Information security frameworks for assisting GDPR compliance in banking industry

João Serrado, Ruben Filipe Pereira, Miguel Mira da Silva and Isaías Scalabrin Bianchi

Abstract

Purpose – *Data can nowadays be seen as the main asset of organizations and data leaks have a considerable impact on the organization's image, revenues and possible consequences to the affected clients. One of the most critical industries is the bank. Information security frameworks (ISF) have been created to assist organizations and other frameworks evolved to update these domain practices. Recently, the European Union decided to create the general data protection regulation (GDPR), applicable to all organizations dealing with personal data of citizens residing in the European Union. Although considered a general regulation, GDPR implementation needs to align with some industries' laws and policies. Especially in the Bank industry. How these ISF can assist the implementation of GDPR is not clear.*

Design/methodology/approach – *The design science research process was followed and semi-structured interviews performed.*

Findings – *A list of practices to assist the bank industry in GDPR implementation is provided. How each practice map with assessed ISF and GDPR requirements is also presented.*

Research limitations/implications – *As GDPR is a relatively recent subject, it is hard to find experts in the area. It is more difficult if the authors intend to find experienced people in the GDPR and bank industry. That is one of the main reasons this study does not include more interviews.*

Originality/value – *This research provides a novel artefact to the body of knowledge. The proposed artefact lists which ISF practices banks should implement to comply with GDPR. By doing it the artefact provides a centralized view about which ISF frameworks (or part of them) could be implemented to help banks comply with GDPR.*

Keywords *Information security, Frameworks, GDPR, General data protection regulation, Data protection*

Paper type *Research paper*

João Serrado and Ruben Filipe Pereira are both based at Instituto Universitário de Lisboa (ISCTE-IUL), Lisbon, Portugal.
Miguel Mira da Silva is based at Higher Technical Institute, University of Lisbon, Lisboa, Portugal.
Isaías Scalabrin Bianchi is based at the Federal University of Santa Catarina, Florianopolis, Brazil.

1. Introduction

The rapid development of computers in the past 20 years, with the reduced prices for data storage, allows the processing of large amounts of personal data (PD) (Martin *et al.*, 2019; Radvanovsky and Brodsky, 2013). Plus, with the large volume of PD collected, companies are facing serious vulnerabilities, like the misuse, that could result in privacy breaches (Agarwal, 2016).

The roles between governments, data subject (DS) rights and data protection authorities (DPA) are different across the countries, due to significant levels of enforcement and legal competencies (Custers *et al.*, 2018). Therefore, The European Union (EU) published their own directive for data protection (DP), since the adoption in 1995, the Data Protection Directive 95/46/EC (Council, 1995) has been the central legislative for PD privacy instrument in the EU (Tikkinen-Piri *et al.*, 2018). Considering this is not a regulation, all

Received 3 February 2020
Revised 15 April 2020
Accepted 28 May 2020

member states must translate it into local laws, which makes a non-uniformization of the laws across the EU.

As its inception, DP has, in turn, been driven by the development of information technology (IT) (Phillips, 2018) and in the past years with the increased use of IT by the citizens, in particular the residents in EU, the Data Protection Directive 95/46/EC no longer meet the privacy requirements of the present-day digital environment. To solve this problem the European Commission (EC) has been developing, since 2009, the general data protection regulation (GDPR), that has published a proposal for the DP reform in 2012 (Tikkinen-Piri *et al.*, 2018).

In May 2018, the GDPR came into effect to replace the Data Protection Directive 95/46/EC, to meet current challenges related to personal DP and to harmonize DP across the EU (Tikkinen-Piri *et al.*, 2018).

One major difference from the old directive is, that GDPR is a regulation and not a directive. This means that it will apply directly in all member states without them translating it into local laws. One of the main objectives of GDPR is to lead to the consistency of DP in the EU and this justifies the transition from a directive to regulation (Malatras *et al.*, 2017; Randolph, 2020).

The regulation challenges the way that companies process data, where our data is a product companies trade and sell (Krempel and Beyerer, 2018). Therefore, as every industry has their own specifications (for instance, financial services or healthcare) and, as GDPR is not regulated by a specific sector, it requires significant time effort to understand the specific requirements of each industry (Díaz Díaz *et al.*, 2020; Lopes *et al.*, 2020; Martin *et al.*, 2019).

The creation of a digital single market in the EU has motivated that the digital economy in the EU has become increasingly reliant on the control and processing of PD. This progression creates enormous opportunities for business, but in another way leaves open serious issues such as the implementation of new technologies and the increasing public awareness and concern for the importance of personal DP (Lucic *et al.*, 2018) and generate serious privacy, trust and security risks (Almeida Teixeira *et al.*, 2019). To answer these challenges nowadays exists in the market a set of information security frameworks (ISF) to improve the organization's security (Srinivas *et al.*, 2019).

The lack of trust can reduce the development, use and adoption of new technologies (Radvanovsky and Brodsky, 2013) and many new business opportunities may be missed if appropriate DP practices are not implemented (Ayala-Rivera and Pasquale, 2018). So the GDPR came to bring and benefit companies by offering DP practices across the EU member states and others that deal with PD of EU citizens and by enabling more integrated EU DP policies (Tikkinen-Piri *et al.*, 2018), moreover the adoption of the requirements in addition to ensuring compliance with the GDPR also brings competitive advantage to the companies.

The GDPR aims to meet the current challenges related to PD, consolidate online privacy rights and improve Europe's digital economy and provide individuals with better capabilities for controlling and managing their PD (Mantelero, 2013; Randolph, 2020), hence striving to reinforce the DS trust in PD collecting companies. Within the new DP framework, individual service users may also benefit from the free movement of data if it results in growing businesses with improved and personalized services (Ayala-Rivera and Pasquale, 2018).

The banking industry is one of the most regulated industries in the world, mainly because the giant reserves of rich data and its large scope for ambitious hackers, the DS expect their PD to be secure and protected by the most robust processes and technologies. It means that information security (IS) must be a priority throughout this industry to ensure that

all transactional processes are efficient, reliable, secure and compliant (Sydekum and Networks, 2018).

Based on this information and as organizations need to rearrange their own processes and technologies to be compliant with GDPR, especially a set of critical sectors, this research focuses on the banking industry. Therefore, this research aims to investigate how can current ISF help banks comply with GDPR.

2. General data protection regulation

The GDPR was designed to harmonize DP laws across Europe to give greater protection and capabilities to individuals for controlling their PD in the face of new technological developments. Plus, GDPR applies to all the organizations that handle PD about EU residents, regardless of their physical locations (Ayala-Rivera and Pasquale, 2018; Cardoso-Cachopo and Oliveira, 2003).

GDPR comes with two new elements never seen before in DP. First, DP is mandatory and fines are huge. Infringements are fined up to €20mn or up to 4% of the total worldwide annual turnover of the preceding financial year, whichever is higher. The second part is called the territorial scope. The regulation does not only apply to EU companies but also to every company selling into the EU or marketing to EU citizens (Krempel and Beyerer, 2018), this means that applies to companies outside the EU, not just because they have a website accessible to a citizen in the EU, but because compliance is required when offering of goods or services to DS.

This regulation has four major focus points, namely, accountability, transparency, protection and reliability. GDPR brings an onus to collect PD for a specific purpose only, to uphold the trust of the person who gives their PD, to maintain and protect the information and to erase it when no longer required. PD and the special category personal data should be protected and the EU is safeguarding the economic value of digitally kept information of citizens through GDPR. In the wrong hands, an amalgamation of multiple data points from the same individual potentially leads to identity fraud (Philip, 2019).

Moreover, although some of the GDPR obligations were already specified in the Data Protection Directive 95/46/EC, these have mainly been perceived as "recommendations." Therefore, most organizations have only started recently to implement measures to comply with the GDPR (Ayala-Rivera and Pasquale, 2018).

So, the major challenge related to a solid implementation of the GDPR is the organizations lack awareness and understanding of the forthcoming changes and requirements that the GDPR enforces through its new rules. These requirements have various practical implications for the organizational design of systems, practices and processes, as well as personnel training (awareness) and assignment of new responsibilities in the organizations (accountability). In short, it brings out the need to review the current DPR practices, technological DP measures and IS measures, as well as possibly plan new ones to ensure compliance with the GDPR (Ayala-Rivera and Pasquale, 2018). Additionally, frequency in communication between IS and privacy teams is considered crucial for effective overall enterprise cybersecurity (Heimes, 2016).

3. Related work

This section aims to explore what the scientific community has been studying regarding the application of ISF in the GDPR domain or GDPR implementation. Table 1 presents seven relevant documents that were found relating these research topics. From this universe, only two explore the implications during the implementation of GDPR and four explore the use of ISF.

Table 1 Related work

ID	Author	Title	ISF?	Industry
RS.1	Tankard and Pathways (2016)	What the GDPR means for businesses	ISO27001	Generic
RS.2	Almeida Teixeira *et al.* (2019)	The critical success factors of GDPR implementation: a systematic literature review	ISO27001	Generic
RS.3	Freitas and Mira da Silva (2018)	GDPR compliance in SMEs: There is much to be done	–	Industrial SME
RS.4	Krystlik (2018)	With GDPR, preparation is everything	–	Generic
RS.5	Wilson (2018)	A framework for security technology cohesion in the era of the GDPR	–	Generic
RS.6	Lopes *et al.* (2019)	How ISO 27001 can help achieve GDPR compliance	ISO27001	Generic
RS.7	Centro Nacional de Cibersegurança (2019)	Quadro Nacional De Referência para a Cibersegurança	ISO27001&COBIT	Generic

Overall, the related articles mention the difficulties of implementing GDPR and the lack of awareness among companies. This happens because GDPR is a recent subject and concrete measures are not mentioned, appealing for implementing the requirements according to the level of risk that they have, for all the industries managing PD.

Plus, four studies argue that ISF (ISO 27001 or COBIT) may help organizations achieving the level of compliance desired by GDPR, as the ISF is not new and offers more concrete guidelines for implementing IS measures, reducing the risk of data breaches. However, none of these studies provide insights on how these ISF can do it.

As one can see in Table 1, there is no related work investigating how can ISF help in GDPR compliance. Moreover, the few existent research studies focus on the preparation without using ISF and are generic to all industries.

To sum up, there are studies pointing to ISF as useful to help companies comply with GDPR, but no studies provide practical insights on how that can be done. Neither to the banking industry.

As one of the most regulated industries, the banking industry faces several legal aspects to manage and protect their client's data (Betron, 2012; Irwin, 2018). With the appearance of GDPR banks have now more compliance challenges to hold when using client's data and legal aspects to deal with in most phases of the personal data handling process (Gruschka *et al.*, 2019). The authors expect to collect some qualitative information about legal aspects/implications of GDPR adoption in the banking industry along with the research, but it is not the focus of the investigation. Instead, this research is broader in its nature and insights from several aspects are expected.

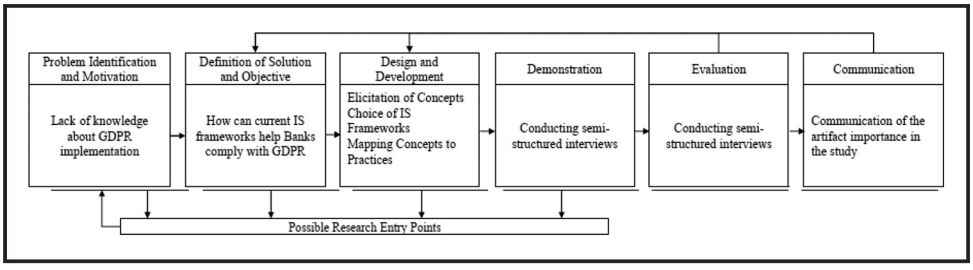
Therefore, this research intends to contribute with novel insights on how ISF can assist banks in GDPR adoption and compliance.

4. Research methodology

This research applies the design science research (DSR) to design, build and evaluate how can current ISF helps banks comply with GDPR. As this research purposes to expand the limits of human capacities and organizations, to create the artefacts invoking the DSR Methodology is the right choice (Hevner *et al.*, 2004; Peffers *et al.*, 2007). Figure 1 presents the DSR process applied in this research.

The first two activities of this process have already been mentioned, in the respective chapters. In the design and development activity, is where all the design of the proposed artefact is performed. The demonstration and evaluation phase are where the

Figure 1 DRS process model

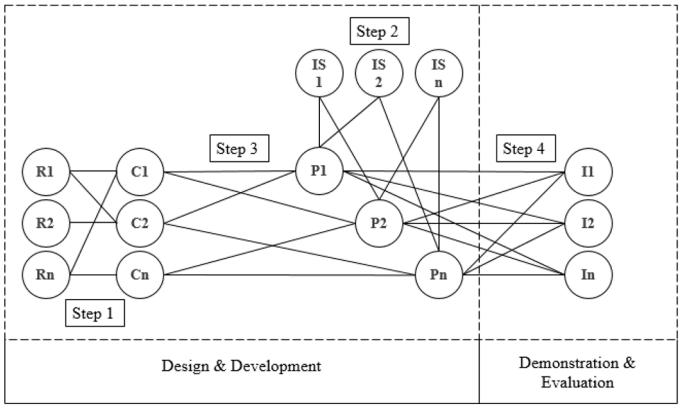


authors prove that the artefact can be used in practice and where its validity is assured. By conducting semi-structured interviews, a validation of the work developed is done, as well as the demonstration that it can be applied in the banking industry, by collecting the practices proposed in the research and already used by the interviewees. The interviewees are experienced professionals in the areas of DP or IS and all of them work in the banking industry. Finally, in the communication, the authors submit the main findings to respectful journals of the area.

5. Design

This research aims to investigate how can ISF assist GDPR compliance in the banking industry. To pursue our goal and design the artefact, the authors have performed a set of steps. Figure 2 synthesizes the Design of the proposed artefact. Four steps were performed sequentially. The final step was used to demonstrate and evaluate the proposed artefact.

Figure 2 Diagram of the design – requirement



Notes: R – Requirement (Requirements from the GDPR, i.e., the articles);C Concept (Concepts extracted from the requirements);
IS – Information Security Frameworks (ISF that exists in the market);
P – Practices (Practices or controls from the ISF); I – Interview

5.1 Step 1 – elicitation of the list of concepts

The first part of the design consisted of reading all the GDPR regulation (11 chapters and 99 articles) and from each of them extracting concepts that are related to the security of data, DP and rights of DS. It must be noted that articles related to DPA obligations such as, for example, investigations carried out to data breaches and penalties that could be applied to organizations, were not considered.

5.2 Step 2 – choice of is frameworks

Several ISF exists, that despite not mandatory some could be certified to attest the compliance of the organizations with IS requirements. These frameworks offer a solid base to start implementing IS in the organizations, offering structures and practices not present in GDPR.

5.3 Step 3 – mapping concepts with framework practices

After complete Steps 1 and 2, it was time to map the concepts with each ISF. For each elicited concept, one or more practices from the frameworks were selected when met the requirement of the concept. For each concept, that GDPR does not give any specific instruction on how to implement it, the authors sought for practices in ISF that could provide more precise instructions to achieve the appropriate level of compliance.

5.4 Step 4 – Conducting semi-structured interviews

This step aimed to demonstrate and evaluate the applicability of the artefact with experts in the area, i.e. that have experience in the banking industry and in GDPR. Therefore, the qualitative method interview was chosen to elicit qualitative information on the subject.

The goal of interviews is to collect data that cannot be obtained using quantitative methods, interviewing people that give insight into the subject studied and their opinion (Hove and Anda, 2005).

Several types of interviews exist such as structured interviews, semi-structured interviews and non-structured interviews (Seaman, 1999). This research used individual semi-structured interviews to obtain more information and validate the practices that are applied in the banking industry, the questions are open-ended, asking other information when necessary.

6. Development

The design of the artefact is described in the previous section. This section details each of the steps presented so the reader can better understand what and how the steps were performed.

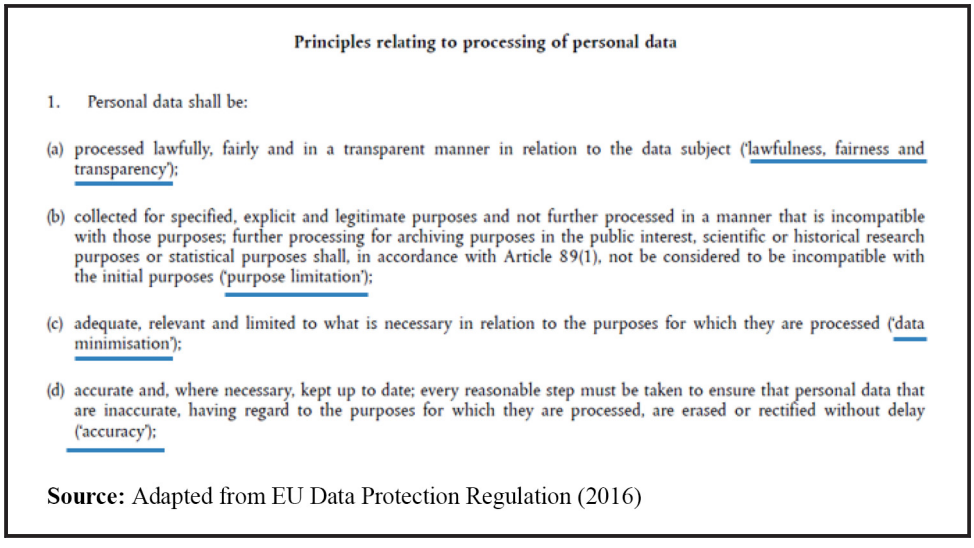
6.1 Step 1 – elicitation of the list of concepts

The first part of the artefact consists of extracting from the GDPR articles/requirements all the concepts that are related to the security of data, DP and rights of DS. For instance, in Figure 3 one can see the following concepts: lawfulness, fairness and transparency, purpose limitation, etc.

It should be noted that both the same concept can be elicited from more than one article and one article could have more than one concept.

At the end of this step, 37 concepts were extracted from the 11 chapters (Table 2) and 99 articles that compose the GDPR. Some chapters were not considered, as are not related to DPA obligations (for example, independent supervisory authorities or penalties that could

Figure 3 Example of elicited concepts from Article 5



Principles relating to processing of personal data

1. Personal data shall be:

(a) processed lawfully, fairly and in a transparent manner in relation to the data subject ('lawfulness, fairness and transparency');

(b) collected for specified, explicit and legitimate purposes and not further processed in a manner that is incompatible with those purposes; further processing for archiving purposes in the public interest, scientific or historical research purposes or statistical purposes shall, in accordance with Article 89(1), not be considered to be incompatible with the initial purposes ('purpose limitation');

(c) adequate, relevant and limited to what is necessary in relation to the purposes for which they are processed ('data minimisation');

(d) accurate and, where necessary, kept up to date; every reasonable step must be taken to ensure that personal data that are inaccurate, having regard to the purposes for which they are processed, are erased or rectified without delay ('accuracy');

Source: Adapted from EU Data Protection Regulation (2016)

Table 2 Chapters of GDPR

Chapters with concepts	Principles
	Rights of the data subject
	Controller and processor
	Transfers of personal data to third countries or international organizations
Chapters without concepts	General provisions
	Independent supervisory authorities
	Cooperation and consistency
	Remedies, liability and penalties
	Provisions relating to specific processing situations
	Delegated acts and implementing acts
	Final provisions

be applied to the organizations and other subjects), and therefore are not directly related to the mandatory requirements of the organizations. Example of extracted concepts from GDPR exemplifies a set of concepts collected from Article 5 (Figure 2):

Example of extracted concepts from GDPR

Concepts

- Lawfulness, fairness and transparency;
- Data minimization;
- Inaccurate data; and
- Storage limitation.

6.2 Step 2 – selected is frameworks

From the list of ISF existent in the market, the following four frameworks were chosen to ground the remaining steps of the research: ISO/IEC 27001:2013 (ISO/IEC, 2013), ISO 27552 (ISO/IEC DIS 27552, 2019), NIST SP 800–53 rev.4 (NIST, 2013) and COBIT, 2019 framework (COBIT, 2019).

ISO/IEC 27001:2013 appears to be the most used in Europe by professionals and NIST SP 800–53 in the US. COBIT is a reference in IT governance and was recently updated (2019). For last, ISO 27552 is a new framework, that is an extension of the ISO/IEC 27001:2013 and addresses the DPR and in especially the GDPR requirements.

Along with this document the practices are the controls from ISO 27001, NIST SP 800–53 and ISO 27552 or the activities from COBIT.

6.3 Step 3 – mapping concepts with framework practices

In this step, individually, for each of the identified concepts, was performed a research of the practices presented in every ISF, to check if the practice can fulfill the level of compliance. The goal is from each of the concepts, that does not give any specific instruction to implement them, find practices that give more precise instructions and can be applied to the banking industry to achieve the level of compliance. In case the practice fulfills the requirement of the concept, then it would add to the list.

Some practices were used more than one time because they can be used to comply with more than one concept and as we will see in the next section, some may not be the indicated for the concept or may not be applied in the banking industry.

Not all the concepts could be mapped with at least one practice from each framework, as there are some subjects that the frameworks do not cover at 100% such as for example, the concept "lawfulness, fairness and transparency," in Table 3, that is not covered by the ISO/IEC 27001:2013.

7. Demonstration and evaluation

After the development of the artefact, the authors searched for experts in the banking industry and GDPR available to be interviewed. To choose the experts, first, the authors looked to their personal contact list and then in the LinkedIn professional network. Overall, 17 experts and 11 banks were invited to participate in the study. In the end, a total of seven experts from six banks accepted to be interviewed. The interviews were conducted in person on the headquarters of six Portuguese banks, with a total of seven interviewees, from different departments, responsibilities and years of experience. All the selected interviewees have both pieces of knowledge in GDPR, DP and IS.

The requirements to participate in the study were:

- The expert should have participated in at least one GDPR project.
- The expert has professional experience in IS and/or DP.

The goal of the interviews is to demonstrate and evaluate the developed artefact. To conduct the interviews, a questionnaire was developed with the following structure. First, the header of the questionnaire is composed of generic questions (Figure 4), to certify the experience of the interviewee in the banking industry and GDPR. Then, a set of questions about the interviewee's organization was presented.

Table 3 Example of a concept with the practices

Article	*Paragraph/Line*	*Concept*	*ISO 27552*	*ISO 27001:2013*	*COBIT, 2019*	*NIST SP 800–53 v4*
5	1-A	Lawfulness, fairness and transparency	7.2.2-Identify lawful basis 8.2.2-Organization's purposes	–	EDM05.02-Direct stakeholder engagement, communication and reporting	AP-2-Purpose specification

Figure 4 Interviewee specific questions

Interviewee	
Years of experience	
Current Job Role	
Years of experience in banking industry	
What are your responsabilities?	
Months of experience in GDPR	
How many GDPR projects have you been envolved	
Classify how much are you familiar with GDPR?	☐Excellent ☐Very Good ☐Good ☐Fair ☐Poor
Point out which of the following frameworks that you have experience	☐ISO 27001 ☐ISO 31000 ☐ISO 38500 ☐ISO 22301 ☐NIST SP 800-53 ☐COBIT ☐Other: _____

For each practice mapped to a concept, one question was formulated, to understand if the practice fulfills de concept, always in the banking industry. In each of these questions, the interviewee could choose one of the following: not applicable (N/A), partially compliant (PC), fully compliant (FC).

Then, the interviewees were asked if each of the elicited practices was being implemented at their organization (bank), with the following options: In Implementation (II), Implemented (I).

Plus, the analyzed frameworks were not revealed to the interviewees until the end of the interview to avoid bias answers.

Figure 5 lists an example of the first concept and mapped practices with the possible questions to be answered by the interviewees. In addition to these questions and when possible, additional information (qualitative) was gathered about the concepts and practices in the banking industry, as well as feedback about the implementation of the practices.

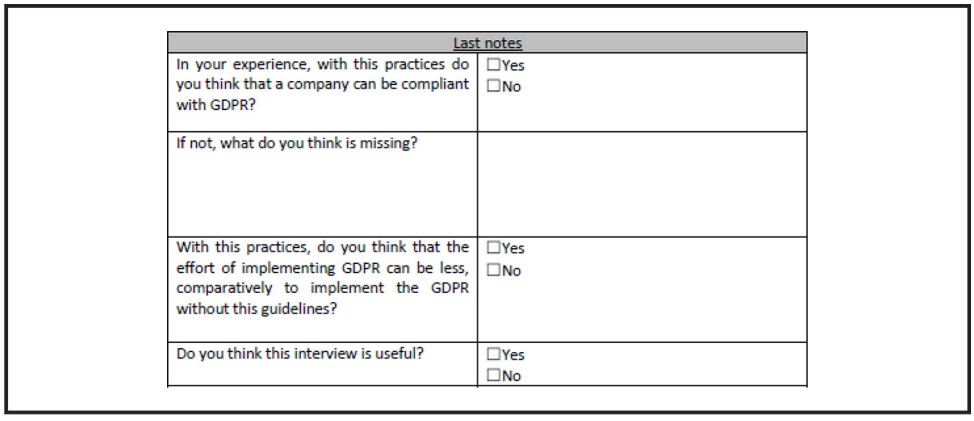
At the end of the interview (Figure 6), each interviewee was asked: if the listed concepts and practices were enough to a bank to comply with GDPR; if the implementation effort would be smaller; and if the interview was useful to increase their knowledge.

In Table 4, it is possible to see an overview of interviewees, as well as their knowledge in GDPR and frameworks. Regarding the evaluation made by the interviewees about their

Figure 5 Concepts and practices question

Concepts and Practices	Level of Compliance				
Lawfulness, fairness and transparency	N/A	PC	FC	II	I
• Identify lawful basis					
• Organization's purposes					
• Direct stakeholder engagement, communication and reporting					
• Purpose Specification					

Figure 6 Last notes



Last notes	
In your experience, with this practices do you think that a company can be compliant with GDPR?	☐Yes ☐No
If not, what do you think is missing?	
With this practices, do you think that the effort of implementing GDPR can be less, comparatively to implement the GDPR without this guidelines?	☐Yes ☐No
Do you think this interview is useful?	☐Yes ☐No

Table 4 Interviewee's comparation

Interview	*Years of experience*	*Role*	*Years of experience in the banking industry*	*Months experience in GDPR*	*No. of GDPR projects*	*How much are familiar with GDPR (*)*	*Frameworks in which they have experience*	*Interview duration*
I.1	8	IT Auditor	8	12	1	Good	ISO27001; ISO31000; ISO22301; COBIT; NIST Cybersecurity Framework	1:30
I.2	13	IT Auditor	13	12	1	Good	ISO27001; NIST SP 800–53; COBIT; ITIL	1:00
I.3	15	Senior Manager of IS/IT	12	26	2	Very good	ISO27001; ISO31000; ISO22301	1:30
I.4	14	DPO	12	10	1	Very good	ISO27001; COBIT	1:30
I.5	25	CISO	19	30	2	Good	ISO27001; ISO31000; ISO38500; ISO22301; COBIT; ISO20000; ISO9001; ISO14000	2:00
I.6	26	DPO	26	30	1	Very good	ISO 27001; NIST SP 800–53; ISO 27005	2:00
I.7	33	Responsible of Risk and Security of IS/IT	30	30	1	Good	ISO27001; ISO22301; COBIT	2:30

Note: *Scale = Excellent; Very good; Good; Fair; Poor

knowledge of GDPR, it is normal to have dissonances between the experience (months) and the given evaluation, as it will depend on the feeling of each one and the degree of involvement of them in the projects, during this period of months.

From the banks that participated in this study, half have more than 500 employees, as shown in Figure 7. Plus, all banks are present in Portugal and four of them have an international presence.

The interviewees said that all the banks follow/perform a framework or best practice. The most used framework among the interviewed banks is ISO 27001, with the justification that is the ISF of reference in Europe. The second most used framework is COBIT, related to IT governance and IS, this framework is widely used by IT auditors as a reference for the processes to be audited in the banking industry.

Figure 8 shows the distribution of used frameworks in the banks. This list is not restricted only to ISF.

Figure 7 Number of employees

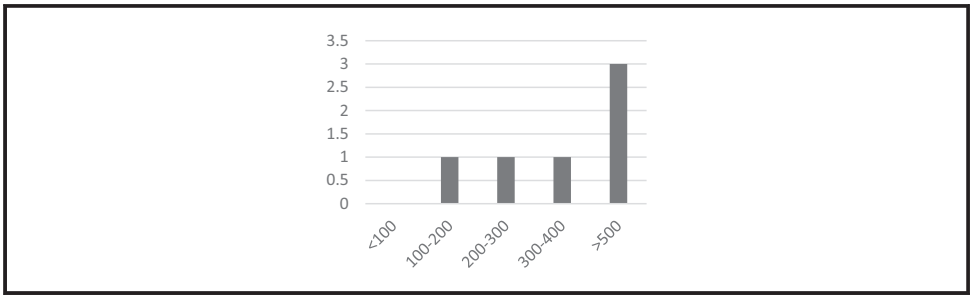
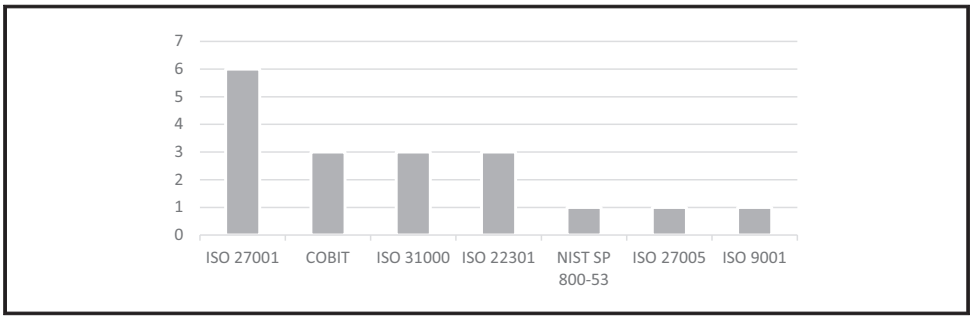


Figure 8 Frameworks followed/performed in the banks



As can be seen, most of the banks are of a considerable size, with a strong international presence, which requires compliance with more laws than those required in Portugal. Plus, all the banks already follow at least one ISF. For instance, ISO 27001 is followed (partly) by all the interviewed banks. Moreover, there is a strong concern in this industry to comply with this type of law, to avoid reputational damage.

All the interviewees agreed that all the presented concepts are correct and no further concepts were proposed as missing. Interviewees also agreed that all concepts are required to be in place. However, interviewees argued that some exceptions exist for this industry, as GDPR sometimes overlaps other existing laws of the sector.

At the end of each interview, a set of questions was performed so interviewees could assess the content and usefulness of the proposal.

As can be seen in Table 5, all the interviewees considered that they can be compliant with these practices. Regarding the effort required to implement GDPR, all interviewees said that

Table 5 Final set of questions

	Can you be compliant with these practices?	*Would the effort of GDPR implementation decrease by implementing these practices?*	*Is this research useful?*
I.1	Yes	Yes	Yes
I.2	Yes	Yes	Yes
I.3	Yes	Yes	Yes
I.4	Yes	No	Yes
I.5	Yes	Yes	Yes
I.6	Yes	Yes	Yes
I.11	Yes	Yes	Yes

the effort decrease, except for one interviewee, arguing that it will always depend on the approach of each bank and if there is no ISF already to be followed, the effort would be the same. The usefulness of the proposal was validated by all the interviewees.

8. Analysis and discussion of results

Due to the existence of different answers to the same question, this section discusses and analyses our results.

9. X analysis of the results

To separate practices into three groups (N/A, PC and FC), a formula was created to obtain a score per practice, with the following assumptions:

- Score of each practice = (Sum of answers with N/A * 0) + (Sum of answer with PC * 1) + (Sum of answers with FC * 2)
- N/A = 0
- PC = 1
- FC = 2

For example, in Figure 9, the practice "Identity lawful basis," have 12 on the score, based on this calculation (0*0) + (2*1) + (5*2) = 12.

To differentiate the practices that are fully compliant with the concept, partially compliant or not applicable, a range of values was created, as can be seen in Figure 10 based on the score formula.

After applying the previous formula in all practices, 13 out of 37 concepts have practices that are fully compliant. This means that 35% of the concepts have at least one practice that addresses the entire concept in the banking industry. Table 6 lists the concepts that have at least one practice that fulfills all the requirements, with the related practice(s).

In Table 7, there are the concepts that have practices with less or equal seven in their score. The information gathered during the interviews was enough to justify this low score

Figure 9 Concept and practices with the score

Framework	Concepts and Practices	Level of Compliance					Score
	Lawfulness, fairness and transparency	N/A	PC	FC	II	I	
ISO 27552	Identify lawful basis		2	5	1	5	12
ISO 27552	Organization's purposes		4	3		6	10
COBIT 2019	Direct stakeholder engagement, communication and reporting		4	3	6		10
NIST SP 800-53 Rev.4	Purpose Specification		3	4	1	5	11

Figure 10 Score matrix

Level of Compliance	Score range	Color
N/A – Not Applicable	*0 – 7.99*	
PC – Partially Compliance	*8 – 11.99*	
FC – Fully Compliance	*12 – 14*	

Table 6 Concepts with practices fully compliant

Concept	*Practice*
Lawfulness, fairness and transparency	Identify a lawful basis
Storage limitation	Support data archiving and retention
	Data retention and disposal
Accountability	Policies for information security
	Information security roles and responsibilities
Right of access by the data subject	Individual access
Right to rectification	Access, correction and/or erasure
	Evaluate and update or retire information
Notification obligation regarding rectification or erasure of personal data or restriction of processing	PII controllers' obligations and third parties
Right to data portability	Providing a copy of PII processed
Right to object	Provide a mechanism to object to PII processing
Notification of a personal data breach to the supervisory authority	Responsibilities and procedures
Data protection impact assessment	Privacy impact assessment
Designation of the data protection officer	Acquire and maintain adequate and appropriate staffing
	Governance and privacy program
Tasks of the data protection officer	Establish roles and responsibilities
	Governance and privacy program
General principle for transfers	Information sharing with third parties

Table 7 Concepts with practices not applicable

Concept	*Practice*
Information to be provided where personal data are collected from the data subject	Automated decision-making
Information to be provided where personal data have not been obtained from the data subject	Provide a mechanism to modify or withdraw consent
	Provide a mechanism to object to processing
	Providing a copy of PII processed
	Automated decision-making
	System of Records Notices and Privacy Act statements
Right of access by the data subject	Automated decision-making
	Identify a basis for international PII transfer
	Direct stakeholder engagement, communication and reporting
Right to object	Providing information to PII principals
Automated individual decision-making, including profiling	Establish data profiling methodologies, processes and tools
	Data mining protection
Regularly testing, assessing and evaluating	Review the effectiveness of business process controls
Communication of a personal data breach to the data subject	Response to information security incidents
	Define classification schemes for incidents and service requests

and most of it is because of the specifications of the industry. The next section presents the discussion and findings.

10. Discussion on findings

For the "security of personal data" and "security of processing" concept, the opinion is that none of the existing practices is 100% compliant. However, the presented set of practices are required to be compliant in the banking industry.

Regarding the concept of "storage limitation," six of the interviewees agreed that is very difficult to implement due to the existence of old systems and many dependencies between them. Plus, this inhibits the banks to delete the information after the retention period, the solution is rebuilding the systems/applications, which are currently developed in technologies already obsolete.

Regarding "data portability," all the interviewees agreed that despite having the fully compliant practice, it is urgent to create a form for data portability between banks, like what is already widely used in telecommunications companies. For instance, to transfer data to third parties, banks may be required to transfer PD to other countries and must comply with the Foreign Account Tax Compliance Act (FATCA), which requires the sending of PD about the US citizens.

All practices that refer to automated decisions have a low score because in the banking industry there are no automated decisions, there is some process automation that is evolving fast (Santos *et al.*, 2019), but the final decision is made by humans. For example, it is impossible to automatically decide if a mortgage loan can be decided based only on the automated decision (at this moment).

Regarding the concept "information to be provided where PD has not been obtained from the data subject," unlike other industries when banks collect data, they can only obtain them from their regulator, for effects of money laundering and terrorist financing or other debtors blacklist. In this case, the DS cannot ask for rectification or erasure because there are other laws/regulations that overlap the GDPR. If this information is incorrect, the DS must prove the home institution, responsible for the incorrect data and never directly to the bank.

The practice "review effectiveness of business process controls" is not necessary because it is very abstract and redundant, as there are more complete practices outlined for the concept.

The practices of the concept "communication of a personal data breach to the data subject" had a low score because they are not in the context of this concept. In reporting the incident to the DS it is not necessary to say what is being done to mitigate the problem, only to the regulator.

As can be seen in Table 8, the average practices score per concept points that most of them are in the partially compliance range. This is in line with interviewee's comments, who said that in the banking industry most practices complement each other to comply with the concept. The overall average of the concepts is 9.7, which is among the "partially compliance" range. There are two concepts that have a score below eight. As explained earlier most of the practices do not apply in the banking industry, although the concepts are necessary. These results reinforce the interviewee's comments regarding the practices, with the exception of those removed (Table 7), that complement each other, thus obtaining a list of good practices from the main ISF that help in GDPR implementation.

11. Conclusion

This research aimed to explore how can current ISF help banks comply with GDPR. The main GDPR concepts (requirements) on this field were elicited and then mapped with the practices of the chosen ISF. Forwardly, semi-structured interviews were conducted with experts working in the banking industry.

In the end, several conclusions can be withdrawn about the specificities of the banking industry, ISF and GDPR implementation. According to our findings, one may argue that an ISF is a good starting point to implement GDPR and get more specific instructions, on how to implement controls to mitigate the IS and DP risk that the organizations are exposed.

In terms of particularities in the banking industry, the main findings are:

- When PD have not been obtained from the DS, the DS cannot deny the consent.
- There are not completely automated decisions.
- Storage limitation is very difficult to implement, even though is mandatory and applicable in this industry.

Table 8 Practice score level per concept

Concept	*Practice score level*
Lawfulness, fairness and transparency	10.75
Data minimization	10
Inaccurate data	9.8
Storage limitation	11
Security of personal data	9.46
Accountability	9.92
Transparent information, communication and modalities for the exercise of the rights of the data subject	10.16
Information to be provided where personal data are collected from the data subject	9.11
Information to be provided where personal data have not been obtained from the data subject	*7.22*
Right of access by the data subject	9
Right to rectification	11.33
Right to erasure ("right to be forgotten")	8.75
Right to restriction of processing	10.4
Notification obligation regarding rectification or erasure of personal data or restriction of processing	10.5
Right to data portability	10
Right to object	9.2
Automated individual decision-making, including profiling	*7.75*
Data protection policies	10
Codes of conduct	10.2
Data protection by design	9.12
Data protection by default	9
Processor	9.6
Records of processing activities	9.69
Security of processing	9.7
Pseudonymization	9.14
Encryption of personal data	9.42
Confidentiality, integrity, availability and resilience	10.11
Restore the availability	10.25
Regularly testing, assessing and evaluating	8.71
Approved certification	9
Notification of a personal data breach to the supervisory authority	10.71
Communication of a personal data breach to the data subject	8.85
Data protection impact assessment	9.87
Designation of the data protection officer	11.5
Tasks of the data protection officer	11
Certification	8.5
General principle for transfers	10.66

- There is no template for data portability between banks.
- Other laws can overlap GDPR such as FATCA, money laundering and terrorist financing.
- With the use of ISF the banks can develop certifications of compliance, for example, if they implement the entire controls of ISO 27001 because the GDPR expressly provides that adherence to approved certifications to demonstrate compliance.

In general, the interviewees are satisfied with the proposal because of the ability to improve the GDPR implementation and reduce the level of effort. Plus, with these practices they can have a more solid view of what to do, to comply with GDPR.

Plus, there is not a single ISF that has practices for all concepts. This is because of several factors such as:

- Only ISO 27552 has been developed to comply with GDPR.
- The NIST SP 800-53 is very technical and oriented to IS and DP.

- ISO 27001 was last updated in 2013 when DP was not yet a hot topic.
- COBIT is very focused on governance and management of IT, although it was updated in 2019 and added new controls to IS.

However, the ISF used in this research complement each other. Considering this research goal one may argue that it is possible for an ISF to assist in the implementation of GDPR, achieving compliance and thereby decrease the level of effort required.

In conclusion, the research question, "how can current ISF help banks comply with GDPR" was answered positively, even if more than one ISF may be required.

This research took contributions by exploring an area that was not properly explored, improving the body of knowledge on how can banks implement GDPR using ISF.

Some limitations exist. This research grounds its demonstration and evaluation of the knowledge of the interviewees and their organizational context. Moreover, the interviewees were performed with experts that work in Portugal. More interviews should be performed in the future. This would also be interesting with interviewees from other countries. Despite being a rigid industry, regional and cultural differences may influence the implementation of these domains (Pereira and da Silva, 2012). Plus, legal aspects and implications of GDPR adoption deserve to be further investigated in such a critical industry. Other techniques (case study, Delphi, survey, etc) can also be used to cross results and find new insights.

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Corresponding author

Isaías Scalabrin Bianchi can be contacted at: isaias.bianchi@ufsc.b