Is Metaverse Technology Ready to Welcome Online Banking Users?

A Systematic Literature Review

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Abstract—The advent of the Web 3.0 era has precipitated the gradual emergence of Metaverse technology as the frontier of next-generation interactive technology transformation in banking. Nevertheless, a considerable disparity exists between the user experience of Metaverse banking in virtual interactive environments and traditional online banks. Consequently, in the nascent stages of Metaverse banking development, examining how existing banking users adopt Metaverse technology and exploring related controversies from an information systems implementation perspective is imperative. The present study employs a systematic literature review methodology, screening 19 relevant articles published between 2020 and 2024 from two leading academic databases, Web of Science (WOS) and Scopus. The review identifies factors hindering current bank users' adoption of Metaverse banking, such as privacy concerns and lack of social norms, while elucidating motivational drivers in Metaverse contexts, including usability and perceived enjoyment. Moreover, from a banking application perspective, this study proposes implementation recommendations for the initial deployment of Metaverse banking, including lowering user adoption barriers and enhancing immersive experiences. The study draws upon contemporary customer needs to analyse key decision-making considerations when using Metaverse banking services. It highlights key adoption barriers and drivers for sustained usage, emphasising potential challenges in the initial development phase, such as privacy leaks and user behaviour monitoring in virtual environments. Furthermore, it identifies unexplored research gaps in the early implementation stage of Metaverse banking. This review synthesises current knowledge on Metaverse technology in banking and outlines practical considerations and strategic directions for its integration within the industry.

Keywords—Banking; human-computer interaction; information systems; Metaverse; virtual reality

I. INTRODUCTION

At present, Metaverse banking has sparked widespread academic discussion [1]. This study, employing a systematic literature review methodology, evaluates the primary adoption issues faced during the early technological implementation stage of Metaverse banking. Following a series of structured procedures inherent to systematic reviews, the study traces the origins of Metaverse banking by combining empirical research on online banking users with the discourse surrounding Metaverse technologies, thereby exploring both the challenges and advantages of Metaverse banking from an adoption perspective.

Metaverse banking represents a frontier business strategy integrating Metaverse technologies with online banking services [2]. By leveraging the advantages of the Metaverse, it aims to enable users to access banking services anytime and anywhere through a decentralised approach [3]. It uses immersive technologies to simulate the face-to-face interactions of traditional offline banking [4], thereby reducing the distance-related costs of accessing banking services [5]. Additionally, it seeks to enhance the connection between users and banks while preserving the high-quality service traditionally associated with physical bank branches[6].

In 2021, Facebook's rebranding to Meta by its CEO, Mark Zuckerberg, sparked intense debate within the retail industry regarding Metaverse banking [1]. Financial institutions such as JPMorgan Chase, HSBC, and IBK have already begun experimenting with this new paradigm by purchasing land and establishing virtual platforms within digital worlds [7]. The decentralised architecture and immersive experiences of the Metaverse are expected to empower banks to deliver more efficient business solutions, reduce labour costs, and strengthen customer relationships. However, research on Metaverse banking remains mainly exploratory, with a limited investigation into users' technology adoption. In the financial sector, user acceptance has been identified as a critical factor [4]. The unfamiliarity of technology induces concerns and apprehension among users [8], and the current lack of empirical research presents early risks and challenges for implementing Metaverse banking. For enterprises, this translates into significant uncertainty, which is currently viewed as a major barrier to the development of Metaverse banking.

From the initial review of the literature on Metaverse Banking, this research finds that the service quality of online banking, as the precursor of Metaverse Banking, has been extensively examined. The service quality of online banking

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encompasses users' final adoption decisions and reflects their perspectives and perceptions under a given technology. Within the scope of this study, such findings provide potential functional insights into linking Metaverse technologies with the banking sector. Accordingly, this study employs service quality as the primary retrieval criterion to explore research on Metaverse Banking in its early stage of technological development, thereby analysing users' perceptions of technology adoption from the perspective of Metaverse Banking's initial evolution.

II. MOTIVATION

Metaverse technology has been recognised as a frontier of the Web 3.0 revolution [1], widely anticipated by both the market and academia. It is expected to empower the development of multiple technologies [5], providing industries with more efficient solutions and delivering higher-quality technological services to the public. However, studies have indicated that 85% of users have not engaged with the Metaverse or related virtual technology products [4].

Despite the transformative potential of Metaverse technology in redefining the connection between users and business operations, research on financial technology adoption emphasises that such innovations should enable users to integrate with financial systems [9] seamlessly. A review of the current state of research on Metaverse banking reveals a gap in studies addressing its early-stage implementation [7]. Reviewing the current research on Metaverse banking reveals several perspectives[10]. Discuss the impact of Metaverse technologies on various industries and their future opportunities and prospects[11]. Further examination, from a business perspective, of the potential applications and challenges of the Metaverse in commerce and trade will be conducted[12]. Explore the possibilities of decentralisation, future directions, opportunities and challenges empowered by Metaverse technologies[4]. Investigate the potential and challenges of the banking sector development[5]. Propose possible directions and conceptual frameworks for future research. Thus, the study finds that existing research has yet to sufficiently address the implementation of Metaverse banking in its early stages, as most literature primarily focuses on discussions of the technology's future trajectory. Such a gap introduces significant uncertainty regarding its initial integration into banking operations [10]. This highlights the urgent need for academia to devote greater attention to and engage in more profound exploration of Metaverse banking.

Clarifying the early implementation challenges of Metaverse banking will accelerate its integration into financial services and advance the banking sector's transition into the Web 3.0 era.

III. METHODOLOGY

The systematic literature review (SLR) method employed in this study is illustrated in Fig. 1. By clearly defining motivation, research questions (RQs), and keywords, the study further identified the electronic databases used for retrieval. This research draws on the three-stage approach described by Kitchenham and Charters, combined with the SLR practices from Brereton's experience in software engineering [13].
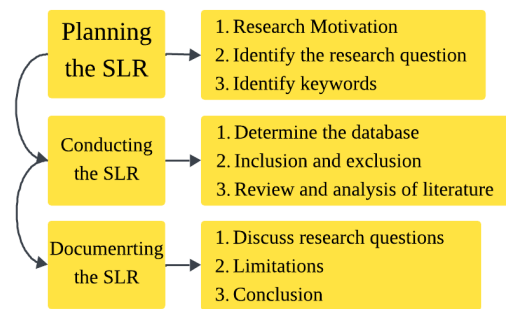

Fig. 1. SLR method.

A. Research Questions

As the banking industry continues to accelerate the exploration and implementation of virtual financial services, Metaverse banking technologies are gradually becoming a focal point for transforming financial service models. However, existing research provides limited clarity on the key factors influencing banking users' adoption decisions regarding Metaverse technologies. This lack of clarity introduces uncertainty into the implementation process for financial institutions, potentially leading to deviations in resource allocation and strategic decision-making. Without identifying the core factors driving customer adoption, implementing Metaverse banking will likely incur higher resource costs and decision-making risks. Based on these justifications, below are the specific research questions:

1) RQ1: What are the key factors determining user adoption of Metaverse Bank?

Identifying the decisive factors influencing users' adoption of Metaverse banking will enhance the precision of Metaverse technology implementation within the banking sector. It will provide strategic guidance for banks engaging in Metaverse initiatives, help mitigate uncertainties during the early stages of development, and offer user-centred recommendations to support effective implementation from the perspective of banking customers.

The emergence of Metaverse technology has driven a transformation in the service model of the financial industry. Within the current research context of Metaverse banking, the Metaverse presents opportunities and significant challenges to the banking sector. While its advanced interactive capabilities and immersive user experiences offer novel possibilities, they also introduce substantial differences from traditional online banking services, particularly in the early stages of Metaverse banking implementation. These differences may heighten users' sense of uncertainty and concern. Consequently, in the initial phase of Metaverse banking adoption, users' perceptions of banking services become a critical focus of analysis. Therefore, these three research questions arise on the adoption of the Metaverse for banking services:

2) RQ2: What is the current adoption status of Metaverse banking in its initial development stage?

Metaverse technology has brought transformative user experiences and business models to the banking industry,

driving financial services toward immersive and interactive application trends [14]. Although some banking institutions have initiated exploratory attempts, research on user adoption of Metaverse banking in its early development stage remains scarce. Metaverse banking presents significant differences in user experience and service delivery compared to traditional banking technologies, potentially making it difficult for long-term users of conventional technologies to learn and adapt [15] quickly. Therefore, to promote the empowerment of the banking industry through Metaverse technologies, this study aims to explore the user adoption status of Metaverse banking during its initial development phase.

The development of technology often participates in the continuous empowerment of fixed markets. In the long-term evolution of the banking industry, the fixed needs of its users have already been well established. As Metaverse technology gradually integrates into the banking sector, user adoption perspectives toward traditional banking service technologies have become increasingly critical. The views of user groups who were the audience of previous technological applications facilitate the rapid integration of new technologies into the industry and enhance the success rate of these technologies in empowering business functions. At the same time, by maximising the mitigation of user concerns arising in the early stages of new technology development, such perspectives also shape the initial impression of new technologies within the user's field of perception.

3) RQ3: What are the implementation suggestions for bank users to promote the adoption of the Metaverse in its initial development stage?

The current research lacks guiding recommendations regarding how Metaverse technologies can effectively empower banking services during the initial implementation stage [7]. At the same time, systematic analyses focusing on users' financial needs are scarce, and research on the implementation pathways of Metaverse banking remains in an early exploratory phase, leaving a theoretical gap for practical reference in the banking industry's early-stage development [1]. Therefore, this study will take traditional banking users' adoption cases as the primary reference to explore user feedback on adopting Metaverse technologies in banking services and provide targeted and actionable guidance for the initial implementation of Metaverse banking.

In empowering banking services through the Metaverse, Metaverse banking remains characterised by immature technology, a lack of standardised protocols, and limited user awareness in early technological development. From the perspective of financial technology adoption, the successful adoption of new technologies should ensure a seamless user experience while meeting the performance demands of financial services. Therefore, the challenges encountered during the early development phase may offer valuable guidance for the initial implementation of emerging technologies, thereby reducing trial-and-error costs and implementation barriers for banks.

4) RQ4: What are the potential challenges for banks in promoting Metaverse banking during their initial development stage?

As the next generation of financial technology transformation, Metaverse banking faces numerous challenges at the initial stages of industry and technological development, characteristic of an early-cycle emergence. Most existing studies focus on conceptual discussions and potential forecasts of Metaverse banking, while research analysing the actual challenges and barriers encountered by banking users during its early development remains scarce. User acceptance is a critical milestone for the technological maturity of Metaverse banking [4]. Therefore, this study explores the challenges users face in adopting Metaverse banking during the initial development stage, filling the theoretical gap and providing strategic support for integrating Metaverse technology into the banking industry.

B. Keywords Search

Based on the RQs, this study requires a review of the characteristics of online banking technologies and Metaverse technologies and their corresponding user needs. Therefore, the keywords "Metaverse" and "Online Banking" were initially selected. Given that both Metaverse and online banking fall under online services, this study adopts the optimised online service quality framework proposed by [16], which includes explicit dimensions relevant to the banking industry. This ensures the methodological relevance of online banking within this study. Accordingly, the dimensions of responsiveness, efficiency, fulfilment, reliability, security, and website attributes were included [17].

However, due to potential ambiguity in the retrieval of the term "website attributes" and based on interpretations in previous studies, this research replaces it with the terms "usability" and "ease of use." As a result, the final set of retrieval keywords is defined as:

("Metaverse" OR "online banking") AND ("security" OR "availability" OR "usability" OR "privacy" OR "efficiency" OR "responsiveness" OR "fulfilment" OR "reliability").

C. Database Search

The databases used for this systematic literature review include Web of Science (WoS) and Scopus. From an authoritative perspective, WoS is one of the most widely used databases in academic research, while Scopus offers a broad collection of mainstream literature. Using these two databases, the initial search yielded 2,184 articles. The preliminary screening criteria included publications from the past five years, English language, and document types limited to articles and review papers. The resulting sample size is considered sufficient for analysis.

D. Inclusion Criteria and Screening Process

The initial search formula and databases were used to retrieve 5,823 documents. After the implementation of screening criteria predicated on publication year (2020–2024) and document type (journal articles and review papers), the number was reduced to 2,435. To ensure the uniformity of the research sample, additional restrictions were implemented to retain exclusively English-language publications, which resulted in the final selection of 2,184 research articles. Subsequently, Rayyan automated screening tools were employed to remove duplicates, retaining 1,375 preliminary research samples. The sample size for this systematic literature review is illustrated in Fig. 2.
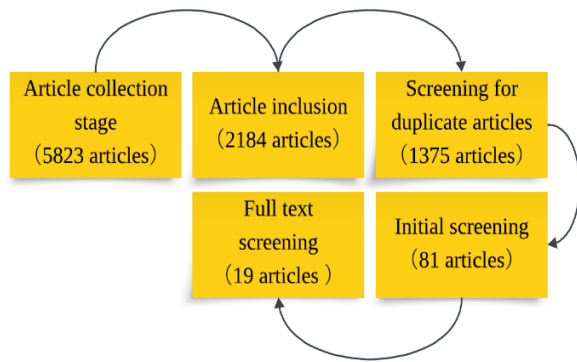
Fig. 2.   Sample selection process for this systematic literature review.

In Fig. 2, during the title and abstract screening phase, the research prioritised including research in which titles and abstracts potentially referenced the Metaverse technology's effectiveness and technical characteristics. Concurrently, articles that primarily focused on underlying technical principles and development were excluded from the analysis. Empirical studies examining online banking user needs were included, while research centred on single functionalities or business impacts was excluded. Eighty-one documents were identified as being directly pertinent to the research objectives. During the full-text screening phase, a review of the relevant literature revealed that many studies primarily focused on exploratory research of Metaverse technology in third-party applications (e.g. education; gaming) or retrospective studies on online banking. Consequently, the present study exclusively retained literature analysing the adoption of online banking technology and included review studies evaluating the effectiveness of Metaverse technology. After thoroughly examining the full texts, 19 articles were selected for inclusion in the final analysis.

IV. RESULT

Thirteen studies indicate a negative relationship between users and perceived risk in online banking. Perceived risk factors have been identified as significant barriers to adopting banking technologies. Among these studies, two were sourced from the Web of Science (WoS) database and eleven from the Scopus database. Notably, [18] provides a more detailed explanation of the dimensions of perceived risk.

A total of eight studies explain the mediating factors and relationships between adoption intention and usage attitude, including two from the Web of Science (WoS) database and six from the Scopus database.

In the context of the Metaverse, five studies address the barriers Metaverse users face, explaining the indirect factors that hinder user adoption. Among these, four studies were sourced from the Scopus database and one from the Web of Science (WoS) database.

A total of four studies identify the usage motivations of Metaverse users, highlighting the indirect factors that promote these motivations. Among them, three studies were sourced from the Scopus database and one from the Web of Science (WoS) database.

TABLE I.   RESULTS ORGANIZATION

Described content		
Section 4.1	Subsections 4.1.1	Perceived risk of bank users
	Subsections 4.1.2	Banking users' adoption intentions
	Subsections 4.1.3	Bank users' attitudes
Section 4.2	Subsections 4.2.1	Factors that hinder banking users' adoption intentions
	Subsections 4.2.2	Factors that mainly drive bank users' adoption decisions
	Subsections 4.2.3	Factors driving user adoption decisions
Section 4.3		Metaverse Bank Current User Adoption Factors

The organisation of this study's chapters is outlined in Table I. This study's literature review indicates that users' intention primarily drives their decisions regarding adopting Metaverse banking. Section 4.1 of this study identifies the critical factors influencing users' formation of adoption intentions, categorising these factors into positive and negative sub-factors. Section 4.2.1 discusses the sub-factors contributing to negative perceptions; within these negative factors, negatively correlated factors represent the key determinants influencing users' consideration of adopting banking services, whereas other negative factors impact users' motivation to adopt. Conversely, Section 4.2.2 examines positively correlated factors, which primarily facilitate users' adoption intentions, unlike negative factors. Additionally, Section 4.2.3 discusses in greater detail both the positively correlated factors and their impacts on users' adoption intentions.

A. The Formation of the Adoption Motivation of Banking users

In online banking, three key components primarily influence user adoption factors. These conclusions are drawn from multiple empirical studies rather than theoretical constructs or definitions. Literature categorises these components as follows:

1) Perceived risk: Perceived risk is identified as a critical barrier to the adoption of banking technologies [18]. In 15 reviewed studies, it is consistently reported that perceived risk negatively influences online banking user adoption. Users' perceptions of risk lead to harmful adoption intentions and attitudes, which hinder their actual adoption behaviour in the banking sector [19].

2) Adoption intention: Adoption intention refers to an individual's subjective willingness to use a new technology or service in the future. It reflects the extent to which a person is prepared to take actual usage actions. Across the 15 studies reviewed, the adoption of banking technologies was found to be primarily driven by users' intentions. The examined studies largely focus on contexts in India, Tunisia, and various parts of Europe, highlighting that users' intention to adopt is the primary driver of whether they choose to use banking services [20].

3) Usage attitude: Usage attitude refers to an individual's positive or negative disposition toward a technology or service during usage. In the 15 studies investigating factors that

promote the adoption of online banking, usage attitude is consistently found to have a positive influence on adoption intention. This attitude is often shaped by previous usage experiences or perceptions formed in non-contact scenarios with the technology [21]. Usage attitude determines whether users maintain a positive perspective toward the technology before use.

Given the specific nature of the financial industry, users' adoption decisions are mainly driven by concerns over security and risk. Whether the technology is ultimately used depends on adoption intention, while the user experience is primarily shaped by usage attitude.

B. The Composition of Factors that Motivate the Adoption of Metaverse Banking

The publications in this review describe various factors promoting the adoption of Metaverse banking. According to the findings of this study, several factors positively influence users' usage attitudes, and many of these factors simultaneously enhance users' adoption intentions through their impact on usage attitudes. Perceived risk emerges as the primary and only negatively correlated factor hindering banking sector customer adoption [18]. It is reviewed in the following sections.

1) The negative factors adopted by the Metaverse banking industry: According to the study by [18], the perceived risk of banking users comprises six dimensions: privacy, security, social, financial, time, and performance risks. These dimensions collectively form a comprehensive assessment of potential technological risks made by users before adopting online banking technologies.

Privacy risk primarily refers to the potential for personal information leakage during online banking services. This type of risk plays a critical role in determining whether users will continue to use banking services [22], [23]. Security risk involves external infringements that may threaten banking services, and this risk typically causes substantial disruption to users' perceptions. Social risk manifests as the potential relational risks arising from users' interactions and communications with banking staff during online banking transactions [19], [21], [24].

The performance risk reflects user concerns that the bank's services or products may not meet expected performance standards. This is particularly relevant in online environments, where system failures or technological weaknesses may lead to adverse outcomes [25]. Financial risk encompasses the initial economic expenditures in purchasing banking services and potential additional financial burdens incurred during service maintenance and continued usage. Time risk refers to the excessive time required for online banking services [20]. This includes time spent navigating the banking platform, learning to operate system functions, and correcting transactional errors.

These dimensions of risk collectively influence users' overall perception of risk in online banking and subsequently affect their technology adoption decisions [18], [26], [27].

The negative factors influencing users' adoption of Metaverse banking are presented in the Fig. 3. A Metaverse design lacking social functionality makes it difficult for users to receive feedback and interaction support from others, a critical component in replicating real-world experiences [28], [29]. The absence of social features weakens users' sense of social presence within the Metaverse environment, negatively affecting their motivation to use the system[30]. Furthermore, if implementing Metaverse technology leads users to perceive it as overly complex, it may hinder their ability to manage banking-related tasks effectively. When users encounter vulnerabilities in banking services [29], this perceived complexity can suppress their willingness to accept such services and intensify psychological barriers related to uncertainty and operational difficulty.
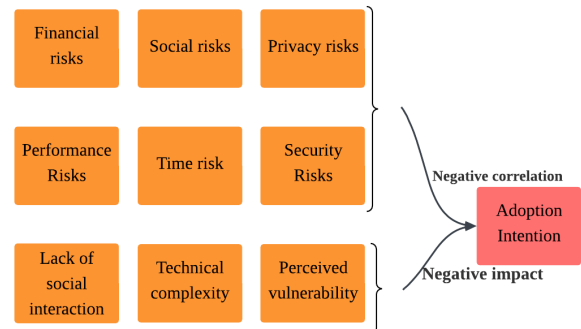

Fig. 3. Negative factors affecting the current user adoption of Metaverse banking.

2) Positive correlation factors for the adoption of Metaverse banking users: Perceived usefulness and perceived ease of use in online banking have been identified as positively correlated factors influencing customer adoption in 13 studies [28]. Perceived usefulness is the user's subjective assessment of how well the current technology can help solve practical problems. Perceived ease of use refers to the degree to which banking users subjectively believe that using a banking technology platform requires minimal effort. Usefulness and ease of use determine users' adoption intentions and are positively associated with their usage attitudes [31].

Perceived usefulness and perceived ease of use are two key determinants of whether users adopt banking technologies, and they comprise several sub-factors [27], [28]. Perceived usefulness is mainly driven by perceived ease of use and privacy [25]. Perceived ease of use refers to the extent to which users perceive the system as easy to use and whether they can conduct business in a way they consider simple [18], [21]. Privacy reflects the degree to which users believe their personal information is secure.

Perceived ease of use is also shaped by government support and system availability [21], [28]. Government support manifests in users' perceptions that banking platforms endorsed or supported by government authorities are easier to use [19], [28], [32]. Availability refers to how quickly users can learn and operate the system effectively, with minimal errors, thereby enhancing their overall user experience [33].

The positively correlated factors influencing user adoption are presented in Fig. 4. A positive correlation exists between the

immersive experience of Metaverse technology and users' intention to use it [29], similar to the relationship observed with perceived usefulness and ease of use. Additionally, users' sense of social presence within the Metaverse is positively related to their immersive experience [29]. This implies that a strong sense of social presence in the Metaverse environment enhances users' immersion, which fosters their intention to adopt Metaverse technologies.

Furthermore, system interoperability is positively associated with social presence [20], [24]. Interoperability enables users to interact more easily and intuitively with the platforms provided by Metaverse, thereby increasing their overall acceptance of Metaverse banking services. User perceptions of curiosity, enjoyment, and self-efficacy also enhance perceived ease of use regarding Metaverse banking technologies [27]. At the same time, perceived enjoyment and social norms positively influence perceived usefulness. The synergistic effect of these multiple factors significantly improves users' positive attitudes toward online banking services and promotes the adoption of new technologies from various perspectives [25], [26].
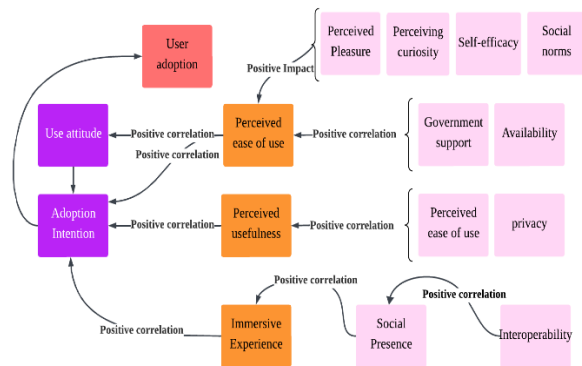

Fig. 4. Positively correlated factors affecting current user adoption of Metaverse banking.

3) Positive factors for the adoption of Metaverse banking users: Performance and effort expectancy influence users' adoption of online banking services [20]. Performance expectancy is the degree to which users believe using a particular service or system will effectively help them achieve their goals [20], [34]. This perception primarily stems from users' assessments of the service's practical utility. Existing studies have pointed out the notable advantages of online banking in terms of convenience and cost-effectiveness—for example, enabling users to manage their accounts efficiently anytime and anywhere at lower costs—which fosters positive performance expectations and, in turn, increases users' willingness to adopt financial technologies such as mobile payments and online banking.

Meanwhile, effort expectancy refers to users' subjective judgment of the ease of use of a new technology or service before adoption. Banking technologies encompass system simplicity, complexity, and comprehensibility. Research consistently shows that ease of use can effectively stimulate users' positive attitudes toward technology and significantly enhance their intention to use it. For instance, studies by Gupta

and Arora on mobile payment adoption among Indian users [19], [33] on Internet banking in Jordan, and [35] on mobile banking services in Iran's private banks all confirm that users are more likely to adopt banking services when they perceive them as easier to use.

In summary, performance and effort expectancy jointly drive users' decisions to adopt online banking services [20]. In online banking, facilitating users' adoption intentions includes lowering usage costs, which reduces economic barriers and brings users closer to banking services by lowering the cost of usage. Simple usage enhances users' self-efficacy, helping them believe they can operate banking services independently, reducing unfamiliarity and fear of the technology and strengthening their motivation to use it. Banks should establish a positive brand image to enhance credibility and market recognition, build strong social influence to provide external support for user decision-making and enhance perceived enjoyment during service interactions to elicit positive emotional responses. Proactively identifying and responding to user needs encourages product innovation driven by users, increasing satisfaction and accumulating positive experiences, which reinforce users' continued usage intentions. Ultimately, this strengthens perceived trust and creates a positive feedback loop for the bank's adoption strategy [24], [29].

The positive factors are illustrated in Fig. 5. The Metaverse, with its unique interface and interactive mechanisms, also positively influences users' adoption intentions [36]. The degree of anthropomorphism in Metaverse avatars facilitates emotional connections during user–system interactions [37], leading banking users to perceive the system as a service entity with human-like characteristics [34]. This perception reduces users' alienation toward technology and stimulates their willingness to explore it actively.

The immersive experience the Metaverse offers enhances users' alignment with platform functionalities and usage scenarios by simulating realistic environments and interactive contexts. This deeper engagement actively guides users to participate in banking processes [36]. Furthermore, the realism conveyed by the Metaverse increases users' perceived credibility of Metaverse banking services, reinforcing the rationality and goal relevance of their usage behaviour and strengthening their positive expectations toward adoption [38].
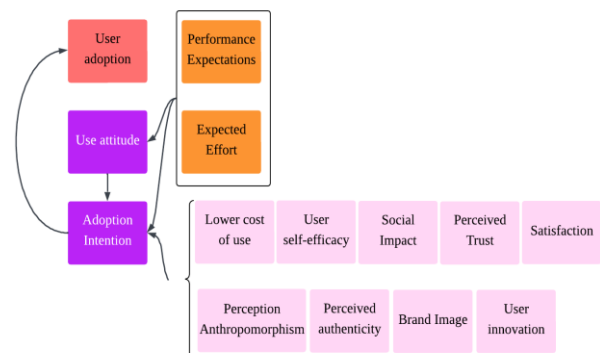

Fig. 5. Positive factors influencing Metaverse banking's current user adoption.

C. Summary of user Adoption Factors for Metaverse Banking

The factors influencing Metaverse user adoption are presented in Table II. In the early decision-making process of user adoption in the Metaverse, perceived risk is a set of negative factors that initially trigger user concerns. Perceived risk exerts a persistent and adverse effect on banking users' adoption intention and actual behavior [20]. When facing new financial technologies, users tend to evaluate risks, and uncertain perceptions of privacy breaches, account security, economic stability, or information reliability may suppress adoption motivation [24]. This undermines users' trust in virtual technologies and reduces their perceived controllability over operations, intensifying their tendency to avoid engagement.

The negative factors in Metaverse technology tend to shape a fixed usage impression during users' initial contact with Metaverse banking. This results in increased operational complexity, frustrated initial experiences, and decreased service satisfaction. Such unfavourable first-time experiences weaken users' perception of the platform's functional value, reducing their intention to continue using the service [25]. Unlike perceived risk, these factors do not directly cause users to reject Metaverse banking but instead suppress the drivers of long-term usage.

Banking users' subjective perception of usability determines the psychological threshold for their continued use of Metaverse banking. When the operational paths are intuitive, the interface logic is clear, and the business process feedback is smooth, users' cognitive load is reduced to an acceptable level, enhancing their sense of self-efficacy and laying a positive foundation for usage [28]. On this basis, users' evaluation of the usefulness of Metaverse banking is reflected in their overall judgment of efficiency and outcomes in achieving financial objectives. When virtual banking demonstrates precise alignment with real-world needs in fund management, risk alerts, and value-added services, users are more likely to regard it as a necessary and trustworthy financial service. The highly realistic spatial presentation, contextualised data visualisation, and real-time interaction in the Metaverse environment encourage users to focus on immersive experiences, enhancing their usage satisfaction and fostering emotional bonds that drive their intention for continued use [36]. This, in turn, promotes establishing a long-term and sustainable relationship between users and the bank.

TABLE II. METAVERSE BANKING ADOPTION FACTORS

Factor support	Factor name	Factor definition
Perceived risks in online banking services	Privacy risk	Users' concerns about the leakage of their personal information
	Safety risk	Users are worried about their losses due to system vulnerabilities and cyberattacks.
	Social risk	Users are concerned about the negative factors from outside society when using banking services.
	Financial risk	Users' concerns about the impact of banking services on their property safety
	Time risk	Users' concerns about time loss caused by banking factors during the process of using banking services
	Performance risk	Users' concerns about the impact on business progress due to system performance

Negative factors in the Metaverse	Metaverse social interaction	The Metaverse banking needs to have a social interaction function with others.
	The perceived complexity of the Metaverse	Users' judgment of the complexity of a Metaverse bank before they come into contact with it
	The perception of the Metaverse is fragile	The Metaverse banking needs to ensure the stability of its services
Perceived usability	Government support	Support from authoritative institutions
	Availability	The degree to which users can enjoy quick, stable and straightforward business services
	Perceived pleasure	The extent to which users enjoy the process of handling business
	Perceive curiosity	The degree of users' curiosity about the use of banking services
	Self-efficacy	Adopt simple designs to drive the user's design flow.
	Social norms	Legal regulations of the Metaverse society
Perceived usefulness	Perceived usability	User-friendly design that enables users to experience quickly
	Privacy	Formulate privacy protection policies for users.
Immersive experience	Social existence	The user's recognition of their virtual self in the Metaverse
	Interoperability	The ease of use for users to operate virtual avatars in the Metaverse
Adoption intention (positive impact)	Expected effort	The user's initial expectation of effort before use
	Expected performance	The user's initial expectation of performance feedback before use
	Low-cost value	Lower-cost use value
	User self-efficacy	The user believes that they can independently complete the business.
	Social influence	Users are externally influenced by their attitudes and behaviours in external social relationships.
	Perceived trust	The sense of trust that users have towards banks in the absence of information
	Satisfaction	The user's satisfaction with the actual use
	Perceptual personification	Feel the degree to which the avatars in the Metaverse banking are similar to real humans.
	Perceived authenticity	The degree to which Metaverse banking is similar to those in the real world
	Brand image	Users' impression of the brand
	User innovation	Use the degree to which user demands are met.

V. RESEARCH QUESTION DISCUSSION

A. RQ1

The key factors influencing Metaverse user adoption are presented in Table III. Perceived risk among traditional banking customers refers to the user's subjective anticipation of potential losses or adverse consequences from using specific technologies or banking services. Perceived risk poses a direct barrier to adopting Metaverse banking technologies. The higher the perceived risk, the lower the likelihood that users will adopt such technologies, significantly suppressing their motivation to engage [31]. In contrast, adoption intention represents the positively correlated factors that drive users toward usage. These factors are primarily shaped by users' previous experiences with technology and their psychological evaluations of current systems. Usage attitude, in turn, functions as a reinforcing

mechanism that enhances users' positive perceptions of banking services and mitigates negative resistance [27], thereby indirectly facilitating the transformation of intention into actual adoption behaviour.

TABLE III. KEY FACTORS IN USER ADOPTION OF METAVERSE BANKING

Factor effect	Factor Description
Perceived Risk	Negative factors that hinder user adoption
Adoption Intention	Positive factors driving user adoption
Attitude	Positive factors that promote user adoption

From the perspective of Metaverse banking, perceived risk is a critical barrier in users' adoption decisions, influencing whether users will further consider engaging with banking services [29]. Adoption intention is the central determinant of user behaviour, directly guiding whether users proceed to adoption. In contrast, usage attitude plays a supportive role by positively shaping users' evaluations and acceptance of the technology, thereby indirectly influencing adoption intention and the final decision to adopt

B. RQ2

In the current state of Metaverse user adoption, as presented in Table IV. Privacy risk and perceived privacy reflect users' concerns regarding privacy dimensions in the context of Metaverse banking and their expectations for privacy protection [18], [19].

Security risk and financial risk represent users' concerns about the safety of banking systems and the potential for financial loss. Specifically, users have expressed apprehension about the economic risks of Metaverse banking technologies [18]. The more unrestricted usage of Metaverse technology may further deepen users' concerns about such risks.

Social risk, influence, brand image, and government support represent external environmental factors impacting user adoption. Social risk emphasises users' fear of encountering adverse social outcomes, while social influence and brand image relate to the impact of social norms and platform reputation on adoption decisions. Government support refers to users' recognition of a banking platform's legitimacy, even without prior usage experience, due to endorsement by authoritative institutions. These factors influence users' adoption decisions, highlighting the role of external social evaluations in shaping users' willingness to adopt [18].

Performance risk and performance expectancy capture users' concerns and aspirations regarding the stability and effectiveness of system performance. Banking users expect reliable platforms that consistently support business operations. Frequent technical issues contribute to users' sense of vulnerability and erode trust in Metaverse banking, thereby hindering adoption behavior [25].

Social interaction, social presence, and interoperability are interdependent in the early stages of Metaverse development. Together, they form the basis of user interaction behaviours and subjective system perceptions in Metaverse banking [29]. A well-designed social system within the Metaverse contributes to users' sense of belonging, trust, and immersive experience in a virtual social environment.

From the perspective of Metaverse banking, perceived complexity, perceived ease of use, usability, and effort expectancy, though originating from different research perspectives, all fundamentally refer to the perceived ease of use and learnability of a technological system. These factors reflect users' psychological burden and behavioural threshold during learning and usage. The immersive mode offers further possibilities for user education and interactive engagement[30]. Designing systems that align with users' expected effort levels and offering intuitively easy-to-use features can reduce system complexity and facilitate adoption decisions.

Perceived enjoyment and perceived curiosity relate to users' psychological satisfaction and anticipation of user experiences. Perceived curiosity primarily stimulates interest and the desire for novel experiences [29], while perceived enjoyment pertains to emotional fulfilment during use. Both contribute to users' adoption intentions and attitudes as feedback mechanisms that enhance user engagement in Metaverse environments [36].

Perceived anthropomorphism and perceived realism, while focusing on the human-like expression of the platform and the authenticity of the interaction environment, aim to assess the realistic experience the Metaverse offers [39]. Lifelike anthropomorphic designs and authentic user experiences promote the intention to adopt Metaverse technologies, enhancing immersive experiences and emotional trust in Metaverse banking services and strengthening adoption intentions and continued usage behaviour.

Satisfaction and user innovativeness stem from perspectives of experiential evaluation and individual tendencies toward adopting new technologies. Both reflect users' feedback on technology experiences and exploratory motivation [21]. Satisfaction represents the overall emotional evaluation of current usage outcomes and is a key precursor to continued use or recommendation behaviour. User innovativeness captures individuals' willingness to try and adopt emerging technologies. In the design of Metaverse banking systems, continuous user feedback should be used to optimise the system, thereby enhancing user satisfaction iteratively.

TABLE IV. THE STATE OF METAVERSE BANKING ADOPTION

Factor effect	Name of homogeneous factor
Negative correlation factor	Privacy risks and privacy
	Security risks and financial risks
	Social risk, Social influence, Brand image, Government support
	Time risk
	Performance risk and expected performance: The fragility and trust of perception in the Metaverse
Positive correlation factor	Perceivable ease of use, usability, expected effort, and user self-efficacy
Negative influencing factors	Metaverse social interaction, social presence, and interoperability
	The perceived complexity of the Metaverse
Positive influencing factors	Perceive pleasure and perceive curiosity.
	Low-cost usage threshold
	Social norms
	Perceptual personification and perceptual authenticity
	Satisfaction and user innovation

C. RQ3

The implementation guidelines for Metaverse banking are suggested in Table V. In the early development stage of Metaverse banking, customer willingness to adopt Metaverse technologies remains in a sensitive phase. At this stage, perceived enjoyment and curiosity can be effective facilitators between banks and users, smoothing the adoption process. In particular, perceived curiosity motivates users to explore and engage with Metaverse banking.

The immersive advantages of the Metaverse offer significant technical potential for implementation in banking services. Perceived realism and perceived anthropomorphism both contribute to users' willingness to adopt Metaverse technologies [29]. During the initial implementation phase, ensuring that the Metaverse banking experience closely resembles that of the real-world banking environment will further support the adoption decisions of traditional banking users [30]. By embedding the operational flows of conventional banking services, the system allows users to engage with familiar banking processes. This reduces the need for extensive user education on the new technology and fulfils users' expectations for banking services. It also enables users to conduct banking activities in a familiar setting, enhancing their sense of self-efficacy through the capabilities of Metaverse technology.

Metaverse banking should adopt low-cost usage models to lower the entry barriers for customer participation, enabling a broader user base to engage with the technology in its early stages [29]. More inclusive design approaches should also be implemented to accommodate users with diverse characteristics. Leveraging the scalability of Metaverse functionalities will allow diverse user groups to efficiently and seamlessly complete transactions in the Metaverse banking environment.

TABLE V.   METAVERSE BANKING ADOPTION RECOMMENDATIONS

Positive factor	Initial implementation suggestions
Perceived usability	Adopt a usage method that users are familiar with or can quickly understand
Expected effort	Adopt business processes that meet users' expectations.
Self-efficacy	Implement business processes that are sufficient to make users confident.
Availability	Adopt a more compatible design.
Perceive pleasure, Perceive curiosity.	Leverage the capabilities of the Metaverse and adopt a more attractive Metaverse banking design.
Perceptual personification	Adopt a more anthropomorphic design to highlight human features in the picture.
Perceived authenticity	Adopt more realistic, authentic bank images.
Low-cost usage threshold	Lower the usage threshold of the Metaverse banking to enable more users to participate.
Social norms	Establish social norms for the Metaverse banking to limit the negative impacts of free interaction among users.
Satisfaction and user innovation	Continuously follow up on the demands of Metaverse banking users and quickly improve and optimise.

Regulations should be established to guide user-to-user interactions and prevent potential negative consequences resulting from unregulated engagement, which could otherwise hinder user adoption and satisfaction [40].

During the early implementation of Metaverse banking [37], banks must consistently monitor and respond to customer needs, providing timely feedback to improve customer satisfaction quickly [21]. Banks should actively encourage users to raise concerns and iteratively refine the platform based on user feedback, ensuring a user-centred and responsive development process.

D. RQ4

The current implementation challenges of Metaverse banking are presented in Table VI. The primary distinction between Metaverse banking and traditional online banking lies in Metaverse banking's ability to extend users' social interactions and conduct banking activities within a virtual world. This dual functionality benefits banks and users and introduces greater uncertainty and risk. A more open and flexible Metaverse banking platform increases the risk of personal privacy breaches during user activities. Without clearly defined social norms, interactions between users may lead to virtual misconduct, such as verbal abuse or humiliation, compromising user safety. Establishing social norms within the Metaverse is a critical challenge during the early adoption phase of Metaverse banking [38].

The involvement of authoritative institutions in implementing Metaverse banking can further enhance users' perceived ease of use. Users are more likely to perceive Metaverse banking platforms supported by credible institutions as more straightforward. Such institutional backing also contributes to building social influence and a trustworthy brand image in the financial market. Establishing a reliable social influence and a credible brand image represents another major challenge during the initial adoption phase [40].

Users already have expectations regarding the processing speed of banking services. As such, they will likely express concerns about processing time and system performance when engaging in financial transactions [41]. During the early technological development stage, it is essential for Metaverse banking to ensure the timely completion of tasks and performance that meets user expectations to prevent apprehension. Ensuring stable system performance is key to enhancing users' perceived reliability of Metaverse banking technologies.

As Metaverse banking expands user interaction, it is necessary to determine how users should operate their virtual avatars and what methods can effectively facilitate user-to-user engagement [36].

In its early stages, Metaverse banking should avoid overly complex system designs that may overwhelm users with perceived technical difficulty [29]. Making the technology feel simple and easy to use remains one of the foremost challenges for successfully adopting Metaverse platforms.

TABLE VI. POTENTIAL CHALLENGES IN THE INITIAL DEVELOPMENT OF METAVERSE BANKING

Challenging factors	Factor Description
Privacy risks	The virtual world inevitably generates risks such as privacy leakage and behaviour monitoring.
Social norms	Improper behaviour between users will pose a threat to users.
Ease of use	How to make users feel that it is simple and easy to use
Performance expectations	How to avoid users' concerns about bank performance
Metaverse interactions	How to promote the more convenient use of avatars by Metaverse users

VI. CONCLUSION

This study primarily focuses on an exploratory literature review of the market adoption of Metaverse banking during its early development stage. It identifies the adoption characteristics of traditional banking users from the perspective of online banking. It integrates this with literature on service quality in Metaverse banking to address the current research gap regarding how Metaverse technologies influence user adoption in the early stages of development within the banking sector. The study reveals key features and needs of online banking users alongside the actual performance of Metaverse technologies at this stage of development. It offers implementation recommendations for Metaverse Banking and outlines future research directions, thereby accelerating the integration of Metaverse technologies into the banking industry.

The research emphasises that Metaverse Banking should construct a coherent Metaverse social framework, encompassing the operational mechanisms of virtual environments and social interaction mechanisms for banking users. More effective technological solutions should be adopted to ensure customer privacy and financial security. However, the current research findings remain limited, as this study has not yet conducted empirical validation through practical cases. Thus, the validity of these conclusions awaits further verification. Accordingly, from the perspective of the initial implementation of Metaverse Banking, this study provides a reference for technological implementation rather than a definitive and comprehensive guideline.

Based on the current research findings, future studies should adopt empirical approaches to further clarify the interrelationships among factors influencing users during the initial adoption stage. Particular attention should be given to understanding users' psychological states when they first engage with banking services in immersive interactive environments, thereby providing guidance for integrating Metaverse technologies into banking and facilitating the transformation of banking services in the new digital era.

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