The Future of HR: Metaverse Adoption and Its Complexities

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Abstract

The metaverse concept merges virtual and augmented reality, integrating the physical and digital realms. This integration is achieved by amalgamating virtual reality headsets, blockchain technology, and avatars. This article explores the implications and difficulties of the developing metaverse-driven Human Resource Management (HRM) landscape as it becomes more widely accepted. A systematic methodology is employed in this study to identify and categorize the primary barriers that impede the integration of the metaverse within HRM. Interpretive Structural Modelling (ISM) and MICMAC analysis examine the connections and interdependencies among these barriers. The research findings highlight "Virtual Leadership Challenges" as the main barrier hindering the integration of the metaverse in HRM. "Legal and Regulatory Compliance" closely follows it. In addition to identifying these barriers, the research offers managerial strategies to facilitate the integration of the metaverse. The core recommendations emphasize the importance of making decisions based on data, improving the hiring and integration of new employees, fostering employee involvement, and dealing with concerns related to data privacy. The metaverse is intricately connected to the future of work, highlighting the need to understand its complexities and acknowledge its possibilities within HRM.

Keywords: Augmented Reality, Blockchain Technology, Human Resource Management (HRM), Interpretive Structural Modelling (ISM), Metaverse, Virtual Reality

JEL Classification: M12, M14, M15, M51, M53, M54, O15, O32

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1. Introduction

The concept of the metaverse, initially introduced in Neal Stephenson's 1992 literary work "Snow Crash," has evolved into an encompassing virtual reality (VR) environment that seamlessly merges the internet with augmented reality (AR), employing avatars and software agents. The launch of Horizon Worlds by Meta Platforms (formerly Facebook) in 2021, along with Mark Zuckerberg's visionary perspective, ignited extensive discussions within academic and professional circles regarding the societal implications of the metaverse (Fernandez & Hui, 2022). Zuckerberg's concept envisions merging the virtual and physical worlds, enabling work, communication, and socialization through avatars and holographic representations within a shared simulated environment (Meta, 2022). While a universally accepted definition of the metaverse remains elusive, many concur with Damar's concise description (2021). According to this characterization, the metaverse is an intermediary layer between an individual and the physical world—a three-dimensional virtual environment enabling shared experiences powered by augmented and virtual reality technologies.

Recently, metaverse platforms such as Horizon Workrooms and Mesh, developed by tech giants like Meta and Microsoft, have gained traction in Human Resource (HR) management. The ongoing pandemic has accelerated this trend, with organizations increasingly using the metaverse to host meetings, foster community engagement, and even recruit talent in virtual environments. According to an ExpressVPN survey, most US employers (66%) and many employees (3 out of 5) express a keen interest in exploring immersive technology, indicating a growing inclination among the workforce toward metaverse adoption in HR practices. The transformative potential of the metaverse on future work and collaboration is highly anticipated within the HR domain. However, as organizations increasingly embrace the metaverse, it becomes imperative to scrutinize its promises and potential pitfalls and barriers. This research intends to illuminate the challenges associated with the metaverse's adoption, focusing on the perspective of Human Resource Management (HRM).

The study aims to encompass various perspectives, which are as follows-

- Identify and document the primary barriers that are currently impeding the adoption of metaverse technologies within the realm of human resource management.

- Develop a comprehensive model elucidating the interconnections and dependencies among the identified metaverse adoption barriers.

- Evaluate the strength and direction of causal relationships among the identified constructs of metaverse adoption barriers, quantifying the intensity of these interrelationships to gain insights into their impact and implications.

- Categorize the identified barriers into suitable clusters based on their shared characteristics, facilitating a clearer understanding of their collective effects on metaverse adoption in human resource management.

The structure of the paper is arranged such that it commences with the introduction section, proceeds to the literature review section, followed by the methodology section, the results, and discussions, managerial implications, and culminates with the conclusion section.

2. Literature Review

The metaverse environment refers to a virtual domain that facilitates diverse interactive encounters and enables individuals to speak with one another through virtual avatars. The swift progression of state-of-the-art technologies such as virtual reality, augmented reality, and artificial intelligence has significantly expedited the metaverse's growth, enabling many captivating prospects for collaboration and engagement.

Microsoft has just announced its intentions to connect its virtual and augmented reality technology, known as Mesh, with Teams, a widely utilized messaging application. The connection has the potential to facilitate the creation of immersive environments within Teams, providing users with a unique and engaging communication experience.

The noteworthy advancements serve as prime examples of the metaverse's capacity to fundamentally transform modes of communication, collaboration, and professional activities inside a profoundly immersive and interconnected virtual realm (Sharma,2023).

Based on a recent poll conducted in early 2022 by Axios, a prominent news site, in collaboration with Momentive, an AI platform manufacturer, it was found that a considerable proportion of participants expressed a sense of indifference towards the metaverse. Expressly, 60% of respondents indicated a need for more awareness. While more participants indicated apprehension rather than enthusiasm towards the metaverse, an outsize proportion of 58% reported a neutral stance, expressing neither fear nor excitement over the forthcoming immersive digital realm. (Pratt,2022)

According to the "2022 Pulse Survey" conducted by PwC, a notable 46% of participants, which included Chief Information Officers (CIOs) and Chief Technology Officers (CTOs), expressed a strong belief in the metaverse's substantial significance for their innovation strategy. Additionally, many research firms, consultancies, and industry analysts have made estimations of the potential worth of the metaverse market, ranging from hundreds of billions to multiple trillions of dollars, anticipated to be reached by the year 2030.

2.1. The utilization of data-driven strategies for decision-making within the metaverse

Within the expansive and intricate virtual domain of the metaverse, a considerable amount of data is generated. The data holds significant value as a resource for organizations, enabling them to make informed decisions based on data analysis within human resources. The following examples illustrate the effective utilization of data inside the metaverse:

Performance analytics in virtual workspaces involve the utilization of the metaverse to gather extensive data about employee performance. There are various parameters that human resource managers can scrutinize and observe. This can include factors such as work duration, level of involvement, and quality of work output to identify workers with extraordinary work output and aspects that may require improvement.

Predictive analytics inside the metaverse can be used to anticipate challenges that may come and to predict employee behavior in advance. To predict the likelihood of disengagement or turnover, human resource managers can have the freedom to analyze employee data by utilizing machine learning algorithms. This empowers them to retain crucial talented personnel by employing proactive tactics.

Diversity and inclusion analytics can be used to evaluate HR managers' effectiveness of diversity and inclusion measures, which relates to utilizing data within the metaverse. Such data can offer a meaningful understanding of the demography within the virtual workgroup. There are various parameters that Human resource managers can scrutinize and observe through the use of analytics. This can comprise, although not limited to, factors such as age, gender, ethnicity, etc. This will enable HR managers to find imbalances or even cases of exclusion within the organization and develop and execute plans to obviate those issues to improve those areas.

Human resources are being offered a vast range of data-driven opportunities by metaverse. This will enable the organization to execute informed decisions and create HR practices that will be more comprehensive, efficient, and productive. Metaverse can be utilized in the field of HR in the following business functions: -

Recruitment: Utilizing the metaverse offers a potential avenue for augmenting the recruitment procedure by providing candidates with a genuine and immersive preview of the job and work milieu. By leveraging virtual and augmented reality technologies, individuals seeking employment can participate in enhanced job previews that offer increased interactivity. It becomes easier for HR managers to choose a candidate for a particular post based on their ability. Virtual reality (VR) can improve the hiring process by using assessments and interviews in virtual mode, which will encourage inclusiveness, making it easier to select better-qualified personnel. This approach is likely to lessen the feeling of isolation of remote workers and also help to create a more vibrant first impression for them.

The use of metaverse can make far-reaching changes in the onboarding process for newly employed staff members, especially in cases where they may not be able to attend work physically. A virtual onboarding program can utilize the use of interactive avatars, give new hires a thorough tour of the workplace from every perspective, make it easier for them to meet key team members and departments, and even give a platform to let them practice certain critical job functions in certain

simulated environments. Such an onboarding plan will even help forge a solid relationship between recently acquired staff members and the company even though they are working in a virtual condition.

Using metaverse in performance management permits achieving more accurate and objective workforce assessments. Performance evaluations that are data-driven and impartial will advance objectivity and fairness and can be done by application of sensors and data analysis. Enterprises possess the capacity to deploy metaverse simulations to evaluate the skills and knowledge of their staff in a realistic environment. This helps in making it possible to identify areas that need improvement. This facilitates providing targeted training and development programs to overcome the weak areas.

Using metaverse, companies can empower workers with a higher degree of involvement and interaction vis a vis their pay and perks. Virtual and augmented reality can be utilized to enhance employees' comprehension of the benefits available to them. This kind of immersive experience helps employees develop better-informed decision-making abilities, which in turn enables staff members to maximize their emoluments packages.

Another area that can benefit is using Metaverse simulations as a tool in a company's replacement planning process. It allows efficient identification of individuals with better potential for the job and their suitability for taking on a leadership role. Augmented reality can help improve leadership development by helping employees hone their abilities as leaders through simulated real-life events and, in the process, gain insightful knowledge based on these experiences. Additionally, it facilitates knowledge exchange within the workforce, thereby ensuring the retention of critical knowledge within the organization.

Another aspect that metaverse can facilitate is supervising staff attendance and time through automation and restructuring the procedure for time tracking. Using technology like virtual reality, it is possible to manage work such as shift changes and real-time scheduling more efficiently, which in turn helps an organization maintain an optimal number of people. Additionally, through the employment of virtual portals, a facet of metaverse, the procedure for staff members to report absences and submit leave requests can be seamless. This approach has the benefit of enabling managers to assess requests quickly and decide on whether to approve or reject them. It also facilitates managers in making instant schedule adjustments if so required.

Cost Analysis for Implementation: Implementing a metaverse environment for HR tasks necessitates significant initial expenditures, encompassing the acquisition of necessary hardware and software components essential for the establishment and functioning of the virtual workspace. Nevertheless, the metaverse is anticipated to yield cost efficiencies over an extended period by mitigating the necessity for actual office premises, transportation expenditures, and other outlays linked to a conventional work environment. Additionally, it is expected to enhance productivity, enhance communication, and cultivate more effective collaboration. Undertaking a cost-benefit

analysis enables organizations to ascertain the prospective return on investment associated with integrating the metaverse into their human resources operations (Christy,2023).

2.2. Barriers to the adoption of the metaverse

Table 1. Barriers to the implementation of a metaverse in the HRM context

Sr No.	Barriers	Description	References
1	Talent Sourcing Challenges	HR professionals must adjust their recruitment techniques to validate candidates' virtual identities in the Metaverse. The challenge is hiring qualified candidates while preventing identity fraud and impersonation. This unique environment requires innovative talent sourcing approaches to navigate the virtual realm and make educated recruiting decisions while maintaining security and credibility.	Durgesh (2022)
2	Virtual Onboarding Hurdles	Ensuring new hires comprehend corporate policies, culture, and job duties in an immersive virtual environment is complex. The challenges include designing interesting and instructive virtual onboarding experiences, managing recruit technological issues, and fostering a sense of belonging and connection in a virtual workplace.	Durgesh (2022)
3	Training and Adaptation Obstacles	To be adept at utilizing Metaverse related software for HR tasks, there could be a requirement to give comprehensive training to the employees. This could impede as the employees may be reluctant to accept the change in the environment also entail the requirement to adjust to such new processes.	Durgesh (2022)

4	Disconnect in Engagement and Collaboration	There would be challenges in a virtual work environment sustaining employee engagement and encouraging teamwork. HR managers must develop innovative strategies to overcome such obstacles and establish a cohesive team with genuine cooperation between members.	Durgesh (2022)
5	Performance Evaluation Challenges	The use of metaverse may make traditional performance evaluation methodologies less relevant. In such a scenario, HR departments must develop alternate strategies to evaluate employee performance and productivity. There will be a requirement to have new approaches to performance assessment due to the shift to a virtual environment, which will align with the dynamics of metaverse.	Durgesh (2022)
6	Work-Life Balance and Wellbeing Imbalance	The application of metaverse into the day-to-day working of employees may result in blurred changes in their work and personal lives. This could also affect their work-life balance and overall wellbeing. To tackle the possible problems of stress and to ensure the formation of a sustainable work-life balance, HR managers need to find solutions.	Durgesh (2022)
7	Diversity and Inclusion Challenges	In virtual settings, diversity and inclusion will require concerted efforts to ensure free and fair representation and incorporation of a wide range of voices and perspectives. HR managers must ensure that the environment that uses metaverse encourages inclusivity and hospitality for all employees.	Durgesh (2022)

8	Data Security and Privacy Concerns	A vast collection of user data will be used in the metaverse environment. Therefore, the implementation of strong data privacy regulations is essential for the HR departments for the protection of employee data and to alleviate the risk of data breaches.	Durgesh (2022)
9	Legal and Regulatory Compliance	To guarantee free and fair representation and incorporation of a wide range of voices and perspectives, HR managers must ensure that the environment using metaverse encourages inclusivity and hospitality for all employees, irrespective of their varied backgrounds.	Durgesh (2022)
10	Virtual Leadership Challenges	In the emerging scenario of virtual leadership and management in the workplace, acquiring a different skill set within the metaverse is required to manage the teams effectively. HR departments must train and assist leaders in supervising virtual teams and projects more skilfully.	Durgesh (2022)
11	Integration and Interoperability Issues	With the progress of the metaverse, two aspects that merit vital attention are interoperability and integration. Establishing continuous communication with virtual collaboration tools, immersive platforms, and other similar technologies is a necessity for HR departments.	Durgesh (2022)
12	Technical Infrastructure Challenges	Creating and maintaining a vast and interlinked virtual environment, such as the metaverse, has its technical challenges. Challenges such as achieving smooth cross-platform interoperability, reducing latency, and handling wide-ranging data processing requirements must be addressed effectively.	Pratt (2022)

13	Accessibility Challenges	An aspect that is of utmost importance in the metaverse is accessibility. This is because the metaverse is becoming a part of the digital existence. There could be challenges for people with disabilities, low-income people, and those in areas with poor internet and hardware, which could lead to problems in gaining access to certain services.	Pratt (2022)
14	Cultural Adaptation Challenges	Adopting metaverse necessitates a substantial cultural change in the very understanding of day-to-day work process and even social engagement. A certain cross section of the people may likely show resistance to such major changes. This could be due to several reasons, starting from apprehension about the integration of virtual and physical boundaries to the absence of interpersonal connections.	Pratt (2022)
15	Digital Divide	Integration and adoption of metaverse in society is fraught with the danger of worsening the inequalities in digital access between individuals with advanced technological resources and those without such resources. It is imperative to bridge this gap to avoid further fragmentation of specific populations.	Pratt (2022)
16	Higher Equipment Costs	One of the major challenges linked to access to the metaverse is the prohibitive cost of the associated equipment, which acts as a major hurdle to individuals. Similarly, even organizations may need help with creating necessary technological infrastructure within the metaverse.	Pratt (2022)

17	Safety Concerns (Bullying, Harassments, and Assaults	The metaverse may face problems such as bullying, harassment, and attacks. Organizations must create and implement strict rules and regulations to handle such situations effectively and provide a secure virtual atmosphere.	Pratt (2022)
18	Addiction Challenges	Certain behavioral factors can be addictive in nature due to the immersive quality of the metaverse. A cross section of individuals may face difficulties in discerning between the virtual and actual reality. This, in turn, can lead to addictive tendencies.	Pratt (2022)
19	Unfair Assessment Practices	The effect of the metaverse's immersive traits on the appraisal and analysis of the performance of employees is a critical factor in ensuring that there is impartiality and neutrality in the entire process. This becomes even more important in the virtual environment.	Pratt (2022)
20	Overdependence	The immersive nature of the Metaverse can lead to overdependence among employees. HR departments must monitor and address these tendencies to maintain a healthy work-life balance. Dependency challenges may require interventions and policies to ensure employees use the Metaverse responsibly while continuing to deliver productivity.	Pratt (2022)

21	Inadequate Age Verification Measures	A crucial factor in the metaverse is age verification to protect people, particularly minors, from exposure to unsuitable environments. HR teams must maintain a healthy and safe environment by ensuring that appropriate methods and tools are utilized for implementing HRM in the metaverse.	Jamison and Glavish (2022)
22	Cross-Cultural Dynamics	The Metaverse serves as a platform that facilitates the interaction of individuals hailing from various cultural backgrounds, hence giving rise to potential disparities in cultural standards. Failure to appropriately manage and manage this issue can result in misunderstandings, confrontations, and potential offenses.	Jamison and Glavish (2022)
23	Knowledge Gap	Users may need more awareness of potential risks and appropriate conduct in the metaverse. Human resources experts are required to impart knowledge and establish a set of instructions for employees, to promote responsible and courteous conduct inside the virtual realm. Bridging the knowledge gap is essential for HRM to create a secure and respectful work environment within the metaverse.	Jamison and Glavish (2022)
24	Suppression of Freedom and Safety	Navigating the delicate equilibrium between facilitating freedom of expression and safeguarding user safety and welfare can present considerable difficulties. Human resources (HR) departments face the challenge of effectively managing these intricate matters to cultivate a secure and all-encompassing Metaverse atmosphere for the workforce.	Jamison and Glavish (2022)

25	Antisocial Behavior	The Metaverse has experienced an increasing prevalence of antisocial behaviors, including but not limited to physical assault, bullying, harassment, and the use of hate speech. Instances of abuse, bigotry, and explicit content have grown increasingly widespread within virtual social applications such as VRChat and similar platforms. Consequently, this has resulted in the creation of a poisonous and inhospitable atmosphere for users. HR professionals must address these challenges to maintain a respectful and inclusive virtual workplace environment and protect employees from harmful behaviors in the Metaverse.	Jamison and Glavish (2022)

3. Research Methodology

The research objective of the study is to find the factors that form barriers to adopting metaverse in the field of HR management. ISM approach and MICMAC analysis were chosen for a detailed analysis of the factors considered as primary barriers. A thorough analysis of the literature and consultation with experts and practitioners of HR management was conducted to determine the primary obstacles or barriers to adopting metaverse. The literature review initially identified 30 barriers. However, after further discussions and more in-depth analysis, 25 noteworthy obstacles were identified. For research, 12 industrial and six academic specialists in high-ranking positions in their respective organizations were consulted. The opinions and insights of this group are considered reliable and have the relevant knowledge to provide an answer to the research question.

3.1. ISM

The foundation of ISM, as proposed by Warfield, highlights the requirement of including specialists in such decision-making objectives. Gardas et al. (2019) brought out that ISM technique can be used to assess and understand the interrelationships among the stated components. The ISM method is commonly used in many areas as a useful method for modeling complex situations. This is also validated by Attri et al. (2017) and Gardas et al. (2017) through empirical research. Employing a hierarchical framework is beneficial in simplifying complex circumstances, as per Rana et al. (2018).

The present study systematically summarizes the different phases of the ISM method. In the initial phase, suitable approaches are the objective for determining the factors influencing the barriers or problems being considered.

This is followed by the next step, in which assistance is taken from professionals with the requisite knowledge and expertise in the relevant field to build connections among the identified components. The creation of the SSIM includes the integration of many linkages, encompassing symbols denoted as "V, A, X, O."

In the next phase, i.e., the third phase, the SSIM converts to form an "initial reachability matrix (IRM)," which is built on certain prearranged guidelines. The symbols "V, A, X, O" meet certain requirements that enable them to be transformed into binary elements, which expressly represent the numbers 1 and 0. The IRM is produced using the previously outlined methods.

The "final reachability matrix (FRM)" is formed after the IRM goes through a transitivity validation process in the fourth phase. Based on the principle of transitivity, a causal link between factor i and factor k must exist if there is a causal connection between factor j and factor k in addition to a causal connection between factor i and j.

In the fifth stage, a multi-level hierarchical structure is established using the FRM, and a directed graph is constructed using partitioned levels. In addition, the above-mentioned method removes transitivity from the directed graph. It substitutes the names of the factor nodes for the nodes, resulting in the final ISM model.

3.2. Overview of MICMAC assessment

After implementing Interpretive Structural Modelling (ISM), the subsequent stage often entails conducting a MICMAC assessment. The MICMAC approach, first developed by Duperrin and Godet in 1973, is based on the concepts of matrix multiplication and builds upon the knowledge gained from ISM. The main objective of MICMAC analysis is to identify and understand the dynamic interplay between "influence and dependency" linked to each construct. Moreover, it functions as an indirect mechanism of classification, facilitating a thorough analysis of the intricate components of each notion, as highlighted in research conducted by Bhosale and Kant in 2016.

3.3. The utilization of ISM methodology

3.3.1. SSIM Creation

After the identification of the constructs, the subsequent phase entails the development of the SSIM. Table 2 presents a graphical depiction of the SSIM. The elucidation of these interrelationships can be summarised as follows:

O: Denotes the absence of a causal relationship between construct i and construct j, and conversely.

X: Denotes a reciprocal relationship between construct i and construct j, where both constructs influence one other.

V: The variable "V" indicates that construct i impacts construct j.

A: Indicates that construct j has a significant impact on construct i.

3.3.2. Development of IRM

The symbols employed in the SSIM matrix are transformed into binary values, specifically 1 or 0, to produce the IRM, as depicted in Table 3.

3.3.3. Development of FRM

The IRM is subjected to a transitivity examination to obtain the FRM. Based on the transitivity principle, if construct i influences construct j, and construct j subsequently affects construct k, it can be inferred that construct i intrinsically impacts construct k. Table 4 illustrates the resultant FRM, where transitive relationships are indicated by an asterisk (*).

3.3.4. Level Partitioning

The FRM is employed to generate three distinct sets corresponding to each construct, namely the "reachability set," the "antecedently set," and the "intersection set." The set of reachable elements for a specific construct is defined as the collection of all elements tagged as 1 in the corresponding row of the FRM. Similarly, the previously established criteria for a concept consist of all the items designated as 1 in their corresponding column. Furthermore, the intersection set comprises components shared by the reachability and antecedent sets.

According to Sage's observation in 1977, constructs that possess an identical "reachability set" and "intersection set" are classified as the "top level of the ISM hierarchy." These structures are the ones that will be impacted by all other constructs at lower levels. After identifying these high-level constructions, they are temporarily excluded from further consideration in later iterations. A similar process is iterated in these iterations until all constructs are correctly assigned to their respective levels.

A directed graph, sometimes known as a digraph, is also created using the determined levels (Table 5).

3.3.5. Building ISM Model

Constructing the ISM model involves removing transitivity from the directed graph (digraph) and replacing the nodes with the corresponding constructs. The ISM model is subsequently examined for potential internal contradictions. If any discrepancies are detected, necessary modifications are implemented, and the entire procedure is repeated, commencing from establishing the Structural Self-Interaction Matrix (SSIM) and advancing to constructing the ISM model, as demonstrated in Tables 2 to 4.

On the other hand, if the model does not display any internal errors, the resulting ISM model is regarded as conclusive. The finalized model is depicted in Figure 1 within the context of our specific case.

Table 2. SSIM Matrix development

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
C_1		V	V	V	V	V	V	V	A	A	O	O	V	O	V	V	O	V	O	O	O	O	O	O	O
C_2			V	O	O	O	O	V	A	A	V	V	V	V	O	V	V	V	O	V	O	X	O	O	O
C_3				O	O	O	O	V	A	A	O	V	O	O	V	V	O	O	O	O	O	O	V	V	V
C_4					O	O	O	O	O	O	O	V	O	O	O	O	O	O	O	V	O	V	O	V	V
C_5						O	O	O	O	O	O	V	O	O	V	O	V	V	O	V	O	O	V	V	O
C_6							O	O	O	O	O	V	O	V	V	O	O	O	V	O	O	O	O	O	V
C_7								O	A	O	V	V	V	O	V	V	O	O	O	O	O	O	O	V	O
C_8									A	A	V	O	O	O	V	O	O	O	V	O	O	O	O	O	O
C_9										A	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V
C_10											V	V	V	V	V	V	V	V	V	V	V	V	V	V	V
C_11												O	O	O	O	O	O	V	V	V	O	O	V	O	O
C_12													V	V	V	V	V	O	O	V	V	V	V	V	V
C_13														V	X	O	V	V	O	O	O	O	O	O	O
C_14															V	O	V	O	V	O	V	O	O	O	O
C_15																O	O	O	O	O	V	V	O	O	V
C_16																	O	O	O	V	V	V	O	O	V
C_17																		V	V	V	O	V	V	V	O
C_18																			O	X	O	O	O	O	O
C_19																				V	O	O	O	O	O
C_20																					V	O	V	V	V
C_21																						V	V	V	V
C_22																							O	V	V
C_23																								V	V
C_24																									O
C_25																									

Table 3. Initial Reachability Matrix development

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Driving Power
C_1	1	1	1	1	1	1	1	1	0	0	0	0	1	0	1	1	0	1	0	0	0	0	0	0	0	12
C_2	0	1	1	0	0	0	0	1	0	0	1	1	1	1	0	1	1	1	0	1	0	1	0	0	0	12
C_3	0	0	1	0	0	0	0	1	0	0	0	1	0	0	1	1	0	0	0	0	0	0	1	1	1	8
C_4	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	1	1	6
C_5	0	0	0	0	1	0	0	0	0	0	0	1	0	0	1	0	1	1	0	1	0	0	1	1	0	8
C_6	0	0	0	0	0	1	0	0	0	0	0	1	0	1	1	0	0	0	1	0	0	0	0	0	1	6
C_7	0	0	0	0	0	0	1	0	0	0	1	1	1	0	1	1	0	0	0	0	0	0	0	1	0	7
C_8	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	4
C_9	1	1	1	0	0	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	21
C_10	1	1	1	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	21
C_11	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	1	0	0	1	0	0	5
C_12	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	0	1	1	1	1	1	1	12
C_13	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1	1	0	0	0	0	0	0	0	5
C_14	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	1	0	1	0	0	0	0	5
C_15	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1	1	0	0	1	5
C_16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	1	0	0	1	5
C_17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1	1	1	0	7
C_18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	2
C_19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	2
C_20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	1	1	1	6
C_21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	5
C_22	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	4
C_23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	3
C_24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
C_25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Dependence Power	3	5	5	2	2	2	3	6	2	1	6	9	8	7	12	8	8	10	8	12	8	10	10	13	13	

Table 4. Final Reachability Matrix Development

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Driving Power
C_1	1	1	1	1	1	1	1	1	0	0	1*	1*	1	1*	1	1	1*	1	1*	1*	1*	1*	1*	1*	1*	23
C_2	0	1	1	0	0	0	0	1	0	0	1	1	1	1	1*	1	1	1	1*	1	1*	1	1*	1*	1*	18
C_3	0	1*	1	0	0	0	0	1	0	0	1*	1	1*	1*	1	1	1*	1*	1*	1*	1*	1*	1	1	1	18
C_4	0	1*	1*	1	0	0	0	1*	0	0	1*	1	1*	1*	1*	1*	1*	1*	1*	1	1*	1	1*	1	1	19
C_5	0	1*	1*	0	1	0	0	1*	0	0	1*	1	1*	1*	1	1*	1	1	1*	1	1*	1*	1	1	1*	19
C_6	0	1*	1*	0	0	1	0	1*	0	0	1*	1	1*	1	1	1*	1*	1*	1	1*	1*	1*	1*	1*	1	19
C_7	0	1*	1*	0	0	0	1	1*	0	0	1	1	1	1*	1	1	1*	1*	1*	1*	1*	1*	1*	1	1*	19
C_8	0	1*	1*	0	0	0	0	1	0	0	1	1*	1*	1*	1	1*	1*	1*	1	1*	1*	1*	1*	1*	1*	18
C_9	1	1	1	1*	1*	1*	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	24
C_10	1	1	1	1*	1*	1*	1*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25
C_11	0	1*	1*	0	0	0	0	1*	0	0	1	1*	1*	1*	1*	1*	1*	1	1	1	1*	1*	1	1*	1*	18
C_12	0	1*	1*	0	0	0	0	1*	0	0	1*	1	1	1	1	1	1	1*	1*	1	1	1	1	1	1	18
C_13	0	1*	1*	0	0	0	0	1*	0	0	1*	1*	1	1	1	1*	1	1	1*	1*	1*	1*	1*	1*	1*	18
C_14	0	1*	1*	0	0	0	0	1*	0	0	1*	1*	1*	1	1	1*	1	1*	1	1*	1	1*	1*	1*	1*	18
C_15	0	1*	1*	0	0	0	0	1*	0	0	1*	1*	1	1*	1	1*	1*	1*	1*	1*	1	1	1*	1*	1	18
C_16	0	1*	1*	0	0	0	0	1*	0	0	1*	1*	1*	1*	1*	1	1*	1*	1*	1	1	1	1*	1*	1	18
C_17	0	1*	1*	0	0	0	0	1*	0	0	1*	1*	1*	1*	1*	1*	1	1	1	1	1*	1	1	1	1*	18
C_18	0	1*	1*	0	0	0	0	1*	0	0	1*	1*	1*	1*	1*	1*	1*	1	1*	1	1*	1*	1*	1*	1*	18
C_19	0	1*	1*	0	0	0	0	1*	0	0	1*	1*	1*	1*	1*	1*	1*	1*	1	1	1*	1*	1*	1*	1*	18
C_20	0	1*	1*	0	0	0	0	1*	0	0	1*	1*	1*	1*	1*	1*	1*	1	1*	1	1	1*	1	1	1	18
C_21	0	1*	1*	0	0	0	0	1*	0	0	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1	1	1	1	1	18
C_22	0	1	1*	0	0	0	0	1*	0	0	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1	1*	1	1	18
C_23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	3
C_24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
C_25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Dependence Power	3	22	22	4	4	4	4	22	2	1	22	22	22	22	22	22	22	22	22	22	22	22	23	24	24	

Table 5. Level Partitioning (LP) analysis

Elements	Reachability Set	Antecedent Set	Intersection Set	Level
1	1,	1, 9, 10,	1,	5
2	2, 3, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	2, 3, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	3
3	2, 3, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	2, 3, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	3
4	4,	1, 4, 9, 10,	4,	4
5	5,	1, 5, 9, 10,	5,	4
6	6,	1, 6, 9, 10,	6,	4
7	7,	1, 7, 9, 10,	7,	4
8	2, 3, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	2, 3, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	3
9	9,	9, 10,	9,	6
10	10,	10,	10,	7

11	2, 3, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	2, 3, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	3
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14	2, 3, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	2, 3, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	3
15	2, 3, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	2, 3, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	3

16	2, 3, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	2, 3, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	3
17	2, 3, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	2, 3, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	3
18	2, 3, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	2, 3, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	3
19	2, 3, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	2, 3, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	3
20	2, 3, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	2, 3, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	3

21	2, 3, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	2, 3, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	3
22	2, 3, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	2, 3, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,	3
23	23,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23,	23,	2
24	24,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24,	24,	1
25	25,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 25,	25,	1

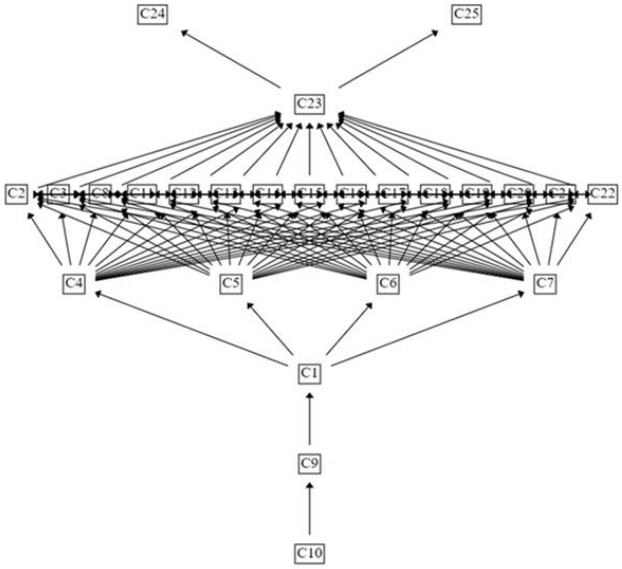

Figure 1. Final ISM model

4. Results and Discussions

4.1. ISM Results

The objective behind the ISM model was to develop a hierarchical comprehension of the interrelationships between obstacles to adopting the metaverse within human resource management (HRM). According to the ISM model, Virtual Leadership Challenges are identified as the most significant barrier. This highlights the significance of effective leadership in the metaverse for HRM success. Human resource managers should prioritise the development of metaverse-appropriate leadership skills to address various challenges effectively.

The ISM model has uncovered a significant correlation among "Legal and Regulatory Compliance" and "Virtual Leadership Challenges." The importance of leadership in ensuring compliance with the metaverse's laws and regulations cannot be overstated. HR professionals must understand and comply with these distinct legal frameworks.

Additionally, it has been shown that the challenges related to talent acquisition are strongly influenced by the complexities involved with virtual leadership. The connection above highlights the pivotal significance of leadership in the process of talent acquisition inside the metaverse. In the current digital ecosystem, HR professionals must engage in innovative practices and identify efficient strategies for sourcing and recruiting talented individuals.

The ISM model revealed additional factors at the third level, including "Virtual Onboarding Hurdles," "Training and Adaptation Obstacles," "Data Security and Privacy Concerns," "Integration and Interoperability Issues," "Technical Infrastructure Challenges," "Accessibility Challenges," "Cultural Adaptation Challenges," "Digital Divide," "Higher Equipment Costs," "Safety Concerns (Bullying, Harassments, and Assaults)," "Addiction Challenges," "Unfair Assessment Practises," "

Overdependence," "Inadequate Age Verification Measures," and "Cross-Cultural Dynamics." The elements above were shown to be influenced by "Talent Sourcing Challenges," indicating that the resolution of talent sourcing challenges can potentially alleviate numerous additional challenges in the field of Human Resource Management within the metaverse.

Additionally, the model emphasized the importance of the "Knowledge Gap" variable, which has an impact on both "Suppression of Freedom and Safety" and "Antisocial Behaviour." This statement highlights the significance of education and knowledge in effectively resolving matters pertaining to freedom, safety, and conduct within the metaverse. It emphasizes that human resources professionals must prioritize closing this knowledge deficit.

4.2. MICMAC Results

Classifying the identified barriers into four categories (Autonomous, Dependent, Linkages, and Driving) in the context of implementing metaverse in HRM practices provides valuable insights into their interrelationships, dependencies, and relative importance.

Autonomous Barriers: Considering the given scenario, it was observed that no autonomous barriers were found. Autonomous barriers are commonly characterized by low dependence on external control and low driving power. In essence, these entities exhibit a state of relative isolation inside the system, hence exerting minimal influence on other barriers. This implies that the barriers encountered in the field of Human Resource Management (HRM) pertaining to the metaverse exhibit interdependence, such that resolving a single barrier could potentially impact other interconnected difficulties.

Dependent Barriers: Dependent barriers are typically characterized as barriers that demonstrate a substantial reliance on other factors while having relatively little influence or driving power. The category encompassing HRM in the metaverse includes "Suppression of Freedom and Safety," "Antisocial Behaviour," and "Knowledge Gap." These barriers are of utmost importance and should be regarded as issues of great significance. The high dependence on these barriers necessitates their resolution as a crucial step in mitigating other barriers and ensuring the effective adoption of the metaverse in the field of Human Resource Management (HRM).

Linkages Barriers: Linkages barriers have high driving power and are highly dependent on other factors, making them sensitive and unstable. In the context of HRM, barriers like "Virtual Onboarding Hurdles," "Training and Adaptation Obstacles," "Data Security and Privacy Concerns," "Integration and Interoperability Issues," "Technical Infrastructure Challenges," "Accessibility Challenges," "Cultural Adaptation Challenges," "Digital Divide," "Higher Equipment Costs," "Safety Concerns (Bullying, Harassments, and Assaults)," "Addiction Challenges," "Unfair Assessment Practices," " Overdependence," "Inadequate Age Verification Measures," and "Cross-Cultural Dynamics" fall into this category. These are central to the challenges in HRM adopting the metaverse and should be addressed with care.

Driving Barriers: Driving barriers have high driving power and low dependence on other factors. These are the root causes of other barriers and should be prioritized. In HRM for the metaverse adoption, "Talent Sourcing Challenges," "Legal and Regulatory Compliance," "Virtual Leadership Challenges," "Disconnect in Engagement and Collaboration," "Performance Evaluation Challenges," "Work-Life Balance and Wellbeing Imbalance," and "Diversity and Inclusion Challenges" fall into this category.

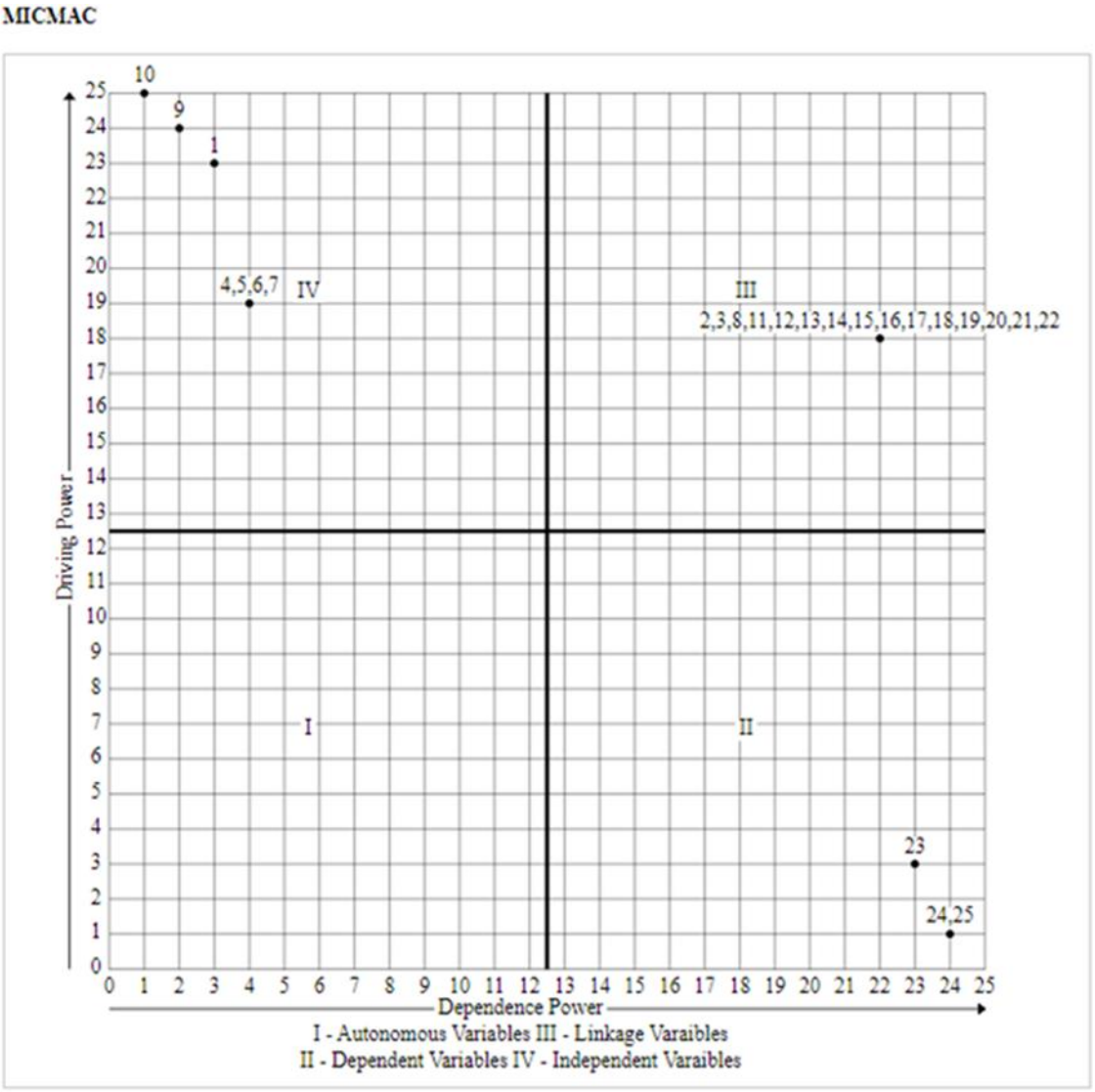

Figure 2. MICMAC analysis results

5. Managerial Implications

Integrating the metaverse into Human Resource Management (HRM) practices raises various strategic issues for organizations embracing this digital frontier. HR must first invest in enhanced "Candidate Verification," using digital credentials and blockchain for secure and transparent metaverse candidate skills and qualifications verification. "Virtual Onboarding" requires metaverse-

specific immersion programs to integrate new hires into the virtual business culture and their roles. "Change Management" becomes crucial, requiring thorough training programs that teach metaverse skills and resolve change resistance.

HR should also emphasize "Employee Engagement" in virtual work situations, using innovative methods like virtual team-building activities and social events to develop community and collaboration. For fairness and constructive employee feedback, "Performance Evaluation" requires data-driven assessment methodologies using simulations and objective metrics. Implementing rules and activities to maintain "Work-Life Balance" to reduce metaverse burnout and stress is essential.

Promoting "Diversity and Inclusion" in the metaverse requires monitoring and addressing inequities and exclusion while supporting diversity. To comply with growing data protection rules, "Data Privacy" needs rigorous restrictions and security. Information about "Regulatory Compliance" changes in virtual work, including data protection and remote work agreements, is essential.

Leaders managing distant teams and projects in the metaverse need "Leadership Training" in digital leadership. "Interoperability" between HR systems and virtual collaboration tools and platforms must be frictionless to improve data interchange and efficiency. For the metaverse to run smoothly, "Technical Infrastructure" investment must solve cross-platform compatibility, latency, and data processing.

HR must also address "Accessibility" issues, especially for disabled people and those in low-income or connectivity-challenged locations, to ensure equal opportunity. Bridging the "Digital Divide" to include metaverse-deprived groups is essential. Lastly, "ROI Assessment" should be a regular practice to help organizations justify costs and prove the worth of their metaverse adoption efforts. These extensive implications guide HRM practices to navigate the metaverse's transformational landscape.

6. Conclusion

In conclusion, the metaverse, a concept born from science fiction but rapidly becoming a technological reality, is poised to reshape the landscape of human resource management and the modern workplace. As explored in the preceding sections, the metaverse offers many opportunities and challenges for HR professionals. However, it is crucial to acknowledge the dark side of the metaverse, encompassing issues such as security, data privacy, digital addiction, and organizational culture transformation. HR professionals must proactively address these challenges to ensure a smooth transition into this new digital frontier. Considering the growing interest in the metaverse and its projected impact on various industries, including HR, organizations must stay ahead of the curve. By understanding and effectively managing the barriers and complexities associated with metaverse adoption, HRM can position itself as a strategic partner, guiding organizations toward a future that maximizes the benefits while mitigating the risks of this transformative technology. As we progress, research objectives must continue to focus on identifying, categorizing, and addressing the barriers

to metaverse adoption in HRM. By doing so, we can harness the full potential of the metaverse to create more inclusive, innovative, and productive workplaces that prioritize employee wellbeing and foster a culture aligned with organizational values.

The future scope of studying metaverse adoption within Human Resource Management (HRM) holds immense promise and encompasses several critical research areas. First, "Metaverse Leadership Development" will require more profound research to create customized leadership programs that teach virtual leadership abilities. Meanwhile, understanding "Metaverse Ethics and Social Responsibility" is crucial, covering metaverse engagement's social and ethical effects on privacy, security, inclusivity, and corporate social responsibility. “Metaverse Work-Life Balance" research is needed to develop policies, practices, and technologies to support a healthy work-life balance in the metaverse, preventing virtual burnout and screen time management. To enable data-driven decision-making, the "Metaverse Data Analytics" field must be investigated to develop tools and metrics to evaluate metaverse initiatives' effects on HR KPIs and employee engagement.

References

Attri, R., (2017), "Interpretive structural modelling: a comprehensive literature review on applications," *International Journal of Six Sigma and Competitive Advantage*, 10(3-4), 258-331.

Bhosale, V. A., R. Kant, (2016), "An integrated ISM fuzzy MICMAC approach for modelling the supply chain knowledge flow enablers," *International Journal of Production Research*, 54(24), 7374-7399.

Christy, A., (2023), "How will the metaverse impact HR?" https://alltechmagazine.com/how-will-the-metaverse-impact-hr/

Damar, M., (2021), "Metaverse shape of your life for future: A bibliometric snapshot," *Journal of Metaverse*, 1(1), 1-8.

Durgesh, (2022), "6 Major HR Challenges the Metaverse Can Help Overcome," https://www.eventcombo.com/a/913/6-major-hr-challenges-the-metaverse-can-help-overcome/

Fernandez, C. B. and P. Hui, (2022), "Life, the Metaverse and Everything: An Overview of Privacy, Ethics, and Governance in Metaverse," *eprint arXiv*, 2204.01480.

Gardas, B. B., R. D. Raut, and B. Narkhede, (2017), "Modeling causal factors of post-harvesting losses in vegetable and fruit supply chain: an Indian perspective," *Renewable and sustainable energy reviews*, 80, 1355-1371.

Gardas, B. B., R. D. Raut, N. Cheikhrouhou, and B. E. Narkhede, (2019), "A hybrid decision support system for analyzing challenges of the agricultural supply chain," *Sustainable Production and Consumption*, 18, 19-32.

Jamison, M. and M. Glavish, (2022), "The Dark Side of the Metaverse, Part I," https://www.aei.org/technology-and-innovation/the-dark-side-of-the-metaverse-part-i/

Pratt, K. M., (2022), "Metaverse pros and cons: Top benefits and challenges," https://www.techtarget.com/searchcio/tip/Metaverse-pros-and-cons-Top-benefits-and-challenges/

Rana, N. P., S. Luthra, S. K. Mangla, R. Islam, S. Roderick, and Y. K. Dwivedi, (2018), "Barriers to the development of smart cities in Indian context," *Information Systems Frontiers*, 21, 503-525.

Sage, A., (1977), *Interpretive Structural Modeling: Methodology for Large-scale Systems*, New York: McGraw-Hill.

Sharma, S., (2023), "Exploring the Potential of Metaverse Environment for HR Functions: Benefits, Costs, and Challenges," https://www.ihrim.org/2023/04/exploring-the-potential-of-metaverse-environment-for-hr-functions-benefits-costs-and-challenges/