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ORIGINAL ARTICLE

Robotic process automation in banking industry: a case study on Deutsche Bank

Alice Saldanha Villar[1] · **Nawaz Khan**[2]

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Abstract
Robotic process automation (RPA) is a software robot technology designed to execute rules-based business processes by mimicking human interactions across multiple applications. As a virtual workforce, this software application has proven valuable to organizations looking to automate repetitive, low-added-value work. The combination of RPA and Artificial Intelligence (AI) is called CRPA (Cognitive Robotic Process Automation) or IPA (Intelligent Process Automation) and has led to the next generation of RPA bots. It has been transforming the banking industry by making the core financial operations exponentially more efficient and allowing banks to tailor services to customers while at the same time improving safety and security. Although intelligent automation is enabling banks to redefine how they work, it has also raised challenges regarding protection of both consumer interests and the stability of the financial system. This article presents a case study on Deutsche Bank's successful implementation of intelligent automation and also discusses the ethical responsibilities and challenges related to automation and employment. We demonstrate how Deutsche Bank successfully automated Adverse Media Screening (AMS), accelerating compliance, increasing adverse media search coverage and drastically reducing false positives. This research contributes to the academic literature on the topic of banking intelligent automation and provides insight into implementation and development.

Keywords Intelligent automation · Banking automation · Robotic process automation (RPA) · Cognitive robotic process automation (CRPA) or Intelligent process automation (IPA)

1 Introduction

With advancements in technology, banks and other financial institutions are under enormous pressure to improve service quality, reduce cost, and increase efficiency**.** The emerging technology practice known as Intelligent Process Automation (IPA) has become an essential tool for the banking industry to remain competitive in Industry 5.0, which requires unparalleled accuracy and efficiency. IPA refers to a combination of Robotic Process Automation (RPA) and Artificial Intelligence (AI). Together, they promise to accelerate digital transformation and reshape the banking industry.

The financial industry has always produced a large volume of tasks and processes, making banking a perfect environment for intelligent automation. Banks and other financial institutions have been exploring intelligent automation, especially in robotics (automation of repetitive tasks), analytics (big data mining), and chatbots (digital dialogue with customers).

Deutsche Bank, one of the world's leading banks, has made massive investments into digital technology to increase efficiency, reduce costs, increase profitability, and improve the customer experience. This case study shows how Deutsche Bank successfully combined RPA with AI to improve productivity and quality. This is a descriptive case study done through data taken from secondary sources, such as internal records, corporate white papers, and interviews with different business units of Deutsche Bank. Blue Prism and WorkFusion, vendors that have partnered with Deutsche Bank, supply information about RPA implementation. Data

✉ Alice Saldanha Villar
alsaldanhavillar@gmail.com

✉ Nawaz Khan
nawaz.khan@kaplan.com

[1] Department of Computer Science, University of Essex, Colchester, Essex, UK

[2] College of Management and Technology, Walden University, Minneapolis, Minnesota, USA

from numerous academic books, journals and articles (primarily collected through Google Scholar) provide a brief literature review and a better understanding of RPA implementation at Deutsche Bank.

This article is developed over seven sections, including this Introduction. Section 2 presents Deutsche Bank's digital journey and describes the reasons why the bank implemented RPA. Section 3provides a theoretical background for this case study. In this section, we analyze the main concepts related to RPA, its phases of evolution and RPA architecture, showing the implementation pipeline for both RPA and Cognitive RPA (CRPA). We also examine the characteristics and advantages of RPA deployment in the banking sector, covering the most relevant applications. Section 4 details how Deutsche Bank has successfully implemented Intelligent Automation. This section examines the framework for Information Security Governance (ISG) and RPA governance, including implementation, maintenance, compliance, risk management, and responsibilities. Section 5 analyzes Deutsche Bank's automation of Adverse Media Screening (AMS). Section 6 discusses the ethical responsibilities and challenges of Deutsche Bank's automation process. Finally, Sect. 7 presents concluding remarks evaluating the Deutsche Bank case study.

2 Digital journey: factors influencing RPA adoption at Deutsche Bank

The era of big data burst onto the scene in the first decade of the twenty-first century, and brought both challenges and opportunities. Initially, Big Data described the growing availability of large datasets in information technology. It gradually broadened to include the set of techniques and technologies required to manage this enormous data quantity [25]. While processing vast amounts of information, Big Data technology reduces costs significantly and expedites computing tasks and new service offerings. In the banking sector, Big Data management and analytics have demanded new processing methods to enhance business insights, data-driven decision-making, and process optimization [28, 70].

As customers' interaction with financial service providers becomes more digitized, data becomes financial organizations' most critical asset. As suggested in a recent Deutsche Bank whitepaper, 80–90% of financial institutions' data is unstructured (in document/text form). In the era of Big Data, what matters to businesses is how efficiently they can handle the complex material they have on hand [28].

Big Data is fuel for the so-called "data economy," which is a global digital ecosystem where data is treated as an asset to be collected, analyzed and exchanged between companies, governments or other parties [24]. The data economy winners will be those that can quickly extract meaningful information from their data, deliver better services to their customers, and become more efficient. In banking and financial services, the benefits of the evolving data economy are clear: a better understanding of, and response to, customers' needs, enhanced cybersecurity, and reduced risk of fraud and malicious activity [22, 57].

Well aware of the transformational potential of Big Data, Deutsche Bank has been making major investments across all areas, modernizing processes and experimenting with several options such as new software packages and workflow modernization tools. Mark Matthews, head of operations for the corporate bank, investment bank, and capital release units, observed that those tools delivered incremental change; however, those changes came at a very high cost and were slow and haphazard in their implementation, leaving an abundance of activities where manual handling of core business processes were still needed [23]. Traditional manual bank processes proved to be time-consuming and prone to human error, resulting in poor customer experiences. These processes created large quantities of forms and required manual file-processing and fact-checking.

This inefficiency led to the adoption of Robotics process automation (RPA) and artificial intelligence (AI) at the Deutsche Bank. As Matthews observed, when Deutsche Bank started its digital journey, the aim was not to solve a single issue. Although well aware of opportunities in some prominent areas, such as Know Your Customer (KYC) and anti-money laundering (AML), the bank was especially interested in improving operations in areas that had not benefited from other major technological programs. Matthews' data science team included employees, as well as external experts who created activity maps, cost models, and organizational plans to connect mini-ecosystems across the bank. They created an inventory of detailed projects to justify the funding necessary for each project. As a result, RPA implementation changed the work culture by facilitating cross-functional cooperation [23].

Deutsche Bank has shown that merging Big Data analytics with cognitive RPA is incredibly beneficial. With the information gathered from these technologies, it is possible to gain insight about industry trends, customer experience, business patterns and internal workings. Businesses can extract insight from Big Data, identify unnecessary steps, and process bottlenecks to improve efficiency. Once large amounts of raw data are transformed into meaningful patterns and information for business decision-making, the real value of RPA is revealed [17].Thus, it becomes possible to provide more targeted and personalized services, ensuring a better customer experience. In the era of Big Data, customers demand personalized experiences, as well as top-quality services and products. Mike Clarke, product manager at Deutsche Bank, reinforced this message at the Network Forum Americas Conference in New York, emphasizing the

need to provide tailored solutions that evolve as quickly as the services we use in our daily lives [10].

The next generation of customer experiences will be through channels supported by AI, automating customer service and improving financial outcomes. According to the World Economic Forum's research, AI has been driving an unprecedented shift in how financial institutions should attract and retain loyal customers. Due to AI advancements, financial institutions will differentiate themselves through a new set of competitive factors: customization, capturing attention, and developing ecosystems. The first relates to how well financial institutions provide personalized services to optimize their customer's financial outcomes. The second refers to their ability to engage customers and access data through combined interactions that go beyond financial services (e.g. offering forecasting services to merchants, booking repairs for vehicle damage, etc.), which improves customer retention. Finally, the third describes the financial institutions' ability to bring together data analytics from multidimensional networks to provide differentiated advice and deepen client relationships [49].

Big Data analytics has been implemented across various aspects of banking and financial services, and mastering its tools has become one of the most crucial tasks for the banking sector. Big Data, with its volume, variety, and velocity, has empowered AI in recent years. The synergy of these technologies holds exceptional promise for future business growth. In 2018, Servion Global Solutions predicted that, by 2028, AI will power 95% of all customer interactions. They predict that consumers will eventually prefer artificial intelligence and chatbots to human interaction [53].

3 Theoretical background

a. RPA phases of evolution

In Robotic Process Automation, we can identify four phases of continuous evolution, as shown in Fig. 1:

Assisted RPA (RPA 1.0) is typically deployed though the server to an employee workstation to automate repetitive tasks. RPA bots require user or administrator intervention and are most often used for front-office activities involving repetitive tasks. Given that bots and employees work together on semi-automated processes, Assisted RPA can be categorized as Human–Robot Collaboration (HRC).

Unassisted RPA (RPA 2.0) is most often used for back-office activities and allows complete end-to-end automation. RPA bots operate independently and with high efficiency, executing tasks and interacting with applications without human intervention. This kind of automation is only suited to standardized processes with minimal exceptions, and can only handle structured data. Thus, workflows have to rely on

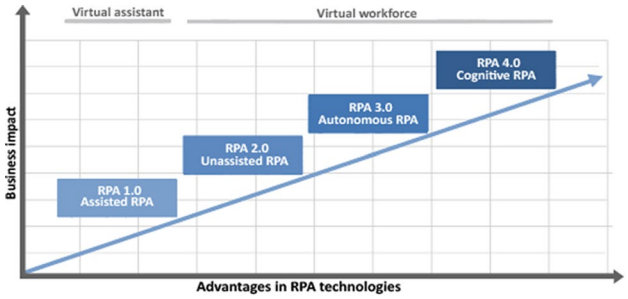

Fig. 1 RPA phases of evolution, based on information provided by Everest Group [21]

human-in-the-loop processes to turn unstructured data into structured data that bots can process.

Autonomous RPA (RPA 3.0) is normally deployed through the cloud and allows dynamic scaling. It takes automation to the next level by completing more advanced processes. Although RPA 3.0 introduces some aspects of AI to process more complex tasks, it is still limited to dealing with structured data. Thus, workflows still rely on human-in-the-loop processes to structure data that bots can process. Autonomous RPA uses advanced analytics, creating prescriptive suggestions to deal with exceptions.

Cognitive RPA (RPA 4.0) is the most advanced form of Robotic Process Automation. It can process both semi-structured and unstructured data, including word-processing documents, images, audio, videos, instant messages and emails. In order to manage unstructured datasets, bots first create structured data using advanced AI capabilities like Optical Character Recognition (OCR), Natural Language Processing (NLP) and Data Mining.

b. Differentiating RPA and AI

RPA is best suited to highly manual and repetitive activities, and has a wide range of applications in finance and banking, telecommunications, manufacturing, insurance, public sector, healthcare and pharmaceuticals, Business Process Outsourcing (BPO) and retail industry. As RPA allows companies to automate a wide range of front, middle and back office activities, it frees employees to perform high-value-added tasks that require creativity and knowledge.

To analyze the relationship between RPA and AI, we first need a brief definition of both. A diverse panel of industry participants have provided definitions of these terms: IEEE [40].

- Robotic Process Automation is "the use of a preconfigured software instance that uses business rules and predefined activity choreography to complete the autonomous execution of a combination of processes, activities,

transactions, and tasks in one or more unrelated software systems to deliver a result or service with human exception management."

- Artificial Intelligence is "the combination of cognitive automation, machine learning (ML), reasoning, hypothesis generation and analysis, Natural Language Processing (NLP) and intentional algorithm mutation, producing insights and analytics at or above human capability."

In short, RPA refers to the use of software "robots" that mimic human actions to automate a company's processes; this software uses business rules and predefined logic to automate repetitive computer-based tasks, with human involvement only required in exceptional cases. It is important to differentiate RPA from other forms of process automation, such as screen recording, scraping and macros. RPA's core function is via element identification within an interface. Therefore, RPA technology works on the UI (User Interface) by mimicking user actions [1].

In contrast, AI involves the simulation of human intelligence by machines. As a subset of AI, Machine Learning (ML) is based on the idea that systems can learn from data and identify patterns to progressively improve performance of a specific task. AI and RPA are valuable digital transformation tools, and the choice of which to implement depends on the specific case [71].

AI bridges the gap where RPA fails to deliver expectations. One common criticism of traditional RPA is that it only deals with structured data to automate rule-based tasks; it is unable to directly manage unstructured data, requiring bots to first structure data using capabilities such as Optical Character Recognition (OCR) and Natural Language Processing (NLP) [14]. When organizations combine RPA technology with AI, they can turn unstructured content into a structured dataset before the RPA-driven process begins. Once RPA is merged with AI, its capabilities are enhanced [27, 69].

c. Differentiating traditional RPA and Cognitive RPA

Cognitive Robotic Process Automation (CRPA), also known as Intelligent Process Automation (IPA), is automation powered by cognitive computing technologies. The differences between RPA and CRPA can be divided into four categories: underpinning technologies, methodology, data processing capabilities and scope of application.

Traditional RPA uses a process-based approach that automates rules-based actions following an 'if-then' method, which requires technologies such as workflow automation, screen scraping, and macro scripts. On the other hand, CRPA uses a knowledge-based approach that relies on cognitive technologies such as Machine Learning (ML), Natural Language Processing (NLP), Text Analytics and Data Mining. These advanced tools give the system human-like capabilities, such as judgment-based decision-making, to automate processes. In CRPA the machines learn from data and are able to recommend courses of action and make intelligent decisions just like humans would. Unlike traditional RPA, which requires minimal (or no) coding since it primarily involves configuration and deployment of frameworks, Cognitive RPA is based on machine learning and therefore requires programming.

RPA can only use standardized data, so it processes data only when the data is available in a structured or semi-structured format. It can be thought of as a data operator. RPA deployment involves any rules-based, high volume and repetitive processes that does not require human judgment, such as: Horton et al. [35], Dilmegani [18].

- logging into applications,
- moving files and folders,
- reading and writing to databases,
- making calculations,
- scraping data from the web,
- opening emails and attachments,
- filling forms,
- connecting to system API's,
- copying and pasting data,
- extracting structured and semi-structured data from documents,
- following 'if/then' decisions and rules,
- collecting social media statistics.

Cognitive RPA, on the other hand, can handle unstructured data inputs through advanced AI capabilities, which exponentially expands the value of workplace automation and the scope of application across a wider range of activities.

The RPA lifecycle gives structure to the automation process, so that at each stage we can ensure that the implementation works as expected. Figure 2 shows the traditional implementation pipeline. Figure 3 shows the Cognitive RPA implementation pipeline, in which cognitive abilities of Machine Learning enable the system to learn from data and make decisions without relying on rules-based programming.

d. Main applications of RPA in the banking industry

The global RPA market size is predicted to grow at a Compound Annual Growth Rate (CAGR) of 29.5% between 2018 and 2026, which is mainly due to the increasing need to automate business processes across multiple industry sectors. This demand has significantly pushed the market, which is estimated to reach USD 8.7812 billion by 2026 [59].

AI and RPA applications in banking can be classified into five broad categories, as demonstrated in Fig. 4:

Next, we present some of the most relevant applications of RPA and AI in banking:

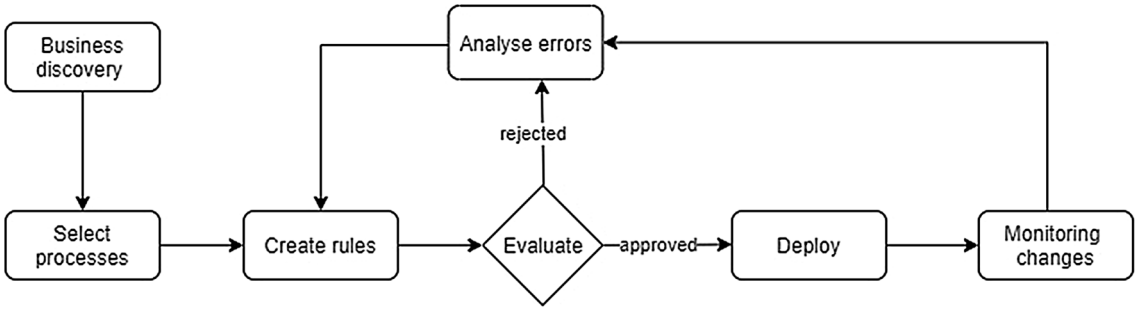

Fig. 2 Robotic process automation pipeline

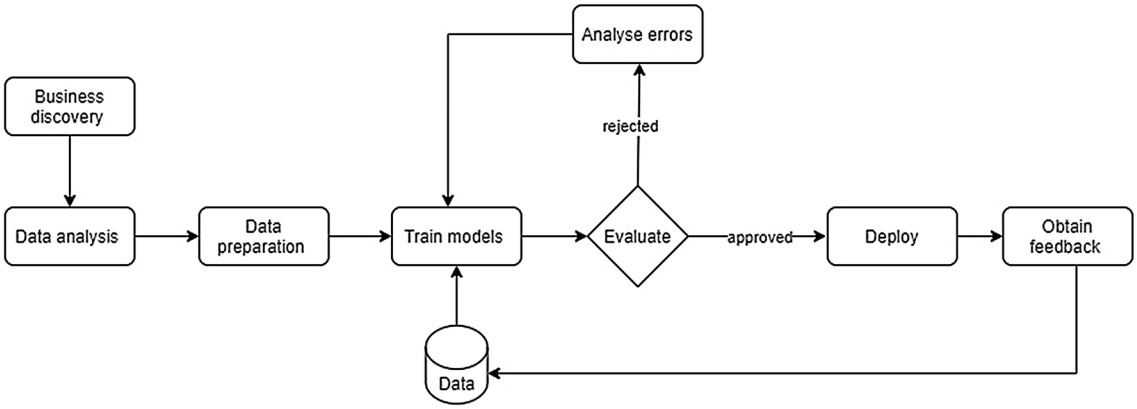

Fig. 3 Cognitive robotic process automation pipeline

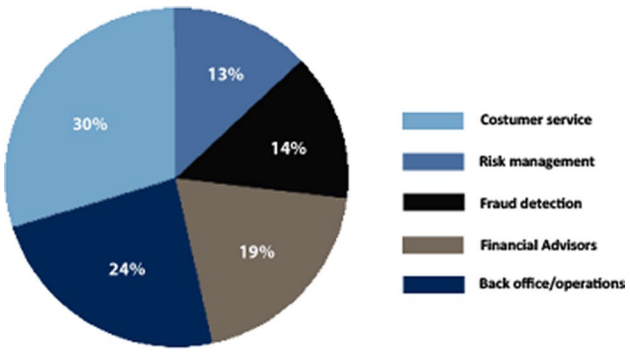

Fig. 4 Data based on a survey conducted by Deloitte and Efma [15]

Accounts Payable (AP) RPA/AI technology can streamline and automate AP processes, providing better visibility and control over data. It converts the entire manual process into a digital workflow, giving notifications to allow the resolution of any error that occurs. By reducing manual handling, AP automation helps to reduce the risk of fraud, while increasing visibility, control and security of digital payments.

Customer service The information provided by the combination of RPA and AI can be used to gain insight into customers' values and necessities, upcoming market trends, and internal business. This allows banks to respond faster and offer more targeted and personalized services at scale, thereby saving time, reducing costs, minimizing errors, and reducing risks.

Compliance and Report Generation RPA with AI tools, such as natural language generation capabilities, can automatically extract information from a wide variety of documents and generate periodic reports. Software robots prepare automated reports to ensure data is accurately updated in real-time, minimizing the possibility of errors, which saves time and increases productivity on a large scale.

Credit card processing Manual credit card processing has proven to be inefficient, prone to errors and fraud. Credit card fraud has become one of the most prevalent forms of cybercrime in recent years, exacerbated by the strong growth in online and mobile payments [50]. RPA/AI can reduce long waiting periods and make quick decisions to approve or reject an application with a rule-based process. It has been used as a solution to detect and prevent real-time fraud in online banking. To identify fraudulent activities, algorithms check clients' credit card transactions in real-time and compare new transactions with previous amounts and locations. AI blocks transactions if it sees risks [42].

Mortgage & Lending RPA/AI provides a scalable, consistent, and reliable method to automate and streamline loan processing, completing back-end tasks more accurately and efficiently. It makes the process more agile so customers and employees can have a better loan experience. AI tools can make lending decisions more accurate and fair, as they can predict defaults with greater accuracy.

Account opening/closing With RPA/AI technology, the account opening and closing process becomes faster, more accurate, and data transcription errors are eliminated. There can be various reasons for the enormous number of account closure requests banks receive. One of them is when the client fails to submit mandatory documents. Automation allows banks to tackle this problem by tracking them and sending automated notifications and reminders to provide the required documents.

Know Your Customer (KYC) and Anti-Money Laundering (AML) KYC is the mandatory verification that clients are who they claim to be and the procedures are part of a bank's AML policy. Due to the expensive manual process required, banks have started using RPA/AI to collect, screen, and validate customer data, thereby facilitating comprehensive compliance and minimizing risks relating to money laundering, financing terrorism, and other financial crimes. Using advanced data analytics to detect fraudulent transactions, AI allows the analyzation of real-time activities. When algorithms identify inconsistencies, they raise a red flag, and a more detailed KYC check by bank employees is performed [42].

4 Intelligent automation at Deutsche Bank

a. Implementation process and benefits

To overcome operational hurdles caused by silos of data and unlinked systems, Deutsche Bank wanted to bundle the decentralized back-office units in a small number of operations centers, to focus on process optimization and IT-based workflow from the outset. Multiple RPA software providers, such as Blue Prism, Automation Anywhere, WorkFusion, Celaton, and UiPath, offer solutions. Vendors may develop and incorporate their own AI subsystems, or leverage AI service providers such as Microsoft Azure ML or IBM Watson [61]. Deutsche Bank took a hybrid approach, using both homegrown and off-the-shelf software. The bank selected BluePrism for attended automation and WorkFusion's Intelligent Automation Cloud as an unattended automation platform [54, 82].

Matthews stated that Deutsche Bank selected BluePrism for attended automation because it gives the company broad control to set the rules that govern the use of data within the bank's systems [23]. Blue Prism works with cloud partners to give enterprises a scalable intelligent digital workforce and easy drag-and-drop access to AI and ML technologies. Via the Blue Prism platform, enterprise users of Amazon Web Services (AWS), Google Cloud Platform (GCP), IBM Watson, and Microsoft Cognitive services can access a variety of AI-powered software robots to automate complex tasks. These partnerships make it easy for enterprises to incorporate AI into any Blue Prism process. Blue Prism platform supports compliance and security by logging every step and change in process, ensuring alignment with governing bodies and internal policies [5, 8].

Deutsche Bank selected WorkFusion in part because it provides automation training through an online training platform, Automation Academy®. The software allows users to drag and drop icons to automate a work process, generating code automatically so the bank's employees do not have to be programmers to use it. WorkFusion solutions don't require large datasets or data science teams, as its learning bots can adapt to changes in data and real-time advanced analytics [23]. WorkFusion recommends following security best practices at all automation stages: environment setup, developing bots, executing automated business processes, etc. This will ensure the proper security of a company's RPA and cognitive bots, and eliminate existing security threats [81, 82].

WorkFusion offers easy-to-use solutions for Anti Money Laundering (AML), Know Your Client (KYC), and claims processing in banking and financial services. The software automates the time-consuming process of training and selecting Machine Learning algorithms. Its cognitive capabilities use historical data and real-time human actions to train models to automate tasks that once required human judgment, like extracting, categorizing and validating unstructured information. As a result, Deutsche Bank saved millions and teams could re-allocate employees' time to higher-value tasks [72, 81].

At Deutsche Bank, employing cognitive automation has dramatically reduced the human intervention required to process paper documents, increasing profitability in the process. Deutsche Bank reported it had automated 30–70% of back- and mid-office processes using RPA technology, accelerating functions like trade finance, cash operations, loan operations, and tax payment. RPA has also proven its transformational value in guiding employees through their day-to-day work, dramatically reducing training time [83]. Dean Mazboudi, who led Deutsche Bank's innovation lab in New York for nearly 3 years, stated that RPA improved the bank's workforce, making employees happier and more efficient, as well as enhancing human know-how and expertise within the company. Implementing a number of intelligent automation solutions, Deutsche Bank has become more efficient across a number of workflows [56].

Correspondingly, the implementation of RPA in the Deutsche Telekom case illustrates the advantages of deploying RPA on customer satisfaction, financial performance and process compliance. In this case, 25 experts developed the first prototype after 2 weeks and launched an initial solution after 6–8 weeks. Due to its non-invasive nature, RPA could be applied on top of existing information systems with no need to change the existing enterprise IT landscape, thereby achieving rapid implementation. The fast adaptation and integration of RPA systems also helped the employees accept process automation, as benefits were quickly realized; that triggered the demand for further automation [73].

Other case studies on RPA have highlighted that RPA software's ease of configuration; it works by dragging, deleting, and linking icons. People with process and subject-matter expertise can be trained to automate processes within a few weeks, no programming skills needed. Furthermore, RPA proved to be enterprise safe, easily meeting IT requirements such as security, scalability, and auditability. By freeing employees from tedious, low-value-added tasks, RPA made them available for higher-value tasks that require creativity, ingenuity and decision making [3, 45, 60, 67]. The core advantages of RPA in the banking industry are shown in Fig. 5.

b. RPA Governance

A foundational component of any RPA program is a clear robotic governance model. The Governance Institute of Australia [31] defines governance as "the system by which an organization is controlled and operates, and the mechanisms by which it, and its people, are held to account. Ethics, risk management, compliance and administration are all elements of governance." Hence, an RPA governance model can be described as a framework that incorporates the implementation, maintenance, and development of the automation process, providing guidelines and recommendations for self-regulation.

Since RPA is a software tool intended to automate business processes, RPA governance is a combination of governance of Information Technology (IT) and Business Process Management (BPM). While IT governance focuses on the development of strategies to achieve business goals through technology, BPM governance covers a wider scope, as it is a management approach focused on the governance of business initiatives.

Existing literature outlines three layers of IT governance: (i) Strategic level (board of directors); (ii) management level (executive and senior); (iii) operational level (IT and business operational management). While the operational level focuses mainly on the development and maintenance of RPA software robots, the management level focuses on administrative activities, monitoring and decision making [77]. On the other hand, BPM governance focuses on how processes work, identifying areas for improvement and solutions to reach maximum efficiency and sustainability. BPM governance focuses on establishing the right structures, metrics, roles, and responsibilities to improve and manage performance [68].

Mazboudi observed that RPA shouldn't be used as a standalone solution, but as another tool, along with tighter integration, better architecture, and upgraded workflow capabilities [56]. As a combination of IT and BPM governance, a successful RPA governance program has to provide a clear framework of the procedure for implementation, development and maintenance of RPA. Furthermore, it must establish guidelines and policies to assure the quality of the automation process, mitigate risks, and ensure secure operation of deployed software robots.

Any uncertainty in the automation process may increase the risks to financial institutions. Processes must be correctly engineered for automation before launching a wide-scale automation project. It is necessary to first assess the efficiency of each individual process because, if one process in the automation chainset is inefficient, it can create a significant bottleneck [47]. Mazboudi recommends, if possible, to modify a process and move it closer to the digital end

Enterprise safe RPA is designed to efficiently meet enterprise requirements for security, scalability and audibility.
Lower costs RPA software license fees and implementation cost less than employees.
Efficiency and Production RPA boosts productivity and frees humans from monotonous tasks, so they can spend their time on cognitively demanding activities.
Easy to configure RPA is easy configured and does not require programming skills.
Accuracy RPA eliminates human error, resulting in precise process execution and improved compliance.
Scalability RPA implementation is easy and can be either large or small, according to the company's needs.
Lightweight and flexibility RPA software can be smoothly run on desktop-class machines. It has only a few rules and requires minimal maintenance.

Fig. 5 Core advantages of RPA in the banking industry

of the spectrum prior to RPA implementation. This is why automation often requires rethinking the existing business process [56]. As Bill Gates once famously said: "The first rule of any technology used in a business is that automation applied to an efficient operation will magnify the efficiency. The second is that automation applied to an inefficient operation will magnify the inefficiency." [16]

Deutsche Bank's approach has been to start with small, foundational RPA projects to create clear use cases for automation. As Mazboudi pointed out, their best strategy was to "follow the money" and ensure that the use case has high return potential [56]. Along the same line of thought, Hoback et al. [34] claim that many successful banking RPA programs started small, automating what RPA is best at: digital, repeatable, structured, rules-based tasks. Once that part of the automation process was completed, they transitioned to intelligent automation, applying AI and RPA to semi-structured and unstructured data.

Ultimately, the chief benefit of transitioning from traditional RPA to Intelligent Automation is the potential to realize benefits at scale. AI technology allows organizations to scale automation horizontally (by including semi-structured and unstructured data), and vertically (by processing greater amounts of data faster) [33]. While developing their RPA implementation strategies, financial institutions and other organizations need to understand where their needs fit within the evolution of RPA. In the endeavor to expand, RPA software vendors aim to augment traditional capabilities in five additional areas: Process Mining (also referred to as process discovery or e-process mining), Ingestion Engine (OCR, computer vision and many other technologies), Analytics, User Experience (UX) and Machine Learning (ML) [5].

Figure 6 shows the Maturity Spectrum of Automation according to WorkFusion [79]:

Existing literature summarizes main strategic elements in the RPA governance model for managing, such as: clear strategy, proper documentation, performance management, risk management, change management, clear roles and responsibilities, communication, compliance and infrastructure implementation methodology. The critical implementation challenges can be: the unclear division of responsibilities between the IT department and business groups, the lack of understanding about how RPA works and its implementation, poor management, and the required changes in management process throughout the organization [55, 66].

Mazboudi observed that a critical factor in enabling RPA implementation is the underlying data setup and management [56]. Along the same line, as Vishnu et al. [78] mention, "the easier the codification, the easier it is to create the underlying data flow and automate it." Well-defined data structures and detailed knowledge about the business processes are essential for effective automation.

In the financial sector, the increased automation of data has raised ethical and privacy concerns for the legal liability of machine decisions, which can cause reputational and financial damage to organizations. RPA software mimics humans and can make incorrect decisions that may not be noticed for some time [58, 76]. Since the requirements for automation in RPA are subject to rapid change, their implementation presents technical and innovative challenges that demand flexibility. Once automation is in place, its management and internal infrastructure should keep pace with the core systems evolution [80]. Whenever automation processes are overlaid onto existing systems, care must be taken to ensure that any changes do not impair the automated processes. After all, software robots cannot deviate from their preprogrammed functions, which may lead to erroneous results when they encounter unanticipated scenarios [46]. If there are no adequate supervision and control mechanisms, eventual changes made to the system may impact the robots' functioning and lead to operational inefficiencies. When the systems evolve, the software robots must be altered and adapted too [26, 45].

b. Information security governance

Digital data is a key strategic and operational asset for many organizations, and especially for the financial services industry. As the amount of data created and consumed in the world rapidly grows, information security becomes more complex and leaves businesses increasingly exposed

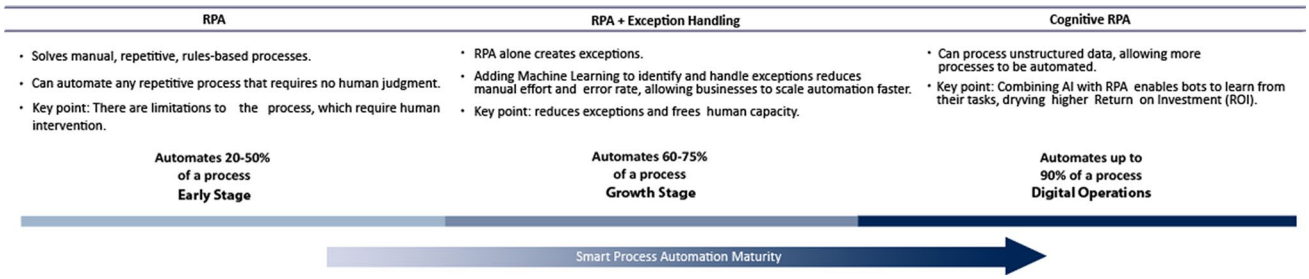

Fig. 6 Maturity Spectrum of Automation, based on information provided by WorkFusion [79]

to cyber threats [38]. As the Intelligent Automation project grows and reaches the maturity stage, a crucial technical challenge is information security governance, which aims to ensure that an organization has the correct information structure, leadership, and guidance [9].

The deployment of automation across financial services raises challenges in protecting both consumer interests and the financial system's stability. The security risk derives from the fact that software robots are required to access business data. To protect data from misuse, it is crucial to control the development process of robots, as well as manage security and privacy issues, so software robots are permanently monitored. This is even more important for companies that deal with large volumes of private or confidential data, such as banks.

According to Ernst & Young [20], 74% of security professionals are currently concerned about insider threats and argue that RPA can provide better security. Greater automation, along with reduced manual handling, mitigates internal fraud risk and reduces the time it takes to detect a security breach, resulting in significant savings. However, although automation combats internal fraud, cybercrime exposure also increases as more information and transactions are digitized. Janine Durbin, director and working capital advisor of Global Transaction Banking at Deutsche Bank, observed that designing a cybercrime prevention program requires a robust corporate governance structure. She emphasized that clear policies defining risks and providing guidance are critical keys for reducing internal and external fraud. Processes should be reviewed at least annually, and re-designed if necessary, to ensure the latest fraud prevention technology is incorporated [19].

Durbin observes that cybersecurity, once part of the company's IT department, now transcends the entire organization. Therefore, the whole workforce should be educated on how to prevent attacks. Since employees frequently and inadvertently cause security breaches, they have to understand the various ways they can be tricked. Nowadays, every single person working within an organization must understand his or her role and responsibility for the organization's cybersecurity defense. Deutsche Bank has made the effort to turn its employees into a "human firewall" by training them with online courses and creating a culture that prioritizes information security. Deutsche Bank relies on regulators to mitigate cyber risks with policies such as: Deutsche Bank [12], Fitsche [29].

- strong collaboration and data sharing;
- improvements in technology infrastructure;
- third-party vendor management;
- improved control of administrator access through the use of a two-factor layered authentication and by monitoring the use of administrative accounts;
- adequate plans for responding to, and recovering from, cyber incidents.

However, cross-border financial services involve multiple jurisdictions, and therefore it is not enough to have a few regulators demanding banks implement security regulations. Managing cybersecurity concerns for cross-border financial services in a digital society requires global collaboration. Industry sectors and policymakers have to work together to develop cybersecurity norms that manage risks systematically to harmonize complex regulatory systems [36, 65] .

As organizations become data-centric (rather than process-centric), they increasingly use data for decision-making. In the financial services industry, winning the data economy will require the best analytic competencies and strong data quality. Deutsche Bank's Chief Information Security Office (CISO), established in 2013, is responsible for setting and implementing its information security strategy. It aims at maintaining an appropriate level of information security protection group-wide and protecting the confidentiality, integrity, and availability of business and client information [11]. At Deutsche Bank, improved data frameworks come from regulatory requirements such as Payment Services Directive 2 (PSD2) and General Data Protection Regulation (GDPR). The Basel Commission for Banking Supervision's Principles for data aggregation and risk reporting is another regulatory framework that actively assesses firms' approaches to data quality [6, 44].

In October 2019, as part as its digital transformation strategy, Deutsche Bank created a new division, called Technology, Data and Innovation (TDI). The aim was to take further ownership of processes previously outsourced and build in-house engineering expertise. TDI mission was to provide and use the right common data, skills, and tools to make decisions and enable innovative solutions that create value for clients and the bank. Bernd Leukert, Chief Technology, Data, and Innovation Officer, pointed out that the bank's technology strategy allows the entire workforce to work from home at scale and securely meet clients' needs and convenience [12, 44].

At the end of 2019, Deutsche Bank introduced WeChat via the Symphony Connect Solution. In June, 2020, the bank announced that the Symphony platform would integrate WhatsApp into Deutsche Bank's communication channels with clients. This innovative way to interact with clients means that more than three million users can communicate directly with Deutsche Bank employees [13]. Customer Relationship Management (CRM) is no longer seen as a narrow "technology project" or "IT department initiative" but a cross-functional and customer-driven strategy that maximizes relationships and encompasses the entire organization [7, 30, 39]. In Deutsche Bank's case, its client-centric culture improves understanding of its clients' needs,

helping them face challenges such as shifting demographics, globalization, digitalization, evolving consumer behavior, and climate change [28].

d. RPA and cognitive computing

Deutsche Bank's experience has shown that implementing RPA and cognitive computing is more effective than just RPA because it applies Machine Learning to the automation of more nuanced work, such as recognizing a document, and the digitization of unstructured data to search for specific information. Although there is no commonly accepted definition of cognitive computing in either academia or industry, this term has been used to refer to a collection of emerging technologies that mimic the way the human brain works, aiming to help improve human decision-making [32]. As Modha et al. [48] observe, its purpose is "to develop a coherent, unified, universal mechanism inspired by the mind's capabilities." Cognitive computing is the key theory that forges the union of RPA and AI [37]. It uses algorithms to define patterns in large amounts of data, dealing with Natural Language Processing (NLP) to create meaning, generate hypotheses, offer suggestions, and provide insights.

Using NLP, the data science team went through Deutsche Bank's archive of over 100 million emails between employees, partners, and customers. The bank found that employees used email to bridge the gap between systems in many cases. Their new NLP system unlocked a wealth of knowledge across additional areas. Matthews mentioned that the key to the bank's success was the ability to train the system using its own company and industry-specific vocabulary [23, 56].

A survey conducted by The Economist Intelligence Unit on behalf of Temeno [75] showed that more than three-quarters (77%) of global bankers believe that unlocking value from AI will be the difference between successful and unsuccessful banks. A growing number of banks and other financial institutions have been exploring the value of intelligent automation for improved customer service, efficiency, and risk management, primarily in robotics (automation of repetitive tasks), analytics (big data mining), and chatbots (digital dialogue with customers).

At Deutsche Bank, the value of merging RPA and AI is that these technologies are components of wider solutions and process flows. For example, these technologies can help: Manning [51]

- Automate, model and alert intraday liquidity and collateral changes.
- Improve banks' ability to identify intraday liquidity and collateral pricing patterns, volatility (whether due to business as usual or potential fraud) and outlier transactions.
- Respond to crises more quickly through the deployment of automatic throttles, whether the issues are geopolitical, systemic, institutional or client-specific stresses.

Implementation of intelligent automation, otherwise known as cognitive banking, has been restructuring the way financial institutions interact with information and customers. Cognitive banking creates value in all areas of a bank: improved engagement, new analytic insights, and enterprise transformation. It complements human expertise, personalizes customer engagement, and provides access to ecosystem partners. It enables seamless conversation with customers, expedites banking processes, and generates knowledge-driven opportunities for ecosystem processes. In addition, it reshapes business and operating models, while creating new roles and encouraging innovation [41].

Unstructured data amounts to approximately 80% of the data organizations encounter today. A cognitive system automates processes that involve semi-structured and unstructured content, elevating the benefits of traditional rule-based RPA and increasing the number of processes that can be end-to-end automated. Because intelligent automation can deal with various data types from multiple sources, it can recommend, design, and launch usage-based products aligned with market expectations [43]. A cognitive system allows machines to learn from data so they can deliver efficient and accurate solutions. Each customer interaction with the bank becomes a learning opportunity for the bank, which ultimately leads to increased customer satisfaction [62].

In the banking industry, AI is fundamentally changing services, creating entirely new operating models and paving the way for a new set of competitive dynamics that will reward institutions focused on sophisticated data use. AI-driven technology has made enormous advances in the ability to use machines to automate and enhance: McWaters and Galaski [49].

- Pattern detection—recognizing (ir)regularities in data.
- Foresight—estimating the probability of future events.
- Customization—generating rules from specific profiles and applying general data to optimize outcomes.
- Decision-making—Generating rules from general data and applying these rules to specific profiles.
- Interaction—Communicating with humans through digital and analog systems.

To understand the different ways AI can be used in financial institutions, consider how AI capabilities are intertwined with other emerging technologies and how they are mutually reinforcing.

Figure 7 shows several examples of these mutually reinforcing interactions:

The World Economic Forum (WEF) outlines how this mutual reinforcement cycle between AI and other technologies will increase digitalization across financial institutions. Advances in any of these technologies will improve all other technologies that interact with it.

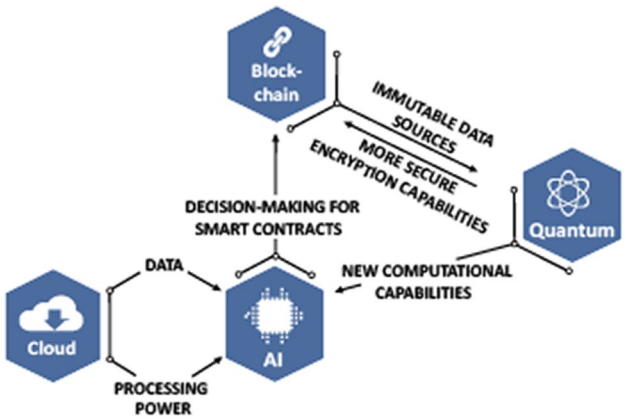

Fig. 7 Several examples of mutually reinforcing interactions, based on information provided by the World Economic Forum [49]

The potential list of interactions will continue to develop and grow endlessly. The WEF outlines some examples: McWaters and Galaski [49].

- Blockchain offers the possibility of immutable data; once one puts data in the blockchain, it cannot be removed or altered. Since all of the verification is done by the system itself, the users do not need a trusted central authority, which could be critical for identity management.
- While quantum computing presents a real threat to encryption methods, it also brings new powerful techniques to make blockchain more resistant.
- Cloud computing delivers data storage and the processing power necessary to train new AI models.
- AI powered by quantum computing allows banks to tackle unforeseen problems. The financial services industry can take advantage of quantum computing speed to help deal with complexities such as fraud detection.

5 Automated adverse media screening at Deutsche Bank

Adverse media screening (AMS), also called media monitoring or negative news search, is a service that provides research and analysis of unfavorable media and negative news about an individual or organization across various news sources, as well as those from unstructured sources. AMS can be applied throughout the Know Your Customer (KYC) and Anti-Money Laundering (AML) customer lifecycle to avoid a bank's risk of exposure from clients.

Onboarding a customer with a criminal record can put the financial institution at risk of exposure to money laundering, which could have legal repercussions and threaten the organization's reputation. AMS aims to reveal a person or organization's involvement in money-laundering, financial fraud, drug trafficking, organized crime, and other unlawful activity. An essential part of KYC/AML processes for banks, AMS searches for adverse reports and triggers further investigation if necessary.

Traditionally, AMS has required manual checks and human interpretation of vast amounts of data, which poses an enormous operational challenge. Because large amounts of unstructured data need to be analyzed and interpreted, manual AMS is time-consuming and inefficient, delaying onboarding and affecting customer satisfaction. Manually searching for adverse media has a high risk of failure due to the "needle in a haystack" nature of this process and the required accuracy. Workfusion's AI-driven automation capabilities are being used to automate AMS at Deutsche Bank. The software scans news sentiment and context for negative news, rather than looking for rudimentary word associations [2].

According to WorkFusion [81], financial institutions spend, on average, 40 h to evaluate adverse media for a single client onboarding. According to Workfusion data on implementation of its AMS automation solution, this can account for more than 10% of onboarding time, a costly and inefficient process. Automated AMS saves effort, reduces time, and delivers highly precise results. It reduces false positives and empowers compliance programs with faster decisions, minimizing manual reviews. Automated AMS saves analysts' time as it performs risk analysis, sentiment analysis and compiles lists of flagged articles, all of which used to require human judgment. Further, it explains the risks present in news articles, improving transparency by documenting the decision-making process behind each action. Deploying WorkFusion's solutions for adverse media monitoring, Deutsche Bank accelerated compliance threefold, increased adverse media search coverage, and eliminated 80% of false positives.

WorkFusion's automated adverse media monitoring highlights three main benefits: WorkFusion [81]

- *Decreased manual handling time* The overall manual handling work is reduced by 70% on average in the end-to-end process (new fetching, analysis, linking to internal KYC data, case handling, and audit trail generation).
- *Enhanced accuracy* The Machine Learning models for AMS are created by humans and because human analysis is error-prone, they do not eliminate the risk of human error. However, the ongoing retraining continually improves the outcomes. WorkFusion has reported that bot accuracy surpasses human accuracy when the Machine Learning models incorporate 1000–2000 training records. Their recent implementations of AMS in multinational financial institutions show accuracy rates of around 95%.

- *False positives reduction* Intelligent automation solutions can reduce false positives by 75–95%, freeing analysts to investigate high-risk activities.

WorkFusion's AMS approach, as demonstrated in Fig. 8, has three phases: information gathering from core systems, risk analysis and prioritization, and case management.

6 Discussion: ethical responsibilities and challenges

AI has become an essential component of modern business structure and has been optimizing every banking "office" (front, middle, and back). In the end, the most successful banks will be the ones that have a business strategy centered on cognitive RPA, customer-oriented solutions, and holistic approaches rather than individual processes. However, these AI-based optimization projects tend to derive value primarily from workforce reduction. McKinsey Global Institute suggested that by 2030, AI could replace as much as 30% of the world's current human labor [52]. Establishing a workforce that views AI as an opportunity rather than a threat will require a collaborative relationship and open internal communication between an institution's workforce and its leadership.

Businesses have the ethical responsibility to make employees aware of the upcoming technological changes and commit to providing support for those affected by automation, which can be done by helping them to develop new skills and prepare for new activities. In the age of AI, financial institutions need to attract and train people so that they develop the skills and capabilities to work alongside the machines. As talent strategy becomes a source of competitive advantage for tomorrow's business environment, financial institutions will increasingly compete to attract and retain highly sought-after AI talents [49].

Gülabatin Sun, Head of Operations PW&CC, observed that Deutsche Bank's most important success factor is its management system, which has been educating its employees about the possibilities and challenges offered by automation in their jobs [74]. In 2019, Deutsche Bank hosted an RPA fair in India, where it provided classes and gave demonstrations on automation to employees. Since most automation workflow is process-based, operations staff should lead. In recognition of this, Deutsche Bank has launched a new "operations engineer" career path, which requires skill in process re-engineering, digital automation, and data analytics [23].

As shown in Fig. 9, in 2019 Deutsche Bank invested € 70 million in training its employees with a cost per FTE of € 0.8 thousand. This is in line with prior years as the bank continued to deliver training efficiently [64].

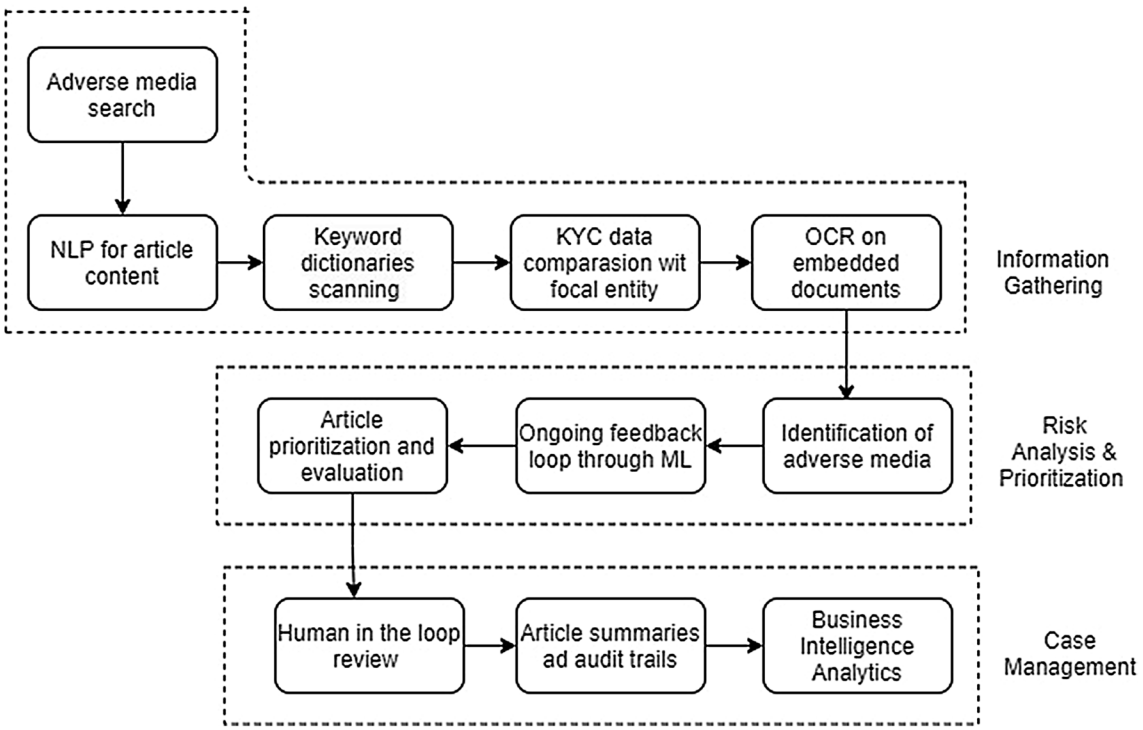

Fig. 8 AMS pipeline, based on information provided by WorkFusion [81]

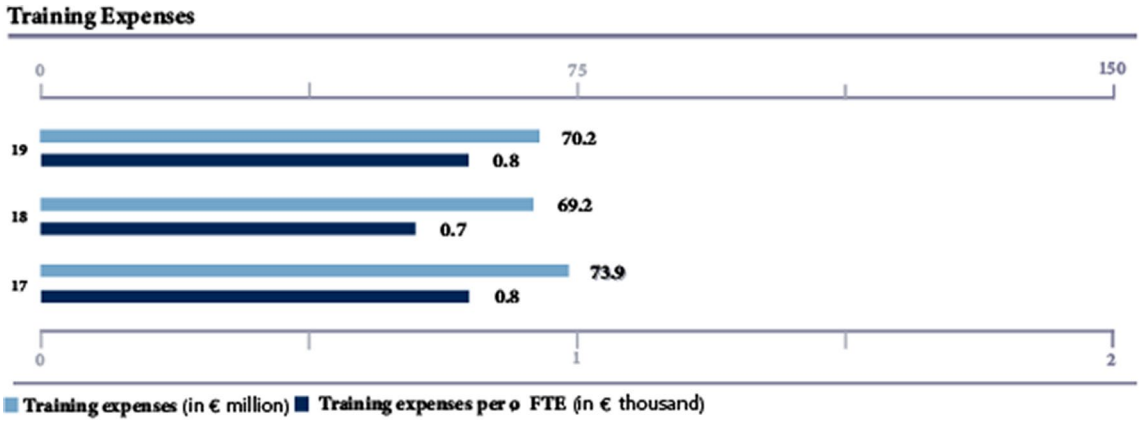

Fig. 9 Training Expenses, sourced from Deutsche Bank's Human Resources Report 2019 [64]

Filling vacant positions with suitable internal candidates has helped Deutsche Bank reduce redundancy and recruitment costs. Recruiting internally to retain and redeploy qualified and experienced employees saved the bank € 32 million in 2019 and € 39 million in 2018. To encourage internal mobility, the bank advertises all vacant positions to the staff for at least 2 weeks prior to public announcement. In 2019, 37.6% of all job vacancies were filled internally, while in 2018, that number was 37.2% (excluding Postbank). At the Managing Director and Director levels, the internal fill rate was 40.2% in 2019 and 40.5% in 2018. At the Vice Presidential level, the percentages of vacancies filled internally increased to 47.5% and 47.8%, respectively [64].

In 2019, the bank verified that highly engaged employees were not only more likely to perform better, but also 36% more likely to remain in the organization. Thus, Deutsche Bank encourages employee engagement through regular communication between manager and employee. Regular conversation (once a month or more frequent) was found to motivate employees and raise productivity, as employees said they felt more comfortable addressing workplace issues [64].

As AI increasingly automates routine work in banking, it will displace workers who are not able to rejoin the workforce with their existing skills. Jobs will be lost despite retraining efforts and internal mobility strategy. Through a robot program called Operations 4.0 launched in July, 2019, Deutsche Bank has automated large parts of its back-office to reduce adjusted costs by about € 6 billion by 2022. Given that RPA implementation produced better management of cash positions, the resulting investment has allowed Deutsche Bank's RPA project to pay for itself [4].

Significant transformation leads to significant challenges for Deutsche Bank's workforce agenda. On May 29, 2018, Deutsche Bank announced it would reduce its full-time workforce to less than 90,000 by the end of 2019 (on December 31, 2019, Deutsche Bank had 87,597 employees, a decrease of 4140 employees or 4.5% in 2019). On July 7, 2019, the Management Board announced on additional reduction in its full-time workforce to approximately 74,000 by 2022. Figure 10 shows the progress of Deutsche Bank's people and workforce agenda by mapping KPIs against the identified strategic goals [63, 64].

While implementing these restructuring measures, the bank filled front office roles in growth areas (e.g. Global Transaction Banking, Wealth Management and Asset Management), hiring talented professionals to meet the growing demand in regulatory roles (e.g. Anti-Financial Crime, Audit, and Compliance).

7 Conclusion

This paper has provided an overview of the transformative value of intelligent automation at Deutsche Bank. We analyzed its RPA governance model, including implementation, development, maintenance, compliance, risk management, roles, and responsibilities. We demonstrated how Deutsche Bank successfully deployed WorkFusion's solutions for Adverse Media Screening (AMS), accelerating compliance, increasing adverse media search coverage and drastically reducing false positives.

We examined Deutsche Bank's Information Security Governance (ISG) and how intelligent automation can improve a bank's cybersecurity system. We verified that, in addition to adequately implementing and updating technical controls, Deutsche Bank's strategy to protect itself against cybercrime is to turn its employees into a "human firewall" by training them and generating a culture of information security. Further, we discussed the most significant challenges of automation to Deutsche Bank's workforce. We examined how the bank has been investing in training and internal recruitment strategies to reduce costs and retain talented and qualified employees.

KPIs - People and workforce priorities in 2019 and beyond

KPI	Rationale	Goal
Restructuring support	Our transformation strategy requires sizeable workforce reductions as part of our cost control and FTE planning.	By 2022 FTE employee reduction to 74,000
Internal mobility	Measuring the level to which we foster the movement of employees to new roles across the bank (both within and across divisions) brings the benefit of enriching employee career paths, transferring key skills and experience across the bank, as well as identifying opportunities for redeployment in areas that have seen business change.	By 2019 Cross-divisional: 2.4% of headcount Intra-divisional: 1.5% of headcount Total mobility goal: 3.9% of headcount
Diversity & Inclusion	In March 2019, the Management Board decided to restate the voluntary group-wide aspirational goals for the representation of women. The goals set for December 2021 focus on the top three corporate titles individually (in % of headcount).	By 2021 Representation of women: Managing Director (21%) Vice President (35%) Director (28%)
Feedback culture	The Feedback Culture Survey zwas introduced in 2019 based on Deutsche Bank People.	By 2019 70% favorable

Fig. 10 KPIs—People and workforce priorities in 2019 and beyond, sourced from Deutsche Bank's Human Resources Report 2019 [64]

Across the banking industry, AI technology is being applied to improve RPA data processing capacity. Deutsche Bank's intelligent automation journey has shown that, in the age of cloud computing and platform economies, the most successful banks will be the ones that build a customer-oriented strategy and deploy intelligent automation in a holistic manner rather than for individual processes. Our case study has demonstrated that a human-centric approach to the deployment of intelligent automation will be essential to optimize and sustain improvements, ensuring exceptional customer experience at the lowest possible cost.

8 Availability of data and material

This research, based on a literature review on RPA technology, aims to show how Deutsche Bank successfully implemented RPA to improve productivity and quality. This is a descriptive case study done through secondary data taken from different sources, such as Deutsche Bank's internal records, corporate white papers, and interviews with different business units of Deutsche Bank. Data was also collected from Google scholar for academic books and journal articles to provide a better understanding of RPA technology.

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Declarations

Conflicts of interest/Competing interests I declare that I have no significant competing financial, professional, or personal interests that might have influenced the performance or presentation of the work described in this manuscript.

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