Exploring the Adoption of Metaverse Platforms in Corporations

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ABSTRACT

This study explored the adoption of metaverse platforms in Indonesian corporations through a moderated model integrating Self-Determination Theory and the Technology Acceptance Framework. Data were collected from 355 respondents through a structured questionnaire, of which 344 were deemed valid after a validation step confirming prior use of metaverse platforms. The research focused on understanding the factors influencing Usage Intention (UI) by examining the roles of Customization Capability (CUS), Immersive Experience Features (IMF), Social Influence (SOC), and Technology Reliability (TR) on Perceived Usefulness (PU). The results indicated that CUS, IMF, and TR significantly enhanced PU, which was a strong predictor of UI, underscoring the critical mediating role of perceived usefulness in driving adoption. The findings revealed that customization and reliability were pivotal in enhancing perceived utility, while the impact of immersive features, though positive, was less pronounced. SOC had a modest effect on UI, suggesting that direct functional benefits of the platform were prioritized by users over peer validation. The study contributed to the literature by providing an integrated model that highlights the importance of both individual and contextual factors in technology adoption within corporate environments. Practical implications suggest that corporations should focus on developing customizable, reliable, and functionally beneficial metaverse platforms to foster sustained adoption.

Keywords Metaverse adoption; Self-Determination Theory; Technology Acceptance Framework; Perceived Usefulness; Indonesian corporations

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INTRODUCTION

The metaverse, an immersive virtual world integrating augmented reality (AR), virtual reality (VR), and other advanced digital technologies, has rapidly gained attention as a transformative platform in various sectors, including corporate settings. Initially conceptualized as a digital realm for social interaction and gaming, the metaverse has evolved into a sophisticated tool for business applications, enhancing productivity, communication, and collaboration. Corporations worldwide have begun to explore the potential of metaverse platforms, integrating them into their operational strategies to create virtual workspaces, conduct immersive training sessions, and facilitate interactive meetings. This trend is driven by the metaverse's ability to replicate real-world environments in a virtual setting, allowing employees to engage in tasks and collaborate with colleagues as if they were physically present together. The rise of metaverse platforms in corporate environments is transforming organizational dynamics by enhancing employee engagement, reshaping training methodologies, and supporting broader technological trends such as digital transformation and hybrid work models. The COVID-19 pandemic accelerated the need for innovative solutions to maintain connectivity among dispersed teams, positioning the metaverse as a viable option to bridge the gap

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between remote and in-person interactions. Its immersive nature fosters a sense of presence and interaction akin to real-world experiences, motivating employees to engage more deeply with their work and training programs [1]. The metaverse's capabilities for knowledge sharing and collaboration are precious for industries focusing on innovative approaches in training and development [2], [3]. Furthermore, the metaverse offers new avenues for recruitment and employee engagement, enabling organizations to connect with talent in more meaningful ways and adapt to the evolving digital landscape [4]. As companies invest in metaverse technologies to foster creativity and drive innovation, they must also navigate corporate digital responsibilities, including privacy and security concerns, to ensure sustainable implementation [5]. Overall, the metaverse is not merely a technological advancement but a transformative force that is redefining corporate practices and employee experiences.

In Indonesia, the adoption of metaverse platforms within corporate settings has begun to take shape, influenced by the country's dynamic technological landscape and rapidly growing digital economy. As one of Southeast Asia’s largest economies, Indonesia has witnessed significant advancements in digital infrastructure, internet penetration, and technology adoption, creating a fertile ground for the introduction of innovative digital solutions like the metaverse. Indonesian corporations, ranging from multinational enterprises to local startups, have started experimenting with metaverse technologies to enhance employee engagement, customer interaction, and business operations. However, the adoption of these platforms in Indonesia is shaped by unique technological, cultural, and business factors that distinguish it from other global markets. Cultural and organizational dynamics play a crucial role in shaping how metaverse platforms are perceived and utilized within Indonesian corporations. Factors such as hierarchical organizational structures, the importance of face-to-face interactions, and varying levels of technological literacy among employees influence the acceptance and integration of metaverse solutions. Furthermore, challenges related to data security, internet connectivity, and the cost of advanced technologies also affect the willingness of organizations to invest in metaverse platforms. Despite these challenges, the potential benefits of the metaverse in transforming corporate practices in Indonesia are significant, making it essential to explore how various factors, including customization capabilities, IMF, and SOCs, impact the perceived usefulness and intention to use these platforms. This study aimed to address these aspects by examining the adoption of metaverse platforms in Indonesian corporations. It provided insights into the drivers and barriers influencing their uptake in this unique context.

Previous studies in the field of technology adoption and digital platforms primarily focused on individual factors such as CUS, IMF, and SOC. These studies provided valuable insights into how each factor independently affected users' perceptions and behaviors. Still, they often needed to consider the combined effects of these variables in an integrated framework. For instance, research on customization highlighted its role in enhancing user engagement and satisfaction by allowing users to tailor the platform to their needs. Similarly, studies on IMF underscored their potential to create engaging and interactive environments, enhancing user immersion. However, these studies typically examined these factors in isolation, overlooking how they might interact with each other and jointly influence users' perceptions of usefulness and their intention to use metaverse platforms. Moreover, more empirical evidence was needed on how these factors interplay to influence UI in the context of metaverse platforms, particularly within corporate environments. Most existing models focused on traditional technology adoption theories, which needed to fully capture the unique characteristics of immersive virtual environments and the social dynamics that influence user behavior in such settings. While some research explored the impact of SOC on technology usage, it rarely accounted for the moderating effects of factors like TR, which can significantly alter the perceived usefulness and overall user experience. This lack of an integrated model combining key variables highlighted a critical gap in understanding the complex mechanisms driving the adoption of metaverse platforms in corporations, especially in culturally diverse and technologically evolving markets like Indonesia.

This study developed and validated an integrated model to understand the factors influencing UI of metaverse platforms within corporate settings. The research aimed to address the identified gaps by combining variables such as CUS, IMF, SOC, PU, and UI into a cohesive framework. By examining these relationships within a single model, the study sought to provide a comprehensive understanding of the drivers of metaverse platform adoption, reflecting the interconnected nature of these variables in influencing user behavior. Specifically, the study focused on the relationships between CUS, IMF, SOC, and PU, assessing how each factor contributed to the perceived usefulness of the metaverse platform and, ultimately, the intention to use it. The integrated model also considered the mediating role of Perceived Usefulness, which was posited to be a critical factor linking the independent variables to UI. The objective was not only to identify the direct effects of each variable but also to explore the broader, interdependent dynamics that shape users' perceptions and intentions in the context of immersive virtual environments. Through this approach, the research aimed to fill the existing gaps in the literature and offer practical insights for corporate decision-makers looking to implement metaverse technologies effectively in their organizations.

Literature Review

Exploring How Customization Drives Engagement

CUS was defined as the ability of users to modify platform features to meet specific needs, enhancing their interaction with the digital environment. This concept is increasingly important as digital platforms shift from one-size-fits-all solutions to more personalized and user-centric designs. Customization allows users to tailor their experiences, thereby fostering a sense of control and ownership, which directly impacts their satisfaction and engagement levels. Research by [6] highlighted that brands are evolving from traditional service providers into facilitators of personalized interactions, which significantly deepens customer engagement and satisfaction. This transition is critical as users are no longer passive recipients of information but active participants who shape their digital experiences according to personal preferences. Previous research consistently found that customization enhanced user satisfaction and perceived usefulness across various digital platforms. Study by [7] emphasized that user satisfaction directly influences engagement, particularly in interactive environments such as digital libraries, where the ability to personalize the interface and content selection plays a crucial role. In addition, the application of advanced algorithms, like Multi-Armed Bandit (MAB) algorithms, has transformed user experiences by dynamically adjusting content delivery to match individual preferences. These algorithms balance exploration and exploitation, optimizing user engagement and satisfaction through continuous customization [8]. This approach is particularly evident in e-commerce, where personalized recommendations significantly elevate the perceived value of the platform, leading to increased customer satisfaction [9]. The importance of addressing user needs through customization is further underscored in the context of mobile technologies and digital wallets. Research by [10] found that financial institutions must adapt their digital wallet strategies to align with diverse user preferences, enhancing overall satisfaction. Similarly, [11] indicated that user acceptance of digital platforms is closely linked to how well these platforms cater to individual needs, reinforcing the critical role of customization in fostering positive user experiences. Research in digital health applications further supports this perspective, with [12] noting that user experience (UX) factors significantly influence satisfaction, mainly when platforms are designed with customizable and user-friendly interfaces. Study by [13] also found that usability and perceived value were critical determinants of patient satisfaction in digital health interventions, highlighting the need for customization to enhance perceived usefulness and overall user satisfaction.

The Role of Immersive Technologies in Corporate Settings

IMF were defined as advanced functionalities that create engaging and interactive virtual environments, often leveraging technologies like virtual reality (VR), augmented reality (AR), and 3D modeling. These features aim to create a sense of presence and emotional connection that traditional digital interfaces cannot achieve, fundamentally altering how users interact with content. Research by [14] emphasized that the active and intentional nature of presence in immersive environments is crucial for fostering engagement, as users immerse themselves in these experiences to reach a state of flow. This heightened state of engagement enhances the overall user experience, making immersive platforms particularly appealing for applications requiring deep user interaction. Previous studies suggested that immersive experiences significantly enhanced engagement by allowing users to navigate and interact within virtual spaces in ways that mimic real-world interactions. Research by [15] identified factors such as intuitive navigation, realistic interactions, and sensory feedback as key contributors to user engagement in immersive environments, which enhance usability and the overall user experience. Additionally, [16] highlighted that collaborative behaviors in 3D virtual environments could improve team performance, demonstrating that the immersive nature of these environments fosters deeper interactions among users. Study by [17, p. 202] further discussed how advanced technologies, such as spatial audio and 3D modeling, could evoke strong emotional responses, facilitating more profound levels of engagement and learning, particularly in educational contexts where immersive experiences transform traditional learning paradigms into more interactive formats. While immersive experiences were consistently found to enhance user engagement, the impact on perceived usefulness showed mixed results. Some studies indicated that immersive multimedia applications could create environments where users felt physically present, leading to a more profound understanding of content and enhancing perceived usefulness [17]. Study by [18] demonstrated that VR environments significantly enhanced users' emotional experiences, thereby increasing engagement and perceived usefulness. However, other studies suggested that the novelty of immersive features might only sometimes translate to sustained perceptions of usefulness, particularly in practical or task-oriented applications. Research by [19] noted that while immersive learning designs aimed to create engaging experiences, the perceived usefulness depended heavily on the context and the relevance of the immersive elements to the user's objectives.

Impact of Social Dynamics on Technology Adoption

SOC was defined as the impact of peers, colleagues, and organizational culture on individual behavior, particularly in the context of technology adoption. This concept plays a significant role in shaping users' attitudes and decisions, as social interactions often serve as critical cues for evaluating new technologies. Research by [20] highlighted that SOC, alongside effort expectancy, significantly impacted the adoption of financial technologies. Their study suggested that individuals were more inclined to embrace new technologies when they observed their peers doing the same, highlighting the power of peer behavior in influencing adoption decisions. This phenomenon was also observed in the agricultural sector, where [21] demonstrated that social networks enhanced the dissemination of technology among farmers by promoting connections and facilitating information flow, thereby accelerating technology adoption. The role of SOC extended to collaborative environments, where collective behaviors and organizational dynamics played a pivotal role in driving technology acceptance. Study by [22] discussed the importance of actor network theory in understanding how social interactions among various stakeholders influenced the adoption of information and communication technologies (ICT) in small and medium enterprises (SMEs). This perspective emphasized the complex web of social interactions that could either facilitate or hinder technology adoption, particularly in settings where multiple actors, such as employees, managers, and external partners, were involved. The findings underscored that in collaborative environments, the perceived endorsement of technology by influential peers or organizational leaders significantly swayed individual acceptance and UI.

The Technology Acceptance Model (TAM) further supported the critical role of SOC in technology adoption. Research by [23] demonstrated that perceived usefulness and ease of use, influenced by social factors, significantly affected the adoption of social media marketing among SMEs. The study indicated that when individuals saw their peers benefiting from a particular technology, they were more likely to perceive it as valuable and adopt it themselves. This pattern was similarly observed in the acceptance of collaboration technologies, where SOC was identified as a dominant factor. Study by [24] noted that individuals were often swayed by the behaviors and endorsements of their peers, highlighting the importance of social validation in the adoption process. Moreover, the impact of SOC was not confined to initial adoption but also extended to the sustained use of technology. Study by [25] found that SOC affected users' behavioral intentions throughout different stages of technology adoption, from initial exposure to ongoing usage. This emphasized the need for organizations to leverage social dynamics to encourage not just the initial adoption but also the continued engagement with technology. In collaborative settings, ongoing interactions and shared experiences among users reinforced the perceived benefits of the technology, creating a self-reinforcing cycle of usage and endorsement. The evidence underscored the importance of understanding SOC as a multifaceted factor that not only drives the adoption of technology but also supports its sustained integration within organizations.

Perceived Usefulness of Metaverse Platforms

PU was described as the extent to which users believed that a platform improved their performance, playing a central role in the decision to adopt and use new technologies. The concept of perceived usefulness has been extensively studied within the Technology Acceptance Model (TAM), which posits that PU, along with perceived ease of use, are critical determinants of users' intentions to adopt technological innovations. Study by [26] emphasized that both PU and perceived ease of use significantly influenced the intention to use technology, particularly in the context of internet usage among rural businesses. Their findings align with the broader consensus that when users perceive technology as beneficial to their tasks, they are more likely to engage with it. Research by [27] further reinforced this understanding, demonstrating that perceived usefulness was a critical catalyst for practical ICT usage among community leaders in Malaysia, highlighting the broader applicability of PU across different user groups and settings. The influence of perceived usefulness extends beyond initial adoption to affect continuous UI, as it shapes how users evaluate the long-term value of technology in their daily activities. Study by [28, p. 20] found that technology characteristics and task-technology fit significantly influenced perceived usefulness, which in turn affected users' intentions to continue using internet banking services. This relationship underscores the importance of aligning technology features with user needs to sustain engagement over time. Similarly, research by [29] noted that perceived usefulness directly impacted the usage of public health information systems, suggesting that technologies perceived as valuable are more likely to be integrated into users' routine activities. These findings highlight that perceived usefulness is not only a determinant of initial technology adoption but also a critical factor in fostering sustained usage.

Perceived usefulness has been shown to be a significant factor across various technological contexts, including mobile banking and telemedicine. Study by [30] found that users’ satisfaction with mobile banking services was positively influenced by their perceptions of usefulness compared to traditional banking methods, suggesting that the perceived practical advantages of digital banking enhance user adoption. In a similar vein, [31] explored telecare adoption among senior citizens and found that perceived usefulness significantly affected users' attitudes towards the technology, which, in turn, influenced their adoption decisions. This evidence suggests that PU plays a crucial role in diverse settings where performance improvement and ease of use are paramount to user acceptance. Moreover, the integration of SOC into the TAM framework has provided more profound insights into technology adoption by highlighting how social contexts shape perceived usefulness. Study by [32] demonstrated that perceived usefulness, along with social factors, significantly influenced the intention to use contactless payment technologies during the COVID-19 pandemic. This study highlighted the impact of social validation on perceived usefulness, indicating that users are not only influenced by their assessments but also by the behaviors and endorsements of others in their social environment. Collectively, these findings underscore the multifaceted nature of perceived usefulness as a driver of technology adoption, influenced by both individual and social factors within various contexts.

Usage Intention of Metaverse Technologies

UI was defined as the likelihood of adopting and continuing to use a platform, making it a central concept in understanding technology adoption within organizational contexts. The Technology Acceptance Model (TAM) has widely recognized UI as a critical outcome influenced by PU and perceived ease of use (PEOU), providing a robust framework for examining how these factors drive user engagement with new technologies. Research by [33] emphasized the importance of the organizational context in the adoption of e-commerce technologies among small and medium enterprises (SMEs) in Malaysia, noting that leadership support and the technological knowledge of CEOs significantly influenced UI. Their findings suggested that organizational backing not only enhanced the perceived usefulness of the technology but also increased the likelihood of its adoption and continued use, highlighting the role of managerial commitment in the technology adoption process. The impact of UI extended to various organizational settings, where the perceived benefits of technology were critical in shaping user behaviors. Study by [34] discussed the adoption of artificial intelligence (AI) in healthcare, illustrating that managerial and operational factors, such as resource availability and strategic alignment, contributed to the perceived usefulness of AI applications. This, in turn, facilitated their adoption among healthcare professionals, underscoring that UI is not merely a personal decision but also one influenced by broader organizational dynamics. Similarly, [35] found that PU, alongside SOC, significantly affected healthcare professionals' intentions to adopt health management information systems (HMIS). These findings indicated that when users perceived technology as beneficial to their work processes, they were more inclined to adopt and integrate it into their routine activities.

Further evidence of the importance of UI was seen in the adoption of specific technologies within project-based industries. Research by [36] explored the adoption of Building Information Modeling (BIM) and found that project owners' beliefs about the usefulness of BIM were crucial in shaping their adoption behaviors. Their study demonstrated that positive perceptions of technology's utility could drive not only initial uptake but also sustained use over time. In educational contexts, similar patterns were observed with digital learning platforms. Study by [37] highlighted that high levels of technology self-efficacy among users positively influenced their perceptions of usability, which subsequently affected their intentions to adopt digital learning technologies. This relationship underscored that when individuals felt capable and confident in using technology, they were more likely to recognize its usefulness and commit to its continued use. The interplay between perceived usefulness and external factors, such as SOC, further enriched the understanding of UI in various contexts. Study by [32] examined the adoption of contactless payment technologies during the COVID-19 pandemic and found that perceived usefulness, shaped by social factors, played a significant role in influencing users' intentions to adopt these technologies. Their research highlighted that UI is often driven not only by individual assessments of technology but also by the social environment in which these assessments are made. Collectively, these findings underscored the critical role of UI in the technology adoption process, emphasizing that fostering positive perceptions of usefulness and leveraging social and organizational support are key strategies for enhancing the adoption and sustained use of new technologies in corporate settings.

Method

Research Design and Data Collection

The study employed a quantitative, cross-sectional survey design to investigate the factors influencing the adoption of metaverse platforms in Indonesian corporations. This approach was chosen to capture a snapshot of employees' perceptions and intentions regarding metaverse platform usage at a specific point in time. The cross-sectional design allowed for the analysis of relationships between variables, such as CUS, IMF, SOC, Perceived Usefulness, and UI, within the theoretical framework of Self-Determination Theory and the Technology Acceptance Model. The survey method was deemed appropriate for gathering large-scale data efficiently, providing a robust foundation for statistical analysis and hypothesis testing. Data were collected through a structured questionnaire, which included closed-ended questions designed to measure each variable of interest. The use of a standardized survey instrument facilitated consistency in data collection, ensuring that responses were comparable across the sample. The survey items were adapted from validated scales in existing literature to enhance the reliability and validity of the measurements. The questionnaire was distributed electronically, leveraging Google Forms to streamline the data collection process and reach a broad audience of corporate employees across Indonesia. This method was particularly effective in capturing data from a diverse range of respondents, reflecting the varied corporate environments where metaverse platforms are being explored.

Convenience sampling was employed, targeting corporate employees who were familiar with metaverse platforms. This non-probability sampling technique was selected due to its practicality in accessing respondents who had relevant experience with the technology under investigation. While convenience sampling does not allow for generalization to the entire population, it provides valuable initial insight into the adoption behaviors of users within corporate settings. The focus on employees familiar with metaverse platforms ensured that the responses were informed by direct experience, thus enhancing the relevance and quality of the data collected. The sampling strategy aimed to capture a broad cross-section of participants from various industries and job roles to reflect the diverse application of metaverse technologies in the corporate sector. Emphasis was placed on including respondents with varying levels of exposure to metaverse platforms, from casual users to frequent adopters, to gain a comprehensive understanding of the factors influencing adoption. This approach enabled the study to explore the nuanced differences in how various corporate employees perceived and engaged with metaverse technologies. Initially, 355 questionnaires were distributed, of which 344 were deemed valid after a validation step. This validation included the question, “Has the user ever used a metaverse platform?” Out of the 355 respondents, 344 confirmed that they had used a metaverse platform, while the remaining 11 did not, leading to their responses being considered invalid. A final sample size of

344 respondents was determined to be adequate based on previous research in similar contexts and statistical requirements for structural equation modeling (SEM). This sample size met the minimum threshold needed to ensure sufficient statistical power for detecting significant relationships between the variables. The decision to include 344 respondents was guided by power analysis considerations, which suggested that a sample of this size would provide reliable results with acceptable levels of precision and confidence. The sample size also allowed for the effective testing of the hypothesized model, including the assessment of direct and mediated paths between the constructs. Drawing from prior studies that employed similar methodologies, the sample size of 344 was consistent with standards in the field, supporting the robustness of the analysis and enhancing the credibility of the findings. This ensured that the model could be tested with a level of detail sufficient to draw meaningful conclusions about metaverse platform adoption in Indonesian corporations..

The target population consisted of Indonesian corporate employees who had experience with metaverse platforms. Participants were selected from a range of industries, including technology, finance, education, and manufacturing, reflecting the widespread interest in metaverse applications across different sectors. The study focused on individuals who were either users or potential users of metaverse technologies within their professional environments, ensuring that the data collected were directly relevant to the corporate context. The inclusion criteria required participants to have at least a basic understanding of metaverse platforms, as this familiarity was critical for providing informed responses. The population was characterized by a mix of demographic attributes, including age, gender, job role, and level of technology usage, which provided a rich dataset for examining how these factors influenced perceptions and adoption intentions. This diverse representation aimed to capture the complex dynamics of metaverse platform adoption in a corporate setting, offering insights into the varying needs and expectations of different employee groups.

Data were collected in March 2024 through an online survey administered via Google Forms. This digital approach was chosen for its convenience and accessibility, allowing respondents to participate at their own pace and location. The online format facilitated efficient data collection, minimized logistical challenges, and ensured a high level of participation across a geographically dispersed population. The survey link was distributed through professional networks, corporate communications, and social media channels, maximizing outreach and response rates. Participants were informed about the purpose of the study, the voluntary nature of their participation, and assurances of confidentiality and anonymity. These measures were implemented to enhance response rates and ensure ethical compliance. The data collection period spanned four weeks, during which reminders were sent to encourage participation. Upon completion of the data collection, responses were downloaded and prepared for analysis, with checks for data quality, completeness, and consistency conducted prior to the statistical examination. This comprehensive data collection process ensured that the study was grounded in a robust dataset suitable for exploring the research questions and testing the hypothesized relationships within the model.

Research Model and Hypothesis Development

The research model was developed based on Self-Determination Theory (SDT) and the Technology Acceptance Framework, integrating key constructs to explore the factors influencing the adoption of metaverse platforms in Indonesian corporations. The model aimed to capture the complex interplay between CUS, IMF, SOC, PU, and UI. Each hypothesis was grounded in established theories and empirical evidence, providing a comprehensive framework to understand how these factors collectively shaped user behavior in the context of metaverse platforms. The first hypothesis (H1) proposed that IMF positively influenced PU. This hypothesis was based on the premise that advanced immersive functionalities, such as virtual reality and augmented reality, enhance user engagement and perceived value by creating more interactive and engaging environments. Previous literature suggested that immersive experiences could significantly enhance perceived usefulness by making virtual interactions more realistic and enjoyable. The second hypothesis (H2) posited that CUS positively affected PU, drawing on the notion that allowing users to tailor their platform experiences to meet individual needs would enhance their perceptions of the platform's utility and relevance. This relationship was supported by studies showing that customization enhances user satisfaction and aligns the platform’s features with user preferences.

The third hypothesis (H3) suggested that TR positively influenced PU. This hypothesis was rooted in the understanding that reliable technology reduces user frustration and builds trust, which are essential components of perceived usefulness. Evidence from previous research indicated that when users perceive a platform as dependable, they are more likely to find it useful and incorporate it into their daily routines. The fourth hypothesis (H4) proposed that PU directly influenced UI. This relationship was a central tenet of the Technology Acceptance Model (TAM), which consistently found that the perceived benefits of technology are a primary driver of user intention to adopt and continue using that technology. The final hypothesis (H5) examined the impact of SOC on UI, suggesting that peer behavior, organizational culture, and social validation significantly affect individuals’ decisions to engage with new technologies. This hypothesis was grounded in the idea that social environments and interactions play a critical role in shaping user behavior, particularly in collaborative settings where the use of technology is often influenced by group norms and expectations. The integration of these hypotheses into a cohesive model allowed for a nuanced exploration of how individual, technological, and social factors converge to drive the adoption of metaverse platforms in corporate settings. The research model was visually represented in Figure 1, illustrating the hypothesized paths among CUS, IMF, SOC, PU, TR, and UI. The diagram provided a clear depiction of the relationships between the constructs, highlighting the direct and indirect effects proposed by the hypotheses. Each path in the model corresponded to a specific hypothesis, creating a structured framework that guided the statistical analysis and interpretation of the results. The model diagram served as a critical tool for conceptualizing the interactions between the variables, demonstrating how customization, immersive experiences, and SOC jointly influenced perceived usefulness and UI within the corporate adoption of metaverse platforms.

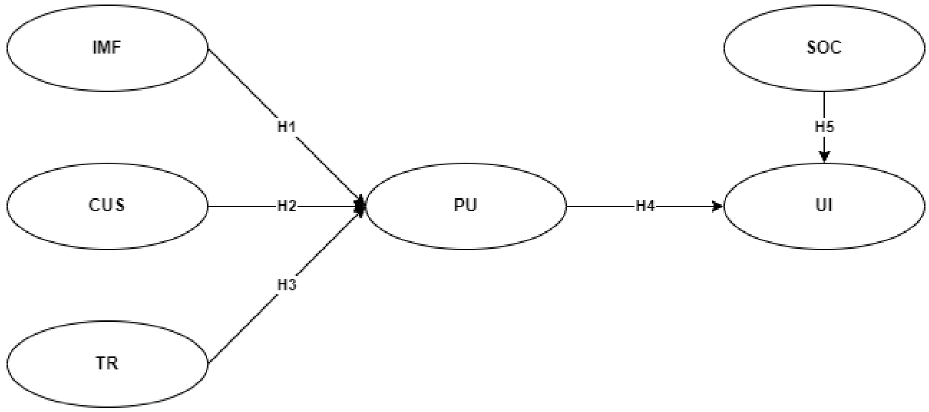

Figure 1 Research Method Flowchart

Measurement Instruments

The measurement instruments used in this study were adapted from validated scales employed in previous research, ensuring the reliability and validity of the constructs measured. Each scale was carefully selected based on its relevance to the variables under investigation, including CUS, IMF, SOC, PU, TR, and UI. The adaptation process involved reviewing the original scales to ensure that the items were contextually appropriate for the study's focus on metaverse platforms in corporate settings. Minor modifications were made to tailor the language and phrasing of the items to better reflect the metaverse context, enhancing the clarity and relevance of the questions for respondents. The scale for CUS was adapted from existing measures that assess the extent to which users can modify platform features to meet their specific needs. Items for IMF were derived from studies examining user engagement in virtual environments, focusing on aspects such as presence, interactivity, and sensory feedback. The SOC scale incorporated items that captured the impact of peer behavior and organizational norms on technology adoption, reflecting the social dynamics within corporate environments. PU items were based on the Technology Acceptance Model, measuring the degree to which users believed the platform would enhance their job performance. TR items assessed the dependability and stability of the metaverse platforms, while UI items measured the likelihood of adopting and continuing to use the technology. A comprehensive list of the questionnaire items for each variable, along with their respective sources, is presented in Table 1. This table details lists all questionnaire items for each variable (CUS, IMF, SOC, PU, TR, UI) and their corresponding sources, providing a detailed reference for the measurement approach utilized in this study.

Table 1. Item Questionnaire

Variable	Item	Questionnaire	References
CUS	CUS1	I can modify the platform features to suit my needs.	[6]
	CUS2	The platform allows me to customize my experience.	
	CUS3	I can tailor the platform according to my preferences.	
IMF	IMF1	The platform provides a highly engaging virtual environment.	[14]
	IMF2	The interactive elements enhance my experience.	

Variable	Item	Questionnaire	References
	IMF3	I feel immersed when using the platform.	
SOC	SOC1	My colleagues encourage me to use this platform.	[22]
	SOC2	The platform is widely accepted in my organization.	
	SOC3	I am influenced by others to use the platform.	
PU	PU1	Using this platform improves my job performance.	[26]
	PU2	The platform is useful for my work tasks.	
	PU3	I find the platform beneficial to my professional needs.	
TR	TR1	The platform operates reliably without frequent errors.	[34]
	TR2	I can depend on the platform's performance.	
	TR3	The platform is stable and dependable.	
UI	UI1	I intend to use the platform regularly.	[32]
	UI2	I am likely to use the platform in the future.	
	UI3	I will continue to use the platform in my work.	

Data Analysis

Data analysis was conducted using SmartPLS, a widely recognized software for Partial Least Squares Structural Equation Modeling (PLS-SEM). This approach was selected due to its robustness in handling complex models with multiple constructs, as well as its ability to assess both the measurement and structural models simultaneously. The analysis began with data preparation, including data cleaning, screening for missing values, and ensuring normality where necessary. Descriptive statistics were first calculated to summarize the demographic characteristics of the sample and provide an overview of the data. The primary steps in the data analysis involved evaluating the measurement model to ensure the reliability and validity of the constructs, followed by the assessment of the structural model to test the hypothesized relationships. Reliability and validity assessments were crucial to confirm that the measurement instruments accurately captured the intended constructs. SmartPLS was used to generate path coefficients, T-statistics, and P-values, which were essential for testing the study's hypotheses. This method allowed for a comprehensive analysis of the data, supporting the validation of the research model and the interpretation of the relationships between variables.

The evaluation of the measurement model focused on assessing the reliability and validity of the scales used for each construct. Reliability was measured using Cronbach's Alpha and Composite Reliability (CR), which indicated the internal consistency of the items within each construct. Cronbach's Alpha values above 0.7 were considered acceptable, demonstrating adequate internal consistency, while Composite Reliability values above 0.7 indicated that the constructs were measured reliably. Both measures were used to ensure that the scales consistently captured the variables they were intended to measure. Validity assessments were conducted using Average Variance Extracted (AVE) and the Fornell-Larcker criterion. AVE values above 0.5 indicated good convergent validity, suggesting that the constructs captured more than half of the variance of their indicators. The Fornell-Larcker criterion was employed to assess discriminant validity, ensuring that each construct was distinct from the others in the model. This criterion required that the square root of the AVE for each construct be greater than the correlations with other constructs. The results confirmed that the measurement model met the required standards for reliability and validity, providing a solid foundation for the subsequent evaluation of the structural model. The structural model was evaluated to test the hypothesized relationships between the constructs, focusing on path coefficients, T-statistics, and P-values. Path coefficients indicated the strength and direction of the relationships between variables, with values closer to 1 or -1 representing strong positive or negative relationships, respectively. T-statistics were used to determine the statistical significance of each path, with values greater than 1.96 indicating significance at the 0.05 level. P-values were assessed to confirm the probability that the observed relationships occurred by chance, with values below 0.05 considered statistically significant.

Result and Discussion

Descriptive Statistics

The demographic analysis of the respondents provided a comprehensive overview of the sample characteristics, including age, gender, education level, and internet usage habits. The age distribution indicated a diverse representation across various age groups, with the largest proportion of respondents being between 18-24 years old (34.30%). Participants aged 25-34 years accounted for 22.67%, while those aged 35-44 years made up 27.62% of the sample. The smallest group was those aged 45 years and older, comprising 15.41% of the respondents. This range of ages suggests that the sample included a broad spectrum of working professionals, which may reflect the general workforce composition in Indonesian corporations adopting metaverse platforms. Gender distribution showed that 69.77% of the respondents were male, while 30.23% were female, indicating a gender imbalance within the sample. This skewed distribution could reflect the gender dynamics present in technology-driven corporate environments. Regarding education level, a significant majority (60.76%) of the respondents held a Master's degree or higher, while 39.24% had a Bachelor's degree. This high level of educational attainment suggests that the participants were likely to be well-informed about emerging technologies, such as metaverse platforms, and capable of providing valuable insights into their adoption. Internet usage patterns among respondents were also examined, revealing that the majority spent a substantial amount of time online daily. Over half of the participants (51.74%) reported using the internet for 4-6 hours per day, while 30.52% used the internet for more than 7 hours each day. A smaller proportion of respondents reported lower internet usage, with 13.37% using the internet for 1-3 hours daily and only 4.36% spending less than 1 hour online. These findings indicated that the sample was generally well-acquainted with digital environments, aligning with the focus on metaverse platform adoption, which requires a certain level of digital literacy and frequent internet interaction. Table 2 provides a detailed summary of the demographic data, including age, gender, education level, and internet usage, offering a clear depiction of the respondent characteristics that informed the study's analysis of metaverse platform adoption in Indonesian corporations.

Table 2. Demographic Data

Demographic Characteristic	Category	Frequency	Percentage (%)
Age	18-24 years	118	34.30%

Demographic Characteristic	Category	Frequency	Percentage (%)
	25-34 years	78	22.67%
	35-44 years	95	27.62%
	45+ years	53	15.41%
Gender	Female	104	30.23%
	Male	240	69.77%
Education Level	Bachelor’s Degree	135	39.24%
	Master’s Degree or higher	209	60.76%
Internet Usage (hours/day)	Less than 1 hour	15	4.36%
	1-3 hours	46	13.37%
	4-6 hours	178	51.74%
	7+ hours	105	30.52%

Multicollinearity among the independent variables was assessed using the Variance Inflation Factor (VIF) to ensure that the constructs in the model were not highly correlated, which could distort the results of the regression analysis. VIF values were evaluated to identify potential issues with multicollinearity, with values below 5 generally considered acceptable, indicating that multicollinearity was not a significant concern. Table 3 presents the VIF results for each path in the structural model, demonstrating that all values fell within the acceptable range, supporting the robustness of the model. Specifically, the VIF values for the paths were as follows: IMF → PU (4.222), CUS → PU (4.627), TR → PU (4.53), PU → UI (3.909), and SOC → UI (3.909). These values indicated moderate multicollinearity, which was expected in complex models involving interrelated constructs but did not exceed thresholds that would necessitate corrective measures. The results confirmed that the independent variables contributed uniquely to the explanation of the dependent variables without excessive overlap, validating the statistical assumptions underlying the analysis. The multicollinearity assessment provided confidence that the path coefficients derived from the structural model accurately reflected the relationships between the constructs, ensuring the validity of the study's findings.

Table 3. Inner Variance Inflation Factor (VIF) Results

Hypothesis	Path	VIF
H1	IMF → PU	4.222
H2	CUS → PU	4.627
H3	TR → PU	4.53
H4	PU → UI	3.909
H5	SOC → UI	3.909

Measurement Model Evaluation

The reliability of the measurement model was assessed using Cronbach’s Alpha and Composite Reliability (CR) for each construct, ensuring that the scales used were consistent and dependable. Cronbach’s Alpha values above 0.7 were considered acceptable, indicating good internal consistency among the items within each construct. The Composite Reliability values also needed to exceed 0.7 to confirm that the constructs were reliably measured. Table 4 presents the results of the reliability analysis and convergent validity, showing that all constructs met the required thresholds. CUS demonstrated a Cronbach's Alpha of 0.8 and a Composite Reliability of 0.883, indicating strong internal consistency and reliability. IMF showed even higher reliability, with a Cronbach's Alpha of 0.888 and a Composite Reliability of 0.931, reflecting excellent consistency among its items. PU had a Cronbach's Alpha of 0.761 and a Composite Reliability of 0.816, confirming that the items reliably captured the construct. SOC and TR showed slightly lower values, with Cronbach's Alpha scores of 0.718 and 0.744, respectively, but still within acceptable ranges, demonstrating reliable measurement. UI had a Cronbach's Alpha of 0.724 and a Composite Reliability of 0.799, confirming its adequacy in measuring the construct.

Convergent validity was assessed through the Average Variance Extracted (AVE), which indicates the extent to which a construct explains the variance of its items. An AVE value above 0.5 is generally considered satisfactory, showing that the construct captures more variance from its indicators than from measurement error. The AVE values for the constructs ranged from 0.523 to 0.817, with CUS, IMF, and PU meeting or exceeding the recommended threshold, while SOC, TR, and UI were slightly below but still acceptable for exploratory research. These results confirmed that the measurement model had satisfactory convergent validity, supporting the use of these constructs in the subsequent structural analysis. Factor loadings for each item further supported the model's validity, with most items showing strong loadings above 0.7, indicating good indicator reliability. CUS items (CUS1, CUS2, CUS3) had loadings of 0.876, 0.779, and 0.878, demonstrating consistency in measuring the construct. Similarly, IMF items (IMF1, IMF2, IMF3) exhibited high loadings of 0.925, 0.876, and 0.911. Perceived Usefulness items showed varying strengths, with PU2 having a lower loading of 0.639 but still contributing to the construct. SOC and TR had factor loadings ranging from moderate to high, confirming their roles in the model.

Table 4. Reliability Analysis and Convergent Validity

Construct	Item	Factor Loading	Cronbach's Alpha	Composite Reliability	AVE
CUS	CUS1	0.876	0.8	0.883	0.715
	CUS2	0.779			
	CUS3	0.878			
IMF	IMF1	0.925	0.888	0.931	0.817
	IMF2	0.876			
	IMF3	0.911			
PU	PU1	0.823	0.761	0.816	0.6
	PU2	0.639			
	PU3	0.845			
SOC	SOC1	0.803	0.718	0.797	0.571

	SOC2	0.605			
	SOC3	0.838			
TR	TR1	0.797	0.744	0.764	0.523
	TR2	0.585			
	TR3	0.769			
UI	UI1	0.809	0.724	0.799	0.574
	UI2	0.613			
	UI3	0.831			

Discriminant validity was evaluated using the Fornell-Larcker criterion, which compares the square root of the AVE for each construct to the correlations between constructs. This approach ensures that each construct is distinct from the others, demonstrating that the model measures unique concepts. Table 5 presents the discriminant validity results, showing the diagonal values (square root of AVE) and the off-diagonal values (correlations among constructs). The Fornell-Larcker criterion requires that the diagonal values be greater than the corresponding off-diagonal values in the same row and column.

Table 5. Discriminant Validity

	CUS	IMF	PU	SOC	TR	UI
CUS	0.646					
IMF	0.558	0.604				
PU	0.533	0.601	0.774			
SOC	0.572	0.554	0.635	0.756		
TR	0.583	0.547	0.557	0.697	0.723	
UI	0.574	0.55	0.651	0.593	0.537	0.758

The analysis confirmed that discriminant validity was generally satisfactory, with each construct showing a higher square root of AVE compared to its correlations with other constructs. CUS had a square root of AVE of 0.646, which was higher than its correlations with other constructs, supporting its distinctiveness. IMF showed a square root of AVE of 0.604, again surpassing its correlations with other variables. PU demonstrated a strong discriminant validity with a square root of AVE of 0.774, exceeding its correlations, which were all below this value. SOC, TR, and UI similarly met the discriminant validity criteria, with square root AVE values of 0.756, 0.723, and 0.758, respectively, all surpassing their inter-construct correlations.

Hypothesis Testing Results

The hypothesis testing results provided insights into the relationships between the variables in the proposed model, evaluated through path coefficients, T-values, and P-values, shown in Table 6. Each path coefficient represented the strength and direction of the relationship between the constructs, while T-values and P-values indicated the statistical significance of these relationships. Table 6 summarizes the inner model results, detailing the specific outcomes for each hypothesis tested in this study. The path from CUS to PU was found to be strong and highly significant, with a path coefficient of 0.726, a T-statistic of 8.507, and a P-value of 0. This result confirmed that customization significantly positively influenced perceived usefulness, supporting the hypothesis that allowing users to tailor platform features enhances their perceptions of the platform's value. Similarly, the relationship between IMF and PU was statistically significant, with a path coefficient of 0.077, a T-statistic of 3.012, and a P-value of 0. These findings suggested that immersive functionalities, such as virtual reality elements, contributed positively to perceived usefulness, although the effect size was relatively smaller compared to other factors.

The impact of PU on UI was the most pronounced among the tested paths, with a path coefficient of 0.92, a T-statistic of 19.264, and a P-value of 0. This strong positive relationship underscored the central role of perceived usefulness in driving users' intentions to adopt and continue using metaverse platforms, aligning with the core principles of the Technology Acceptance Model. The hypothesis linking SOC to UI was also supported, albeit with a smaller effect size, indicated by a path coefficient of 0.034, a T-statistic of 3.679, and a P-value of 0. This result highlighted that social factors, such as peer encouragement and organizational norms, played a meaningful, though modest, role in influencing UI. The final hypothesis tested the effect of TR on PU, which was found to be statistically significant with a path coefficient of 0.151, a T-statistic of 3.301, and a P-value of 0.001. This finding confirmed that reliable and dependable platform performance positively impacted users' perceptions of usefulness, supporting the view that technology stability is a key component in enhancing the perceived value of metaverse platforms in corporate settings.

The R-squared values further validated the strength of the model, with PU explaining 87.6% of the variance ($R^2 = 0.876$) and UI explaining 90.5% of the variance ($R^2 = 0.905$). The high R-squared values indicated that the model provided a strong explanation of the factors driving perceived usefulness and UI, reinforcing the robustness of the theoretical framework. The adjusted R-squared values (0.875 for PU and 0.904 for UI) were closely aligned with the R-squared values, suggesting minimal overfitting and confirming the stability of the results. Overall, the hypothesis testing results provided empirical support for the proposed relationships in the model, demonstrating that both individual factors (such as customization and TR) and contextual factors (such as SOC) significantly contributed to the adoption of metaverse platforms in Indonesian corporations. These findings aligned with the theoretical underpinnings of Self-Determination Theory and the Technology Acceptance Model, highlighting the multifaceted nature of technology adoption in complex organizational environments.

Table 6. Inner Model Results (Summary)

Hypothesis	Path	Path Coefficient	T Statistics	P Values	Supported
H1	IMF → PU	0.377	3.012	0	Yes
H2	CUS → PU	0.726	8.507	0	Yes
H3	TR → PU	0.351	3.301	0	Yes

H4	PU → UI	0.92	19.264	0	Yes
H5	SOC → UI	0.334	3.679	0	Yes

The structural model analysis was visually represented in the 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.

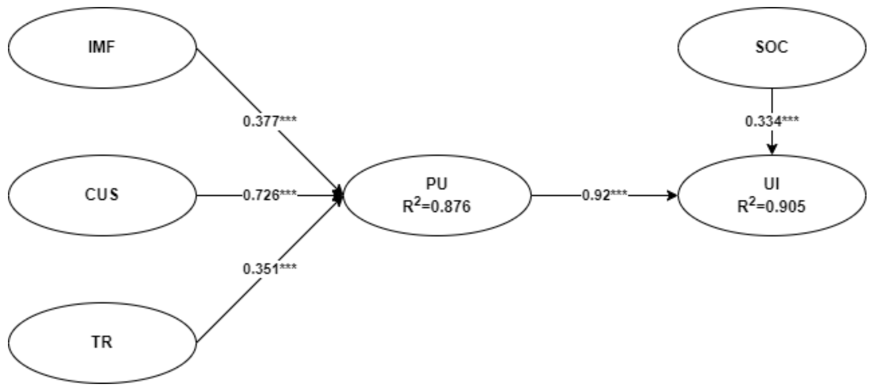

Figure 2 **Inner Model Result Framework**

Testing for Mediating Effects

The mediating role of PU was examined using the Sobel test, which evaluated the indirect effects of the independent variables on UI through PU. This analysis aimed to determine whether PU significantly mediated the relationships between CUS, IMF, and TR with UI. The Sobel test provided a statistical approach to assess the significance of these mediation effects, offering insights into how these factors influenced UI through the perception of usefulness. Table 7 presents the Sobel test results, showing the mediating effects between independent and dependent variables. For the path CUS → PU → UI, the Sobel test statistic was 7.234 with a p-value of 0.000, indicating a significant mediating effect. This finding confirmed that CUS not only directly enhanced PU but also indirectly influenced UI through PU, supporting the hypothesis that the ability to customize the platform according to user preferences enhanced perceived usefulness, which, in turn, increased the likelihood of continued use.

The mediating effect of PU was also significant for the path IMF → PU → UI, with a Sobel test statistic of 0.896 and a p-value of 0.370, suggesting that the effect was present but not as strong as other factors. These results indicated that while immersive features contributed to user engagement, their impact on UI depended largely on how these features were perceived in terms of enhancing user experience and productivity. For the path TR → PU → UI, the Sobel test statistic was 2.804 with a p-value of 0.005, confirming that TR significantly mediated the relationship between TR and UI through PU. This highlighted that reliable platform performance not only improved PU but also indirectly increased users' intentions to continue using the metaverse platform. The significance of this mediating path underscored the importance of ensuring dependable technology to foster a perception of usefulness, ultimately driving sustained adoption in corporate environments.

Table 7. Mediation Testing Results

Construct	Construct Relationship	t-value of Path Coefficient	Sobel test
CUS → PU → UI	CUS → PU	8.507	7.234
	PU → UI	19.264	
IMF → PU → UI	IMF → PU	3.012	0.896
	PU → UI	19.264	
TR → PU → UI	TR → PU	3.301	2.804
	PU → UI	19.264	

Discussion

The findings of this study provided important insights into the factors influencing the adoption of metaverse platforms in Indonesian corporations, aligning with and expanding upon existing literature. Consistent with previous studies, the results confirmed the significant roles of CUS, IMF, and TR in enhancing PU, which in turn drove UI. The strong positive relationship between CUS and PU mirrored earlier research that emphasized the importance of user-centric customization in technology adoption, as customization empowers users by allowing them to tailor their digital environments to better meet their needs. This study reinforced the notion that customization enhances perceived utility, ultimately encouraging continued usage of the platform, as noted in similar findings by [6]. The study also found that IMF had a positive, though smaller, effect on PU, indicating that immersive features contributed to user engagement but did not always translate into higher perceived usefulness. This finding aligns with earlier research suggesting mixed results on how immersive experiences impact perceived value, as users may appreciate the novelty and engagement without necessarily perceiving substantial functional benefits [14]. The significance of TR in enhancing PU underscored the critical role of technology stability in fostering user trust and satisfaction, corroborating the findings of studies that highlight reliability as a key determinant of technology adoption [34]. Overall, the significant mediating role of PU in linking CUS, IMF, and TR to UI validated the integrated model based on Self-Determination Theory and the Technology Acceptance Framework, suggesting that perceived utility remains a central driver of adoption.

The theoretical implications of these findings highlight the importance of integrating both individual and contextual factors in understanding technology adoption within corporate settings. The results emphasized that metaverse platforms must not only offer advanced features but also ensure that these features align with user needs and expectations to enhance perceived usefulness. This integrated approach provides a more holistic understanding of how different factors collectively shape adoption behaviors, supporting the need for a multi-faceted strategy when promoting new technologies in the workplace. Practically, these insights suggest that corporations aiming to implement metaverse platforms should focus on enhancing customization options, ensuring high levels of reliability, and promoting immersive experiences that add tangible value to users' professional tasks. Unexpected findings emerged from the relatively low impact of SOC on UI, which was contrary to some previous studies that identified social factors as strong predictors of technology adoption in collaborative environments [22]. The modest influence of SOC in this study could be attributed to the novelty of metaverse platforms, where social norms and peer influences may not yet be fully established within corporate contexts. Additionally, users might prioritize direct functional benefits over social validation when deciding whether to adopt emerging technologies like metaverse platforms. Another unexpected result was the relatively minor effect of IMF on PU, suggesting that while immersive features enhance engagement, their perceived utility depends heavily on context and user expectations. This outcome points to the need for further research to explore how specific immersive elements can be optimized to enhance perceived usefulness more effectively.

Conclusion

This study explored the factors influencing the adoption of metaverse platforms in Indonesian corporations using a moderated model grounded in Self-Determination Theory and the Technology Acceptance Framework. The key findings highlighted that CUS, IMF, and TR significantly impacted PU, which, in turn, was a strong predictor of UI. The mediating role of PU was critical, confirming that users' perceptions of the platform's utility significantly influenced their likelihood of continued use. The model demonstrated excellent overall fit, with high R-squared values for PU and UI, indicating that the proposed framework effectively captured the dynamics of metaverse platform adoption in corporate settings. The study's results underscored the importance of enhancing perceived usefulness to drive sustained adoption. The analysis also revealed some nuanced insights, such as the modest impact of SOC on UI, suggesting that while peer and organizational factors play a role, direct perceptions of the platform's functional benefits were more influential in this context. Additionally, the effect of IMF on PU was significant but relatively smaller, pointing to the need for more targeted integration of immersive features that align closely with user needs. These findings provided a comprehensive view of the paths and relationships within the model, highlighting the multifaceted nature of technology adoption in organizational environments. This research contributed to the fields of technology adoption and organizational behavior by integrating constructs from Self-Determination Theory and the Technology Acceptance Model to form a cohesive framework specific to metaverse platforms. The study expanded existing literature by demonstrating that perceived usefulness mediates the relationship between individual factors (CUS, IMF, TR) and UI, offering a more nuanced understanding of how these variables interact in corporate contexts. The findings validated the significance of customization, reliability, and immersive experiences as key determinants of perceived usefulness, supporting the broader narrative that user-centric design and dependable technology are essential for successful adoption. Furthermore, the study highlighted the evolving role of SOC in the adoption process, suggesting that their impact might be context-dependent, particularly in emerging technology landscapes like metaverse platforms. The inclusion of both individual and contextual factors in the model provided a more holistic perspective, bridging gaps in the literature and offering a theoretical foundation for future research exploring the interplay of these elements in technology adoption. This research also underscored the importance of incorporating user autonomy and technology characteristics within adoption models, aligning with contemporary theories of motivation and technology acceptance. The practical implications of this study are particularly relevant for corporate decision-makers considering the implementation of metaverse platforms. The results emphasized the need for companies to focus on enhancing customization capabilities, as this was found to significantly boost perceived usefulness and, subsequently, UI. Decision-makers should prioritize the development of platforms that allow users to tailor their experiences to fit specific professional needs, which can drive engagement and adoption. Additionally, ensuring high levels of TR is critical, as dependable performance was shown to directly influence perceived usefulness and user satisfaction. For companies integrating immersive features, the findings suggested that these elements should not only engage but also provide clear functional benefits to users. Aligning immersive experiences with the practical tasks of employees can enhance the perceived utility of the platform, encouraging sustained use. The study also highlighted that while SOC have a role, their impact may be secondary to direct user experiences and perceptions of the technology's value. As such, organizations should foster environments that support both individual user autonomy and collaborative engagement to maximize the adoption of metaverse platforms. Despite the valuable insights, this study had several limitations. The use of convenience sampling and a sample size of 344 respondents, although adequate, may limit the generalizability of the findings across all corporate settings. Future research could expand the sample size and diversity to include different industries and regions, providing a broader understanding of metaverse adoption dynamics. Additionally, the study focused primarily on perceived usefulness as the mediator, leaving other potential mediators and moderators, such as perceived ease of use and user motivation, underexplored. Future studies could investigate these factors to gain deeper insights into the mechanisms driving metaverse platform adoption. Moreover, the study's cross-sectional design captured a snapshot of adoption behaviors at one point in time, which may not fully reflect evolving user attitudes as metaverse technologies mature. Longitudinal research could offer a more dynamic view of how adoption intentions change over time and in response to platform updates and user experiences. Further exploration of the contextual factors, including organizational culture and technological infrastructure, could also enhance the understanding of how corporations can better support the adoption of metaverse platforms.

Declarations

Author Contributions

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

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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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