Embedding Virtual Reality in HRM Practices to Enhance Workforce Agility in the Manufacturing Industry

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Abstract. As of 2022, Malaysia's National Business Digital Adoption Index (BDAI) reported an overall average rating of 2.1 out of 5, signifying progressive digital transformation among businesses. Within this background, the manufacturing industry achieved a BDAI score of 2.26, indicating a quicker rate of embracing digitalisation than other industries. Additionally, the Future of Jobs Survey 2023 revealed that resilience, flexibility, and agility are the top skills required from 2023 to 2027. In light of this, human resource management (HRM) practices are vital in reshaping workforce agility, producing a workforce that is competent, flexible, proactive, and adaptable in this dynamic environment. With digitalisation, HRM evolved into digital HRM which necessitates VR applications in its practices. This study aims to fill the gap by investigating the extent to which VR HRM in the recruitment and selection process, talent management and performance evaluation impact workforce agility in the manufacturing industry. Responses from 150 manufacturing firms will be collected via an online questionnaire, applying the convenience sampling method. PLS analysis will be used for data analysis. Research findings could provide valuable insights for firms seeking to integrate VR into sustainable HRM practices to promote workforce agility for competitive advantage. Policymakers could develop HRM policies/strategies for long-term planning.

Keywords: Virtual Reality, Workforce Agility, HRM Practices.

1   Introduction

Technology development has changed the competitiveness of many industries worldwide. It has been used as a driver of change. For Malaysia, it has become increasingly important to embrace the digital transformation by these technologies, as this is a national strategic initiative that will attract companies, talents, and investment. Malaysia Digital Economy Corporation (MDEC), in its exploration of the digital adoption rate of industries, reported an overall Business Digital Adoption Index (BDAI) of 2.1 out of 5 in 2022 [1]. Of this, the manufacturing industry has one of the highest rates which is 2.26. (Figure 1).

Industry Verticals	Technology						Digital Investments	Enablers		Total
	Digital Infrastructure & Connectedness	Digital Process & Application	Digital Experience	Data	Digital Innovation	Cybersecurity	Digital Investment Strategy	People/Talent	Governance	
Agriculture										2.10
Construction										2.17
Manufacturing										2.26
Mining & Quarrying										2.17
Services										2.29
Total	2.54	2.21	1.65	2.11	1.66	1.86	2.64	2.37	2.61	

Fig 1. Digital adoption – Industry Analysis (Source: Pilot BDAI Survey, 2022, MDEC)

Recognising the potential of the manufacturing industry in digital transformation [2] launched the National Policy on Industry 4.0 (Industry4WRD) to push the manufacturing industry toward digital transformation and increase the manufacturing sector's contribution to the overall economy. One of the action plans involves using augmented reality (AR) and virtual reality (VR) in human resource management, to increase the workforce's agility in anticipation of an impending digital transformation.

This is in tandem with the Future of Job Survey 2023 conducted by the World Economic Forum. This survey reported that the top three essential skills required in a digital working environment are workforce responsiveness and agility, namely proactivity, adaptivity and resilience [3]. To achieve success, core HR processes such as recruitment, talent management and performance evaluation should be reviewed. These processes should be embedded with these new technologies [4] to develop a more agile workforce.

VR and AR are not new technologies. There is already existing research on its use in the field of science (e.g., medicine and engineering). However, research and exploration in the human resource field are limited, making it difficult to make scientifically grounded evaluations on what and how VR and AR can be embedded into HR practices and their possible results. Several limitations were also cited when using these new technologies. Of concern is interpersonal interaction, where there is an artificial distance between individuals and organizations when new technologies are used [5].

1.1   Research Problem

In view of the importance of digitalisation, numerous industries have begun efforts to integrate new technologies into their business processes. Organisations have also initiated various efforts, which may include efforts to use digital data to simplify work processes or add value to customer interaction [6-7];. The use of virtual reality (VR) and augmented reality (AR) has this potential [6][8].

Yet the proliferation of digitization and its various functionalities have expanded. One such possibility is in the field of human resources management (HRM). VR and AR offer benefits such as cost-effectiveness, scalability, accessibility, interactivity, feedback, and personalization [7].

Unfortunately, many organizations are also hesitant to adopt these technologies, citing reasons such as cost and maintenance, technical issues, ethical concerns, user

acceptance, organizational culture, and change management. Organisations are also unsure how to use these technologies in their operational activities, or even the effectiveness of the data provided. In addition, VR and AR may pose security and privacy risks, as they involve collecting and processing sensitive data from users, such as biometric, behavioural, or personal information. Hence, there is resistance or scepticism from employees or managers, who may perceive them as unnecessary, intrusive, or ineffective. Many also expect significant changes in the organizational culture, processes, and policies which may be disruptive [6][9].

From the literature, it is apparent there are limited studies on the applications of VR and AR on HRM. Existing research is also fragmented and has mixed findings. Many companies have not yet fully embraced digitalisation or have merely implemented it in selected sections of their operations. Most studies concentrated on the area of training and development with limited studies on other HR processes [5]. Organisations seem perplexed about how VR and AR technologies can be effectively integrated into HRM practices to enhance employee engagement, learning, and performance. Many traditional HRM approaches are still relevant but infusing the good practice of traditional HRM with the capabilities of new technologies remains an enigma. Hence, this paper intends to highlight the vast opportunities of the use of AR and VR in HRM, by highlighting its various possibilities in core HRM processes such as recruitment, talent management and performance evaluation. Subsequent discussions will be on the impact of virtual and augmented reality to enhance workforce agility in manufacturing processes.

1.2   Research Objectives

This research aims to ascertain the extent to which VR applications in HRM practices can enhance workforce agility in the manufacturing industry in Malaysia.

The following are the objectives of this study:
1. To examine whether VR in the recruitment and selection process has a significant effect on workforce agility in the manufacturing industry in Malaysia.
2. To determine whether VR on talent management has a significant effect on workforce agility in the manufacturing industry in Malaysia.
3. To investigate whether VR on performance evaluation has a significant effect on workforce agility in the manufacturing industry in Malaysia

2   Literature Review

2.1   Virtual Reality HRM

VR is an emerging technology that helps to create diverse, realistic environments with rich sensory stimulation, spontaneous interactions, and immersive experiences [10]. VR technology is said to have significantly altered the way businesses operate. VR is widely applied in education, healthcare, military affairs, medicine, social media, hospitality, product development, and entertainment [5][8].

The application of AR and VR does come with positive and negative effects. On the positive side, these new technologies can mirror near-real-world experiences. Hence, it would be useful when simulating future human resource management development

possibilities [4]. Strategically, VR also provides insightful interventions in the practice of human resources. In the research by [11], it is an effective tool, enabling management to plan and reduce time, distance, and resources for training, learning and development. It accelerates the learning process of HRD professionals as information is easily accessible [12]. For example, VR interventions in evaluating a potential candidate's skill set or the staff's suitability for promotion. With VR, these skills assessments will be more efficient and accurate.

The research by [13] and [14] further highlighted several areas in the HR processes where VR can be successfully implemented. The areas would encompass recruitment and selection that lead to the promotion of the company's brand through integration and training. [10] have asserted that although the use of AR and VR in recruitment is uncommon, the application possibility is promising.

Though impactful and promising, studies also reveal that many organisations have not developed, implemented, or assessed VR, reflecting this as an area which warrants further exploration. Most current studies discussed developing and testing VR solutions on existing HR processes. The potential of VR in HR processes can be further explored as it has unique immersive and interactive characteristics [15]. Although some initial studies seem mundane and uninteresting, most researchers remain optimistic about its future potential. HR practitioners and communities are constantly amazed by the novelty of solutions offered by VR in their internal processes and its possibilities for building a more agile workforce.

2.2   VR on recruitment and selection

Human resource professionals continually search for technology to enrich work compatibility with the HR process [4]. Integrating VR in recruitment could enable businesses to offer superior and more efficient services than conventional human resources. The primary goal of recruitment is attracting and retaining a talented workforce [16].

VR offers HR managers a cost-efficient method to assess potential candidates. Multiple interview sessions are possible as companies evaluate the suitability of a candidate [17]. Using VR is essential when finding top talent to fill critical roles. In addition, the potential candidate would also have the opportunity to experience interaction with their future employers.

VR offers the technical advantages of a highly immersive, three-dimensional interaction and audio-visual perception of reality. The symbiosis of situational and visual recruitment reflects a wave of the future and the organisation's technological capabilities. VR is a highly effective method to recruit talented individuals to join the organization [18-19]. Using interactive technologies and a two-way communication process for recruiting is a positive step toward enhancing the organisation's image to its pools of potential candidates. In summary, candidates would be more motivated to apply for jobs as they immerse themselves in the VR platforms.

In summary, the area of recruitment offers a myriad of solutions in comparison to traditional recruitment processes. However, the use of VR is limited in recruitment and selection. Much research is required to assess these new methods' effectiveness and offer solutions to overcome any limitations as commented on by [6]. Nonetheless, [20]

remain optimistic about the potential of VR in ensuring efficient and effective HRM processes, particularly in recruitment and selection.

2.3   VR on Talent Management

One of the critical activities in HRM is training and development. VR technology has made significant contributions in this field [21-22]. Organisations have adopted various technologies to increase the effectiveness of conducting and managing training programmes.

One of the popular VR technologies used in the training environment is simulations. VR lets users view or be 'immersed' in an alternate world. [23] proved that the trainee could experience the organisation's virtual environment by using VR in the training environment, enabling numerous forms of interactions that simulate reality in various contexts. This statement is supported by research done on medicine by [24] which agree that virtual simulations found vast improvements in training outcomes, where the trainees are more responsive, interactive, and engaging. Such developments would be useful in building a more agile workforce.

Although VR and its various benefits offer numerous advantages, studies have also highlighted it could challenge technical communications [25], even though these advances in technology are easier to operate and less costly and offer a promising future. Using these new technologies offers enormous opportunities for future training and development efforts. However, the technology is still relatively new. Further study is needed to explore how the new technology could enhance engagement levels, interaction, and feedback, which will be helpful to further the body of knowledge in this field despite the challenges [26].

2.4   VR on Performance Evaluation

Performance evaluation or appraisal involves reviewing employees' job performance and overall organisational contribution - employee skills, achievements, and growth, or areas where improvements are the main assessment areas. The results of these evaluations enable organisations to determine current performance, its achievers (and non-achievers), or even if a termination is required. VR has been implemented in performance measurement and feedback [27]. The research by [6] reported that a performance evaluation system can be used to track employee performance. The information is ongoing and valuable for all parties' analysis and resource planning. The results can also be quickly disseminated and serve as a prompt for managers to initiate meetings with employees to discuss areas of improvement.

In addition, VR technology allows employees to interact with management regardless of time and geographic location, identifying problem areas with speed and efficiency. These technologies also allow feedback from multiple sources (for example, workgroup customers) so that employees can continually improve their performance [28].

Similarly, VR also provides simulations to candidates identified for promotion or transfers. They can experience what it would be like to work in specific jobs or when they are transferred. These will be helpful to employees [29]. In addition, VR-based

Virtual Assessments would also help organisations predict the different roles and skills employees could perform. Such information would be helpful for long-term performance evaluation and strategic human resource planning [27].

However, there are challenges. The interpersonal distance between managers and employees is still evident. Feedback is provided electronically, and face-to-face meetings are limited. Managers would not be able to capture the attention of their employees, which could affect their performance or alter their subsequent behaviours [30]. Nonetheless, VR remains a valuable tool in performance evaluation and enabling a more agile workforce [31].

2.5   Workforce Agility

The term "agile" first gained popularity among North American scholars in the early 1990s and is widely portrayed as having the capabilities to recognise changes and responsiveness to changes [32]. Initially, the word "agility" appeared in the context of air combat where it captured the air-craft's ability to change its state of manoeuvrability [33]. Although the focus on agility has extended from organisational agility to workforce agility, there is still no specific definition of agility of workforce or workforce agility [34]. Nonetheless, workforce agility can be referred to as the capability of workers to adapt to a workplace that is uncertain and changing rapidly [35], quick adaptability to modifications in client needs, technologies, and regulations [36], synchronise their intelligence, competence, proactive, adaptive, flexible and resilience behaviours towards a dynamic and fast-changing working environment [35][37].

Initial research denotes that an agile workforce is illustrated by capabilities such as intelligence (the ability to interpret changes and respond promptly and strategically to the customers' needs), competencies (acquiring new skills for a business change), collaboration (the ability to cooperate effectively across pro-jects and functions), culture (a setting that effectively supports employee empowerment and independent decision-making) and information systems (availability of IT architecture supports) [33]. These capabilities of work-force agility [33] were viewed from the IT perspective [38]. Other studies express workforce agility from the three dimensions of behaviour namely proactivity behaviour, adaptivity behaviour and resilience behaviour [39]. Proactivity refers to employees' initiative behaviours in recognising, and anticipating change-related problems, and initiating activities in solving these problems; adaptivity refers to the flexibility towards changing different roles competently, and resilience is referred to as positive behaviour towards changes and stressful situations [39]. Subsequent research extends the dimensions of workforce agility to include additional behaviours such as collaboration, teamwork, knowledge sharing, adaptability to change, independence, courage, bravery, enthusiasm to learn, and independence [40-41]. Due to divergence in understanding the attributes of workforce agility, behaviour dimensions such as accepting changes, decision-making, transparency, cooperation, reflection, user-centricity, literacy, testing, self-organization, and learning - have been combined in recent studies to provide a comprehensive model of agility [42].

Nevertheless, the three dimensions of the behaviour model (proactivity, adaptivity and resilience) are still prevalent and commonly adopted by the authors in their studies

[43]. For instance, [44] confirm that all three dimensions of workforce agility have a potential impact on the acceptance of information systems in a dynamic environment. [45] indicate that embracing new ways of working practices in the manufacturing industry can enhance workforce agility. [36] affirm that workforce agility increases organisational financial and non-financial performance and the increase in non-financial performance leads to better corporate reputation.

Proactivity refers to the degree of participation in actions that are advantageous to the business and the workers. Numerous factors, such as self-motivation, self-efficacy, teamwork, and autonomy in making decisions, are necessary for this quality [32-33][37][46]. When the workforce took the initiative to investigate the problems and find solutions using the available resources at hand, the proactive workforce made improvements to the work environment [38].

According to [35], flexibility and adaptability at an individual level relate to the willingness to accept and take part in changes to work requirements, assignments, and expectations. The ability to deal with environmental uncertainties and accommodate differences also contributes to the notion of flexibility and adaptability in the workforce. Although many studies overlooked the influence of workforce flexibility and instead concentrated on machine flexibility, labour flexibility in the manufacturing environment is closely tied to manufacturing flexibility in terms of mix and volume flexibility [38]. Adaptability is also seen as a reaction to a change and the ability of the workforce to acclimatise to the changing work environments [46].

During COVID-19, the workforce experienced greater productivity improvements, more happiness and better overall wellbeing as more flexibility was given to employees, making them more agile. This perspective led to the belief that a flat organisational structure would be most appropriate to support and nurture workforce agility [36].

Resilience reflects positive attitudes towards changes, new concepts, new technologies, and new organizational structures for work and production [47]. The degree to which the workforce and the environment can tolerate mismatches is another viewpoint of resilience [38]. More so, a resilient workforce could still function effectively even under stress caused by environmental changes. A workforce with positive attitudes to change, novel ideas and tolerance to uncertainties and unexpected circumstances are resilient work-force [48].

Organisations that emphasise workforce agility concurrently increase resilience; and can assist their employees in adjusting promptly to changes and man-aging their stress levels effectively [40]. Besides, cultivating and developing a resilient workforce that can respond powerfully and positively to volatile and uncertain environment enable the employees to improve their coping with problems and emotions, which in turn, would boost organisational resilience [49].

Workers can acquire and indulge in agility capabilities from training conducted, participation and collaboration opportunities provided by the organisations [34]. An agile workforce typically exhibits higher levels of creativity, problem-solving skills, and task diversity management [35]. Thus, workforce agility would be a way to increase output and profit and could provide businesses with a competitive edge [35]. Accordingly, the ideas of agility were introduced to industries as a technique to respond and adapt to the

dynamic and volatile business environment [47]. The manufacturing industries experienced a rise in the concept of agility as early as the 1990s [33].

Workforce agility is an advanced strategy and a continuous enhancement process which is driven by the high demands for the dynamic capabilities of organisations for business growth and competitiveness [50]. Successful organisations view human capital as the most crucial of the company and this stance would increase their implementation level of practices to enhance workforce agility [51]. According to [51], only when HR practices are essentially executed in the organisations' activities will the significance of human resources be validated. Their findings indicate that the initial path to creating an agile workforce is through the HR practices of selective recruitment, talent management, and effective performance evaluation. [50] add that it is necessary to transform the workforce by regularly updating employees' competencies in conjunction with their career development and organizational development. For HRM procedures to be effective in fostering flexibility in the workforce, human resource managers must be proactive in evaluating the workforce agility essentials for the organizations and setting up agile HR functions [50].

3   Research Framework

Based on the reviews of past research, a research framework is proposed for this study. Workforce agility is the dependent variable in this study and virtual reality HRM is the independent variable. Workforce agility is expected to be influenced by virtual reality applications in HRM practices such as recruitment and selection, talent management and performance evaluation. As such, the research framework is depicted in Figure 2 below.
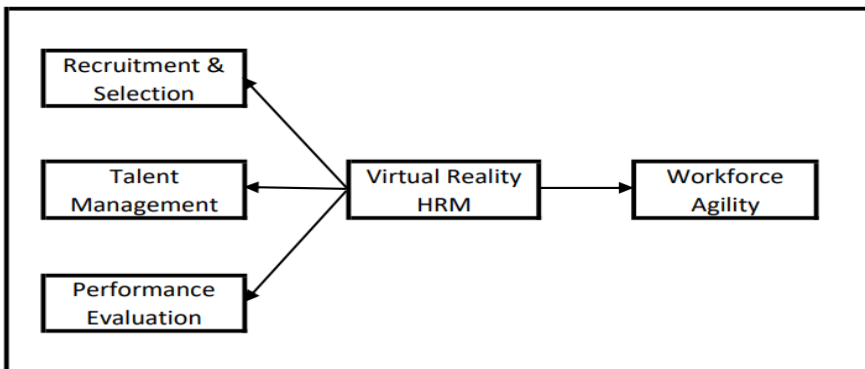

Fig 2. Research Model

4   Research Methodology

This study focused on the quantitative technique to examine the VR applications in HRM practices that could affect workforce agility in the manufacturing sector. The pertinent variables within the VR applications in HRM practices that will be investigated are VR applications in recruitment and selection, talent management and performance evaluation.

Questionnaire surveys will be disseminated via online platforms to collect 150 responses from the workforce in the manufacturing sector. This sample size is anticipated to be greater than the G*Power-based minimum sample size [52]. The respondents who are identified via convenience sampling will be requested to respond to the e-questionnaire either by using the provided link or the QR code. To increase the response rate, the researchers will follow up with the respondents via personal telephone calls. The purpose of this academic study will be briefly explained in an explanation attached to the electronic questionnaire, and all information gathered will be kept confidential.

Structural equation modelling (SEM) will be used to analyze the primary data and determine how these VR HRM variables relate to worker agility in the manufacturing industry.

5   Conclusion

In response to the rapidly changing business environment, firms operating in the manufacturing industry actively embark on digital transformation initiatives. The manufacturing firms reported a BDAI score of 2.26 out of 5, indicating a commendable acceleration of digitalisation. In the pursuit of being competitive and responding continually to the dynamic environment, the cultivation of an agile workforce is critical. Thus, integrating HRM practices with VR applications is pivotal to reshaping the workforce to produce a workforce that is resilient, flexible, proactive and adaptable in this volatile business landscape. While VR applications have been applied mainly to scientific fields, the application of VR in HRM is a novel concept that has the potential to link VHRM and workforce agility.

This study endeavours to fill the gap by investigating the influence of VR HRM on workforce agility. Specifically, it examines the extent to which embedding VR applications in the recruitment and selection process, talent management and performance evaluation contributes to the creation of workforce agility in the manufacturing industry. Research findings could offer valuable insights for manufacturing firms aiming to integrate VR into sustainable HRM practices to promote workforce agility, thus, delivering a marked competitive edge. Moreover, policymakers could hinge on the findings to develop HRM policies and strategies for long-term planning.

Hence, it is critical to explore empirical studies, using larger samples to enable generalisation and to extend the body of knowledge in this field.

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