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TECHNOLOGY AWARENESS AND METAVERSE ADOPTION INTENTIONS: A MODERATED MEDIATION MODEL BASED ON THE THEORY OF PLANNED BEHAVIOR*

Research

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Technology Awareness and Metaverse Adoption Intentions: A Moderated Mediation Model Based on the Theory of Planned Behavior

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Abstract

This study explains the mechanism by which technology awareness shapes employees' intention to use metaverse technology. Applying the theory of planned behavior, this study also explains the mediating roles of attitude, subjective norms, and perceived behavioral control. It also uses perceived risk as a moderator that weakens all mediation effects. Data were collected through a cross-sectional survey of 384 employees in service organizations in Istanbul. For analysis, partial least squares structural equation modeling was performed using SmartPLS. The results show that technology awareness significantly affects employees' intention to use the metaverse through the three mediating variables. Moreover, perceived risk is a significant moderator of all mediating variables linking technology awareness to the intention to use metaverse technology. This empirical research not only contributes to the planned behavior literature but also provides practical insights for service organizations. It helps them realize the significance of technology awareness initiatives in the workplace and the need to mitigate perceived risks when operating within metaverse platforms.

Keywords: Technology awareness, metaverse, theory of planned behavior, perceived risk.

JEL Code: M15, M54, O33

Teknoloji Farkındalığı ve Metaverse Benimseme Niyeti Arasındaki İlişkinin İncelenmesi: Planlı Davranış Teorisine Dayalı Bir Düzenleyici Aracılık Modeli

Özet

Bu çalışma, teknoloji farkındalığının çalışanların metaverse teknolojisini kullanma niyetini nasıl şekillendirdiğini açıklayan işleyişi ele almaktadır. Planlanmış davranış teorisini esas alan bu çalışma, tutum, öznel normlar ve algılanan davranışsal kontrolün aracı rollerini de açıklamaktadır. Ayrıca, tüm aracı etkileri açıklamak için algılanan riski bir moderatör olarak ele almaktadır. Veri, İstanbul'da hizmet sektöründe faaliyet gösteren işletmelerde çalışan 384 kişinin katılımıyla gerçekleştirilen kesitsel bir anket çalışmasıyla toplanmış ve SmartPLS kullanılarak kısmi en küçük kareler yapısal eşitlik modellemesi tekniğiyle analiz edilmiştir. Sonuçlar, teknoloji farkındalığının üç aracı değişken aracılığıyla çalışanların metaverse kullanma niyetini önemli ölçüde etkilediğini göstermektedir. Dahası, algılanan risk, teknoloji farkındalığını metaverse teknolojisini kullanma niyetine bağlayan tüm aracı değişkenlerin önemli bir moderatörüdür. Bu görgül araştırma, planlanmış davranış literatürüne katkıda bulunmanın yanı sıra, hizmet sektöründe faaliyet gösteren işletmeler için pratik bilgiler de sağlamaktadır. Bu araştırma, iş yerinde teknoloji farkındalığı girişimlerinin önemini ve metaverse platformlarında faaliyet gösterirken algılanan riskleri azaltma ihtiyacının anlaşılmasına yardımcı olmaktadır.

Anahtar Kelimeler: Teknoloji farkındalığı, metaverse, planlı davranış teorisi, algılanan risk.

JEL Kodu: M15, M54, O33

Introduction

The world is changing. Technological advancement has transformed the way organizations operate in today's dynamic environment. It has given a new direction to every detail in the organization's operations, ultimately impacting shareholders' value. Within the realm of technological advancements, the metaverse is one of the most innovative, multi-layered, and inclusive technologies, combining a user's physical reality with their digital existence to create an immersive and interactive ecosystem. As part of the fourth industrial revolution, the metaverse has evolved primarily from gaming and entertainment. However, with its continuous transformation, its potential has expanded significantly for business organizations, employee performance, and customer engagement, adding value to all stakeholders (Jo, 2023; Koohang et al., 2023). Recognizing the significance and future potential of metaverse technology, organizations seek to understand how to successfully institutionalize it to enhance their overall performance (Chen, 2024; Kumar et al., 2024).

Being a multi-layer technology, the metaverse is a comprehensive platform for business organizations to streamline their operations (Chen, 2023; Hasani et al., 2024). At the same time, it's not straightforward when it comes to its adoption in the workplace. A business can introduce any emerging technology into its operations, but employee readiness to embrace it remains an important factor that cannot be ignored. Ultimately, it will be the people working in organizations who will use the new technology, such as the metaverse ecosystem. Therefore, understanding the deep psychological factors behind employees' intention to use new technologies, such as the metaverse ecosystem, is an aspect that cannot be ignored for their effective utilization (Heruatmadja & Ramadhan, 2023; Marabelli & Lirio, 2024).

Although the literature shows studies to understand metaverse adoption among students and customers (Chong et al., 2023; Alfaisal et al., 2024; Pillai et al., 2024), empirically understanding the employees' perspective on adopting it in the workplace is still under exploration (Šímová & Zychová, 2023; Hasani et al., 2024; Kumar et al., 2024). Compared with consumers and students, employees do not adopt metaverse technology purely on a voluntary basis; rather, they are inclined toward its use because of their work responsibilities, digital presence or collaboration requirements, or simply their organizational expectations (Kumar et al., 2024). This makes employees a theoretically

unique sample in terms of planned behavior, where the workplace environment may characterize employees' attitudes, subjective norms, and perceived behavioral control differently from other samples indicated earlier. Following the room for future research identified in the literature (Hasani et al., 2024; Venkatesh, 2025), this study investigates the factors that shape employees' intention to use metaverse technology, with a focus on organizations in the services sector. People employed in service organizations are highly influenced by their exposure to the latest technology, which is reflected through their communication and presentation while interacting with their colleagues and customers (Gursoy et al., 2023; Ooi et al., 2023). Moreover, to better understand intention towards metaverse usage, this study adopts the Theory of Planned Behavior (TPB) as its theoretical foundation.

The theory of planned behavior was introduced by Icek Ajzen, who presented a comprehensive framework for understanding how intention to behave in a particular way is shaped by one's attitude, subjective norms, and perceived behavioral control towards that behavior (Ajzen, 1985). In the context of metaverse adoption, these three fundamental aspects show how we feel, how we are influenced by others, and how we perceive our confidence in using a new technology like the metaverse. In particular, this study extends TPB by including technology awareness as an antecedent to its three core variables, which ultimately shape intentions (Raddatz et al., 2023; Albayati et al., 2023).

It is worth noting that, like any other technology, the metaverse is not without its uncertainties and risks (Kumar et al., 2023), which may shape the impact of technology awareness on metaverse adoption intentions, especially as it continues to evolve. The risk factors may include failure of expected performance or estimated benefits of the metaverse, as well as concerns about the platform being unsafe or insecure (Kumar et al., 2023; Al-Emran et al., 2024). Following this critical argument, this study presents perceived risk as a moderating variable that weakens the awareness-usage intention path, which was modeled alongside the mediation of three TPB variables. Bringing all these psychological factors together, this study contributes to the technology acceptance literature from a wider perspective by empirically applying it in the metaverse adoption context and introducing perceived risk as an important moderator of the TPB framework. Using the TPB in a workplace setting also contributes to its

explanatory strength by broadly infusing the employee-centric technology adoption literature into the context of services-sector organizations, unlike consumer-oriented settings, where adoption is voluntary (Kumar et al., 2024; Hasani et al., 2024). Moreover, this study also contributes to the corporate world by highlighting the importance of technology awareness and the impact of perceived risks on employees' performance, as companies compete in an era focused on virtual reality, artificial intelligence, and metaverse integration.

The remaining sections of this paper present the theoretical framework, as reflected in the discussion of past literature, for all variables in this study. After that comes the methodology section, which explains the study's research design. Next to the methods section is the findings section, which discusses the study's data analysis results. Lastly, the discussion and conclusion section provides an explanation of all the sections together, considers the results, and concludes with a discussion of limitations and future research.

Theoretical Framework

Metaverse

The metaverse refers to a persistent, dynamic, and multi-user virtual platform that bridges physical reality and the digital world, creating a unified, immersive experience. People create their avatars to represent themselves in the Metaverse. An avatar is your virtual body in the Metaverse. It is how you move, interact, and express yourself within this digital landscape (Chen, 2023; Zhu & Yi, 2024). Refer to Figure 1 for a few examples of avatars. By using their avatars, individuals interact and socialize with others, conduct economic transactions, and experience things that may not be possible in the real world (Kumar et al., 2024).



Figure 1. Examples of Avatars
Source: Author's own creation

Being portrayed as one of the top technologies (Jo, 2023), the Metaverse is said to motivate users, as it is a platform that caters to content-centric interests and social interactions (Ibili et al., 2023). This convergence holds significant appeal for business organizations, which view it as an opportunity to reimagine customer engagement, brand interaction, and even internal operations (Polyviou & Pappas, 2023). Microsoft Mesh, Nvidia Omniverse, Meta Horizon Workrooms, and Roblox are some well-known business-oriented metaverse platforms (Weinberger & Gross, 2023; Smith, 2025).

Organizations are actively exploring how Metaverse technology can transform the way employees work, collaborate, and learn (Chen, 2023). However, for successful implementation, it is crucial to explore employees' intentions to use the Metaverse (Heruatmadja & Ramadhan, 2023). From employees' perspective, the metaverse helps enhance their work performance. This could include improved collaboration with colleagues in virtual spaces, enhanced communication practices, and greater access to more engaging or interactive training opportunities (Soliman et al., 2023; Wong et al., 2023).

Technology Awareness

In the dynamic landscape of organizations today, technology awareness has emerged as a key differentiator (Flavián et al., 2022), shaping individual potential within an organization and collective innovation and adoption of emerging technologies (Mohanraj et al., 2023). Technology awareness can be defined as the comprehension of

both present and emerging technologies, along with an understanding of their potential and impact on various spheres of human life (Silverio-Fernandez et al., 2019; Saini & Shri, 2024). Technology awareness is not something that has been established recently. Its roots can be traced back to the early stages of human civilization (Pacey & Bray, 2021). Understanding how human beings advanced throughout their evolutionary timeline, from the very basic tools to modern state-of-the-art technology, shows us the pivotal role of technological awareness in our present lives (Hosseiny et al., 2021; Rajendra et al., 2022). The technological development we see and experience in today's world may not have existed if there hadn't been an element of awareness about new technologies (Pacey & Bray, 2021).

Research has emphasized the importance of technology awareness as a key factor in business digital transformation (Khan & Qudrat-Ullah, 2021), citing the 2022 Deloitte Tech Trends (Sokołowski et al., 2023). Although there is some argument that a higher level of technology awareness or any initiative for it can be associated with increased perceptions of job insecurity among employees (Arias-Pérez & Vélez-Jaramillo, 2022), many have proven that technology awareness has a positive relation to employees' performance because of their efficiency in tasks (Mohanraj et al., 2023) and creative self-efficacy (Yin et al., 2024). Recent works show that technology awareness empowers employees to take charge of their careers. Being aware of in-demand skills and emerging technologies, individuals can identify areas for upskilling and reskilling (Shehawy et al., 2026).

Technology Awareness and Intention to Use Metaverse

Employees with a strong foundation in technology are likely to be more receptive to using the metaverse within the workplace. When employees are tech-savvy, they can effectively leverage metaverse tools, thereby increasing productivity (Pillai et al., 2024). Also, technology-aware employees exhibit greater adaptability and learning agility, readily integrating changes in the metaverse into their workflows (Shehawy et al., 2026). Employees with high technology awareness are better equipped to understand the potential applications of the metaverse within their specific work environment. This understanding can lead them to perceive the metaverse as a valuable tool, increasing their intention to use it regularly (Chakraborty et al., 2023).

Tech-aware employees are generally more comfortable navigating new technologies and have a better grasp of technical functionalities. This can make them perceive the metaverse as less daunting and easier to learn. With a lower perceived barrier to entry, they are more likely to experiment with the metaverse and explore its potential benefits (Xi et al., 2024). Accordingly, the following hypothesis is developed.

H_1: There is a positive relationship between employees' technology awareness and intention to use the metaverse.

Mediating Role of Attitude

Attitude represents an individual's overall evaluation of an object or concept, according to the Theory of Planned Behavior (Ajzen, 2002). Literature reveals three key components: cognition, affection, and behavior, which collectively shape a person's overall attitude (Lau et al., 2023). The cognitive component can be the perceived utility of metaverse use in an employee's mind. Affection can be understood as the employee feeling excited due to the immersive experience in the metaverse. Lastly, behavior is the overall outcome of the components of attitude and represents the employee's attitude (Ajzen, 2002).

With the development of metaverse platforms, employees with technological awareness recognize that the metaverse will benefit their work and career growth (Yang & Jiang, 2024). This is also because their awareness of technology has reduced their uncertainty and fear, enabling them to appreciate the metaverse's benefits. For that reason, they are more likely to develop a positive attitude toward experiencing the metaverse (Yin et al., 2024; Yang & Jiang, 2024). Psychologically, as explained by the theory of planned behavior, a positive attitude is essentially a result of familiarity with the metaverse's potential benefits, such as increased productivity, exposure to new experiences, and a platform for self-improvement (Albayati et al., 2023). Likewise, employees recognize the metaverse's potential for enhanced collaboration, communication, and stronger social connections, fostering a positive attitude toward it, which ultimately leads to their intention to use the metaverse and their behavior (Yin et al., 2024). Accordingly, the following hypothesis is developed.

H_2: Attitude toward the use of the metaverse positively mediates the relationship between technology awareness and intention to use the metaverse.

Mediating Role of Subjective Norms

Subjective norms refer to an individual's inclination toward a specific behavior, influenced by their social environment, including friends, family, colleagues, and broader societal norms. The subjective norms comprise three important components: perceived social pressure, social influence, and normative beliefs (Pradhananga et al., 2022). Social pressure emerges when an individual feels expectations from their significant others toward a particular behavior. As this social pressure increases, the individual becomes increasingly influenced by the opinions and judgments of those in their social circle, a phenomenon known as social influence. Normative belief refers to the ideology or ethos within a society or among its people that influences an individual's behavior (Pradhananga et al., 2022).

When studying metaverse adoption in the workplace, subjective norms reflect the importance that employees assign to the perceived opinions of those around them, as well as to social trends surrounding metaverse usage (Albayati et al., 2023). Technology awareness can influence the subjective pressures that an individual perceives. For instance, employees with a strong foundation in technology awareness are likely to have tech-savvy social circles and potentially be early adopters of new technologies (Albayati et al., 2023). Additionally, such employees seek to be among like-minded individuals who are equally knowledgeable about technology and its potential career benefits. If people in their social circle encourage the use of metaverse technology at work, it can trigger positive subjective norms toward the metaverse (Jafar et al., 2024). Sooner or later, observing their peers actively encouraging or appreciating the metaverse technology might make employees feel social pressure to conform and be more likely to use it themselves (Arpaci et al., 2022; Gawshinde et al., 2023). Accordingly, the following hypothesis is developed.

> **H_3:** Subjective norms toward the use of the metaverse positively mediate the relationship between technology awareness and intention to use the metaverse.

Mediating Role of Perceived Behavioral Control

Perceived behavioral control (PBC) refers to an individual's belief in their ability to perform a specific behavior successfully (Ajzen, 2002). When an individual recognizes their capability to complete a specific task or behave in a certain way while also

considering the internal and external factors that may support or hinder it, they are in a better position to decide if they will proceed with that task or behave in a particular way (Lim & Weissmann, 2023; Shahzad et al., 2024). In the context of metaverse usage intentions, perceived behavioral control refers to employees' confidence in navigating, interacting with, and utilizing the metaverse platform effectively (Park, 2024).

There are two important factors to consider when understanding how PBC comes into play for any particular behavior, such as metaverse adoption in our case. First is the control belief, which concerns the employee's belief system about factors that may support (e.g., availability of metaverse equipment) or hinder (e.g., unavailability of internet or required training) the use of the metaverse platform (Lim & Weissmann, 2023). Second is perceived power, encompassing factors that may affect metaverse usage, even when it is accessed (Lim & Weissmann, 2023). The literature suggests that employees with a high sense of perceived behavioral control feel confident in their ability to use the metaverse effectively, which can lead to a stronger intention to engage with the platform and explore its features (Albayati et al., 2023). Similarly, a lack of familiarity with hardware and software interfaces, combined with difficulty in understanding complex navigation methods, can lead to a low sense of perceived behavioral control among employees (Gawshinde et al., 2023). Accordingly, the following hypothesis is developed.

H_4: Perceived behavioral control over using the metaverse positively mediates the relationship between technology awareness and intention to use the metaverse.

Moderating Role of Perceived Risk

Perceived risk refers to an individual's subjective assessment of the potential negative consequences of a particular action or decision (Kumar et al., 2024; Phamthi et al., 2024). It has been studied for many years, primarily to investigate risk perception in gambling (Slovic, 1967), investment, consumer behavior (Sheth & Venkatesan, 1968), or health-related behaviors (Van, 1998), and has helped researchers understand people's responses to particular actions.

Several theoretical frameworks explain the nature of perceived risk. Uncertainty Theory holds that when people know little about something, they tend to perceive it as riskier. When a person is unsure about a decision, factors such as past experiences and

personal characteristics also influence how risky they perceive something to be (Liu & Mair, 2023; Chen et al., 2024). The Technology Acceptance Model (TAM) suggests that people are more likely to adopt a new technology when they find it useful and easy to use. However, if they perceive technology as posing cyber risks, they may hesitate to adopt it, even if they understand how it works (Azhar et al., 2024; Alshammari & Al-Mamary, 2025). Cognitive Dissonance Theory explains that when the metaverse feels too different from a person's values or daily life, it creates a kind of mental discomfort that makes them resistant to using it (Kumar et al., 2024). Social Learning Theory suggests that people are influenced by what they see and hear around them (Okorley et al., 2024). Finally, Innovation Resistance Theory posits that many people resist new technologies simply because they find them too complicated or believe they will disrupt their routine work (Kumar et al., 2024). All these theories suggest that even employees who are aware of metaverse technology may still be unwilling to use it if they perceive it as risky. As a result, their perceived risk may outweigh any positive feelings initially created by their awareness (Adu-Gyamfi et al., 2022; Bao et al., 2024; Wang et al., 2024; Pillai et al., 2024; Alshammari & Al-Mamary, 2025). So, the next hypothesis is developed as follows.

> **H_5:** For those who perceive high risk for using the metaverse, the relationship between technology awareness and attitude toward the use of the metaverse will be weaker.

Employees may be encouraged to adopt new technology by support from friends, family, or peers, which typically motivates adoption (Lim & Weissmann, 2023). However, when the perceived risks associated with technology are high, such as the metaverse, employees become more vigilant about potential challenges they may face (Rahimi & Oh, 2024). They may observe the benefits their peers or colleagues get from using the metaverse. Conversely, they also notice a sense of dependency on virtual technology with continued usage, leading to psychological impacts (Chen, 2024).

The literature indicates that perceived risk plays a significant role in shaping individuals' willingness to engage with the metaverse (Chen, 2024; Rahimi & Oh, 2024). This risk perception is not only limited to potential psychological effects but also encompasses a range of risks, including those concerning personal data security, financial exposures within the platform, lack of regulation, and ethical encounters, etc.,

all of which are particularly due to limited control over other users' behavior within the metaverse platform (Louisot, 2024). Although perceived risk has been widely studied across multiple dimensions in the literature, the significance of a particular risk dimension depends on the technology and research agenda (Dwivedi et al., 2022; Kumar et al., 2023). For example, a recent study on the metaverse shows that perceived risk significantly led to lower usage intention, whereas in another case, the privacy risk specifically showed no effect among users (Al-Sharafi et al., 2024). This implies that the risk factor is not a unified construct, but one whose relevant sub-dimensions shift depending on its application in a particular context. Accordingly, the next hypothesis is developed as follows.

> **H_6:** For those who perceive high risk for using the metaverse, the relationship between technology awareness and subjective norms toward the use of the metaverse will be weaker.

Employees with a good understanding of technology usually hold strong perceived behavioral control (PBC) toward using the metaverse. This strong PBC is generally attributed to self-confidence in the resources and knowledge required to perform well in the metaverse (Lim & Weissmann, 2023; Shahzad et al., 2024). However, given the dynamic nature of the metaverse, which is continuously evolving, this perceived behavioral control may weaken if high perceived risks are associated with metaverse usage (Zhou et al., 2024), which means even having high perceived behavioral control cannot fully mitigate the risks associated with the metaverse platform (Alsharida et al., 2025). This perceived risk underscores the point mentioned earlier: perceived behavioral control may influence one's behavior on the metaverse platform (Ajzen, 2002), but not that of other users. Despite having reasonable confidence in one's ability to manage practical usage within the metaverse, the employee knows the boundaries of personal control beyond which there are uncontrollable risks related to other users, data privacy, lack of any regulatory body, etc., and therefore underscores the strength of perceived behavioral control (Zhou et al., 2024). Based on this reasoning, the last hypothesis is developed as follows.

> **H_7:** For those who perceive high risk for using the metaverse, the relationship between technology awareness and perceived behavioral control for the use of the metaverse will be weaker.

Figure 2 shows the theoretical framework developed considering all the above hypotheses.

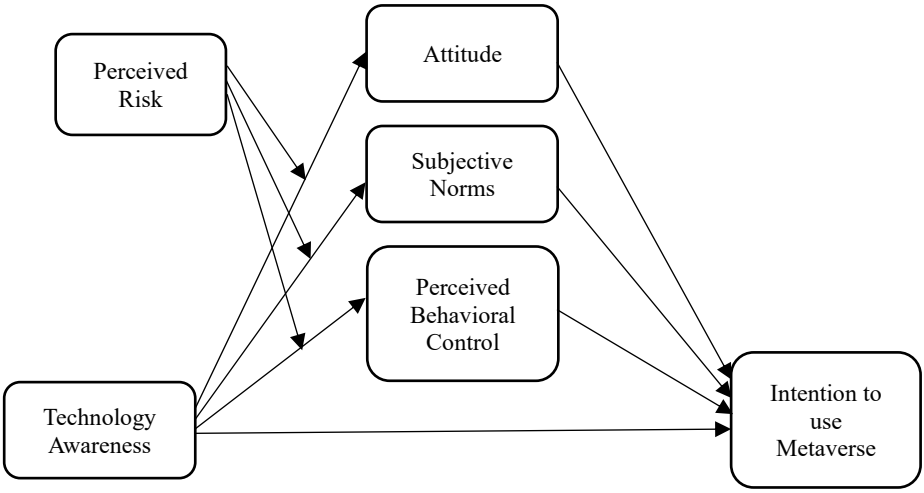


Figure 2. Theoretical Framework

Method

This research is based on the philosophy of positivism, which holds that reality can be studied, observed, and measured systematically using numbers and statistics (Saunders, 2019). Following positivism, this study adopts a deductive approach, meaning that rather than developing a new theory, the researcher starts with an existing theory and uses real-world data to test it (Saunders, 2019). Moreover, a quantitative survey strategy was chosen with a cross-sectional time horizon, which means data were collected from respondents at a single point in time. The survey strategy was chosen because it allows the researcher to collect data from many people and to turn theoretical ideas into measurable questionnaire items (Saunders, 2019).

Sample and Data Collection

This study focused broadly on employees from service-sector organizations in Istanbul, Türkiye, with respondents drawn through professional networks and references in the telecommunications, banking, and software companies. Service organizations are especially relevant in this context, as their direct and continuous interaction with customers makes them among the most influenced by any technological transformation, and the metaverse technology presents good opportunities to improve

service delivery, remote collaboration, and customer experience (Gursoy et al., 2023; Ooi et al., 2023). It is important to note that the goal is simply to understand the overall perceptions of employees from the service-sector organizations as a single group. Therefore, respondents were not asked to share any personal information, which helps maintain confidentiality. For sample size, the subject-to-item ratio method was used, which is a widely accepted approach to calculating sample size (Bell et al., 2023). Using this method, the minimum sample size was 230. However, the sample size was increased to 384 respondents to improve statistical power and avoid potential errors (Bell et al., 2023).

Table 1. Demographics of Respondents

Variable	Frequency	(%)
Age		
21 to 30	235	61.2
31 to 40	122	31.8
41 to 50	23	6
51 or more	4	1
Total	384	100
Gender		
Male	275	71.6
Female	109	28.4
Total	384	100
Education		
High School or less	8	2.1
Associate	12	3.1
Bachelor	166	43.2
Master or more	198	51.6
Total	384	100

Of the 400 questionnaires distributed, 384 were deemed usable after excluding duplicate submissions and straight-lining patterns. Before checking the measurement (outer) and structural (inner) models, a demographic test was conducted on three controlled variables: age, gender, and education. Most respondents fell within the 21–30 years age bracket, accounting for 61.2% of the total sample. Regarding gender, male respondents comprised 71.6% of the sample, with female respondents accounting for the remaining 28.4%. The largest proportion of respondents held a master's degree or higher (51.6%). An important point to note is that the demographic data were not collected for statistical analysis, only for sample description. We can say that the sample in this research is mostly composed of young, educated, male professionals, with the

majority in the early career stage and holding a master's degree. This demographic profile aligns with the workforce composition of organizations seeking technological advancements targeted by this study. See Table 1 for demographics of respondents.

Data Collection Procedure

The data collection instrument used in this study was a structured questionnaire with a 5-point Likert scale, a standard measurement format in survey-based research for cross-contextual application (Saunders, 2019). The questionnaire was prepared in English. Before data collection, ethical approval was obtained on 05.12.2024 from the ethics committee of Istanbul Ticaret University, under the number E-65836846-044-339411. We used convenience and snowball sampling techniques, which ensured that all participants were relevant to the study and were reached through a network of trust. Following this, potential respondents were personally contacted, given a brief explanation of the study, and asked for their consent to take part. The questionnaires were distributed online via Google Forms. We clearly stated that participation in the survey is entirely voluntary, and individuals were free to decline to participate for any reason.

Data Collection Instruments

Intention to use the metaverse was measured using a 3-item scale adapted from Dirsehan and Can (2020). A sample item is "I intend to use metaverse technology."

Technology awareness was measured by a 5-item scale adapted from Raddatz et al. (2023). A sample item is "I learn about metaverse technology on social media or other websites."

Perceived risk was measured using six items adapted from Kumar et al. (2023). A sample item is "The metaverse would be insecure." The six measurement items capture two important dimensions of perceived risk: performance risk and security risk. These dimensions were chosen because they significantly reflect employees' concerns about expected performance and the secure operation of metaverse technology. According to Kumar et al. (2023), both performance and security risks exhibit the strongest effects among other risks on resistance to metaverse adoption, supporting their relevance in this present context, which is an important aspect to study perceived risk (Al-Sharafi et al., 2024). Since this research aims to examine the overall moderating effect of

perceived risk within the TPB framework rather than comparing its individual dimensions, the six items were treated as a single reflective construct of perceived risk, which is consistent with the operationalization of perceived risk in the previous technology adoption studies (Xie et al., 2021; Pillai et al., 2024).

Attitude, subjective norms, and perceived behavioral control were each measured using 3 items adapted from Liu and Park (2024). Representative items for these three scales are "I think participating in the metaverse would be beneficial for me," "Most people who are important to me will agree that I use the metaverse," and "I think that I would be able to experience the metaverse well," respectively.

Validity and Reliability Tests

To test the validity of the scales, a three-step validation process was conducted. First, qualified English-language scholars reviewed all questionnaire items to assess grammatical accuracy and clarity, thereby confirming face validity. After that, the questionnaire was reviewed by the second author and experienced academic scholars in organizational research to ensure that each item was appropriate and aligned with the study objectives, thereby confirming content validity. Thirdly, a measurement model analysis was performed to assess the internal consistency (i.e., reliability) and construct validity (i.e., convergent and discriminant validity) of the scales.

Following the standard PLS-SEM procedure recommended by Hair et al. (2019), this assessment involved four stages: outer loadings, internal consistency reliability, convergent validity, and discriminant validity. We examined the *outer loadings* of all indicators to confirm that each item reliably measures its intended construct. According to Hair et al. (2019), the accepted minimum threshold for outer loadings is 0.70. As shown in Figure 3, all 23 items across the six constructs exceeded this threshold and are statistically significant ($p < 0.001$), confirming adequate indicator criterion.

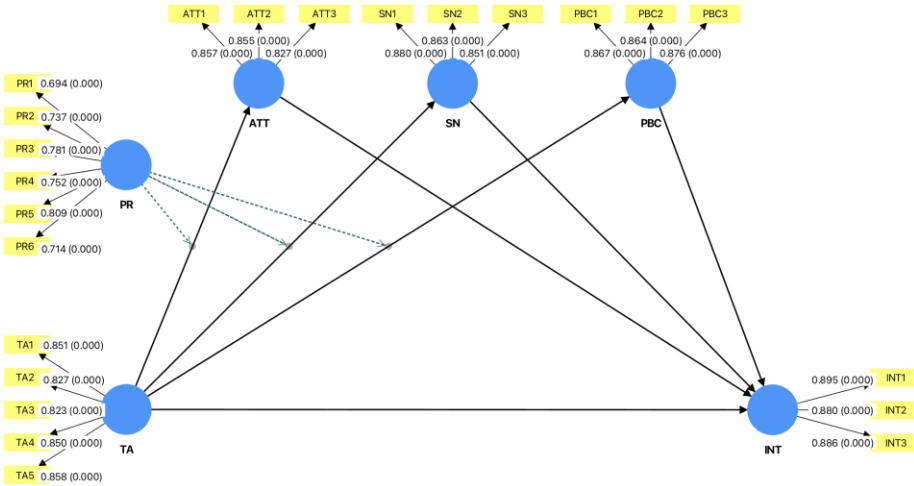


Figure 3. Outer Loadings of Measurement Model

Internal consistency was assessed using Cronbach's Alpha and Composite Reliability. Cronbach's Alpha values above 0.70 and Composite Reliability values above 0.80 are considered acceptable (Hair et al., 2019). As shown in Table 2, all Cronbach's Alpha values range from 0.803 to 0.897, and all Composite Reliability values range from 0.883 to 0.924, both well above the minimum thresholds, confirming internal consistency for all the constructs.

Table 2. Reliability and Validity of All Latent Constructs

Construct	α	CR	AVE	CV
Attitude (ATT)	0.803	0.883	0.716	Yes
Intention (INT)	0.864	0.917	0.787	Yes
Perceived Behavioral Control (PBC)	0.838	0.903	0.755	Yes
Perceived Risk (PR)	0.846	0.884	0.561	Yes
Subjective Norms (SN)	0.831	0.899	0.747	Yes
Technology Awareness (TA)	0.897	0.924	0.709	Yes

CR: Composite Reliability, AVE: Average Variance Extracted, CV: Convergent Validity

After assessing internal consistency, we assessed convergent validity, which refers to the degree to which the indicators of a construct share a high proportion of variance with one another, confirming that they all measure the same construct. We used the Average Variance Extracted (AVE), with a value of 0.50 or higher, considered

acceptable (Hair et al., 2019). As shown in Table 2, all AVE values exceed the minimum threshold, confirming adequate convergent validity of all constructs.

We also assessed discriminant validity, which confirms that each construct measures something unique and does not overlap substantially with other constructs. We used the Fornell-Larcker criterion for discriminant validity as it is considered the most widely accepted in organizational behavior research (Hair et al., 2019). As shown in Table 3, the results confirm that the square root of AVE for each construct exceeds its correlations with other constructs, satisfying the Fornell-Larcker criterion and thereby establishing discriminant validity in this measurement model.

Table 3. Discriminant Validity (Fornell-Larcker Criterion)

	ATT	INT	PBC	PR	SN	TA
ATT	**0.846**					
INT	0.635	**0.887**				
PBC	0.494	0.744	**0.869**			
PR	0.354	0.498	0.429	**0.749**		
SN	0.569	0.752	0.625	0.459	**0.864**	
TA	0.589	0.809	0.675	0.448	0.664	**0.842**

Note: Bold diagonal values are the square root of AVE, and off-diagonal values are inter-construct correlations.
ATT: Attitude toward metaverse, INT: Intention to use metaverse, PBC: Perceived behavior control, PR: Perceived risk, SN: Subjective norms, TA: Technology awareness

Furthermore, given the cross-sectional design of this study and the use of self-reported questionnaires for data collection, the Common Method Bias (CMB) was addressed prior to the structural model evaluation. For this purpose, in line with Kock (2015), a full collinearity variance inflation factor (AFVIF) test has been performed using WarpPLS. The results show an AFVIF value of 2.417, which is within the 3.3 threshold, suggesting that there is no common method bias affecting the validity of the collected data. Figure 4 shows the summary of the WarpPLS report.

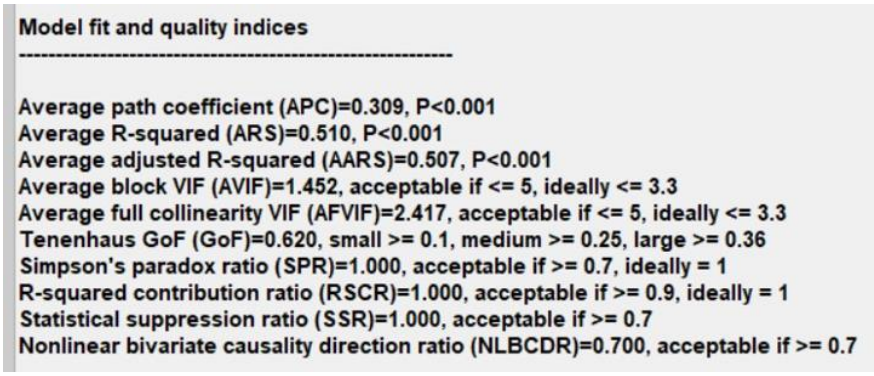


Figure 4. Full Collinearity Variance Inflation Factor

Data Analysis Procedure

This study used the partial least squares structural equation modeling (PLS-SEM) technique through the latest version of SmartPLS software (Ringle et al., 2024). PLS-SEM can test both measurement and structural models simultaneously (Hair et al., 2019). The measurement model assesses whether the questionnaire items are reliable and valid, while the structural model tests the relationships among variables as proposed in the theoretical framework. Also, PLS-SEM does not require data to be normally distributed, making it more flexible than other techniques such as covariance-based SEM (Hair et al., 2019).

After confirming the common method bias, the structural model was assessed in accordance with the guidelines of Hair et al. (2019). Accordingly, five analyses were conducted: structural multicollinearity, path coefficients for hypothesis testing, coefficient of determination (R^2), effect sizes (f^2), and, finally, cross-validated redundancy (Q^2) for predictive relevance. We assessed *structural multicollinearity* using the Variance Inflation Factor (VIF) values generated by SmartPLS. A VIF above 5.0 is considered problematic, while a VIF below 3.3 is considered ideal in PLS-SEM (Hair et al., 2019). The VIF values for all structural paths ranged from 1.039 to 2.426, and the VIF for the measurement model ranged from 1.571 to 2.399, all within the threshold indicating no structural multicollinearity in our inner model.

Findings

Results show that TA has a strong and significant positive effect on INT (β= 0.384), supporting H_1. All three mediators, i.e., ATT, SN, and PBC, show significant positive

effects between TA and INT, with β values of 0.070, 0.144, and 0.150, respectively, and are significant at the 5% level, supporting H_2, H_3, and H_4 through their indirect effects. Among all moderation paths, the strongest effect is observed for PR×TA→SN (β: -0.112), indicating that PR most powerfully weakens the influence of TA on SN. This is closely followed by PR×TA→ATT (β: -0.105) and PR×TA→PBC (β = -0.095). Therefore, all moderation paths, including H5, H6, and H7, are also supported. See Table 4 for details.

Table 4. Path Coefficients

	Hypothesis	**Path**	**β**	**p-value**	**Decision**
Direct	H1	TA → INT	0.384	0.000	Supported
Mediation	H2	TA → ATT → INT	0.070	0.000	Supported
	H3	TA → SN → INT	0.144	0.000	Supported
	H4	TA → PBC → INT	0.150	0.000	Supported
Moderation	H5	PR × TA → ATT	-0.105	0.002	Supported
	H6	PR × TA → SN	-0.112	0.000	Supported
	H7	PR × TA → PBC	-0.095	0.002	Supported

We also checked the *Variance Accounted For (VAF)* for all mediators to assess the strength of mediation in our model. The total indirect effect of TA on INT through all three mediators combined is 0.364, while the total effect is 0.748. The collective VAF is 48.6%, which falls within the 20%–80% range, confirming partial mediation overall. When examined individually, the VAF for ATT, SN, and PBC is 15.4%, 27.2%, and 28%, where ATT's value falls below the 20% threshold, which is expected and methodologically explainable. When more than one mediator is simultaneously present in a model, the total indirect effect is distributed across all pathways, thereby decreasing the VAF of each mediator. This is consistent with the guidelines of Hair et al. (2019), which advise evaluating VAF both individually and collectively in multi-mediation models.

After the path coefficients, we checked the *coefficient of determination* (R^2). It shows the level of variance in the dependent variable explained by the model. Our results showed that 78.2% of the variance was explained by INT, which is considered significant for a good model. Also, the model explained 37.1%, 48.9%, and 48.7% of the variance in ATT, SN, and PBC, respectively. Likewise, the adjusted R^2 values for INT, ATT, SN, and PBC were 0.779, 0.366, 0.485, and 0.483, respectively. These values

show that our proposed theoretical framework is significant, as it provides a strong explanation of all chosen variables.

After R^2, we checked the *effect size (f^2)* that shows how much the R^2 value changes when a specific predictor is included or excluded from the model. Following Jacob Cohen (1988), f^2 values of 0.02, 0.15, and 0.35 indicate small, medium, and large effects, respectively. Referring to Table 5, TA demonstrates the strongest effect sizes in the model, with large effects on SN and PBC and medium effects on ATT and INT. Lastly, we assessed the Stone-Geisser Q^2 value using the PLS predict procedure in SmartPLS to evaluate the model's out-of-sample predictive relevance for each dependent variable. Stone-Geisser Q^2 was introduced by Stone (1974) and Geisser (1974) and measures the model's predictive relevance beyond simply fitting the data on which it was estimated.

Table 5. Effect Sizes (f^2)

Variables	f^2	Effect Size
ATT -> INT	0.049	Small
PBC -> INT	0.144	Small
PR -> ATT	0.023	Small
PR -> PBC	0.049	Small
PR -> SN	0.079	Small
PR x TA -> ATT	0.021	Small
PR x TA -> PBC	0.022	Small
PR x TA -> SN	0.030	Small
SN -> INT	0.146	Small
TA -> ATT	0.337	Medium
TA -> INT	0.279	Medium
TA -> PBC	0.527	Large
TA -> SN	0.469	Large

Following Hair et al. (2019), Q^2 values greater than 0 confirm predictive relevance, while values of 0.25, 0.50, and 0.75 represent small, medium, and large predictive relevance, respectively. Stone-Geisser Q^2 values are shown in Table 6 below, confirming the predictive relevance of all variables.

Table 6. Predictive Relevance

Construct	Q^2	Predictive Relevance
ATT	0.359	Medium
PBC	0.478	Medium
SN	0.477	Medium
INT	0.676	Medium

Discussion and Conclusion

This research examined the effect of technology awareness on employees' intention to use the metaverse for work in service organizations, using the theory of planned behavior as the underlying framework. For that purpose, a moderated mediation theoretical framework was proposed, including attitude, subjective norms, and perceived behavioral control as mediating variables, and perceived risk served as a moderating variable. The results provide empirical support for all seven hypotheses proposed in this study, yielding theoretical and practical insights into the existing body of knowledge on workplace metaverse adoption.

The direct effect of technology awareness on the intention to use the metaverse is positive and significant ($\beta = 0.384$, $p < 0.001$), supporting the first hypothesis. This finding supports the previous claim that employees with a good understanding of new technologies are more likely to consider them relevant and beneficial to their profession (Flavián et al., 2022; Chakraborty et al., 2023). Therefore, technology awareness helps reduce fear of the unknown and psychological pressure associated with adopting new technology, especially metaverse technology, which is continually evolving. We can also relate this notion to a broader perspective on technology adoption, in which technology adoption is linked to understanding its applications and benefits (Raddatz et al., 2023; Xi et al., 2024). The medium effect size observed for this path ($f^2 = 0.279$) confirms its substantive contribution to the overall model, reinforcing the importance of awareness-building as a foundational precondition for successful workplace metaverse integration.

The mediation of attitude between technology awareness and intention to use the metaverse is found significant ($\beta = 0.070$, $p < 0.001$), supporting H_2, which aligns with the previous studies suggesting that employs are more inclined towards metaverse when they are well educated about it and develop a positive attitude towards its benefits

for their professional growth (Yang & Jiang, 2024; Albayati et al., 2023). Although the VAF value of it taken individually was less than the 20% threshold, it is well supported by Hair et al. (2019) as it was part of a multi-mediator model where the total indirect effect was distributed among all three mediators simultaneously and the collective VAF value was 48.6% (far above the minimum 20% threshold), confirming overall partial mediation. The significant mediation of attitude is also consistent with previous studies employing the theory of planned behavior for technology adoption, which identify attitude as a significant mediator between cognitive antecedents and subsequent behavioral intentions (Yin et al., 2024). Moreover, the lower VAF for attitude compared with subjective norms and perceived behavioral control can be explained by the interactive nature of metaverse technology, which depends not only on individual perceptions but also on mutual collaboration and shared communication among users (Hennig-Thurau et al., 2023). Employees may meaningfully lean more towards how the significant others in their organizations are reacting to the metaverse, and whether they have the required skills and capabilities to operate within its immersive environment (Albayati et al., 2023), rather than emphasizing their personal opinions about it. Hence, subjective norms and perceived behavioral control exert a stronger influence than attitude in triggering employees' intentions in a workplace context.

Subjective norms show a significantly stronger mediating role, with a β of 0.144 and a VAF of 27.2%, supporting H3. These findings highlight the importance of social stimuli in shaping employees' intentions towards the metaverse, especially in workplace environments where peer expectations are a leading factor in professional life. Research shows that employees who are technologically aware are inclined to be part of a social circle that similarly encourages and appreciates new technologies, such as the metaverse, and considers them a useful component for professional development (Albayati et al., 2023; Jafar et al., 2024). The stronger effect of subjective norms relative to attitude suggests that social validation and normative values exert a greater influence than individual understanding, particularly in a workplace setting. This resonates with the existing body of literature on technology adoption at the organizational level, in which the social environment is recognized as a key motivator for adopting new platforms (Arpaci et al., 2022; Gawshinde et al., 2023).

The third mediator, perceived behavioral control, shows the strongest mediating effect ($\beta = 0.150$, $p < 0.001$), supporting H_4, with a VAF of 28%. These findings are further supported by the large effect size of technology awareness on perceived behavioral control ($f^2 = 0.527$), suggesting that technologically aware employees have a stronger belief in their ability to utilize and engage with metaverse technology efficiently. In a broader context, the dominance of perceived behavioral control over other mediators aligns with the existing body of knowledge on technology acceptance, suggesting that perceived behavioral control and self-efficacy are significant antecedents in challenging digital environments, leading to eventual behavioral intention (Lim & Weissmann, 2023; Shahzad et al., 2024).

Perceived risk shows a significant moderation effect on all three mediators in the model, supporting all three moderation hypotheses. Subjective norms have the strongest moderating effect ($\beta = -0.112$, $p < 0.001$) of perceived risk, followed by attitude ($\beta = -0.105$, $p = 0.002$) and then perceived behavioral control ($\beta = -0.095$, $p = 0.002$), which had the lowest moderating impact in the model, confirming H_5, H_6, and H_7. These results show that perceived risk has a significant moderating effect, weakening the impact of technology awareness on all three mediators in the theory of planned behavior. Especially, the strongest moderation on subjective norms suggests that even a socially supportive environment may not be able to maintain employees' positive comprehension about the metaverse when they identify high risk with its usage in terms of privacy, security, or expected performance, etc., which confirms the previous claims (Kumar et al., 2024). Although all the moderating paths of perceived risk were statistically significant, their effect sizes were comparatively small. The findings show that perceived risk weakens the positive effect of technology awareness across the three TPB variables; in practice, its influence is modest and should not be considered a leading driver of employees' intention towards the metaverse. One possible explanation regarding the small effect sizes of perceived risk can be understood by the stronger mediating roles of subjective norms and perceived behavioral control, indicating that employees are more influenced by peer support and their confidence to use the metaverse as compared to the perceived risks associated with it. However, this does not materially undermine the modest influence of perceived risk, as it remains significant in triggering concerns about metaverse adoption related

to performance and security, without having a dominant role like technology awareness.

Furthermore, the perceived risk creates a personal threat assessment that influences the confidence of employees, even when they have perceived behavioral control when it comes to high risks associated with metaverse platforms that are beyond individual control, such as data breaches, unregulated usage, or absence of any formal authority (Zhou et al., 2024; Alsharida et al., 2025). In general, these results extend the existing body of knowledge on perceived risk, adding to its moderating influence, which operates not only on behavioral outcomes but also on the deeper psychological pathways through which technology awareness shapes the intention to use any new technology.

This study has three theoretical contributions to the literature. First, it confirms the explanatory power of the proposed model, which integrates technology awareness as an antecedent to the TPB framework, with a high R^2 (78.2%) and medium predictive relevance (Q^2 = 0.676). Secondly, it establishes the perceived risk variable as a significant moderator that overrides the technology-driven pathways to all the TPB variables, a conceptual extension of the technology adoption literature. Lastly, this study addresses an empirical gap in the metaverse domain regarding service-sector organizations, which have received little attention in prior metaverse research (Kumar et al., 2024; Šímová & Zychová, 2023).

This study provides a range of practical implications that can be effectively utilized in organizations. The substantial value of technology awareness underscores the importance of targeted organizational workshops, training, and campaigns to build technology awareness. These workshops and training sessions should not be limited to providing information about metaverse but include real time customer interactions, employees' collaborative assignments, and team meetings to demonstrate practical cases. Considering the role of subjective norms, managers may introduce internal social campaigns like early adopters, technology ambassadors, group-based metaverse experts, and department-based metaverse projects to encourage peer learning. Companies should also raise awareness of risk management, or at least about risk mitigation strategies, when using metaverse platforms. For instance, the management may introduce seminar sessions for cyber security awareness, provide explicit

guidelines about using metaverse safely, and provide a dedicated support system in the early stages of metaverse implementation.

Every study has limitations, and this one is no exception. Firstly, a cross-sectional design may not be very helpful for the causal behavioral outcomes of technology adoption. Longitudinal research may help us understand employees' risk perceptions of metaverse technology, particularly as it continues to evolve. Another limitation is the sample of this study, which comprises the service sector of Istanbul as a whole, reflecting the researchers' established networks rather than a deliberate design. Future research may be carried out with diversified samples across different service industries for the improved generalizability of current findings. Specifically, a Multi-Group Analysis (MGA) can be performed to ensure the robustness and external validity of the current framework across multiple service industries. Also, this study employed a mono-method research design, which may limit its generalizability in statistical terms. Future research should adopt triangulation to achieve stronger results, lending greater confidence to arguments based on the outcomes. Lastly, the framework may also be extended to include additional variables, such as organizational support, individual innovativeness, and Technology Trust, to understand it from multiple perspectives.

Declaration of Interest

There are no conflicts of interest among the authors.

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Authors' Contribution

The first author's contribution includes conceptualization, literature review, methodology, data collection and analysis, and interpretation of findings. The second author was involved in the critical assessment of the theoretical framework, methodology, and findings, as well as the necessary manuscript revisions.

Ethical Approval

- Name of the institution granting ethical approval: Istanbul Ticaret University Ethics Committee.

- Approval date and number: Date: 05.12.2024, Document No: E-65836846-044-339411.
- Brief description of the ethical approval: The questionnaire entitled "Investigating Relationships between Technology Awareness and Intention to Use Metaverse: Mediating Roles of Attitude toward Metaverse, Subjective Norms toward Metaverse and Perceived Behavioral Control Over Using Metaverse and Moderating Role of Perceived Risk of Using Metaverse" was reviewed by the Ethics Committee and found to comply with ethical principles and standards.

References

Adu-Gyamfi, G., Song, H., Obuobi, B., Nketiah, E., Wang, H., & Cudjoe, D. (2022). Who will adopt? Investigating the adoption intention for battery swap technology for electric vehicles. Renewable and Sustainable Energy Reviews, 156, 111979.

Alfaisal, R., Hashim, H., & Azizan, U. H. (2024). Metaverse system adoption in education: a systematic literature review. Journal of Computers in Education, 11(1), 259-303.

Ajzen, I. (1985). From intentions to actions: A theory of planned behavior. In Action control: From cognition to behavior (pp. 11-39). Berlin, Heidelberg: Springer Berlin Heidelberg.

Ajzen, I. (2002). Perceived behavioral control, self-efficacy, locus of control, and the theory of planned behavior 1. Journal of applied social psychology, 32(4), 665-683.

Albayati, H., Alistarbadi, N., & Rho, J. J. (2023). Assessing engagement decisions in NFT Metaverse based on the Theory of Planned Behavior (TPB). Telematics and Informatics Reports, 10, 100045.

Al-Emran, M., Al-Sharafi, M. A., Foroughi, B., Iranmanesh, M., Alsharida, R. A., Al-Qaysi, N., & Ali, N. A. (2024). Evaluating the barriers affecting cybersecurity behavior in the Metaverse using PLS-SEM and fuzzy sets (fsQCA). Computers in Human Behavior, 159, 108315.

Al-Sharafi, M. A., Al-Emran, M., Al-Qaysi, N., Iranmanesh, M., & Ibrahim, N. (2024). Drivers and barriers affecting metaverse adoption: a systematic review, theoretical framework, and avenues for future research. International Journal of Human–Computer Interaction, 40(22), 7043-7064.

Alshammari, M. M., & Al-Mamary, Y. H. (2025). User acceptance of AI-powered training: extending the technology acceptance model (TAM). Future Business Journal, 11(1), 239.

Alsharida, R. A., Al-rimy, B. A. S., Al-Emran, M., Al-Sharafi, M. A., & Zainal, A. (2025). Predicting cybersecurity behaviors in the metaverse through the lenses of TTAT and TPB: a hybrid SEM-ANN approach. Online Information Review.

Arias-Pérez, J., & Vélez-Jaramillo, J. (2022). Ignoring the three-way interaction of digital orientation, Not-invented-here syndrome and employee's artificial intelligence awareness in digital innovation performance: A recipe for failure. Technological Forecasting and Social Change, 174, 121305.

Arpaci, I., Karatas, K., Kusci, I., & Al-Emran, M. (2022). Understanding the social sustainability of the Metaverse by integrating UTAUT2 and big five personality traits: A hybrid SEM-ANN approach. Technology in Society, 71, 102120.

Azhar, M., Ali, R., & Naz, A. (2024). Faith in metaverse: understanding adoption intentions of metaverse amongst the Muslim students. Journal of Islamic Marketing.

Bao, X., Yu, J., & Shou, M. (2024). Exploring metaverse: affordances and risks for potential users. Information Technology & People.

Bell, E., Bryman, A., & Kleinknecht, S. W. (2023). Social research methods. Oxford University Press.

Chakraborty, D., Polisetty, A., Khorana, S., & Buhalis, D. (2023). Use of metaverse in socializing: Application of the Big Five personality traits framework. Psychology & Marketing.

Chen, L., Wang, Y., Peng, J., & Xiao, Q. (2024). Supply chain management based on uncertainty theory: a bibliometric analysis and future prospects. Fuzzy Optimization and Decision Making, 1-38.

Chen, Z. (2024). Metaverse office: Exploring future teleworking model. Kybernetes, 53(6), 2029-2045.

Chong, K. M., Cham, T. H., Lau, E., Wong, B. K. M., & Syed Annuar, S. N. (2023). Log Out or Stay Connected? Unveiling the Intention for Continuous Use in the Metaverse. In Current and Future Trends on Intelligent Technology Adoption: Volume 1 (pp. 1-22). Cham: Springer Nature Switzerland.

Dirsehan, T., & Can, C. (2020). Examination of trust and sustainability concerns in autonomous vehicle adoption. Technology in Society, 63, 101361.

Dwivedi, Y. K., Hughes, L., Baabdullah, A. M., Ribeiro-Navarrete, S., Giannakis, M., Al-Debei, M. M., ... & Wamba, S. F. (2022). Metaverse beyond the hype: Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy. International journal of information management, 66, 102542.

Flavián, C., Pérez-Rueda, A., Belanche, D., & Casaló, L. V. (2022). Intention to use analytical artificial intelligence (AI) in services–the effect of technology readiness and awareness. Journal of Service Management, 33(2), 293-320.

Gawshinde, S., Al-Aflak, A., & Khurana, A. (2023, December). Metaverse Adaptability in Theory Context. In International Working Conference on Transfer and Diffusion of IT (pp. 389-398). Cham: Springer Nature Switzerland.

Geisser, S. (1974). A predictive approach to the random effect model. Biometrika, 61(1), 101-107.

Gursoy, D., Lu, L., Nunkoo, R., & Deng, D. (2023). Metaverse in services marketing: an overview and future research directions. The Service Industries Journal, 43(15-16), 1140-1172.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). Multivariate data analysis.

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. European business review, 31(1), 2-24.

Hasani, T., Rezania, D., & Mohammadi, M. (2024). Towards a framework for successful metaverse adoption in small and medium-sized enterprises: an exploratory study. International Journal of Engineering Business Management, 16, 18479790241257118.

Hennig-Thurau, T., Aliman, D. N., Herting, A. M., Cziehso, G. P., Linder, M., & Kübler, R. V. (2023). Social interactions in the metaverse: Framework, initial evidence, and research roadmap. Journal of the academy of marketing science, 51(4), 889-913.

Heruatmadja, C. H., & Ramadhan, A. (2023). Drivers and barriers of intention to work within metaverse environment. Multimedia Tools and Applications, 1-25.

Hosseiny, S. H., Bozorg-Haddad, O., & Bocchiola, D. (2021). Water, culture, civilization, and history. In Economical, Political, and Social Issues in Water Resources (pp. 189-216). Elsevier.

Jafar, R. M. S., & Ahmad, W. (2024). Tourist loyalty in the metaverse: the role of immersive tourism experience and cognitive perceptions. Tourism Review, 79(2), 321-336.

Jo, H. (2023). Tourism in the digital frontier: A study on user continuance intention in the metaverse. Information Technology & Tourism, 25(3), 307-330.

Khan, R. A., & Qudrat-Ullah, H. (2021). Adoption of LMS in higher educational institutions of the Middle East. New York: Springer.

Kock, N. (2015). Common method bias in PLS-SEM: A full collinearity assessment approach. International Journal of e-Collaboration (ijec), 11(4), 1-10.

Koohang, A., Nord, J., Ooi, K., Tan, G., Al-Emran, M., Aw, E., ... & Wong, L. (2023). Shaping the metaverse into reality: multidisciplinary perspectives on opportunities, challenges, and future research. Journal of Computer Information Systems, 63(3), 735-765.

Kumar, A., Shankar, A., Shaik, A. S., Jain, G., & Malibari, A. (2023). Risking it all in the metaverse ecosystem: forecasting resistance towards the enterprise metaverse. Information Technology & People.

Kumar, A., Shankar, A., Agarwal, R., Agarwal, V., & Alzeiby, E. A. (2024). With enterprise metaverse comes great possibilities! Understanding metaverse usage intention from an employee perspective. Journal of Retailing and Consumer Services, 78, 103767.

Kumar, A., Shankar, A., & Nayal, P. (2024). Metaverse is not my cup of tea! An investigation into how personality traits shape metaverse usage intentions. Journal of Retailing and Consumer Services, 77, 103639.

Lau, M. M., Ng, P. M. L., Chan, E. A. H., & Cheung, C. T. Y. (2023). Examining purchase intention for luxury fashion: integrating theory of reasoned action, with affect-behavior-cognition (ABC) model, identity and social identity theories. Young Consumers, 24(1), 114-131.

Lim, W. M., & Weissmann, M. A. (2023). Toward a theory of behavioral control. Journal of Strategic Marketing, 31(1), 185-211.

Liu, S., & Mair, J. (2023). The impact of uncertainty on tourists' controllability, mood state and the persuasiveness of message framing in the pandemic era. Tourism Management, 94, 104634.

Liu, H., & Park, K. S. (2024). Exploring the impact of metaverse tourism experiences on actual visit intentions: An integrated model of presence, the Technology Acceptance Model, and the Theory of Planned Behavior. International Journal of Tourism Research, 26(1), e2616.

Louisot, J. P. (2024). Managing Risk in the Metaverse. In Enterprise Risk Management in Today's World: A Current and Futuristic View of the Complexity, Resilience, Responsibility and Tools in ERM, Part B (pp. 173-184). Emerald Publishing Limited.

Marabelli, M., & Lirio, P. (2024). AI and the metaverse in the workplace: DEI opportunities and challenges. Personnel Review.

Mohanraj, D., Gangadharan, S., Nirmala, G., & Ramesh, M. G. (2023). Impact of Techno-Stress on Job Performance Among its Employees in Chennai City. European Economic Letters (EEL), 13(5), 1435-1441.

Okorley, E. N. A., Mensah, J. V., & Amoah-Mensah, A. (2024). Social learning theory outcomes and organizational performance: evidence from Ghana telecom firms. Journal of Management and Governance, 1-28.

Ooi, K. B., Tan, G. W. H., Aw, E. C. X., Cham, T. H., Dwivedi, Y. K., Dwivedi, R., ... & Sharma, A. (2023). Banking in the metaverse: a new frontier for financial institutions. International Journal of Bank Marketing, 41(7), 1829-1846.

Pacey, A., & Bray, F. (2021). Technology in World Civilization, revised and expanded edition: A Thousand-Year History. Mit Press.

Park, E. (2024). Examining Metaverse Game Platform Adoption: Insights from Innovation, Behavior, and Coolness. Technology in Society, 102594.

Phamthi, V. A., Nagy, Á., & Ngo, T. M. (2024). The influence of perceived risk on purchase intention in e-commerce—Systematic review and research agenda. International Journal of Consumer Studies, 48(4), e13067.

Pillai, R., Ghanghorkar, Y., Sivathanu, B., Algharabat, R., & Rana, N. P. (2024). Adoption of artificial intelligence (AI) based employee experience (EEX) chatbots. Information Technology & People, 37(1), 449-478.

Pillai, R., Sivathanu, B., Rana, N. P., Preet, R., & Mishra, A. (2024). Factors Influencing Customers' Apparel Shopping Intention in Metaverse. Journal of Computer Information Systems, 1-16.

Pradhananga, A. K., & Davenport, M. A. (2022). "I Believe I Can and Should": Self-efficacy, Normative Beliefs and Conservation Behavior. Journal of Contemporary Water Research & Education, 175(1), 15-32.

Raddatz, N., Coyne, J., Menard, P., & Crossler, R. E. (2023). Becoming a blockchain user: understanding consumers' benefits realisation to use blockchain-based applications. European Journal of Information Systems, 32(2), 287-314.

Rahimi, R. A., & Oh, G. S. (2024). Beyond theory: a systematic review of strengths and limitations in technology acceptance models through an entrepreneurial lens. Journal of Marketing Analytics, 1-24.

Rajendra, P., Kumari, M., Rani, S., Dogra, N., Boadh, R., Kumar, A., & Dahiya, M. (2022). Impact of artificial intelligence on civilization: Future perspectives. Materials Today: Proceedings, 56, 252-256.

Ringle, C. M., Wende, S., & Becker, J. M. (2024). SmartPLS 4. Boenningstedt: SmartPLS (2022).

Saini, N., & Shri, C. (2024). Environmental, social, and governance reporting adoption factors for sustainable development at the country level. Environment, Development and Sustainability, 1-40.

Saunders, M. N., Lewis, P., & Thornhill, A. (2019). Research methods for business students (Eighth). Harlow: Pearson education limited.

Shehawy, Y. M., Khan, S. M. F. A., & Alshammakhi, Q. M. (2026). The knowledgeable nexus between Metaverse startups and SDGs: The role of innovations in community building and socio-cultural exchange. Journal of the Knowledge Economy, 17(1), 2433-2468.

Sheth, J. N., & Venkatesan, M. (1968). Risk-reduction processes in repetitive consumer behavior. Journal of Marketing research, 5(3), 307-310.

Sokołowski, A., Wrzalik, A., & Niedbał, R. (2023). Blockchain Technology Awareness Among Managers of Large Enterprise. Procedia Computer Science, 225, 3031-3039.

Slovic, P. (1967). The relative influence of probabilities and payoffs upon perceived risk of a gamble. Psychonomic Science, 9(4), 223-224.

Shahzad, K., Ashfaq, M., Zafar, A. U., & Basahel, S. (2024). Is the future of the metaverse bleak or bright? Role of realism, facilitators, and inhibitors in metaverse adoption. Technological Forecasting and Social Change, 209, 123768.

Šímová, T., & Zychová, K. (2023). Who and What is Driving Remote Working Research? A Bibliometric Study. Vision, 09722629221139064.

Smith, H. (2025). The metaverse-industrial complex. Information, Communication & Society, 28(5), 797-814.

Stone, M. (1974). Cross-validatory choice and assessment of statistical predictions. Journal of the royal statistical society: Series B (Methodological), 36(2), 111-133.

Van Der Pligt, J. (1998). Perceived risk and vulnerability as predictors of precautionary behaviour. British journal of health psychology, 3(1), 1-14.

Venkatesh, V. (2025). Paradigm changing metaverse: future research directions in design, technology adoption and use, and impacts. Decision Support Systems, 188, 114307.

Wang, L., Feng, X., & Zang, L. (2024). Does risk perception influence individual investors' crowdfunding investment decision-making behavior in the metaverse tourism?. Finance Research Letters, 62, 105168.

Weinberger, M., & Gross, D. (2023). A comparison of virtual worlds based on the metaverse maturity model. ITU Journal on Future and Evolving Technologies, 4(4), 537-548.

Xi, N., Chen, J., Gama, F., Korkeila, H., & Hamari, J. (2024). Acceptance of the metaverse: a laboratory experiment on augmented and virtual reality shopping. Internet Research, 34(7), 82-117.

Yang, C., & Jiang, P. (2024). The effect of employee STARA awareness on job crafting: exploring the moderating role of positive stress mindset. Journal of Managerial Psychology.

Yin, M., Jiang, S., & Niu, X. (2024). Can AI really help? The double-edged sword effect of AI assistant on employees' innovation behavior. Computers in Human Behavior, 150, 107987.

Zhou, Z., Chen, Z., & Jin, X. L. (2024). A review of the literature on the metaverse: definition, technologies, and user behaviors. Internet Research, 34(1), 129-148.

Xie, J., Ye, L., Huang, W., & Ye, M. (2021). Understanding FinTech platform adoption: impacts of perceived value and perceived risk. Journal of Theoretical and Applied Electronic Commerce Research, 16(5), 1893-1911.