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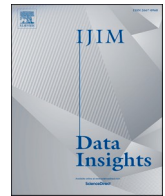
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Impacts of digitization on operational efficiency in the banking sector: Thematic analysis and research agenda proposal

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ABSTRACT

The purpose of this paper is twofold: (i) to identify the thematic categories and central topics connecting digitization and operational efficiency in the banking sector; and (ii) to develop a research agenda to guide future research endeavors to advance knowledge related to digital operational efficiency (DOE). Employing a two-stage content-centric review approach, this study comprehensively outlines overarching themes and subsequently delves into specific dimensions. The first stage aimed to provide an overview of research connecting operational efficiency and digitization in the banking sector and to refine the search criteria for content analysis. The second stage employed content analysis concentrated on journal articles published between 2018 and 2023. Central topics include enhancing banking industry performance through industry 4.0 technology and partnerships, the impact of the COVID-19 pandemic on bank digital transformation, organizational adaptations for embracing new digital business models, and elevating customer experience through novel operational paradigms. The research agenda proposed include the following: DOE conceptual development; digital bank break-even analysis; optimization of the product and service portfolio offered by digital banks; and consumer experience and level of service of digital banks. By delving into the impact of industry 4.0 technologies, pandemic, and digital business models, this paper enriches our understanding of the complex interplay between digitization and operational efficiency. The proposed research agenda offers a roadmap for future scholarly endeavors, contributing to the evolution of theoretical frameworks in this field. This paper offers insights relevant for banking industry professionals, providing them with valuable guidance on how to enhance their performance, optimize their digital product and service portfolio, and elevate the overall customer experience in the rapidly evolving landscape of digital banking.

1. Introduction

It is of utmost importance for banks and the financial services industry to assess the outcomes of their operations. This evaluation holds significant weight as it showcases their financial efficiency to various stakeholders, including the market, investors, competitors, and ultimately fosters a sense of trust among their customers (Pio et al., 2023). A well-established avenue to achieve this is through the utilization of the Operational Efficiency Index (OEI), which is determined by dividing the cost by the revenue (Nguyen, Tripe & Ngo, 2018; Khan & Shireen, 2020;

Allen & Rai, 1996).

By employing this methodology, financial analysts and investors are empowered to conduct thorough financial analyses and comparisons across companies (Bangarwa & Roy, 2022). This encompasses scrutinizing variables such as payroll expenditures, revenues across distinct lines of business (e.g., credit cards and corporate banking), thereby enabling the identification of the most proficient companies. Furthermore, this approach aids in discerning which entities are most conducive for investment or divestment (Luo, Fan & Zhang, 2017).

The advent of digital transformation has brought about a paradigm

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shift in the banking industry, altering the landscape of traditional banking operations and reshaping the manner in which financial institutions interact with their clients (Al-Dmour, Asfour, Al-Dmour & Al-Dmour, 2022). This technological evolution has not only streamlined internal processes but has also revolutionized customer engagement through innovative digital channels (Pio et al., 2023; Bueno, Sigahi & Anholon, 2023). Rapid advancements in information technology, data analytics, high-layered datasets (Zaib & Ourabah, 2023) and artificial intelligence have paved the way for a digital ecosystem that transcends geographical boundaries and time zones (Singh et al., 2022). As banks embrace digital platforms, the scope and scale of their operations have expanded exponentially, enabling them to offer a diverse range of services, from mobile banking to digital wallets and virtual advisory services (Shaikh & Anwar, 2023). Consequently, the banking sector finds itself at a pivotal juncture, where the integration of digital tools has become instrumental in enhancing operational efficiency and positioning institutions at the vanguard of industry transformation (Bueno, Sigahi & Anholon, 2023).

The incorporation of digital technologies, including industry 4.0, within the banking sector has ushered in a new era of operational efficiency, redefining how financial tasks are executed, monitored, and optimized (Schepinin & Bataev, 2019; Arjun, Kuanr & Suprabha, 2021). Automation and digitization of routine tasks have not only reduced manual errors but have also expedited transaction processing, thereby leading to significant time and cost savings. Moreover, digital platforms enable banks to gather, process, and analyze vast volumes of data, offering insights that empower institutions to make informed decisions for resource allocation, risk management, and service enhancement (Al-Dmour, Asfour, Al-Dmour & Al-Dmour, 2022; Banna & Alam, 2021; Pandey, Mittal & Subbiah, 2021). Consequently, the paradigm shift towards digitization has not only elevated the efficiency of individual operational components but has also synergistically harmonized various facets of banking operations, thus augmenting the overall operational efficiency of the sector (Winasis, Wildan & Sutawidjaya, 2020; Beheshtinia & Omid, 2017).

The pursuit of digital operational efficiency (DOE) in the banking sector bears profound implications not only for managers and stakeholders within the financial industry but also for broader society (Du et al., 2020; Sia, Weill & Zhang, 2021). As banks harness the power of digital technologies to optimize their operations, they are better poised to allocate resources effectively, optimize costs, and mitigate risks (Pandey, Mittal & Subbiah, 2021; Hoffmann, 2019). This heightened operational efficiency translates to improved financial performance and sustainable growth, thereby instilling confidence among investors and shareholders (Chhaidar, Abdelhedi & Abdelkafi, 2022). Moreover, the efficiency gains trickle down to customers in the form of enhanced services, quicker response times, and personalized experiences, all of which foster customer loyalty and trust (Pio et al., 2023).

From a societal perspective, a digitally efficient banking sector contributes to economic stability, financial inclusivity, and technological progress. As banks evolve into technologically adept entities, they play a pivotal role in driving innovation, spurring job creation, and bolstering economic resilience (Winasis, Wildan & Sutawidjaya, 2020; Anis et al., 2023). Thus, the pursuit of DOE transcends its immediate impact, resonating through both the microcosm of banking management and the broader canvas of societal advancement.

Given the context presented, the objectives of this paper unfold along dual dimensions: (i) to identify the thematic categories and central topics connecting digitization and operational efficiency in the banking sector; and ii) to develop a research agenda to guide future research endeavors to advance knowledge related to digital operational efficiency (DOE). This study is primarily driven by the recognition of the evolving landscape of banking operations amidst the ongoing process of digitization (Chauhan, Akhtar & Gupta, 2022). Given the relatively limited understanding in this area, there is a compelling need for a thorough examination and categorization of existing literature

(Indriasari, Prabowo, Lumban Gaol & Purwandari, 2022). By undertaking this comprehensive review, we aim to establish a structured conceptual basis that not only synthesizes current knowledge but also paves the way for further research in this field.

The remainder of this paper is structured as follows: in the Section 2, the research methodology is detailed, comprising two cycles: the first cycle involves a comprehensive approach for an overview and refinement of the literature, while the second cycle employs a focused content review approach. Section 3 presents the results and discussions and is divided into three key components: "Categorization of the literature on DOE" presents the findings related to the thematic categorization of literature on digital operational efficiency (DOE); "Central topics in research on DOE" discusses the significant research themes identified in the study; and "Research agenda" outlines the proposed directions for future research. Lastly, Section 4 summarizes the main findings and their implications in the context of digitization and operational efficiency in the banking sector and state the research limitations.

2. Theoretical background

Digital transformation has emerged as a pivotal force reshaping the banking sector, propelled by rapid advancements in technology and evolving consumer preferences (Kitsios, Giatsidis & Kamariotou, 2021; Rodrigues, Ferreira, Teixeira & Zopounidis, 2022). This can be seen as a disruptive innovation, as coined by Christensen (Christensen, 1997), characterized by new technologies that disrupt existing markets and value networks, often leading to the displacement of established industry leaders by innovative newcomers.

In recent years, traditional banking operations have undergone significant digitization, encompassing a wide array of functions ranging from customer interactions to backend processes (Naimi-Sadigh, Asgari & Rabiei, 2022). This transformation is driven by various factors, including the proliferation of smartphones, increasing internet penetration, and the emergence of innovative financial technologies. As highlighted by Diener and Špaček (Diener & Špaček, 2021), banking institutions are increasingly recognizing the imperative to embrace digitalization to remain competitive and relevant in today's fast-paced digital landscape. However, this transformation is not without its challenges. Barriers such as legacy systems, regulatory constraints, and organizational inertia often impede the pace of digitalization efforts, underscoring the complex nature of the transition (Washington, Rehman & Lee, 2022).

Digital transformation in the banking sector has become synonymous with adapting to the demands of the modern era, where technology plays an increasingly central role in everyday life. The digitization of traditional banking operations extends far beyond mere automation; it represents a fundamental shift in how financial institutions engage with their customers, manage processes, and deliver value (Naimi-Sadigh, Asgari & Rabiei, 2022; Ramdani, Rothwell & Boukrami, 2020). This evolution is fueled by a confluence of factors, including the widespread adoption of smartphones and the internet, which have democratized access to financial services and empowered consumers with unprecedented levels of convenience and choice (Tuli, 2023). Moreover, the rise of innovative financial technologies, often spearheaded by nimble Fin-tech startups, has disrupted traditional banking paradigms, compelling incumbents to innovate or risk obsolescence (Boot, Hoffmann, Laeven & Ratnovski, 2021). As highlighted by Kitsios et al. (Kitsios, Giatsidis & Kamariotou, 2021), digital transformation in the banking sector is not merely a matter of technological implementation but a strategic imperative for organizations seeking to maintain relevance and competitiveness in an increasingly digital world.

Despite the undeniable benefits of digital transformation, banks face formidable challenges on the path to digitalization. Legacy systems, characterized by outdated infrastructure and fragmented data architectures, pose a significant obstacle to progress, hindering agility and interoperability (Dudin, Shkodinskii & Usmanov, 2021). Moreover,

navigating the intricate web of regulatory requirements, ranging from data privacy and (Rodrigues, Ferreira, Teixeira & Zopounidis, 2022; Al-Alawi, Al-Khaja & Mehrotra, 2023) to compliance with anti-money laundering (AML) regulations, adds layers of complexity to digitalization efforts. Regulatory constraints can stifle innovation and necessitate careful navigation to ensure compliance while driving digital transformation initiatives forward. Additionally, organizational inertia, stemming from entrenched processes, cultural resistance to change, and legacy mindsets, presents a formidable barrier to digital adoption (Almeida & Ramos, 2022). Overcoming these challenges requires a holistic approach that addresses technological, regulatory, and cultural dimensions, emphasizing the need for strong leadership, strategic vision, and cross-functional collaboration within banking organizations.

The digital transformation of banks faces significant barriers, with legacy systems and infrastructure posing one of the primary challenges. Many banks operate on outdated technology platforms that hinder agility and interoperability, making it challenging to integrate new technologies and adapt to evolving customer demands (Dudin, Shkodinskii & Usmanov, 2021). Upgrading or replacing these systems requires substantial investment and expertise, presenting a formidable hurdle to digital initiatives. Cultural resistance and organizational inertia within banking institutions also impede digital transformation. Banks are traditionally conservative institutions with entrenched processes and risk-averse cultures, making it challenging to embrace innovation and agility (Almeida & Ramos, 2022). Overcoming this resistance requires strong leadership and effective change management strategies to foster a culture of innovation and adaptability. Additionally, talent shortages and skills gaps present significant barriers, as banks struggle to attract and retain professionals with expertise in areas such as data analytics and cybersecurity (Diener & Špaček, 2021). Addressing these challenges requires a concerted effort from banks to invest in technology infrastructure, navigate regulatory requirements, foster a culture of innovation, and attract and retain digital talent.

Despite these barriers, the digital era has ushered in a myriad of benefits and trends within the banking sector, revolutionizing traditional banking practices and enhancing overall efficiency and customer experience (Ramdani, Rothwell & Boukrami, 2020; Dudin, Shkodinskii & Usmanov, 2021; Martino, 2021). One prominent trend is the proliferation of digital banking channels, offering customers unprecedented convenience and accessibility to financial services. As noted by Kaur et al. (Kaur, Kiran, Grima & Rupeika-Apoga, 2021), the adoption of digital banking channels is gaining traction, particularly in emerging economies, driven by factors such as the expansion of internet infrastructure and the proliferation of mobile devices. Moreover, digital transformation has enabled banks to streamline operations, reduce costs, and improve service delivery through the integration of innovative technologies such as artificial intelligence (AI) and machine learning (ML) (Rodrigues, Ferreira, Teixeira & Zopounidis, 2022). Additionally, the advent of Fintech firms has catalyzed innovation in the banking sector, fostering competition and driving incumbents to adapt and innovate to meet evolving customer demands (Kadyan, Bhasin & Sharma, 2022).

Furthermore, the digital era has witnessed a paradigm shift towards customer-centricity, with banks increasingly focusing on delivering personalized and seamless experiences across digital touchpoints. As elucidated by Chauhan et al. (Chauhan, Akhtar & Gupta, 2022), customer experience has become a strategic differentiator for banks, necessitating the adoption of user-friendly interfaces, predictive analytics, and AI-driven recommendation engines to cater to individual preferences and anticipate customer needs. Moreover, the convergence of digital banking with emerging technologies such as blockchain and Internet of Things (IoT) is expected to unlock new possibilities in areas such as payments, identity verification, and risk management (Indriarsi, Prabowo, Lumban Gaol & Purwandari, 2022). These trends collectively underscore the transformative impact of digitalization on the banking industry, promising enhanced efficiency, agility, and

customer-centricity in the pursuit of sustainable growth and competitiveness.

In a systemic perspective, the digital transformation of the banking sector represents a pivotal shift in how financial institutions engage with customers, manage processes, and deliver value (Naimi-Sadigh, Asgari & Rabiei, 2022; Ramdani, Rothwell & Boukrami, 2020; Salih, Alsalhi & Abou-Moghli, 2024). While the journey towards digitalization is fraught with challenges, including legacy systems, regulatory constraints, and cultural resistance, banks are increasingly recognizing the imperative to embrace digitalization to remain competitive and relevant in today's fast-paced digital landscape (Diener & Špaček, 2021). However, despite these barriers, the digital era has brought forth a myriad of benefits and trends within the banking sector, revolutionizing traditional practices and enhancing overall efficiency and customer experience. From the proliferation of digital banking channels to the adoption of innovative technologies such as artificial intelligence and machine learning, banks are poised to leverage digital transformation to drive sustainable growth and competitiveness in the digital age (Rodrigues, Ferreira, Teixeira & Zopounidis, 2022; Martino, 2021). As the banking industry continues to evolve, embracing digitalization will be crucial for organizations seeking to thrive in an increasingly digital world.

3. Materials and methods

In order to identify the main research topics, themes, and debates surrounding digital transformation and operational efficacy within the banking sector, a content-centric review approach (Sigahi & Szelwar, 2023; Ng et al., 2022; Morooka et al., 2023) was selected. This study adopted a structured review approach as outlined by Vashar et al. (Varsha, Chakraborty & Kar, 2024), which was conducted in two stages (cycles), as explained in this section.

3.1. First cycle: comprehensive approach for overview and refinement

The first cycle (Fig. 1) aimed to provide an initial overview of research on the subject and conduct a preliminary analysis of the literature to refine the search criteria for the content review. As proposed by Vashar et al. (Varsha, Chakraborty & Kar, 2024), this preliminary review mapping aids researchers in assessing whether they can delve into a substantial body of material or if they must further refine their search to pinpoint a specific research query.

The Scopus and Web of Science databases were considered, utilizing the entire available search period and various document types. Employing this methodology, a total of 3765 documents were retrieved, distributed chronologically as depicted in Fig. 2.

The trajectory of research publications within the domain of the digitization of the financial sector paints a compelling narrative that mirrors the evolution of technological advancements. In the initial phase until 1995, a discernible dearth of scholarly outputs marked this nascent field, potentially reflecting the relatively incipient integration of digital technologies within the financial landscape. The period from 1996 to 2008 witnessed a consistent and measured rise in research endeavors, signifying a growing recognition of the transformative potential of digitization within the financial sector. During this interval, researchers and practitioners alike began to explore the multifaceted dimensions of digitization's impact on banking operations, customer experiences, and regulatory dynamics. The subsequent span from 2009 to 2018 is characterized by a systematic surge in research publications, underscoring an intensified academic and industry interest in comprehending the intricacies of the digital financial ecosystem. This phase aligns with a global acceleration of digital transformation and industry 4.0 initiatives (Arjun, Kuanr & Suprabha, 2021), prompting robust investigations into the implications of fintech innovations, cybersecurity challenges, and regulatory adaptations. Notably, the surge in research continued unabated from 2019 until April 2023, reaching unprecedented heights. This exponential increase reflects the contemporary urgency to dissect

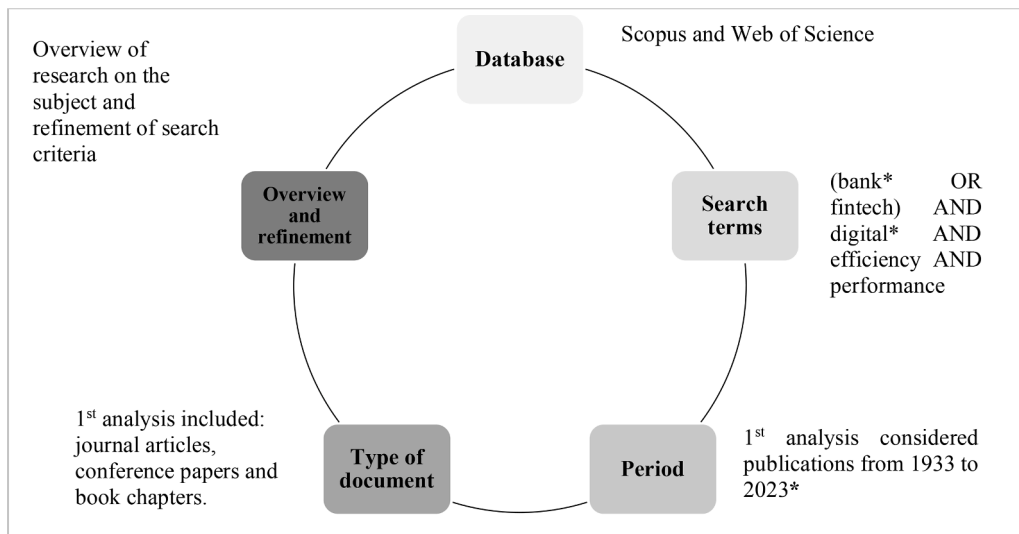


Fig. 1. First review cycle.
 *Note: Publications up to the time of the study were considered, i.e., April 2023.

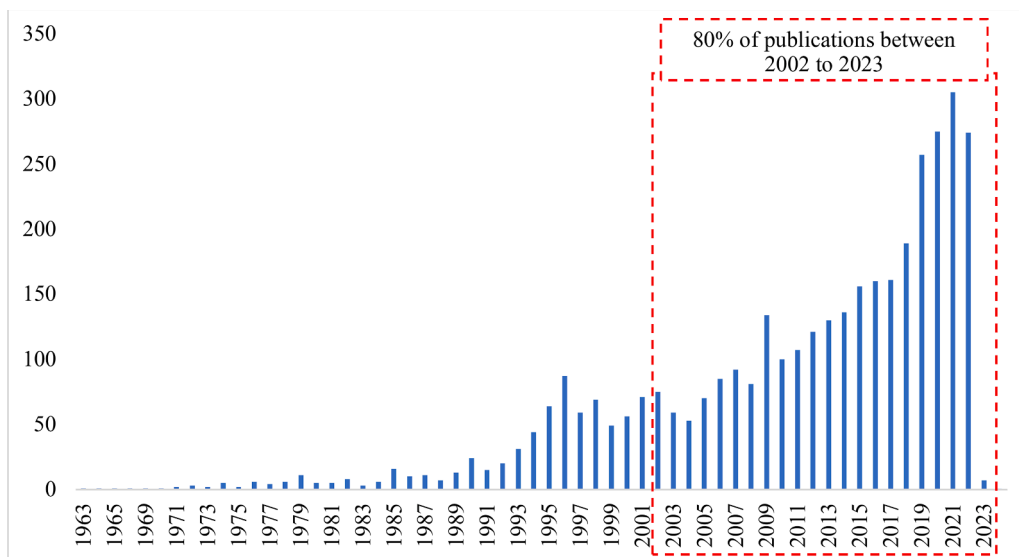


Fig. 2. Publication evolution.

the ever-evolving dynamics of digitization, encompassing emerging phenomena like blockchain, digital currencies, and the transformative potential of artificial intelligence within financial services (Singh et al., 2022; Mbaidin, Alsmairat & Al-Adaileh, 2023). Collectively, this chronological spectrum of research publication trends encapsulates the journey of academic inquiry, mirroring the unfolding narrative of digitization’s indelible imprint on the financial sector.

It is worth noting that approximately 80% of the publications were conducted in the last two decades, signifying a significant degree of novelty in the subject matter. This observation prompted the content analysis to center on a more limited timeframe, prioritizing recent research endeavors.

3.2. Second cycle: focused content review approach

In order to further amplify the pertinence of the study, a subsequent phase was initiated, concentrating the analysis on journal articles published within the last six years (as depicted in Fig. 3).

The rationale behind selecting this time span emanates from its

alignment with the recent apex of digital evolution within the financial sector. This era has borne witness to seminal developments in novel digital technologies, concomitantly accelerated by the catalytic impact of the COVID-19 pandemic, which propelled the digitization process at an unprecedented pace (Banna & Alam, 2021; Battisti, Alfiero & Leonidou, 2022). Furthermore, the second cycle of this review was meticulously tailored to heighten the pertinence of the analysis. Accordingly, a deliberate decision was made to focus on journal articles, deliberately excluding contributions presented at conferences or disseminated as book chapters.

Guided by this rationale, a search across the designated databases yielded a total of 1025 documents. Out of this corpus, 733 were deemed incongruent with the precise scope of this paper. Consequently, a refined and definitive sample of 292 articles was defined to serve as the basis for conducting this study.

The content review was developed following the recommendations from Elo and Kyngäs (Elo & Kyngäs, 2008), encompassing a structured progression through five phases:

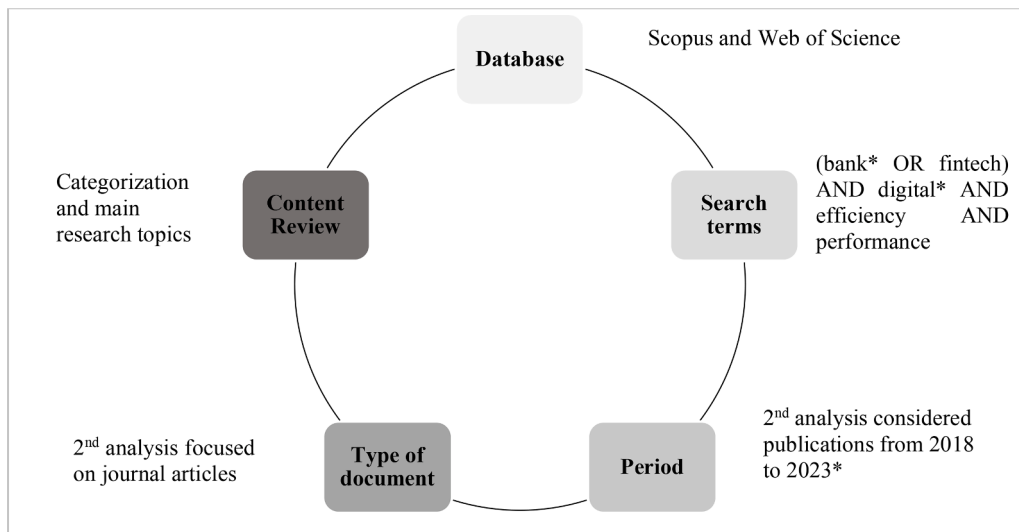


Fig. 3. Second review cycle.

*Note: Publications up to the time of the study were considered, i.e., April 2023.

- I. Preparation: Initially, the researchers analyzed the preferred content analysis approach. Given the dearth of preceding insights concerning the topic under examination, the inductive approach was chosen. This decision is rooted in the intent to transmute specific discussions into a broader conceptual framework, thereby charting an organic evolution of understanding;
- II. Open coding: This phase entails the concurrent annotation of notes and headings within the text as it is perused. This practice engenders an iterative process of analysis, facilitating the identification and delineation of emerging patterns, themes, and salient nuances intrinsic to the discourse;
- III. Coding: Subsequently, the annotated notes are systematically transcribed onto coding sheets. These sheets function as reservoirs for the accumulation of notes, subsequently harnessed for the purpose of generating categories. The inherent flexibility of this approach permits the organic generation of categories, thereby accommodating the emergent complexity of the content;
- IV. Categorization: The ensuing stage involves the logical consolidation of categories under overarching headings of higher order. This strategic aggregation serves the dual purpose of streamlining the taxonomy and curtailing the proliferation of categories, thereby engendering a more coherent and succinct framework;
- V. Abstraction: This final phase is synonymous with the synthesis of understanding, achieved through the formulation of a comprehensive, generalized depiction of the research topic. This synthesis is executed through the generation of categories, underpinned by content-characteristic descriptors, aiming at encapsulating the core thematic fabric elucidated within the content analysis process.

4. Results and discussion

4.1. Categorization of the literature on DOE

The 292 documents selected were analyzed and categorized in 28 categories (Table 1). Those 28 categories were developed according to the content review method following the steps proposed by Elo and Kyngäs (Elo & Kyngäs, 2008), aiming to create groups which present meaningful categories representing the current articles discussions.

Further delving into the content of the 292 articles, it emerges that a subset of 23 exhibits a sharper confluence with the focal research topic. Those articles are distributed in the categories as shown in Table 2.

Table 1

Categorization of the DOE literature.

Categories	N° of articles	Frequency (%)	Cumulative frequency (%)
Performance of the banking sector	66	22.6	22.6
Blockchain / Tokenization	23	7.9	30.5
Digital currency	23	7.9	38.4
Fintech	22	7.5	45.9
Digital transformation	22	7.5	53.4
Technological reshaping	19	6.5	59.9
Benefits and risks analysis for digital finance adoption	15	5.1	65.1
New technological applications	15	5.1	70.2
Customer experience in banks	14	4.8	75.0
Artificial intelligence	13	4.5	79.5
Fraud	10	3.4	82.9
Bank's digital ecosystem	8	2.7	85.6
Digital financial inclusion	7	2.4	88.0
Digital finance and financial performance	6	2.1	90.1
Digital banking trends	5	1.7	91.8
Customer digital adoption	4	1.4	93.2
Digital banking service quality	3	1.0	94.2
Agile approaches in bank's sector	2	0.7	94.9
New digital products	2	0.7	95.5
Big data analysis	2	0.7	96.2
Open banking	2	0.7	96.9
MIS	2	0.7	97.6
Human capital and digital efficiency	2	0.7	98.3
Bank's growth roadmap strategy	1	0.3	98.6
Digital-only banks	1	0.3	99.0
Cloud	1	0.3	99.3
Marketing influence on bank's performance	1	0.3	99.7
Branchless banking	1	0.3	100
Total	292	100	100

Source: Authors.

4.2. Central topics in research on DOE

Through an in-depth content analysis of the articles and the convergence between the main topics of discussion, six distinct topics emerged (Fig. 4), serving to elucidate the central discussions within the DOE literature. These topics are elaborated upon in the subsequent

Table 2
Distribution of selected articles and key topics according to the categories.

Categories	N° of articles	Main topics of discussion
Performance of the banking sector	10	<ul style="list-style-type: none"> Historical assessment focused on profitability, liquidity, asset quality New dimensions introduced by digitalization on customer experience, operational efficiency and technological agility Digital banking service quality, omnichannel engagement Adaptation strategies for the digital age prompt critical examination
Digital finance and financial performance	3	<ul style="list-style-type: none"> Paradigm shift due to digital finance impact on financial institutions Blurring boundaries between banking and technology Digital payment systems, mobile apps, automated investment platforms Risk management, cost reduction, portfolio optimization
Technological reshaping	2	<ul style="list-style-type: none"> Profound influence of AI, blockchain, tokenization adoption AI-driven chatbots enhance customer service; blockchain ensures secure, transparent transactions Tokenization offers fractional ownership, liquidity opportunities Cybersecurity, data privacy, regulatory compliance Operational landscape changes, risk management, regulatory adherence
Digital transformation	2	<ul style="list-style-type: none"> Shift in banking operations through digital integration Customer interactions, internal processes, and business models Reimagining of value creation Innovation culture, digital literacy, agile methodologies Holistic approach aligning tech initiatives with strategic goals
Digital banking service quality	1	<ul style="list-style-type: none"> Evolving customer expectations in digital age User-friendly interfaces, personalized experiences, prompt issue resolution Customer satisfaction, loyalty, brand perception User experience design, efficient backend systems, data-driven insights Determinants and impact on customer behavior
Bank's growth roadmap strategy	1	<ul style="list-style-type: none"> Expanding market share, diversifying revenue streams, entering new segments Strategies related to fintech partnerships, digital infrastructure investment, targeted marketing Strategy effectiveness, financial performance implications, potential barriers Decision-making for sustainable growth in the digital economy
Digital-only banks	1	<ul style="list-style-type: none"> Operations exclusively in digital realm, with no physical branches Offers cost savings, agility, enhanced customer experiences Challenges related to trust-building, regulatory compliance, brand establishment
Benefits and risks related to digital finance adoption	1	<ul style="list-style-type: none"> Potential benefits: operational efficiency, customer engagement, expanded market reach Inherent risks: cybersecurity, data breaches, regulatory compliance, technology dependencies

Table 2 (continued)

Categories	N° of articles	Main topics of discussion
Artificial intelligence	1	<ul style="list-style-type: none"> Balancing short-term gains with long-term sustainability Financial services landscape through data-driven decision-making, automation AI-powered algorithms analyze datasets, optimize strategies, personalize experiences Ethical concerns: bias in algorithms, job displacement Role of AI in financial sector, impact on performance Strategies to address ethical and regulatory challenges
Blockchain / Tokenization	1	<ul style="list-style-type: none"> Secure, transparent transactions, new financial instruments Blockchain's decentralized ledger ensures trust, immutability Tokenization enables fractional ownership, increased liquidity Challenges: scalability, interoperability, regulatory acceptance Exploration of applications, benefits, challenges Transformative potential, role in future of financial services
Total	23	-

Source: Authors.

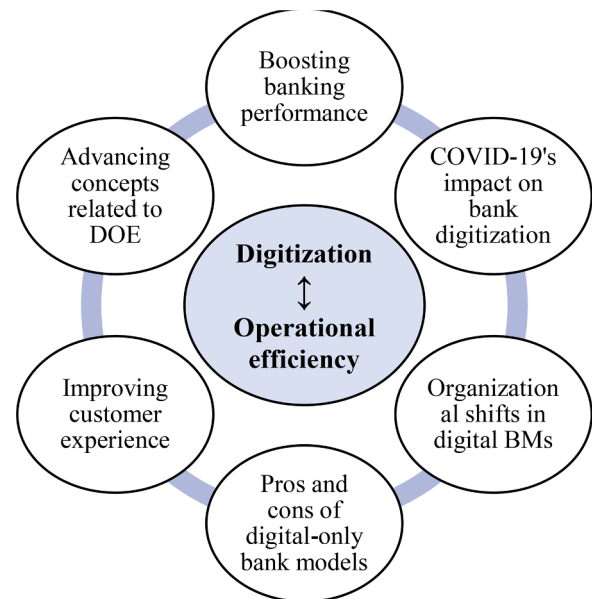


Fig. 4. Central topics connecting digitization and operational efficiency in the banking sector.

Source: Authors.

sections, providing valuable insights into the core debates in this domain.

4.2.1. Enhancing banking industry performance through technology and partnerships

This focal area encompasses 12 out of the 23 (approximately 52%) most pertinent articles. Notably, Chhaidar et al. (Chhaidar, Abdelhedi & Abdelkafi, 2022) shed light on the transformative impact of strategic partnerships and investments in fintechs, particularly for major banks with extensive operations. Their findings emphasize the significant

financial benefits derived from such collaborations, which streamline operations through innovative technologies. Conversely, Ozdemir (Ozdemir, 2022) provides an intriguing perspective on the advantages enjoyed by neobanks and smaller traditional banks through their partnerships with fintechs. By adopting advanced technologies unburdened by legacy systems, these entities can offer superior customer experiences. However, this transition presents challenges, including risk aversion, higher funding costs, increased capital requirements, and the formidable market dominance of larger financial institutions (Bueno, Sigahi & Anholon, 2023).

Moreover, the discourse encompasses the intricate dynamics of competition and concentration within the financial services sector. Borilli (Borilli, 2021) highlights a notable shift in market dynamics in Brazil between 2010 and 2020. The study reveals a reduction in market concentration alongside an evolving competitive landscape, attributed to the rising influence of emerging players such as digital banks and fintechs (Neves, Oliveira, Santini & Gutman, 2023). This shift prompts a recalibration of market shares among larger banking entities, signaling a significant transformation in the competitive landscape of the banking industry.

These insights offer a multifaceted view of the opportunities and challenges inherent in enhancing banking industry performance through technology and partnerships. While strategic collaborations present avenues for growth and innovation, they also require careful navigation of regulatory, operational, and competitive landscapes to realize their full potential in driving sustainable value for both banks and their customers.

4.2.2. *The influence of the COVID-19 pandemic on the digital transformation of banks*

The COVID-19 pandemic has catalyzed a rapid and profound transformation within the banking sector, accelerating the adoption of digital technologies and reshaping the way banks interact with their customers and operate their businesses.

One of the primary issues that have emerged in the wake of the pandemic is the urgent need for banks to enhance their digital capabilities to meet the evolving needs and expectations of customers. With social distancing measures and lockdowns limiting in-person interactions, consumers have increasingly turned to digital channels for their banking needs, including online banking, mobile banking, and digital payments. This surge in digital usage has placed immense pressure on banks to ensure the reliability, security, and usability of their digital platforms to accommodate the growing demand and deliver seamless customer experiences.

Moreover, the shift to remote work and virtual collaboration has necessitated banks to invest in technologies that enable employees to work remotely while maintaining productivity and efficiency. This includes deploying remote access solutions, collaboration tools, and cybersecurity measures to safeguard sensitive data and mitigate the risk of cyber threats in an increasingly remote and distributed work environment.

Furthermore, the pandemic has highlighted the importance of leveraging data and analytics to gain deeper insights into customer behavior, preferences, and needs. By harnessing the power of data analytics, banks can personalize their offerings, anticipate customer needs, and deliver targeted products and services that meet the unique requirements of individual customers. However, this also raises concerns around data privacy and security, requiring banks to strike a balance between leveraging customer data for innovation while respecting privacy rights and regulatory requirements.

In response to these emerging challenges, banks have begun to explore promising solutions to accelerate their digital transformation efforts and adapt to the new normal created by the pandemic. This includes investing in cloud computing, artificial intelligence, machine learning, and robotic process automation to automate routine tasks, streamline processes, and enhance operational efficiency. Additionally,

banks are increasingly partnering with fintech startups and technology providers to leverage innovative solutions and accelerate their digital innovation initiatives.

Moreover, banks are embracing agile methodologies and organizational structures to foster innovation, adaptability, and responsiveness in an increasingly dynamic and uncertain environment. By adopting agile principles, banks can iterate quickly, experiment with new ideas, and respond rapidly to changing market conditions, enabling them to stay ahead of the curve and drive continuous improvement in their digital transformation journey.

Looking ahead, while the COVID-19 pandemic has presented unprecedented challenges for banks, it has also provided a unique opportunity to accelerate their digital transformation and emerge stronger and more resilient in the post-pandemic world. By addressing emerging issues, embracing promising solutions, and fostering a culture of innovation, banks can position themselves for long-term success in an increasingly digital-first and customer-centric landscape.

4.2.3. *Organizational changes to adopt a new digital business model*

A pivotal facet in the realm of digital transformation pertains to the indispensable support accorded to employees navigating this profound transition. Winasis et al. (Winasis, Wildan & Sutawidjaya, 2020) emphasize that effectuating a novel digital customer experience necessitates not only systemic shifts but also a concomitant recalibration of employee behaviors. The study examined 25 indicators – 11 delineating work stress and 14 encapsulating employee engagement – culled from diverse international journals. The research scrutinizes a cohort of 448 respondents within a Jakarta-based private bank, a crucible of sweeping technological metamorphosis during the 2018–2020 timeframe. The empirical insights unveil the deleterious impact of work stress on employee engagement, with profound implications warranting strategic interventions. To counterbalance this, strategic interventions encompassing curbing excessive working hours, instituting performance-based rewards, and furnishing comprehensive support during the transformative journey emerge as pivotal mitigating factors (Winasis, Wildan & Sutawidjaya, 2020). Thus, proactively charting a blueprint for requisite training and support to acclimate employees to the emergent technological landscape assumes paramount significance, pivotal to ensuring the seamless implementation of the new digital business paradigm.

The findings from the literature shed light on the intricate relationship between organizational changes and the successful adoption of a new digital business model (Almeida & Ramos, 2022). The negative impact of work stress on employee engagement underscores the need for proactive organizational interventions to support employees during times of technological transition (Winasis, Wildan & Sutawidjaya, 2020). This highlights the importance of fostering a supportive organizational culture that values employee well-being and provides the necessary resources and training to navigate the challenges posed by digital transformation (Santos, Hayward & Ramos, 2012). Moreover, the identification of specific strategic interventions, such as curbing excessive working hours and implementing performance-based rewards, underscores the role of targeted organizational initiatives in mitigating the adverse effects of work stress and fostering employee engagement (Winasis, Wildan & Sutawidjaya, 2020). Ultimately, by prioritizing organizational changes that prioritize employee support and engagement, businesses can position themselves for success in the adoption of new digital business models, driving innovation and sustainable growth in an increasingly digitized landscape.

4.2.4. *Digital-only banks business models: benefits and risks*

Digital-only banks epitomize a fresh and distinct business paradigm, predicated upon seamless client service and the removal of entry barriers through technological prowess. Integral to this innovation are features like user-friendly apps, core banking systems delivered as Software as a Service (SaaS), customer familiarity with digital

communication channels, and more. However, entrancing customers into this novel banking landscape is not devoid of challenges. Saif et al. (Saif et al., 2022) underscore that understanding customer behavior entails dissecting three core factors: external influences (critical mass, service variety, environmental considerations), customer autonomy (exemplified by trust), and the cognitive outlook on technology adoption (embracing convenience, financial efficiency, utility, and security perceptions, alongside perceived value). Notably, convenience, financial efficiency, service variety, trust, perceived value, and environmental concern wield positive influence in attracting customers. Yet, lingering concerns over functional and security risks cast a shadow, accounting for the struggles faced by digital-only banks in the United States and Japan.

In parallel, Schepinin and Bataev (Schepinin & Bataev, 2019) devised a methodology centered on gauging IT project returns, thereby estimating the prospective benefits of investments in this domain. Their findings underscore that a fledgling challenger bank must amass a minimum of 200,000 clients within its inaugural year to achieve successful trajectory. Hence, the digital-only banking model is a work in progress, striving to curate compelling products and services to captivate and enhance customer rapport, despite the potential hurdles of limited offerings and customer trust.

The connection between these papers underscores the multifaceted nature of the digital-only banking business model, which presents both benefits and risks. On one hand, the convenience, financial efficiency, and perceived value offered by digital banks can attract customers seeking streamlined and accessible banking experiences (Ramdani, Rothwell & Boukrami, 2020). Additionally, the scalability and potential for cost savings associated with digital infrastructure and SaaS solutions present compelling opportunities for profitability and growth. However, the challenges of establishing trust, mitigating security risks, and ensuring a diverse range of services underscore the complex nature of this endeavor (Dudin, Shkodinski & Usmanov, 2021). Furthermore, the necessity of achieving a critical mass of customers within a short time-frame, underscores the high stakes and competitive dynamics inherent in the digital banking space. Overall, the interconnected insights from these papers highlight the dynamic interplay between customer preferences, technological innovation, and strategic decision-making in shaping the trajectory of digital-only banks.

4.2.5. Elevating customer experience through novel operational approaches

The bedrock of a robust customer experience rests on diverse facets, including comprehensive journey assessments, persona delineations, targeted segmentation, and the strategic employment of intelligent automation (IA) like chatbots and AVIRs (Mbama & Ezepe, 2018). As customer experience flourishes, so does the bank's overall performance, translating into diminished customer interactions such as chat sessions and phone calls (Mbama, Ezepe, Alboul & Beer, 2018).

A case in point is the investigation conducted by Andrade and Tumelero (Andrade & Tumelero, 2022), which probed the augmentation of customer service efficiency through IA integration. Amplifying the chatbot service's efficacy, synergized with IA for nuanced comprehension of customer requisites, service types, and query resolution, yielded a staggering 178 million interactions and 7.8 million attendances in 2020. This transformative stride resulted in a notable reduction in phone calls to human attendants at call centers, efficiently addressing frequent customer needs and affording human attendants the bandwidth to tackle more intricate requirements, thereby fostering an enriched customer experience. Conversely, Mir et al. (Mir, Rameez & Tahir, 2023) focus on evaluating online service quality in India's financial services sector and establish a clear correlation between digital banking service quality and customer satisfaction. Both studies underscore the importance of leveraging technology and refining service quality to elevate the customer experience, ultimately contributing to enhanced business performance.

The connection between these papers highlights the significance of elevating customer experience through novel operational approaches in

the banking industry. By embracing IA and refining digital service quality, banks can not only improve customer satisfaction but also streamline operations and reduce costs. Collectively, these insights underscore the transformative potential of innovative operational approaches in enhancing the overall banking experience, ultimately driving business success and competitiveness in the digital era (Kaur, Kiran, Grima & Rupeika-Apoga, 2021).

4.2.6. Conceptual advancement via expert surveys and panels

A particularly interesting avenue for enriching the discourse lies in the formulation of concepts through surveys and panels – an approach with high potential to invigorate the exploration of DOE. This research methodology, steeped in empirical insights, offers an avenue to unravel nuanced dimensions of study.

Illustrating this approach, Al-Dmour et al. (Al-Dmour, Asfour, Al-Dmour & Al-Dmour, 2022) conducted a study delineating the nexus between marketing knowledge management and business performance. Undertaking a quantitative survey involving 336 managers across 13 Jordanian commercial banks, their findings illuminate a notable positive impact of marketing knowledge management on business performance, effectively bridging a gap in the existing literature. Another example is Shaikh and Anwar (Shaikh & Anwar, 2023), who harnessed the potential of panel research to discern the parameters that underpin the digital mode of transactions, influencing financial and operational performance while curbing bank costs. A comprehensive panel data set spanning 2011 to 2020, encompassing 32 public and private banks, underscored the potency of fostering Real-Time Gross Settlement (RTGS) and facilitating credit-based transactions in enhancing banks' performance and trimming funding costs.

By systematically gathering data and analyzing trends over time, researchers can gain valuable insights into the intricate dynamics of various factors influencing organizational performance in the banking sector (Salih, Alsalihi & Abou-Moghli, 2024). Expert knowledge-based approaches have the potential not only to enrich existing conceptual frameworks but also provides practical implications for banks seeking to optimize their operations and enhance performance in an increasingly digital landscape (Abubakar, Hashim & Hussain, 2016). Overall, expert surveys and panels offer a robust methodology for advancing conceptual understanding and driving innovation within the banking sector, paving the way for more informed decision-making and strategic planning.

4.3. Research agenda

Based on the discussions, four main research avenues were identified for future researchers advance knowledge on DOE: (i) DOE conceptual development, (ii) Digital bank break-even analysis, (iii) Optimization of the product and service portfolio offered by digital banks and (iv) Consumer experience and level of service of digital banks. Table 3 depict the key ideas identified in each of them.

4.3.1. DOE conceptual development

In the realm of DOE, a foundational research avenue beckons—one that hinges upon a comprehensive and nuanced conceptual framework. Pioneering scholars are urged to embark on an endeavor aimed at synthesizing and systematizing the fundamental tenets of DOE. This entails dissecting the intricacies of digitization processes within the financial sector, pinpointing key determinants, variables, and interdependencies that define operational efficacy. Researchers could delve into the evolving landscape of digital technologies, their amalgamation with traditional banking functions, and the emergent paradigms that underscore the digital transformation journey. By formulating a robust theoretical underpinning, this avenue lays the groundwork for subsequent empirical studies, enabling a deeper understanding of how digitization impacts operational efficiency across diverse banking domains.

The importance of studying this topic extends beyond academia and directly influences the practical landscape of the financial industry. In

Table 3
Research agenda proposal.

Research avenue	Key topics	Key references
DOE conceptual development	<ul style="list-style-type: none"> Development of a comprehensive conceptual framework for DOE Research aiming to consolidate fundamental DOE principles Conceptual research on banking operations and customer experiences in the digital era Guidelines for policymakers and regulatory bodies in shaping informed policies for the digital era 	(Arjun, Kuanr & Suprabha, 2021; Neves, Oliveira, Santini & Gutman, 2023; Bangarwa & Roy, 2022)
Digital bank break-even analysis	<ul style="list-style-type: none"> Understanding the intricacies of digital bank break-even dynamics, including the determinants that drive financial sustainability The interplay between transaction volumes, fee structures, technology adoption costs, and customer acquisition to identify critical thresholds How both traditional banks and new entrants adapt to the evolving digital landscape Insights for policymakers and regulators to ensure a stable and competitive financial ecosystem 	(Mbaidin, Alsmairat & Al-Adailleh, 2023; Saif et al., 2022)
Optimization of the product and service portfolio offered by digital banks	<ul style="list-style-type: none"> Optimization of digital bank product and service portfolios High-demand services, fintech integration, and personalized product recommendations through data analytics and machine learning How to tailor offerings to customer preferences and leveraging advanced technologies 	(Pandey, Mittal & Subbiah, 2021; Alonso-Robisco & Carbó, 2022; Mirza, Afzal, Umar & Skare, 2023)
Consumer experience and level of service of digital banks	<ul style="list-style-type: none"> How to enhance consumer experience and service quality in digital banks Impact of technology, including intelligent virtual assistants, chatbots, and AI-driven customer support Data privacy, security, and transparent communication's role in nurturing customer trust 	(Singh et al., 2022; Pio et al., 2023; Mir, Rameez & Tahir, 2023)

Source: Authors.

today's fast-paced digital age, financial institutions face unprecedented challenges and opportunities due to technological advancements. Understanding the intricate relationship between digitization and operational efficiency in banking is not merely an academic pursuit; it is a strategic imperative for businesses in this sector. By conducting in-depth research in this area, financial institutions can gain valuable insights into how to optimize their operations, enhance customer experiences, and stay competitive in a rapidly evolving landscape. Additionally, regulatory bodies and policymakers can benefit from this research to develop informed policies that foster innovation while ensuring the stability and security of financial systems. In essence, the importance of

this research transcends theoretical exploration and directly impacts the way we conduct and regulate financial services in the digital era.

4.3.2. Digital bank break-even analysis

Another compelling trajectory for future exploration lies in unraveling the intricate fabric of digital bank break-even dynamics. This avenue invites researchers to embark on an empirical journey, dissecting the determinants that steer digital banks toward equilibrium – where revenues and costs attain a harmonious balance. Investigating the interplay between transaction volumes, fee structures, technology adoption costs, and customer acquisition, scholars can decipher the critical thresholds that govern digital banks' financial sustainability. Furthermore, an in-depth analysis could uncover the temporal dimensions of break-even, considering how factors like technological advancements and market dynamics influence the break-even point over time. This line of inquiry holds profound implications for digital banking strategies, shedding light on the pivotal junctures where digital banks transition from investment-intensive phases to self-sustaining models.

It is important that future research projects study the unraveling dynamics of digital bank break-even points cannot be overstated, as it has far-reaching implications for the financial industry's evolution. In an increasingly digitized world, traditional banks are facing disruption from agile digital counterparts. Understanding the factors that determine when and how digital banks reach financial equilibrium is vital for both incumbents and new entrants in the sector. For established banks, this knowledge can inform strategies for competing effectively in the digital space, helping them adapt and innovate to stay relevant. For emerging digital banks, it offers a roadmap for achieving financial sustainability, a critical milestone in their growth trajectory. Additionally, policymakers and regulators can benefit from this research to ensure a stable and competitive financial ecosystem, balancing innovation with consumer protection. In essence, unraveling the complexities of digital bank break-even dynamics is central to shaping the future of banking and finance in a rapidly evolving digital landscape.

4.3.3. Optimization of the product and service portfolio offered by digital banks

Within the burgeoning digital banking landscape, the strategic curation of product and service portfolios emerges as an avenue ripe for exploration. Researchers are invited to traverse this trajectory, delving into the intricacies of product offerings and service dimensions within the digital banking realm. This involves a meticulous analysis of customer preferences, market trends, and competitive benchmarks to ascertain the optimal configuration of digital bank offerings. Avenues for investigation encompass the identification of high-demand services, the integration of cutting-edge fintech solutions, and the strategic alignment of offerings with customers' financial needs and aspirations. The research could also probe the efficacy of cross-selling strategies and the potential for personalized product recommendations fueled by data analytics and machine learning. By optimizing the digital bank's product and service ecosystem, this avenue promises to amplify value proposition, foster customer engagement, and underpin sustainable growth.

The importance of studying the optimization of digital bank product and service portfolios extends beyond the banking industry itself, influencing the broader landscape of financial technology and customer-centric business models. In an era where convenience, accessibility, and tailored experiences are paramount, digital banks are at the forefront of redefining how financial services are delivered. As they navigate the delicate balance between innovation and customer satisfaction, the outcomes of this research have the potential to transform not only banking but also set new standards for customer-centricity across industries. By tailoring their offerings to customer preferences, harnessing advanced technologies, and leveraging data-driven insights, digital banks can create a paradigm shift in how financial services are consumed. This research, therefore, holds the key to reshaping the

future of financial services by offering customers more personalized, efficient, and value-added solutions while guiding businesses toward sustainable growth in the competitive digital banking landscape.

4.3.4. Consumer experience and level of service of digital banks

In the digital era, consumer experience and service quality stand as linchpins of competitive differentiation for digital banks. As such, an imperative research trajectory revolves around unraveling the nuanced contours of consumer interactions and service delivery within the digital banking sphere. Scholars are beckoned to scrutinize the intricacies of user journeys, appraising the touchpoints that shape customer perceptions, satisfaction, and loyalty. An exploration into the adoption and efficacy of intelligent virtual assistants, chatbots, and AI-driven customer support mechanisms can unveil the transformational potential of technology in enhancing service accessibility and responsiveness. Moreover, investigating the role of data privacy, security protocols, and transparent communication in nurturing customer trust in digital banking environments remains a pivotal dimension of this research avenue. By discerning the facets that underscore superior customer experiences, researchers can inform digital banks' strategies, accentuating customer-centricity, and engendering enduring relationships in the dynamic digital realm.

The value of further investigating consumer experience and service quality within digital banks cannot be overstated in today's highly competitive financial landscape. As digital banking continues to disrupt traditional models, the quality of customer interactions becomes a key driver of success. Research in this area has far-reaching implications, not only for the financial sector but also for the broader realm of customer-centric businesses. By delving into the intricacies of user journeys and the impact of technology on service delivery, this research can set benchmarks for superior customer experiences in the digital age. It informs digital banks on how to effectively leverage technology, secure customer trust through robust data privacy measures, and maintain transparent communication practices. Ultimately, the insights gained from this research help digital banks create lasting customer relationships, differentiate themselves in the market, and contribute to the evolution of customer service standards across industries, fostering trust and loyalty in the dynamic digital realm.

5. Conclusion

This research paper has navigated the dynamic landscape of digitization in the financial sector, unveiling a nuanced tapestry of insights that collectively redefine the contours of operational efficiency and customer experience. The synthesis of contemporary literature, empirical analyses, and conceptual deliberations has culminated in a comprehensive understanding of the pivotal dimensions shaping the trajectory of banking in the digital age.

In terms of contributions, this paper sheds light on the pivotal role of digital technologies and partnerships in shaping the performance of the banking industry. It unravels the transformative impact of the COVID-19 pandemic, underscoring how digitization became a pivotal strategy for resilience and adaptation. Moreover, it delves into novel operational approaches and emphasizes the paramount importance of customer-centricity, offering a comprehensive research agenda that propels future inquiries.

These insights bear implications for both theory and practice. The conceptual development of DOE lays a robust foundation for further theoretical exploration, while the analysis of digital bank break-even dynamics and optimization of product portfolios guide practical strategies for sustainable digital banking models. The elevation of customer experience underscores the imperative of crafting seamless, technology-driven interactions that resonate with evolving consumer expectations, shaping a customer-centric paradigm in financial services.

While this study endeavors to offer a comprehensive review of the literature on digital banking operational efficiency, it is essential to

acknowledge its limitations. Firstly, the content-centric approach adopted may inadvertently overlook certain nuanced aspects inherent in individual studies. Despite efforts to ensure thoroughness, the inherent biases and limitations present in the selected articles could impact the overall interpretation of findings. Moreover, the research trajectory outlined in this study provides a generalized framework, which may require validation through context-specific analyses to ensure its applicability across diverse banking environments. Furthermore, the quality of the reviewed literature warrants critical examination, as variations in research methodologies, sample sizes, and data sources could influence the robustness and reliability of the findings. This issue becomes even more important to consider due to the still incipient knowledge produced and published in high-impact journals. Additionally, the dynamic nature of the digital banking landscape poses inherent challenges in capturing the evolving facets of operational efficiency and customer engagement accurately. Future research endeavors should aim to address these limitations by adopting more nuanced methodologies, incorporating diverse perspectives, and continually reassessing findings in light of emerging trends and developments. Despite these challenges, this research serves as a valuable foundation for ongoing explorations into the multifaceted nature of digital transformation within the financial sector, emphasizing the need for adaptive strategies and continuous reevaluation in response to evolving market dynamics.

Regarding potential future directions, there is a need to delve deeper into the impact of emerging technologies such as artificial intelligence, blockchain, and IoT on operational efficiency within the banking sector. Understanding how these technologies are adopted and integrated into banking operations can provide valuable insights into their effectiveness in optimizing processes. Additionally, further investigation into the long-term effects of the COVID-19 pandemic on bank digital transformation efforts is warranted. Analyzing how banks have adapted their operations in response to the pandemic and assessing the sustainability of these adaptations can offer valuable lessons for future crisis preparedness and resilience building. Moreover, exploring the organizational adaptations required for banks to effectively embrace and implement new digital business models is essential. This could involve studying changes in organizational structure, culture, and processes necessary to support digital innovation and transformation initiatives. Furthermore, efforts to optimize the product and service portfolio offered by digital banks and enhance the overall customer experience in digital banking through novel operational paradigms should be prioritized. By addressing these research directions, scholars can contribute to advancing knowledge in the field of DOE in banking, supporting the evolution of theoretical frameworks and practical strategies for enhancing bank performance in the digital era.

CRedit authorship contribution statement

Luiz Antonio Bueno: Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Tiago F.A. C. Sigahi:** Writing – review & editing, Writing – original draft, Validation, Supervision, Resources, Methodology, Funding acquisition, Formal analysis, Data curation. **Izabela Simon Rampasso:** Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Funding acquisition, Formal analysis. **Walter Leal Filho:** Writing – review & editing, Visualization, Validation, Supervision, Resources, Project administration, Funding acquisition. **Rosley Anholon:** Writing – review & editing, Writing – original draft, Validation, Supervision, Resources, Project administration, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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