Horizontal and Vertical Value Creation in Bankrobotics and the AI-Washing Phenomenon*

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Artificial intelligence, machine learning, intelligent robots and related innovative technologies are emerging as driving forces that are reprogramming the traditional remnants of the banking sector. The purpose of this groundbreaking study is to localise the concept of bankrobotics, clarify the conceptualisation of bankrobotics technologies and analyse their applications in banking. Their value creation is interpreted along vertical and horizontal dimensions. On the basis of in-depth interviews, the approach and implementation of their organisational adoption are discussed, along with the factors inhibiting value creation. The author proposes the classification of partner chain-based AI systems, the introduction of incident databases and the establishment of disclosure obligations regarding investments in bankrobotics, to avoid the spread of the AI-washing phenomenon in the banking sector.

Journal of Economic Literature (JEL) codes: G21, O33

Keywords: artificial intelligence, bankrobotics, value creation, banking AI incident database, AI-washing

1. Introduction

The innovative technologies of the digital era are impacting the economics of many industries, while promoting productivity, profitability and efficiency as well as the customisation of services and the customer experience and the management of risks and security through the rationalisation of operations (*Aghion et al. 2017; Wirtz et al. 2018; Kaya 2019; EP 2020; EC 2018, 2019; EBF 2019; Cheng – Jiang 2020*). The Covid-19 pandemic was the main driver behind companies' digital transformation in recent years (*Harkácsi – Szegfű 2021*). The activities of FinTech firms that filled a gap in improving the quality of market services facilitated the financial inclusion of groups excluded from the services of mainstream financial institutions (incumbent traditional banks, insurers) and the enhancement of the consumer experience (*ESA 2022; Alt et al. 2018*). In the FinTech industry, payment

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service solutions, blockchain technology and robo-advisory services have become crucial (*Bagó 2023*). In connection with the rise of FinTech and BigTech companies, neobanks and challenger banks, the Bank for International Settlements (BIS) has pointed out the potential risks of traditional banks being crowded out from the market as well as of the fragmentation and marginalisation of banking activities (*BIS 2018*). The utilisation of FinTech technologies has brought about an era of personalisation and immediate omnichannel customer service, triggering a change in banks' business models (beyond banking) (*El-Gohary et al. 2021*). In response to the changed consumer needs of the digital era (hyperpersonalisation, consumer experience), incumbent banks operating in the shadow of their FinTech and BigTech competitors had no choice but to increase their digital capabilities, coupled with reorganisation (*Szikora – Nagy 2020; EP 2020, 2021, 2022; EBA 2020; Prisznyák 2023*). Along with their own digital transformation, banks also play a key role in financing the digital transition of the economies, and in how that shapes global society. Banks' engagement in sustainability and social awareness-raising regarding artificial intelligence (AI) and the related innovative technologies has also increased considerably in the recent period (*Tomašev et al. 2020*). The active use of digital technologies (sustainable robo-advisory services, green crowdfunding) provides a major boost to the social development of green finance (*Horváth 2022*).

The hype surrounding AI generates strong investor and consumer pressure on organisations to use AI. This paper seeks to introduce the concept and research avenue of bankrobotics and present the use of bankrobotics technologies in banks' front/middle/back office areas. Value creation for stakeholders is examined in the vertical and horizontal value creation model of bankrobotics. The implementation of value creation in the market is assessed through in-depth interviews. Based on the reported experiences, the different forms of implementing investment in bankrobotics and the various managerial approaches are analysed, along with the management's level of familiarity with AI and the related innovative technologies, as well as the main factors inhibiting value creation. I also draw attention to AI-washing, which hampers value creation, and propose a classification of partner chain-based AI risks and the establishment of a publicly available AI incident database.

2. Research questions and hypotheses

To answer the research questions summarised in *Table 1*, the literature is analysed, along with the in-depth interviews with banking and IT experts who took part in the introduction of the innovative technologies.

Table 1
Research questions and hypotheses

Research question	Hypothesis
Q1: What is AI?	**H1:** Corporate asset.
Q2: What are the typical forms of investments and developments in bankrobotics?	**H2** In-house, partnering, acquisition and hybrid forms can all be observed.
Q3: What are the approaches to investment?	**H3:** Top-down approach.
Q4: What about the technological know-how of bank managers?	**H4:** Corporate leaders are not always able to distinguish technologies (AI, ML, robot).
Q5: What organisational and other factors support/hinder the value creation of investments in bankrobotics?	**H5:** Legal constraints, data, labour demand, organisational culture.

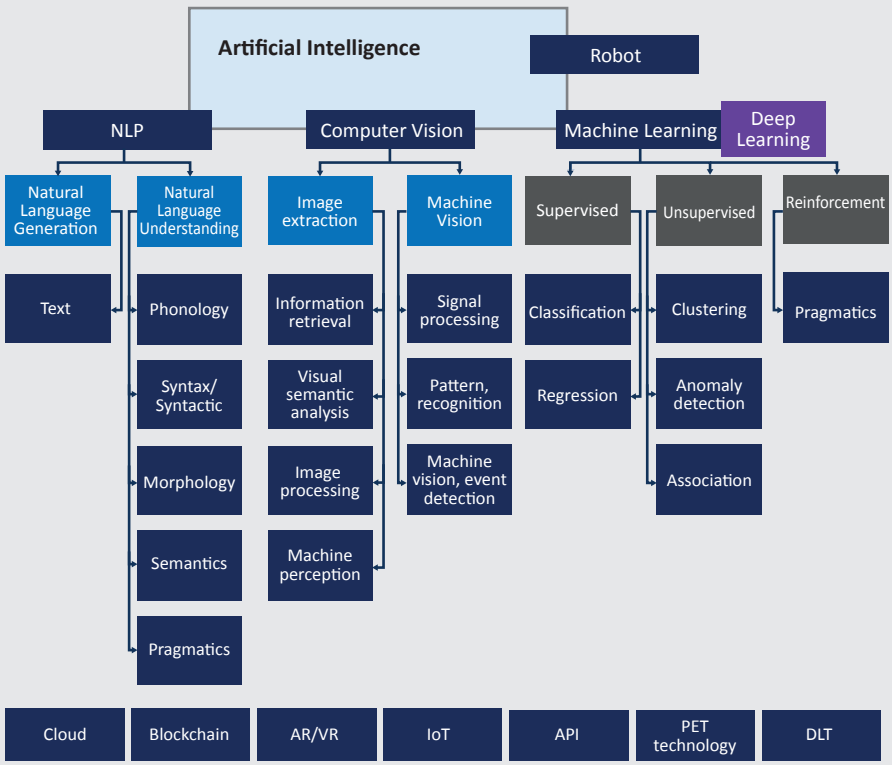
3. The concept of bankrobotics and the AI-washing phenomenon

In response to the challenges of the digital era, many leading large banks have devised a technology/AI strategy aligned with the organisational strategy and launched AI and robot projects. Investment in innovative technologies improves banks' response capacity (*Pintér – Herczeg 2023*). In an effort to distinguish itself and backtest its cost-optimisation strategy, the China Construction Bank Corporation opened the world's first human-free, fully-automated branch in 2018 (*Zhang 2018*). The rationalisation of branches and assessing the level of social acceptance are important aspects for the organisations undergoing digital transformation and looking to ensure their future competitive advantage (*Payne et al. 2021*). This phenomenon can also be seen at euro area banks (*Discanno 2023*). However, the operational performance of the companies that adopt digital technologies does not automatically increase when such technologies are implemented (*Szalavetz 2022*).

The technologies of the digital era pose a challenge to banks when they need to navigate the triangle of efficiency, risk management and client needs, compounded by more and more stringent regulatory requirements (*EBF 2019*). Although there is no generally effective method for stimulating FinTech innovation by regulators, the practical application of an innovation hub and a regulatory sandbox seem to be conducive (*Fáykiss et al. 2018*). Artificial intelligence, different algorithms-based machine learning (ML) and deep learning, intelligent robots, computer vision, natural language processing (NLP), cloud technologies, application programming interfaces (APIs), distributed ledger technology (DLT), virtual reality (VR), IoT (the Internet of Things), quantum supercomputers and privacy enhancing technologies (PET) all vary widely in the banking sector, which is based on strong customer confidence and a regulatory framework (*Figure 1*). The complementary application of these technologies is among the strongest reset drivers in the traditional operation of the financial system and the banking sector (*Alt – Puschmann 2016*).

In response to the increasing use of these technologies in the banking sector and the importance of the sector-specific regulatory environment, I hereby propose to establish the concept of bankrobotics and a sector-specific research avenue.

Figure 1
Innovative technologies applied in banking



Note: AR: Augmented Reality

From the perspective of technology, the concept of bankrobotics refers to the application of innovative FinTech technologies in the banking sector to rationalise and improve banking processes and services. By contrast, FinTech is a broader category that should be interpreted in the wider financial sector as it also covers areas (and market players) other than the banking sector. In other words, bankrobotics can be defined as a key component of FinTech, but the two concepts are not synonyms, due to their different goals and the different frameworks of regulatory challenges.

In the banking sector, the use of AI and ML technologies is often referred to as banking robotics, bankrobotics or robo-banking. *One might wonder why "robotics" and "robo-banking" are used for AI and machine learning technologies that are software systems rather than physical robots.*

Due to the convergence of technologies, the line between robots and AI concepts has become blurred (*Török – Ződi 2021*). To put it another way, the two otherwise different technologies are sometimes falsely identified as synonyms. The universal use of the term "robot" in the banking sector is attributable to various factors. Using the term "robot" for slave-like work has its roots in the literature (Čapek, Asimov), referring to robots who work as servants in a human-centric world, or to physical robots aimed at replacing human workflows. The innovative technologies used in the banking sector are increasingly seen in several front/middle/back office workflows, facilitating process automation, 24/7 customer service and the replacement of monotonous, repetitive processes (robot-like activities). Consequently, in the banking sector, the term 'robot' is used for the automation of processes by a robot (software). Beyond entertaining fantasies, today's society can experience the integration of robots in real life. The banking sector has several humanoid (service) robots, although they are yet to be introduce in Hungarian branches. They use a combination of the above technologies to promote the social acceptance of robots (*Figure 2*). In their case, the software-based AI is coupled with a hardware. To reflect the blend of software and physical form, the most commonly used term is simply "robot". I argue that the AI hype can also lead to an incorrect use of the terms, as the consumer and investor pressure in the market has considerably increased the use of "robot" and "AI" among organisations (when referring to products/services/processes in marketing texts).

Figure 2
Intelligent robots in banks' customer areas

	2010	2014	2015	2016	2016	2016	2017	2018	2019	2019
Robotics company	YDreams	Softbank Robotics	Aldebaran Robotics	Softegy Innovations	Nautilus Hyosung	IDMind	Paaila Technology	Sberbank robot lab	Nam A Bank	Promobot
Bank deploy the robot	Santander Group	HSBC, Mizuho Bank, Rabobank, Capital Bank of Jordan, Emirates NBD, Leumi Group, DSK Bank	Mitsubishi UFJ bank	City Union Bank	Sberbank	Banco Bradesco	Paaila Technology	Sberbank robot lab	Nam A Bank	National Bank of Oman, Sberbank
Hungarian robot landscape	X	X	X	X	X	X	X	X	X	X

Note: Figure by the author.

The Federal Trade Commission (FTC) encourages companies to avoid overselling technological capabilities and making hollow promises when advertising AI-based products. (*FTC 2021, 2023*). *State et al.* (*2023*) emphasise the rise of AI-washing, where the term AI is often used for basic ML algorithms. For the same concept, *Seele and Schultz* (*2022*) use "machinewashing", emphasising organisations' deliberately deceptive or misleading behaviour (communication). "AI-washing" refers to corporate practices/behaviour where an organisation seeks to position itself positively (reputation) by emphasising AI-based operation and solutions and their advantages to key stakeholder groups (investors, customers, media, others), without actually engaging in any meaningful activity in that area. In connection with the threat posed by this, the European Union's *Ethics Guidelines for Trustworthy Artificial Intelligence* (*EC 2019*) contains policies that discuss the responsibility of service providers. In this context, requirements are stipulated for the accurate description of products and reliable and transparent communication (*EC 2019, EC 2020*). I argue here that in the long run AI-washing could undermine investor confidence, as AI-based value creation does not happen if organisations' AI capabilities are not improved over the long term.

4. Introduction and application of bankrobotics technologies

When assessing the investment objectives of innovative FinTech technologies, *Kou et al.* (*2021*) find that the most important aspects are related to competitiveness, operational efficiency, cost-optimisation and other non-financial factors (customer satisfaction). *Shaikh et al.* (*2017*) highlight the rise in sales volume, while *Eyal* (*2017*) focuses on the option to increase market value, and *Leung and Chung* (*2020*) emphasise potential cost cuts and increased efficiency.

Based on the assessment of the available AI capabilities and their objectives, banks decide on the form of investment in bankrobotics (the technology applied) and the form of implementation. The discipline of innovation management has long discussed the value creation that can be achieved through the external knowledge-enhancing opportunities offered by internal corporate R&D activities and innovation capabilities (*Lunn 2016*). Investments in bankrobotics can be realised in various forms: (1) in-house, (2) acquisition, (3) partnering, and (4) hybrid (*Tanda – Schena 2019; Schena et al. 2018*). Relying on external knowledge (partnering, acquisition), banks can increase the range of solutions and knowledge regarding the technology applied. Banks usually offer differentiating services in-house to safeguard data assets and bank security, while non-differentiating activities are typically supported

by supplier and partner developments (*McKinsey 2020*). In the case of in-house developments, free, open-source solutions offer a cost-effective way to enhance an organisation's digital capabilities (*HGMA-PWC 2019*).

The use of artificial intelligence, robots and the related innovative technologies in banks' front/middle/back office areas creates value in a complex manner, typically linked to various points in the workflow (*Prisznyák 2022a*). During the conceptual analysis of bankrobotics technologies, one might ask *what can these technologies be used for and how do they facilitate the value creation of the different banking processes?*

Artificial intelligence refers to systems that display intelligent behaviour by analysing their environment and taking actions, with some degree of autonomy, to achieve specific goals (*EC 2018*). It is difficult to give a legal definition of AI due to the absence of a uniform AI concept. The European Commission has made great strides towards regulating a trustworthy artificial intelligence (*EC 2019, 2020, 2021*). Pursuant to the prevailing legislation, it is considered a corporate asset among intangible assets (software), but it has additional qualities that raise issues of whether the technology can be classified as a legal person. However, the weak point of these proposals is the ability of applying moral and ethical considerations (*Stefán 2020*). As regards the legal person status of AI, its development and autonomy can be the key to the solution in the future (*Klein 2021*). AI includes the algorithm-based ML models often used in the banking sector, which allow projections to be made and preprogrammed tasks to be run (*EBA 2020; EP 2020*). There is no single ideal algorithm, as the choice of algorithm is aligned with the objectives of the business area during ML model building (*Prisznyák 2022b*).

In front office sales and marketing, ML plays a key role in CRM strategies, customer classification, transaction management, the preparation of action plans and proposals, churn rate projections, fraud prevention, chatbots and client communication, and biometric identification and verification (*Aggarwal et al. 2014*). Robo-advisors and virtual assistants support portfolio and wealth management by forecasting trends and returns, and by portfolio optimisation and asset allocation (*Rouf et al. 2021; Marchinares – Alonso 2020; Bartram et al. 2020; Strader et al. 2020; Beketov et al. 2018*). In the middle office area, it supports lending processes and thus the preparation of credit scoring systems' decisions (scoring, others) and client profiles. In a related paper, *Nica et al.* (*2021*) analysed the assessment opportunities for client profiles used in mortgage management. In back office areas such as Compliance, KYC, KYI and AML, ML offers crucial help in customer registration, AML/CFT issues and the analysis of suspicious transactions using video/e-KYC and AML solutions (*Prisznyák 2022b; Johari et al. 2020; Jullum et al.*

2020). Other major areas for use include customer service, where machine learning models assist in customer sentiment analysis and the development of customer management strategies based on the incoming complaints. In HR, ML models can effectively support recruitment, selection, the review of CVs and the performance assessment of employees (*Vasantham 2021*). They are also crucial in bank security (the prevention of cyberattacks).

The whole organisation is also impacted by the use and value creation of NLP and computer vision technologies (*Chaubey et al. 2022*). NLP supports the communication between customers and the bank and in-house communication (analysis of written and spoken texts), sentiment and behaviour analysis as well as the digitalisation and analysis of documents (*Aparaj et al. 2013; Elcholiqi – Musdholifah 2020*). Character recognition can help assist in lending, AML/CFT and the analysis, translation and summary of data, news and documents (legal documents, annual financial statements) from external sources. Character recognition and the related document analysis can also considerably support the work of customer service through the recognition of loan applications, account statements and reports (*Khurana et al. 2023; Patel – Trivedi 2020*). Therefore, it effectively supports customer identification and the forecasting of customers' financial difficulties (*Hajek et al. 2014*).

ML and NLP technologies are often assisted by computer vision using a sensor (camera), not only with robots. Computer vision also promotes bank security through the cameras installed in branches (detection and prevention of suspicious transactions, ATM manipulation). The visual recognition of data helps it assist customer identification, processes requiring verification and the monitoring of the movement of documents within the bank (*Chaubey et al. 2022*).

Other solutions that support operation include cloud technologies (storage of large amounts of data), IoT (collection and analysis of data from devices, such as smart devices and cameras), VR (the use of a virtual environment to enhance the customer experience), APIs (integration of an application with other service providers and systems, establishment of data links), PET (protection of the personal customer data, encryption and anonymisation of data) as well as DLT and blockchain technology (secure data management and monitoring) (*Campbell et al. 2021*).

5. An interpretative model of vertical and horizontal value creation in bankrobotics

The potential impact and value creation of bankrobotics technologies is presented along vertical and horizontal dimensions (*Figure 3, Table 2*). *We will see the value created by bankrobotics technologies, for whom it is created and at what levels.* From the perspective of vertical value creation, the following levels should be analysed separately: (1) nano (operation level); (2) micro (organisational level), (3) mezzo (bank sector), (4) macro (national economy), and (5) global. At the individual levels, the examination of the vertical value creation dimensions is further refined by completing the analysis from the perspective of the following players as well: (1) investors, (2) customers/clients, (3) institution (bank), and (4) employees. The limitation of the model is that it does not discuss other stakeholder groups. Different stakeholder groups have different forms of value created for them by investments in bankrobotics (the technologies applied), which is presented in *Table 2*.

Figure 3
A model of horizontal and vertical value creation in bankrobotics

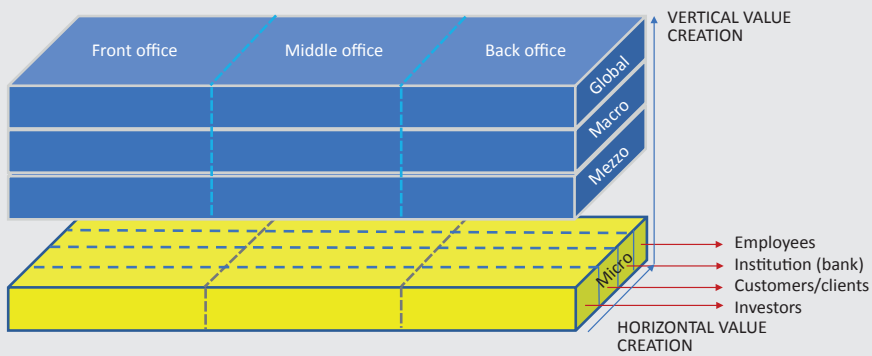


Table 2
Horizontal and vertical value creation in bankrobotics

	Investors	Customers/clients	Institution (bank)	Employees
Nano	• identification of investment opportunities based on a personalised risk management strategy, decision support • enhancement of investor confidence • reducing transaction costs	• improvement of the customer experience and the service • increasing personalisation • objective evaluation • financial inclusion • availability of new products and services	• cooperation between specialised areas (business/IT/legal), responsibilities, risk management • operation optimisation (reduced resource needs, improved quality), KPIs • more digital services • omnichannel and communication • data collection and analysis	• allocation of labour to tasks with higher value added • replacement of monotonous tasks • integration of AI/robot into a team
Micro	• portfolio management and wealth management optimised by an innovative technology • identification of trends, analysis of market sentiment	• omnichannel communication supported by AI (chatbot, AI advisor, 24/7) • protection of personal data	• AI strategy, responsible areas • development of digital organisational capabilities (in-house/partnering/acquisition), conducive organisational culture • integration of AI/robots into the organisational culture • supporting business model transformation • change management (change of mindset) • (cyber)security	• awareness-raising, training • development of new responsibilities • redefining tasks and responsibilities • attraction of AI talent
Mezzo	• impact of reduced transaction costs on trading (facilitating market liquidity)	• overall reduction of banks' costs • branch rationalisation trend • competitive enhancement of the consumer experience	• transformation of the range of digital products/services • rise of neobanks • development of an AI ecosystem in the banking sector • ethical AI policies for the banking sector • creation of data and knowledge pools	• increased demand for AI experts in the banking sector • transformation of banking (necessary skills, knowledge, competencies)
Macro	• impact of bankrobotics regulation on investments • algorithmic trading can increase the efficiency and speed of financial markets	• facilitation of the financial inclusion of underbanked players in the macroeconomy • awareness-raising about AI in society, supporting education (FinTech, sustainable banking)	• more efficient, lower-cost and faster financial transactions in the economy as a whole (supporting productivity growth) • financing and improvement of digital organisational capabilities (supporting cybersecurity) • reduction of economic disparities (financial inclusion) • management of market distortions (AI risk) • reduction of regulatory costs • promoting the transparency and stability of the financial system (money laundering, suspicious transactions), increased confidence	• polarisation of the labour market, frictional unemployment • enhancement of employees' digital competencies
Global	• transforming investment climate in the national economy • impact of investor confidence and market sentiment on AI hype cycles • general democratisation of trading (robotic support not requiring expertise)	• transformation of digital consumer habits • social challenges of human–robot interactions (robot rights, legal personality) • social diffusion and inhibitors (incidents) of AI and the related innovations • enhancement of certain human skills • impact on social inequalities • consequences of the unethical use of AI	• supporting sustainable banking and ESG objectives • the impact of technology on cross-border services and global trade • financial integration of developing countries (temporary slump in the learning phase) • clarification of responsibility and insurance issues • international collaboration (AI ecosystem) • development of data and security regulation for international banking	• rise of (physical) robots • transformation of labour demand • increased income inequalities within society • social conflict (?)

6. Own research results: The practical implementation of investments in bankrobotics

6.1. Data collection: in-depth interviews

In line with the research questions presented, structured in-depth interviews were conducted between December 2022 and May 2023 related to the practical implementation of investments in bankrobotics. The interviewees were banking, business and software development professionals who participated in projects related to AI, ML and robot developments (*Table 3*). The duration of the interviews was capped at 120 minutes, but they usually lasted 90–120 minutes. The results are published anonymously. The in-depth interviews are limited by the experiences of the interviewees (specialisation in IT, banking sector), which may reduce the potential of generalising the survey.

Table 3
Summary of the experiences about the investments in AI and robots: in-depth interviews and bankrobotics WS

#	Profession	Experience (years)	Interview (minutes)	Industry, sector
1.	Head of AI Division	9	120	Banking sector, information technology
2.	R & D Director	15	120	Information technology
3.	Software developer	6	90	Information technology
4.	Machine learning engineer	7	90	FinTech, healthtech
5.	Project manager	25	120	Information technology
6.	IT manager	25	80	Banking sector
7.	Automation manager	12	90	Banking sector
8.	Machine learning engineer	17	120	Banking sector, pharmaceutical industry
9.	IT Programmer	23	120	Banking sector, pharmaceutical industry
10.	Software Development Engineer	7	120	Information technology
11.	Research & Development, AI developer	6	120	Information technology
12.	IT project leader	6	120	Banking sector, pharmaceutical industry
13.	IT specialist	20	90	Banking sector
14.	Project controller	6	84	Banking sector
Total interviews (hours)			24.7	

Note: Bankrobotics WS is a series of workshops organised by the Institute for Training and Consulting in Banking Ltd.

6.2. Research results

The summary of the interviews related to Q1, Q2, Q4 and the responses can be found in *Annex 1*.

6.2.1. Corporate asset feature of AI (*Q1*)

With one person declining to comment, all interviewees agreed that with its present capabilities, artificial intelligence is a corporate asset, and it should not be treated as a legal personality. However, 40 per cent of respondents can imagine robot rights and the question of legal personality being discussed to reach a social consensus, as AI develops in the future.

6.2.2. The implementation of investments in bankrobotics (*Q2*)

Based on the experiences from the in-depth interviews, the development of AI systems in the banking sector usually starts in-house, in relation to customer-specific processes and those related to the ordinary course of business, supplemented by the inclusion of advisors and partner firms. In the case of R&D processes and processing system and specialised workflows, the inclusion of an external developer and/or cooperation with (FinTech) tech companies becomes more important. In other words, cooperation is strongly influenced by the nature of the project and the fulfilment of in-house, specialised preconditions (in-house IT/AI skills) at the bank. In-house development of front/middle office decision support systems has the advantage that the banks' intellectual property, data assets and customer data are protected, bank security and cybersecurity are facilitated, and code base ownership and the management of capacity planning issues are ensured. The development of AI-driven processing systems (typically a back office activity) is often supported by contracted suppliers. The advantages of developments completed by external providers include bridging the gaps in technology and capacities (flexible capacity planning – time, employees), but partnerships also involve counterparty risk. External knowledge can be acquired in various forms. Acquisition (start-ups) and venture capital investments can both facilitate the integration of technology and expertise unavailable to the bank. Acquisition can also mitigate the security risks related to bank data through ownership. It can be seen that the in-house development of an organisation's AI skills and knowledge is supported by AI solutions from suppliers and acquired firms as well as experience from expertise and projects. The form of implementation is influenced by the business objective (differentiation), the business area and bank security issues.

7.2.3. The approach to investment (*Q3*)

According to the in-depth interviews, investments in robotics are dominated by a top-down approach, mainly driven by pressure from investors and market competition. In extreme cases, a bottom-up approach can come into focus, especially at firms that place an emphasis in their organisational culture on motivating employees, or when the organisation does not have an AI strategy and the management does not have knowledge about AI. However, there are also hybrid solutions, when – in a bottom-up manner – business development proposals shape a corporate AI strategy that has not fully matured.

7.2.4. Management's knowledge about AI and the related innovative technologies (*Q4*)

AI hype and a lack of knowledge about AI on the part of managers can cause problems in cooperation with suppliers, due to unrealistic expectations about technology and value creation. Issues arising from the management's lack of technological knowledge can already be detected in the negotiation phase of projects. Key points in project planning include: the objective of the planned investment in bankrobotics (technology) and the value creation of the business area (improved efficiency, saved resources, other), the planning of the necessary preconditions (assets, AI experts) and capacities, data security issues as well as the establishment of risk and success factors (KPIs). When partners are involved, one common problem is the bank management's unrealistic expectations about the technology and the development time (time needed for testing), which leads to underestimated resources in planning. Ideally, the communication between the bank's management and the supplier is supported by an IT expert at the bank. These experts play a crucial role in formulating realistic expectations about bankrobotics projects on behalf of the bank's management. In the absence of this key player, unrealistic expectations can cause problems in the cooperation between the bank and the supplier.

6.2.5. Factors inhibiting/supporting implementation and value creation (*Q5*)

The factors inhibiting implementation and value creation are classified into 7 main categories and 29 subcategories based on the experiences shared in the in-depth interviews. *Table 4* shows the supporting factors, the absence of which can hamper the value creation of investments in bankrobotics.

Table 4
Classification of factors supporting the value creation of investments implemented in bankrobotics

Main category [subcategory]	Subcategory	Subcategory elements
Organisation [9]	AI strategy	Development of an AI strategy in line with the AI strategy of the parent company
	Establishment of a dedicated organisational unit and organisational forums	Establishment of the responsible organisational unit, positions, responsibilities and accountability
	Organisational culture conducive to AI	Environment supporting innovation; integration of the "robot" into the organisation (team member)
	Awareness-raising about AI	Awareness-raising and training of employees
	Size and global presence of the organisation	Alignment to the cultural, regional and local AI regulation environment
	Cost/profit pull factors	Establishment and continuous review of value-creating and cost factors
	Protection of the bank's data assets and supporting cybersecurity	Observance of data security rules and policies; establishment and support of operating and security requirements, system protection (access rights, cybersecurity at banks), ensuring compliance
	Organisational capacity-building	Necessary instruments (hardware, software); knowledge transfer, AI knowledge base
	Social responsibility and external knowledge transfer	Collaboration with universities, start-ups; supporting awareness-raising among customers and society
Executives, management [2]	Change management	Governing organic transformation, change of mindset, commitment (embodied in action as well); supportive organisational communication
	Technological skills	Basic AI knowledge, technological skills (avoiding unrealistic expectations caused by AI hype)
Operational employees [2]	Managing employee fears and resistance	Managing employee resistance (fear of job loss, rising workload in IT) through organisational change management
	AI experts, employee skills, education	Attraction of AI experts; talent management

Table 4
Classification of factors supporting the value creation of investments implemented in bankrobotics

Main category [subcategory]	Subcategory	Subcategory elements
Other stakeholder groups [4]	Investors, market	Communication of accurate technological capabilities (AI-washing), communication about the investment in bankrobotics vis-à-vis consumers and investors
	Competition and market trend analysis	Competition and technological trend analysis
	Customers	Customer needs and requirements (assessment, discussion); measuring technological penetration and satisfaction; customer education: responsible product use and judgement
	Partner, supplier	Choosing a supplier with specialised AI expertise, knowledge transfer; managing counterparty risk
Data and data governance [3]	Acquisition and storage of the necessary data	Provision of the necessary amount and quality of data (managing data quality issues, proper data cleansing), storage (server/cloud)
	Data loading, data feed, system connections	Availability of in-house and external data silos, API integration; harmonisation of subsidiary and partner systems
	Data security	Protecting customer data, anonymity, rethinking technology workflow
Technology [4]	Project management: Management/business/ development/legal team cooperation	Using a short chain of communication and creating a communication link between the bank and the supplier: having an IT/AI expert at the bank is crucial for realistic scheduling, clarifying expectations and the reliable estimation of the necessary resources; accurate business need specifications (related KPIs)
	AI risk management system	Operation of a risk management system
	Model building – algorithm selection	Appropriate data labels: representativity; choosing the appropriate algorithm and model calibration; ensuring model requirements (transparency, non-discrimination, explainability)
	Operation, monitoring and human oversight	Workflow support of the system: human oversight; controlling system performance (accuracy, negative feedback loops), reparameterisation when necessary, defining intervention scenarios (system shutdown)
Legal considerations [5]	Compliance	Compliance with legal regulations (AI laws, DORA, GDPR, others), risk classification; implementation of ethical guidelines
	Information to customers and contracts	Customer information in line with legal requirements – integration into customer contracts
	Application limits	Slow adaptation in the international and domestic regulatory environment
	Regulatory sand box	Providing an opportunity for the business area to test the model (supporting the bank's IT/AI experts)
	Data reporting obligations, documentation	Observance of model and operating requirements (technical documentation, record-keeping requirements)

Based on the experiences detailed above, I summarised the results of my research results in *Table 5*.

Table 5
Summary of research results

Research question	Hypothesis accepted/ rejected	Research results
Q1	**H1: accepted**	AI should be treated as a corporate asset.
Q2	**H2: accepted**	In-house, partnering, acquisition and hybrid forms can all be observed.
Q3	**H3: accepted**	Top-down approach dominates. The bottom-up approach is characteristic of organisations that do not have an AI strategy and where the management has limited knowledge about AI. As a hybrid solution, the top-down approach can be transformed based on the specification of the bottom-up business area/IT/supplier.
Q4	**H4: partially accepted**	AI hype and the lack of knowledge about AI on the part of managers can cause problems in the cooperation with suppliers, due to unrealistic expectations about technology and value creation.
Q5	**H5: accepted and adding additional factors**	The factors inhibiting the implementation and value creation of investments in bankrobotics were classified into main and subcategories, as presented in *Table 4.*

7. Conclusions and proposals

Investments in bankrobotics typically create value for an organisation as a whole, not just for a specific business unit, thanks to the related activities. The difficulties involved in measuring value creation highlight the risks of the implemented technologies and the need to classify them as well as the operation of the related risk management frameworks. In risk classification, organisation-specific *partner chains should be defined.* Partner chains are neighbouring areas working in close cooperation that can impact each other's activities indirectly but significantly, due to their shared business processes as well as the systems and the data used. The risk classification of the AI systems used in these partner chains should be established based on the interaction between the areas and the application of the technology in the individual areas.

In relation to publicising investments in bankrobotics, banks and regulatory authorities need to work together to develop the requirements while considering the following:

- The extent and impact of the investment in bankrobotics: investments that can have a major impact on banking operation and customers need to be treated as a priority (e.g. ML-based IRB models) and disclosed.

- Security and data protection: investments need to comply with stringent security and data protection requirements, as well as the European Union guidelines and laws on ethical AI. In the course of disclosure, these aspects should be given priority so that customers receive sufficient information on the use of the system, its security and capabilities and the protection of their data.

To supplement the current practices (FinTech and Digitalisation Report), the author proposes the introduction of a publicly available database of AI incidents during the operation of investments in bankrobotics, which should be coordinated by the supervisory authority while considering the following minimum requirements: incident ID, incident title (short summary); detailed description of the incident; date of the report/detection of the error; date of the intervention/correction; banking areas affected; (potentially) affected customers; the company developing the AI system or the name of the bank (in the case of an in-house development); operating bank. This proposal rests on the following main considerations:

- *Trust and responsibility:* The AI law published by the European Union determines the rules of responsibility for damages caused related to the development, operation and dissemination of AI systems, where in certain cases high-risk AI systems can be subject to more stringent rules, and even a certification can be required to prove the appropriateness of the system. In this context, the proposed database would be transparent and help establish and maintain mutual trust between market participants and stakeholders, thereby facilitating transparency and accountability, and the development and operation of ethical AI systems, in line with the European Union's guidelines on ethical AI.

- *Development of the banking sector:* The disclosure of incidents stimulates innovation and the necessary developments, promoting the development of organisational capabilities and banks' accountability culture.

- *User/customer protection and customer experience:* In addition to the group of customers affected (households, companies, other customers), the basic details of the incident would be known to customers, which would improve the protection of the users involved in the incident. Successful, transparent management of incidents can help restore confidence and allows customers to make conscious decisions while interacting with AI systems.

Verifying AI labels (avoiding AI-washing): AI systems need to be supervised by the competent authorities. The supervisory authority needs to have policies in place for labelling AI systems, and the exact definition of AI systems and the risk classification used should be clearly established. These policies can determine labelling requirements and supervisory procedures.

Compliance inspections: the supervisory authority needs to conduct regular inspections at banks to verify the labelling and use of AI systems, and to supervise and investigate the reported AI incidents.

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Annex

Annex 1
Research questions and answers – interviews on questions Q1, Q3 and Q4, summary of answers

#	Q1	Q3	Q4
1.	no comment	top-down	the business area has limited knowledge, the modelling department usually does not know it
2.	corporate asset	top-down	the project leaders usually have a realistic requirement (higher expectations can also be seen)
3.	corporate asset	top-down	sometimes – typically affects the order process
4.	corporate asset	top-down	FinTech managers are usually well-versed in a wide range of technologies
5.	corporate asset	bottom-up	superficial knowledge of AI
6.	corporate asset	hybrid	superficial, misconceptions
7.	corporate asset	top-down	a competency hub is operated within the organisation, and AI training is a part of that
8.	corporate asset	bottom-up	the management has broad knowledge
9.	corporate asset	bottom-up	lack of prior knowledge
10.	corporate asset	top-down	prior shortcomings and high expectations
11.	corporate asset	top-down	superficial, prior shortcomings and high expectations
12.	corporate asset	top-down	gaps in knowledge, only second-hand knowledge
13.	corporate asset	top-down	shortcomings and high expectations
14.	corporate asset	top-hybrid	the project leaders usually have a realistic requirement, but they have less information about implementation and the technology