Creating an immersive environment of Metaverse for businesses

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Abstract

Metaverse is an immersive environment that shares online space with users to interact with an artificial world through avatars or other digital representations. By leveraging the immersive features of Metaverse, businesses can create new opportunities for revenue generation, customer engagement, collaboration, innovative products, services, or innovation. The development and governing of user interfaces and virtual environments are challenging. Since the metaverse concept is emerging, numerous questions remain about designing, executing, and benefiting from it in the business environment. This study identifies enablers that can support creating an immersive Metaverse environment for businesses to gain new business opportunities. The study deploys multi-criteria decision-making techniques, "Total Interpretive Structural Modelling," and "Cross-Impact Matrix Multiplication Applied to Classification" to establish cross-relationships among enablers. The study also provides a hierarchical roadmap for creating an immersive metaverse environment. Recognizing which enablers hold the most influence in a hierarchy can lead to the strategic development of an immersive environment. This study will help researchers, policymakers, technology consultants, and business practitioners explore Metaverse's most impacting enablers to gain competitive advantages and future opportunities for the business.

Keywords: Metaverse; virtual reality; immersive experience; business opportunities; TISM-MICMAC.

1 Introduction

In the immersive virtual environment of Metaverse, individuals, locations, and objects from the real world are represented by digital avatars with which people can interact, communicate, work together, and meet (Buhalis et al., 2023; Polyviou & Pappas, 2022). Metaverse technology is a virtual environment where people can get immersed in an artificial world (Bansal et al., 2022). The users engaged with the digital platform and formed social connections by using avatars in the immersive environment of Metaverse (Dwivedi et al., 2022). Metaverse aims to give users an immersive, spatial experience by utilizing cutting-edge technologies (Oleksy et al., 2023).

The technological revolution can transform the real world beyond time limitations (Kraus *et al*., 2022). Practitioners and scholars are increasingly investigating and debating the societal consequences of meta platforms' rollout of Horizon Worlds and its influence on various aspects of working culture and socialization (Kraus *et al*., 2022; Pamucar *et al*., 2022). In the

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Metaverse, people may freely move between the actual and virtual worlds while engaging in work, conversation, and socialization through Cyber-virtual simulations in mixed-reality settings (Li *et al*., 2023).

Frontiers of convergent technologies are shaping Metaverse, which is a fully immersive networked world of virtual reality, AI, crypto, and blockchain (Dwivedi *et al*., 2022). In a metaverse environment, virtual and real interactions can take many forms, ranging from fully immersive virtual experiences to hybrid experiences that blend elements of virtual and real worlds (Li *et al*., 2023). Businesses, governments, and societies would depend on the strength and scope of Metaverse to exchange knowledge, offer services, and work together in ways that have never been possible (Huynh *et al*., 2023). In the next decade, people will be surrounded by virtual objects and environments that will provide new interfaces and connections to time, places, and people with the emergence of human-computer interfaces (Bale *et al*., 2022).

People have already started spending time in a metaverse environment for education, training, shopping, office work, and entertainment (Huynh *et al*., 2023). The Metaverse often conducts business using digital assets like cryptocurrencies and non-fungible tokens (NFT). With the Metaverse environment, the manufacturing process, like acquiring raw materials, production, prototyping, and testing, could be sped up (Li *et al*., 2023). More sophisticated technologies are needed to facilitate the emergence of Metaverse and user-centered exploration. Metaverse must provide user-centric activities and realistic experiences (Zhao *et al*., 2022).

With e-commerce and m-commerce shopping trends, the Metaverse can be at the forefront of developing innovative and valuable customer interactions (Buhalis *et al*., 2023). Brands have been compelled to improve digital experiences so that consumers can disseminate information in retail sectors (Bansal *et al*., 2022). While preserving the adaptability of a remote or mixed working culture, Metaverse may also provide a way to improve the office environment. Metaverse can help in designing virtual reality workspaces to promote conversations, interactions, and collaborative activities (Buhalis *et al*., 2023; Huynh *et al*., 2023). Metaverse provides a digital platform where training, orientations, and corporate sessions can be performed for the employees to boost the efficiency and profitability of the business (Kraus *et al*., 2022).

To engage customers, businesses must allow them to connect with their brands, features, and market trends (Huynh *et al*., 2023; Prieto *et al*., 2022). Metaverse may improve the shopping experience by refining search engine optimizations and advertisement metrics, understanding buying behavior, and using virtual avatars (Prieto *et al*., 2022). Therefore, business organizations should have a long-term plan on a priority basis to deploy metaverse technology (Giang & Shah, 2023). Developing systems to monetize metaverse environments necessitates a broad range of skills, planning, development, marketing, and collaboration, regardless of the focused aspect being customers' experience, adverts, purchasable objects, or games (Prieto *et al*., 2022).

The metaverse idea is currently in its early stages, and there are still many questions about how it will be implemented and what benefits it will have for businesses (Hajian *et al*., 2024). The existing research has examined users' intention to utilize Metaverse in terms of perceived usefulness (Aburbeian *et al*., 2022), embodied presence (Zhang *et al*., 2022), informativeness and interactivity (Hwang *et al*., 2022), perceived ubiquity, user innovativeness (Salloum *et al*., 2023) and reducing cyber challenges (Sebastian, 2022; Hajian *et al*., 2024).

The metaverse environment encounters various challenges like governance (Dwivedi *et al*., 2022), *laws, regulations, and protections* of intellectual property (Lnenicka *et al*., 2024), technological scalability and interoperability between platforms (Aysan *et al*., 2024). Overcoming these challenges requires thoughtful planning and phased approaches (Al-Adwan, 2024). Besides, Metaverse facilitates technological solutions, transforming traditional businesses (Mkedder & Das, 2024).

The substantial initial investment needed for virtual and augmented reality technology, software, and infrastructure is one of the main obstacles (Al-Adwan, 2024). Researchers have an opportunity to investigate how virtual worlds emerged, what makes virtual platforms successful or unsuccessful, and what the best practices and potential hazards are when creating and implementing virtual environments thanks to the Metaverse.

The Metaverse enables social interactions among users to produce value and co-create experiences. Adequate technologies are required for different stakeholders, like enterprises, customers, and users, to facilitate the experience and value co-creation in the virtual context (Buhalis et al., 2022). Businesses using metaverses to improve consumer or employee experiences should consider their target markets' infrastructure and equipment needs and the technical requirements for such offers. Polyviou and Pappas (2022) have introduced a framework for analyzing the metaverses and business value in terms of measurements and value, such as how organizations, users, governments, and platforms create, measure, or distribute the value generated using metaverses.

The Metaverse can inspire the development of innovative tools for various tasks and processes or inspire the production of new tools for tasks already completed. This can encourage the development of novel or improved solutions to current problems. Digital innovations can create corporate value inside and outside organizations (Polyviou & Pappas, 2022). By leveraging the features of Metaverse, businesses can create new opportunities for revenue generation, customer engagement, collaboration, and innovation (Bale *et al*., 2022). The study has drawn a few research gaps based on previously published work analysis i) the enablers that can support the creation of an immersive environment of Metaverse are briefly explored in previous literature, and ii) Minimal resources are available for strategic planning and decision-making to create an immersive Metaverse environment. From the identified research gaps, this research has come up with the following research questions:

RQ1: What enablers can support creating an immersive Metaverse environment for businesses?

RQ2: How are these enablers interrelated for strategic planning and decision-making for business organizations to create an immersive environment for businesses?

To resolve identified questions in any research, there are many approaches for gathering empirical data: surveys, interviews, ethnography, social network analysis, experimental design, time series data, and so on. Conducting empirical qualitative research in a metaverse context opens new frontiers for researchers (Hajian *et al*., 2024).

The study appends to the body of knowledge regarding different enablers that drive the immersive environment of Metaverse. The proposed hierarchical model (figure 1) appends resource-based theory (RBT) and holds ideas for the strategic planning for Metaverse to improve computer-mediated shopping experiences to advance competitive business value. Businesses can leverage the outcomes of this study to formulate strategies for interactive virtual workspaces that can facilitate immersive experiences and interactions among stakeholders, including customers, employees, suppliers, and communities. Businesses can adopt innovative approaches to generating revenue and new business value in a virtual dynamic environment. The study also advances Uses and Gratifications (U&G) theory to steer strategically to develop immersive shopping experiences tailored to individual preferences. The developed hierarchical model sets multiple directions for future investigation of immersive metaverse environments for creating business value and success. The categorization of enablers through MICMAC analysis provides a more profound investigation of how distinct enablers are interrelated and affect an immersive metaverse environment.

The rest of the article's structure is as follows. Section 2 deals with the literature review and the factors selected for the study. Section 3 explains the methodology and tools used to carry it out. Section 4 elaborates on the findings of the analysis of TISM with MICMAC Analysis. In section 5, there is a discussion, contributions, constraints, and potential avenues for future study, while in section 6, conclusions have been drawn.

2 Review of Literature

2.1 Theories associated with Metaverse and business

The study thoroughly examined papers on the concept of an immersive environment, Metaverse, and associated technologies in the context of businesses. The existing literature describes Metaverse as a virtual environment using virtual reality through software agents and avatars (Lichtenthaler, 2018). The term "metaverse" refers to merging physical and digital realms, allowing users to move between them quickly for multiple uses such as employment, learning and development, health, hobby exploration, and social interaction. (Buhalis *et al.*, 2023). The Metaverse combines reality with the virtual environment through blockchain technology, avatars, and virtual reality headgear (Prieto *et al*., 2022).

The “technology acceptance model (TAM)” is a standard theory in metaverse studies. Previous studies on Metaverse have been focused on implementation based on this theory. The “practice-based view (PBV) theory” can be utilized to clarify how the Metaverse improves company performance (Bromiley & Rau, 2014). In metaverse retailing, U&G theory provides a valuable lens through which to analyze consumer behaviour dynamics. In Metaverse, customers actively seek virtual experiences that suffice their retail needs and tastes rather than acting as passive recipients (Hong & Chow, 2023). According to the U&G hypothesis, people engage with media and virtual worlds to fulfill various social and psychological needs (Hassouneh & Brengman, 2014; Chakraborty *et al*., 2023).

Using new technologies to create value requires addressing various social, environmental, and economic issues that may influence different societal stakeholders (Polyviou & Pappas, 2022). To study the potential of a metaverse environment for businesses' marketing capacities and procedures, Kozlenkova *et al*. (2014) used resource-based theory (RBT) (Barrera & Shah, 2023). The scope and volume of economic activity and the environment in which it takes place incredibly increase by transacting in metaverses. RBT works on the assumption that companies are collections of resources and competencies. Even when two organizations are operating in roughly the same markets or industries, RBT offers specific assumptions as to why it can occasionally be challenging to obtain the same high levels of economic value provided by another firm. RBT pays close attention to the creation and distribution of economic value. Organizations can employ RBT to attain market parity (Barney *et al.*, 2021).

2.2 Key enablers for the immersive environment of Metaverse

Few articles have discussed metaverse benefits and its impact on business organizations (Hajian *et al*., 2024). The Metaverse is an opportunity that businesses must carefully examine (Giang & Shah, 2023*)*. Companies must move quickly to assess and integrate Metaverse into their operations (Huynh *et al*., 2023). Virtual worlds have emerged as the predominant setting for metaverse-related research, consumer research, branding, and advertising (Buhalis *et al*., 2022*)*. Considering that each component should have distinct qualities and not have the same meaning as another, fifteen enablers were identified (table 1) from the existing literature after discussing with experts (table 2) through the purposive sampling method. Initially, the enablers were identified from various peer-reviewed literature studies to cover the concept's scope. A list was prepared for identified enablers consulted by experts (Table 2). The experts could also share their comments and suggestions regarding the enablers. Some enablers were merged and discarded based on the consensus of the experts to establish their level of agreement to reduce the duplicity and to increase a comprehensive understanding of the study. The detail of each enabler is presented below-

Immersive experience (V1)

Metaverse enables immersive experiences (V1) in real and virtual environments (Buhalis *et al*., 2023). By exploring virtual environments based on shared interests and preferences, users can collaborate to discover new and engaging experiences, enhancing their overall sense of immersion. Metaverse technology can support immersive experiences using 3D identities, realistic sensory stimulation, and interactive communication through emerging technologies (Capatina *et al*., 2024). Digital twins and other interface features are supported by Metaverse, allowing users to explore options in an immersive setting (Dwivedi et al., 2022). In the Metaverse, users can share their multimedia experiences and immersive content, influencing virtual and real-world settings by forming communities and exchanging digital content and interests (Buhalis *et al*., 2022).

Organizational agility (V2)

Business agility implementation demands high complexity and stakeholder cooperation (Huynh *et al*., 2023). An agile organization can adapt to changes in the environment and pivot its strategy and operations as needed to stay aligned with evolving user needs and trends. Collaborative platforms in Metaverse provide new levels of effectiveness, openness, and collaboration in flexible work settings (Prieto *et al*., 2022*)*. Working side by side in virtual platforms substantially improves transparency and enables us to get over real-world physical limitations (Bale *et al*., 2022).

Digital immersive environment (V3)

Digital immersive environments can be customized to create virtual environments that are relevant and engaging for a wide range of users. Dimensions of immersiveness are interactive, visual, emotional, and narrative (Bilgihan *et al*., 2024). Users can have an engaging, realistic, and reliable experience in an immersive virtual environment (Richter & Richter, 2023). One significant barrier to businesses and consumers utilizing this new technology is the need for immersive platforms in Metaverse (Jaung, 2022; Mkedder & Das, 2024). Cyber-Physical Systems (CPS) can help converge the physical and virtual world using sensors, actuators, intelligence, and connectivity (Martínez-Gutiérrez *et al*., 2024).

Unified business strategy (V4)

A unified business strategy can help organizations scale their operations and offerings consistent with their vision and purpose. Aharon *et al*. (2022) explored the areas where Metaverse can improve customer experiences, streamline operations, or generate new revenue streams. Various monetization strategies can be developed, such as selling virtual goods, offering subscriptions, charging for access to premium experiences, or leveraging advertising opportunities.

Monetization model (V5)

Emerging monetization prospects are likely one of the most critical developments in Metaverse. Businesses involved with Metaverse could immediately gain the benefits of new models early on and gain market share (Pamucar *et al*., 2022). Platform-based services are one of the ways to monetize the Metaverse. One Stop Metaverse Shops can be created by businesses that combine basic platform functionality with new services that cover cognitive content moderation, connectivity services, AI, and edge computing (Wei, 2022). Organizations can integrate immersive environments into their business model. Through the emergence of new industries, virtual collaboration can boost productivity. Metaverse can transform the economy using virtual marketplaces and currencies to facilitate digital commerce (Hajian *et al*., 2024).

Technological infrastructure (V6)

To implement Metaverse, organizations should focus on various issues like architecture, networking, communication, computation costs, interacting avatars, and online platforms (Xu *et al*., 2023; Hajian *et al*., 2024). The Metaverse can be connected to the physical world using IoT, sensors, blockchain technology, AI, edge computing, different Internet-based devices, and digital twins (Hajian *et al*., 2024). Users can create native virtual environments that suit their interests using the digital environment of the Metaverse. It is a collection of many virtual ecosystems that users can access (Hwang & Chien, 2022). Nevertheless, the Metaverse opens the potential for advancement when combined with augmented and virtual reality (Giang & Shah, 2023). Researchers and practitioners can consider the financial effects of using information technology by examining the business value of the technology with a firm-level focus (Polyviou & Pappas, 2022).

Visualization techniques (V7)

Visualization techniques can help users to analyze and understand data in virtual environments. Data visualization techniques help identify patterns, trends, and relationships, enabling users to make intelligent decisions and interact more effectively with the virtual environment. Zhao *et al*. (2022) suggested a framework based on graphics, visualization techniques, and interactions for Metaverse and user-centric exploration. The graphics create an integrated environment fusing physical and virtual worlds by creating 3D sceneries, player characters, and non-player characters (NPCs) for the Metaverse's visual architecture.

Digital immersive literacy (V8)

Digital immersive literacy refers to the ability to understand and navigate digital immersive environments. Users should also effectively navigate and understand immersive digital environments. Skill sets like VR design, blockchain, and cybersecurity are crucial for immersive environments (Bilgihan *et al*., 2024).

User-centric exploration (V9)

Zhao *et al*. (2022) proposed a framework to illustrate visualization methods, graphics, and interaction for creating Metaverse's visuals and user-centric exploration (Lnenicka *et al*., 2024). Diverse communication channels and the ability to manipulate digital artifacts are two benefits of a virtual collaboration environment for remote teams (Polyviou & Pappas, 2022). Effective interaction mechanisms and strategic planning are required to facilitate immersive user experiences in Metaverse (López-Cabarcos & Piñeiro-Chousa, 2024).

Regulatory compliance (V10)

Minimal performance standards and regulations are available for Metaverse (López-Cabarcos & Piñeiro-Chousa, 2024). Cryptocurrencies and NFT make trading virtual goods and services more accessible in the Metaverse. Although digital wallet Metaverse networks facilitate social connections, individuals still need control over which portions of personal information are accessible to whom (Zallio & Clarkson, 2022*)*. It must abide by the laws governing rights and tax matters (Pamucar *et al*., 2022*)*. Wu *et al*. (2023) have provided a comprehensive taxonomy of financial and security risks associated with decentralized Metaverse.

Regulatory needs and recommendations can influence metaverse systems and services' structure, functionality, and design. Global laws, like the "General Data Protection Regulation (GDPR)" of the "European Union (EU)," may also be inefficient in regulating privacy concerns in Metaverse (Dwivedi *et al*., 2022). Specific laws may apply to online content usage, data privacy, security, and virtual currencies, depending on the nation or location. These rules can be complicated for firms to comply with, and they put up barriers for new companies looking to enter the Metaverse (Mkedder & Das, 2024).

3-D Modelling (V11)

Metaverse is a vast network of 3-D virtual environments (Bale *et al*., 2022*)*. The technologies used to create graphically interactive, three-dimensional virtual representations on a computer are called 3D modeling (Barrera & Shah, 2023). It is a digital infrastructure that mimics the actual world by utilizing augmented reality, VR, blockchain technology, and social media. 3-D models can create virtual reality, characters, objects, and environments.

Ethics and governance (V12)

The Metaverse and its avatars must have adequate and consistent system regulations with user identity and data privacy secured in contrast to the social media market, which is primarily unregulated and very dubious regarding its ethics and privacy guidelines (Wei, 2022). A governance system is necessary to stop fraud, trolling, and other types of undesirable behavior in addition to content creation, such as events, games, and products (Zallio & Clarkson, 2022). Ethical constraints should be considered throughout the evolution of Metaverse (Aysan *et al*., 2024).

Ethics and governance can create a metaverse environment that is safe, fair, and sustainable while fostering innovation, collaboration, and community building among users. To run the Metaverse, governance should guarantee transparency and decision-making (Dwivedi *et al*., 2022). The governance model usually comprises regulatory frameworks, interoperability protocols, and governance structure (Aysan *et al*., 2024).

Innovative engaging content (V13)

Metaverse technology has the potential to drive brands towards innovation and engage consumers in novel ways. How advertising systems interact with consumers will dramatically transform (Hajian *et al*., 2024). Theories on customer engagement and loyalty may need to be redefined considering ideas like "telepresence" and avatar-based personalization (Bilgihan *et al*., 2024).

Data ownership and integrity (V14)

Businesses considering joining the Metaverse as users or owners should be aware of two crucial privacy considerations: the platform privacy, which they intend to follow, and their privacy policies (Kraus *et al*., 2022). This is difficult since there is no legislative structure till now. Consumers may need to be more informed about what metaverse privacy entails. Companies should take the initiative to implement successfully (Zallio & Clarkson, 2022).

Virtual and real interactions (V15)

Virtual communication can take different forms, such as communication, collaboration, socialization, and participation in virtual activities. Innovative and engaging content can encourage users to explore virtual environments in a personalized, dynamic, and interactive way. Any digitally created location or experience is considered an aspect of virtual space (Hajian *et al*., 2024). "virtual reality" describes fully immersive experiences that substitute a simulated world for the real one. The process of adding digital data to the real world and enhancing it with computer-generated perceptual data is known as augmented reality (Hajian *et al*., 2024).

When a new product is released, consumers may wish to buy metaverse-specific products to have experience before purchasing it (Huynh *et al*., 2023). Businesses can guarantee that customers should have access to experiences by supporting technologies as they create identities in each space (Bale *et al*., 2022). Operating a business in the Metaverse requires metaverse-capable talent, regardless of where the company is positioned. However, these fields have a distinct dearth of expertise because of wide gaps between software specializations and skilled experts (Papagiannidis *et al*., 2022). The summary of selected vital enablers is shown in Table 1.

Enabler	Description	References (Year)
Immersive experience (V1)	A large-scale, open, communicative, constantly dynamic virtual setting with a real-time, fully functional world.	Prieto *et al*., 2022; Buhalis *et al*., 2023; Capatina *et al*., 2024
Organizational agility (V2)	The ability of an organization to reinvent itself, transform quickly, adapt, and grow in a dynamic, uncertain environment.	Bale *et al*., 2022; Prieto *et al*., 2022; Huynh *et al*., 2023
Digital immersive environment (V3)	The application of technology enhances augmented, virtual, and mixed and combines physical integration with digital one.	Buhalis *et al*., 2022; Bilgihan *et al*., 2024
Unified business strategy (V4)	A unified approach combines conventional business methods like direct marketing with internet resources like blogs, online content, social networks, email, or advertising.	Aharon *et al*., 2022
Monetization model (V5)	Users must pay charges to get the privilege of occupying space in the virtual world. Service providers must develop innovative business strategies to monetize the Metaverse for its users.	Pamucar *et al*., 2022; Hajian *et al*., 2024

Technological infrastructure (V6)	Telecommunications providers may need to create more compact wireless cell networks and adopt new technologies that can recognize and react dynamically to various data types to better support early metaverse experiences and enable future experiences at scale.	Zallio & Clarkson, 2022; Xu *et al*. 2023
Visualization technique (V7)	Present data in virtual reality and real-time data with aesthetically pleasing visual features. Users have a more incredible experience of the information when they engage with it in a thorough and immersive way, which improves the effectiveness of the data visualization process. It interacts almost as naturally with three-dimensional data due to clarity as 3D data objects.	Bale *et al*., 2022; Zhao *et al*., 2022
Digital Immersive literacy (V8)	"Digital immersion" describes integrating the physical environment and informational virtual world. It involves using technologies that alter or enhance the physical environment, including AR, VR, extended, and mixed reality.	Kraus *et al*., 2022; Bilgihan *et al*., 2024
User-centric exploration (V9)	A digitally enhanced virtual platform where users can interconnect in a digital environment.	Papagiannidis *et al*., 2022; Lnenicka *et al*., 2024
Regulatory compliance (V10)	To control the immoral use of technology, national legislation and regulatory bodies have set laws, rules, and regulations pertinent to a particular business based on the industry and nation in which it operates.	Zallio & Clarkson, 2022; López-Cabarcos & Piñeiro-Chousa, 2024; Dwivedi *et al*., 2022; Mkedder & Das, 2024
3-D Modelling (V11)	Any surface of an item, whether inanimate or alive, can be represented mathematically using coordinates in three dimensions by altering its edges, vertices, and polygons. An interconnected system of 3D virtual worlds called a "metaverse" focuses on social and commercial interaction.	Bale *et al*., 2022; Barrera & Shah, 2023
Ethics and Governance (V12)	Concerns about identity control, privacy, economic injustices, social accessibility, and freedom of expression make up most ethical issues in digital platforms.	Wei, 2022; Zallio & Clarkson, 2022; Aysan *et al*., 2024
Innovative engaging content (V13)	Virtual experiences can be divided into games, virtual locations, and virtual occasions. Metaverse allows interaction with people in entirely new ways while advancing existing capabilities.	Hwang & Chien, 2022; Bilgihan *et al*., 2024; Hajian *et al*., 2024
Data ownership and integrity (V14)	The control and usage rights of digital assets and property within these virtual settings are the subject of ownership problems in the Metaverse.	Kraus *et al*., 2022; Wei, 2022
Virtual and real interaction (V15)	a wholly realistic virtual environment where users might engage in real-world-like interactions with one other and virtual things. It would include cutting-edge technology, augmented reality, and virtual reality.	Hwang & Chien, 2022; Giang & Shah, 2023; Hajian *et al*., 2024

Table 1. *Key enablers selected for the study*

3 Methodology

3.1 TISM and MICMAC Analysis

This research adopted "Multi-criteria decision-making (MCDM)" techniques to study selected enablers that can support an immersive environment of Metaverse for business. The links between components and their complexity have been established by applying Total Interpretive Structural Modelling (TISM) and Cross-Impact Matrix Multiplication Applied to Classification (MICMAC). A set of variables can use the "Interpretive Structuring Modelling (ISM)" technique to create a graphical representation of a complicated system. J.N. Warfield first invented this method in 1973; several authors have used its concept and analytical details in their research (Dinesh, 2023; Singh & Sushil, 2013).

The interpretive structural modelling identifies the logic of interrelationship within factors and is innovatively extended by the TISM technique. The TISM approach helps solve complex problems when many elements must be examined (Bag, 2016).

The following are the TISM's methodology steps: -

- Figuring out the elements that are important to the issue. Literature reviews, surveys, or strategies for group problem-solving could all be used to accomplish this. TISM participants include the following-
- Applying pair-wise comparison to establish the contextual link between each factor.
- Designing a "structural self-interaction matrix (SSIM)" of the selected factors (Table 3) to establish pair-wise interactions between the selected factors. The survey and expert opinion approach could be employed to create the matrix.
- The "Initial reachability matrix" (Table 4) is developed from SSIM, and the "final reachability matrix" is by checking transitivity (Table 5).
- Level-by-level partition of "final reachability matrix" (Table 6).
- Building a conical form of reachability matrix (Table 7).
- Developing a digraph based on the connections in a canonical matrix and eliminating all transitive links other than those with a distinct meaning.
- Transforming the resulting digraph into a TISM model (Figure 1) by substituting statements for element nodes and links for interpretation relations.

MICMAC analysis was performed to classify factors according to how they can influence one another. In 1973, Duperrin and Godet developed MICMAC analysis to categorize enablers according to how much they can influence each other (Attri *et al*., 2013). The MICMAC analysis is done using TISM data as inputs. It classifies each component into four groups: independent, autonomous, dependent, and linkage (Figure 2).

3.2 Methodological selection

The TISM technique is interpretive, where the group's judgment decides whether and how the factors/enablers are related. It is a modeling technique to depict the relationships and overall structure as a hierarchical digraph model. The methodology helps to enforce order and direction on the complexity of the relationships among the enablers. TISM and MICMAC have better practice advantages over other MCDM techniques for problems like immersive business metaverse environments.

TISM-MICAMC techniques support systematic ranking and rating of factors. The "Technique for the Order of Prioritization by Similarity to Ideal Solution (TOPSIS)" can yield different rankings of elements compared to other MCDM approaches; however, it cannot preserve the consistency of the weight-assigning procedure. The analytical hierarchy process (AHP) is criticized since it tends to rank reversal. In addition, AHP creates a rigid hierarchy in which elements at the same level are assumed to be independent—the incapacity of ANP to provide weighted consequences among connected components.

"Elimination and Choice Expressing Reality (ELECTRE)" is often used to choose, rank, and arrange options before eliminating them. The "Preference Ranking Organization Method for Enrichment Evaluations" (PROMETHEE) is better for rating processes from best to worst. PROMETHEE only offers a partial ranking of the behaviors. Only the cause-and-effect relationships between the components are shown by DEMATEL. The relationships between the variables are shown using graph theory, albeit the accuracy of the graphs' edge directions is doubtful. Interpretive structural modelling (ISM) captures complexity dynamics but does not examine inverse linkages. Based on the elements' driving forces and dependencies, TISM-MICMAC discloses their inter-contextual relationship. The TISM-MICAMC has been used in several previous studies, like analysis of factors for digital supply chains (Khan *et al*., 2021; Sharma & Kumar, 2023) and industry 4.0 leadership (Bianco *et al*., 2021).

3.3 Survey and details of respondents

The research is an empirical study driven by twenty-seven experts' input to create a SSIM matrix. A structured questionnaire was sent to ninety-five senior executives of companies from September 2022 to January 2023 through email in the form of a 'VAXO' she*et al*ong with a brief description of the purpose of the research, selected factors, and their description to establish contextual relationships. The experts were selected through a profile search over a LinkedIn platform and have at least five years of relevant experience working as senior executives, such as senior managers, vice presidents, technical consultants, IT officers, and business unit heads. Out of the targeted 95 respondents (based on the purposive sampling method), only 29 respondents reverted to the filled 'VAXO' form. Out of 29 responses received, only 27 responses (Table 2) were found complete. Based on responses, a 50% majority response approach has been adopted to establish contextual relationships for SSIM.

Gender	Male	**15**
	Female	12
Age	25-35	5
	36-50	8
	Above 50	14
Education	Graduation	20
	Post Graduation & PhD	7
Occupation	Vice President	3
	Technical Consultant	9
	IT Officers	6
	Business Unit Heads	5
	Marketing professionals	4

Table 2. Respondents' (experts) demographic information

4 Results and Findings

4.1 4.1 Analysis and development of hierarchical model

Based on responses received from the respondents, a "Structural Self-Interaction Matrix" was developed (table 3). A 50% majority response approach has been adopted to establish contextual relationships (Singh & Sushil, 2013).

V= Where V_i influences V_j

A= Where V_j Influences V_i

X= Where $V_i$and V_j both influence each other's

O= Where no relationship between $V_i$and V_j

	V1	**V2**	**V3**	**V4**	**V5**	**V6**	**V7**	**V8**	**V9**	**V10**	**V11**	**V12**	**V13**	**V14**	**V15**
V1	-	A	X	A	O	A	A	A	A	A	A	O	A	A	A
V2		-	V	X	V	V	V	V	V	V	V	V	O	O	V
V3			-	A	A	A	A	A	A	A	A	O	A	A	A
V4				-	V	V	V	V	V	V	V	V	O	V	V
V5					-	V	V	O	O	X	V	X	V	V	V
V6						-	V	V	V	A	V	A	V	X	V
V7							-	V	V	A	V	O	V	A	X
V8								-	X	A	A	A	X	O	A
V9									-	A	A	O	X	A	A
V10										-	V	X	V	V	V
V11											-	A	V	A	X
V12												-	V	V	V
V13													-	A	A
V14														-	V
V15															-

Table 3. *"Structural Self-Interaction Matrix" (SSIM)*

The "initial reachability matrix (IRM)" was created from SSIM by replacing it with 0 or 1 as per the rules of transformation (Table 4, appendix). The transitivity rule has also been tested on the initial reachability matrix and if transitivity has been introduced as 1* (Table 5, appendix). The level partition was accomplished to comprehend the level-wise placement of determinants (Kumar *et al*., 2019). The antecedent and reachability set (Table 6, appendix) were computed from the final matrix of reachability (table 5). The canonical matrix (Table 7, appendix) is constructed after identifying all the portioned levels.

The Canonical Matrix (table 7, appendix) is a matrix form that integrates all the factors that have been grouped into the same portioned level, helps validate level partitions, and aids in developing the TISM digraph. Based on the level partitioning (table 6) and conical matrix (table 7), all enablers were arranged at their respective partitioned levels to form the TISM digraph, and direct links were then created according to the cross-relationship identified within the final reachability matrix. In the digraph, the important transitive links are displayed (Figure 1).

4.2 Cross-impact relationships

The cross-impact factors were analysed using the developed digraph (figure 1). Unified business strategies (V4) provide a clear and consistent direction for the organization to decide on changing circumstances. When the market or business environment changes, the companies can do so more rapidly and effectively. Organizational agility (V2) identifies new opportunities for businesses. By involving a diverse range of stakeholders in developing strategies, the organization can ensure that it is aligned with the needs and priorities of the entire organization.

An agile organization can quickly understand new regulations, implement the necessary changes, and avoid compliance failures. In metaverse situations, organizational agility can be crucial to meeting regulatory compliance. By being flexible, responsive, and collaborative, organizations can more effectively navigate the complex regulatory landscape and comply with regulations promptly and efficiently. The unified business strategies influence the adoption of technological infrastructure in the Metaverse through the development of interoperable systems and standards. An agile organization should establish robust data security procedures and strict policies to safeguard data from unauthorized access, misuse, and disclosure. To develop metaverse strategies and to encourage consumers to engage in the Metaverse, every firm needs to build trust in business users and systems (Golf-Papez *et al*., 2022).

Ethical frameworks help to define the values and principles of an organization. Ethics and governance (V12) practices can help businesses identify and manage risks associated with regulatory compliance (V10). Organizations can minimize the risk of compliance failures by having robust risk management processes. Monetization through advertising is a common practice in metaverse environments. Businesses can adjust quickly and successfully as the market or business environment changes (Aharon *et al*., 2022).

Regulatory compliance often requires organizations to assess and mitigate risks related to their operations. Regulatory compliance related to advertising can impact how organizations monetize their products and services. The chosen monetization model (V5) can influence the way 3-D Modelling is approached and utilized in the Metaverse. Business models for the Metaverse can expand on the benefits of growing digital services (Weking *et al*., 2023). Regulations related to data privacy can impact how organizations collect, use, and share personal data in metaverse environments. Regulations that promote open standards and data interoperability can impact data ownership (V14) in metaverse environments.

The stakeholders must work together to build a reliable metaverse and derive value from it (Golf-Papez *et al*., 2022). Regulations like open virtual reality standards can promote interoperability between different online platforms and help to ensure that data can be easily shared and owned across different platforms to promote trust with customers and regulators. Adhering to ethical principles and establishing governance structures, organizations can ensure that visualization techniques (V7) are used to build user credibility.

The hardware, software, and network technologies used to create and run the virtual environment are considered the Metaverse's technological infrastructure (V6). The design of hardware and software systems must be robust and secure, with appropriate measures to prevent data breaches and cyber-attacks. The developers can use technologies like 3D Modelling, mixed reality, blockchain, AI, social platforms, electronic shopping, digital twins, online games, and big data (Barrera & Shah, 2023; Jaung, 2022).

AI can produce intelligent virtual characters to interact with users for a more immersive experience. The technological infrastructure of Metaverse is essential for creating innovative and engaging content (V13). The network architecture must also be reliable, with high bandwidth and low latency, to support real-time user interactions. The quality and speed of the network can influence the ability to establish and maintain virtual connections, which can impact the quality and reliability of virtual interactions (V15). Data accuracy is also essential to the effectiveness of digital immersive experiences. The completeness of data is vital for creating a realistic and immersive experience.

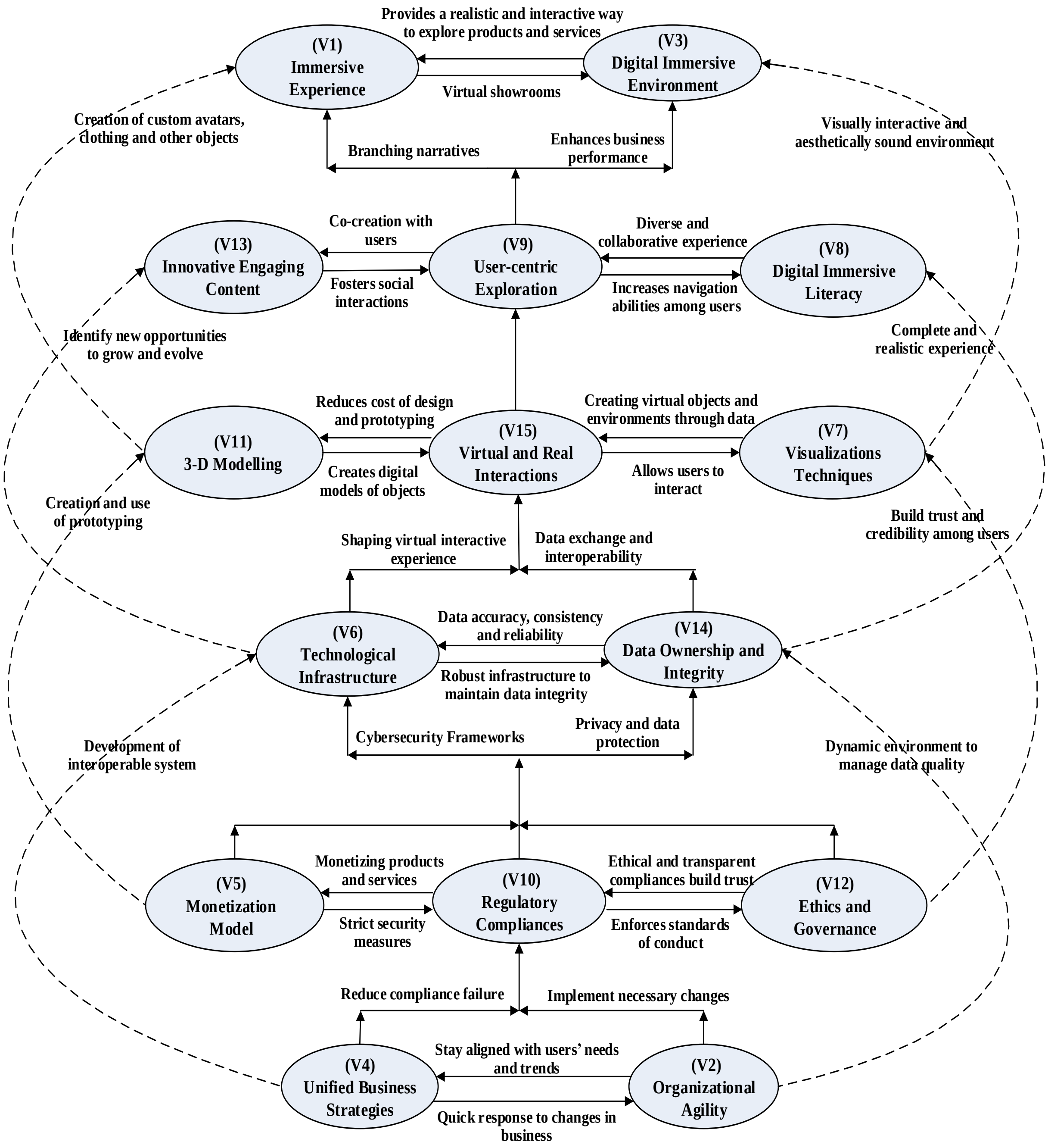

Figure 1. *TISM digraph analyzing cross relationships among enablers for creating an immersive environment of Metaverse for businesses.*

Visualization techniques (V7) can increase users' sense of presence and engagement. 3D graphics, virtual reality, and animation can give customers a more dynamic and realistic experience, making virtual interactions more compelling and engaging. Data visualization techniques can help identify trends, patterns, and relationships to enable users to make informed choices and communicate more successfully with the virtual environment.

Visualization techniques can be used to create realistic and believable environments that accurately represent the real world.

AI-based agents populate digital immersive environments (V13) (Zallio & Clarkson, 2022). Techniques like photorealistic rendering, motion capture, and 360-degree video can be applied to produce exciting experiences that feel like the real thing. Users' sense of presence and immersion may be improved as a result. 3D Modelling (V11) facilitates visually interactive representations of objects (Barrera & Shah, 2023).

3-D modelling allows the creation of custom avatars, clothing, and other objects in Metaverse. The accuracy of the 3D models can impact the realism and effectiveness of virtual interactions. Virtual interactions can greatly influence user-centric exploration, such as personalized recommendations and notifications that can guide users toward virtual environments and experiences that align with their interests. Touch-sensing interactions can empower the customers (Golf-Papez *et al*., 2022; Jaung, 2022).

The integration of online channels enlarges firms' innovation performance. Innovative and engaging content (V13) can facilitate social interaction in the Metaverse, enabling users to share experiences and explore virtual environments. Innovative and engaging content can stimulate users' creativity and stimulate them to create and share their content in the Metaverse. Immersive technologies strongly influence gestures of communication (Zallio & Clarkson, 2022).

Digitally literate users are more likely to have an easier time navigating virtual environments, which can encourage user-centric exploration (V9). By verbally commanding voice assistants and managing their involvement and interactivity, users may personalize their experience (Buhalis *et al*., 2023). User-centric exploration can increase user engagement with immersive environments. Metaverse enables immersive experiences (V1) in virtual and real environments (Buhalis *et al*., 2023). By exploring virtual environments based on shared interests and preferences, users can collaborate to discover new and engaging experiences, enhancing their overall sense of immersion. Digital immersive environments (V3) can be customized to create relevant and engaging virtual environments for many users.

4.3 MICMAC Analysis

For each enabler, dependence (DP) is calculated as column sum, and the driving power (DR) is determined as row sum (table 4). All the factors are divided into autonomous, dependent, linkage, and independent factors using both driving and dependent power. In this study, as there are fifteen factors, the 7.5 scale is the midpoint (i.e., 15/2= 7.5 scales), and the graph is divided into four quadrants (figure 2).

i. **Cluster I (Autonomous Variables)**: weak DR and DP represented by this area. Any variable here signifies a weak variable. Figure 2 shows that no variables are visible in the first cluster, i.e., cluster I, and that selected factors are well chosen.
ii. ***Cluster II (Dependence Variables)**:* This cluster indicates all variables with intense DP and weak DR. V1, V3, V8, V9, and V13 are five variables are there. These enablers are situated at the top level of the proposed hierarchy model. Other variables influence these due to weak DR.
iii. ***Cluster III (Linkage Variables):*** This cluster has strong DR and DP. All factors that fall under this cluster are linkages and actions taken on these factors influence all other factors. Here, V7, V11, and V15 appear as linkage factors.

iv. *Cluster IV (Independent Variables):* This cluster indicates weak DP and strong DR. Here, V2, V4, V5, V6, V10, V12, and V14 appear as independent factors influencing the hierarchal model.

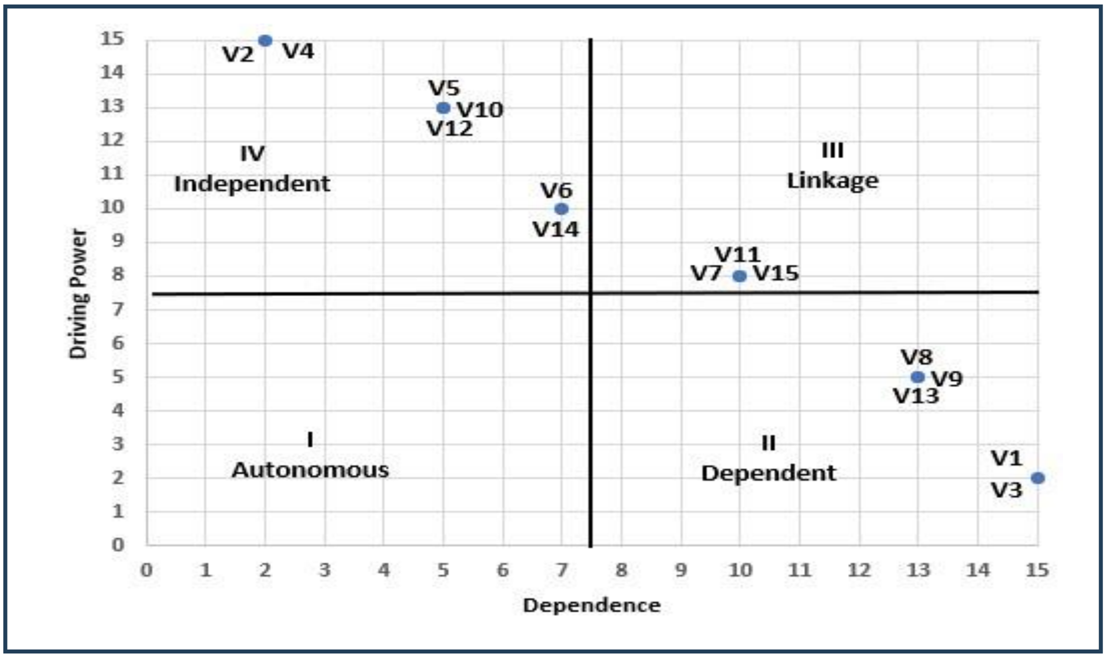

***Figure 2**. MICMAC Analysis*

5 Discussions

The proposed model (figure 1) discovers relationships among all factors. Organization agility (V2), unified business strategy (V4), monetization model (V5), regulatory compliance (V10), ethics and governance (V12), technological infrastructure (V6), and data ownership and integrity (V14) are seven crucial factors that influence changes in remaining factors that affect businesses. Visualization techniques (V7), virtual and tangible interactions (V15), and 3-D Modelling (V11) are linkages. Other factors are dependent, and further change in these variables is a result of changes in independent and linkage enablers.

It is pertinent that businesses must develop a unified business strategy (V4) and organizational agility (V2). Unified business strategies provide clear direction, improve decision-making, enhance resource allocation, promote better communication, and foster greater flexibility. The organizations can develop strategies that are aligned with their goals and priorities. Organizations can ensure their strategies by identifying potential risks and developing contingency plans. Organizations with high agility can collaborate with regulators, customers, and suppliers to implement necessary changes and ensure compliance. An agile organization can innovate to develop new solutions that comply with regulations. The businesses can leverage their unified strategies (V4) to address important ethical and social considerations.

Ethical solid and governance (V12) practices can ensure regulatory compliance (V10). By establishing a clear ethical framework, implementing effective governance practices, managing risks, promoting transparency and accountability, and providing employee training, organizations can improve their compliance efforts and minimize the risk of compliance failures. Regulatory compliance (V10) often requires organizations to adopt and enforce standards of conduct that promote ethical behavior. Organizations must be aware of the regulatory landscape and comply with relevant regulations related to the monetization model (V5), data privacy, intellectual property, open standards, and security. Compliance with regulations can promote ethical behavior, transparency, risk management, and stakeholder engagement, all essential components of ethical governance.

The possibility for unlawful, immoral, or unethical behavior in virtual environments requires appropriate legislation; these environments also provide ethical and legal difficulties (Buhalis *et al*., 2023). Individuals and institutions can create, promote, and offer new goods and services with the help of new business models in Metaverse (Barrera & Shah, 2023). As enhanced activities in the metaverse increase, VR hardware and in-game advertising revenue considerably rise (Huynh *et al*., 2023). Investments in such business models and technology are being made to create virtual platforms that could combine important online industries like e-tail business, social networking engagement, education, entertainment sectors, AI, and big data (Jaung, 2022).

The technological infrastructure (V6) of the Metaverse is closely tied to data integrity (V14). The system's speed, responsiveness, and stability can affect the ability to perform virtual activities. Organizations must prioritize data ownership and integrity (V14) when designing and building digital immersive environments (V3) to ensure users can effectively navigate, understand, and create content.

The visualization techniques (V7) play a critical role in enabling and enhancing virtual interactions (V15) by allowing a more immersive, collaborative, and engaging virtual environment to support effective communication, collaboration, and decision-making. By using the proper visualization techniques, organizations can create realistic, straightforward, interactive, and aesthetically pleasing environments, helping to enhance the overall user experience and engagement. 3-D modelling (V11) is critical to many virtual environments and can support various virtual interactions (V15). 3-D modelling technology can create different environments, objects, and virtual try-ons in Metaverse (Golf-Papez *et al.,* 2022).

By creating immersive user experiences (V1), augmented reality improves virtual reality's 3-D real-time environment rendering capabilities (Barrera & Shah, 2023). Customers purchase activities in virtual worlds resembling the Metaverse for various reasons, including discovery, self-expression, sociability, escapism, and amusement (Barrera & Shah, 2023). Virtual interactions (V15) can facilitate collaborative exploration in the Metaverse. Virtual interactions are critical in facilitating user-centric exploration in the Metaverse, enabling people to engage in a more personalized, collaborative, and interactive virtual environment.

Innovative and engaging content (V13) can significantly impact user-centric exploration (V9). Digital immersive literacy (V8) can be critical in shaping user-centric exploration (V9) in the Metaverse. Investments in metaverse-related business and technology are being made to integrate significant internet industries, including social networking, online retail, entertainment, education, and big data with artificial intelligence (Barrera & Shah, 2023).

User-centric exploration (V9) can enhance user engagement and facilitate more diverse experiences in Metaverse. Digital immersive environments (V3) provide the tools and features to make immersive experiences possible. By incorporating advanced graphics, natural interaction, personalized content, and engaging storytelling, developers can create compelling and immersive experiences. With immersive 3-D virtual worlds, the Metaverse may offer a new way of interacting with the natural world (Jaung, 2022).

5.1 The study's theoretical contributions

The proposed hierarchical model (figure 1) appends resource-based theory (RBT) and holds ideas for the strategic planning for Metaverse to improve computer-mediated shopping experiences to advance competitive business value (Bromiley & Rau, 2016). This study identifies and explores the enablers for creating an immersive metaverse experience (RQ1). The developed hierarchical model (figure 1) sets multiple theoretical directions for future investigation of immersive metaverse environments for successful business. In addition, the study presents a hierarchical road map for developing an immersive metaverse ecosystem that would provide ways for generating value, engaging users, cooperating, and innovating new goods and services in a cyber-physical world.

The examination of dependent (V1, V3, V8, V9, V13), linkage (V7, V11, V15), and independent factors (V2, V4, V5, V6, V10, V12, V14) adds to the theoretical distinction of these enablers. This classification thoroughly analyzes how distinct enablers interact and affect an immersive metaverse environment (RQ2). To provide a deeper understanding of the cross-interaction between enablers and their impacts on building an immersive metaverse environment for businesses, this model (figure 1) can also be used as a point of reference for future studies.

As suggested in resource-based theory (RBT) (Bromiley & Rau, 2016), resources like R&D capabilities, logistics, brand management, low-cost processes, suppliers, customer demand, technology change, planning, managing, and coordinating systems develop the dynamic capabilities and competence of a business organization. Businesses can get an edge by continuously reorganizing or reconfiguring various resource classes and developing new applications to satisfy consumer demand and generate value from many angles. (Utami & Alamanos, 2022). Digital immersive environment (V3) (outcome of this study) promotes “value co-creation” and “technology-enhanced experience” (Buhalis *et al*., 2022) for the customers. E-retailers may gain value through the sales of virtual products (Polyviou & Pappas, 2022).

The "technology acceptance model" and "innovation adoption theories" are the cornerstones of metaverse research, which will build upon them to create metaverse-focused research (Buhalis *et al*., 2022). The research additionally supports the U & G theory as a strategic framework for creating immersive retail experiences customized to individual preferences. Based on customers' aspirations to use the Metaverse continuously, the U & G theory forecasts the future utilization of these immersive retailers (Chakraborty *et al*., 2023). The researchers can further explore various enablers discussed in the proposed hierarchical model, including user-centricity, collaboration, training, shopping experience, work culture, entertainment, and communication.

The study explores a new dimension to user-centric experience (V9) by allowing businesses to design dynamic and immersive experiences for their customers. This could entail trying out different marketing strategies or creating chances to create new instruments or procedures to help employee-driven digital breakthroughs (Polyviou & Pappas, 2022). The study also sets a research direction for the knowledge segment to study the influences of digital environments on human behavior, cognition, and emotions. To understand the impact of the business model for Metaverse adoption, innovation adoption research should look at the Metaverse environment holistically, taking into account aspects such as entrepreneurship, food and beverage, human resources, strategy, management, and strategy (Buhalis *et al*., 2022) to identify innovative ways of generating economic value (Barney *et al*., 2021).

5.2 Practical contributions and implications

Recognizing the most influential enablers can inform the strategic creation of an immersive environment. The hierarchy of these enablers (figure 1) must be considered by companies seeking to enter the Metaverse, as doing so can significantly increase their chances of developing an immersive environment that is successful.

The proposed model (Figure 1) presents several enablers, such as business models, user experience, social interaction, governance, regulation, and innovation, to develop an immersive metaverse environment. To support the redefinition of human work-related processes, government associations (V12) may capitalize on these opportunities and create laws that promote the adoption of metaverses at workplaces (Polyviou & Pappas, 2022). Virtual worlds can enhance the collaborative experience of workers in remote teams.

Businesses must plan strategically to use Metaverse to generate emerging business opportunities, economic value, customer engagement, shopping experiences, and designing new products or services. In addition, users must acquire new abilities to facilitate the metaverse transfer and guarantee the seamless and efficient use of metaverses (Polyviou & Pappas, 2022). The conventional customer base will remain crucial in the banking, insurance, financial services, manufacturing, retail, and tourism industries. For specific business use cases, these sectors will either create their own Metaverse for consumers or join/rent out others (Giang & Shah, 2023).

Metaverse has significant practical implications for businesses across various industries. Metaverse allows businesses to engage clients innovatively through virtual services and goods. Visualization techniques (V7) can increase users' sense of presence and engagement. 3-D graphics, virtual reality, and animation can give users a more realistic and interactive environment. Virtual interactions (V15) can significantly influence user-centric exploration, like personalized recommendations and notifications. Unified business strategies (V4) provide a clear and consistent direction for the organization to make decisions and act quickly in response to changing circumstances. The lesson learned is that service providers must increase their client base and rely less on their existing clientele (Zallio & Clarkson, 2022).

Using the Metaverse, businesses can develop immersive and interactive training programs that help to improve employee learning and retention. By leveraging the immersive features of Metaverse, businesses can create new opportunities and value for revenue generation, customer engagement, collaboration, new products, services, or innovation. Businesses are required to have long-term technical strategies to take advantage of the Metaverse. The proposed hierarchical model and MICMAC analysis suggest developing strategies for successfully incorporating emerging technologies into business to maximize business benefits using a metaverse environment.

Businesses can leverage the outcomes of this study to create interactive virtual workspaces. Businesses can learn important information about customer preferences by tracking users' behavior and interactions in a virtual environment. And behaviors to identify new business opportunities. Individuals and institutions can create, promote, and sell innovative products and services in Metaverse. One can get new prospects and greater autonomy by customizing business offerings using Metaverse and co-creating business value (Buhalis *et al.*, 2023).

5.3 Limitations & Future scope

The study analyzed 15 enablers for strategic planning for a technology-illusive Metaverse environment for businesses. There might be more factors to address the digital immersive environment by viewing from other domains of business organization development, capability building, cyber security, revenue generation, and digital transformation perspectives. Adding or subtracting any factor can change the hierarchy. It is challenging to rank among enablers in the TISM hierarchical process.

Future studies may focus on several areas of metaverse applications in businesses. As businesses begin to use the Metaverse, research will be needed on the most effective business models to generate revenue within the Metaverse. Metaverse can be advanced with the help of generative AI, which can significantly speed up its expansion and advancement. Future research may be conducted to optimize user experiences in a metaverse environment, including interface design, user engagement, and personalization. Future research could explore different models for governing the Metaverse and the potential regulatory frameworks that may be necessary for developing and launching innovative products within the Metaverse.

6 Conclusions

This study incorporates earlier investigations into the metaverse conceptualization. The importance of Metaverse is increasing because of the new opportunities and value it offers to enterprises for global virtual communication and collaboration. The enablers that affect Metaverse's success and value creation in businesses are this study's central subject. The enablers have been identified from literature studies. Experts were consulted to finalize the selected enablers and provide SSIM input. As an outcome of the TISM process, a hierarchical model is proposed to describe how various factors are linked to each other and their level of importance. The results would assist business practitioners in understanding enablers that influence the successful incorporation of technology into business processes and assist in maximizing the benefits of a metaverse environment.

Organizational agility (V2) can be critical in meeting regulatory compliance in metaverse environments. The chosen monetization model (V5) can influence the way 3-D modeling (V11) is approached and utilized in the Metaverse. 3-D Modelling also facilitates visually interactive representations of objects. The network's speed can influence the reliability of virtual interactions (V15). Organizations must be aware of the regulatory landscape and comply with relevant regulations related to the monetization model (V5), data privacy, intellectual property, open standards, and security. Maintaining the confidentiality of data in the virtual environment demands data integrity (V14).

Avatar realism has significantly been improved using real-time recognition, tracking, and simulation technologies. Governments will need to introduce rules and policies to deal with the new issues brought up by the Metaverse. User-centric exploration (V9) can increase user engagement with immersive environments (V3). Immersive experiences (V1) can be tailored to facilitate users with unique and meaningful experiences. Digital immersive literacy (V8) navigates digital immersive environments. Metaverse's technological infrastructure (V6) is essential for creating innovative and engaging content (V13) to facilitate social interactions and sharing experiences.

For Metaverse, a robust and advanced technology infrastructure (V6) is required, including high-speed networking capabilities, powerful servers, data centers, AI-driven analytics, APIs tailored to 3D environments, real-time data processing, and management. Personalized recommendations, immersive experiences, and interactive components can all help to extend customer engagement and boost the possibility of future sales conversion. The businesses may need to navigate interoperability challenges when connecting with other businesses or users within the Metaverse. This may make creating a seamless and integrated experience across multiple platforms challenging.

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Appendix

	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15
V1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
V2	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1
V3	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
V4	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1
V5	0	0	1	0	1	1	1	0	0	1	1	1	1	1	1
V6	1	0	1	0	0	1	1	1	1	0	1	0	1	1	1
V7	1	0	1	0	0	0	1	1	1	0	1	0	1	0	1
V8	1	0	1	0	0	0	0	1	1	0	0	0	1	0	0
V9	1	0	1	0	0	0	0	1	1	0	0	0	1	0	0
V10	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1
V11	1	0	1	0	0	0	0	1	1	0	1	0	1	0	1

V12	0	0	0	0	1	1	0	1	0	1	1	1	1	1	1
V13	1	0	1	0	0	0	0	1	1	0	0	0	1	0	0
V14	1	0	1	0	0	1	1	0	1	0	1	0	1	1	1
V15	1	0	1	0	0	0	1	1	1	0	1	0	1	0	1

Table 4. *Initial Reachability Matrix*

	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	DR
V1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2
V2	1	1	1	1	1	1	1	1	1	1	1	1	1*	1*	1	15
V3	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2
V4	1	1	1	1	1	1	1	1	1	1	1	1	1*	1	1	15
V5	1*	0	1	0	1	1	1	1*	1*	1	1	1	1	1	1	13
V6	1	0	1	0	0	1	1	1	1	0	1	0	1	1	1	10
V7	1	0	1	0	0	0	1	1	1	0	1	0	1	0	1	8
V8	1	0	1	0	0	0	0	1	1	0	0	0	1	0	0	5
V9	1	0	1	0	0	0	0	1	1	0	0	0	1	0	0	5
V10	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	13
V11	1	0	1	0	0	0	1*	1	1	0	1	0	1	0	1	8
V12	1*	0	1*	0	1	1	1*	1	1*	1	1	1	1	1	1	13
V13	1	0	1	0	0	0	0	1	1	0	0	0	1	0	0	5
V14	1	0	1	0	0	1	1	1*	1	0	1	0	1	1	1	10
V15	1	0	1	0	0	0	1	1	1	0	1	0	1	0	1	8
DP	15	2	15	2	5	7	10	13	13	5	10	5	13	7	10	

Table 5*. Final Reachability Matrix*

	Reachability Set	Antecedent set	Intersection	Level
V1	1,3	1,2,3,4,6,7,8,9,10,11,13,14,15	1,3	I
V2	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	2,4	2,4	
V3	1,3	1,2,3,4,5,6,7,8,9,10,11,13,14,15	1,3	I
V4	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	2,4	2,4	
V5	1,3,5,6,7,8,9,10,11,12,13,14,15	2,4,5,10,12	5,10,12	
V6	1,3,6,7,8,9,11,13,14,15	2,4,5,6,10,12,14	6,14	
V7	1,3,7,8,9,11,13,15	2,4,5,6,7,10,11,12,14,15	7,11,15	
V8	1,3,8,9,13	2,4,5,6,7,8,9,10,12,13,14,15	8,9,13	
V9	1,3,8,9,13	2,4,5,6,7,8,9,10,11,12,13,14,15	8,9,13	
V10	1,3,5,6,7,8,9,10,11,12,13,14,15	2,4,5,10,12	5,10,12	
V11	1,3,7,8,9,11,13,15	2,4,5,6,7,10,11,12,14,15	7,11,15	
V12	1,3,5,6,7,8,9,10,11,12,13,14,15	2,4,5,10,12	5,10,12	

V13	1,3,8,9,13	2,4,5,6,7,8,9,10,11,12,13,14,15	8,9,13	
V14	1,3,6,7,8,9,11,13,14,15	2,4,5,6,10,12,14	6,14	
V15	1,3,7,8,9,11,13,15	2,4,5,6,7,10,11,12,14,15	7,11,15	
Iteration 2				
V2	2,4,5,6,7,8,9,10,11,12,13,14,15	2,4	2,4	
V4	2,4,5,6,7,8,9,10,11,12,13,14,15	2,4	2,4	
V5	5,6,7,8,9,10,11,12,13,14,15	2,4,5,10,12	5,10,12	
V6	6,7,8,9,11,13,14,15	2,4,5,6,10,12,14	6,14	
V7	7,8,9,11,13,15	2,4,5,6,7,10,11,12,14,15	7,11,15	
V8	8,9,13	2,4,5,6,7,8,9,10,12,13,14,15	8,9,13	II
V9	8,9,13	2,4,5,6,7,8,9,10,11,12,13,14,15	8,9,13	II
V10	5,6,7,8,9,10,11,12,13,14,15	2,4,5,10,12	5,10,12	
V11	7,8,9,11,13,15	2,4,5,6,7,10,11,12,14,15	7,11,15	
V12	5,6,7,8,9,10,11,12,13,14,15	2,4,5,10,12	5,10,12	
V13	8,9,13	2,4,5,6,7,8,9,10,11,12,13,14,15	8,9,13	II
V14	6,7,8,9,11,13,14,15	2,4,5,6,10,12,14	6,14	
V15	7,8,9,11,13,15	2,4,5,6,7,10,11,12,14,15	7,11,15	
Iteration 3				
V2	2,4,5,6,7,10,11,12,13,14,15	2,4	2,4	
V4	2,4,5,6,7,10,11,12,14,15	2,4	2,4	
V5	5,6,7,10,11,12,14,15	2,4,5,10,12	5,10,12	
V6	6,7,11,14,15	2,4,5,6,10,12,14	6,14	
V7	7,11,15	2,4,5,6,7,10,11,12,14,15	7,11,15	III
V10	5,6,7,10,11,12,14,15	2,4,5,10,12	5,10,12	
V11	7,11,15	2,4,5,6,7,10,11,12,14,15	7,11,15	III
V12	5,6,7,10,11,12,14,15	2,4,5,10,12	5,10,12	
V14	6,7,11,14,15	2,4,5,6,10,12,14	6,14	
V15	7,11,15	2,4,5,6,7,10,11,12,14,15	7,11,15	III
Iteration 4				
V2	2,4,5,6,10,12,14	2,4	2,4	
V4	2,4,5,6,10,12,14	2,4	2,4	
V5	5,6,10,12,14	2,4,5,10,12	5,10,12	
V6	6,14	2,4,5,6,10,12,14	6,14	IV
V10	5,6,10,12,14	2,4,5,10,12	5,10,12	
V12	5,6,10,12,14	2,4,5,10,12	5,10,12	
V14	6,14	2,4,5,6,10,12,14	6,14	IV
Iteration 5				

V2	2,4,5,10,12,	2,4	2,4	
V4	2,4,5,10,12	2,4	2,4	
V5	5,10,12	2,4,5,10,12	5,10,12	V
V10	5,10,12	2,4,5,10,12	5,10,12	V
V12	5,10,12	2,4,5,10,12	5,10,12	V
Iteration 6				
V2	2,4	2,4	2,4	VI
V4	2,4	2,4	2,4	VI

Table 6. *Representation of levels.*

	V1	V3	V8	V9	V13	V7	V11	V15	V6	V14	V5	V10	V12	V2	V4
V1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
V3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
V8	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
V9	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
V13	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
V7	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0
V11	1	1	1	1	1	1*	1	1	0	0	0	0	0	0	0
V15	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0
V6	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
V14	1	1	1*	1	1	1	1	1	1	1	0	0	0	0	0
V5	1*	1	1*	1*	1	1	1	1	1	1	1	1	1	0	0
V10	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
V12	1*	1*	1	1*	1	1*	1	1	1	1	1	1	1	0	0
V2	1	1	1	1	1*	1	1	1	1	1*	1	1	1	1	1
V4	1	1	1	1	1*	1	1	1	1	1	1	1	1	1	1

Table 7. *Canonical Matrix*

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