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Improving Digital Onboarding Processes for Financial Services - A Multivocal Literature Review

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Abstract. It is vital for financial institutions to acquire and digitally onboard customers in a user-friendly and seamless manner. This is relevant and urgent for financial products. Despite its importance in the financial sector, digital onboarding has not been studied from a business process perspective. To address this gap, we conduct a multivocal literature review to examine how customer onboarding is defined, its main sub-processes, associated issues, how onboarding processes can be improved, and the value of such improvements. Our results show that the main issues concern consumer-facing aspects, competition, regulations, and organizational aspects. Moreover, process improvements aim to address customer experience, compliance, incorporating digital technologies, and data-driven decision support. Therefore, the results of this paper are twofold. First, we address a gap in the study of digital onboarding from a business process perspective. Second, we classify the findings in a framework for improving customer onboarding processes in financial services. The framework is particularly useful for business and process analysts who work with redesigning onboarding processes for digital financial services.

Keywords: customer onboarding processes, financial services, business process management, multivocal literature review, business process redesign

1 Introduction

If financial institutions wish to thrive, they must gain new customers. Therefore, customer acquisition and retention are vital. Companies use different ways to measure and increase potential customers' probability of converting into actual ones. The process by which companies help introduce customers to products to become revenue-generating is called "customer onboarding" (Renz et al., 2014; Aspen, 2017). Traditionally, customer onboarding concerned physical products that required a physical presence, and,

therefore, onboarding was conducted in face-to-face settings. However, with digitalization, products, and customer onboarding have become digitalized. In contrast to the physical face-to-face model, where onboarding in the financial domain might involve showing a clerk a physical document to allow them to visually verify the person, in a digital model, the customer can apply by proving their digital credentials fully online without the need to interact with an employee (García et al., 2021).

However, financial institutions are heavily regulated and must comply with regulations, such as customer due diligence (CDD), which complicates and impacts the customer experience in the digital model. For instance, regulations such as Know-Your-Customer (KYC) and Anti-Money Laundering (AML) require banks to fulfill complicated identity verification procedures. Moreover, old processes and legacy technology hinder banks from delivering a positive digital customer experience (Garriock, 2016; Wood and Chugani, 2017; WEB, 2016). As a whole, this has led the digital onboarding processes in the financial domain to be driven more by regulatory requirements and less by customer experience, which has been the focus in less regulated markets, such as onboarding for online learning platforms (Dieter and Tkacz, 2020; Renz et al., 2014).

Financial Technology (FinTech) companies, i.e., organizations that use digital technology to provide financial service to customers (Gai et al., 2018), have challenged the dominance of incumbent banks. FinTechs often focus on providing one or few financial products with an advantage (lower price, better quality, superior customer experience) (Watson and de Naurois, 2019). As customers can change services providers with the introduction of open banking, an optimized customer onboarding for digital financial service providers becomes relevant in gaining new customers (Watson and de Naurois, 2019).

There has been limited research on customer onboarding for financial products. For instance, (Soltani et al., 2018) and (Moyano and Ross, 2017) discuss using new digital technologies for innovating customer onboarding from the perspective of KYC requirements. Others, such as (Carlèn, 2017) and (Aspen, 2017), discuss customer onboarding from a user experience design perspective. However, to our knowledge, customer onboarding has yet to be studied from a business process perspective. This paper aims to address this gap.

In light of the above context, we examine how customer onboarding is defined, its main sub-processes, associated issues, how customer onboarding processes can be improved, and what value such process improvements deliver. More specifically, this paper explores the customer onboarding process of digital financial service providers. Therefore, we address the research questions (RQ) of *How are customer onboarding processes defined* (RQ1)?, *What are the constituting sub-processes of customer onboarding processes* (RQ2)?, *What are the issues with customer onboarding processes* (RQ3)?, *What redesigns have been applied to address issues in customer onboarding processes* (RQ4)?, and *What value can redesigning customer onboarding processes deliver* (RQ5)?

This paper's contribution is to fill a gap by providing an overview of state of the art in customer onboarding processes - how they are defined, what issues there are, improvement methods considered, and the values - as well as a framework for approaching customer onboarding process improvement. The contribution is particularly relevant for

business and process analysts who optimize and improve digital customer onboarding processes. We address the research questions by conducting a multivocal literature review (MLR) (Garousi et al., 2019). We chose MLR to include the 'voice of practice' in customer onboarding process research (Garousi et al., 2019) and due to the scarcity of academic research in this field.

Against this background, the rest of the paper is structured as follows. In section 2, the review protocol is presented. The results of the MLR study are presented in section 3 and discussed in section 4. Section 5 presents the framework for improving customer onboarding processes, and finally, section 6 concludes the paper.

2 Review protocol

In this section, we present the review protocol. We applied a multivocal literature review (MLR) (Garousi et al., 2019). An MLR is based on SLR that primarily focuses on grey literature in addition to published peer-reviewed literature. In recent years, there has been a growing interest in using grey literature (Soldani et al., 2018), specifically in software engineering (Garousi et al., 2016). We apply the MLR protocol following the guidelines proposed by Garousi et al. (Garousi et al., 2019), which, in turn, is based on the systematic literature review procedure suggested by Kitchenham (Kitchenham, 2004). Although Kitchenham (Kitchenham, 2004) proposes to include grey literature, an MLR provides specific suggestions for managing grey literature. Thus, MLR can be considered an extension of SLR with a specific focus on grey literature. The protocol and final list of papers are available as supplementary materials.

2.1 Research questions

Following the guidelines for systematic reviews in (Kitchenham, 2004) and (Garousi et al., 2019), we defined research questions (RQ). The first RQ aims at understanding how customer onboarding is defined. Given the lack of a standard definition, we seek to understand how it is defined to gain insights into the scope of such processes, i.e., where they begin and end. The second RQ seeks to understand the main steps of customer onboarding processes, i.e., their constituent sub-processes. With RQ3, we focus on eliciting commonly experienced issues with onboarding. Then, in RQ4, we examine what redesigns have been applied to customer onboarding processes. Finally, RQ5 explores the values derived from implementing redesigns. Thus, our research questions are as follows.

- RQ1: How are customer onboarding processes defined?
- RQ2: What are the constituting sub-processes of customer onboarding processes?
- RQ3: What are the issues with customer onboarding processes?
- RQ4: What redesigns have been applied to address issues in customer onboarding processes?
- RQ5: What value can redesigning customer onboarding processes deliver?

2.2 Search strategy

The search was performed according to suggested guidelines (Kitchenham, 2004; Garousi et al., 2019). We defined the search strings, selected the electronic databases to apply the search strings on, defined selection criteria (inclusion and exclusion criteria), performed relevance screening, and conducted a secondary search by examining the references in the list of relevant papers to identify additional papers. The search strings were developed based on the study's scope and keywords (Kitchenham, 2004). To this end, the key term "onboarding process" was included. In addition, the terms "customer onboarding," "client onboarding," and "user onboarding" were also included. We tested these key terms and identified the need for further refinement to capture relevant studies. Therefore, we added the terms "improvement," "automation," "development," "engineering," "component," and "phase."

The results of our initial search indicate that onboarding process research has primarily focused on employee or other collaborative work (e.g., open-source software contributors) (Fagerholm et al., 2013; Steinmacher et al., 2016; Garcia et al., 2017; Kosa and Yilmaz, 2016). Our goal is to gather information relevant to customer onboarding processes. Conversely, employee onboarding is generally understood as successfully bringing a new employee up-to-date with the company they joined to become an effective contributor quickly (Bauer, 2010). As employee onboarding is out of the scope of our study, we refined the search strings to exclude results containing the term "employee." Thus, the individual search strings used are as follows:

1. "onboarding process" AND "improvement" -"employee"
2. "onboarding process" AND "automation" -"employee"
3. "onboarding process" AND "development" -"employee"
4. "onboarding process" AND "engineering" -"employee"
5. "onboarding process" AND "component" -"employee"
6. "onboarding process" AND "phase" -"employee"
7. "customer onboarding" AND "improvement" -"employee"
8. "client onboarding" AND "improvement" -"employee"
9. "user onboarding" AND "improvement" -"employee"

The search strings were applied to the electronic databases of Scopus and Web of Science. These databases were selected as they index most peer-reviewed publications within the business process and software engineering domains. Although there is overlap between the two databases, previous studies have shown that they yield different research outputs (Singh et al., 2021; Chadegani et al., 2013). Except for a few papers, most of the Scopus and Web of Science results were not related to customer onboarding. Therefore, the chosen databases were barely used. Instead, we focused on grey literature by applying the search strings to the Google search engine. For identification of grey literature, we used (Garousi et al., 2019). We define white (academic) literature as those peer-reviewed, i.e., published in journal papers, conference papers, and academic theses. We define 1st tier grey literature as handbooks and white papers and 2nd tier to be presentations (Garousi et al., 2019). These first two tiers of grey literature include high and moderate outlet control and credible sources. The 3rd tier, as specified

in (Garousi et al., 2019), were not included as they stem from sources with low control and credibility (such as blogs, emails, and tweets).

Next, we defined the selection criteria to systematically filter out irrelevant papers until a final set of relevant papers remained (see Table 1). We defined a set of exclusion criteria, i.e., criteria used to filter out duplicates (EC1), non-English language papers (EC2), papers inaccessible with University subscriptions or papers behind paywalls (EC3), or short papers (EC4). Papers not excluded were assessed for relevance with inclusion criteria. Academic papers (white literature), 1st and 2nd tier grey literature in the domain of customer onboarding processes were included (IC1). Then, the papers were examined to ensure they contained sufficient information for further analysis (IC2) and were applicable within the financial industry (IC3). Papers that failed at least one of the exclusion criteria were discarded. The inclusion criteria were applied top to bottom, i.e., if a paper failed an inclusion criterion, it was excluded, and no further inclusion criteria were considered. Then, we examined the references in the list of relevant papers to identify additional papers and applied the same filtering criteria. After having applied the criteria, a final list of relevant papers was identified.

Table 1. Inclusion and exclusion criteria

Criteria		Description
Exclusion	EC1	Is the paper a duplicate?
	EC2	Is the content of the paper non-English language?
	EC3	Is the paper inaccessible?
	EC4	Is the paper less than five pages?
Inclusion	IC1	Is the paper a type of 1st or 2nd tier grey literature or an academic article (white literature) in the domain of customer onboarding processes?
	IC2	Does the paper elaborate on the sub-processes of the onboarding process?
	IC3	Is the paper's topic applicable within the financial industry?

A total of 2089 hits were gathered using the search strings provided in the 'Search strings' section (see Figure 1). Excluding duplicates, papers written in languages other than English, and papers that were inaccessible or less than five pages, 968 results remained. In the first round of relevancy filtering, 363 papers were excluded by title (IC1). These papers were clearly out of the scope of our study. In the second round, 374 were excluded after being examined, according to IC2. As a result, 231 papers were left for further analysis. In the final round, the remaining papers were examined in full (IC3). A total of 67 results remained, and after examining the references in the list of relevant papers, the final list of papers constitutes 76 relevant papers.

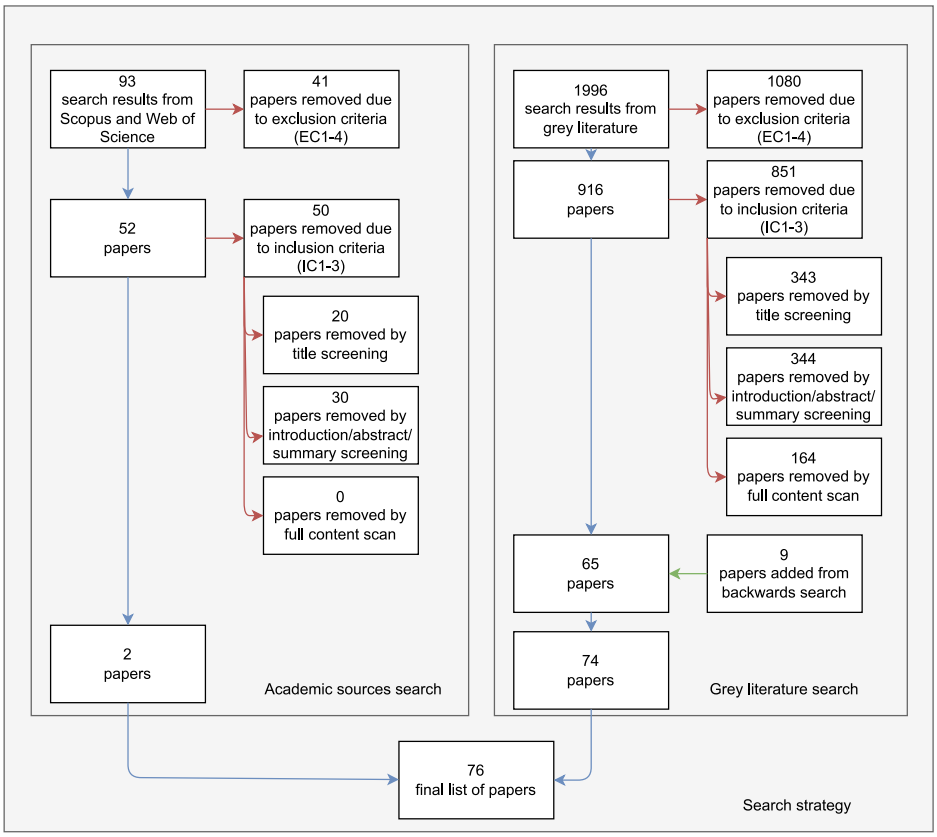


Fig. 1. Search strategy visualized

2.3 Data extraction

Following the recommendation of (Kitchenham, 2004), we developed a data extraction form. The data extraction consists of two main parts. The first part considers metadata about the papers. This part includes information about the title, authors, institution, publication year, type of the paper, and if the paper is white or grey literature. The second part concerns the data required to address the research questions. Therefore, the data extracted concern context, the problem domain, and the processes discussed within the domain. The context is, for example, the industry and the paper's objective. The domain data covers the state of the topic (the problems within it), methods of improvement, and target state descriptions (value of achieving improvements). Process data covers the used process terms, process composition, and detailed descriptions of the processes.

3 Results

In this section, we present the results of our review. We address how customer onboarding processes are defined in the first subsection (RQ1). Then, in the second subsection, we present the results on the sub-processes of customer onboarding (RQ2), followed by identified issues with onboarding processes in the third subsection (RQ3). Finally, we present results related to what redesigns have been applied to address issues in the customer onboarding process in subsection four (RQ4) and the value from such redesigns in the fifth subsection (RQ5).

3.1 Definitions of customer onboarding

The first research question, "*How are customer onboarding processes defined?*", covers the definitions of customer onboarding processes. Although all papers did not explicitly provide a definition, we identified 12 distinct definitions (see Table 2). Many papers consider KYC to be synonymous with or proxy for customer onboarding. Therefore, nine additional definitions that use KYC as the central aspect of onboarding were also identified (see Table 3).

Customer onboarding has been defined as the customer's first experience with the organization or product (Paknikar et al., 2014; Watson and de Naurois, 2019; Bitterli et al., 2020; Joshi and Kar, 2020; Carlèn, 2017) (definitions 1,2,3,4,5). For instance, in (Carlèn, 2017) (definition 5), customer onboarding is defined as "*focusing on user's first encounter with a product*." This customer-oriented view is furthered in (WEB, 2018c) (definition 6) by specifying the financial services provider as the initiating party. Thus, they take an opposing view to onboarding, beginning with the organization approaching the customer.

Extending the previous definition, authors of (WEB, 2017a) (definition 7) define onboarding as a question: "*Who are you, do I want to do business with you, and do I have enough information to confirm that I can do business with you?*" Such a definition emphasizes the process for confirmation or termination of a business relationship. The definition included in (Guiral et al., 2019) (definition 8) differs in that they define onboarding as setting up a business relationship and, therefore, extends the scope of onboarding from initial interactions to the entire customer life cycle. In contrast, the definition of (Dieter and Tkacz, 2020) states that onboarding is the procedure for establishing or otherwise setting up a new user account.

The authors of (Lowmaster, 2018) (definition 10) define onboarding from a risk perspective. They define onboarding as "*the process to minimize counterpart and fraud risk, as well as to satisfy any relevant KYC and AML procedures*." This risk-based definition enriches definition five. It adds another layer of detail to the decision making of whether a business can or cannot start a relationship with a customer. Definitions provided in (Underwood et al., 2019) and (Grace et al., 2016) (definitions 11 and 12, respectively) further clarify the risk-based approach by including tax residency, employment, commercial customer profiling checks, and ongoing CDD procedures as part of the onboarding process.

A set of papers diverge in their definitions in that they consider the KYC process to be the central aspect of onboarding and, therefore, define onboarding as the KYC pro-

Table 2. Onboarding definitions

Category	#	Definition	References
Onboarding	1	Customer onboarding is the first real experience of the customer with the organization	(Paknikar et al., 2014)
	2	Client onboarding is the first touch point where customers interact with the financial institution	(Watson and de Naurois, 2019)
	3	Customer onboarding refers to the phase of a prospective customer starting the business relationship with the bank.	(Bitterli et al., 2020)
	4	Customer onboarding is the first touch point where the customer gets the first experience and impression about the bank, and in return, the bank gets the opportunity to delight their new customer for the first time.	(Joshi and Kar, 2020)
	5	(1) Onboarding is the process of letting new users acquire the necessary skills in order to become active customers. (2) User onboarding is the" process of increasing the likelihood that new users become successful when adopting your product." (3) User onboarding is a discipline in UX design focusing on the user's first encounter with a product	(Carlèn, 2017)
	6	Customer onboarding is the process of a financial services provider establishing a business relationship with a customer	(WEB, 2018c)
	7	Customer understanding and onboarding means: who are you, do I want to do business with you, and do I have enough information to confirm that I can do business with you?	(WEB, 2017a)
	8	Onboarding is the commencement of the operational process or the start of account maintenance	(Guiral et al., 2019)
	9	Customer onboarding is the procedure for establishing or otherwise setting up a new user account.	(Dieter and Tkacz, 2020)
	10	Onboarding is a process to minimize counterparty and fraud risk, as well as to satisfy any relevant KYC and AML procedures	(Lowmaster, 2018)
	11	Client onboarding is an extensive process that requires firms to carry out CDD and be able to verify the identity of clients on an ongoing basis to prevent activities such as money laundering, financial fraud, identity theft, and terrorist financing.	(Underwood et al., 2019)
	12	The onboarding process includes KYC checks but also broader points such as the individual's tax residency or employment information, as well as information to assist with the institution's customer profiling from a more commercial standpoint.	(Grace et al., 2016)

Table 3. KYC definitions

Category	#	Definition	References
KYC	13	KYC is a method to confirm the identity of customers.	(WEB, 2018d)
	14	KYC is the process by which you need to know the customer. It is ideally supposed to provide you with a better profile of your customer.	(WEB, 2015a)
	15	KYC profile provides reviewers with easy access to relevant onboarding info.	(McArdle et al., 2019)
	16	KYC is a CDD process that enables banks and financial institutions to verify the identity of their customers in order to prevent illegal activities.	(WEB, 2019b)
	17	The KYC process is the process by which financial institutions are obliged by regulators to onboard their customers before conducting any activity with them in order to avoid working with customers that pursue either of the aforementioned illicit activities.	(Moyano and Ross, 2017)
	18	Customer identification, verification, and CDD are collectively referred to as KYC.	(Kipkemboi, 2019)
	19	KYC is the process of having financial institutes engage with their prospective clients to verify their identity. Through this process, financial organizations obtain better insight into their clients and establish a rapport by which they gain a better understanding of how their clients' funds are obtained, accessed, and withdrawn.	(Soltani et al., 2018)
	20	The KYC process is composed of customer identification, verification, and due diligence and is a key process for managing integrity risks in the financial system and preventing fraud.	(Koenig, 2020)
	21	KYC process is the process of verifying the identity of the customer by assessing the customer's profile. KYC verification evaluates the risk profile of a customer to ensure that they comply with AML laws.	(WEB, 2020k)

cess. Such an approach considers identifying and verifying customers, such as in (WEB, 2018d) (definition 13), as the single purpose of customer onboarding. This definition is extended in (WEB, 2015a) (definition 14) by clarifying that KYC explicitly refers to the need to get to know the customer and create a better customer profile. This definition is also proposed in (McArdle et al., 2019) (definition 15). However, (WEB, 2019b) and (Moyano and Ross, 2017) (definitions 16 and 17, respectively) extend this definition by including the CDD process, a regulatory requirement for financial institutions, for the explicit purpose of preventing illegal activities. Finally, in (Kipkemboi, 2019; Soltani et al., 2018; Koenig, 2020; WEB, 2020k) (definition 18,19,20,21), the KYC process is defined as a set of processes that includes customer identification, verification, and CDD.

3.2 Sub-processes of customer onboarding

Here, we present the results related to the second research question, i.e., "*What are the constituting sub-processes of customer onboarding processes?*". First, we present results on the main discovered sub-processes and their ordering. Then, we present the onboarding process captured as process models[1].

3.2.1 Main sub-processes of customer onboarding. Although most papers list a set of main sub-processes, suggesting that they constitute the minimum requirements of an onboarding process, they differ in their naming, what tasks they encompass, and the order of the sub-processes. For instance, *Validate Information* and *Review Application* both refer to the same concept (Tufchi, 2016; Garvey et al., 2015). Furthermore, *Fulfill CDD Procedures* is, at times, used generically and includes various terms, such as background and compliance checks, credit score checks, verification, KYC and AML checks (Mohanty, 2013; WEB, 2016; Paknikar et al., 2014) or is used as equivalent with, for example, *Check KYC* (WEB, 2017c, 2018c). However, we have identified the main sub-processes to be: *Create Onboarding Request*, *Approve Request*, *Fulfill CDD Procedures*, *Set Up Account*, *Validate Information*, *Upsell, Cross-sell and Generate Leads*, *Provision Welcome Package* and *Perform Monitoring, Reporting, and Analytics*. (see Table 4 [2][3]).

[1] We represent process models as proposed in the papers. This means that we follow the authors' grouping of activities.

[2] We provide sample references in the paper. Tables with a full list of references are available as supplementary material A.

[3] We present the ordering in the given table by how frequently the term appears. In contrast, we follow up with a description of each sub-process in order as described here because it more closely follows a possible onboarding process, making it easier for the reader to follow.

Table 4. Main sub-processes of the customer onboarding process

Sub-process	Freq.	Alternative terms	Sample references
Fulfill CDD Procedures	43%	Check KYC, Check AML, Check Compliance, Check Background, Check Credit	(Mohanty, 2013),(WEB, 2018b),(WEB, 2016)
Create Onboarding Request	42%	Submit Application/Collect Information	(WEB, 2017c),(Guiral et al., 2019),(WEB, 2019b)
Approve Request	30%	Process Application/Make New Business Decision/Generate Legal Agreements	(Paknikar et al., 2014),(WEB, 2019c),(Banga, 2019)
Set Up Account	26%	Select Product	(Tufchi, 2016),(WEB, 2012),(WEB, 2010)
Validate Information	17%	Review Application	(Garvey et al., 2015),(Lobo, 2012),(WEB, 2017b)
Upsell, Cross-sell, and Generate Leads	11%		(WEB, 2012),(Adomavicius et al., 2017),(WEB, 2019c)
Perform Monitoring, Reporting, and Analytics	11%	Perform Ongoing CDD	(Clark et al., 2015),(Touil, 2016),(WEB, 2010)
Provision Welcome Package	9%	Send Welcome Kit	(Garriock, 2016),(WEB, 2016),(WEB, 2018e)

Create Onboarding Request is the exchange of information that expresses customer readiness for a business relationship (WEB, 2017c; Mohanty, 2013). The onboarding request can be initiated by the customer (Watson and de Naurois, 2019) or by the financial service provider (Mohanty, 2013). An onboarding request does not necessarily have to be for a new customer; it may also be for an existing customer seeking to use a new product (WEB, 2016). For example, onboarding requests may be for account opening, credit card, or a loan (Paknikar et al., 2014). This sub-process does not need to be finalized for another to start but can be continuous where the data is enriched when needed (Mohanty, 2013). The authors of (Tufchi, 2016), (Mohanty, 2013), and (WEB, 2017c) place *Create Onboarding Request* as the first sub-process. Alternative terms for this sub-process are *Submit application* and *Collect information*. For example, (Garvey et al., 2015), (Paknikar et al., 2014), (WEB, 2018b), and (WEB, 2017d), use the terms *Submit application*, *Collect Information*, or *Gather Data* for the first sub-process of customer onboarding. In (WEB, 2016), however, *Create Onboarding Request* and *Capture Data* are separated into two sub-processes.

The *Approve Request* sub-process focus on the customer's risk level and can involve four-eye checks of customer data, multi-level supervisor validation, and a set of predefined business rules (WEB, 2017d). Alternative terms used for the same concepts are *Process Application* (Garvey et al., 2015), *Make New Business Decision* (Tufchi, 2016), and *Generate Legal Agreements* (Mohanty, 2013). The *Approve Request* is commonly placed as the sub-process following *Fulfill CDD Procedures* that will be explained in the next paragraph (Lobo, 2012; WEB, 2018b). Authors of (Mohanty, 2013; WEB, 2016; Paknikar et al., 2014; WEB, 2019b) further specify *Approve Request* to be between the sub-processes of *Fulfill CDD Procedures* and *Set Up Account*, while (Tufchi, 2016) and (Garriock, 2016) include it as an early decision before *Fulfill CDD Procedures* and after *Create Onboarding Request*.

Fulfill CDD Procedures is the collection of information to understand the nature of the relationship the customer is seeking with the bank and whether the customer will introduce risks to the organization (Wood and Chugani, 2017). This sub-process has been called the "necessary evil" for KYC and AML compliance (WEB, 2019a). There is no commonly accepted approach to CDD as the methods are largely left to the organizations, local governments, and overseeing institutions to determine (Touil, 2016). CDD often includes KYC or AML (WEB, 2016; Paknikar et al., 2014), or both. In some cases, it is equivalent to KYC (WEB, 2017c, 2018c). Therefore, this sub-process is embedded in the customer onboarding as mandatory (Lobo, 2012). *Fulfill CDD Procedures* is commonly placed as the second sub-process of customer onboarding (Mohanty, 2013; WEB, 2010). For instance, (WEB, 2018b), (Adomavicius et al., 2017), (WEB, 2017c), and (Paknikar et al., 2014) place CDD as the second sub-process and include a combination of AML and KYC checks as part of this sub-process. However, in (WEB, 2019b), AML-related verification is separated into a third sub-process while KYC remains the second sub-process. On the other hand, (Lobo, 2012) places AML-related verification first, KYC second, and CDD as a separate fourth sub-process.

Set Up Account is the sub-process composed of activities involved when registering the party (the customer) or the accounts (the products) in the information systems of financial organizations (Mohanty, 2013). Setting up accounts can include authentication

measures, i.e., the customer's ability to identify themselves (PIN codes) (WEB, 2018c). Alternatively, *Set Up Account* may also refer to *Select Product*, which means activating additional financial products that do not necessarily require additional CDD or data entry (Garriock, 2016). set as the last sub-process of the customer onboarding processes (Tufchi, 2016; Garvey et al., 2015; Garriock, 2016; Mohanty, 2013; WEB, 2017d, 2016; Clark et al., 2015; WEB, 2017c; Paknikar et al., 2014; WEB, 2019b).

Validate Information sub-process involves activities that ensure the customer data is valid (e.g., does not contain errors or duplicates) (Adomavicius et al., 2017; WEB, 2015a). Ensuring good data is a critical area that challenges financial institutions because erroneous or fraudulent data can be propagated throughout the organization (WEB, 2010). This sub-process has also been referred to as *Review Application* (Garvey et al., 2015).

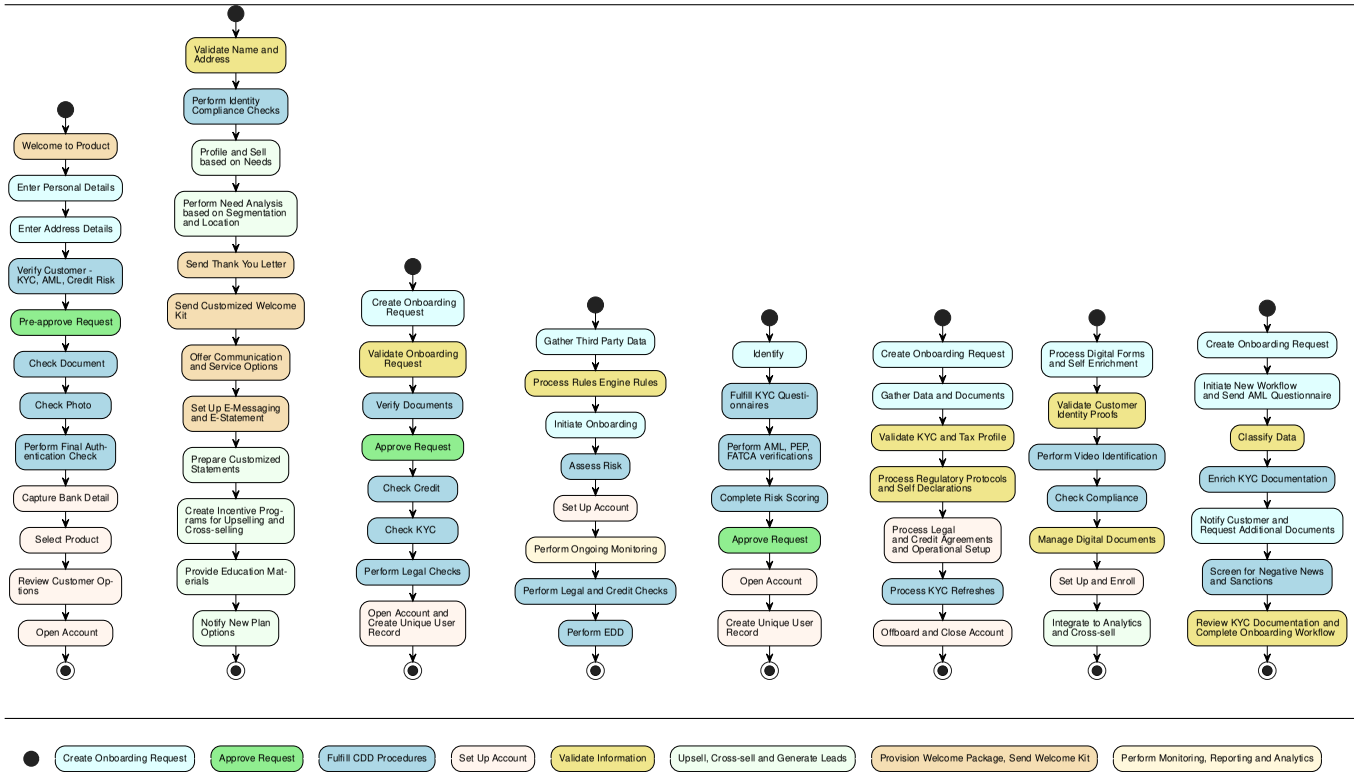
The *Upsell, Cross-sell, and Generate Leads* sub-process encompasses growth activities, i.e., offering improvements to existing products, complementary products, or using existing customers to gain exposure to other potential customers, such as referrals (Adomavicius et al., 2017; WEB, 2010). This sub-process aims to understand customer needs and preferences to discover opportunities for further revenue-increasing measures (Garvey et al., 2015; WEB, 2007).

Provision Welcome Package is a sub-process that can be composed of a welcoming message, introductory information (Garriock, 2016), welcoming kits, or a thank you letter after the opening of an account (WEB, 2010, 2007; Babu, 2019). *Perform Monitoring, Reporting, and Analytics* consists of the methods and tools implemented to enable the aforementioned ongoing risk mitigation and growth opportunities (Touil, 2016; Clark et al., 2015). This sub-process is included in the onboarding and continues to be executed throughout the customer life cycle (Clark et al., 2015; Touil, 2016; WEB, 2010).

3.2.2 Process models. Forty papers contained information to elicit a process model for the onboarding of customers. Here, we focus on process models that contain at least seven activities (see Table 5). Process models with six activities are described in Supplementary material B. The process models are at the activity level, whereas the previous section discussed sub-processes. Therefore, as shown in Table 5, the activities are color-coded according to which sub-process they belong. For instance, *Open Account* and *Create Unique User Record* in (WEB, 2019b) correspond to activities within the *Set Up Account* sub-process. Therefore, these activities are colored in light beige. Likewise, *Sign Contract* in (WEB, 2019c) are activities of the *Approve Request* sub-process (green color). The sub-processes are shown below the process models. The entire catalog of process models is available in the supplementary materials.

Table 5. Onboarding process models with seven or more activities color-coded by onboarding sub-process

(Garriock, 2016)	(WEB, 2010)	(Tufchi, 2016)	(WEB, 2020j)	(WEB, 2019b)	(Garland et al., 2020)	(Joshi and Kar, 2020)	(Parekh, 2020)



The authors of (Garriock, 2016) start the onboarding process with a welcoming message (*Welcome to Product*) followed by customer data entry (*Enter Personal Details, Enter Address Details*). Next, data is verified, and credit risk is assessed (*Verify Customer*). The verification process is followed by a decision on whether the application can be further processed or rejected (*Pre-approve Request*). If it is processed, then document (*Check Document*), photo (*Check Photo*), and final authentication checks are performed (*Perform Final Authentication Check*). In the next step, the bank details are registered (*Capture Bank Detail*), and products are selected (*Select Product*). Once the customer has made a selection (*Review Customer Options*), the account is opened (*Open Account*), and the onboarding process is concluded (see (Garriock, 2016) in Table 5).

In contrast to the previous, authors of (WEB, 2010) (see (WEB, 2010) in Table 5) propose structuring the onboarding process according to time periods. Therefore, customer onboarding is split into three sequential groups. These are ”first day activities and open account,” ”1-2 weeks of orientation and follow-up”, and ”first 2-3 months of cross-selling and up-selling”. The first group is equivalent to customer registration. Thus, it includes the activities of name and address validation (*Validate Name and Address*), client identity compliance (*Perform Identity Compliance Checks*), need-based selling/profiling (*Profile and Sell based on Needs*), and needs analysis (*Perform Need Analysis based on Segmentation and Location*). This is followed by the second group where a ”thank you” letter is sent (*Send Thank You Letter*), a customized welcome kit is prepared (*Send Customized Welcome Kit*), communication and product options are offered (*Offer Communication and Service Options*), and e-messaging and e-statements are set up (*Set Up E-Messaging and E-Statement*). Next is the third and last group, where customized statements are created (*Prepare Customized Statements*), incentive programs for up-selling and cross-selling are presented (*Create Incentive Programs*), education materials (*Provide Educational Materials*) and any new plan options are communicated to the customer (*Notify New Plan Options*).

The process model of (Tufchi, 2016) diverges from the previous two. Instead of the introductory welcome message (*Welcome to Product*), they propose *Create Onboarding Request* as the first activity. This activity includes gathering data about the customer and product selection. This is followed by validation of the onboarding request (*Validate Onboarding Request*) and verification of documents (*Verify Documents*). Then comes the *Approve Request* where the organization’s internal business rules are followed to reach an approval similar to (Garriock, 2016). Contrary to the previous process model, doing credit checks (*Check Credit*), KYC checks (*Check KYC*), and legal activities checks of the customer (*Perform Legal Checks*) are performed after the *Approve Request*. The onboarding process is then concluded for the customer with the new account opened and a unique customer record created (*Open Account and Create Unique User Record*).

In (WEB, 2020j), the onboarding process starts with *Gather Third Party Data* followed by *Process Rules Engine Rules*. The *Initiate Onboarding* as an independent activity is the third step, indicating the previous activities as preliminary preparation for the process. This is followed by *Assess Risk* and *Set Up Account*, which is similar to (WEB, 2019b). Next is the *Perform Ongoing Monitoring* activity, and finally, the ac-

tivities *Perform Legal and Credit Checks* and *Perform EDD* of the sub-process *Fulfill CDD Procedures* complete the onboarding flow, contrary to (Touil, 2016).

In (WEB, 2019b), the process starts with identification (*Identify*), an activity that is equivalent to data gathering and entering customer details in (Garriock, 2016). The next activity captures customer answers to KYC questionnaires (*Fulfill KYC Questionnaires*). This is followed by AML verification (*Perform AML, PEP, FACTA verifications*) and risk scoring (*Complete Risk Scoring*). The authors then include *Approve Request* as the final approval. This diverges from the approaches in (Garriock, 2016) and (Tufchi, 2016) where *Pre-approve Request* and *Approve Request* are more in the middle of the process. Notably, the former does not include a separate *Approve Request*. In (WEB, 2019b), the authors continue with account opening. The last sub-processes for customer onboarding are account opening and customer user record creation similar to (Garriock, 2016) and (Tufchi, 2016) (*Open Account, Create Unique User Record*).

The authors of (Garland et al., 2020) start the onboarding process with *Create Onboarding Request* and *Gather Data and Requirements*, which follows the same approach as (WEB, 2016). They further follow up with activities in the same sub-process area (*Validate Information*) as the subsequent activities are *Validate KYC and Tax Profile* and *Process Regulatory Protocols and Self Declarations*. Next, the authors of (Garland et al., 2020) define the activities of *Process Legal and Credit Agreements and Operational Setup* and *Process KYC Refreshes*. Finally, the onboarding process is finalized with *Offboard and Close Account*. Therefore, the authors of (Garland et al., 2020) consider the customer onboarding process to be continuous in that it lasts throughout the customer life cycle, includes activities with existing customers, and concludes at the end of the customer life cycle when the customer account is closed.

In (Joshi and Kar, 2020), the first activity of the customer onboarding process is *Process Digital Forms and Self Declarations*, referring to the collection of information. Next, the information is validated as part of *Validate Customer Identity Proofs*. Then, for *Fulfill CDD Procedures*, activities like *Perform Video Identification* and *Check Compliance* are executed. These activities are managed in *Manage Digital Documents* followed by setting up the account (*Set Up Account and Enroll*). The process is completed with *Integrate to Analytics and Cross-Sell*.

Finally, the author of (Parekh, 2020) considers the first two activities to be *Create Onboarding Request* and *Initiate New Workflow and Send AML Questionnaire*, which can be considered as part of the *Create Onboarding Request* sub-process, similarly to (Tufchi, 2016; WEB, 2016). Next, this data is classified (*Classify Data*). They follow up with enrichment of data for KYC with *Enrich KYC Documentation*. Further information may be requested as part of *Notify Customer and Request Additional Documents*. The complete data set is then used to screen for third-party information (*Screen for Negative News and Sanctions*). Finally, they complete the onboarding process with *Review KYC Documentation and Complete Onboarding Workflow*.

It should be noted that there is a lack of consensus on when an onboarding process ends (Carlèn, 2017). For example, an onboarding process may end when the customer has finished the initial registration process (Clark et al., 2015; WEB, 2017c), every time a new product is added to the customer's list of products subscribed to (Garvey et al., 2015; Paknikar et al., 2014), or never (Carlèn, 2017).

3.3 Issues in customer onboarding processes

The results of issues with customer onboarding processes (RQ3) are presented here. The identified issues can be grouped as customer-facing, competitive, regulatory, and organizational (see Tables 6 and 7). Customer-facing issues concern aspects that affect the direct relationships with customers. Competitive issues arise from other players in the marketplace, whereas compliance issues are those born of regulatory pressures. Finally, organizational issues relate to how the banks manage their onboarding processes.

The most commonly reported customer-facing issue (see Table 6) is *Low customer satisfaction* (41%). This issue results from inconsistent user experience and friction across the onboarding process (WEB, 2015a). For example, in (WEB, 2015a), manual data entry is a source of friction. Another common issue is *Data inconsistencies and lack of customer understanding* (37%) caused by the low quality of information and data available in different places. This leads to a lack of a single view of the customer and negatively impacts the quality of reporting. For example, as discussed in (Beaumier et al., 2019), many organizations have unverified legacy customer data, customer data with missing or partially filled fields, data that conflicts with other systems, or outdated data. The issue of *Changing customer demands* is reported in 20% of papers.

As discussed in (Watson and de Naurois, 2019), customers expect to have access to multi-channel experiences, streamlined experiences in completing the onboarding process, and personalized experiences tailored to their individual situations. Accommodating such expectations require companies to innovate, but regulations restrict companies from updating operating models and operational processes (WEB, 2017a). In 20% of papers, the *Failure to identify the customer* is an issue. This issue refers to failing to adequately identify the identity of the customer (WEB, 2018c). According to (Garriock, 2016), this is partly due to digitalizing face-to-face processes. Such digitalization can lead up to an 85% leakage rate, where customers abandon onboarding before completion of identification and select a competitor with a better user experience. This is because customers have lower commitment online compared to face-to-face. Thus, customer loss occurs more frequently if the processes do not accommodate the customer's preferred method of contact (Garriock, 2016). Another issue is *Insufficient product accessibility* (18%), i.e., specific products are only accessible during business hours or at a branch office despite the capability of 24/7 service (Soltani et al., 2018). This may result from missing functionalities in some channels (e.g., web page or call center) or limited work hours (e.g., call center not available 24/7). In customer onboarding, for instance, identification would be provided only physically during office hours despite having the option to do it through a video call at customer's convenience or fully automating it. *Lack of customer communication*, reported in 8% of papers, stems from when the customer, due to transparency issues, is uninformed about their application progress (WEB, 2007; Tufchi, 2016).

Competitive issues arise from changes in the external business context (Milani, 2019), i.e., the competitive business environment that affects the industry. In this regard, competitive issues arise from having a comparatively inferior onboarding process. Thus, competitors with better onboarding processes are expected to be more successful as they achieve higher rates of, for instance, successful completion of customer onboarding. Competitive issues are considered in 12% of the final papers. Notably,

competitive issues are only discussed in general terms such as *Increased competition* (Guiral et al., 2019; WEB, 2019a). However, for incumbents, increased competition from "BigTech" (large technology companies that have user data and are competitive across industries (Watson and de Naurois, 2019)) and FinTech companies is an issue (Watson and de Naurois, 2019; Banga, 2019). Specifically, BigTech and FinTech are not limited by legacy behavior, processes, or technology, allowing them to develop customer-centric solutions from the start (Watson and de Naurois, 2019; Banga, 2019).

The most frequently identified compliance issue is *Increasing regulatory requirements* (see Table 7). For instance, one is the rate and amount of regulatory changes introduced and the challenge of staying compliant (WEB, 2019b; Master and Pande, 2019; Lowmaster, 2018). The changes in the regulatory landscape and the increased requirements make creating a customer's KYC profile more difficult (Master and Pande, 2019). Increased requirements require manually working with an increasing number of sources to verify and validate customer information. Another issue is the reputational damage companies face if they fail to stay compliant (McArdle et al., 2019). Yet another issue is risks associated with understanding regulatory requirements and implementing them correctly (Kipkemboi, 2019). Finally, companies consider the risk of failing to detect fraudulent behavior as a vital compliance issue (Underwood et al., 2019).

Organizational issues concern those that arise from how onboarding processes are managed. For instance, 45% highlight *Lack of automation* (see Table 7) as an issue (Vysya and Shah, 2018; Underwood et al., 2019; WEB, 2017b). For example, as discussed in (Vysya and Shah, 2018), customer service may require agents to navigate different systems while communicating with customers. Automated tools that help collect and access information could improve this process. Another issue is the *lack of standardization and the accompanying high error rates*. This issue, discussed in 37% of papers, relates to extensive onboarding processes, having variations, and requiring trained staff to manage them (Lobo, 2012; WEB, 2017a). When such problems are combined with *Organizational silos* (37%), they cause lacking coordination and communication (Garvey et al., 2015), resulting in persistent silos with data duplication (Wood and Chugani, 2017). The onboarding process cost, i.e., *High costs*, is also an issue. About (35%) of the papers discuss cost as an important issue. For example, compliance costs are rising due to increasing demands on KYC/AML procedures (Vysya and Shah, 2018; WEB, 2017a) while such activities are, essentially, non-adding value for companies. Another issue is *Lack of digitalization* (31%) which results in processes being paper-based (WEB, 2018b). For example, as discussed in (WEB, 2018b), paper-based processes are not aligned with the millennial generation's habits and expectations. Therefore, such processes are user-unfriendly and complex. Furthermore, *Rigid, legacy technology* (27%) is difficult to maintain and update. This results in inflexible IT systems that are difficult to update for compliance (Garvey et al., 2015). One of the less-discussed issues is the *Lack of comprehensive strategic leadership* (16%) that is expressed as ad-hoc problem solving and uninformed decision making (Watson and de Naurois, 2019; Beaumier et al., 2019). Finally, when the implementation of solutions that enable, for instance, up-selling is not feasible due to technical issues (WEB, 2007), strategic misalignment (WEB, 2019c), or *Missed growth opportunities* (12%) it becomes an issue.

Table 6. Customer and competition issues in customer onboarding

Category	Issue	Freq.	Description	Sample references
Customer	Low customer satisfaction	41%	Customer satisfaction is impacted by inconsistent user experience; lack of customer-centricity affects processes that become boring, slow, and frustrating	(Kapoor, 2020b),(WEB, 2020j),(WEB, 2020d)
	Data inconsistencies and lack of customer understanding	37%	Inaccurate or missing customer data have effects in incorrect or missing reporting due to low information quality; duplicate and scattered data do not support a single customer view and cause customer information silos	,(McArdle et al., 2019),(Koenig, 2020),(Chui and Lee, 2020)
	Changing customer demands	20%	Changing customer preferences, expectations, and demands cause the need to innovate, which is hindered by rigid business rules, outdated banking operating models, and operational processes	(Moyano and Ross, 2017),(WEB, 2020i),(Monaghan, 2020)
	Failure to identify customer	20%	Identification and authentication gaps cause institutions not to be able to trust the customer to do business with them leaving many potential customers unbanked	(WEB, 2020b),(WEB, 2020a),(WEB, 2020c)
	Insufficient product accessibility	18%	Low accessibility to products due to the requirement for the customer to be physically present for agreements, lack of offline or omnichannel support, or limited business working hours leave customers disconnected	(WEB, 2020a),(WEB, 2020c),(Dieter and Tkacz, 2020)
	Lack of customer communication	8%	Transparency issues leave customers unsure of their situation with the institution, progress of applications, and completion of documents	(Master and Pande, 2019),(WEB, 2017b),(WEB, 2020i)
Competitors	Increased competition	12%	Increasing competition requires institutions to innovate at a fast speed and search for new partnerships not to be left behind	(Watson and de Naurois, 2019),(Banga, 2019),(Kipkemboi, 2019)

Table 7. Organization and compliance issues in customer onboarding

Category	Issue	Freq.	Description	Sample references
Compliance	Increasing regulatory requirements	49%	Fast changing, difficult to understand, and increasing regulatory requirements increase risks of failing to comply, becoming victim to fraud and reputational harm	(Agarwal et al., 2020),(Healy, 2020),(Dieter and Tkacz, 2020)
Organization	Lack of automation	45%	Manual processes and lack of automation are one of the most discussed issues in the final list of papers	(WEB, 2011),(WEB, 2020b),(WEB, 2020i)
	High error rates as a result of lack of standardization	37%	Long, complex, and overcomplicated processes, as well as bad staff training, lack of standardization, low specialization, and high volume work, are among the many factors causing high error rates	(Christopher and Paul, 2020),(Parekh, 2020),(Chui and Lee, 2020)
	Organizational silos among personnel	37%	Lack of coordination and communication across teams and departments, but also across organizations, lead to persistent organizational silos and duplication of information and effort	(Moyano and Ross, 2017),(Monaghan, 2020),(Garland et al., 2020)
	High costs	35%	high costs is an issue discussed in many papers	(Koenig, 2020),(WEB, 2020e),(WEB, 2020j)
	Lack of digitalization	31%	Lack of digitalization results in processes being excessively paper-based	(Batt, 2020),(Joshi and Kar, 2020),(WEB, 2020d)
	Rigid, legacy technology	27%	Legacy technology and infrastructure that is not properly maintained, updated, and replaced result in rigid, inflexible, and inefficient systems	(Gopalakrishnan et al., 2020),(WEB, 2020k),(WEB, 2020f)
	Lack of comprehensive strategic leadership	16%	Ad hoc problem solving, uninformed decision making, short-term thinking, and misaligned strategic action and thinking are among the executive leadership problems	(WEB, 2019c),(Klidjian, 2020),(Monaghan, 2020)
	Missed growth opportunities	12%	Revenue opportunities are foregone, and customer base growth opportunities are missed by not taking advantage of cross-selling and upselling approaches	(WEB, 2019c),(Kapoor, 2020a),(Bitterli et al., 2020)

3.4 Redesigning customer onboarding processes

This sub-section presents applied redesigns to address such issues (RQ4). Our analysis shows that the redesigns concern improving customer experience, addressing compliance issues, introducing digital technologies, and implementing data-driven decision making (see Tables 8 and 9).

3.4.1 Customer experience. Customer experience redesign refers to changes that aim to improve the customer experience. For instance, *Personalize to implement better up-selling and cross-selling* (20%) refers to identifying new opportunities for offering additional products (Guiral et al., 2019). In such cases, the onboarding process can be redesigned to enable existing information to be accessible to sales for up-selling and cross-selling. This is relevant for companies that recognize growth activities like up-selling and cross-selling as part of the customer onboarding process (see Table 4 and Table 5).

Enhance service quality is a redesign that improves accessibility to products. For example, as discussed in (WEB, 2017d), processes can be redesigned to accommodate customers' preferences by enabling digital signatures on mobile devices or online conversations with the organization's representatives during onboarding. In 17% of papers, *Build an omnichannel strategy* is discussed, referring to redesigning the process to enable a seamless experience across devices and channels.

Another redesign relates to *Create a customer-centric culture* (11%). For instance, the authors of (WEB, 2019c) propose the customer-centric onboarding journey as a critical digitalization consideration. Customer experience is created from the first interaction, emphasizing the importance of new customer onboarding to leave a good impression. This involves redesigning processes to enable discovering customers' expectations and meeting and exceeding them continuously. This may include preparing for customer problems and informing the customers of any potential obstacles ahead of time (Guiral et al., 2019).

Lastly, to *Streamline changing providers for the customer* allows customers to move between different providers for the same product. For example, an onboarding process could be redesigned to gather available customer information and preferences from previous providers to set up the product with minimal customer interaction. This concept can be extended to using complementary products across providers. For instance, with the customer's permission, an additional product from another provider can be set up on top of an existing product the customer uses. An example is direct debits, where the customer instructs the bank to allow a company to be paid from their account (WEB, 2009). This type of product may be set up with the help of the bank when the customer moves their checking account from one bank to another (WEB, 2018a). Another example is tools that enable sharing of KYC utilities across organizations. Such solutions can facilitate the onboarding process from a customer experience perspective (Garvey et al., 2015).

Table 8. Customer experience and compliance redesigns of customer onboarding

Category	Redesign	Freq.	Description	Sample references
Customer experience	Personalize to implement better up-selling and cross-selling	20%	Implement up-selling and cross-selling functionality combined with personalization and proactive communication. Prefer product-account holder match timing over using preset sequences	(WEB, 2012),(Kapoor, 2020a),(Dieter and Tkacz, 2020)
	Enhance service quality	20%	Provide 24/7 services using instant and real-time channels with offline capabilities. Provide convenience through personalized customer support	(WEB, 2017d),(Adomavicius et al., 2017),(WEB, 2007)
	Build an omnichannel strategy	17%	Build a comprehensive omnichannel strategy that includes modern platforms such as mobile devices. Provide intuitive user interfaces with a unified design and user-friendly functionality	(Garriock, 2016),(Clark et al., 2015),(WEB, 2007)
	Create a customer-centric culture	11%	Create a customer-centric company culture and use customer-focused approaches, such as minimizing requested data from customers and not tracking or selling user activity	(Clark et al., 2015),(Guiral et al., 2019),(WEB, 2017b)
	Streamline changing providers for the customer	7%	Ease the process of changing financial services providers for the customer	(Garvey et al., 2015),(Koenig, 2020),(WEB, 2020e)
Compliance	Convey data safety and security	27%	Convey safety and security to the customer by protecting customer data, maintaining data integrity, tightly controlling data access, and setting up quality controls and effective safeguards	(WEB, 2019d),(WEB, 2017b),(Batt, 2020)
	Centralize regulatory oversight	25%	Centralize regulatory oversight and compliance to simplify fulfilling regulatory requirements for the customer and avoid excessive compliance information requests	(WEB, 2018c),(Atick and Safdar, 2014),(Christopher and Paul, 2020)
	Implement compliance monitoring	24%	Implement compliance monitoring and customer regrading at appropriate times in the customer life cycle to decrease duplication of effort and increase adherence to regulatory requirements	(Tyrzyk, 2020),(Healy, 2020),(WEB, 2020h)
	Share costs to optimize expenditures and increase profitability	13%	Find methods to share costs on regulatory requirements fulfillment to increase profitability	(WEB, 2018b),(WEB, 2010),(WEB, 2018f)
	Drive operational efficiencies using existing compliance information	5%	Explore strategic possibilities of using the risk, regulatory and compliance data that already exists within the organization	(Garvey et al., 2015),(Beaumier et al., 2019),(Gopalakrishnan et al., 2020)

Table 9. Digital technologies and data-driven decision making redesigns of customer onboarding

Category	Redesign	Freq.	Description	Sample references
Digital technologies	Digitalize using innovative tools	72%	Increase digitalization by developing new tools, implementing off-the-shelf tools, eliminating legacy software, and integrating innovative technologies such as AI, blockchain, RPA, and cloud technologies	(Tufchi, 2016),(McArdle et al., 2019),(Bitterli et al., 2020)
	Provide a digital identity and verification	51%	Create a suite of digital verification and authentication methods by allowing digital document uploading, digital signatures, digital identity creation, multimodal biometrics	(Garriock, 2016),(Kipkemboi, 2019),(Joshi and Kar, 2020)
	Leverage third party services and databases	33%	Leverage third-party services, APIs, and national databases for decision support	(WEB, 2019d),(WEB, 2019a),(WEB, 2020d)
Data-driven decision making	Automate data flows	53%	Automate data flows, remove manual steps, reduce steps, minimize data entry, and increase the availability of accurate data	(Mohanty, 2013),(Grace et al., 2016),(Watson and de Naurois, 2019)
	Standardize and modernize processes	43%	Increase transparency and consistency by using modern approaches and taking advantage of existing industry standards	(Wood and Chugani, 2017),(WEB, 2017d),(Ralph, 2016)
	Integrate reporting into decision making	38%	Integrate analytics, reporting, and performance metrics to identify customers at risk of attrition and high-value segments, as well as acquire the ”right” account holder and create optimal customer tiers	(Garvey et al., 2015),(Banga, 2019),(Kapoor, 2020a)
	Centralize data for 360-degree customer view	30%	Create a 360-degree customer view, increase clean data, and standardize data structures by centralizing and aggregating data and data flows	(Mohanty, 2013),(WEB, 2018b),(Underwood et al., 2019)
	Establish governance and oversight	28%	Establish a strategic governing body that will design an optimal target operating model and focuses on leading and managing change and enabling collaboration	(WEB, 2017a),(Vysya and Shah, 2018),(Parekh, 2020)
	Break down silos through clarity of responsibilities	12%	Provide ownership of business functions and break down siloes by creating efficiency through clarity of responsibilities	(Master and Pande, 2019),(Guiral et al., 2019),(WEB, 2020g)

3.4.2 Compliance. Redesigning for compliance refers to meeting changing regulatory oversight requirements by conveying safety and security to the customer, centralizing regulatory oversight, implementing compliance monitoring, and efficiently using existing compliance information. *Convey data safety and security*, covered in 27% of papers, is the most common compliance-specific redesign. Financial institutions are required to meet security, confidentiality, and legal requirements. These must be considered for all sub-processes of the customer onboarding process. For example, organizations and their partners (such as external service providers) with whom data is shared must have robust security procedures for managing customer data. The organization is responsible that everyone who uses the customer data understands the financial industry's requirements (WEB, 2012). To maintain compliance, the organization must be able to adapt its business processes as well as technical system implementations quickly. As discussed in (Garriock, 2016), this can be achieved by using, for example, the Kaizen model (which encourages constant small incremental changes to improve quality and efficiency) in the process redesign.

The second most common compliance-specific redesign is to *Centralize regulatory oversight* (25%). The process is redesigned by facilitating consistency in setting up compliance-related processes. For example, the responsibility for the process strategy can be moved out of the product silos within the organization (WEB, 2012). This would enable the process redesign to be performed with specific and measurable goals, which supports transparency to check adherence and reduce redundancies (WEB, 2012; Garvey et al., 2015).

Another compliance redesign is to *Implement compliance monitoring* (24%). As a first step, according to (WEB, 2010) and (WEB, 2017d), organizations must automate the validation of information early. The automatic validation then allows it to be fed downstream for compliance needs (see Table 5 for (WEB, 2010)). A strict first line of defense ensures correct data is used for all following activities in the customer onboarding process, like compliance checking and messaging and ongoing compliance during the whole customer lifecycle (WEB, 2010).

Share costs to optimize expenditures and increase profitability (13%) refers to redesign efforts focused on cost sharing in regulatory compliance processes across an organization's business functions or between organizations to increase profitability and reduce costs. For example, redesigning processes to use common KYC services across many organizations or different business functions that are standardized and allow to share the cost of onboarding customers (WEB, 2018b).

The least discussed redesign in this category is *Drive operational efficiencies using existing compliance information* (5%). In many cases, the data required for compliance already exists within the organization but is not effectively used. Re-purposing risk-related information created in the onboarding process can help lower costs and drive revenue (Garvey et al., 2015). As pointed out in (Garvey et al., 2015), the process can be redesigned so the compliance data is readily available for, for example, the data analytic teams to create an improved picture of customer insight.

3.4.3 Digital technologies. We identified digital technologies as a strategy for redesigning customer onboarding processes. According to (Parviainen et al., 2017), digi-

talization is applying digital technologies or turning existing products into digital variants to offer advantages over tangible products. An example of digitalization is to replace face-to-face identity document verification with online video conferencing solutions (Adomavicius et al., 2017). Digitalization can also refer to applying innovative digital tools to fulfill gaps (no tools used previously) or remove inefficiencies from using legacy tools. For example, a strict outdated rule processing engine can be replaced with fully automated AI tools that better assess customer risk (Vysya and Shah, 2018).

The most common redesign concerning digital technologies is *Digitalize using innovative tools* (72% of papers). For instance, blockchain technology provides a uniform solution and reduces the aggregate cost of customer identification and verification across participating organizations (Soltani et al., 2018; Moyano and Ross, 2017). As discussed in (Moyano and Ross, 2017), the current KYC process requires customers with a relationship with multiple banks to perform the same process of exchanging and verifying documents with each bank. With blockchain technology, this process could be redesigned to remove duplicate efforts.

Also, processes can be redesigned to allow for self-service by introducing AI that provides answers automatically without human agent involvement, thereby enhancing customer support at a lower cost (Babu, 2019). Robotic Process Automation (RPA) refers to replacing manual processes with easy-to-deploy automatic solutions. For example, while the customer or the organization's representative can enter initial customer address information, an RPA solution automates most manual activities (Vysya and Shah, 2018).

Another typical redesign is to *Provide a digital identity and verification* (51%). As discussed in (Grace et al., 2016), onboarding processes can be redesigned to reduce inherent concerns of potential risk and AML threats by implementing a universally compatible digital identity solution. For instance, a bank ID can be used as a digital identity across public and private organizations in Norway. Similarly, organizations can redesign processes to use a digital identity to simplify and expedite the processes while meeting compliance requirements. Access to a verified digital identity allows the customer to be uniquely identifiable remotely by providing a set of personal attributes online, such as biometrics, thereby removing the need for physical meetings (Babu, 2019). In another example (Ralph, 2016), UK citizens can use the service available at "gov.uk" to prove their identity online when using public services. A redesign that enables such solutions simplifies onboarding citizens to new public services by either using an existing identity or creating one with a certified identity verification provider.

The redesign of *Leverage third party services and databases* refers to redesigning processes to take advantage of third-party services to streamline customer onboarding. As a redesign effort, organizations may, for example, integrate third-party providers to gather existing credit scores (like Experian[4] or Equifax[5]) or to take advantage of third-party custom credit scoring engines, or to implement fraud prevention systems through third parties (Adomavicius et al., 2017). Other redesigns would be to integrate blockchain-based digital identity networks in the identity verification process and

[4] https://www.experian.com/
[5] https://www.equifax.com/

e-signatures for contract signing (e.g., DocuSign[6]) (Adomavicius et al., 2017). Integrating third-party services can make a customer onboarding process faster and enable completing onboarding in a single sitting with the customer, with no follow-ups required (Garvey et al., 2015).

3.4.4 Data-driven decision making. Data-Driven Decision making (DDD) refers to methods that focus on data as the basis for decisions instead of relying on intuition (Brynjolfsson and McElheran, 2016). Redesigning the customer onboarding process to enable DDD is possible by automating data flows, integrating reporting into decision making, and centralizing data management. For instance, customer onboarding processes are redesigned by *Automate data flows* (53%). According to (WEB, 2017d), automation is a prerequisite for strategic customer onboarding projects (i.e., redesign efforts) by, for instance, creating electronic risk rules and auto-generated forms.

As commonly discussed, organizations make efforts to *Standardize and modernize processes* as a redesign effort (43%). According to authors of (WEB, 2007), different departments independently develop their customer onboarding processes. For instance, an organization might have different onboarding processes for business and private customers. They are highly incompatible and have few, if any, possibilities to reuse information between them. Therefore, although both departments belong to the same organization, they will onboard the same customer independently (WEB, 2007). Such issues can be alleviated by standardizing the onboarding processes across all departments and making the same essential tools available to all employees (WEB, 2007). Alternatively, existing processes can be streamlined or decommissioned to simplify customer onboarding (Garriock, 2016).

Another redesign is that of *Integrate reporting into decision making*, which is discussed in 38% of papers. For example, newly onboarded customers are the most likely at risk of attrition (Garvey et al., 2015; WEB, 2012). Onboarding processes can be redesigned to incorporate DDD that assesses the risk of attrition per customer (Garvey et al., 2015). When the risk of attrition is communicated to the sales teams, they can adapt their strategies to include growth activities that improve customer engagement, thereby reducing the risk of attrition.

Centralize data for 360-degree customer view (30%) is another redesign. Such a redesign involves implementing IT systems, such as a CLM system, to integrate onboarding with other systems (such as existing systems managing customers and accounts). Incorporating centralized data in onboarding processes, as discussed in (Watson and de Naurois, 2019), saves customers time and effort by, for example, removing excessive information requests and taking full advantage of existing customer data. This leads to less attrition during onboarding and higher satisfaction. In addition, when processes incorporate modern data management solutions based on a single data model (”360-degree customer view”)(Guiral et al., 2019), new opportunities arise, such as big data (to mine customer preferences and suggest additional products during onboarding), API-first systems (to avoid duplicate data entry), and automation (to provide real-time feedback to the customer while they are being onboarded) (Watson and de Naurois, 2019).

[6] https://www.docusign.com/

In 28% of papers, *Establish governance and oversight* is proposed. For example, in (Master and Pande, 2019), the authors report a redesign of setting up a Center of Excellence (CoE), a limited group of personnel in a credit card company, that focuses on the onboarding process and develops training materials, frameworks, and reporting hierarchy to improve on the existing process.

In 12% of the papers, *Break down silos through clarity of responsibilities* is discussed. Creating global policies for the onboarding process and revising the traditional team structures that work within this process allows for creating clear expectations on minimum standards and clarifies responsibilities, leading to a higher probability of completing the process and becoming customers (Guiral et al., 2019; WEB, 2019c).

3.5 Value of redesigning customer onboarding processes

In this sub-section, we present the reported values realized by redesigning onboarding processes (RQ5). We present the results according to the redesigns presented earlier and, therefore, concern customer experience, compliance, digital technologies, and data-driven decision making (see Tables 10 and 11).

3.5.1 Customer experience. The value of redesigning processes from a customer experience perspective impacts customer satisfaction and provides customers with better access to accounts, access to a variety of services, and personalization.

The most common customer experience value is in *Improved customer satisfaction*, which 39% of the papers discuss. For example, redesigning the process to support digital identity and streamlining workflows enables customers to complete the onboarding process more quickly, provide their credentials, and access their bank accounts with less effort. These changes increase customer satisfaction (Ralph, 2016; Master and Pande, 2019).

The second most common value in customer experience is the *Improved access to products* (35%). The value is gained through reduced effort in the process of onboarding customers for new products and improved likelihood of completion of onboarding (Kipkemboi, 2019; WEB, 2015a). Another value is *Increased variety of products* (27%). For instance, redesigning the identity verification process to make it fully digital enables the bank to offer additional products. Foundational products like credit or mortgages can be offered online if digital identity verification exists to confirm the identity of the customer (WEB, 2015a).

The last identified value is *Improved customer-centricity and personalization* (8%). These redesigns may allow for more creativity in customer engagement during the onboarding process phase as less time and effort are spent on low-value-adding activities. For instance, cross-sell opportunity prompts can be personalized (Garvey et al., 2015).

Table 10. Customer experience and compliance values of redesigning customer onboarding

Category	Value	Freq.	Description	Sample references
Customer experience	Improved customer satisfaction	39%	Higher customer satisfaction, trust, and goodwill leading to lower customer churn	(WEB, 2013),(WEB, 2019d),(Lowmaster, 2018)
	Improved access to products	35%	Seamless experience through reduced time for account setup and an easier account setup	(WEB, 2018c),(Parekh, 2020),(Garland et al., 2020)
	Increased variety of products	27%	Increased variety of products with omnichannel support, such as mobile	(Babu, 2019),(WEB, 2019b),(Kapoor, 2020b)
	Improved customer-centricity and personalization	8%	Improved creativity in customer engagement and personalization	(Garvey et al., 2015),(WEB, 2017c),(WEB, 2020g)
Compliance	Reduced compliance risks	53%	Enhanced theft identification and fraud prevention through improved credit scoring, a refined audit trail, risk categorization, and documentation.	(Lobo, 2012),(Lowmaster, 2018),(Christopher and Paul, 2020)
	More profitable customer relationships for the organization	51%	More profitable customer relationships through reduced costs and increased revenue	(Guiral et al., 2019),(Soltani et al., 2018),(Healy, 2020)
	Secure access to products	29%	Built-in privacy and security. Secure and convenient access for the customer with secure identification and authentication.	(McArdle et al., 2019),(Moyano and Ross, 2017),(Chui and Lee, 2020)

3.5.2 Compliance. The value of redesign for compliance is reduced compliance risks and costs, i.e., *Reduced compliance risks* (53%). This refers to public institutions' oversight and regulatory power over the organization to ensure their processes meet regulatory compliance requirements. Among the values of customer onboarding process redesign is the ability to better identify theft and prevent fraud during the onboarding process. For example, this may happen through improved credit scoring, refined audit trail capabilities, and improved risk categorization and documentation abilities (Vysya and Shah, 2018). Compliance risks are also reduced, for example, as a result of improved transparency into inefficiencies of processes, such as the discovery of gaps in risk assessment (Lobo, 2012).

The value of *More profitable customer relationships for the organization*, discussed in 51% of papers, arise through reduced costs and increased revenue as a result of, for example, decreased false positive fraud results during the onboarding process (WEB, 2017b, 2018d).

Secure access to products, discussed in 29% of papers, refers to security and privacy measures built into the organization's processes and historically, specifically its onboarding process of new customers, e.g., knowledge-based authentication in identity proofing (WEB, 2013). This allows for the feeling of security but also provides convenience. For example, in providing a fully digital onboarding process, allowing for secure customer identification and authentication makes the customer more willing to provide the necessary information for a bilateral trusted relationship to be created that satisfies authorities' regulatory requirements (Ralph, 2016).

3.5.3 Digital technologies. As stated in (Parviainen et al., 2017), the value of redesigning processes in digital technologies has the impact of cutting costs up to 90 percent and improving turnaround times up to several orders of magnitude. *Reusable and customizable services*, discussed in 18% of papers, refer to technical services built to meet the needs of and be adaptable to various stakeholders. This includes, for example, savings realized in the public sector as a result of digital transformation in identity verification processes (WEB, 2018f).

As a result of redesigning the process to work with modern reusable, highly customizable services, functions and responsibilities within the organization become more transparent and better support each other. For example, a single user interface for the end-to-end customer onboarding process can be implemented that includes a rule engine to easily comprehend customer risk (WEB, 2016). Reusable common services across organizations also provide value across institutions. For instance, in sharing KYC verifications across many financial institutions, customers only need to perform the identification process once and have it securely shared, thereby also reducing cost (Moyano and Ross, 2017).

Table 11. Digital technologies and data-driven decision making values of redesigning customer onboarding

Category	Value	Freq.	Description	Sample references
Digital technologies	Reusable and customizable services	18%	Reusable and customizable services allow for shared functions across the organization and interoperability	(Garvey et al., 2015),(McArdle et al., 2019),(Atick and Safdar, 2014)
Data-driven decision making	Increased employee productivity	43%	More efficient and effective operations and reduced staff requirements through modern standard processes and clearly defined customer touchpoints	(Babu, 2019),(Koenig, 2020),(Batt, 2020)
	Less manual steps and human error	29%	Less manual steps, redundancies, and rework, as well as less human error and handoffs	(Carlèn, 2017),(WEB, 2020i),(Agarwal et al., 2020)
	Improved customer insights	27%	Visibility into where the customer is in the process with advanced analytics and real-time transparency. Consolidated view of the customer and their preferences and desires, allowing for improved targeting	(WEB, 2016),(Moyano and Ross, 2017),(Gopalakrishnan et al., 2020)
	High-quality data	20%	High-quality, accurate, and up-to-date data enables data-driven decisions and requires less documentation	(WEB, 2018c),(Watson and de Naurois, 2019),(WEB, 2020j)
	Clear goals and collaboration across teams	8%	Alignment of clear goals across teams and departments improved collaboration	(WEB, 2019a),(WEB, 2020e),(Garland et al., 2020)

3.5.4 Data-driven decision making. The value of data-driven decision making is to reduce manual steps and human errors; improve customer insights and data quality. The most common value gained as part of DDD is *Increased employee productivity* (43%). This value arises from, for example, standardizing and modernizing internal operating processes (WEB, 2019c). For example, the value may be seen in AML investigators pivoting from repetitive tasks to evaluating AML risks (McArdle et al., 2019).

Another value is *Less manual steps and human error* (29%). According to (Beaumier et al., 2019), fewer manual processes provide a higher degree of optimized work environment for the onboarding process. The value of *Improved customer insights*, discussed in 27% of papers, benefits both the customer and the organization. Advanced real-time analytics allows for better product offerings to customers. According to one report, obtaining a single view of the customer has been the Holy Grail for decades - despite collecting increasingly more data, the ability to synthesize it into information and insight is lacking (Garvey et al., 2015).

Another value is that of *High-quality data (20%*. For example, as covered in (Watson and de Naurois, 2019), the implementation of modern CLM (*customer lifecycle management*) systems allows for high-quality data management during the process of onboarding. This data can, then, be confidently used for the rest of the customer lifecycle, thereby further enabling accurate data-driven decisions throughout the organization (Watson and de Naurois, 2019; Garvey et al., 2015).

A less common value, discussed in a total of 8% of papers, is *Clear goals and collaboration across business functions* (WEB, 2019a). Redesigning the process to handle the customer from the beginning of the first contact of the onboarding process as part of an overall business strategy makes it possible to make the customer relationship work for the business's goals and ambitions (Guiral et al., 2019).

4 Discussion

In this section, we discuss the definitions of customer onboarding from a business process perspective. Then, we present the Value-Driven Framework for Improving Customer Onboarding Processes in Financial Services (VDF-Onb). Finally, we discuss the limitations of our study.

4.1 Definitions of customer onboarding processes

The first research question concerned how customer onboarding is defined in the context of financial services. We note that onboarding has been defined differently. Although some of the definitions shared similarities, no two papers defined onboarding in the same way. The variety concerns non-overlapping areas, such as whether KYC is included, different start and end of onboarding processes, and perspectives, such as customer versus applicant-centered definitions. It seems that existing definitions can be divided into organizational- or customer-centric definitions. Organizational-centric definitions focus on achieving the organization's internal goals, e.g., fraud prevention. On the other hand, customer-centric definitions consider positive customer experience as the primary focus.

In financial services, the quest for an umbrella term for onboarding has been driven by regulatory requirements (i.e., organization's needs), which are imprecise by design. For example, the EU Anti-Money Laundering Directive requires institutions to identify customers and verify their identity using information from reliable and independent sources—however, guidelines for how are not provided (WEB, 2015b). At the same time, FinTechs are incorporating customer needs into customer onboarding, which is where the customer onboarding focus is in less-regulated markets (like educational platforms' onboarding) (Dieter and Tkacz, 2020; Renz et al., 2014).

Existing definitions (see Table 2) do not consider the business process perspective. For process analysts working with redesigning onboarding processes, specifically for digital solutions, it is helpful to have a definition that encapsulates the key components of onboarding and their relations. Therefore, we propose a definition of onboarding for financial services from a business process perspective. We aim to define customer onboarding in the context of financial industries. An industry-agnostic definition of onboarding would be too generic and, therefore, not accommodate the specific needs of financial institutions. For instance, for banks, some definitions express the customer onboarding definition exclusively through the *Fulfill CDD Procedures* sub-process (more specifically, the KYC requirements fulfillment) as discussed in Section 3.1 and Table 2. On the other hand, for example, music streaming services focus on post-registration to help customers understand product features (Aspen, 2017).

Based on the following discussion, we define onboarding for financial industries from a business process perspective as follows: *Customer onboarding starts with the first interaction between the financial services provider and the customer, fulfills the goal for the financial institution to uniquely identify the customer, verify their identity and obtain insights into the customer's activities on an ongoing basis in order to prevent illegal activities, and understand the customer and help the customer understand the product.*

According to (Aguilar-Saven, 2004) *a business process is the combination of a set of activities within an enterprise with a structure describing their logical order and dependence whose objective is to produce a desired result*. Therefore, our business process-oriented definition includes a start and an end of the process, key activities, their dependency on each other, and their logical ordering. Given these requirements, we include the start (i.e., the first interaction), the goal-driven end (i.e., the mutual understanding achievement), and key activities (i.e., identification, verification, insights) in the above definition and consider activities dependencies and logical ordering in the following discussion. Furthermore, we consider organizational- and customer-centric aspects necessary for a successful relationship. Thus, the definition should incorporate both, i.e., facilitate understanding of the customer and help the customer understand the product.

The onboarding definitions identified from the papers include an explicit starting point for the process, i.e., the first interaction between the financial institution and the customer (Table 2). Furthermore, the sub-processes of *Create Onboarding Request* and *Approve Request* are the two most common sub-processes (shown in Table 4, and Create Onboarding Request and Approve Request are often the first sub-processes (see Table 5). Therefore, we follow the approach that the customer onboarding process starts with

the first interaction between the financial services provider and the customer. As a result, we define the start as *the first interaction between the financial services provider and the customer*.

Our review did not indicate a clear end-point for the onboarding process (see Section 3.2.2). A customer-oriented view considers onboarding happens once and often is defined to end when the customer account is set up (WEB, 2017c; Clark et al., 2015). A product-oriented view considers onboarding per product (Garvey et al., 2015; Paknikar et al., 2014). A continuous view takes the approach that onboarding essentially never ends (Carlèn, 2017). Rather than defining a specific sub-process as an end-point, we define the end-point of the process to be the achievement of the goal, i.e., when the process fulfills the goal for the financial institution to understand the customer and help the customer understand the product.

The components of the onboarding process are derived from the sub-processes (see Table 4) in combination with the goal of the process as discussed above. Internally, for an organization, the goal is to focus on understanding the customer. This is done through proxies such as customer identity verification (such as the *Check KYC* sub-process) and risk and regulatory compliance-specified requirements (such as the *Check AML* sub-process), collectively termed here as the *Fulfill CDD Procedures* sub-process (see Table 4). Furthermore, this is also conducted continuously to ensure compliance (see Table 4 under *Perform Monitoring, Reporting, and Analytics*). Therefore, onboarding includes identifying the customer, verifying their identity, and obtaining insights into the customer's activities on an ongoing basis. As a result, we explicitly specify these key activities in the definition by concluding that the institution must *uniquely identify the customer, verify their identity, and obtain insights into the customer's activities on an ongoing basis in order to prevent illegal activities*.

4.2 Value-driven framework for improving customer onboarding processes in financial services

This paper proposes a Value-Driven Framework for Improving Customer Onboarding Processes in Financial Services (VDF-Onb). This section explains the framework's structure, how to read it, and who could benefit from it.

The framework is derived from the research questions about issues in customer onboarding, the redesigns to apply, and the resulting values. We grouped these dimensions into various categories to create the framework and ordered them by frequency. As a result, the framework can aid practitioners, such as business and process analysts, to improve their digital onboarding processes for financial products. It will complement methodologies such as co-design, serving as a guideline on where efforts should be focused (Taveter et al., 2022). Thus, the framework enables analysts to comprehensively understand main issues, potential solutions, and alternative redesigns when improving onboarding processes.

The VDF-Onb framework is divided into three top-level columns: value, redesign, and issue (see Figure 2). The value column represents the reported values realized by redesigning onboarding processes (further detail in Section 3.5). Value, therefore, indicates the objective of the redesign. The redesign column represents the changes that, if applied, can contribute to achieving the values (further detail in Section 3.4). The issue

column represents the underlying inefficiencies that motivate the need for a redesign (further detail in Section 3.3).

The value, redesign, and issue columns are further divided into name, description, and category. Name is the term used for the value, redesign, or issue, while description elaborates the context. Below each name and description, references where such values, redesigns, or issues have been discussed, are provided.

As shown in the framework in Figure 2, the category columns group the values, redesigns, and issues side by side. The first column captures the value as the framework starts from the potential value achieved. To achieve a certain value, redesigns are necessary. Therefore, the redesign is next to the value. The redesigns must be implemented to address a specific issue or issues. Thus, the redesigns and issues are directly linked and reside side-by-side. Therefore, the column immediately left of the redesigns is the issues column.

A process analyst might seek to improve a process by capitalizing on the value of high-quality data. They will discover this value in the leftmost column as part of the data-driven decision making sub-category. Reviewing other values in the sub-category, the analyst discovers closely related values, such as increased employee productivity, less manual steps, and human error. This information can be used to acknowledge other areas of the business that are affected as a result of aiming for higher-quality data. Having specified the targeted value and acknowledged potentially coupled values, the analyst looks at the potential redesign alternatives. The analyst can then weigh the options according to their specific business issues and decide which redesigns to pursue.

For further information, analysts can look to the column on the right, where a list of issues is presented. These issues are presented from most to least common. With this information, the analyst can look at the assigned goal to assess whether the current business situation is critical enough for the business to pursue. Starting from the most common issue in the organizational category, lack of automation, the analyst can assess how this issue compares to other issues that could be improved. Then, the next issue, high error rates as a result of lack of standardization, can be assessed. Thus, the analysts can consider whether a particular business goal should be undertaken. Alternatively, the framework can be read from right to left. Practitioners can start from the most common issues under each category, weigh them against their business situation, and select the most appropriate redesigns.

To complement the framework presented in Figure 2, we present a detailed description in Tables 12, 13, 14 and 15. The structure follows the same approach as the framework. Additionally, each value, redesign, and issue have an accompanying description and relevant references to the original sources.

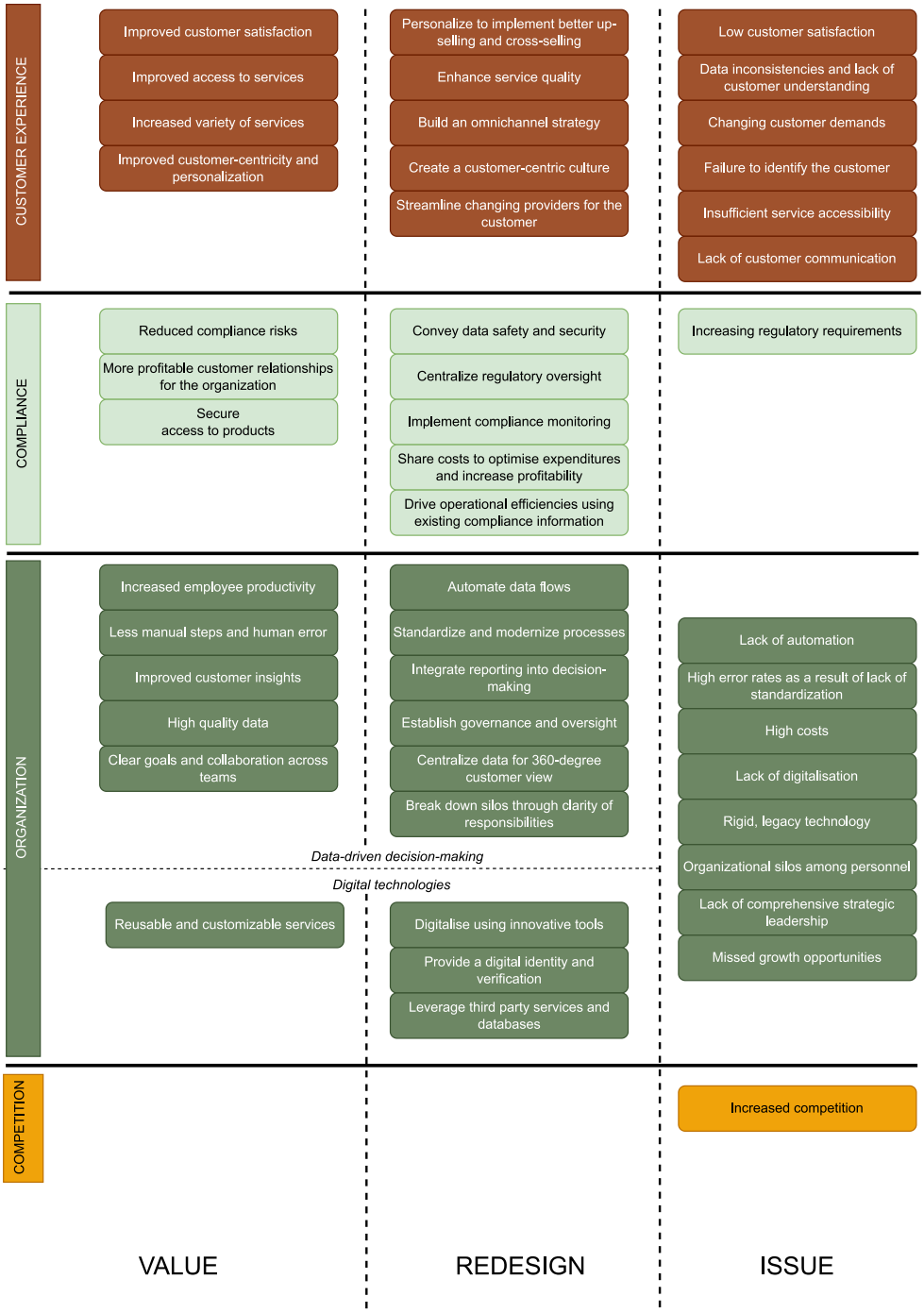


Fig. 2. Value-driven framework (VDF-Onb)

Table 12. Description of the value-driven framework for improving customer onboarding processes (VDF-Onb) (part 1, with sample references)

VALUE			REDESIGN			ISSUE	
NAME	DESCRIPTION	CAT.	NAME	DESCRIPTION	CAT.	NAME	DESCRIPTION
Improved customer satisfaction	Higher customer satisfaction, trust, and goodwill leading to lower customer churn	Customer experience	Personalize to implement better up-selling and cross-selling	Implement up-selling and cross-selling functionality combined with personalization and proactive communication. Prefer product-account holder match timing over using preset sequences	Customer experience	Low customer satisfaction	Customer satisfaction is impacted by inconsistent user experience; lack of customer-centricity affects processes that become boring, slow, and frustrating
(WEB, 2013),(WEB, 2019d),(Healy, 2020)			(WEB, 2012),(WEB, 2010),(WEB, 2019a)			(Grace et al., 2016),(WEB, 2019b),(Batt, 2020)	
Improved access to products	Seamless experience through reduced time for account setup and an easier account setup		Enhance service quality	Provide 24/7 services using instant and real-time channels with offline capabilities. Provide convenience through personalized customer support		Data inconsistencies and lack of customer understanding	Inaccurate or missing customer data have effects in incorrect or missing reporting due to low information quality; duplicate and scattered data do not support a single customer view and cause customer information silos
(Agarwal et al., 2020),(Tyrzyk, 2020),(Christopher and Paul, 2020)			(Garriock, 2016),(WEB, 2012),(WEB, 2017d),(Adomavicius et al., 2017)			(WEB, 2017a),(WEB, 2017c),(Bitterli et al., 2020)	
Increased variety of products	Increased variety of products with omnichannel support, such as mobile		Build an omnichannel strategy	Build a comprehensive omnichannel strategy that includes modern platforms such as mobile devices. Provide intuitive user interfaces with a unified design and user-friendly functionality		Changing customer demands	Changing customer preferences, expectations, and demands cause the need to innovate, which is hindered by rigid business rules, outdated banking operating models, and operational processes
(WEB, 2016),(WEB, 2018c),(WEB, 2011)			(Garriock, 2016),(WEB, 2015a),(WEB, 2019c)			(Watson and de Naurois, 2019),(Soltani et al., 2018),(Kapoor, 2020a)	
Improved customer-centricity and personalization	Improved creativity in customer engagement and personalization as a result of a customer-centric organization		Create a customer-centric culture	Create a customer-centric company culture and use customer-focused approaches, such as minimizing requested data from customers and not tracking or selling user activity		Failure to identify the customer	Identification and authentication gaps cause institutions not to be able to trust the customer to do business with them leaving many potential customers unbanked
(Gopalakrishnan et al., 2020),(WEB, 2020g),(WEB, 2020k)			(Garvey et al., 2015),(WEB, 2019c),(WEB, 2018d)			(WEB, 2018f),(WEB, 2020b),(Monaghan, 2020)	
			Streamline changing providers for the customer	Ease the process of changing financial services providers for the customer		Insufficient service accessibility	Low accessibility of services such as the requirement for the customer to be physically present for agreements, lack of offline or omnichannel support, or limited business working hours leave customers disconnected
			(Koenig, 2020),(WEB, 2020e),(WEB, 2020f)			(WEB, 2020a),(Dieter and Tkacz, 2020),(Kapoor, 2020b)	
						Lack of customer communication	Transparency issues leave customers unsure of their situation with the institution, progress of applications, and completion of documents
						(WEB, 2007),(Master and Pande, 2019),(WEB, 2020i)	

Table 13. Description of the value-driven framework for improving customer onboarding processes (VDF-Onb) (part 2, with sample references)

VALUE			REDESIGN			ISSUE		
NAME	DESCRIPTION	CAT.	NAME	DESCRIPTION	CAT.	CAT.	NAME	DESCRIPTION
Reduced compliance risks	Enhanced theft identification and fraud prevention through improved credit scoring, a refined audit trail, risk categorization, and documentation.	Compliance	Convey data safety and security	Convey data safety and security to the customer by protecting customer data, maintaining data integrity, tightly controlling data access, and setting up quality controls and effective safeguards		Compliance	Increasing regulatory requirements	Fast changing, difficult to understand and increasing regulatory requirements increase risks of failing to comply, becoming victim to fraud and reputational harm
(Healy, 2020),(Joshi and Kar, 2020),(WEB, 2020j)			(Guiral et al., 2019),(Babu, 2019),(Underwood et al., 2019)				(WEB, 2017b),(Lowmaster, 2018),(Soltani et al., 2018)	
More profitable customer relationships for the organization	More profitable customer relationships through reduced costs and increased revenue		Centralize regulatory oversight	Centralize regulatory oversight and compliance to simplify fulfilling regulatory requirements for the customer and avoid excessive compliance information requests				
(Tyrzyk, 2020),(Garland et al., 2020),(WEB, 2020d)			(WEB, 2018c),(Master and Pande, 2019),(Atick and Safdar, 2014)					
Secure access to products	Built-in privacy and security. Secure and convenient access for the customer with secure identification and authentication.		Implement compliance monitoring	Implement compliance monitoring and customer regrading at appropriate times in the customer lifecycle to decrease duplication of effort and increase adherence to regulatory requirements				
(WEB, 2020f),(Chui and Lee, 2020),(WEB, 2020h)			(Garvey et al., 2015),(WEB, 2012),(Ralph, 2016)					
			Share costs to optimize expenditures and increase profitability	Find methods to share costs on regulatory requirements fulfillment to increase profitability				
			(WEB, 2018b),(WEB, 2019c),(WEB, 2018f)					
			Drive operational efficiencies using existing compliance information	Explore strategic possibilities of using the risk, regulatory and compliance data that already exists within the organization				
			(Garvey et al., 2015),(Beaumier et al., 2019)					

Table 14. Description of the value-driven framework for improving customer onboarding processes (VDF-Onb) (part 3, with sample references)

VALUE			REDESIGN			ISSUE		
NAME	DESCRIPTION	CAT.	NAME	DESCRIPTION	CAT.	CAT.	NAME	DESCRIPTION
Reusable and customizable services	Reusable and customizable services allow for shared functions across the organization and interoperability	Digital technologies	Digitalize using innovative tools	Increase digitalization by developing new tools, implementing off-the-shelf tools, eliminating legacy software, and integrating innovative technologies such as AI, blockchain, RPA, and cloud technologies	Digital technologies	Organization	Lack of automation	Manual processes and lack of automation
(WEB, 2016),(WEB, 2018f),(Moyano and Ross, 2017)			(Babu, 2019),(Christopher and Paul, 2020),(Klidjian, 2020)				(WEB, 2017d),(Koenig, 2020),(Garland et al., 2020)	
			Provide a digital identity and verification	Create a suite of digital verification and authentication methods by allowing digital document uploading, digital signatures, digital identity creation, multimodal biometrics			High error rates as a result of lack of standardization	Long, complex, and overcomplicated processes, as well as bad staff training, lack of standardization, low specialization, and high volume work, are among the many factors causing high error rates
			(Ralph, 2016),(WEB, 2020a),(Chui and Lee, 2020)				(Carlén, 2017),(Beaumier et al., 2019),(Christopher and Paul, 2020)	
			Leverage third party services and databases	Leverage third-party services, APIs, and national databases for decision support			Organizational silos among personnel	Lack of coordination and communication across teams and departments, but also across organizations, lead to persistent organizational silos and duplication of information and effort
			(Wood and Chugani, 2017),(Adomavicius et al., 2017),(Dieter and Tkacz, 2020)				(Watson and de Naurois, 2019),(Soltani et al., 2018),(WEB, 2020e)	
							High costs	High costs
							(Vysya and Shah, 2018),(Underwood et al., 2019),(Moyano and Ross, 2017)	

Table 15. Description of the value-driven framework for improving customer onboarding processes (VDF-Onb) (part 4, with sample references)

VALUE			REDESIGN				ISSUE	
NAME	DESCRIPTION	CAT.	NAME	DESCRIPTION	CAT.	CAT.	NAME	DESCRIPTION
Increased employee productivity	More efficient and effective operations and reduced staff requirements through modern standard processes and clearly defined customer touchpoints	Data-driven decision making	Automate data flows	Automate data flows, remove manual steps, reduce steps, minimize data entry, and increase the availability of accurate data	Data-driven decision making	Organization	Lack of digitalization	Lack of digitalization results in processes being excessively paper based
(WEB, 2019b),(Koenig, 2020),(WEB, 2020b)			(WEB, 2018d),(WEB, 2019a),(Kapoor, 2020a)				(Tufchi, 2016),(Watson and de Naurois, 2019),(WEB, 2020d)	
Less manual steps and human error	Less manual steps, redundancies, and rework, as well as less human error and handoffs		Standardize and modernize processes	Increase transparency and consistency by using modern approaches and taking advantage of existing industry standards			Rigid, legacy technology	Legacy technology and infrastructure that is not properly maintained, updated, and replaced result in rigid, inflexible, and inefficient systems
(WEB, 2020i),(Tyrzyk, 2020),(Klidjian, 2020)			(WEB, 2019a),(Batt, 2020),(WEB, 2020d)				(Lowmaster, 2018),(WEB, 2020i),(WEB, 2020k)	
Improved customer insights	Visibility into where the customer is in the process with advanced analytics and real-time transparency. Consolidated view of the customer and their preferences and desires, allowing for improved targeting		Integrate reporting into decision making	Integrate analytics, reporting, and performance metrics to identify customers at risk of attrition and high-value segments, as well as acquire the "right" account holder and create optimal customer tiers			Lack of comprehensive strategic leadership	Ad hoc problem solving, uninformed decision making, short-term thinking, and misaligned strategic action and thinking are among the executive leadership problems
(WEB, 2019c),(WEB, 2020g),(Garland et al., 2020)			(Agarwal et al., 2020),(Chui and Lee, 2020),(WEB, 2020j)				(WEB, 2017a),(WEB, 2019c),(Monaghan, 2020)	
High-quality data	High-quality, accurate, and up-to-date data enables data-driven decisions and requires less documentation		Centralize data for 360-degree customer view	Create a 360-degree customer view, increase clean data, and standardize data structures by centralizing and aggregating data and data flows			Missed growth opportunities	Revenue opportunities are foregone, and customer base growth opportunities are missed by not taking advantage of cross-selling and up-selling approaches
(Lowmaster, 2018),(Kapoor, 2020b),(WEB, 2020h)			(Kapoor, 2020a)(Tyrzyk, 2020),(WEB, 2020d)				(WEB, 2007),(Babu, 2019),(Gopalakrishnan et al., 2020)	
Clear goals and collaboration across teams	Alignment of clear goals across teams and departments; improved collaboration		Establish governance and oversight	Establish a strategic governing body that will design an optimal target operating model and focuses on leading and managing change and enabling collaboration				
(Christopher and Paul, 2020),(Parekh, 2020),(Bitterli et al., 2020)			(Atick and Safdar, 2014),(WEB, 2020c),(Joshi and Kar, 2020)					
			Break down silos through clarity of responsibilities	Provide ownership of business functions and break down siloes by creating efficiency through clarity of responsibilities				
			(WEB, 2018c),(Beaumier et al., 2019),(Garland et al., 2020)					

4.3 Limitations

The method of literature review studies has inherent threats to validity. We found academic literature in this field to be scarce. Therefore, the majority of the papers are from non-academic sources, such as reports and whitepapers, leading to a possible subjective quality assessment threat as specified in (Zhou et al., 2016). As a result of the lack of academic papers, the definition for many of the terms and how they are used is not available in academic literature. However, they may be commonplace in the private sector. This may be a cause for the threat to validity of the lack of standard languages and terminologies where different terms for similar concepts are used (Zhou et al., 2016).

Among the private sector papers, the domain for discussion is fairly concentrated in one industry. This would likely bias any framework meant to be transferable across business industries leading to the generalizability threat to validity as specified in (Ampatzoglou et al., 2019) and (Zhou et al., 2016), hence why the discussion here is also limited to the financial services industry. It is also unreasonably challenging to identify whether the papers have passed a rigorous review process, so excessive weight may be given to low-quality papers and be a source of researcher bias, subjective interpretation bias in quality assessment (Ampatzoglou et al., 2019; Zhou et al., 2016).

5 Conclusion

This paper investigated the current body of knowledge on customer onboarding processes in the financial industry. We investigated the issues present in the industry, redesigns implemented to address them, and the values they provide through a multivocal literature review (MLR), a form of SLR.

As a contribution, we aggregated the results into a value-driven framework for improving customer onboarding processes (VDF-Onb). The framework covers issues in the customer onboarding processes, the redesigns that can be applied to the issues, and finally, possible values that may arise from having performed the redesigns. We consider the primary audience who benefit from such a framework to be business and process analysts who work with redesigning onboarding processes in the digital financial solutions area, as the framework encapsulates the key components of onboarding and their relations. We believe the framework to be especially useful to financial institutions looking to maintain and grow their customer base through improved customer experience amidst increasing competition from FinTech companies and within the constraints of increased regulations (such as KYC and AML).

In the future, we aim to explore how customer onboarding processes can be improved by conducting in-depth interviews with domain experts. The aim is to unravel more details that can later be used for designing an approach to improve onboarding processes systematically.

References

Adomavicius, A., Price, E., Wilkinson, C. (2017). Digital customer onboarding: Building valuable customer experiences through digital bank channels, available at `https://dbcms.s3.`

amazonaws.com/devbridgecom/bcms/file/7fd3b314b0324639b297b5ad6b680a49/DB_WhitePaper_DigitalCustomerOnBoarding.pdf.

Agarwal, P., Kapoor, S., Agarwal, S., Seth, S. (2020). Future of robo-advisors in investment and wealth management, available at https://www.wipro.com/content/dam/nexus/en/industries/securities-and-capital-markets/latest-thinking/future-of-robo-advisors-in-investment-and-wealth-management.pdf.

Aguilar-Saven, R. S. (2004). Business process modelling: Review and framework, *International Journal of production economics* **90**, 129–149.

Ampatzoglou, A., Bibi, S., Avgeriou, P., Verbeek, M., Chatzigeorgiou, A. (2019). Identifying, categorizing and mitigating threats to validity in software engineering secondary studies, *Information and Software Technology* **106**, 201–230.

Aspen, L. L. (2017). Designing for the modern music consumer-onboarding and loyalty building of new users to a music streaming service.

Atick, J. J., Safdar, Z. (2014). Digital identity toolkit a guide for stakeholders in africa, available at https://openknowledge.worldbank.org/bitstream/handle/10986/20752/912490WP0Digit00Box385330B00PUBLIC0.pdf.

Babu, S. (2019). Enhancing customer acquisition through digital account opening, available at https://www.tcs.com/content/dam/tcs-bancs/pdf/bancsprotected/Enhancing%20Customer%20Acquisition%20through%20Digital%20Account%20Opening.pdf.

Banga, A. (2019). Transforming sme lending: Using deep learning to create an internal data marketplace, available at https://www.tcs.com/content/dam/tcs/pdf/discover-tcs/Research-and-Innovation/Transforming-SME-Lending.pdf.

Batt, A. (2020). Fic: Overview of regulatory measures to speed up further digitalization of financial services in serbia, available at https://fic.org.rs/wp-content/uploads/2020/12/FIC-Initiative-Digitalization-of-financial-services-in-Serbia.pdf.

Bauer, T. N. (2010). Maximizing success, *SHRM Foundation's Effective practice guidelines series* .

Beaumier, C., Creegan, S., Brauneis, M., Moore, M., Reese, B., Taylor, M., Irving, K., Gavin, E. (2019). Anti-money laundering - getting to efficient, available at https://www.protiviti.com/sites/default/files/united_kingdom/insights/aml-getting-to-efficient-protiviti_global.pdf.

Bitterli, M., Pisa, T., Pennetti, M. (2020). Client onboarding: Our way to enhance your client's onboarding experience, available at https://www2.deloitte.com/content/dam/Deloitte/ch/Documents/financial-services/deloitte-ch-en-fs-kyc-client-onboarding.pdf.

Brynjolfsson, E., McElheran, K. (2016). The rapid adoption of data-driven decision-making, *American Economic Review* **106**, 133–39.

Carlèn, F. (2017). User onboarding: An investigation in how to increase the activation of new customers using design, available at http://publications.lib.chalmers.se/records/fulltext/252779/252779.pdf.

Chadegani, A. A., Salehi, H., Yunus, M. M., Farhadi, H., Fooladi, M., Farhadi, M., Ebrahim, N. A. (2013). A comparison between two main academic literature collections: Web of science and scopus databases, *arXiv preprint arXiv:1305.0377* .

Christopher, S., Paul, C. (2020). Know your customer strategies for a successful due diligence program during the covid-19 pandemic, available at https://us.nttdata.com/en/-/media/assets/white-paper/know-your-customer-whitepaper-21-july-2020.pdf.

Chui, D., Lee, J. (2020). Key observations of insurers' aml/cft control on virtual customer onboarding, available at https://www.ia.org.hk/en/supervision/antimoney_laundering/files/AML_Online_Sharing_Session_20201204_Presentation.pdf.

Clark, A., Connors, M., Wang, C. (2015). Redefining the wealth management client onboarding experience, available at https://www.accenture.com/hu-en/~/media/Accenture/Conversion-Assets/DotCom/Documents/Global/PDF/Industries_12/Accenture-Redefining-Wealth-Management-Client-Onboarding.pdf.

Dieter, M., Tkacz, N. (2020). The patterning of finance/security: A designerly walkthrough of challenger banking apps, *Computational Culture* .

Fagerholm, F., Johnson, P., Guinea, A. S., Borenstein, J., Münch, J. (2013). Onboarding in open source software projects: A preliminary analysis, *2013 IEEE 8th international conference on global software engineering workshops*, IEEE, pp. 5–10.

Gai, K., Qiu, M., Sun, X. (2018). A survey on fintech, *Journal of Network and Computer Applications* **103**, 262–273.

Garcia, M. G., Watt, J. L., Falder-Saeed, K., Lewis, B., Patton, L. (2017). Orienting and onboarding clinical nurse specialists: a process improvement project, *Clinical Nurse Specialist* **31**(3), 163–168.

García, M. K., Venegas, E., Aguilera, E., Panizo, J. M., Kelly, C., Serrano, D. et al. (2021). Digital onboarding in finance: a novel model and related cybersecurity risks, *Open Research Europe* **1**.

Garland, B., Cameron, T., Nuottajarvi, E. (2020). The future of client onboarding, available at https://www.sifma.org/wp-content/uploads/2020/04/IHS-Markit-and-SIFMA-AMG-The-Future-of-Client-Onboarding.pdf.

Garousi, V., Felderer, M., Mäntylä, M. V. (2016). The need for multivocal literature reviews in software engineering: Complementing systematic literature reviews with grey literature, *Proceedings of the 20th International Conference on Evaluation and Assessment in Software Engineering*, EASE '16, Association for Computing Machinery.

Garousi, V., Felderer, M., Mäntylä, M. V. (2019). Guidelines for including grey literature and conducting multivocal literature reviews in software engineering, *Information and Software Technology* **106**, 101–121.

Garriock, D. (2016). Customer digital onboarding, available at https://www.experian.co.uk/assets/business-services/brochures/digital-onboarding.pdf.

Garvey, J., Savelloni, M., Inserro, R., Sidebottom, P., Nicolacakis, D., Prasad, M. (2015). Delivering the onboarding experience customers demand, available at https://www.pwc.se/sv/pdf-reports/fs-viewpoint-all-aboard.pdf.

Gopalakrishnan, S., Sahoo, D., Ghosh, J., Callahan, C., Basu, A. (2020). Client-facing technologies for investment banks, available at https://www2.deloitte.com/content/dam/Deloitte/us/Documents/process-and-operations/us-client-facing-technologies-for-investment-banks.pdf.

Grace, D., Joyce, S., Clark, A., Loy, V. (2016). The future of onboarding, available at https://www.pwc.com/il/he/bankim/assets/pwc-the-future-of-onboarding.pdf.

Guiral, P., Jones, J., West, B. (2019). Happier clients. more profitable relationships through client lifecycle management, available at https://www.accenture.com/_acnmedia/pdf-108/accenture-happier-clients-and-profitable-relationships-through-client-lifecycle-management.pdf.

Healy, R. (2020). Anti-money laundering. the pillars of aml compliance, available at https://veriphy.com/wp-content/uploads/2020/01/Anti-Money-Laundering-Guide-Pillars-of-AML-Compliance.pdf.

Joshi, M., Kar, A. (2020). Transforming customer onboarding with ai, available at https://www.infosys.com/industries/financial-services/insights/documents/transforming-customer-onboarding-ai.pdf.

Kapoor, A. (2020a). Account opening software, available at https://landing.newgensoft.com/hubfs/_2020%20Website%20files/Brochures/Brochure_%20Online%20Account%20Opening%20Software.pdf.

Kapoor, A. (2020b). Newgen touchless customer onboarding application, available at https://landing.newgensoft.com/hubfs/_2020%20Website%20files/Brochures/Brochure%20-%20Newgen%20Touchless%20Customer%20Onboarding%20Application.pdf.

Kipkemboi, K. (2019). Overcoming the know your customer hurdle: Innovative solutions for the mobile money sector, available at https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2019/02/Overcoming-the-KYC-hurdle-Innovative-solutions-for-the-mobile-money-sector-1.pdf.

Kitchenham, B. (2004). Procedures for performing systematic reviews, *Keele, UK, Keele University* **33**(2004), 1–26.

Klidjian, D. (2020). Compliance operating model deep-dive, available at https://www.pwc.ch/de/publications/2020/compliance_operating_model_deep-dive.pdf.

Koenig, K. (2020). Unlocking financial inclusion, available at https://www.asbasupervision.com/en/bibl/publications-of-asba/working-groups/2483-03-unlocking-financial-inclusion/file.

Kosa, M., Yilmaz, M. (2016). Gamifying the onboarding process for novice software practitioners, *European Conference on Software Process Improvement*, Springer, pp. 242–248.

Lobo, C. (2012). Risk based approach - putting it into practice, available at http://www.dfsa.ae/Documents/Events%202012/RBA%20-%20Putting%20it%20into%20practice.pdf.

Lowmaster, K. (2018). Private sector economic impacts from identification systems, available at http://documents1.worldbank.org/curated/en/219201522848336907/Private-Sector-Economic-Impacts-from-Identification-Systems.pdf.

Master, K., Pande, K. (2019). Banking and financial services: Solutions to enable digital transformation for customer onboarding, available at https://www.exlservice.com/resources/assets/library/documents/Case-Booklet.pdf.

McArdle, P. J., Klauder, A., DeStefano, L. (2019). Technology innovation in aml, sanctions, and kyc/due diligence: Reality vs. aspirations, available at https://guidehouse.com/-/media/www/site/insights/gic/2019/san20_chapter-6---navigant.pdf.

Milani, F. (2019). *Digital business analysis*, Springer.

Mohanty, D. (2013). Efficient client onboarding: The key to empowering banks, available at https://www.cognizant.com/InsightsWhitepapers/Efficient-Client-Onboarding-The-Key-to-Empowering-Banks.pdf.

Monaghan, A. (2020). Notice on financial penalty to commerzbank due to failure to maintain controls, policies and procedures to comply with aml laws and requirements, available at https://www.fca.org.uk/publication/final-notices/commerzbank-ag-2020.pdf.

Moyano, J. P., Ross, O. (2017). Kyc optimization using distributed ledger technology, *Business and Information Systems Engineering* **59**, 411–423.

Paknikar, S., Arya, A., Karni, G., Kumar, S., Mehta, V. (2014). Data visualization & reporting for case management, available at https://www.happiestminds.com/whitepapers/data-visualization-and-reporting-for-case-management.pdf.

Parekh, I. (2020). Trade lifecycle transformation through rpa, available at https://www.capco.com/-/media/CapcoMedia/Capco-2/PDFs/Trade_Lifecycle_Transformation_Through_RPA.ashx.

Parviainen, P., Tihinen, M., Kääriäinen, J., Teppola, S. (2017). Tackling the digitalization challenge: how to benefit from digitalization in practice, *International journal of information systems and project management* **5**(1), 63–77.

Ralph, L. (2016). Digital identity across borders: opening a bank account in another eu country, available at https://oixuk.org/wp-content/uploads/2016/10/Digital-Identity-Across-Borders-FINAL-Feb2016-2.pdf.

Renz, J., Staubitz, T., Pollack, J., Meinel, C. (2014). Improving the onboarding user experience in moocs.

Singh, V. K., Singh, P., Karmakar, M., Leta, J., Mayr, P. (2021). The journal coverage of web of science, scopus and dimensions: A comparative analysis, *Scientometrics* **126**, 5113–5142.

Soldani, J., Tamburri, D. A., Van Den Heuvel, W.-J. (2018). The pains and gains of microservices: A systematic grey literature review, *Journal of Systems and Software* **146**, 215–232.

Soltani, R., Nguyen, U. T., An, A. (2018). A new approach to client onboarding using self-sovereign identity and distributed ledger, *2018 IEEE International Conference on Internet of Things (iThings) and IEEE Green Computing and Communications (GreenCom) and IEEE Cyber, Physical and Social Computing (CPSCom) and IEEE Smart Data (SmartData)*, IEEE, pp. 1129–1136.

Steinmacher, I., Conte, T. U., Treude, C., Gerosa, M. A. (2016). Overcoming open source project entry barriers with a portal for newcomers, *Proceedings of the 38th International Conference on Software Engineering*, pp. 273–284.

Taveter, K., Ainamo12, A., Iqbal, T., Mooses, K. (2022). A comparative study of two co-design methodologies, *'Designing the Future'5-6 October 2022* .

Touil, K. (2016). Risk-based approach: Understanding and implementation, available at `http://files.acams.org/pdfs/2016/Risk-Based_Approach_Understanding_and_Implementation_K_Touil.pdf`.

Tufchi, S. (2016). Digitizing customer onboarding for capital markets and banks, available at `https://www.mphasis.com/content/dam/mphasis-com/global/en/downloads/WhitePapers/Digitizing-Customer-Onboarding-for-Capital-Markets-and-Bank.pdf`.

Tyrzyk, R. (2020). Written evidence submitted by mr roger tyrzyk, idnow (c190018), available at `https://committees.parliament.uk/writtenevidence/2899/pdf/`.

Underwood, S., Wilbraham, A., Delaney, A. P., Underwood, S., Mcaughtry, L., Webb, J., Ansley, P., Hill, L., Mckeon, J.-A., Zyl, L. V., Snelling, C., Wilbraham, R., Wilbraham, S., Wren, V. (2019). Entity data management handbook, available at `https://a-teaminsight.com/wp-content/uploads/2018/12/A-Team_Group_Entity-Data-Handbook-4th-Edition-Dec2018-1.pdf`.

Vysya, V. N., Shah, K. (2018). Robotic process automation (rpa) in aml and kyc, available at `https://www.infosys.com/industries/financial-services/white-papers/Documents/robotic-process-automation-aml-kyc.pdf`.

Watson, G., de Naurois, F. (2019). Digitalizing client lifecycle management for better customer experiences.

WEB (2007). Improving account opening processes to increase customer loyalty, available at `https://www.adobe.com/financial/pdfs/account_opening_wp.pdf`.

WEB (2009). What is direct debit?, available at `https://www.directdebit.co.uk/DirectDebitExplained/Pages/WhatIsDirectDebit.aspx`.

WEB (2010). Next generation customer onboarding: Driving an automated, integrated multi-channel onboarding strategy, available at `http://www.pbinsight.com/files/resource-library/resource-files/pbbi-next-gen-cust-onboarding.pdf`.

WEB (2011). Integrated client onboarding: turning obligation into opportunity, available at `https://dsimg.ubm-us.net/envelope/143932/367322/1323899648_NexJ-Client-Onboarding.pdf`.

WEB (2012). 10 strategies for an award-winning onboarding process, available at `https://insight.harlandclarke.com/wp-content/uploads/2012/04/10_Strategies_for_Onboarding.pdf`.

WEB (2013). The role of knowledge based authentication (kba) in identity proofing, available at `http://lexisnexis.com/risk/downloads/idm/role-of-knowledge-based-authentication-in-identity-proofing.pdf`.

WEB (2015a). Digital account opening, available at https://www.miteksystems.com/sites/default/files/Documents/dbr_237_final_8-26-15.pdf.

WEB (2015b). Directive (eu) 2015/849, available at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32015L0849.

WEB (2016). Laying the foundation for client centricity at the heart of smarter onboarding, available at https://www.coforgetech.com/sites/default/files/2020-07/Brochure%20-%20BFS%20-%20Laying%20the%20Foundation%20for%20Client%20Centricity.pdf.

WEB (2017a). Anti-money laundering and financial crime compliance a viewpoint for revitalization and efficiency, available at https://www.grantthornton.com/~/media/content-page-files/financial-services/pdfs/2017/BK/AML-Continuum-Article-7-31.ashx.

WEB (2017b). Nuggets: Take back control of your data, available at https://nuggets.life/images/Nuggets-White-Paper.pdf.

WEB (2017c). Setting up an effective client onboarding process, available at http://candelalabs.io/wp-content/uploads/2017/05/setting-up-an-effective-client-onboarding-process-1.pdf.

WEB (2017d). Strategic steps to successful client onboarding, available at https://bit.ly/3yQFeui.

WEB (2018a). Arveldusteenuste üleviimine, available at https://www.pangaliit.ee/arveldused/arveldusteenuste-uleviimine-1.

WEB (2018b). Digital fund distributions: recommendations for the luxembourg fund industry, available at https://www.alfi.lu/getattachment/b50de62d-18f4-44a5-8eaa-7bf126e6b0ab/alfi-alfi-digital-fintech-white-paper-digital-funddistribution.pdf.

WEB (2018c). G20 digital identity onboarding, available at https://www.gpfi.org/sites/gpfi/files/documents/G20_Digital_Identity_Onboarding.pdf.

WEB (2018d). Identity for a connected world: A user centric identity application for regulated industries and the internet of everything, available at https://storage.googleapis.com/blockpass-website-media/wp-content/uploads/2018/09/Blockpass-Whitepaper-v1.3.3.pdf.

WEB (2018e). Onboarding users, available at https://www.ginniemae.gov/issuers/issuer_training/Documents/onboarding_enduser_training_overview.pdf.

WEB (2018f). Public sector savings and revenue from identification systems: Opportunities and constraints, available at http://documents1.worldbank.org/curated/en/745871522848339938/Public-Sector-Savings-and-Revenue-from-Identification-Systems-Opportunities-and-Constraints.pdf.

WEB (2019a). Collaboration, culture and conduct within financial institutions and the impact on clm, available at https://www.fenergo.com/assets/files/industry-knowledge/Whitepapers/Part-Two-Collaboration-in-the-digital-age.pdf.

WEB (2019b). "know your customer" innovation: Why digital onboarding is the key to banking success, available at https://www.comtradeintegration.com/wp-content/uploads/2019/06/Whitepaper-KYC-Comtrade.pdf.

WEB (2019c). Powering digital transformation: Creating a frictionless customer onboarding journey for smes, available at https://www.experian.co.th/wp-content/uploads/2019/08/Spotlight-Paper-SME-Digital-Onboarding-2019.pdf.

WEB (2019d). Trusted identity as a service building trusted and customer centric relationships across integrated ecosystems, available at https://www.staycontactable.com/downloads/whitepaper.pdf.

WEB (2020a). Argos. empower your business with ai-based id verification, available at https://gsma.force.com/mwcoem/servlet/servlet.FileDownload?file=00P6900002pW8qxEAC.

WEB (2020b). Digital identity, available at https://www.fatf-gafi.org/media/fatf/documents/recommendations/pdfs/Guidance-on-Digital-Identity-report.pdf.

WEB (2020c). Digital identity and e-kyc guidelines for the arab countries, available at https://www.amf.org.ae/sites/default/files/research_and_publications/Publications%20On%20AMF/2020/en/Digital%20ID%20%20eKYC%20Guidelines%20for%20the%20Arab%20Region.pdf.

WEB (2020d). eib: eidas enabled i-banking, available at https://worldpaymentsreport.com/wp-content/uploads/sites/5/2018/10/World-Payments-Report-2018.pdf.

WEB (2020e). Existing kyc practices in indonesia and opportunities for implementing e-kyc to accelerate financial inclusion, available at https://www.microsave.net/wp-content/uploads/2020/12/20201201-eKYC-in-Indonesia-Report.pdf.

WEB (2020f). Fintech and e-money customer onboarding benchmarking report, available at https://www.hooyu.com/h/wp-content/uploads/2020/09/PIF_Whitepaper_Fintech_and_Emoney_Benchmarking_report.pdf.

WEB (2020g). How to better understand your customers using context. a guide to transforming your kyc processes, available at https://fintech.global/globalregtechsummit/wp-content/uploads/2020/09/Ebook-How-to-better-understand-your-customers-using-context_-A-guide-to-transforming-your-KYC-process.pdf.

WEB (2020h). Kyc spider. unbox the secret behind reshaping your compliance., available at https://www.kyc.ch/hubfs/PDFs/Factsheets/Factsheet%20Reshape%20Compliance%20with%20Digital%20KYC_ENG_V200313.pdf.

WEB (2020i). Next generation esignatures: Solutions for banking, available at https://www.em360tech.com/sites/default/files/2020-09/Next-Generation-eSignature-Solutions-for-Banking.pdf.

WEB (2020j). Refinitiv client onboarding: An end-to-end client life cycle management solution, available at https://www.refinitiv.com/content/dam/marketing/en_us/documents/brochures/client-on-boarding-brochure.pdf.

WEB (2020k). Video interview kyc. efficient and secure customer onboarding, available at https://shuftipro.com/reports-whitepapers/video-kyc-product-guide.pdf.

Wood, J., Chugani, A. (2017). Is your onboarding off-putting? generating banking and financial services impact, available at https://www.genpact.com/downloadable-content/insight/is-your-on-boarding-off-putting.pdf.

Zhou, X., Jin, Y., Zhang, H., Li, S., Huang, X. (2016). A map of threats to validity of systematic literature reviews in software engineering, *2016 23rd Asia-Pacific Software Engineering Conference (APSEC)*, IEEE, pp. 153–160.

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