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The Impact of Artificial Intelligence, Human Capital on Sustainable Performance of Manufacturing Companies in Malaysia

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Abstract

The performance of manufacturing companies in Malaysia's was the main emphasis of the current study. The Malaysian economy has deteriorated because of the manufacturing sector's deficient performance and low GDP. Thus, this conceptual research goals to study the correlation between artificial intelligence and sustainable performance. The research also examines the mediating role of human capital between artificial intelligence and sustainable performance. Present research revealed comprehensive discussion on how enterprise artificial intelligence impact sustainable Malaysian manufacturing performance. This research highlighted the key value of artificial intelligence and sustainable performance for the consideration of the owner/managers of Malaysian SMEs in the manufacturing sector. In addition, Resource-Based View (RBV) theory and Dynamic Capability Theory (DCT) were employed in this research to examine the impact of artificial intelligence and sustainable performance and the mediation impact of human capital between artificial intelligence and sustainable performance. The research used systematic literature to build its conceptual model. Based on the conceptual model build; present research theorised that the is a positive

relationship between artificial intelligence (human capital and sustainable performance) there is also a positive relationship between artificial intelligence and sustainable performance. In addition, the research posits that human capital mediate the relationship between artificial intelligence and sustainable performance. There are several implications of this conceptual framework for theory and practice are discussed. Future research should conduct an empirical testing to analyse the results.
Keywords: Artificial Intelligence, Human Capital, Sustainable Performance, Dynamic Capability Theory, Resources-Based View Theory, Manufacturing Companies

Introduction

AI can be defined as the ability to "imitate intelligent human behavior," which encompasses the broad knowledge of replicating human abilities which can be described as a technology that can mimic human behavior and perform tasks in a way considered "intelligent" (Fogel, 2022). There is a widespread belief that AI will result in job losses and a sense of insecurity as a result of its introduction (Koo et al., 2021). As a result, employees are continuously under pressure to reskill and upskill themselves so they can keep up with the machine's needs (Li, 2022). As predicted by McKinsey Global Institute (2018), the use of largely automatic equipment in a system of manufacturing will produce a shift away from fundamental cognitive skills towards technology skills (Woetzel et al., 2018).

A new division of labor between humans, robots, and algorithms could result in 85 million jobs being eliminated by human-machine collaboration in 2025, while 97 million jobs can be created (Hepaktan et al., 2022). Therefore, it is imperative that organizations improve their staffing levels (Hepaktan et al., 2022). Thus, both employers and employees must re-evaluate the skill ground where, skill acquisition is a network of contextually- and goal-specific actions (Rotundo & Sackett, 2004). It is important for employees to have the technical, social, emotional, and physical skills necessary to succeed in today's fast-paced technology environment (Tripathy, 2020). According to Kwon (2009), human capital is defined as knowledge, skills, abilities, and other traits that are important for economic activity.

Upadhyay and Khandelwal (2024) argued that while AI can replace human recruiters' repetitive tasks, it cannot replace human interaction and face-to-face emotions. Past study asserts that among the hotly debated developments in HR technology was artificial intelligence (AI) where organizations that want to succeed need to keep employee motivation (Jatoba et al., 2019). Even though AI lacks human emotional and cognitive abilities, artificial intelligence infused human resource strategies have a significant impact on organizational performance (Halid et al., 2024). Past study predicts that AI robots will replace or enhance human capabilities in a variety of areas (Shabbir & Anwer, 2018). Past study claim that artificial intelligence (AI) has the potential to help managers speed up their repetitive and routine tasks in a variety of ways (Noe et al., 2006). In the next few decades, experts forecast artificial intelligence (AI) will outperform humans in both services and less specialized jobs. According to Barboza (2019), AI was one of the most widely debated and challenged trends in HR technology because to prosper and grow, organizations must keep their employees inspired. Despite its lack of human emotional and cognitive abilities, AI infused HR strategies, have significant impact on organizational performance (Halid et al., 2024). The labor force movement is a direct result of recent technological advancements, but in the long run, they have the potential to open up completely new opportunities (Acemoglu & Restrepo, 2018).

Problem Statement

The phrase "triple bottom line" gained recognition and is closely related to sustainable performance Elkington (2018), which ensures that a company's social, environmental, and economic goals are balanced. The term' sustainability' was emphasized in the 12th Malaysian Plan (2021-2025) in the post-epidemic era, despite economic growth rates falling from 6.2% per year between 1971 and 2015 to 2.7% per year between 2016 and 2020 (Malaysia, 2021b). Aiming to achieve the Sustainable Development Goals (SDGs), this Plan's policies prioritize environmental protection, citizen well-being, and equitable wealth distribution (Malaysia, 2021b). Establishing and promoting manufacturers who minimize negative effects on the environment and society while emphasizing economic growth is the duty of both policymakers and owner/managers. While addressing the challenges of competition, stakeholder pressure, and Industry 4.0 technologies, advancing sustainability is crucial for manufacturers' socially useful life, employees' quality of life, and the sustainability of the environment (Adam et al., 2019).

In addition, a high-income country is developed through the use of digital technology management, which is crucial because it facilitates highly skilled and value-added economic activities (Bai et al., 2021). Despite financing efforts to shift Malaysia to an innovation-led economy, innovation attitude remains low due to workforce diversity and limited digital technology accessibility (Alfawaire & Atan, 2021). Sustainability is a key advantage of the digital age, given the advancements in technology that have led to growth in the economy and society with less negative environmental effects (Agrawal et al., 2021). In Malaysia manufacturing firms the broad adoption of advance technology is being hindered by change resistance and a lack of innovation 'mindset, as the majority of manufacturing activities are labor-intensive and heavily dependent on low-skilled workers (Hassan et al., 2018). Adoption of technology has been additionally hindered by the availability of low-skilled foreign labor, high costs, and restricted access to financing (Nasiri et al., 2020). Owing to its extraordinary scale and complexity, the manufacturing sector has long been acknowledged as a vital force behind social and economic advancement, having a major impact on stakeholder welfare, the environment, and global wealth (Ahmad et al., 2020). However, the industry has recently experienced a significant decline, making now an ideal time to conduct research into its sustainability.

Research Design and Methods

A comprehensive literature review was used to make this conceptual paper. Moreover, the literature review has synthesized based on scholarly literature related to artificial intelligence, human capital and its influence on sustainable performance as presented in (Figure 1). Four (4) hypotheses have developed in the present conceptual paper to examine how the variables relate to sustainable performance. Additionally, future researchers may have employed a quantitative method (based on analyses) to collect the study's data. Similarly, the research framework strengthened by resources-based view theory (RBV) and the dynamic capability theory (DCT) theory. The conceptual paper was prepared using a dependable, consistent method for performing a systematic review. The suggested conceptual framework may be empirically evaluated in the future using the quantitative approach.

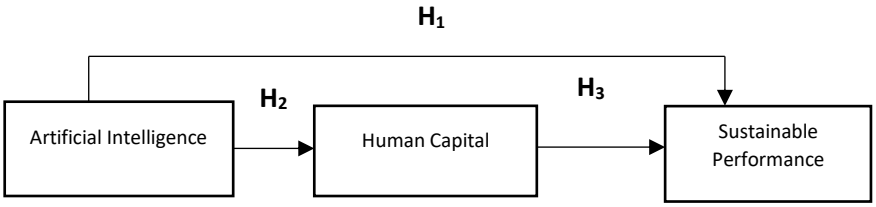

Figure 1: Conceptual Framework

Literature Review

Artificial Intelligence and Sustainable Performance

Earlier research has found that in today's competitive business environment, every organization requires its employees to be competent in developing, managing, and implementing intelligent technology to help the firm's technical processes in pursuing green initiatives (Alnamrouti et al., 2022). Similarly, past studies shows that a company's growth is dependent on its ability to obtain and apply AI knowledge in today's competitive business environment (Di Vaio et al., 2020). Prior research has also shown that a variety of task processes can be digitally envisioned, supported, and enhanced by cooperative teams striving to achieve the company's aims and environmental sustainability goals (Badghish & Soomro, 2024). However, prior research suggested that when digital application of any firm's nature of work consistently neglected, as a result, a company like that might eventually lose its significance (Amankwah-Amoah et al., 2021). Earlier studies have showed that the literature supports the idea that digitization is a global trend that is driving changes in the labor market (Wang et al., 2020). Notably, earlier research has shown that with the help of artificial intelligence, several traditionally difficult jobs can be advanced digitally (Benzidia et al., 2021).

An earlier study found that the primary digital tasks performed by unique interdependent employees can developed more effectively and efficiently (Rashid et al., 2024). Additionally, past studies show that employees' interdependence on digital tasks may influence job outcomes and boost performance with the aid of AI (Chowdhury et al., 2022). Earlier research shows that artificial intelligence and sustainable performance correlate positively (Khan, 2023). Past study points out that due to AI's ability to simplify operations, forecast environmental effects, and optimize resource allocation, it is positioned as a crucial tool for businesses aiming for excellence in sustainable performance (Wamba-Taguimdje et al., 2020). For example, AI's ability to handle vast volumes of data and process complex algorithms makes it positive for sustainable performance in several ways (Rashid et al., 2024). Moreover, one of the primary contributions of artificial intelligence is the efficient allocation of resources (Petrucci & Rivera, 2018). Based on discussion the following hypothesis was proposed:

H_1: There is a positive relationship between artificial intelligence and sustainable performance

Artificial Intelligence and Human capital

AI and its impact on HRM operations have recently received increased attention. For example, previous research found that developing AI-oriented HRM systems contributes to the development, retention, talent acquisition, and assessment of advanced technology multinational enterprises (Faqihi & Miah, 2023). Earlier studies have demonstrated how AI technologies support HRM throughout the hiring, screening, and interviewing of the best

candidates as well as in assessing the efficiency of employee training (Johansson & Herranen, 2019). However, employees are still able to perform many tasks that machines cannot perform, even with the various options provided by implementing advanced technologies in human resource management (Vrontis et al., 2023). Accordingly, prior research indicates that the organization will benefit most from AI integration with human support rather than AI replacing humans entirely (Jarrahi, 2018). Recent studies have shown that increasing the efficiency of human capital in data collection, maintenance, and validation can be achieved by integrating human and AI-based technologies to perform HRM functions (Pathak & Solanki, 2021). Earlier studies have revealed that the use of AI technologies by HR allows them to schedule video interviews with suitable candidates over the Internet where these interviews are conducted by assessing the candidates' interactions, body language, and attitude in order to identify the most suitable candidate for the organization (Chowdhury et al., 2023). Previous research found that these procedures could be carried out entirely without the assistance of people (Johansson & Herranen, 2019). Additionally, AI helps human capital work more efficiently by enhancing planning, scheduling, communication, workflow effectiveness, logistics, and supply change management where all of these functions are integrated by AI's capacity to filter massive data sets using algorithms that leverage powerful computing power and cloud technology (Kolbjørnsrud, et al., 2016). Furthermore, prior research has shown the importance of understanding each member of the team and the consequences of adding a new member (Scott & Le Lievre, 2020). According to earlier research, matching the applicant to the current team is one of the components of a behaviorally intelligent process (McClelland, 1998). Similarly, when looking for an applicant to fill a position, there is no such thing as a perfect fit (Scott and Le Lievre, 2020). In addition, previous research indicates that this disruption may have a positive effect on human resources where AI can support human capital in multiple ways, including by improving the efficiency of the hiring process and by evaluating a larger pool of candidates, both of which will have a direct impact on the hiring quality of human capital (Gnanapragasam et al., 2019). Consequently, this will therefore enable HR to focus on high-quality work while enabling repetitive tasks to complete more quickly and effectively (Gnanapragasam et al., 2019). Furthermore, managers currently have access to a variety of real-time data owing to the availability of AI insights, which will help them make strategic decisions on performance and human capital (Scott and Le Lievre, 2020). Past studies revealed that there is a positive relationship between artificial intelligence and human capital (Gnanapragasam et al., 2019; Roopalatha & Sucharita, 2024). Based on discussion the following hypothesis was proposed:

H_2: There is a positive relationship between artificial intelligence and human capital

Human capital and Sustainable Performance

Human capital is most useful and unique when it is company-specific and remains in the environment where it was developed (Hatch et al., 2004). When a company acquires human capital from a competitor, it undoubtedly gains some of the competitor's knowledge, but it must also go through a period of dynamic adjustment costs while the best uses of the human capital are discovered and tailored to the needs of the new environment (Crook et al., 2011). Thus, human capital can provide sustained performance to the extent that it is unique to the originating firm, and the expenses for adaptation in a unique environment prevent immediate expropriation by competitors (Crook et al., 2011). Furthermore, the same isolating mechanisms that prevent resources from takeovers also make it difficult to find, assess, and

estimate the relationship between resources and competitive advantage (Wang & Mahoney, 2009). However, Prior research has found performance impacts associated with human capital and assumed that competitive advantage is sustainable owing to the intangible, socially complex nature of human capital (Hitlka et al., 2019; Hamadamin & Atan, 2019; Massaro et al., 2018).

According to Pereira et al (2020), successful organizations have embraced the idea that taking care of human capital can give them a distinct competitive advantage, particularly in the age of modern technology (Khan et al., 2020). Human capital is the key to an organization's survival in a rapidly competitive environment Cao & Im (2018), and it involves talented individuals with unique capabilities, intelligence, and skills that meet current requirements of the performance (Agolla, 2018). Human capital, however, is a kind of intangible resource Schneider (2018), currently when getting machinery and equipment is no longer a source of differentiation between companies, but rather the need to get rare human competencies (Cantoni & Mangia, 2018; Hecklau, et al., 2017). There is a distinction between tangible and intangible human capital because losing skilled workers makes an organization less competitive (Riley et al., 2017).

Previously, the HC literature has shown a significant relationship with superior performance Adesina (2021); Tjahjadi et al (2020), but approaches to developing added value for company vary depending on their human capital, whether it seek for innovation or high-quality products (Kianto et al., 2017). According to Minbaeva (2018), this was demonstrated by the company's capacity to generate income or a competitive strategic advantage from its human capital. For instance, an earlier study revealed that patients' perceptions of value are influenced by the strong relationship between human capital and the effectiveness and creativity of frontline health services (Abazeed, 2017). This shows that the strong relationship between human capital and performance, in line with authors (AlQershi et al., 2022; Dwikat et al., 2023; Fareed et al., 2016) who show that human capital is fundamental in positively affecting sustainable performance. Based on discussion the following hypothesis was proposed

H_3: There is a positive relationship between human capital and sustainable performance

Human Capital Mediates the Relationship between Artificial Intelligence and Sustainable Performance

According to Ireland et al (2003), if a firm manages its resources strategically and methodically, it will be more successful. According to Abdullah and Sofian (2012), an organization's human capital which includes knowledge, professional skills and experience, ability, educational attainment, and employee creativity directly affects how well it performs. Human capital affects MSMEs' Performance (Abdullah & Sofian, 2012; Ahmad & Mushraf, 2011; Khalique et al., 2018; Rokhman et al., 2023). Research from the past suggests that although AI is excellent at performing repetitive tasks, human ability is still essential in areas that call for creativity, empathy, and moral judgment (Ghosh & Nundy, 2020). Human resource development plays a crucial role in facilitating organizational change and cultivating a culture of continuous learning, according to Ross et al (2019), who support a human-centrical approach to AI adoption. Furthermore, Bryson et al (2017) issue a warning about the possible dangers of AI dependency and promote the ethical design of AI systems that respect human autonomy and importance. Although the current body of literature provides insightful analysis on the relationship between advances in AI and human capital, empirical research is

still needed to interpret people's work experiences and perceptions in the context of organizations (Vrontis et al., 2023). According to Irawan et al (2021a), human capital indicators need more in-depth understanding in the context of small industries. As such, human capital could not directly or even indirectly play a prerequisite role in a firm sustainable performance through innovation performance. Prior studies noticed a positive relationship between artificial intelligence and human capital (Bhardwai et al., 2020; Chung, 2022; Purwaamijaya & Prasetyo, 2022). Furthermore, past research found a positive relationship between human capital and sustainable performance (Akankunda et al., 2024; Dwikat et al., 2023; Syed et al., 2020; Xu et al., 2019). According to Hayes and Preacher (2014), when there are positive, causal and consistent relationships between the variables of a research, a mediation effect may exist. Therefore, there is a high possibility that human capital mediates the relationship between artificial intelligence and sustainable performance. Based on the above discussion the present study proposes the following hypothesis:

H_4: Human capital mediates the relationship between artificial intelligence and sustainable performance

Underpinning Theories

Dynamic Capability Theory (DCT) and Artificial Intelligence and Sustainable Performance

By incorporating AI into the dynamic capability theory framework, an organization's ability to recognize opportunities, act upon them, and reallocate resources toward long-term success is highlighted (Warner & Wäger, 2019). In addition to increasing productivity and creativity, AI makes sure that businesses are flexible and adaptable when faced with sustainability issues (Dwivedi et al., 2021). Businesses can achieve long-term sustainable growth by using AI to balance economic, environmental, and social aims (Zhao & Gómez Fariñas, 2023). The theory of dynamic capability (DCT) centers on the ability of an organization to effectively integrate, construct, and reorganize both internal and external competencies in response to swiftly evolving environments (Wang & Shi, 2011). For example, AI drives sustainable performance in a variety of ways, including AI contributes to the efficient use of natural resources, reducing waste, and minimizing the negative environmental effects (Kar et al., 2022). Artificial intelligence tools can help organizations stay ahead of sustainability challenges by continuously checking the effects on the environment, changes in regulations, and technological advancements (Ahmad et al., 2021).

Resource-Based View (RBV) Theory and Human Capital

The RBV defines resources broadly as "anything that could be viewed as the strength or weakness of a given firm." According to Wernerfelt (1984), a firm's assets, capabilities, organizational processes, firm attributes, information, and knowledge are all under its control and allow it to develop and apply strategies that increase its effectiveness and efficiency (Barney, 1991& 2011). The RBV assumes that knowledge is independent and represented because it comes from specific individuals (Grant, 1991). Companies mostly neglect the collective knowledge found in organizational routines, structures, and culture, as well as the knowledge that remains after employees leave the company (Lewin & Baetjer, 2011). However, RBV explains how it is important to consider the collective knowledge and abilities within organization Wernerfelt, 1984).

Design/Method/Approach

The conceptual paper originated by carefully considering journal articles, conference materials, conference proceedings, and books about the subject topic and keywords. The theoretical framework shown in (Figure 1) was created based on the scope of the available research review and the differences between research studies. According to a review of the literature, earlier research has found a positive relationship between artificial intelligence, human capital, and sustainable performance. As artificial intelligence is applied more and skilled human capital develops, Malaysian manufacturing companies' sustainable performance will grow.

Results and Discussion

As part of the conceptual study design, a comprehensive review of pertinent books, journal articles, conference materials, proceedings, and systematic reviews was performed. The size of the literature review and the variations in the research were considered when developing the theoretical framework (Figure 1). Earlier research shows a positive correlation between artificial intelligence, human capital, and sustainable performance, with the possibility of human capital acting as a mediator.

Study Implication

This paper presents an opportunity for Malaysian manufacturers and the government to refocus on long-term performance. Based on the results of earlier research, the empirical evidence suggests that this study is crucial to help Malaysian policymakers develop an appropriate plan for enhancing the manufacturing sector's sustainable performance by requiring the development of human capital talent and technological adaptation. Consequently, this conceptual paper states that human capital and artificial intelligence are crucial resources and elements that support achieving a company's sustainable performance. No empirical analysis of the conceptual framework has been done. Future research could have included additional influencing factors, such as organizational culture and green intellectual capital. The current paper may argue that artificial intelligence and human capital are an important predictor of corporate long-term performance, and future research could look into leadership support, the Knowledge Management Process, and its relationship with Frugal Innovation in sustainable performance.

Conclusion

This theoretical study evaluated the value of human capital and artificial intelligence, as well as how they affect sustainable performance. The manufacturing companies in Malaysia will be incentivized to utilize their resources more efficiently by investing in artificial intelligence and human capital. This theoretical paper explained how to leverage the capabilities of human capital and artificial intelligence to improve sustainable performance. For an enterprise to perform sustainably, its resources must be used appropriately. Manufacturing companies need to use a variety of strategies to obtain a competitive edge and satisfy their customer's needs with high-quality goods and services because of the rapidly advancing technology and the highly competitive market. This paper aims to encourage owners and managers of manufacturing companies, as well as the Malaysian government, to place greater emphasis on sustainable performance and the factors that influence it.

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