E-ISSN: 3090-6962

JOURNAL OF CENTER FOR ENERGY POLICY AND HUMAN RESOURCES CAPACITY DEVELOPMENT (JCEPHRCD) Vol 2 No. 1

Transformation of Human Resource Management in Green Economic Sustainability and Global Challenges

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Abstract

This study highlights the importance of integrating green economy and human resource (HR) behavior in reducing the gap discrepancy between the current state and long-term goals within the context of sustainability. HR plays a crucial role in supporting the transition to a green economy through interdisciplinary skills, efficient cost control, and a deep understanding of sustainability concepts. The gap discrepancy analysis reveals that the success of the green economy relies not only on changes in business practices or natural resource management but also on changes in the behavior and skills of the involved HR. Therefore, enhancing relevant training and fostering interdisciplinary collaboration are key to bridging this gap. Improving HR capacity in technical skills and understanding social and global responsibility must be a primary focus, enabling HR to implement sustainability principles in social and economic policies. In this way, HR can serve as change agents, accelerating the application of a more sustainable green economy and supporting the achievement of sustainable development that benefits society as a whole.

Keywords: Green Economy; HR Behavior; Gap Discrepancy; Sustainable Development; Interdisciplinary Skills; Green Innovation

Citation: Samad, Abdul Wahab, **Transformation of Human Resource Management in Green Economic Sustainability and Global Challenges** E-ISSN: 3090-6962 Vol 2 Number 1 Page 37 – 52

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Introduction

Human resource (HR) management and development are crucial aspects in ensuring organizational sustainability and competitiveness amid the dynamics of global change. In this era of disruption, characterized by technological advancements, the shift towards a green economy, and increasing attention to global social policies, organizations are required to adopt adaptive and innovative HR strategies. External factors such as digital transformation, sustainability policies, and social entrepreneurship increasingly influence how organizations design and implement their HR policies. This aligns with findings that technology, green economy, and global social policies significantly impact HR strategies, while business innovation has yet to demonstrate a direct, significant effect. Furthermore, social entrepreneurship has been shown to play an essential role in shaping socio-environmental policies that affect HR management at the organizational level. Therefore, integrating innovation and HR strategies, enhancing HR capacity to face global disruptions, and mainstreaming sustainability values become strategic priorities. This study aims to analyze the influence of external factors on HR management and development within organizations, while also providing theoretical and practical contributions to building an HR management system that is responsive, adaptive, and sustainable. Through this approach, the study is expected to enrich the understanding of the dynamic relationships among variables affecting HR management and offer strategic recommendations for organizations to address global challenges (Samad, Ishaq and Setiyadi 2023).

Literature Review

1. The Impact of Industry 4.0 Technology on Corporate Decisions to Reshore Production Activities

According to Fratocchi and Stefano (2020), previous studies have analyzed the impact of Industry 4.0 enabling technologies on companies' decisions to reshore production activities previously relocated overseas back to their home countries. Specifically, these studies examined whether Industry 4.0 technologies act as a driver or an enabler for companies considering this strategic alternative. To explore this, a two-stage exploratory methodology was applied, including a structured literature review and an analysis of empirical evidence related to backshoring decisions by European and US companies. The findings from these studies indicate that most articles conceptualize Industry 4.0 technology as a driver. However, empirical results revealed notable differences between European and US companies in adopting backshoring decisions influenced by Industry 4.0 technologies. Additionally, competencies related to manufacturing activities and Industry 4.0 technologies were identified as critical factors for the companies involved.

The integration of Industry 4.0 technologies into reshoring decisions resonates with the ongoing transition toward **green economy** models. As companies adapt to new technologies, they not only address production efficiency but also enhance environmental sustainability through automation and digitalization, aligning with long-term sustainability goals.

2. The Industrial Revolution Increased Productivity and Per Capita Income

According to Hafez, Liparitito, and Watson (2023), industrialization involves replacing

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human or animal labor with machines and mineral energy sources. Through new technologies (first developed during the Industrial Revolution) and new ways of organizing production, less effort was required to produce more goods. While this may seem commonplace today in a world where we expect the economy to grow at a healthy rate (and worry when growth is insufficient), we also hope to produce more with fewer resources, thereby increasing income per capita. However, these expectations were new and unprecedented around the year 1700. It was only after the onset of the Industrial Revolution that significant and consistent increases in per capita income and labor productivity occurred.

This transformation mirrors the technological shifts happening today, notably in the application of **Industry 4.0 technologies** and the **green economy** framework. Just as industrialization revolutionized production processes and increased income, the modern transition towards green technologies promises to boost productivity while reducing environmental impact, ushering in a new era of sustainability.

3. The Development of Evolutionary Computation

According to Land Jr. and Schaffer (2020), three distinct origins can be identified in the development of this field. L. Fogel, in California, applied this idea to machine learning by developing finite state machines to predict the next symbol in a sequence (Fogel et al., 1966). His approach became known as evolutionary programming (EP). Independently, Rechenberg, in Germany, developed evolutionary strategies to solve complex aerodynamic design problems, where a large number of parameters needed to be adjusted simultaneously. Also independently, J. Holland, in Michigan, developed genetic algorithms as a general model of adaptive processes. Indeed, one can refer back to Alan Turing's 1950 paper on thinking machines, which explicitly referred to adaptive processes in evolutionary terms. When the field unified with the launch of its first journal in 1993, the chosen name for the entire discipline was Evolutionary Computation (EC).

Evolutionary computation, particularly **genetic algorithms (GA)**, plays a critical role in the development of technologies for a **green economy**. By utilizing adaptive mechanisms, these technologies can optimize processes and resources, significantly reducing waste and improving the sustainability of production methods.

4. The Framework of Innovation Types within the Categories of Configuration, Offering, and Experience

According to Keeley et al. (2013), the Ten Types framework is simple and easy to understand, and it is beneficial for diagnosing or enriching ongoing innovations as well as analyzing existing competitors. This framework also helps identify missing dimensions that can strengthen a concept. Divided into three colored categories, the types on the left focus more internally within the company and are distant from the customer, while the end user more directly experiences those on the right. Using a theater analogy, the left side is like backstage, whereas the right side is on stage. The framework does not imply any order or hierarchy, so these innovation types can be combined within a single innovation and can start from any kind. The innovation types are grouped into three categories: Configuration (focusing on the company's internal operations and business systems), Offering (focusing on the company’s core

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products or services), and Experience (focusing on elements directly related to customers).

This framework provides valuable insights for companies working to align their innovation strategies with the principles of a **green economy**. By categorizing innovations into **configuration**, **offering**, and **experience**, companies can integrate sustainability into all aspects of their operations and better cater to environmentally conscious consumers.

5. Differences in Perspective Between Social and Commercial Entrepreneurship in Addressing Social Problems

According to Zhao (2021), the perspective of entrepreneurship differs in its approach to solving social problems through business solutions. The commercial approach can be understood as a way to generate operational revenue and implement market-based business strategies to ensure organizational sustainability. Social entrepreneurship does not always require organizations to generate operational revenue. Organizational sustainability can be achieved through stable donations or external funding, as well as the organization's ability to solve problems, such as opportunity identification, innovation, and risk management. Due to the many elements involved in social entrepreneurship, the definition of social enterprises can become very complex. Therefore, a balanced perspective is needed, one that can better explain the complexity of the facts compared to a dichotomous view, and that is easier to understand and apply. The entrepreneurial perspective aims not to deny the efforts of scholars or practitioners in describing social enterprises with both social and commercial elements, but to more accurately and comprehensively understand the complex phenomenon of social enterprises.

Social entrepreneurship is deeply intertwined with the shift toward a **green economy**, where businesses balance profitability with social and environmental responsibilities. As companies adopt more sustainable practices, the integration of social entrepreneurship strategies helps address key societal issues related to sustainability and environmental protection.

6. The Rapid Pace of Technological and Scientific Change

According to Girasa and Scalabrini (2022), each generation, older people wisely reflect on how life was simpler several decades ago. With rare exceptions, scientific progress developed relatively slowly but steadily, causing some disruptions in the social structure of particular societies, where there were winners and losers—the latter generally including individuals unable or unwilling to adapt to changes transforming their world. While these changes occurred noticeably over decades or even centuries, most contemporary observers note that the pace of change has dramatically accelerated, making it nearly impossible to predict which events will cause significant disruptions beyond the next half-decade. Consider how the use of computers, mobile phones, and the internet at home and in the workplace has changed the way most people live their daily lives. Also consider how the emergence of Bitcoin, founded in 2009 and based on blockchain technology, has altered society's view of the nature of money. Currently, physicists are exploring ways to embed data into subatomic particles so that, perhaps soon, all the world's data and knowledge could be stored in photonic particles with analysis performed directly.

The **rapid pace of technological change** aligns closely with the evolution of **green economy** strategies. As technology

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progresses, industries are rapidly adopting more sustainable practices to reduce environmental impact and enhance operational efficiency, driven by innovations such as blockchain, AI, and clean technologies.

7. The Shift of Healthcare Delivery to Patients' Homes Through Telehealth Technology and Personal Health Devices

According to Rooijakkers (2021), in recent decades, there has been a clear trend in clinical care toward shifting treatment from hospitals and health centers to the home environment, primarily driven by the need to reduce healthcare costs, where new ambulatory monitoring techniques and telehealth can help lower expenses. Providing services in patients' homes makes care more accessible and comprehensive, with a focus on early diagnosis and health maintenance rather than solely on disease treatment. This trend has been further accelerated by the emergence of new health technologies suitable for home use, such as personal health coaching apps, medical diagnostic applications, and platforms like Apple's HealthKit, along with advances in artificial intelligence. The use of connected personal health devices at home has now become commonplace, enabling the monitoring of various health parameters that provide insights into users' conditions.

The shift in healthcare delivery is an example of **digital transformation**, which is also impacting the **green economy** by improving energy efficiency and reducing waste. Remote healthcare technologies, powered by AI and the internet of things (IoT), contribute significantly to reducing carbon footprints, aligning with the sustainability goals of the green economy.

8. The Environmental Dilemma in Choosing Between Maintaining Consumption Habits and Shifting to a Sustainable Paradigm Through Green Economic Engineering

According to Oncel (2023), currently, with increasing stress caused by environmental issues, humanity faces a critical dilemma. Continuing old habits that prioritize consumption for human comfort has led to a dead end, making it no longer a realistic option. On the other hand, shifting the paradigm toward a sustainable and environmentally friendly future is not easy, given the limits humanity has reached—limits that are evident through catastrophic changes encompassing real struggles in the environment and climate. Therefore, this dilemma ends at a crossroads where one path clearly leads to a dark abyss, while the other does not guarantee comfort and prosperity due to the risks of delay we face. However, remaining calm and focusing on the best actions to follow the right path, while understanding the challenges involved, requires trust based on scientific knowledge. In this context, engineering with a green vision will return the initiative to safe hands.

This dilemma underscores the urgent need for **green economic engineering** to provide solutions that move away from traditional consumption patterns toward more sustainable practices. As technological advancements and policy changes push industries and governments toward sustainability, the adoption of green engineering becomes an essential strategy to address environmental crises.

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9. Techno-Economic Analysis in Evaluating the Performance of Products or Processes

According to Murthya (2022), techno-economic analysis (TEA) is formally defined as the process of evaluating the technical and economic performance of a process, product, or system. Like systems analysis, conducting a good TEA requires interdisciplinary effort. It demands engineering skills, strong financial knowledge, a solid understanding of uncertainty and statistical analysis, as well as in-depth knowledge of the technology or system under study. Often, strong process modeling skills are valuable when evaluating complex processes. Once candidate technologies and processes are identified, the objective of the TEA process is defined before beginning the analysis, which will determine the tools needed to carry out the TEA. The TEA process starts with identifying candidate technologies and processes, followed by economic analysis of the process configuration. Various levels of detail and methods are used to conduct TEA, including zero-order estimation methods to gain an initial overview of cost-benefit, as well as net present value (NPV) and internal rate of return (IRR) methods that incorporate the time value of money and are often referred to as discounted cash flow methods.

Techno-economic analysis (TEA) is a key method in evaluating sustainable technologies within the **green economy**. By analyzing the technical and economic feasibility of various green technologies, companies can make informed decisions that balance cost and sustainability, enabling the widespread adoption of environmentally friendly innovations.

10. A Warning to Take Digital Transformation (DX) Seriously to Avoid Further Setbacks in Society 5.0

According to Whittaker (2024), a report sponsored by METI in 2018 issued a warning urging Japanese companies to take digital transformation (DX) seriously and actively engage in it. At the same time, it implicitly acknowledged that years of efforts led by METI's IT Promotion Agency (IPA) had little impact; Japan was heading sleepily toward a future constrained by legacy systems. Whether this gap leads downward toward financial ruin or upward toward a steep climb that is almost impossible to surmount remains unclear, as the report suggested both scenarios. From the early IT economic boom in the 1980s—when Japan controlled much of the world's semiconductor production and appeared ready to challenge US technological leadership in mainframe computers—to the bleak vision for 2025, Japan has fallen far behind. The reasons for this decline in the 1990s and 2000s were discussed in Chapter 1; this chapter focuses on contemporary and prospective DX and the government's role in this regard. If nothing else, the depiction of the gap and the recognition that DX is more than just using IT to perform existing business more efficiently have been widely acknowledged as outcomes of the report. Of course, DX is a prerequisite for achieving Society 5.0.

Digital transformation (DX) plays a crucial role in **green economic** development. Companies and governments that embrace DX not only improve efficiency but also advance sustainability efforts by utilizing smart technologies to reduce waste, optimize resource usage, and lower carbon emissions.

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11. The Synergy Between Circular Economy and Bioeconomy in the Transition Toward Sustainability Based on Biological Materials

According to Gkountani and Tsoulfas (2023), the circular economy is a well-known and promising model, with numerous studies and promotions highlighting its impact on the environment, economy, and society. Meanwhile, the bioeconomy is still in the developmental stage and considered a potential pathway toward sustainability. The application of the circular economy to bio-based materials can bring fundamental changes by shifting production from fossil-based to more sustainable natural resource utilization. Many studies have been conducted as evidence of the importance of this field, aiming to develop methodologies, tools, and technologies that can accelerate sustainability achievements across various production sectors. Stakeholders recognize the urgency of change, prompting multiple actions to be taken. Regulations and technologies also closely collaborate to accelerate this transition. This study discusses how policies and technologies complement each other in implementing these practices at the operational level. Various recommendations are proposed to identify barriers and opportunities in adopting these methods, particularly in the agri-food sector.

The intersection of **circular economy** and **bioeconomy** provides a powerful model for achieving sustainable resource utilization in the **green economy**. By shifting away from fossil fuels and embracing bio-based materials, industries can reduce their carbon footprint and contribute to a more sustainable future.

12. The Interrelationship Between Financial Inclusion and Environmental Sustainability in Achieving the Sustainable Development Goals (SDGs)

According to Ozili (2023), Financial inclusion and environmental sustainability are two concepts often linked to sustainable development (Yin et al., 2019; Klapper et al., 2016). Both contribute to the achievement of the Sustainable Development Goals (SDGs) through different pathways. Specifically, financial inclusion supports sustainable development by reducing global poverty levels through the provision of affordable financial services to marginalized populations. Meanwhile, environmental sustainability plays a role in addressing climate change through environmental protection policies. Strict environmental policies and economic growth aligned with environmental considerations can ensure that economic progress does not come at the expense of ecosystems. This indicates an interrelationship between financial inclusion and environmental sustainability, as both contribute to achieving the SDGs, albeit from different perspectives—namely, the dimension of financial services and environmental protection.

Financial inclusion plays an essential role in supporting the **green economy** by ensuring equitable access to resources that enable sustainable development. By providing underserved communities with access to affordable financial services, it fosters economic opportunities that prioritize sustainability, helping to bridge the gap between financial resources and environmental goals.

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13. Technological Innovation and Integrated Policies in Promoting Green Transportation in South Africa

According to Bikam (2022), previous research has examined technological innovations in green transportation in Limpopo Province, South Africa, focusing on efforts to reduce greenhouse gas emissions through fuel efficiency and the transition to clean energy. South Africa, contributing to the global fight against climate change, has been pursuing sustainable transportation options by investing in electric vehicles, renewable energy sources, and innovative transportation systems. Integrated policies that encourage both technological advancements and environmental protection have been key in driving this transformation in the transport sector.

Green transportation innovations are crucial components of the **green economy**. By integrating technological solutions such as electric vehicles and renewable energy, countries like South Africa are not only tackling environmental issues but also contributing to the global transition toward sustainability. These innovations align with efforts to reduce carbon footprints and promote sustainable economic practices across various sectors.

14. The Role of Artificial Intelligence in Shaping the Future of the Green Economy

As artificial intelligence (AI) continues to advance, it plays an increasingly significant role in shaping the **green economy**. From optimizing supply chains to improving energy efficiency and waste management, AI technologies can contribute to sustainability by reducing waste, minimizing resource consumption, and enhancing productivity. By enabling smarter decision-making, AI helps businesses and governments implement more effective and sustainable practices.

AI can help drive **digital transformation** in various industries, including energy, agriculture, and transportation. By integrating AI into environmental management systems, companies can improve their ability to track and reduce carbon emissions, better manage natural resources, and optimize sustainable practices at scale. As AI continues to evolve, its role in accelerating the green economy will become even more crucial.

15. The Economic Impact of Green Building Practices

Green building practices have become a key component in promoting sustainability within the **green economy**. According to recent studies, the adoption of environmentally friendly building technologies not only reduces energy consumption and waste but also generates long-term financial savings. Green buildings use resources more efficiently and create healthier living environments, contributing to both economic growth and environmental preservation.

As demand for green buildings increases, the construction industry is adapting by incorporating innovative technologies such as energy-efficient systems, renewable energy sources, and sustainable building materials. These innovations align with the principles of the **circular economy**, which emphasizes reducing waste, reusing materials, and maximizing resource efficiency.

16. The Influence of Government Regulations on Sustainable Business Practices

Government regulations play a pivotal role in shaping the development of the **green**

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economy. According to recent research, policies such as carbon pricing, renewable energy incentives, and green certification programs are driving businesses to adopt more sustainable practices. These regulations create financial incentives for companies to reduce their environmental impact, invest in cleaner technologies, and prioritize sustainability in their operations.

In the context of **financial inclusion**, governments also have a crucial role in ensuring that green economy policies are accessible to all sectors of society, including marginalized communities. By implementing inclusive financial policies that support sustainable development, governments can help promote broader participation in the green economy.

17. The Role of Education in Advancing the Green Economy

Education plays a critical role in promoting the **green economy** by raising awareness and fostering the development of skills necessary for sustainable practices. As sustainability becomes an increasingly important issue, educational institutions are integrating environmental studies into curricula at all levels, equipping future leaders with the knowledge to address pressing environmental challenges.

Moreover, businesses and governments are investing in training programs to ensure that employees are equipped with the skills to implement green technologies and sustainable business practices. By fostering a culture of sustainability through education, society can drive the transition toward a greener and more equitable economy

Research Methodology

This study employs a quantitative approach using Structural Equation Modeling (SEM) based on Partial Least Squares (PLS), processed with SmartPLS 3 software. The SEM-PLS method was chosen because it does not require strict data distribution assumptions, is tolerant of moderate sample sizes, and can analyze relationships between latent variables simultaneously through both measurement and structural models.

The data analysis process begins with preparing data in CSV (comma-delimited) format compiled from quantitative data collection. The data is then imported into SmartPLS 3 after creating a new project in the software. Next, the research model consisting of latent variables is drawn within the software, and indicators obtained from the questionnaire are assigned to the latent variables according to the hypothesized model. The quality of the measurement model is tested using the PLS algorithm to ensure construct validity and reliability. Once the measurement model is deemed adequate, hypothesis testing is conducted using the bootstrapping technique to assess the significance of relationships among variables in the structural model.

Using this method, the study can obtain reliable estimates regarding the influence of external factors on adaptive and sustainable human resource management strategies. The SEM-PLS approach also offers flexibility in analysis and the ability to handle data that do not meet classical assumptions, making it highly suitable for complex social and organizational research contexts.

Results and Discussion

Respondent Description

Based on the survey results from 56 respondents, their highest education levels showed considerable variation. The majority of respondents had higher education

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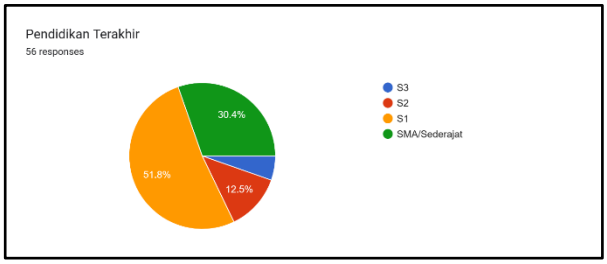
backgrounds, particularly at the Bachelor's (S1) and Master's (S2) levels. The detailed distribution is as follows:

- Bachelor's Degree (S1): The largest group, comprising 51.8% of respondents. This indicates that more than half of the respondents have completed undergraduate education.
- High School or Equivalent (SMA/Sederajat): The second largest group at 30.4%, indicating a significant portion of respondents with upper secondary education.
- Master's Degree (S2): Representing 12.5% of respondents who have pursued graduate education.
- Doctoral Degree (S3): The smallest group at 5.4%, consisting of respondents with doctoral-level education.

This data reflects that the majority of respondents possess relatively high educational qualifications, which may influence their level of understanding and perspectives regarding the issues or topics being studied.

Graph 1.1

Education Level of Respondent



Respondent Job Description

The respondents come from diverse occupational backgrounds, reflecting a wide range of professions within the studied population. The occupation with the highest number of respondents is Civil Servants (PNS), accounting for 19.6%. This indicates that a significant portion of respondents work in government or public administration sectors.

The distribution of respondents' occupations is as follows:

- Civil Servants (PNS): 19.6%
- Private Sector Employees: 12.5%
- Entrepreneurs / Self-employed: 10.7%
- Contract / Temporary Workers: 8.9%
- Factory Workers / Laborers: 8.9%
- Farmers / Fishermen: 8.9%
- Teachers / Lecturers: 8.9%
- Health Workers (Doctors, Nurses, etc.): 8.9%
- Others (not listed in the chart): The remaining respondents are evenly distributed, likely including other categories not fully displayed in the visual representation.

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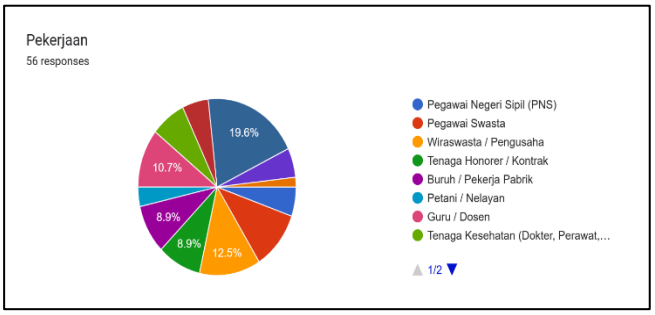
This occupational diversity provides a broad picture of the respondents' socio-economic conditions. It also contributes to a richness of perspectives in answering survey questions, especially if the research topic relates to public policy, social welfare, or community services.

Graph 1.2

Job Description of Respondent



Internal Reliability

Internal reliability in this study was measured using Cronbach's Alpha and Composite Reliability (CR). All research variables showed Cronbach's Alpha values above 0.70, indicating an excellent level of internal consistency. Specifically, Cronbach's Alpha values for variables were as follows: X1 = 0.953, X2 = 0.932, X3 = 0.955, X4 = 0.916, X5 = 0.874, and Y1 = 1.000. Similarly, Composite Reliability values for all variables were also above the 0.70 threshold, with the highest value for variable X3 at 0.978, confirming that the constructs measured by these indicators have high measurement consistency.

Convergent Validity

Convergent validity was tested using Average Variance Extracted (AVE), which indicates the proportion of indicator variance explained by each construct. All variables had AVE values greater than 0.50: X1 (0.878), X2 (0.867), X3 (0.956), X4 (0.795), X5 (0.795), and Y1 (1.000). These high AVE values indicate that the constructs adequately explain the variance of the indicators and are considered convergently valid.

The rho_A Values

The rho_A values, as an alternative reliability measure, also showed promising results, with most variables scoring above 0.70. However, the rho_A value for variable X2 was 1.305, which is technically impossible and likely a calculation or reporting error requiring further verification. Nevertheless, overall model reliability can still be considered valid based on other reliability measures.

Based on the reliability and validity analysis results, all constructs in this study meet good internal reliability and convergent validity criteria. Therefore, the measurement instruments used are reliable for measuring the variables in the research model. This provides a strong foundation for proceeding to structural model analysis and hypothesis testing.

The Effect of Technology and Industry (X1) on Human Resource Management (Y1)

The analysis results show that the variable Technology and Industry (X1) has a significant effect on Human Resource Management (Y1), with a coefficient value of 0.378, a T-value of 2.453, and a p-value of 0.015.

This interpretation suggests that the adoption of technology and industrial changes fosters improvements in HR management effectiveness. Indicators such as digital transformation (X1.4) and productivity resulting from the industrial revolution (X1.2) contribute to changes in

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work systems, productivity measurement, and technology-based HR development.

This strengthens the view that organizations that successfully adopt technological developments strategically tend to have more adaptive and responsive HR management systems to change.

The Effect of Innovation and Competition (X2) on Human Resource Management (Y1)

The variable Innovation and Competition (X2) shows an insignificant effect on Human Resource Management (Y1), with a coefficient value of 0.124, a T-statistic of 0.974, and a p-value of 0.331.

This means that although business innovation and competition continue to evolve, they have not yet directly influenced HR management strategies within the context of this study. The innovation process likely remains focused on product and technological aspects, while its integration into HR policies is not yet optimal.

Indicators such as X2.2 (evolutionary computation) and X2.3 (techno-economic analysis), which tend to be technical, may not have fully impacted the daily management of HR at the organizational level.

The Effect of Entrepreneurship and Social (X3) on Global Social and Environmental Policy (X5)

The analysis results show a significant relationship between Entrepreneurship and Social (X3) and Global Social and Environmental Policy (X5), with a coefficient of 0.337, a T-statistic of 2.576, and a p-value of 0.010.

These findings indicate that entrepreneurial approaches—both social and commercial—contribute to shaping social and environmental policies, especially at the global level. The social awareness brought by the millennial generation (X3.2) and the perspective of social entrepreneurship (X3.1) exert pressure on policymakers to adopt more sustainable and socially inclusive policies.

The Effect of Green Economy and Sustainability (X4) on Technology and Industry (X1)

The variable Green Economy and Sustainability (X4) shows a highly significant effect on Technology and Industry (X1), with a coefficient of 0.483, a T-statistic of 3.299, and a p-value of 0.001.

These results confirm that the push to implement sustainability principles, circular economy, and bioeconomy has become a catalyst for the transformation of industry and technology. Issues such as the sustainable consumption dilemma (X4.1) and the bioeconomy transition (X4.2) act as drivers for the industrial structure to shift toward more environmentally friendly practices.

This transformation also supports technological approaches within the Society 5.0 framework (X1.4), integrating technology-based solutions for social and environmental goals.

The Effect of Global Social and Environmental Policy (X5) on Human Resource Management (Y1)

The variable Global Social and Environmental Policy (X5) has a highly significant effect on Human Resource Management (Y1), with a coefficient of 0.431, a T-statistic of 4.432, and a p-value of 0.000.

This interpretation indicates that global policies related to social and environmental issues directly impact HR management

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strategies within organizations. Policy innovations such as green transportation (X5.1) or social representation issues in conservation (X5.2) drive organizations to adjust their internal HR policies, especially regarding employee welfare, health, and sustainable competency development.

Conclusion

Overall, the results of this study confirm that external dynamics such as technological advancement (X1), the shift toward a green economy (X4), and global social policy flows (X5) have a real and significant impact on how organizations manage and develop their human resources. These three factors not only create adaptive pressures but also open opportunities for transformation in strategic HR management approaches.

Conversely, the business innovation variable (X2) has not yet shown a direct significant effect on HR management. This finding suggests that innovation, without integration into HR frameworks, may not be sufficient to drive change at the organizational level. This opens the door to formulating more synergistic cross-functional strategies between innovation and HR policies.

Furthermore, the interrelationship among variables reveals the critical role of social entrepreneurship as a bridge between socio-environmental orientation and HR managerial practices. In other words, social entrepreneurship acts not only as a catalyst for social change but also as a driver for the emergence of more responsive organizational policies toward sustainability and employee well-being. These findings highlight the need for organizations to be more sensitive to external issues and to embed social values as an integral part of future human resource management strategies.

Recommendations

Based on the findings of this study, it is recommended to adopt a more strategic, integrative, and contextual approach in managing and developing human resources (HR), both at the organizational practice level and in future academic research development.

1. Integration of Business Innovation into HR Strategy

   Considering that business innovation has not yet shown a direct impact on HR management, organizations need to align innovation strategies with HR functions. This can be achieved by strengthening an innovative culture, conducting cross-divisional training, and creating internal mechanisms that support collaboration between HR teams and innovation units.

2. Enhancing HR Capacity to Address Technological Disruption and Global Issues

   External factors such as technological advancement, green economy, and global social policies have proven significant. Therefore, organizations should equip HR with digital skills, environmental awareness, and international social literacy. This will not only enhance competitiveness but also make organizations more adaptive to global changes.

3. Mainstreaming Sustainability and Social Justice Values in HRM

   Principles of the green economy and global social policies should be integrated into HR policies, encompassing recruitment, training,

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and performance management. This is essential to ensure that HR management aligns with sustainability values and social responsibility.

4. Strengthening the Role of Social Entrepreneurship

   The study shows the role of social entrepreneurship in shaping social-environmental policies. Hence, organizations are encouraged to support social entrepreneurship programs as part of their HR development strategies and community empowerment, while also strengthening their social image.

5. Need for Deeper and Contextual Future Studies

   To enrich understanding and validate the relational model among variables, future studies are recommended to:

   - Use qualitative approaches or case studies to explore barriers to integrating innovation into HR practices.
   - Develop mediation or moderation models, such as the influence of organizational culture or HR digitalization as intervening variables.
   - Test models in specific sectors or geographic regions to capture local context effects on HR strategy effectiveness.
   - Add socio-cultural or institutional dimensions, such as the role of regulations and local norms.
   - Apply longitudinal approaches to understand the long-term influence of external factors on HR dynamics.
   - Explore the role of leadership in bridging organizational responses to external pressures and policy changes.

6. Development of Data-Driven Monitoring Systems

   Organizations are advised to develop data-driven monitoring and evaluation systems to assess the real-time impact of external and internal factors on HR. This enables more responsive and evidence-based decision-making.

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