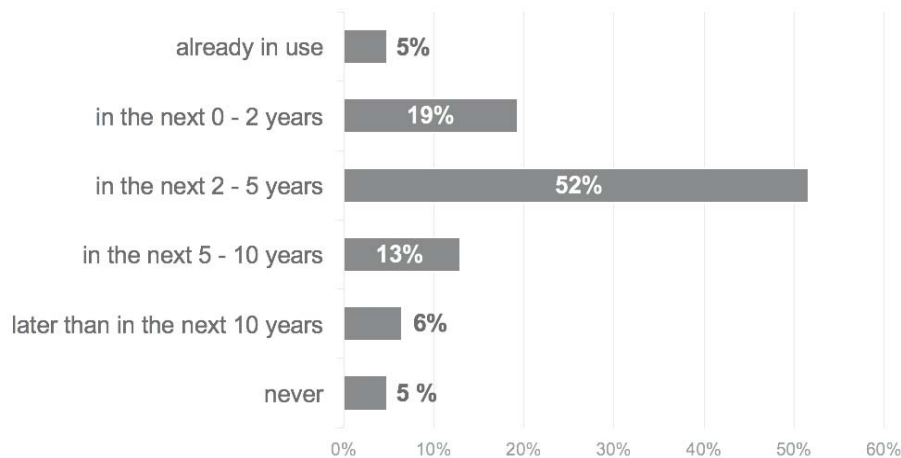


Figure 12: Implementation of Artificial Intelligence technologies

The results presented in figure 12 show that a majority of participants expect AI technologies to be implemented and used in the risk and regulatory compliance management departments in the following two to five years (52 %). Another 19 % are confident that AI solutions will already be in use in the next two years. Thus, a total of 71 % of the participants expect AI solutions to be in use by the end of 2022. Moreover, 5 % of the surveyed say that AI technologies are already in use at their FIs. Furthermore, 13 % expect that it will take five to ten years to implement and use these technologies. 6 % of the surveyed even estimate that it will take more than ten years. The remaining 5 % expect that AI technologies will never be in use in the risk and regulatory compliance management departments of FIs in Germany. These results are in

accordance with the corresponding results of the study by Deloitte and Efma (2017). In the Deloitte study, 42 % of the responding executives of financial firms believe that AI technologies will be mainstream in the following two to five years. Moreover, according to the results of the Deloitte study, 88 % of the respondents estimate that AI technologies will be used by the end of 2022, whereas only 3 % believe that AI technologies will never be in use. Hawley et al. (1990) already predicted initial potential AI applications for FIs in the year 1990. However, in terms of risk and compliance management, European banks and other FIs struggle with the restrictive regulations regarding IT systems by the Basel Committee on Banking Supervision (2013). Therefore, many institutions still hesitate with the implementation of AI technologies. However, due to an increasing business need for AI solutions, many risk managers or compliance officers expect AI applications to be in use by the end of 2022.

The last question aims to evaluate how the surveyed institutions will develop AI solutions in the future. Please note that the participants who answered that AI solutions will never be in use at their institutions (question 16) are excluded from the evaluation of this question. The pie chart in figure 13 illustrates the submitted responses.

Q17: In your opinion, how will your institution mainly develop Artificial Intelligence solutions for the risk and regulatory compliance management in the future?

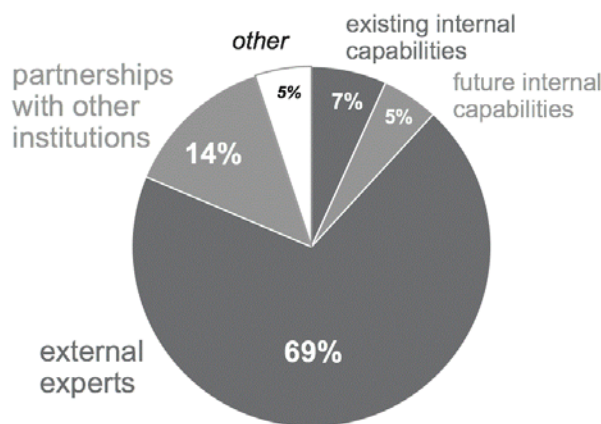


Figure 13: Development of AI solutions

The results presented in figure 13 point out that more than two thirds (69 %) of the surveyed officers estimate that their institutions will mainly use the expertise of external resources to develop AI solutions in the future. 14 % say that their institutions will form partnerships with other institutions to reach this goal. A total of 12 % are convinced that their institutions will mainly develop technological AI solutions with existing (7 %) or future (5 %) internal capabilities. The remaining 5 % use the text box to submit an additional answer to the question. They provide the following answers:

- within the financial group
- existing network of institutions
- within the group of German public savings banks

In a broader context, these three additional responses can be allocated to the response option "partnerships with other institutions". Thus, the proportion of this answer would increase to a total of 19 %. In comparison to the AI survey by Deloitte, the results are similar. According to the Deloitte study, almost half (49 %) of the participants estimate that their institutions will mainly develop AI solutions through external capabilities of consultants and technical AI experts. Besides, 26 % of the respondents of the Deloitte survey believe that they will

partner with other FIs and 15 % say that the implementation will mainly be based on internal capabilities (Deloitte, 2017).

5. CONCLUSION

The ultimate goal of this survey is to provide expert assessments on the future of risk and regulatory compliance management at FIs in Germany. On one side, this survey aims to evaluate handling of the increasing number of regulatory requirements and perspectives on new technological solutions like AI systems on the other side. The participating risk managers and compliance officers estimate that Cybersecurity, Artificial Intelligence and Big Data are the most relevant technological fields by the end of 2022 for the risk and compliance management departments of FIs. These insights are in accordance with the evaluated scientific literature and four selected existing surveys on the subject matter (see chapter 4). At the time the survey was carried out, there have already been various technological solutions dealing with Cybersecurity and Big Data on the market. However, AI technologies have been at an early stage of development at the end of 2017. Accordingly, more than half (53 %) of the respondents say that the risk and regulatory compliance management departments of their institutions have not started to deal with the field of AI yet. The discrepancy between a recognizable need for AI solutions and a lack of engagement in this field of action shows that FIs in Germany have a considerable backlog regarding this thematic field. According to the estimation of 71 % of the survey participants, AI solutions will be implemented and used to improve the risk and regulatory compliance management of their FIs by the end of 2022. These statements are confirmed by a literature analysis and are therefore an indicator for the utmost potential of AI technologies in the risk and compliance management environment. With regard to the practical implementation of AI technologies, 69 % of the respondents expect a need for external resources to develop specific solutions. These statements emphasize the business opportunities for technological companies that feature AI solutions and for consulting firms that specialize in this field of action.

In conclusion, the insights of this survey in combination with the existing scientific literature and the results of four comparable studies emphasize that there is a significant business need for new technological solutions in order to cope with the increasing extent and complexity of regulatory requirements for FIs in Germany. In particular, technologies that cover the topics Cybersecurity, Artificial Intelligence and Big Data are regarded as core issues in terms of risk and regulatory compliance management by the end of 2022. Thus, the last major step for FIs to improve their risk and regulatory compliance management activities and processes has been to digitize them and the next major step will be to make them secure and cognitive using AI technologies.

Expository footnotes

¹ Efma is a global non-profit organization that was established by banks and insurance companies in 1971. The institution aims to facilitate networking between decision-makers. Therefore, it provides insights in order to help FIs to make the right decisions to process innovation and drive transformation (Deloitte, 2017).

² The Institute of International Finance is an international association of financial institutions. It has about 500 members from 70 different countries, which include for instance investment banks, asset managers, insurance companies and central banks. One major objective of this institute is to advocate and support the financial industry in the management of risks and regulatory requirements in order to encourage the stability of the financial sector (Institute of International Finance, 2017).

³ The Bankenfachverband e.V. represents the interests of credit banks in Germany (Bankenfachverband e.V., 2017).

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