Assessing the Adoption of Metaverse Platforms: A Structural Equation Modeling Approach with Mediating Effects of Switching Costs

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ABSTRACT

The adoption of Metaverse platforms, a burgeoning technological innovation, holds significant potential for transforming various sectors, yet its uptake in emerging markets like Indonesia remains underexplored. This study addresses this gap by investigating the key factors influencing the Intention to Use (IU) Metaverse platforms in Indonesia, focusing on the roles of Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), Relative Advantage (RA), and the mediating effect of Switching Costs (SC). The primary objective of this research was to develop and validate a model that explains the relationships between these factors and how they collectively impact user adoption decisions. Specifically, the study aimed to understand how PE, EE, SI, and RA influence the intention to use Metaverse platforms, with SC acting as a mediator. A quantitative research design was employed, utilizing Structural Equation Modeling (SEM) with Partial Least Squares (PLS) to analyze data collected from 380 distributed questionnaires. Of these, 361 were valid and used in the analysis, providing a robust sample to examine the study's hypotheses. Participants were surveyed on their perceptions and intentions regarding Metaverse platforms. The analysis focused on examining the direct effects of PE, EE, SI, and RA on the intention to use, as well as the indirect effects mediated by SC. The findings revealed that PE, EE, SI, and RA significantly influence the intention to adopt Metaverse platforms, with SC playing a crucial mediating role. The study underscores the importance of reducing perceived switching barriers to enhance adoption, especially in a culturally diverse market like Indonesia. These results contribute to the broader understanding of technology adoption in emerging markets and offer practical implications for developers and marketers aiming to promote Metaverse platforms. Future research should explore additional factors such as technological anxiety or perceived risk and consider longitudinal designs to capture changes in user perceptions over time. This study provides a foundational model that can guide further exploration and application of Metaverse technologies in similar contexts.

Keywords Metaverse Adoption, Performance Expectancy, Social Influence, Switching Costs, Structural Equation Modeling (SEM-PLS)

INTRODUCTION

Metaverse platforms have rapidly emerged as one of the most transformative technological developments of the 21st century. These platforms represent a collective virtual shared space, created through the convergence of virtually enhanced physical reality and physically persistent virtual environments. The concept of the Metaverse, while not entirely new, has evolved significantly with advancements in technology. Initially rooted in science fiction, the Metaverse

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now encompasses a vast array of digital experiences that go beyond mere virtual worlds. These platforms allow users to engage in immersive social interactions, participate in virtual commerce, access education and training programs, and enjoy entertainment in ways that were previously unimaginable. The development of the Metaverse has been driven by innovations in virtual reality (VR), augmented reality (AR), blockchain, and other cutting-edge technologies, enabling a seamless integration of digital and physical worlds. The significance of Metaverse platforms has grown exponentially worldwide as both technology companies and consumers recognize their potential to revolutionize various aspects of life and business. Driven by advancements in VR and AR technologies, along with the increasing adoption of blockchain for secure transactions and digital ownership, the development and expansion of the Metaverse have accelerated. Companies like Facebook, rebranded as Meta, have made substantial investments in Metaverse technologies, underscoring their belief in this space as the next major frontier in digital interaction, capable of creating entirely new ecosystems for social interaction, work, education, and entertainment. Recent studies have further emphasized the transformative impact of Metaverse platforms across sectors such as banking and healthcare, where these technologies enhance user engagement and operational efficiency [1], [2]. By facilitating seamless transactions and improving customer interactions, the Metaverse positions itself as a critical tool for businesses seeking innovation and competitive advantage [1]. The integration of advanced technologies, including blockchain and artificial intelligence, within Metaverse platforms enhances security and operational transparency, thereby fostering trust among users [3], [4].

Additionally, the Metaverse reshapes social dynamics and user experiences by emphasizing interoperability and user-friendly design to maximize engagement [5]. As it continues to evolve, the Metaverse's role as a collaborative and immersive platform becomes increasingly vital, driving both technological advancement and user participation in digital environments[6], [7]. Thus, the Metaverse's growing importance is underscored by its ability to revolutionize traditional business models and enhance user interactions in a digital-first world. In the Indonesian context, the relevance of Metaverse platforms has become increasingly apparent, particularly as the country continues to experience rapid growth in its digital economy. Indonesia, with its large and youthful population, represents a fertile ground for the adoption of Metaverse technologies. The younger, tech-savvy demographic is particularly likely to engage with Metaverse platforms, driven by their familiarity with digital environments and social media. The expansion of Indonesia’s digital infrastructure and increasing internet penetration have further supported this trend, making Metaverse platforms more accessible to a broader audience. Moreover, the potential applications of the Metaverse in various sectors, such as entertainment, education, and commerce, offer significant opportunities for growth and innovation in Indonesia. These platforms could play a crucial role in enhancing remote work and online education, which have gained prominence in the wake of the COVID-19 pandemic, as well as in fostering new forms of digital entertainment and social interaction.

The adoption of Metaverse platforms in Indonesia, however, is not without its challenges. Despite the promising outlook, several barriers need to be addressed to realise the full potential of these platforms in the country. Issues such as limited access to high-speed internet in rural areas, the high cost of VR/AR equipment, and varying levels of digital literacy among the population could hinder widespread adoption. Furthermore, concerns related to data privacy, security, and the regulatory environment pose additional challenges that must be navigated to ensure the safe and sustainable growth of Metaverse platforms in Indonesia. Despite these obstacles, the growing interest in the Metaverse, both globally and within Indonesia, suggests that these platforms are likely to become an integral part of the country's digital future, offering new avenues for economic development and social engagement. The adoption of Metaverse platforms in Indonesia faced several distinct challenges that hindered their widespread implementation, particularly in terms of technological infrastructure, awareness, and cultural considerations. One of the most significant barriers was limited access to high-speed internet, especially in rural and remote regions of the country. Although Indonesia had made considerable progress in expanding internet infrastructure, connectivity disparities persisted, with many less urbanised areas experiencing slow internet speeds and unreliable connections. This digital divide not only restricted access to Metaverse platforms but also exacerbated the unequal distribution of technological advancements, limiting the potential for broad adoption across the country.

In addition to infrastructure challenges, a lack of awareness and understanding of the Metaverse concept among the general population posed another barrier to adoption. Many individuals and organizations in Indonesia remained unfamiliar with the technology, which had predominantly gained traction in Western countries [8]. This knowledge gap was further compounded by perceived difficulties in using Metaverse platforms, deterring potential users from engaging with these technologies [9]. Moreover, cultural and religious factors significantly influenced attitudes towards the Metaverse. Negative perceptions from religious leaders regarding the implications of Metaverse usage, especially among younger demographics, served as another deterrent [9], [10]. These factors, coupled with insufficient technological infrastructure, led to concerns about accessibility and performance [11]. Another critical challenge involved the high costs associated with VR/AR equipment, which were integral to fully experiencing the Metaverse. The price of high-quality VR/AR hardware remained prohibitively expensive for the average consumer in Indonesia, limiting the potential user base primarily to affluent individuals or those with a keen interest in technology. Additionally, there was a notable gap in digital literacy across different segments of the population. While younger, urban Indonesians were more familiar with digital technologies, older individuals and those in rural areas often lacked the necessary skills and knowledge to navigate these platforms effectively. Furthermore, concerns related to data privacy and security posed significant obstacles. Users and regulators alike were apprehensive about the potential risks of data breaches and unauthorized access to personal information within the Metaverse. The regulatory environment in Indonesia, which is still in its nascent stages regarding digital governance, also presented uncertainties that could affect the long-term viability of these platforms.

Despite these challenges, several promising opportunities existed for the adoption of Metaverse platforms in Indonesia. The country's large, youthful population, which was deeply engaged with digital content and social media, provided a fertile ground for the expansion of the Metaverse. This demographic was not only tech-savvy but also highly receptive to new and innovative forms of online interaction, making them ideal early adopters of Metaverse technologies. The increasing penetration of smartphones and affordable internet data plans further supported this trend, enabling more users to access these platforms even without advanced VR/AR equipment. Moreover, the potential of Metaverse platforms to enhance remote work, online education, and digital entertainment aligned well with Indonesia’s ongoing digital transformation. The COVID-19 pandemic has accelerated the shift towards remote work and online learning, highlighting the need for immersive and interactive digital environments. Metaverse platforms offered a unique solution by providing virtual spaces where people could work, learn, and socialise in ways that closely mimicked real-world interactions. Additionally, the entertainment sector in Indonesia, already vibrant and rapidly growing, stood to benefit significantly from the immersive experiences that the Metaverse could offer. From virtual concerts and events to interactive gaming, the possibilities were vast, and the demand for such experiences was expected to rise. These opportunities, if capitalised on effectively, could position Indonesia as a leading player in the adoption and innovation of Metaverse technologies within the region.

Previous studies on technology adoption have predominantly focused on individual factors, such as PE, EE, SI, and RA, treating them as isolated variables rather than components of a broader, interconnected framework. Researchers often explored how each of these factors independently influenced user behavior. Still, these studies did not consider how these factors might interact or combine to affect the overall intention to use new technologies, including Metaverse platforms. For instance, while Performance Expectancy (PE) was frequently linked to users' beliefs about the benefits of technology, and EE was associated with ease of use, the potential for these factors to jointly influence adoption decisions was not fully explored. This segmented approach has limited the understanding of the holistic adoption process, particularly in the context of complex, multifaceted platforms like the Metaverse. Moreover, studies that examined SI and RA also tended to do so in isolation, missing opportunities to understand their combined impact on technology adoption. SI, which reflects the effect of peer pressure and societal expectations, and RA, which measures the perceived superiority of new technology over existing alternatives, are critical components in the decision-making process. However, previous research often overlooked how these variables might interplay, potentially amplifying or mitigating each other's effects on users' intentions to adopt Metaverse platforms. This gap highlights the need for a more integrated approach that considers the simultaneous influence of these key variables, providing a more comprehensive understanding of what drives technology adoption.

The absence of integrated models that combine these essential factors into a cohesive framework has left a significant gap in the literature. Without such models, it is challenging to capture the complexity inherent in the adoption of emerging digital platforms like the Metaverse. The Metaverse, as a new and rapidly evolving technological domain, presents unique challenges and opportunities that cannot be fully understood through fragmented analyses. An integrated model would allow for a better understanding of how different factors interact to influence user adoption, providing insights that are more applicable to real-world scenarios. This approach is particularly important in the context of the Metaverse, where user experiences are shaped by a multitude of interconnected elements, ranging from technological ease of use to social acceptance and perceived benefits. The primary objective of this research was to develop and validate an integrated model that could comprehensively explain the factors influencing the intention to use Metaverse platforms in Indonesia. In the rapidly evolving digital landscape, where technologies such as the Metaverse are gaining significant traction, understanding the drivers of user adoption is crucial. The research aimed to move beyond the traditional, fragmented approach of studying individual factors in isolation by proposing a model that integrates multiple key variables. This integrated model combined PE, EE, SI, RA, and SC to provide a holistic view of the adoption process. Through this approach, the study sought to capture the complexity of user behavior in the context of Metaverse platforms, where decisions are likely influenced by a constellation of interrelated factors rather than by single, independent variables.

The study specifically focused on examining the relationships between these identified variables and how they collectively influenced the intention to use Metaverse platforms. The research emphasised the importance of understanding not just the direct effects of each variable on user intentions but also how these variables interact and influence each other within the broader framework of technology adoption. For instance, while PE might directly impact a user's intention to adopt a Metaverse platform, the study also aimed to explore how this expectation might be moderated by factors such as SI or perceived SC. By identifying which factors were most influential and how they interacted, the study provided valuable insights into the adoption dynamics specific to the Indonesian context, offering practical implications for developers, marketers, and policymakers aiming to enhance the uptake of Metaverse technologies.

Literature Review

Performance Expectations in New Technologies

Performance Expectancy (PE) has been widely recognized as a critical determinant in the adoption of new technologies, including the Metaverse. Defined as the degree to which an individual believes that using a particular system will help them achieve gains in job performance, PE is grounded in the notion that users are more likely to adopt a technology if they perceive it as beneficial and capable of enhancing their efficiency and effectiveness in various tasks. The significance of PE has been particularly emphasized in the context of the Metaverse, where the potential to offer immersive and enhanced digital experiences makes it a promising tool for improving productivity and engagement in both professional and personal settings. Previous research has consistently linked PE with the intention to use Metaverse platforms. For instance, [12] identified PE as a significant predictor of users' behavioral intentions to engage with the Metaverse across various contexts. This finding aligns with earlier studies that have shown a positive correlation between users' expectations of performance gains and their willingness to adopt new technologies. However, the extent to which PE influences behavioral intention may vary depending on the specific context in which Metaverse technology is applied. Research by [13] suggested that the impact of PE might be contingent on the perceived relevance and applicability of the Metaverse in users' specific domains, whether for work, education, or entertainment.

Moreover, [14] demonstrated that when the Metaverse meets users' expectations regarding its benefits and usefulness, it significantly enhances their intention to use it. This correlation underscores the importance of aligning the features and capabilities of Metaverse platforms with user needs to drive adoption. Additional research by [15], [16], [17] further supported the notion that factors such as EE, facilitating conditions, SI, and perceived behavioral control also play crucial roles in shaping users' intentions to adopt the Metaverse. These studies indicated that while PE is a primary driver, it operates in conjunction with other factors that collectively influence technology adoption decisions. Furthermore, the experience of space and exchange within the Metaverse, which mimics real-life scenarios, has been shown to increase users' motivation for continuous use by enhancing their engagement and satisfaction [18]. This finding highlights the role of immersive experiences in reinforcing PE, as users are more likely to continue using the Metaverse if they perceive it as providing realistic and valuable experiences. In addition, research by [19] indicated that the adoption of Metaverse technology could be significantly influenced by a combination of PE, EE, SI, and facilitating conditions, suggesting that a holistic approach is necessary to understand the factors driving adoption. Research by [20] found that satisfaction, immersion, and ease of use were directly related to the intention to continuously use Metaverse platforms, further supporting the relevance of PE in the context of user engagement. Elements like hedonic motivation and value price, as explored by [17], also positively affected users' intent to embrace Metaverse platforms, indicating that the perceived enjoyment and cost-effectiveness of these platforms could enhance their appeal. Lastly, [21] identified habit as a vital factor influencing behavioral intentions related to the use of Metaverse technology, suggesting that as users become more accustomed to these platforms, their PE may increase, leading to sustained usage and deeper integration into their daily activities.

Effort Expectancy in Digital Platforms

Effort Expectancy (EE) has been defined as the degree of ease associated with the use of technology, reflecting users' perceptions of how straightforward and user-friendly a system is. This concept is fundamental in the context of emerging technologies like the Metaverse, where the complexity of the platform can significantly influence user adoption. EE encapsulates the idea that technologies perceived as easy to use are more likely to be adopted by users, as lower perceived effort reduces the cognitive and physical barriers to engagement. In the Metaverse, where interactions often involve navigating complex virtual environments and using advanced hardware like VR headsets, the ease with which users can learn and operate the system becomes a critical factor in determining whether they will choose to engage with the platform. Previous research has underscored the significant role that EE plays in shaping users' intentions to adopt new technologies. Research by [17] highlighted that EE is an important factor influencing the intention to use Metaverse platforms, with studies suggesting that users are more likely to embrace these platforms when they perceive the required effort to be minimal. This finding aligns with broader technology adoption theories, which posit that ease of use is a key predictor of user acceptance. Moreover, [17] also noted that the ease of use and perceived effort required to interact with Metaverse technology can directly affect users' intentions to engage with it. This suggests that even highly innovative platforms like the Metaverse must be designed with user-friendliness in mind to facilitate widespread adoption.

The impact of EE extends beyond just the initial intention to use the Metaverse; it also plays a critical role in shaping the overall user experience. Study by [22] demonstrated that the perceived effort significantly affects the Metaverse Experience Browser, a tool designed to enhance user interaction with the Metaverse. This finding highlights the importance of perceived effort in not only attracting users to the platform but also in maintaining their engagement over time. The ease with which users can navigate and interact within the Metaverse can greatly influence their satisfaction and willingness to continue using the platform. Therefore, understanding how EE influences user intentions is essential for designers and developers aiming to create user-friendly and engaging Metaverse experiences. In the context of Metaverse technology, the level of effort users perceive in interacting with the platform can be influenced by several factors. These include the usability of the technology, the learning curve associated with using the Metaverse, and the overall design of the user interface. A steep learning curve or a poorly designed interface could increase the perceived effort, thereby reducing users' intentions to adopt the platform. Conversely, a well-designed, intuitive interface that minimizes the required effort can enhance user engagement and promote adoption. Additionally, the perception of effort is likely to interact with other factors such as PE and SI, further complicating the dynamics of technology adoption. For instance, even if users expect high performance from the Metaverse, they may be deterred if the perceived effort to achieve that performance is too great. Moreover, the relationship between EE and adoption intentions becomes even more critical when considering the potential mediation of SC. Users who perceive high effort in using a new platform may also perceive higher SC, which could further deter adoption. Therefore, reducing perceived effort is not only about making the technology easier to use but also about lowering the barriers to switching from existing technologies to the Metaverse. This insight emphasizes the need for a comprehensive approach to design that considers both the immediate user experience and the broader context of technology adoption. Understanding and addressing EE's role in these processes is crucial for fostering the widespread acceptance of Metaverse platforms, particularly in diverse and emerging markets like Indonesia.

Social Influence in Technology Adoption

Social Influence (SI) has been defined as the degree to which an individual perceives that important others believe they should use a new system. This concept is rooted in the idea that individuals are not solely influenced by their attitudes or beliefs but also by the expectations and behaviors of those around them, such as peers, family members, or colleagues. In the context of Metaverse platforms, SI becomes particularly relevant as the adoption of these technologies often involves social interaction within virtual spaces. The perception that others within one's social circle are using or endorsing the Metaverse can significantly impact an individual's decision to engage with these platforms. Research has consistently shown that SI plays a critical role in shaping individuals' intentions to adopt new technologies, including the Metaverse. Study by [23] found that social interaction factors positively influenced users' continued intention to use Metaverse platforms, indicating that the social environment within these virtual spaces could encourage ongoing engagement. Furthermore, the impact of SI on the adoption of Metaverse technology has been observed across various contexts. For instance, [16] demonstrated that SI was a significant factor in the adoption of Metaverse technology in educational settings, where the influence of instructors and peers played a pivotal role in students' acceptance of the platform. Similarly, [24] identified SI as a key determinant in the adoption of Metaverse technology within retail banking, where the perceived endorsement by colleagues and customers influenced employees' and clients' willingness to use the technology.

The importance of SI extends beyond individual contexts, as it has been recognized as a significant predictor of technology adoption in the broader consumer behavior landscape. Research by [25] highlighted that social factors significantly impact user behavior and decision-making within virtual spaces, emphasizing the role of peer pressure and social norms in driving Metaverse adoption. This aligns with [5] findings that SI is a prominent aspect of Metaverse adoption, particularly as users navigate the complex social dynamics within these immersive environments. These studies collectively underscore the importance of understanding how SI shapes user intentions and behaviors within the Metaverse, suggesting that strategies aimed at promoting the adoption of Metaverse platforms should leverage social dynamics to enhance their effectiveness. Moreover, SI has been shown to work in conjunction with other factors, such as PE, to influence the intention to use Metaverse technology. Research by [14] identified SI as a significant predictor of users' intentions alongside PE, highlighting that the perceived social approval of using the Metaverse can reinforce users' expectations of its benefits. The impact of SI has also been demonstrated across different demographic groups, further illustrating its broad relevance. Research by [23] found that SI was particularly influential among young users, who are often more susceptible to peer influence in their technology adoption decisions. Research by [17] echoed this finding, noting that Generation Y individuals are significantly impacted by SI when considering the use of Metaverse platforms. Understanding the role of SI in Metaverse adoption is crucial for designing strategies that effectively promote the acceptance and use of these platforms. Leveraging social dynamics, such as encouraging influential users or opinion leaders to advocate for the Metaverse, could significantly enhance adoption rates. Additionally, integrating social features that facilitate peer interaction and community building within the Metaverse could further strengthen the influence of SI, making the platforms more attractive to potential users. These insights highlight the need for a comprehensive approach that considers the multifaceted impact of SI on technology adoption, particularly in the context of innovative and socially immersive platforms like the Metaverse.

Relative Advantage of Emerging Technologies

Relative Advantage (RA) has been defined as the degree to which an innovation is perceived as superior to the idea or technology it replaces. This concept is central to innovation adoption theory and plays a crucial role in influencing individuals' intentions to adopt new technologies, including the Metaverse.

When users perceive that adopting the Metaverse offers significant benefits over traditional methods or existing technologies, they are more likely to develop a positive intention to use it. This perceived advantage can manifest in various forms, such as increased efficiency, enhanced user experiences, reduced stress, or greater overall satisfaction. The perception that the Metaverse provides unique and valuable benefits that are not attainable through conventional platforms is a key driver of adoption. Research has consistently demonstrated a positive correlation between RA and technology adoption rates. Research by [26] highlighted that when users perceive the Metaverse as offering greater benefits compared to traditional technologies, their intention to engage with Metaverse platforms is significantly heightened. This perception of RA encompasses a broad range of factors, from the ability to create immersive and interactive experiences to the potential for improved productivity and communication within virtual environments. Users who believe that the Metaverse can deliver these advantages are more inclined to integrate it into their daily activities, whether for work, education, or entertainment purposes.

Other studies have further corroborated the impact of RA on users' decision-making processes and their willingness to engage with Metaverse platforms. Study by [14] found that the perception of RA played a pivotal role in shaping users' intentions to adopt the Metaverse, particularly when the advantages of the technology were clearly communicated and aligned with users' needs. The study emphasized that organizations promoting the Metaverse must effectively highlight its RA to persuade potential users of its value. This involves not only showcasing the technological capabilities of the Metaverse but also demonstrating how it can provide tangible benefits that surpass those offered by existing alternatives. Moreover, the importance of RA in influencing technology adoption extends to how users perceive the overall benefits and usefulness of the Metaverse. Study by [27] noted that understanding and communicating the RA of the Metaverse compared to existing technologies is essential for promoting its widespread adoption across different domains. This involves educating users about the unique features and advantages of the Metaverse, such as its ability to support real-time collaboration in virtual spaces, enhance user engagement through gamified experiences, and offer new opportunities for social interaction and networking. Research by [22] further supported this view, indicating that RA significantly affects customer support, public relations, and overall user satisfaction with Metaverse technologies. By effectively communicating the RA of the Metaverse, organizations can enhance users' perceptions of the technology and encourage its adoption. This approach not only increases user interest but also helps to build a strong case for the Metaverse as a viable and valuable alternative to traditional platforms. Highlighting the unique advantages of the Metaverse, such as its potential to revolutionize communication, entertainment, and commerce, is crucial for driving adoption and ensuring that users fully appreciate the benefits that the technology has to offer. Understanding the role of RA in this process provides valuable insights for developers, marketers, and policymakers aiming to promote the adoption of Metaverse platforms in diverse contexts.

Switching Cost as Barriers to Change

Switching Cost (SC) refers to the perceived costs associated with changing from one technology to another, encompassing a range of factors such as financial expenses, time, effort, and psychological impacts. In the context of technology adoption, SC acts as a significant barrier, often deterring users from transitioning to new platforms due to the various investments required. These costs can manifest in several ways, including the financial burden of acquiring new hardware or software, the time and effort needed to learn and adapt to a new system, and the psychological discomfort associated with leaving behind a familiar environment. Within the realm of Metaverse platforms, where the technology is still emerging and evolving, SC plays a crucial role in influencing users' decisions to adopt or reject these virtual environments. The literature on SC highlights their pivotal role as a barrier to the adoption of new technologies. Previous studies have extensively documented how SC can impede user intentions to engage with new platforms, particularly when the perceived costs outweigh the expected benefits. Study by [28] emphasized that SC is a critical factor shaping individuals' intentions to engage with the Metaverse, as users are often reluctant to abandon established technologies due to the high costs associated with switching. This reluctance is further compounded by the novelty and complexity of the Metaverse, which may require substantial time and effort for users to become proficient. The psychological investment in existing platforms, such as familiarity with user interfaces and established social networks, also contributes to the resistance against adopting new technologies, including the Metaverse.

In addition to the financial and psychological barriers, the effort required to transition to a new technology can significantly influence user behavior. Study by [29] discussed the impact of SC within the services industry, demonstrating that high switching barriers can strongly affect repurchase intentions. This finding is applicable to the context of Metaverse platforms, where users may be hesitant to make the switch due to the perceived effort involved in learning and adapting to a new virtual environment. The decision to adopt a Metaverse platform is not only influenced by the anticipated benefits but also by the potential disruption to existing routines and practices. As a result, SC becomes a decisive factor in whether users are willing to embrace these innovative technologies or remain with their current systems. Recent research has increasingly recognized SC as a critical determinant of usage intentions in the adoption of Metaverse platforms. Research by [17] highlighted that understanding the role of SC is essential for evaluating user acceptance and predicting the success of Metaverse technologies. The significant association between SC and behavioral intention to use the Metaverse underscores the importance of addressing these costs to facilitate adoption. For instance, strategies that minimize the perceived effort, time, and financial investment required to transition to Metaverse platforms could effectively reduce the barriers posed by SC. This approach is particularly relevant in the Metaverse context, where users are often exploring uncharted virtual spaces that require a considerable adjustment period. Understanding the role of SC in the adoption of Metaverse platforms is crucial for devising strategies that alleviate these barriers and enhance user engagement. Organizations and developers can mitigate SC by providing comprehensive onboarding processes, user-friendly interfaces, and support systems that ease the transition for new users. Additionally, highlighting the long-term benefits and relative advantage of adopting Metaverse platforms can help counterbalance the perceived costs, making the transition more appealing. As Metaverse technologies continue to evolve, addressing SC will be a key factor in promoting widespread adoption and ensuring that these virtual environments are accessible and attractive to a broad user base.

Method

Research Design and Data Collection

This study employed a quantitative research approach, utilizing a cross-sectional survey design to examine the factors influencing the adoption of Metaverse platforms in Indonesia. The cross-sectional design was chosen for its ability to capture a snapshot of the population's perceptions and behaviors at a specific point in time. This approach allowed for the collection of data from a large and diverse sample of respondents, providing a broad view of the factors impacting their intention to use Metaverse platforms. The quantitative nature of the research facilitated the statistical analysis necessary for testing the proposed structural equation model, enabling the identification of relationships between the variables of interest. Convenience sampling was employed to select respondents for the study, targeting individuals from various regions across Indonesia. This method was chosen due to its practicality and efficiency in reaching a large number of respondents within a relatively short timeframe. While convenience sampling may introduce some bias due to its non-random nature, it was deemed appropriate given the exploratory nature of the research and the focus on gaining initial insights into the adoption of Metaverse platforms. The sample included a mix of current users and potential users of Metaverse technologies, ensuring that the findings were relevant to a wide audience within the Indonesian context.

Initially, 380 questionnaires were distributed, and as part of the validation process, respondents were asked if they had ever used Metaverse platforms through a specific question, “Have you ever used a Metaverse platform?” Out of the 380 respondents, 361 indicated that they had used a Metaverse platform, while the remaining 19 had not. These 19 responses were deemed invalid as they did not meet the inclusion criteria, resulting in a final sample of 361 valid respondents. The decision to use these 361 responses was also supported by a prior power analysis, which indicated that this sample size would provide adequate statistical power for detecting significant effects within the proposed structural equation model. The power analysis took into account the number of variables in the model, the expected effect sizes, and the desired level of statistical significance, ensuring that the study's findings could be generalized to a broader population. The study targeted a population of Indonesian users and potential users of Metaverse platforms. This population was defined as individuals who either currently engaged with or were likely to engage with Metaverse technologies in the future. The inclusion criteria were broad, encompassing a diverse range of demographic groups, including different age brackets, educational backgrounds, and levels of technological proficiency. The goal was to capture a representative sample of the Indonesian population, reflecting the diverse experiences and attitudes toward Metaverse adoption across the country. The data collection took place in June 2024, using online survey methods to reach respondents in various locations. Data collection was conducted via a structured questionnaire distributed through Google Forms. The questionnaire was designed to capture information on respondents' demographics, their experiences with Metaverse platforms, and their perceptions related to the constructs of PE, EE, SI, RA, SC, and Intention to Use. The survey was disseminated through social media platforms, email lists, and online communities to maximize reach. Respondents were given a specified timeframe to complete the survey, and follow-up reminders were sent to encourage participation. The online format ensured ease of access and allowed for the efficient collection and management of data, which was later used for statistical analysis in the study.

Research Model and Hypothesis Development

The research model was developed based on established theoretical frameworks in technology adoption and behavioral intention. Each hypothesized relationship within the model was grounded in prior research, aiming to explore the factors influencing the adoption of Metaverse platforms in Indonesia.

H1: SI → IU

The first hypothesis proposed that SI would positively impact the IU Metaverse platforms. This relationship was based on the premise that individuals are likely to be influenced by the opinions, behaviors, and expectations of their social network, including friends, family, and colleagues. Previous studies have demonstrated that social pressures and the perceived approval of others can significantly shape an individual's decision to adopt new technologies, particularly in social and collaborative environments such as the Metaverse.

H2: PE → IU

The second hypothesis posited that PE would positively affect IU. PE refers to the degree to which an individual believes that using the Metaverse will help them achieve beneficial outcomes, such as increased efficiency, productivity, or enjoyment. Drawing from the Technology Acceptance Model (TAM) and related theories, it was expected that users who perceived the Metaverse as a valuable tool for enhancing their personal or professional activities would be more inclined to adopt and use the platform.

H3: PE → SC

The third hypothesis suggested that PE would also have a direct effect on SC. It was hypothesized that higher PE could potentially reduce perceived SC, as users might view the benefits of adopting the Metaverse as outweighing the costs associated with transitioning from other technologies. This relationship was informed by the idea that when users expect substantial performance gains, they may be more willing to endure the inconveniences or challenges of switching.

H4: EE → SC

The fourth hypothesis examined the relationship between EE and SC. EE, defined as the perceived ease of using the Metaverse, was expected to negatively influence SC. The rationale was that if users perceive the Metaverse as easy to use and require minimal effort to learn, they would perceive lower SC, thus making the transition to the Metaverse more appealing. This hypothesis drew on concepts from the Unified Theory of Acceptance and Use of Technology (UTAUT), which emphasizes the role of perceived ease of use in technology adoption.

H5: SC → IU

The fifth hypothesis posited that SC would negatively impact IU. This relationship was based on the understanding that higher perceived SC, such as time, effort, financial resources, or psychological barriers, could deter users from adopting the Metaverse. If users perceive the costs of switching to the Metaverse as too high, their intention to use the platform would likely decrease. This hypothesis highlighted the importance of addressing potential barriers to adoption to encourage broader user engagement.

H6: RA → IU

The final hypothesis proposed that RA would positively affect IU. RA refers to the degree to which the Metaverse is perceived as being superior to existing technologies or methods. It was expected that users who perceived the Metaverse as offering unique benefits or significant improvements over alternative platforms would be more inclined to adopt and use it. This hypothesis was grounded in innovation diffusion theory, which asserts that perceived advantages play a crucial role in the adoption of new technologies. To visually represent these hypothesized relationships, a research framework diagram was developed, as shown in Figure 1.

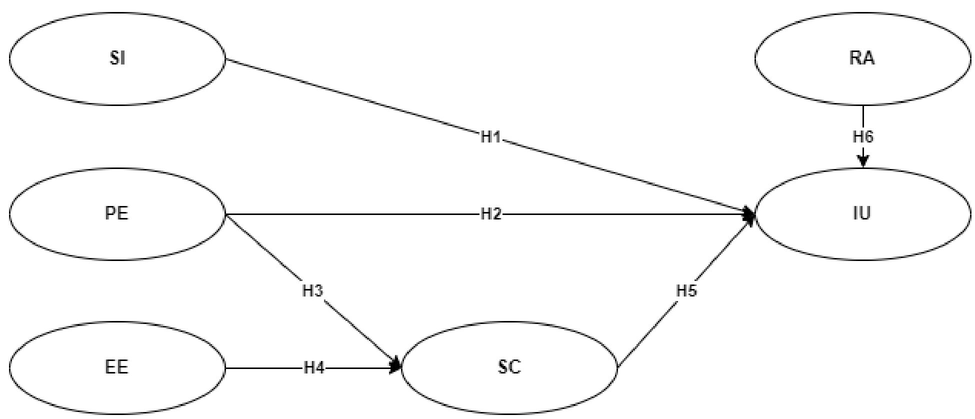

Figure 1 **Research Framework**

Measurement Instruments

In this study, the measurement instruments for each variable were developed or adapted from well-established scales in the technology adoption literature to ensure both reliability and validity. The process involved a thorough review of existing scales, with adaptations made to suit the specific context of Metaverse platforms in Indonesia. Each scale was selected based on its relevance to the constructs being measured, ensuring that the items were both culturally appropriate and reflective of the unique characteristics of the Metaverse environment. The scale for PE was adopted from [30], a foundational source in the technology acceptance literature. This scale included items designed to measure the extent to which users believed that using Metaverse platforms would lead to performance improvements or other beneficial outcomes. The items were adapted to specifically address the benefits perceived in the context of Metaverse use, such as enhanced productivity or enriched virtual experiences. The EE scale was also sourced from [30]. This scale measured the perceived ease of use of Metaverse platforms, with items reflecting how simple and straightforward users found the technology. Adaptations ensured that the items captured the ease of navigating and interacting within the immersive environments of the Metaverse, which may pose different challenges compared to more conventional technologies.

The SI scale, another key component from [30], assessed the degree to which users felt social pressure or encouragement from important others to adopt Metaverse platforms. This scale was adapted to include items that reflected the influence of peers, family, and colleagues within virtual communities, where social dynamics play a crucial role in technology adoption decisions. The scale for RA was drawn from [31], which focused on measuring the perceived superiority of a new technology compared to existing solutions. The items in this scale were adapted to reflect the perceived benefits of Metaverse platforms, such as providing unique, immersive experiences and offering functionalities that surpass traditional digital platforms. The SC scale was adapted from [32], which provided a comprehensive measure of the perceived barriers to switching from one technology to another. This scale included items related to financial costs, time, effort, and psychological discomfort associated with transitioning to Metaverse platforms. The adaptation process ensured that these items were relevant to the specific challenges users might face when considering a switch to the Metaverse. The scale for IU, adopted from [30], included items that measured users' likelihood of adopting and consistently using Metaverse platforms. These items were tailored to reflect the intention to engage with the Metaverse, both in terms of initial adoption and long-term usage, within the Indonesian context. To ensure clarity and transparency in the measurement process, a detailed table of the questionnaire items was included, in Table 1. This table presented the specific items used to measure each variable, along with their corresponding sources.

Table 1. Item Questionnaire

Variable	Item	Questionnaire	References
PE	PE1	I find metaverse useful in my daily life.	[30]
	PE2	Using metaverse helps me accomplish things more quickly.	
	PE3	Using metaverse increases my productivity.	
EE	EE1	Learning how to use metaverse is easy for me.	[30]
	EE2	My interaction with metaverse is clear and understandable.	
	EE3	I find metaverse easy to use.	
SI	SI1	People who are important to me think that I should use metaverse.	[30]
	SI2	People who influence my behavior think that I should use metaverse.	
	SI3	People whose opinions that I value prefer that I use metaverse.	
RA	RA1	increase in business opportunities	[31]
	RA2	enhancement in competitiveness	
	RA3	value added to customers	
SC	SC1	I believe there might be a monetary expense	[32]

Variable	Item	Questionnaire	References
		associated with using Metaverse platforms	
	SC2	I reckon using Metaverse platforms might consume time.	
	SC3	I suspect there could be non-financial costs when using Metaverse platforms.	
IU	IU1	I intend to continue using metaverse in the future.	[30]
	IU2	I will always try to use metaverse in my daily life.	
	IU3	I plan to continue to use metaverse frequently.	

Data Analysis

The data analysis process for this study was conducted using SmartPLS, a software application widely recognized for its ability to perform partial least squares structural equation modeling (PLS-SEM). The analysis began with data preparation, which included cleaning the dataset to address any missing values, outliers, or inconsistencies. This step ensured that the dataset was suitable for subsequent analysis, minimizing potential biases and inaccuracies. Once the data was prepared, the next step involved model estimation, where the measurement and structural models were specified and estimated simultaneously. This approach allowed for the assessment of both the relationships between observed variables and their respective latent constructs, as well as the relationships among the latent constructs themselves. During model estimation, bootstrapping was employed to generate standard errors and confidence intervals, which were necessary for hypothesis testing. The bootstrapping procedure involved creating a large number of subsamples from the original dataset and estimating the model for each subsample. This method provided robust estimates of the path coefficients and allowed for the evaluation of the statistical significance of each hypothesized relationship. The final step in the data analysis process involved evaluating the measurement and structural models to determine the reliability, validity, and overall fit of the model.

To ensure the reliability and validity of the constructs used in the study, the measurement model was evaluated through a series of tests. Reliability was assessed using Cronbach's alpha and composite reliability, both of which measured the internal consistency of the items within each construct. Cronbach's alpha values greater than 0.70 were considered acceptable, indicating that the items reliably measured the underlying construct. Composite reliability was also calculated, with values above 0.70 indicating that the constructs were adequately measured by their respective indicators. In addition to reliability, the validity of the constructs was assessed through convergent and discriminant validity tests. Convergent validity was evaluated by examining the average variance extracted (AVE) for each construct, with AVE values greater than 0.50 indicating that a significant portion of the variance in the indicators was explained by the construct. Discriminant validity was assessed using the Fornell-Larcker criterion, which involved comparing the square root of the AVE of each construct with the correlations between the constructs. Discriminant validity was established when the square root of the AVE for a construct was greater than its correlations with other constructs, confirming that the constructs were distinct from one another. The structural model was evaluated to determine the strength and significance of the hypothesized relationships among the constructs. Path coefficients were calculated for each hypothesized relationship, representing the direct effects of one construct on another within the model. These coefficients were analyzed for their statistical significance using t-values obtained from the bootstrapping procedure. A t-value greater than 1.96 indicated that the path coefficient was significant at the 0.05 level, supporting the corresponding hypothesis. In addition to path coefficients, the overall fit of the structural model was assessed using several model fit indices. The coefficient of determination (R^2) was calculated for each endogenous construct, indicating the proportion of variance explained by the exogenous constructs in the model. Higher R^2 values suggested a better fit of the model to the data.

Result and Discussion

Descriptive Statistics

The demographic characteristics of the sample are summarized in Table 2. The age distribution of the respondents reveals a predominant representation of younger individuals, with the majority falling within the 18-24 years age group. Specifically, 38.50% (139 respondents) belong to this age bracket. The 25-34 years group comprises 21.33% (77 respondents), while the 35-44 years group accounts for 20.50% (74 respondents). Notably, the 45+ years category represents 19.67% (71 respondents) of the total sample. This distribution suggests that the study predominantly captures the perspectives of younger individuals, which aligns with the general trend of higher engagement with digital platforms and technologies among younger demographics. However, the inclusion of older respondents (45+ years) at nearly 20% provides a balanced view, allowing for insights across a broader age spectrum. The gender distribution indicates a male-dominated sample, with 65.37% (236 respondents) identifying as male, compared to 34.63% (125 respondents) identifying as female. This disparity may reflect the gender dynamics in technology usage and engagement within the population studied, where men may have a higher inclination towards technology and digital platforms. The significant representation of female respondents, however, ensures that gender-specific insights can still be gleaned, contributing to a more nuanced understanding of the research variables. In terms of education level, the majority of respondents (42.11%, or 152 respondents) hold a Bachelor’s Degree, followed by 35.46% (128 respondents) who have completed High School or an equivalent qualification. Those with a Master’s Degree or higher comprise 22.44% (81 respondents). This distribution suggests that the sample is relatively well-educated, with a significant portion of respondents possessing higher education qualifications. The predominance of respondents with at least a Bachelor’s Degree is indicative of the educational attainment associated with the use of advanced digital technologies like Metaverse platforms.

Table 2. Demographic Data

Demographic Characteristic	Category	Frequency	Percentage (%)
Age	18-24 years	139	38.50%
	25-34 years	77	21.33%
	35-44 years	74	20.50%
	45+ years	71	19.67%

Demographic Characteristic	Category	Frequency	Percentage (%)
Gender	Female	125	34.63%
	Male	236	65.37%
Education Level	High School or equivalent	128	35.46%
	Bachelor’s Degree	152	42.11%
	Master’s Degree or higher	81	22.44%
Internet Usage	Less than 1 hour	66	18.28%
	1-3 hours	72	19.94%
	4-6 hours	78	21.61%
	7-9 hours	76	21.05%
	10 hours or more	69	19.11%

The data on daily internet usage reveals a diverse range of engagement levels among respondents. A considerable proportion of the sample (21.61%, or 78 respondents) spends 4-6 hours online daily, closely followed by those who use the internet for 7-9 hours (21.05%, or 76 respondents). Notably, 19.11% (69 respondents) report using the internet for 10 hours or more each day, reflecting a high level of digital engagement. Conversely, 19.94% (72 respondents) spend 1-3 hours online, while 18.28% (66 respondents) use the internet for less than 1 hour per day. This distribution indicates that the sample is generally composed of active internet users, with a significant portion of respondents being highly engaged online, which is critical for studying the adoption and use of Metaverse platforms. The descriptive statistics provide valuable insights into the demographic and behavioral characteristics of the sample population. The predominance of younger respondents, particularly those aged 18-24 years, suggests that the study is likely to capture trends and behaviors prevalent among digital natives, who are typically early adopters of emerging technologies like the Metaverse. The gender distribution, while skewed towards males, still includes a substantial proportion of female respondents, allowing for gender-based analysis and comparisons. The high level of education among respondents, particularly the large proportion holding Bachelor’s Degrees, suggests that the sample is well-positioned to engage with complex digital environments. This is further supported by the data on internet usage, where a significant number of respondents are spending considerable time online, making them likely candidates for exploring and adopting new digital platforms such as the Metaverse.

In this study, the assessment of multicollinearity among the variables was a critical step to ensure the reliability of the regression coefficients in the structural equation modeling. Multicollinearity occurs when two or more independent variables in a model are highly correlated, which can lead to instability in the estimated coefficients and reduce the interpretability of the model. To evaluate the presence of multicollinearity, the Variance Inflation Factor (VIF) was calculated for each path in the model, shown in Table 3. The VIF is a measure that quantifies how much the variance of an estimated regression coefficient increases due to collinearity. A VIF value above 10 is typically considered problematic, indicating a high degree of multicollinearity, while values between 5 and 10 suggest moderate multicollinearity.

Table 3. Inner Variance Inflation Factor (VIF) Results

Path	VIF Value
SI → IU	4.111
PE → IU	4.943
PE → SC	4.098
EE → SC	4.098
SC → IU	4.121
RA → IU	4.247

The results of the VIF analysis for each hypothesized relationship are as follows. The VIF for the path from SI to IU was 4.111. This value is well below the critical threshold of 10, indicating that multicollinearity is not a significant issue for this relationship. The influence of social factors on the intention to use Metaverse platforms can thus be interpreted with confidence, as the relationship is not confounded by excessive collinearity. The VIF for the path from PE to IU was 4.943. Like the previous path, this value suggests a low to moderate level of multicollinearity. The performance-related expectations users have regarding Metaverse platforms appear to be a distinct and independent predictor of their intention to adopt these platforms. The VIF for the path from PE to SC was 4.098. This result indicates a low level of multicollinearity, supporting the notion that PE is a unique factor influencing perceived SC. Users' expectations of the platform's performance do not overlap significantly with other predictors of SC. The VIF for the path from EE to SC was also 4.098. This suggests that EE is a distinct factor affecting SC, with minimal multicollinearity. The ease with which users expect to use Metaverse platforms independently influences their perceived cost of switching from current technologies. The VIF for the path from SC to IU was 4.121. This value indicates that the relationship between SC and the IU Metaverse platforms is not heavily influenced by multicollinearity. The negative impact of perceived SC on adoption intentions can therefore be interpreted reliably. The VIF for the path from RA to IU was 4.247. This result suggests a low to moderate level of multicollinearity, confirming that RA is an independent predictor of users' intentions to adopt Metaverse platforms. The perceived benefits of the Metaverse over existing alternatives drive adoption decisions without significant overlap with other variables.

Measurement Model Evaluation

The evaluation of the measurement model was conducted to ensure the reliability and validity of the constructs used in this study. Reliability was assessed using Cronbach's alpha and composite reliability, while validity was evaluated through convergent validity, measured by AVE, shown in Table 4, and discriminant validity, assessed using cross-loadings and the Fornell-Larcker criterion, shown in Table 5. Cronbach's alpha and composite reliability are widely used metrics to assess the internal consistency of a construct. In this study, Cronbach's alpha values ranged from 0.582 to 0.665, which are slightly below the commonly accepted threshold of 0.7. Despite being lower than ideal, these values are acceptable for exploratory research, where new constructs or scales are being tested. Composite reliability values, on the other hand, ranged from 0.782 to 0.818, all of which are above the 0.7 threshold, indicating that the constructs exhibit adequate internal consistency. This suggests that, overall, the constructs are reliable, albeit with some room for improvement in terms of internal consistency. Convergent validity was assessed using the AVE values, which indicate the amount of variance captured by the construct in relation to the variance due to measurement error. The AVE values for the constructs in this study ranged from 0.900 to 0.940, all of which exceed the recommended threshold of 0.5. These high AVE values indicate that the constructs have good convergent validity, meaning that the indicators are well-correlated and effectively measure the same underlying construct.

Table 4. Reliability Analysis and Convergent Validity

Construct	Item	Factor Loading	Cronbach's Alpha	Composite Reliability	AVE
EE	EE1	0.837	0.665	0.818	0.91
	EE2	0.78			
	EE3	0.8			
IU	IU1	0.819	0.616	0.796	0.94
	IU2	0.737			
	IU3	0.792			
PE	PE1	0.821	0.623	0.799	0.94
	PE2	0.756			
	PE3	0.781			
RA	RA1	0.81	0.582	0.782	0.9
	RA2	0.726			
	RA3	0.769			
SC	SC1	0.833	0.642	0.807	0.93
	SC2	0.743			
	SC3	0.807			
SI	SI1	0.803	0.634	0.803	0.91
	SI2	0.752			
	SI3	0.816			

Discriminant validity was evaluated using the Fornell-Larcker criterion, which compares the square root of the AVE for each construct with the correlations between that construct and others in the model. The results indicated that for most constructs, the square root of the AVE was greater than the correlations with other constructs, suggesting good discriminant validity. For example, the square root of the AVE for EE (0.954) was higher than its correlations with other constructs, such as IU (0.914) and PE (0.897). Similarly, the square root of the AVE for IU (0.970) exceeded its correlations with other constructs, such as PE (0.968) and SI (0.949). These findings confirm that the constructs are distinct from each other and measure different concepts within the model. However, it is noteworthy that some constructs, particularly SI and IU, showed high correlations with each other (0.949), which approached the square root of the AVE values. While these values still indicate acceptable discriminant validity, the high correlations suggest that these constructs may be related or overlapping to some extent. This overlap should be considered when interpreting the results, as it may influence the strength and significance of the relationships observed in the structural model.

Table 5. Discriminant Validity

Construct	EE	IU	PE	RA	SC	SI
EE	0.954	0.914	0.897	0.872	-0.953	0.850
IU	0.914	0.970	0.968	0.947	-0.963	0.949
PE	0.897	0.968	0.970	0.944	-0.937	0.917
RA	0.872	0.947	0.944	0.949	-0.912	0.901
SC	-0.953	-0.963	-0.937	-0.912	0.964	-0.896
SI	0.850	0.949	0.917	0.901	-0.896	0.954

The measurement model demonstrated good reliability and validity, with all constructs showing adequate composite reliability and AVE values. The discriminant validity analysis, using the Fornell-Larcker criterion, supported the distinctiveness of the constructs, despite some high correlations. These results provide a solid foundation for the structural model analysis, allowing for confident interpretation of the relationships between the variables in the model.

Hypothesis Testing Results

The hypothesis testing results provided critical insights into the relationships between the constructs in the model, specifically focusing on the adoption of Metaverse platforms in Indonesia. Each hypothesis was tested using path coefficients, T-statistics, and P-values to determine the significance and strength of the relationships.

H1: SI → IU

The first hypothesis (H1) proposed that SI positively affects the IU Metaverse platforms. The path coefficient for this relationship was 0.279, with a T-statistic of 7.701 and a P-value of 0.000. These results indicate that the relationship is both strong and highly significant, supporting the hypothesis. SI, therefore, plays a crucial role in shaping users' intentions to adopt Metaverse platforms, suggesting that the opinions and behaviors of peers and social networks significantly influence the decision to engage with this emerging technology.

H2: PE → IU

The second hypothesis (H2) posited that PE would have a positive effect on the IU Metaverse platforms. The path coefficient was found to be 0.269, with a T-statistic of 4.595 and a P-value of 0.000, confirming the hypothesis. This result highlights the importance of users' expectations regarding the effectiveness and utility of Metaverse platforms in driving their intention to use them. When users believe that the platform will meet their performance needs, they are more likely to adopt it.

H3: PE → SC

Hypothesis three (H3) examined the relationship between PE and SC, suggesting that higher PE would reduce perceived SC. The path coefficient for this relationship was -0.422, with a T-statistic of 7.963 and a P-value of 0.000, providing strong evidence in support of the hypothesis. This negative relationship indicates that as users perceive the Metaverse platform to perform well, the cost (in terms of effort, time, and resources) of switching from other platforms decreases.

H4: EE → SC

The fourth hypothesis (H4) suggested that EE negatively affects SC. The analysis showed a path coefficient of -0.575, with a T-statistic of 11.084 and a P-value of 0.000, strongly supporting the hypothesis. This significant negative relationship underscores the importance of ease of use in reducing the barriers to switching platforms. When users find the Metaverse platform easy to use, their perceived costs of transitioning from other technologies decrease, making them more inclined to adopt the new platform.

H5: SC → IU

Hypothesis five (H5) explored the impact of SC on the IU Metaverse platforms. The path coefficient was -0.35, with a T-statistic of 7.143 and a P-value of 0.000, indicating a strong negative relationship. This finding suggests that higher perceived SC discourage users from adopting Metaverse platforms. When users perceive the transition to be costly, their likelihood of using the new platform decreases, highlighting the need for minimizing these costs to encourage adoption.

H6: RA → IU

The final hypothesis (H6) posited that RA positively influences the IU Metaverse platforms. The analysis revealed a path coefficient of 0.122, with a T-statistic of 3.016 and a P-value of 0.003, which supports the hypothesis. Although the relationship is statistically significant, the effect size is smaller compared to other factors, indicating that while the perceived benefits of Metaverse platforms over existing alternatives do influence adoption decisions, they are not the most critical factor.

Summary of Inner Model Results

The inner model results demonstrated that all hypothesized paths were statistically significant, confirming the proposed relationships between the constructs as shown in Table 6. The significance levels, as indicated by the T-statistics and P-values, were well above the required thresholds, providing strong evidence for the model's predictive validity.

Table 6. Inner Model Results (Summary)

Hypothesis	Path	Coefficient Path	T Statistics	P Values	Supported
H1	SI → IU	0.279	7.701	0.000	Yes
H2	PE → IU	0.269	4.595	0.000	Yes

Hypothesis	Path	Coefficient Path	T Statistics	P Values	Supported
H3	PE → SC	-0.422	7.963	0.000	Yes
H4	EE → SC	-0.575	11.084	0.000	Yes
H5	SC → IU	-0.35	7.143	0.000	Yes
H6	RA → IU	0.122	3.016	0.003	Yes

The structural model analysis was visually represented in the Inner Model Results Framework, shown in Figure 2, highlighting the significant paths and the relationships between the constructs. This figure illustrated the strength and direction of each path, providing a clear overview of how the variables interacted within the model.

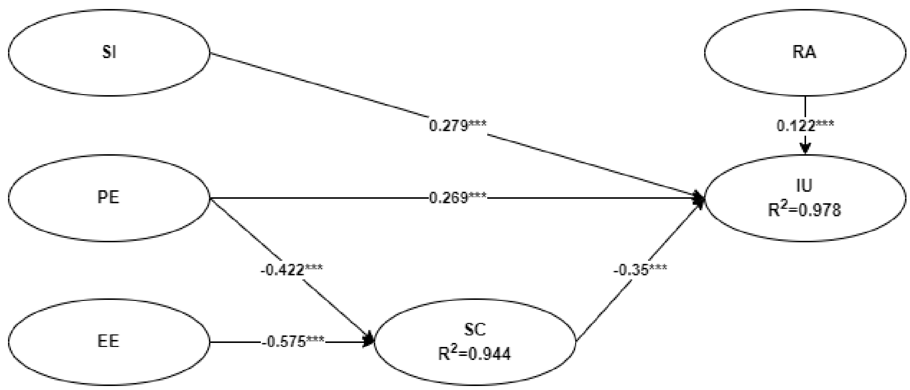

Figure 2 **Inner Model Result Framework**

Testing for Mediating Effects

The mediating effects of SC on the relationships between PE and IU, as well as EE and IU, were examined using the Sobel test, as shown in Table 7. The Sobel test is a statistical method used to determine whether a mediator variable significantly carries the influence of an independent variable to a dependent variable, thereby validating the mediation effect. The Sobel test for the mediation path from PE to IU through SC yielded a test statistic of 2.590. This value is greater than the critical value of 1.96, indicating that the mediation effect is significant at the 0.05 level. This result suggests that SC play a meaningful mediating role in the relationship between PE and IU. Specifically, as users perceive higher performance from the Metaverse platforms, the perceived SC decrease, which in turn positively influences their intention to adopt these platforms. The significant mediation effect highlights the importance of reducing perceived SC to enhance the adoption of Metaverse platforms, particularly when users have high performance expectations. For the mediation path from EE to IU through SC, the Sobel test produced a test statistic of 3.944. This value also exceeds the threshold of 1.96, confirming that the mediation effect is significant at the 0.05 level. This finding indicates that SC significantly mediate the relationship between EE and IU. The results imply that when users perceive the Metaverse platforms as easy to use, the perceived costs associated with switching from other technologies are lower, which in turn increases their likelihood of adopting these platforms. The strong mediating role of SC suggests that user-friendly design and minimizing the effort required to transition to the Metaverse are crucial for encouraging adoption.

Table 7. Mediation Testing Results

Construct	Construct Relationship	t-value of Path Coefficient	Sobel test
PE → SC → IU	PE → SC	7.963	2.590
	SC → IU	7.143	
EE → SC → IU	EE → SC	11.084	3.944
	SC → IU	7.143	

The results of the Sobel tests for both mediation paths underscore the critical role of SC as a mediator in the adoption of Metaverse platforms in Indonesia. These findings suggest that merely improving performance expectations or reducing EE may not be sufficient to drive adoption. Instead, the perceived costs associated with switching must also be addressed to fully realize the potential of these factors in influencing user intentions. The significant mediation effects highlight the need for strategies that simultaneously enhance performance and ease of use while reducing the perceived barriers to switching. For practitioners and developers, this may involve offering incentives, providing comprehensive onboarding processes, or ensuring compatibility with existing technologies to lower the perceived costs of switching. By addressing these mediating factors, the adoption of Metaverse platforms can be more effectively promoted, particularly in markets like Indonesia, where users may be more sensitive to the challenges associated with transitioning to new technologies.

Discussion

The findings from this study provide a deeper understanding of the factors influencing the adoption of Metaverse platforms in Indonesia, specifically through the lens of PE, EE, SI, RA, and SC. These results largely align with the existing literature, while also offering new insights into the unique dynamics present in the Indonesian context. The significant positive impact of PE on the IU Metaverse platforms supports the findings of previous studies, such as those by [27] and [14], which identified PE as a critical determinant of technology adoption. The path coefficient for PE → IU (0.269) confirms that users are more likely to adopt Metaverse platforms when they perceive them as beneficial and capable of enhancing their performance in various tasks. This aligns with the broader literature, which emphasizes that users' expectations of performance gains are crucial in driving adoption decisions. However, this study also reveals that the impact of PE may vary depending on specific contexts within Indonesia, echoing [13] assertion that the relevance and applicability of Metaverse technology in particular domains—such as work, education, or entertainment—can influence the strength of PE's effect on behavioral intention. EE was found to negatively impact SC and indirectly influence the IU Metaverse platforms. The strong negative path coefficient (EE → SC = -0.575) suggests that users who perceive the Metaverse as easy to use are less likely to view the transition from existing technologies as burdensome. This finding aligns with [17], which highlighted the importance of ease of use in technology adoption. Additionally, Farhi (2024) emphasized that perceived effort significantly affects the overall user experience within the Metaverse, reinforcing the need for user-friendly designs to reduce cognitive and physical barriers to engagement. This study contributes to the existing literature by demonstrating that reducing the perceived effort associated with using Metaverse platforms not only enhances user experience but also lowers the perceived costs of switching, thereby facilitating adoption.

SI also emerged as a significant predictor of the IU Metaverse platforms, with a path coefficient of 0.279, corroborating the findings of [23] and [16], who identified the critical role of social dynamics in technology adoption. In the Indonesian context, where communal and social interactions are deeply ingrained in daily life, the influence of peers, family, and colleagues on technology adoption decisions is particularly pronounced. This study further supports the notion that leveraging social networks and community endorsements can significantly enhance the adoption of Metaverse platforms, especially among younger users who are more susceptible to peer influence, as noted by [17]. The relatively smaller yet significant impact of RA on the IU Metaverse platforms (RA → IU = 0.122) suggests that while users recognize the benefits of Metaverse platforms over traditional technologies, these benefits alone may not be the primary driver of adoption. This finding contrasts slightly with [26] emphasis on the importance of perceived benefits in driving technology adoption but aligns with [14] observation that the advantages of Metaverse platforms must be clearly communicated and aligned with user needs to be persuasive. The lower impact of RA in this study may be attributed to the nascent stage of Metaverse technology in Indonesia, where users are still exploring its potential benefits. This indicates that as Metaverse platforms become more established and their advantages more apparent, RA could play a more substantial role in influencing adoption. The significant negative impact of SC on the IU Metaverse platforms (SC → IU = -0.35) reinforces the notion that high SC are a substantial barrier to technology adoption, as documented by [28] and [29]. This study highlights the importance of addressing these costs, particularly in emerging markets like Indonesia, where users may be more risk-averse or reluctant to abandon familiar technologies. The findings suggest that minimizing financial, time, and effort-related barriers is crucial for promoting the adoption of Metaverse platforms. Furthermore, the strong negative relationship between PE and SC (PE → SC = -0.422) suggests that as users perceive the Metaverse to be more effective and beneficial, the perceived costs of switching diminish, further supporting the adoption process.

The results of this study align with much of the existing literature, particularly regarding the importance of PE, EE, and SI in technology adoption. However, the findings also contribute new insights, particularly in the Indonesian context, where SC play a significant role in shaping adoption decisions. The lower impact of RA on the IU Metaverse platforms suggests that more work is needed to effectively communicate the unique benefits of these platforms to users. This study underscores the importance of a holistic approach to promoting Metaverse adoption, one that considers not only the perceived benefits but also the barriers and social dynamics influencing user decisions. For theory, this study extends the UTAUT by incorporating SC as a mediating variable, offering a more comprehensive understanding of technology adoption in emerging markets. Practically, the findings suggest that developers and marketers of Metaverse platforms in Indonesia should focus on reducing perceived SC, enhancing the ease of use, and leveraging social networks to drive adoption.

Additionally, as the Metaverse becomes more established, emphasizing its relative advantages will become increasingly important in persuading users to transition from traditional technologies.

Despite the significant findings and contributions of this study, several limitations should be acknowledged. Firstly, the cross-sectional design of the study limits the ability to establish causality between the variables. While the structural equation modeling (SEM) approach allows for the testing of hypothesized relationships, the data were collected at a single point in time, which means that the observed associations may not reflect causal relationships. Longitudinal studies would be needed to track changes over time and provide more robust evidence of causality. Secondly, the study relied on self-reported data, which can be subject to biases such as social desirability bias or recall bias. Participants may have overestimated or underestimated their intentions to use Metaverse platforms or their perceptions of SC, EE, and other factors. Future research could benefit from incorporating objective measures or behavioral data to complement self-reported responses.

Thirdly, the sample was drawn from a specific population within Indonesia, which may limit the generalizability of the findings. While the sample was diverse in terms of age, education, and occupation, it may not fully represent the broader Indonesian population or users in other cultural or geographical contexts. Consequently, the results may not be entirely applicable to other regions or countries with different socio-cultural dynamics. Expanding the study to include a more diverse or international sample could enhance the generalizability of the findings. Additionally, the study focused on a limited set of variables (PE, EE, SI, RA, SC, IU), which, while grounded in existing literature, may not capture all the relevant factors influencing Metaverse adoption. Other variables, such as perceived risk, technological anxiety, or trust in the technology, were not included but could be significant in shaping users' adoption decisions. Future studies could explore these additional factors to provide a more comprehensive understanding of the drivers and barriers to Metaverse adoption. Finally, the rapidly evolving nature of Metaverse technology presents a challenge in terms of the study's relevance over time. As Metaverse platforms continue to develop and become more integrated into daily life, user perceptions and behaviors may change, potentially altering the relationships observed in this study. Continuous research is needed to monitor these changes and update the findings accordingly. These limitations should be considered when interpreting the results of the study. Despite these constraints, the study provides valuable insights into the factors influencing the adoption of Metaverse platforms in Indonesia and contributes to the broader literature on technology adoption.

Conclusion

This study aimed to explore the factors influencing the adoption of Metaverse platforms in Indonesia, focusing on the role of PE, EE, SI, RA, and SC. Using a Structural Equation Modeling (SEM) approach, the study provided a comprehensive analysis of the relationships between these variables and their impact on users' intention to adopt Metaverse platforms. The results confirmed that PE, EE, SI, and RA significantly influence the IU Metaverse platforms, with SI and PE emerging as particularly strong predictors. These findings align with existing literature, underscoring the importance of perceived performance benefits and social dynamics in technology adoption. The study also highlighted the crucial role of SC as a mediating factor, revealing that reducing perceived effort and switching barriers can significantly enhance users' willingness to transition to Metaverse platforms. Despite these insights, the study acknowledged several limitations, including the cross-sectional design, reliance on self-reported data, and the specific focus on an Indonesian population, which may limit the generalizability of the findings. Future research should consider longitudinal studies, incorporate more diverse samples, and explore additional variables such as perceived risk or technological anxiety to provide a more holistic understanding of Metaverse adoption. In conclusion, while this study has contributed valuable insights into the factors driving Metaverse adoption in Indonesia, it also points to the need for ongoing research to keep pace with the rapid evolution of this technology. Understanding these dynamics will be crucial for developers, marketers, and policymakers aiming to promote the adoption and integration of Metaverse platforms in various sectors.

Declarations

Author Contributions

Conceptualization: I.M.M.E.E.; Methodology: I.M.M.E.E.; Software: I.M.M.E.E.; Validation: I.M.M.E.E.; Formal Analysis: I.M.M.E.E.; Investigation: I.M.M.E.E.; Resources: I.M.M.E.E.; Data Curation: I.M.M.E.E.; Writing Original Draft Preparation: I.M.M.E.E.; Writing Review and Editing: I.M.M.E.E.; Visualization: I.M.M.E.E.; All authors have read and agreed to the published version of the manuscript.

Data Availability Statement

The data presented in this study are available on request from the corresponding author.

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Institutional Review Board Statement

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Informed Consent Statement

Not applicable.

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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