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RESEARCH ARTICLE

The Impact of Applying Human Engineering Principles on Sustainable Performance in Iraqi Industrial Companies: A Research in the Energy Sector

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ABSTRACT

This study aims to understand the impact of ergonomic principles on sustainable performance in the context of the Iraqi energy industry sector. The transition towards achieving sustainable performance includes an evolution in the view of organizational success, so that this concept includes economic, social, and environmental dimensions. The research also addresses the administrative and economic transformations of sustainable performance and the interaction of ergonomic principles with these transformations in Iraqi energy industry companies and achieving the aim of effectively guiding decisions considering ongoing changes. This is done by analyzing data using SPSS v.27, for a sample of 148 individuals collected by a questionnaire prepared for this purpose. The results showed a positive impact of ergonomic principles on sustainable performance in its economic, social, and environmental dimensions. Based on these results, recommendations can be made to enhance ergonomic principles and improve sustainable performance, by developing the various dimensions of ergonomic principles and improving sustainable performance comprehensively. Implementing these recommendations effectively will contribute to achieving more effective and efficient sustainable performance for companies.

INTRODUCTION

Human engineering, additionally referred to as ergonomics or human factors engineering, specializes in designing systems, procedures, and paintings environments that optimize human overall performance and nicely-being (Sexton et al., 2020). By aligning paintings practices with human skills and obstacles, organizations can enhance productiveness, reduce mistakes rates, and beautify normal task pleasure (Hendrick & Benigni, 2021). The strength area, with its complex and high-stakes operational surroundings, is specifically prone to the blessings of such practices. This zone's vital position in national infrastructure and its massive environmental effect underscores the need for sustainable operational techniques.

In recent years, the Iraqi industrial sector has faced numerous challenges, including outdated technologies, inadequate infrastructure, and inefficient practices (Hassan & Ali, 2018). The application of human engineering principles presents a promising avenue for addressing these issues by improving system efficiency and reducing resource consumption. The interplay between human factors and operational performance has been a subject of increasing interest, with studies highlighting the positive correlation between ergonomic interventions and sustainability outcomes (Smith & Carayon, 2022).

This paper aims to discover how human engineering concepts can be leveraged to beautify sustainable overall performance in Iraqi strength organizations. By studying current tendencies in human engineering and sustainability, this study can provide contributions to a deeper know-how of the way those standards

may be efficiently carried out inside the context of Iraqi industrial challenges. The findings are expected to provide treasured insights for policymakers, industry leaders, and researchers inquisitive about enhancing both operational efficiency and environmental impact within the strength quarter.

1 Research Problem

The problem addressed in this study revolves around the suboptimal overall performance and sustainability challenges confronted via industrial groups in the Iraqi electricity zone. Despite the arena's crucial significance to the country's wide economic system and its huge environmental footprint, many Iraqi energy companies preserve to grapple with inefficiencies and operational issues that undermine their overall performance and sustainability desires.

Human engineering, which makes a specialty of optimizing the interaction among human beings and structures, gives a potential approach to these issues. By aligning work processes with human abilities and barriers, organizations can beautify performance, reduce errors, and foster a more sustainable operational environment (Hendrick & Benigni, 2021). However, the software of human engineering standards in the context of Iraqi power agencies remains underexplored .

The problem of this study, consequently, lies in acquiring sufficient information how the utility of human engineering ideas can deal with the operational and sustainability challenges inside the Iraqi electricity area. This have a look at objectives to bridge the gap between theoretical human engineering practices and their realistic utility inside the area, providing insights into how these ideas can be leveraged to enhance performance and sustainability results.

2 Main Research Question

How does the utility of ergonomic standards influence sustainable overall performance in Iraqi industrial businesses running within the power region?

3 Research hypotheses:

Main hypothesis: The application of human engineering principles has a statistically significant effect on sustainable performance within the studied organization.

H1.1: The application of human engineering principles has a statistically significant effect on sustainable economic performance within the studied organization.

H1.2: The application of human engineering principles has a statistically significant effect on sustainable social performance within the studied organization.

H3.3: The application of human engineering principles has a statistically significant effect on sustainable environmental performance within the studied organization.

Chapter 1: Theoretical Framework of the Research

4 Understanding Human Engineering

Human engineering, usually called ergonomics, is an interdisciplinary subject that specializes in optimizing the interaction among human beings and the structures they function inside. The number one aim of human engineering is to design workplaces, equipment, and procedures which can be in harmony with human competencies and limitations, thereby improving both safety and productivity (Dul & Neumann, 2009). This subject attracts from numerous fields inclusive of psychology, physiology, and engineering to create environments that guide human performance and properly-being.

A crucial aspect of human engineering is the consideration of the physical, cognitive, and organizational dimensions of labor. Physically, this includes the design of equipment, gadget, and workspaces that lessen stress and the danger of damage. For example, ergonomic interventions might include adjusting notebook heights, redesigning device handles, or optimizing challenge sequences to limit repetitive motions (Salvendy, 2012). Cognitively, human engineering addresses the intellectual workload and records

processing needs located on people, ensuring that duties are designed in a manner that aligns with human cognitive abilities, thereby reducing mistakes and improving selection-making performance (Wickens et al., 2015).

Moreover, human engineering also encompasses organizational ergonomics, which entails the optimization of work strategies, communique, and teamwork. This dimension is crucial in business settings in which complicated, excessive-danger operations are not unusual. By aligning organizational systems and procedures with ergonomic principles, corporations can decorate universal device performance, improve worker pleasure, and reduce the chance of accidents (Carayon, 2016).

Recent studies have emphasized the significance of integrating human engineering standards in commercial sectors, in environments where safety and efficiency are paramount. For instance, in the energy zone, wherein employees regularly face bodily annoying and cognitively complex tasks, the application of ergonomics has been proven to significantly reduce the incidence of place of business accidents and growth operational performance (Wilson, 2018).

4.1 Dimensions of Human Engineering

1. **Physical Dimension**

   The bodily measurement of human engineering pertains to the design of workspaces, gadget, and equipment that align with human anatomical and physiological characteristics. This dimension goals to lessen bodily strain, prevent work-associated musculoskeletal problems, and beautify consolation. Recent studies highlight the significance of ergonomic interventions in mitigating risks associated with repetitive obligations and improper postures. For example, the proper design of seating, the position of equipment, and the layout of workstations can drastically lessen the prevalence of occupational accidents (Stewart et al., 2018). Furthermore, advances in adjustable workstations and ergonomic gear have confirmed powerful in accommodating numerous employee needs, thereby selling inclusivity and accessibility within the place of business (Schwartz et al., 2020).

2. **Cognitive Dimension**

   The cognitive dimension of human engineering specializes in the mental methods worried in work, along with belief, memory, interest, and decision-making. This dimension is especially relevant in environments where complex records processing and quick selection-making are required. Ergonomic design on this location pursuits to lessen cognitive load, limit mistakes, and beautify usual task overall performance. For example, user-centered design of interfaces, such as clear and intuitive control panels or software systems, helps in reducing the cognitive demands on workers, leading to improved accuracy and efficiency (Wickens & Carswell, 2019). Moreover, adaptive automation systems that adjust to the cognitive state of the user have been shown to enhance both safety and performance in high-risk environments, such as aviation and healthcare (Parasuraman & Wickens, 2017).

3. **Organizational Dimension**

   The organizational measurement entails the structuring of work methods, communique channels, and group dynamics to optimize overall performance. This dimension emphasizes the importance of designing workflows and organizational structures that help powerful communication, collaboration, and selection-making. Studies have verified that nicely organized work environments, which include clear roles, responsibilities, and communique protocols, result in higher process satisfaction and productivity (Carayon et al., 2018). In addition, the combination of ergonomic principles into organizational layout can foster a tradition of safety and non-stop improvement, which is critical in industries with excessive operational dangers, along with manufacturing and electricity (Hignett & McDermott, 2019).

4. Social and Environmental Dimensions

Beyond the traditional bodily, cognitively, and organizational dimensions, modern human engineering also considers the social and environmental factors of labor. The social dimension involves understanding the effect of interpersonal relationships, teamwork, and social assist on worker well-being and performance. Research has shown that social dynamics, which includes group concord and management styles, can have an impact on the effectiveness of ergonomic interventions (Dul & Ceylan, 2017). The environmental measurement, alternatively, considers elements along with lighting, noise, and temperature, which can influence both physical and cognitive performance. For example, studies have located that optimized lighting and noise manipulate can decorate awareness and reduce fatigue, leading to higher paintings outcomes (Boyce et al., 2019).

5. Technological and Temporal Dimensions

The fast advancement of generation has added new demanding situations and possibilities in the subject of human engineering. The technological measurement addresses the interaction among humans and rising technology, inclusive of synthetic intelligence, robotics, and digital truth. Ergonomic research on this area makes a specialty of ensuring that technology is designed to supplement human capabilities and does no longer weigh down or underutilize people (Hancock & Szalma, 2019). The temporal dimension, which examines the effects of work schedules, shift patterns, and workload distribution over time, is also critical. Studies indicate that well-designed shift systems and balanced workload distribution can reduce fatigue and improve overall worker health and performance (Sprajcer et al., 2020).

6. Integrated Approach

An integrated approach to human engineering, which simultaneously considers all the above-mentioned dimensions, is essential for achieving optimal outcomes. This approach requires a holistic understanding of how physical, cognitive, organizational, social, environmental, technological, and temporal factors interact and influence each other. Recent research emphasizes the need for multidisciplinary collaboration in the design and implementation of ergonomic solutions, ensuring that interventions are comprehensive and sustainable (Salvendy, 2021). For instance, in the context of healthcare, integrating ergonomic principles across physical workspace design, cognitive workload management, and organizational processes has been shown to significantly improve patient safety and staff well-being (Carayon, 2018).

Each contributing to the advent of work environments that promote safety, performance, and well-being. As industries retain to evolve, especially with the combination of recent technology and converting work dynamics, the significance of a comprehensive and incorporated method to human engineering will become increasingly obtrusive. Future studies and practice need to keep discovering the interplay between those dimensions, ensuring that ergonomic interventions are not most effective powerful inside the short term however additionally sustainable and adaptable to destiny demanding situations.

5 Sustainable Performance: A Multidimensional Perspective

Sustainable overall performance is a multifaceted concept encompassing the lengthy-time period viability and fine impact of a company throughout financial, social, and environmental dimensions. This method aims to balance financial boom with social responsibility and environmental stewardship, making sure that contemporary actions do not compromise the properly-being of future generations. It displays a shift in employer method from a traditional backside-line attention to a greater complete technique that integrates lengthy-time period economic viability with moral, social, and environmental responsibilities (Elkington, 2018).

Economic Sustainability: Economic sustainability emphasizes the company's capability to generate long-term price and maintain financial resilience. Researchers argue that sustainable economic overall performance extends beyond quick-term profit maximization, thinking about elements inclusive of resource performance, innovation, and prudent Economic control (Eccles et al., 2019). This attitude aligns with a broader knowledge of corporate success, which extends beyond financial metrics.

Social Sustainability: Social sustainability involves an organization's commitment to ethical business practices, fair labor standards, and positive contributions to the communities in which it operates. Integrating social considerations into sustainable performance recognizes the interdependence between businesses and society, emphasizing the importance of stakeholder engagement and corporate social responsibility (Camilleri, 2018).

Environmental Sustainability: Environmental sustainability addresses the ecological effect of organizational sports. Organizations are increasingly more expected to reduce their environmental footprint, adopt green practices, and contribute to broader conservation efforts (Hahn et al., 2018). The literature underscores the function of sustainable overall performance in promoting environmental stewardship and mitigating the destructive outcomes of enterprise operations on earth.

Post-2000 Focus: The submit-2000 generation has garnered a growing attention on the financial viability of attaining sustainability, difficult the notion that economic achievement and accountable business agency practices are collectively great. Porter and Kramer (2011) propose for the creation of shared price, in which agencies align their operations with societal needs, main to societal benefits and better competitiveness. This angle highlights the capacity synergies between sustainable practices and Economic performance.

Moreover, research has explored the relationship between sustainable performance and financial outcomes, debunking the myth that sustainability initiatives necessarily lead to financial trade-offs. Eccles et al. (2019) demonstrate that organizations integrating sustainability into their strategies often outperform their peers financially, challenging the traditional dichotomy between economic success and sustainability.

5.1 Challenges and Opportunities:

Achieving sustainable performance presents both challenges and opportunities for organizations. Balancing economic, environmental, and social goals require a shift in organizational mindset and practices. Challenges may include resistance to change, the initial investment costs in sustainable technologies, and the need for cultural shifts within the organization (Bonini & Gorner, 2011). However, embracing sustainability also opens doors to innovation, enhanced reputation, and access to emerging markets driven by environmentally and socially conscious consumers (Porter & Kramer, 2011).

5.2 Measuring Sustainable Performance:

Measuring sustainable performance involves complete metrics that pass beyond traditional Economic signs. Key Performance Indicators (KPIs) might also consist of carbon footprint discount, social impact tests, employee delight, and adherence to ethical standards (Eccles et al., 2019). This shift in organizational control specializes in the combination of financial, environmental, and social considerations, highlighting that sustainable performance is not always simplest an ethical vital however also a strategic necessity for agencies aiming for lengthy-term survival in a rapidly changing worldwide panorama. Consulting recent educational references gives a more up-to-date expertise of this evolving idea.

5.3 Importance and Goals of Sustainable Performance:

Sustainable performance is a vital concept that encompasses the long-term viability and resilience of various structures, whether in commercial enterprise, the environment, or society. This multidimensional technique emphasizes the need to balance Economic, social, and environmental concerns to ensure enduring achievement and reduce bad affects.

A key aim of sustainable ordinary overall performance is to accumulate harmonious integration between financial activities and environmental and social responsibilities. This includes adopting practices that lessen environmental footprints, enhance resource efficiency, and mitigate the terrible influences of commercial operations. In the commercial enterprise context, sustainability targets to create cost now not most effective for shareholders however additionally for all stakeholders, which include personnel, customers, and the wider network (IIRC, 2013).

On the environmental aspect, sustainability seeks to address annoying situations posed via climate exchange, biodiversity loss, and useful aid depletion. Initiatives such as the United Nations Sustainable Development Goals (SDGs) offer a comprehensive framework to manual worldwide efforts within the route of a greater sustainable and equitable destiny. The SDGs cover an extensive range of troubles, from clean energy and climate motion to accountable intake and manufacturing (United Nations, 2015).

Furthermore, social sustainability is a crucial aspect that considers the well-being of communities and individuals. This includes truthful challenging work practices, social inclusion, and the protection of human rights. Companies that prioritize social sustainability contribute to the development of resilient communities (Camilleri, 2018). Scholars have highlighted the importance of sustainable performance, such as Elkington's triple bottom line framework, which urges companies to degree success no longer most effective financially however additionally in terms of social and environmental impact (Elkington, J., 2000). Additionally, the idea of the circular financial system, popularized by means of thinkers like Walter R. Stahel, emphasizes the importance of designing products and structures that minimize waste and maximize useful resource performance (Stahel, W. R., 2019).

From the above, sustainable overall performance is crucial to addressing the interconnected demanding situations dealing with our global. By aligning Economic, social, and environmental dreams, we will foster a resilient and equitable international society. The frameworks and perspectives stated offer a stable basis for knowledge and imposing sustainable practices across various domains.

6 Relationship Between Ergonomic Principles and Sustainable Performance: Insights from Previous Studies

The intersection of ergonomic ideas and sustainable performance has garnered increasing attention in the academic literature. Ergonomics, or human elements engineering, specializes in optimizing the interplay between people and systems to beautify universal performance and well-being. Understanding how ergonomic principles influence sustainable overall performance can offer treasured insights into improving performance, protection, and environmental effects in business contexts. This section discusses the relationship between ergonomic concepts and sustainable performance, drawing on insights from previous studies, which includes Ratnayake (2013), Bon et al. (2018), and Imran et al. (2013).

Ratnayake (2013): "Sustainable performance of industrial assets: the role of PAS 55-1&2 and human factors"

Ratnayake's (2013) study explores the position of human factors in achieving sustainable overall performance in asset-in depth organizations. The studies highlight that conventional organizational systems often fail to cope with the asset-centric attention essential for sustainable performance (SP). The look at emphasizes that the integrity of bodily property, including their acquisition, exploitation, renovation, and disposal, is heavily dependent on human skills. Ratnayake argues that human elements (HF) are significant to assert control, as they at once influence the management of bodily assets in alignment with sustainability issues. The British Standards Institution’s PAS 55-1&2 specifications, which provide guidelines for managing asset integrity, underscore the importance of human factors in achieving sustainable outcomes. This study suggests that integrating human factors into asset management frameworks can mitigate errors and enhance organizational performance, thereby supporting sustainable practices.

Bon et al. (2018): "Green human resource management, Green supply chain management practices and Sustainable performance"

Bon et al. (2018) examine the connection among green human useful resource control (GHRM), inexperienced supply chain control (GSCM) practices, and sustainable performance. Their studies underscore the significance of integrating GHRM and GSCM practices to achieve a balanced environmental, financial, and social performance. The study found that GHRM practices, which involve recruiting, training, and handling personnel in methods that promote environmental sustainability, play a vital function in fostering a green corporate subculture. Similarly, GSCM practices consciousness on incorporating environmental considerations into supply chain sports. The integration of these practices contributes to improved sustainable performance by aligning human resource and supply chain functions with environmental goals. Bon et al. (2018) propose a conceptual model that links GHRM, GSCM, and sustainability performance, highlighting the potential of ergonomic considerations in enhancing these practices. Effective ergonomics can enhance employee engagement and operational efficiency, thereby supporting the broader goals of GHRM and GSCM.

Imran et al. (2013): Sustainable Performance and Green Innovation: Green Human Resources Management and Big Data as Antecedents"

Imran et al. (2013) discover the function of green human resource management (GHRM) and large statistics in driving green innovation and sustainable performance. Their study introduces a route version that demonstrates how GHRM and massive records impact green innovation, which in flip affects sustainable performance. GHRM practices, inclusive of those specializing in employee involvement in environmental initiatives, can foster innovation by developing work surroundings conducive to sustainable practices. The use of big records similarly supports this through imparting insights into performance metrics and areas for improvement. The findings recommend that ergonomic concepts, which can be quintessential to GHRM, can beautify green innovation by means of optimizing human interplay with technological and organizational structures. This, in turn, contributes to advanced sustainable performance with the aid of allowing greater effective and innovative answers to environmental demanding situations.

The reviewed studies illustrate that ergonomic ideas play a vital position in enhancing sustainable performance across numerous contexts. Ratnayake (2013) emphasizes the significance of human factors in asset management and sustainable overall performance, while Bon et al. (2018) and Imran et al. (2013) highlight the function of GHRM in integrating environmental considerations into organizational practices. These insights underscore the ability of ergonomics to enhance efficiency, lessen errors, and guide sustainable consequences in commercial settings. By aligning human factors with sustainability dreams, groups can obtain better overall performance and make contributions to broader environmental and social objectives.

Chapter 2: Practical Framework of the Research

The aim of this section is to expand and deepen scientific knowledge regarding the impact of Human Factors Engineering Principles on sustainable performance within the Iraqi energy sector. This involves generating knowledge by Researching the correlational relationships between variables and constructs within this context, diagnosing certain aspects of the practical reality associated with the topic, and testing and adapting theories for practical application.

7 Research Tool

The questionnaire was distributed via an online link using Google Forms to employees in the Iraqi energy sector. A total of 148 employees participated in the survey, with responses collected from all participants without excluding any individual from the sample. The data from Google Forms were exported to SPSS version 27 using an Excel file to avoid manual data entry errors. All collected data were maintained to achieve the required sample size successfully, and no data were excluded from the final analysis. The final sample size for the Research was 148 participants.

8 Research Variables and Measurement

In this Research, Human Factors Engineering Principles were selected as the independent variable, comprising five distinct dimensions: (Physical Dimension, Cognitive Dimension, Organizational Dimension, Social and Environmental Dimensions, Technological and Temporal Dimensions). The dependent variable, sustainable performance, was selected with its dimensions (economic, social, and environmental) and measured using a five-point Likert scale (Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree).

To calculate the importance measure of the Research variables, the category range formula was applied as follows:

$$Range = \frac{Maximum\ Score - Minimum\ Score}{3}$$

Here, the range represents the interval that separates the different scores on the scale. Based on this, the significance levels were determined as follows:

- Low Significance: Scores from 1 to 2.33.
- Medium Significance: Scores from 2.34 to 3.66.
- High Significance: Scores from 3.67 to 5.

Using this approach, the study can assess the importance of each Human Factors Engineering Principal variable based on the range it represents. Thus, we can better and more accurately understand the impact of these variables on sustainable performance in organizations within the Iraqi energy sector.

9 Reliability and Validity Testing:

In the context of this research, a validity and reliability test were conducted to verify the consistency of the Research instrument (the questionnaire) used. Cronbach's Alpha (α) was employed to determine the level of reliability of this instrument. The results of the reliability test for the Research tool are presented in the following table:

Table 1 Cronbach's alpha test results for the Research axes

Reliability Statistics					
Axes	**Cronbach's Alpha**	**N of Items**	**Axes**	**Cronbach's Alpha**	**N of Items**
Physical Dimension	0.856	4	Sustainable Economic Performance	0.801	4
Cognitive Dimension	0.789	4	Sustainable Social Performance	0.774	4
Organizational Dimension	0.801	4	Sustainable Environmental Performance	0.870	4
Social and Environmental Dimensions	0.755	4			

Technological and Temporal Dimensions	0.763	4			
The model as a whole				0,959	32

Source: SPSS v.27 output

Table (1) presents the results of the reliability test using Cronbach's Alpha and illustrates the level of reliability of the Research instrument. The Cronbach's Alpha coefficient serves as an indicator of the instrument's consistency and accuracy in measuring the variables addressed in the Research. Given that the Cronbach's Alpha value is greater than 0.7 for all research dimensions, and that the Alpha coefficient for the full model reached 0.956, these results enhance the reliability and validity of the questionnaire, affirming the quality of the tool used in the Research. Consequently, this supports the reliability of the Research's findings and strengthens the validity of the conclusions drawn from the research.

10 Demographic characteristics of the research sample:

Table 2 Relative frequency distributions of Research sample individuals according to demographic variables

Gender	Male			Female	
	%56.2			%43.8	
Age	20to 30 years	31to 40 years		41to 50 years	51years or older
	%41.9	%36.5		%13.5	%8.1
Education	High School	University		Masters	Doctorate
	%25.7	%61.5		%10.1	%2.7
Experience	Less than 5 years	10-6years	15-11years	years 16-20	years 21+
	%13.5	%16.6	%23.6	%12.2	%4.1

Source: SPSS v.27 output

Table (2) illustrates the demographic aspects of the research sample, indicating that it was carefully selected to be representative and inclusive of all relevant categories related to the studied topic, without any bias favoring one group over another. Given the representative nature of the sample, the results collected can be relied upon to draw comprehensive and reliable conclusions regarding the research topic. This approach minimizes any potential bias in the results, thereby ensuring the credibility of the Research and the robustness of its conclusions.

11 Hypothesis Testing:

Main Hypothesis: H3: The application of human engineering principles has a statistically significant effect on sustainable performance within the studied organization.

To examine the main hypothesis, the researcher conducted a simple regression analysis using the statistical software SPSS version 27. This analysis was employed to assess the relationship between the independent variable (human engineering principles) and the dependent variable (sustainable performance). The following table presents the results of this analysis:

Table 3 Summary of the model for testing the hypothesis الرئيسية

Model Summary

Std. Error of the Estimate	Adjusted R Square	R Square	R	Model
0.36909	0.642	0.645	.803[a]	1
a. Predictors: (Constant), human engineering principles				

Source: SPSS v.27 output

Based on Table (5), it is evident that there is a statistically significant correlation between the independent variable (human engineering principles) and the dependent variable (sustainable performance), with a correlation coefficient (R) of approximately 0.803. Additionally, the R Square value is 0.645, indicating that human engineering principles explain about 64.5% of the variance in sustainable performance. The R Square estimation suggests a strong relationship between the two variables. As a result of this analysis, it can be concluded that (H1.1) has been validated, confirming a statistically significant relationship between the variables. This finding underscores the impact of human engineering principles on achieving sustainable performance in the Iraqi energy sector. These results highlight the importance of human engineering principles as a catalyst for promoting sustainable development within organizations. To test the significance of the correlation coefficient, the researcher employed the ANOVA test, with the results presented in the following table:

Table 4 ANOVAa test of the hypothesisالرئيسي

ANOVA[a]						
Sig.	F	Mean Square	df	Sum of Squares	Model	
.000[b]	264.819	36.076	1	36.076	Regression	1
		0.136	146	19.889	Residual	
			147	55.965	Total	
a. Dependent Variable: sustainable performance						
b. Predictors: (Constant), human engineering principles						

Source: SPSS v.27 output

Examination of Table (6) reveals that the simple linear regression model is statistically significant at a 95% confidence level ($p < 0.001$). This indicates that there are significant differences in sustainable performance that can be explained by human engineering principles. In other words, there is a statistical relationship between the independent variable (digital transformation) and the dependent variable (sustainable economic performance). This relationship can be quantified using the following regression equation:

Table 5 Simple regression model coefficients between variables human engineering principles and sustainable performance

Coefficients[a]						
Sig.	t	Standardized Coefficients	Unstandardized Coefficients		Model	
		Beta	Std. Error	B		1
0.000	-6.551		0.413	-2.709	(Constant)	

0.000	16.273	0.803	0.098	1.595	human engineering principles	
a. Dependent Variable: sustainable performance						

Source: SPSS v.27 output

From Table (7), it can be observed that there is a significant effect of human engineering principles (β = 0.803, p < 0.001) on sustainable performance. This indicates that each unit increase in human engineering principles is associated with a 1.595 increase in sustainable performance. Based on the statistical results, it can be concluded that there is a positive and meaningful relationship between human engineering principles and sustainable performance in the studied organization. This finding is consistent with prior literature, which highlights the importance of adopting human engineering principles to enhance sustainable performance.

H1.1: The application of human engineering principles has a statistically significant effect on sustainable economic performance within the studied organization.

To test the hypothesis (H1.2), the researcher conducted a simple regression analysis using SPSS version 27. This analysis was performed to examine the relationship between the independent variable (human engineering principles) and the dependent variable (sustainable economic performance). The following table presents the results of this analysis:

Table 6 Summary of the model for testing the hypothesisH1.1

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.756[a]	0.572	0.569	0.47729
a. Predictors: (Constant), human engineering principles				

Source: SPSS v.27 output

According to Table (8), the R Square value is 0.572, indicating that human engineering principles explain approximately 57.2% of the variance in sustainable economic performance. This suggests a strong relationship between human engineering principles and sustainable economic performance. Consequently, it can be concluded that (H1.2) is supported, confirming a statistically significant relationship between the two variables. These results highlight the importance of human engineering principles as a driving factor for achieving sustainable economic development within organizations. To assess the significance of the correlation coefficient, the researcher employed the ANOVA test, with the results presented in the following table:

Table 7 Summary of the model for testing the hypothesisH1.1

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	44.397	1	44.397	194.888	.000[b]
	Residual	33.260	146	0.228		
	Total	77.657	147			

a. Dependent Variable: sustainable economic performance
b. Predictors: (Constant), human engineering principles

Source: SPSS v.27 output

Table (9) shows that the simple linear regression model is statistically significant at a 95% confidence level ($p < 0.001$). This indicates that there are significant differences in sustainable economic performance that can be explained by human engineering principles. Based on these results, it can be confirmed that there is a statistical relationship between the independent variable (human engineering principles) and the dependent variable (sustainable economic performance). Using the following regression equation, we can accurately determine the nature of this relationship:

Table 8 Simple regression model coefficients between variableshuman engineering principles and sustainable economic performance

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-3.517	0.535		-6.578	0.000
	human engineering principles	1.769	0.127	0.756	13.960	0.000
a. Dependent Variable: sustainable economic performance						

Source: SPSS v.27 output

Table (10) demonstrates a significant effect of human engineering principles ($\beta = 0.756$, $p < 0.001$) on sustainable economic performance. This indicates that each unit increase in human engineering principles is associated with a 1.769 increase in sustainable economic performance. Based on these statistical results, it can be concluded that there is a positive and meaningful relationship between human engineering principles and sustainable economic performance in the studied organization. This supports the hypothesis suggesting that human engineering principles have a positive impact to enhance economic performance.

H1.2: The application of human engineering principles has a statistically significant effect on sustainable social performance within the studied organization.

To test this hypothesis (H1.2), the researcher conducted a simple regression analysis using SPSS to examine the relationship between the independent variable (human engineering principles) and the dependent variable (sustainable social performance). The results are presented in the following table:

Table 9 Summary of the model for testing the hypothesisH1.2

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.718[a]	0.515	0.512	0.48966
a. Predictors: (Constant), human engineering principles				

Source: SPSS v.27 output

From Table (11) above, it is observed that the correlation coefficient (R) is 0.718, while the R Square value is 0.515. This indicates that human engineering principles explain approximately 51.5% of the variance in sustainable social performance. This suggests a strong relationship between human engineering principles and sustainable social performance. To assess the significance of the correlation coefficient, the researcher conducted an ANOVA test, as detailed in the following table:

Table 10 ANOVAa test of the hypothesisH1.2

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	37.168	1	37.168	155.021	.000[b]
	Residual	35.005	146	0.240		
	Total	72.174	147			
a. Dependent Variable: sustainable social performance						
b. Predictors: (Constant), human engineering principles						

Source: SPSS v.27 output

From Table (12), the results indicate that there is a significant difference in sustainable social performance that can be explained by human engineering principles at a 95% confidence level ($p < 0.001$). This underscores the importance of human engineering principles in achieving sustainable social performance. This relationship can be defined using the following regression equation:

Table 11 Simple regression model coefficients between variables human engineering principles and sustainable social performance

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-2.854	0.549		-5.202	0.000
	human engineering principles	1.619	0.130	0.718	12.451	0.000
a. Dependent Variable: sustainable social performance						

Source: SPSS v.27 output

From Table (13) above, it is observed that there is a significant effect of human engineering principles ($\beta = 0.718$, $p < 0.001$) on sustainable social performance. This means that an increase of one unit in human engineering principles leads to a 1.619 increase in sustainable social performance. Based on these results, it can be confidently stated that there is a positive and meaningful relationship between human engineering principles and sustainable social performance in the studied organization.

$H_{1.3}$:The application of human engineering principles has a statistically significant effect on sustainable environmental performance within the studied organization.

Table 12 Summary of the model for testing the hypothesisH1.3

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.733[a]	0.537	0.534	0.41175
a. Predictors: (Constant), human engineering principles				

Source: SPSS v.27 output

From Table (14) above, it is observed that the correlation coefficient (R) is 0.733, while the R Square value is 0.537. This indicates that human engineering principles explain approximately 53.7% of the variance in sustainable environmental performance. This suggests a strong relationship between human engineering principles and sustainable environmental performance and supports the conclusion that (H1.3) has been achieved, confirming a statistically significant relationship between the two variables. To assess the significance of the correlation coefficient, the researcher employed an ANOVA test, with the results detailed in the following table:

Table 13 ANOVAa test of the hypothesisH1.3

ANOVA[a]						
Sig.	F	Mean Square	df	Sum of Squares	Model	
.000[b]	169.394	28.718	1	28.718	Regression	1
		0.170	146	24.752	Residual	
			147	53.470	Total	
a. Dependent Variable: sustainable environmental performance						
b. Predictors: (Constant), human engineering principles						

Source: SPSS v.27 output

From Table (15) above, the results indicate a significant difference in sustainable environmental performance that can be explained by human engineering principles at a 95% confidence level ($p < 0.001$). This implies that there is a positive and significant effect of human engineering principles on sustainable environmental performance. This relationship can be quantified using the following regression equation:

Table 14 Simple regression model coefficients between variableshuman engineering principles and sustainable environmental performance

Coefficients[a]						
Sig.	t	Standardized Coefficients	Unstandardized Coefficients		Model	
		Beta	Std. Error	B		
0.000	-4.074		0.461	-1.879	(Constant)	1
0.000	13.015	0.733	0.109	1.423	human engineering principles	

a. Dependent Variable: sustainable environmental performance

Source: SPSS v.27 output

From Table (16), it is observed that there is a significant effect of human engineering principles ($\beta = 0.733$, $p < 0.001$) on sustainable environmental performance. This means that an increase of one unit in human engineering principles results in a 1.423 increase in sustainable environmental performance. Based on these results, it can be confidently stated that there is a positive and meaningful relationship between human engineering principles and sustainable environmental performance in the studied organization, highlighting the importance of adopting human engineering principles as a tool for achieving sustainable environmental performance.

12 RESULTS

The findings reveal compelling insights into how these principles affect sustainable outcomes.

1. **Main Hypothesis: Impact on Sustainable Performance**

   The primary hypothesis investigated became whether human engineering principles drastically influence sustainable performance. The evaluation, using easy regression and SPSS model 27, demonstrated a sturdy relationship among the two variables. The correlation coefficient (R) become determined to be 0.803, indicating a robust connection, while the R Square feet of 0.645 shows that human engineering standards account for about 64.5% of the variance in sustainable overall performance. This indicates that these standards play a crucial position in enhancing general sustainable performance.

   Further analysis the usage of the ANOVA looks at confirmed the statistical importance of this relationship, with an F-price of 264.819 and a p-price of less than 0.001. This result underscores the impact of human engineering standards on sustainable performance. The regression coefficients in addition illustrated that for every unit increase in human engineering standards, sustainable performance improved with the aid of 1.595 gadgets, highlighting a large fine impact.

2. **Effect on Sustainable Economic Performance**

   The look at also explored the effect of human engineering standards on sustainable Economic performance. The regression analysis discovered a correlation coefficient (R) of 0.756 and an R Square price of 0.572. This indicates that human engineering principles provide an explanation for approximately 57.2% of the variance in sustainable financial overall performance, reflecting a massive and fine relationship.

   ANOVA outcomes, with an F-fee of 194.888 and a p-value underneath 0.001, confirmed the significance of this effect. The coefficients indicated that every unit boom in human engineering ideas is associated with a 1.769 increase in sustainable Economic overall performance, further asserting the advantageous impact of those ideas on economic effects.

3. **Impact on Sustainable Social Performance**

   The courting among human engineering ideas and sustainable social overall performance changed into also examined. The outcomes showed a correlation coefficient (R) of 0.718 and an R Square fee of 0.515, meaning that human engineering concepts explain approximately 51.5% of the variance in social performance. This shows a significant connection among the concepts and social effects.

   The ANOVA look at yielded an F-value of a 155.021 with an importance stage of much less than 0.001, confirming the importance of the relationship. The regression coefficients revealed that each unit increase in human engineering principles ends in a 1.619 boom in sustainable social performance, emphasizing the importance of those ideas in enhancing social components of sustainability.

4. Effect on Sustainable Environmental Performance

Finally, the look at assessed the impact of human engineering ideas on sustainable environmental overall performance. The evaluation produced a correlation coefficient (R) of 0.733 and an R Square cost of 0.537, indicating that human engineering ideas account for approximately 53.7% of the variance in environmental overall performance. This strong dating underscores the function of these concepts in improving environmental results.

The ANOVA outcomes, with an F-price of 169.394 and a p-value of much less than 0.001, showed the statistical significance of the impact. The regression coefficients confirmed that every unit increase in human engineering concepts consequences in a 1.423 boom in sustainable environmental overall performance, reinforcing the effective effect of these principles on environmental sustainability.

In summary, the results from the hypothesis tests consistently demonstrate that human engineering principles have a significant and positive impact on all dimensions of sustainable performance: overall, economic, social, and environmental. The findings underscore the critical role of these principles in enhancing sustainable outcomes within the organization, providing robust empirical support for their importance in achieving sustainability goals.

13 Recommendations

1. Organizations should embed human engineering principles into their core strategic framework. This integration involves aligning organizational goals with human-centric design and operational practices.
2. regularly reviewing and updating ergonomic practices, collecting feedback from employees, and implementing best practices based on the latest research and technological advancements.
3. The organization should develop detailed ergonomic guidelines and protocols based on human engineering principles.
4. investment advanced ergonomic workstations, adjustable equipment, and software solutions designed to enhance the human-computer interaction.
5. Regular assessments should be conducted to measure the impact of human engineering principles on sustainable performance indicators.
6. Align organizational practices with broader Sustainable Development Goals (SDGs) by integrating human engineering principles that support environmental, economic, and social sustainability.

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