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Harmonizing Growth: The Nexus of Green HRM and Triple Bottom Line Perspective of Sustainable Development in Industry 4.0 Era

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Abstract

Green Human Resource Management (GHRM) has emerged as a strategic organizational approach integrating environmental considerations into human resource practices. This paper investigates the positive impact of GHRM on Sustainable Development (SD) within the context of Industry 4.0. As the latest technologies have ushered the gateways of prosperity, they have also brought many challenges. The assurance of the sustainability of the Triple Bottom Line (TBL) perspective, including the environment, society, and economy, has become the nucleus of responsible organizations. Amidst the challenges posed by climate change and environmental degradation, whether GHRM offers a promising avenue to foster sustainability while navigating the complexities of the digital era is a grave concern. It is a serious question that will help navigate the present GHRM practices to a more efficient course. This study was conducted in the aviation setup as it is one of the most heavily dependent on advanced technology and leveraging most of the Industry 4.0 technologies. The results of this study have found that GHRM has a positive and significant impact on all three pillars of sustainable development. Furthermore, Industry 4.0 moderates the relationship between GHRM and SD by strengthening the relationship, which implies that the future operational orientations of the organizations need to be in line with GHRM to reap the full benefit of human resources in the advanced technological era of Industry 4.0.

Keywords: Industry 4.0, Sustainable development, Green Human Resource Management, Aviation Industry

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1 Introduction

The advent of the Fourth Industrial Revolution, often denoted as Industry 4.0, heralds a profound transformation across all sectors, unfolding swiftly. Positioned at the threshold of this new epoch, the infusion of cutting-edge digital technologies into conventional operational frameworks is redefining how organizations fulfill their objectives. Industry 4.0 epitomizes a fundamental departure: automation, data interchange, the Internet of Things (IoT), and Artificial Intelligence (AI) intertwine, engendering a profoundly interconnected and astute manufacturing landscape. Its effects vary across sectors and industries, inducing distinctive changes in each domain. (Javaid et al., 2022). The technologies of Industry 4.0 are a fundamental shift in how industries function and a gradual development in production techniques. Technology contributes to achieving organizational objectives, including operational excellence, financial targets, and customer satisfaction (Olan et al., 2022). These objectives have now reached beyond the boundaries of pre-defined objectives and have included the TBL perspective of sustainable development as an integral part of the organizational goals (Tanova & Bayighomog, 2022).

The pursuit of sustainable development, which is becoming increasingly crucial for all businesses, may be accomplished by a well-performing organization. Applications and concepts related to organizational performance are numerous. Additionally, making contributions that go above and beyond financial gains is increasingly essential for businesses that want to be environmentally friendly. As a result, recent years have seen an increase in the importance of organizational performance to sustainable development (Rafiq et al., 2020). Many businesses have reacted to the environmental issues that society faces by utilizing Green HRM, or HRM practices that are environmentally friendly. Businesses and governments respond to the developing environmental problems as public knowledge of the environmental consequences of corporate operations, such as the increase in pollution and climate change, and their effects on society increases (Tanova & Bayighomog, 2022). Many stakeholders call for governments and businesses to take more decisive action and implement more effective measures.

In addition to preventing more harm, the stakeholders must figure out how to undo any damage already done. Customers are influencing government policies to bind the policies and business activities that may harm the environment by using their purchasing power and ensuring that they, as individuals, avoid the goods or services produced by companies that are not perceived as acting in an environmentally sustainable manner (Paulet et al., 2021). Top-level managers have pledged to maintain sustainability at the top of their agendas in growing numbers.

Additionally, management education and scholars have increased their focus on how businesses are creating and implementing plans to be more ecologically conscious (Tanova & Bayighomog, 2022). This paradigm shift from Human Resource Management to Green Human Resource Management has leashed new opportunities, and its impact on the triple bottom line perspective of sustainable development is still unexplored. Furthermore, the relationship between GHRM and SD in the context of Industry 4.0 is intriguing for researchers and organizations. This unexplored yet undeniable future has opened new venues for researchers to discover these perspectives. Therefore, this study will identify the relationship between GHRM and the TBL perspective of SD, along with the moderating impact of Industry 4.0 on this relationship. The research in the GHRM paradigm mainly concerns leadership and human aspects; however, the technological domain is somewhat missing. Thus, this study will not only bridge the gap in the existing knowledge but will open new dimensions of research for future researchers.

2 Literature Review

Academic researchers and industry professionals have shown a growing interest in creating environmentally friendly workplaces in recent years. This increased focus has led to various research areas centered around environmental sustainability, including one particularly noteworthy

aspect, GHRM. The idea behind the green workplace involves integrating principles of environmental sustainability into traditional business operations, which encompasses critical areas such as supply chain management, human resource management, operations, and marketing. GHRM has emerged as a distinct field of study that explores how environmental sustainability and human resource practices intersect within organizations. It represents a strategic approach where human resource management and green principles are aligned, which is crucial in helping organizations develop and implement sustainable strategies. GHRM is not just a theoretical concept; it serves as a practical framework that assists organizations in achieving their goals related to corporate sustainability (Bahuguna et al., 2023).

According to (Singh et al., 2021), the importance of GHRM practices in enhancing organizational performance highlights how senior management views human resources as a strategic asset for corporate advancement. By strategically positioning human resources within the organizational structure, companies create an environment that fosters innovation and ensures that long-term performance goals align with the effective use of internal resources to address risks and challenges. This strategic approach sets the organization toward sustained success in its industry. It is becoming crucial for companies to incorporate environmentally friendly business practices into their operations to improve sustainable performance, which involves finding a balance between resource utilization and economic growth (Mousa & Othman, 2020). Governments, public organizations, environmental groups, partners, stakeholders, consumers, and society advocate for adopting green policies on a broader scale. The desired outcomes go beyond organizational growth and economic development; they also involve a more nuanced integration with social progress (El-Kassar et al., 2019).

Industry 4.0, a new revolution, is quickly taking over the world's industries. Industry 4.0, a new trend in automation and data sharing, is being implemented by many businesses worldwide. This revolution involves building intelligent systems by integrating advanced manufacturing processes and informatics (Caiado et al., 2021). The phrase "Industry 4.0" was initially used in 2011 at the Hanover Fair in Germany when a working group led by the German Ministry of Education and Research's Research Union Economy-Science introduced the idea (Culot et al., 2020). Industry 4.0 offers a fresh perspective on future technological advancement and corporate success (Javaid et al., 2022). They have gained an advantage over competitors by implementing organizational plans for Industry 4.0 developments. By utilizing data-driven input to augment flexible and efficient automation, they may usher in a new era of manufacturing and delivery, offering complete control over material flow and supply. Benefits of Industry 4.0 include increased resilience and adaptation, enhanced performance and competitiveness, and profitability.

Industry 4.0 would also result in better customer service. As exciting and engaging as Smart Factory technologies may be, the real story behind all the breakthroughs in robotics, machine-to-machine communication, retail production, and decision-making should always be the advantages of Industry 4.0. Industry 4.0 technology aids producers in producing better, more efficient goods. This can improve capital reliability and cost while boosting productivity and speed (Javaid et al., 2022). Industry 4.0 is a combination of technologies, and it is essential to comprehend each one. These advanced technologies have created a dilemma of saving the environment and social aspects along with the economic benefits for the organization. Now, the organization's survival without ensuring the SD is questionable.

Considering the literature mentioned above, we have developed the following hypotheses: Green Human Resource Management has a positive impact on sustainable development; GHRM has a positive effect on the Economic perspective of sustainable development; GHRM has a positive impact on the Environmental perspective of sustainable development; Green Human Resource Management has a positive impact on the Social perspective of sustainable development; Industry 4.0 moderates the relationship between GHRM and the sustainable development by strengthening

the relationship; Industry 4.0 moderates the relationship between GHRM and the Economic perspective of sustainable development by strengthening the relationship; Industry 4.0 moderates the relationship between GHRM and the Environmental perspective of sustainable development by strengthening the relationship; and Industry 4.0 moderates the relation between GHRM and the Social perspective of sustainable development by improving the relationship

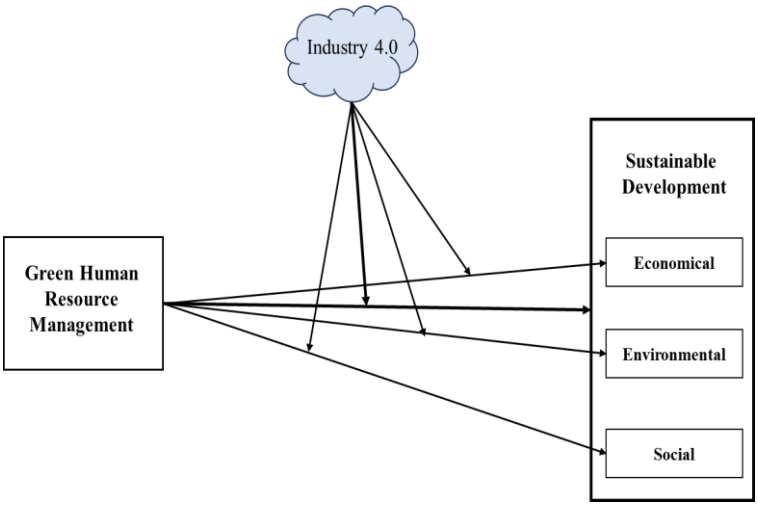

Figure 1: Theoretical Model

3 Methodology

It is a descriptive study as it describes the relation between the independent variables (GHRM) and the dependent variables (sustainable development, triple-bottom-line perspective of SD, economic, environmental, and social perspective) and the moderating impact of Industry 4.0.

3.1 Research Strategy

A research strategy describes the path for achieving the research objectives and answering the research questions. Choosing a particular research strategy ensures the desired outcome of the study. During this study, survey research is utilized to achieve the research objectives, as it is a systematic way of assembling information from and about people to describe, explain, or compare their knowledge, attitudes, and behavior (Sekaran & Bougie, 2016)

3.2 Extent of Researcher Interference and Study Setting

There was minimal interference from the researchers' side as the phenomenon was studied naturally, and the only interference was administering the questionnaire to the sample population (Sekaran & Bougie, 2016). Therefore, the study is conducted in a non-contrived setting where the observed phenomenon proceeded in the natural environment, and the data is only collected once for this cross-sectional study to address the research topic.

3.3 Sampling Design and Sample Population

The sample population of our study is the technical manpower of the aviation industry in Pakistan and the Middle East. Technical staff are the most appropriate choice as they deal with the latest technologies in the field, which makes the dynamics of this population unique, and no previous study has been conducted in the given context. There are a total of seventeen airlines in the said region. The findings from this population are sufficient for the generalization of outcomes because,

in accordance with the Chicago Convention of 1944, all civil airlines are required to adhere to safety and airline protocols as specified by the International Civil Aviation Organization (ICAO)'s Standard and Recommended Practices (SARPs). (International Civil Aviation [ICAO], 1944). As the study is conducted on a small population of seventeen, all the airlines are included except for one (Sekaran & Bougie, 2016). Simple random sampling was used to determine the airlines utilized for this study. In this study, the aviation industry served as the unit of analysis, while the aviation field specialists employed by the airline business served as the observation unit.

3.4 Data Collection

The study employed a quantitative approach, and primary data was collected through the survey using a self-administered questionnaire prepared on Google Forms and distributed online. The cross-sectional technique allows data on all variables to be collected simultaneously across the sample population (Sekaran & Bougie, 2016). Five variables are measured on the Likert scale of five, with a response option of one as Strongly Disagree and five as Strongly Agree.

Green human resource management was evaluated by the instrument developed by (Roscoe et al., 2019), determining that a) The human resources section of our firm seeks candidates with environmental understanding; b) environmental considerations are taken into account during the employee hiring process; c) environmental education is viewed as a critical capital in our organization; d) environmental training is prioritized within the scope of our business; e) the Human Resources team offers ongoing, pertinent, and efficient environmental education opportunities; f) our company's human resources department sets a memorable and unambiguous goal for each employee in terms of green practices; g) we evaluate the contributions of staff members to environmental management; h) the results of personal achievement assessments are documented in our organization.

The triple bottom line perspective of sustainable development was measured by the scale developed by (Nara et al., 2020), where the economic perspective was measured by identifying that: a) Due to the use of technologies, our profitability has increased; b) Due to the use of technologies, the cost of completion of tasks has been reduced; and c) Due to the use of technologies, energy consumption has been reduced. The environmental perspective was measured by inquiring: a) My organization uses renewable and recycled resources; b) My organization has reduced the generation of waste and harmful materials; and c) My organization has reduced pollution emissions. Lastly, the social perceptive was measured by determining that: a) My organization has better working conditions, occupational health, and safety; b) My organization has better training and development of employees; c) My organization has better generation and continuation of jobs; and d) My organization has a better reputation with the community and regulatory compliance.

As Industry 4.0 is an amalgamation of various technologies, therefore Industry 4.0 was measured using digitization, which was measured by a scale developed by (Kotarba, 2017) by inquiring questions on five scales: a) My organization has speed broadband for internet connectivity; b) My organization effectively uses video conferences; and c) My organization uses digital forms and documents. Secondly, Artificial Intelligence was measured by an instrument established by (Mikalef & Gupta, 2021), determining that: a) The company can transmit data throughout organizational and business boundaries; b) My firm has the necessary infrastructure, e.g. CPU and GPU power needed to operate artificial intelligence applications; c) Staff members receive adequate instruction to handle artificial intelligence applications; d) Our leadership team are adept at determining when to use AI. Finally, machine-to-machine communication was evaluated by the instrument developed by (Amodu & Othman, 2018), finding that: a) Our organization has the infrastructure to support machine-to-machine communication; b) Our organization utilizes machine-to-machine communication applications; c) Our organization has seamless connectivity

of electronic gadgets for machine-to-machine communication.

4 Data Analysis

After collecting, we cleaned the data for missing values, unengaged responses, and outliers. Initially, three respondents out of 297 had missing data for more than 10% of the total items, and their responses were deleted (Scheffer, 2002). Secondly, the standard deviation of the responses was carried out to identify unengaged respondents. Two respondents' data was checked for very low standard deviation, and after thoroughly scrutinizing their responses, they were deleted from the data set. Finally, 292 responses were used for result analysis. We use PLS-structural equation modeling to test hypotheses. This method helps us examine and evaluate complex statistical models. In this process, different techniques can be employed to assess the quality of the structural model. PLS-SEM is particularly useful for handling complicated models and dealing with non-normal distributions and complex indicator variables, leading to practical results. Due to these advantages, our study uses PLS-SEM for hypothesis testing.

Skewness and Kurtosis. Scholars commonly use skewness and kurtosis tests to check if data follows a regular pattern. Skewness measures how much the data distribution is distorted, indicating whether it is symmetrical. Positive skewness means the data leans to the left, while negative skewness leans to the right. If skewness falls between -2 and +2, it suggests the data is likely symmetrical. Kurtosis, on the other hand, indicates if there are extreme values in the distribution. Low kurtosis means the distribution has light tails, while high kurtosis means heavy tails. Acceptable kurtosis values are typically between -3 and +3 (Garson, 2012). These tests help determine if data behaves according to the regular pattern. Table 1 shows that all the collected data is within the range of skewness and kurtosis.

Table 1: Kurtosis and Skewness of Data

Item	Missing	Mean	Median	Min	Max	SDev	Excess Kurtosis	Skewness
DIG1	0	3.144	3	1	5	0.849	-0.425	-0.179
DIG2	0	3.082	3	2	5	0.845	-0.973	0.151
DIG3	0	2.938	3	1	5	0.961	-0.242	0.334
AI1	0	4.103	4	3	5	0.442	1.664	0.483
AI2	0	4.124	4	3	5	0.437	1.526	0.614
AI3	0	4.093	4	3	5	0.433	1.939	0.494
AI4	0	4.082	4	3	5	0.447	1.761	0.368
MM1	0	2.948	3	1	5	0.854	-0.422	0.199
MM2	0	2.907	3	1	5	0.92	-0.609	0.106
MM3	0	2.928	3	1	5	0.911	-0.693	0.143
ENV1	0	2.845	3	2	5	0.737	-0.572	0.409
ENV2	0	2.825	3	1	5	0.8	-0.553	0.205
ENV3	0	2.794	3	1	5	0.884	-0.707	0.057
ECO1	0	3.175	3	2	4	0.518	0.198	0.209
ECO2	0	3.165	3	2	5	0.586	1.153	0.568
ECO3	0	3.113	3	1	5	0.59	2.681	0.271
SOC1	0	3.062	3	1	5	0.895	-0.128	-0.296
SOC2	0	3.072	3	1	5	0.997	-0.466	-0.145

SOC3	0	3.062	3	1	5	0.972	-0.374	-0.192
SOC4	0	3.072	3	1	5	0.955	-0.259	-0.074
GHRM1	0	3.804	4	3	5	0.549	-0.121	-0.067
GHRM2	0	3.474	3	3	5	0.594	-0.272	0.843
GHRM3	0	3.32	3	3	5	0.548	1.348	1.51
GHRM4	0	3.567	4	3	5	0.59	-0.656	0.493
GHRM5	0	3.711	4	3	5	0.555	-0.534	0.015
GHRM6	0	3.814	4	3	5	0.504	0.227	-0.295
GHRM7	0	3.845	4	3	5	0.462	0.858	-0.531
GHRM8	0	3.67	4	3	5	0.512	-0.922	-0.257

Reliability and Validity. A Cronbach's Alpha score greater than 0.5 is adequate to demonstrate the validity of the instrument used to collect data for the study (Field, 2009). Furthermore, many researchers have identified that the Cronbach alpha score of above 0.7 establishes the excellent reliability of the instrument (Hair et al., 2017; Hair et al., 2018). Determining the convergent validity of each concept measure is the next stage in evaluating the data collection instrument. Convergent validity is the extent to which the construct converges to define the variance of its elements. Convergent validity is evaluated using the average variance extracted (AVE) for each item on every concept. The AVE is obtained by squaring the loading of every parameter on a build and calculating the mean value. The construct accounts for at least 50% of the item variance when the AVE is 0.50 or higher, which is the acceptable value. (Hair et al., 2018). Table 2 shows that all the values to measure the reliability and validity are within the given ranges.

Table 2: Reliability and Validity

	Cronbach's Alpha	**Composite Reliability (rho_a)**	**Composite Reliability (rho_c)**	**Average Variance Extracted (AVE)**
ECO	0.717	0.746	0.837	0.631
ENV	0.857	0.859	0.913	0.777
GHRM	0.857	0.884	0.89	0.511
IND4	0.904	0.95	0.926	0.602
SOC	0.944	0.947	0.96	0.857

Factor Analysis. The outer loadings in reflective measurement models represent the magnitude of the interconnection between the indicators and a latent variable. A value of 0.3 or higher suggests a moderate relationship between the items and the factor (Tavakol & Wetzel, 2020). Additionally, if the factor loading is less than 0.2, it is recommended to remove that factor from the model (Child, 2006). For instance, I removed a factor related to Industry 4.0 in my study because its loading was below 0.2. The table below presents the factor loading values of the items, with a focus on those with a significant value ($p < 0.5$). Moreover, to consider a factor significant, its T value should exceed +1.96. All factors in the analysis surpassed this threshold, confirming their significance and validity.

Table 3: Analysis (Factor Analysis)

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
DIG1 <- IND4	0.9	0.899	0.011	82.222	0.000
DIG2 <- IND4	0.854	0.853	0.013	68.072	0.000
DIG3 <- IND4	0.879	0.878	0.013	67.9	0.000
AI2 <- IND4	0.276	0.275	0.049	5.668	0.000
AI3 <- IND4	0.466	0.464	0.054	8.666	0.000
AI4 <- IND4	0.681	0.679	0.032	21.417	0.000
ECO1 <- ECO	0.841	0.842	0.013	62.84	0.000
ECO2 <- ECO	0.795	0.794	0.024	32.797	0.000
ECO3 <- ECO	0.744	0.737	0.055	13.5	0.000
ENV1 <- ENV	0.886	0.886	0.012	74.558	0.000
ENV2 <- ENV	0.866	0.865	0.014	63.862	0.000
ENV3 <- ENV	0.892	0.892	0.01	87.281	0.000
GHRM1 <- GHRM	0.626	0.621	0.044	14.067	0.000
GHRM2 <- GHRM	0.571	0.566	0.067	8.573	0.000
GHRM3 <- GHRM	0.834	0.83	0.029	28.582	0.000
GHRM4 <- GHRM	0.822	0.821	0.024	34.017	0.000
GHRM5 <- GHRM	0.778	0.776	0.029	26.979	0.000
GHRM6 <- GHRM	0.785	0.783	0.028	27.625	0.000
GHRM7 <- GHRM	0.753	0.75	0.038	19.775	0.000
GHRM8 <- GHRM	0.463	0.461	0.063	7.359	0.000
MM1 <- IND4	0.904	0.904	0.008	107.864	0.000
MM2 <- IND4	0.891	0.89	0.01	87.098	0.000
MM3 <- IND4	0.86	0.859	0.016	54.837	0.000
SOC1 <- SOC	0.908	0.907	0.012	72.854	0.000
SOC2 <- SOC	0.925	0.925	0.009	108.091	0.000
SOC3 <- SOC	0.937	0.936	0.007	130.117	0.000
SOC4 <- SOC	0.933	0.932	0.008	116.041	0.000

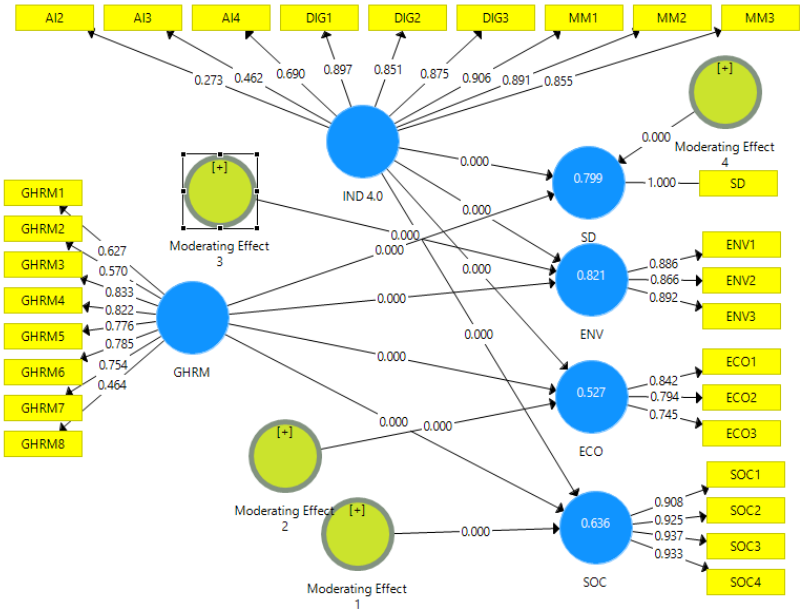

Figure 2: Theoretical Model

5 Results

After determining the data's normality, reliability, and validity, the PLS-SEM was conducted to test the hypothesis. All the hypotheses are significant as the p-value is less than 0.05. The results are depicted in the table below

Table 4: Model with outcome TBL of Sustainable Development

The Model with Outcome TBL of Sustainable Development

	Co eff	STDEV	T Statistics	P Values
GHRM -> ECO	0.473	0.047	10.172	**0.000**
GHRM -> ENV	0.827	0.045	18.397	**0.000**
GHRM -> SD	0.869	0.048	18.214	**0.000**
GHRM -> SOC	0.835	0.049	16.996	**0.000**
Moderating Effect 1 -> SOC	0.241	0.078	3.070	**0.002**
Moderating Effect 2 -> ECO	0.130	0.035	3.687	**0.000**
Moderating Effect 3 -> ENV	0.187	0.047	3.946	**0.000**
Moderating Effect 4 -> SD	0.232	0.062	3.721	**0.000**

The results have established a significant and positive relationship between GHRM and sustainable development (0.869; p 0.000), indicating that with the increase in GHRM, there is an increment of 86.9% in sustainable development. Hence, the first hypothesis that GHRM positively impacts Sustainable Development is accepted. GHRM has a significant and positive relation with the economic perspective of sustainable development (0.473; p 0.000), indicating that with the increase in GHRM, there is an increment of 47.3% for the economic perspective of sustainable development. The second hypothesis that Green Human Resource Management has positively impacts Green human resource management has a significant and positive relation with the environmental perspective of sustainable development (0.827; p 0.000), indicating that with the increase in GHRM, there is an increment of 82.7% for the environmental perspective of sustainable

development. The third hypothesis that GHRM positively impacts the environmental aspect of Sustainable Development is accepted. Also, green human resource management has a significant and positive relation with the social perspective of sustainable development (0.835; p 0.000), indicating that with the increase in GHRM, there is an increment of 83.5% for the social perspective of sustainable development. The fourth hypothesis that Green Human Resource management positively impacts the social aspect of Sustainable Development is accepted.

The results show that there is a significant and positive moderating impact of Industry 4.0 on the relationship between GHRM and sustainable development (0.232; p 0.000), indicating that Industry 4.0 strengthens the relationship between green human resource management and sustainable development, thus the fifth hypothesis that Industry 4.0 moderates the relation between GHRM and the sustainable development by strengthening the relationship is accepted. Similarly, there is a significant and positive moderating impact of Industry 4.0 on the relationship between green human resource management and the economic perspective of sustainable development (0.130; p 0.000), indicating that Industry 4.0 strengthens the relationship between green human resource management and the economic perspective of sustainable development; so, the sixth hypothesis that Industry 4.0 moderates the relation between GHRM and the economy perspective of sustainable development by strengthening the relationship is accepted. Also, the results identify a significant and positive moderating impact of Industry 4.0 on the relationship between green human resource management and the environmental perspective of sustainable development (0.187; p 0.000), indicating that Industry 4.0 strengthens the relationship between green human resource management and the environmental perspective of sustainable development thus the seventh hypothesis that Industry 4.0 moderates the relation between GHRM and the environmental perspective of sustainable development by strengthening the relationship is accepted. Finally, the results have identified that there is a significant and positive moderating impact of Industry 4.0 on the relationship between green human resource management and the social perspective of sustainable development (0.241; p 0.002), that Industry 4.0 strengthens the relationship between green human resource management and the social perspective of sustainable development. Finally, the eighth is that Industry 4.0 moderates the relationship between GHRM and the social perspective of sustainable development by strengthening the relationship is accepted.

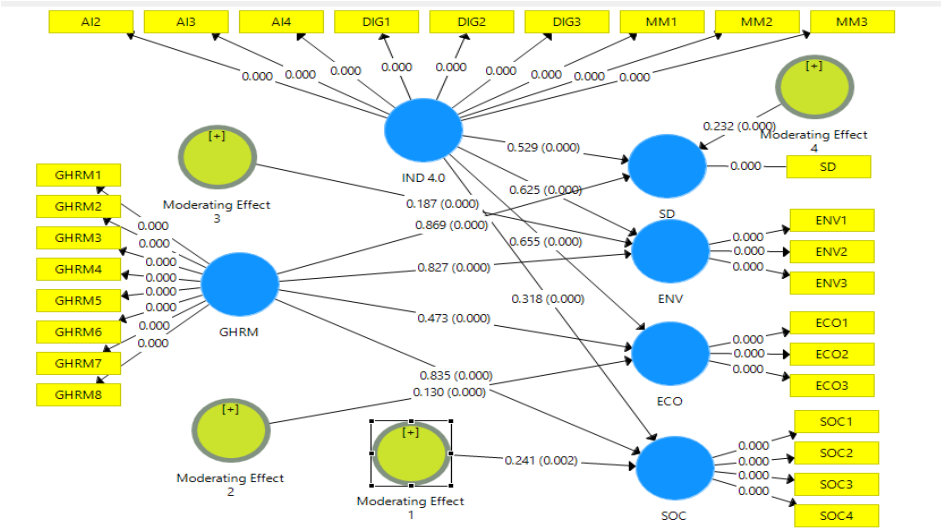

Figure: 3 Structural Model

Table 5 summarizes the acceptance/ rejection of the proposed hypothesis.

Table 5: Hypothesis Acceptance

Hypothesis No	Statement	Result
01	GHRM has a positive impact on sustainable development	Accepted
02	GHRM has a positive impact on the Economical perspective of sustainable development	Accepted
03	GHRM has a positive impact on the Environmental perspective of sustainable development	Accepted
04	GHRM has a positive impact on the Social perspective of sustainable development	Accepted
05	Industry 4.0 moderates the relationship between GHRM and sustainable development by strengthening the relationship	Accepted
06	Industry 4.0 moderates the relationship between GHRM and the Economical perspective of sustainable development by strengthening the relationship	Accepted
07	Industry 4.0 moderates the relationship between GHRM and the Environmental perspective of sustainable development by strengthening the relationship	Accepted
08	Industry 4.0 moderates the relationship between GHRM and the Social perspective of sustainable development by strengthening the relationship	Accepted

6 Discussion

The results show a strong and positive link (p = 0.000) between Green Human Resource Management (GHRM) and sustainable development. The coefficient value of 0.869 indicates an 86.9% increase in sustainable development through GHRM. Since people use technology and adapt to changes in the workplace, their acceptance of these changes is crucial for ensuring sustainable development. These findings support previous research (Bombiak & Marciniuk-Kluska, 2018; Mukhuty et al., 2022; Zubair & Khan, 2019) also discovered a significant positive connection between GHRM activities and sustainable company development. Their study showed that the more positively an activity was viewed for its impact, the more frequently it was implemented in the surveyed companies. Also, Industry 4.0 moderates and strengthens the relationship between GHRM and SD. Bai et al. (2023) also discovered a direct and indirect effect of Industry 4.0 on the SD. It implies that using the Industry 4.0 technologies effectively SD will enhance further GHRM practices. These findings strengthen the results of previously conducted studies (Yavuz et al., 2023).

We investigated how GHRM relates to the economic aspect of sustainable development. We found a significant and positive connection (p = 0.000) between GHRM and the economic dimension of organizations. The coefficient value of 0.473 suggests that as GHRM practices increase, there's a 47.3% rise in the organization's economic perspective of sustainable development. This study concludes that GHRM practices positively impact the economic dimension of sustainable development by fostering efficiency, innovation, and competitiveness within organizations. Companies can decrease resource usage, reduce waste, and enhance operational efficiency by integrating environmental contemplations into human resource policies and practices, such as hiring new employees, their training, and performance management, which not only saves costs by cutting down on energy and resource consumption but also encourages innovation in sustainable technologies and processes.

Moreover, investing in employee training and development related to sustainability helps build a skilled workforce capable of adapting to changing environmental regulations and market demands while making the most of the latest technologies. Ultimately, aligning HRM practices with environmental goals enables companies to improve their long-term financial performance, strengthen their position in the market, and contribute to sustainable economic growth. These research findings further support previous studies that have shown a positive impact of GHRM on economic performance (Carballo-Penela et al., 2023; Shah et al., 2021).

Similarly, the research establishes a positive and significant ($p = 0.000$) relationship between GHRM and the environmental dimension of sustainable development. The coefficient value of 0.827 suggests that as GHRM practices increase, there's an 82.7% rise in the environmental factor of sustainable development. Carballo-Penela et al. (2023) also emphasize the importance of effectively aligning GHRM practices and highlighting the diverse roles each GHRM practice plays in advance of organizations' environmental and economic performance. Initiatives such as employee training on environmental conservation, promoting telecommuting or carpooling to reduce carbon emissions, and implementing paperless office policies to minimize resource consumption actively engage employees in sustainability efforts (Shah et al., 2021). Organizations can reduce energy usage, waste generation, and carbon footprint by fostering a culture of environmental awareness and responsibility among employees. Moreover, green HRM practices contribute to developing a workforce that is both environmentally conscious and motivated to implement eco-friendly practices both within and outside the workplace. Overall, adopting green HRM initiatives is crucial in mitigating environmental impacts and advancing the environmental aspect of sustainable development (Carballo-Penela et al., 2023; Khatoon et al., 2022).

Furthermore, the results reveal a positive and significant ($p = 0.000$) relationship between GHRM practices and the social dimension of sustainable development. The coefficient of 0.835 indicates that as GHRM practices increase, there's an 83.5% improvement in the social aspect of sustainable development. The study shows that GHRM practices significantly impact the social aspect of sustainable development by promoting a culture of corporate social responsibility and employee well-being. By incorporating environmental sustainability into HR policies and practices, organizations demonstrate their dedication to social responsibility, which can enhance their reputation and trust among stakeholders. Moreover, green HRM initiatives, such as advocating for work-life balance, involving employees in sustainability efforts, and providing training on environmental issues, contribute to employee satisfaction and morale (Amrutha & Geetha, 2020), which in turn, can lead to increased engagement, productivity, and employee retention.

Furthermore, by prioritizing social aspects such as employee health and safety and supporting diversity and inclusion, green HRM practices help create a positive work environment and foster community within the organization. Overall, green HRM acts as a vital element in promoting social cohesion and well-being, thus enabling the broader goal of sustainable development. Niazi et al. (2023) also found a significant positive relationship between green human resource management practices and green corporate social responsibility, positively impacting the environment and society.

6.1 Theoretical and Practical Implications

The results of this study will act as the foundation for future researchers to further dig into sustainable development and how to ensure it by the fusion of GHRM practices and Industry 4.0. GHRM practices can play a beneficial role in ensuring sustainable development. Therefore, organizations can effectively leverage Industry 4.0 technologies to advance sustainable development objectives by integrating environmental considerations into HR policies and practices. For instance, GHRM practices such as employee training on environmental awareness and sustainability and the effective and efficient usage of Industry 4.0 technologies focused on

resource efficiency and waste reduction may result in enhanced SD. Furthermore, by nurturing a culture of sustainability among employees, GHRM practices can encourage responsible technology use and inspire innovative solutions to environmental challenges. Ultimately, the collaboration between GHRM practices and Industry 4.0 initiatives can lead to more sustainable outcomes, including minimized environmental impacts, enhanced corporate social responsibility, and increased competitiveness in the global market.

The positive influence of GHRM from an economic perspective will stimulate innovation in sustainable technologies and processes while reducing energy and resource consumption and cutting costs. Additionally, by investing in employee development and training related to sustainability, managers can cultivate a skilled workforce capable of adapting to evolving market demands and environmental regulations. Ultimately, by aligning HRM practices with environmental objectives, businesses can enhance their long-term financial performance, strengthen their market position, and contribute to sustainable economic growth. Ensuring these aspects, managers can demonstrate that their organizations are socially responsible, which will further increase the image and performance of the organization.

6.2 Conclusion

In conclusion, GHRM has demonstrated a significant positive impact on sustainable development. By including environmental factors in human resource policies and practices, organizations can foster a sustainability culture among employees, reducing environmental impacts, enhancing corporate social responsibility, and increasing competitiveness. Moreover, the positive moderating impact of Industry 4.0 on this relationship further enhances the potential for achieving sustainable development goals. By leveraging Industry 4.0 technologies alongside GHRM practices, organizations can effectively harness innovation to address environmental challenges, improve resource efficiency, and promote sustainable economic growth. Together, GHRM and Industry 4.0 create a synergistic approach with great promise for advancing sustainability and driving positive change in the global marketplace.

7 References

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