ISSN 2319-684X | Volume XII Issue 2 | December 2024

ABS International Journal of Management

ISSN 2319-684X (PRINT)

Volume XII Issue 2
December 2024

ASIAN BUSINESS SCHOOL

ASIAN BUSINESS SCHOOL
Approved by AICTE,
Ministry of Education, Govt. of India
Plot A2, Sector 125, Noida - 201303
Post Graduate Diploma in Management

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ABS INTERNATIONAL JOURNAL OF MANAGEMENT

ABS ASIAN BUSINESS SCHOOL

ABS International Journal of Management is the publication of Asian Business School, Noida, India.
https://absjournal.abs.edu.in/

Address for Correspondence:
ABS International Journal of Management
Asian Business School,
Marwah Studios Complex II,
Plot A2, Sector 125,
Noida – 201303.
INDIA
Tel.:0120-4594200

Published by
KUNAL BOOKS
4648/21, 1st Floor, Ansari Road, Daryaganj, New Delhi- 110002
Phones: 011-23275069 (M) 9811043697, 9868071411, 8700829963
E-mail: kunalbooks@gmail.com/ kunalbooks@yahoo.co.in
Website: https//kunalbooks.com

Indexed in J-Gate MENDELEY

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Volume XII Issue 2 December 2024 | ISSN 2319-684X (PRINT)

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An Analytical Study of the Relationship Between Emotional Intelligence and Organizational Commitment in the IT Sector

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ABSTRACT:
In recent years, there has been an increased interest in Emotional Intelligence among Indian organisations. This rise can be accounts to emotional intelligence being more well-known in the field of research. The purpose of the current study was to look into the relationship between corporate executives' emotional intelligence and organisational Commitment. The study was conducted at three IT organisations in the Chandigarh Tricity, which includes organisations from Chandigarh, Panchkula, and Mohali. A sample of 138 employees working in the IT sector was taken to explore the relationship through a questionnaire. Correlation analysis in Smart PLS was used to investigate the association. According to the findings, emotional intelligence and organisational commitment are significantly and favourably correlated, meaning that the more emotionally intelligent a person is, the more committed they will be to their organisation. The theoretical and practical understanding of the connection between corporate executives' organisational commitment and emotional intelligence is affected by these findings.

Keywords: *Emotional Intelligence, Organizational Commitment, Self- Emotional Appraisal, Regulation of Emotion, Use of Emotion, Others' Emotional Appraisal, Affective Commitment, Continuance Commitment, Normative Commitment*

INTRODUCTION

Emotional intelligence is a crucial element for businesses to thrive, particularly in the IT sector. As a result, a lot of emphasis has been paid to the subject of emotional intelligence over the last few years. Organisations today are paying more attention to the emotional side of their employees. By doing this, businesses can count on their staff to work as cooperatively, sincerely, and productively as possible. Employees are unable to maintain a healthy work-life balance in the current climate of constant change and development, which negatively impacts both their professional and personal lives. This imbalance results in a variety of psychological issues, which raise stress levels and reduce workers' productivity. Emotional quotient is prioritised over intelligence quotient to address this problem. Emotional intelligence, which also influences each person's success boosts employees' confidence in their capacity to manage their personal and professional lives. Positive emotions are crucial for the improvement of one's physical and mental well-being. An individual with strong emotional intelligence can identify and effectively manage their emotions and thoughts. Such a person is also aware of their influence on others and knows how to respect their feelings. Also, a person with such qualities understands how to deal with negative emotional responses to inspire others. Emotional intelligence is a concept that is crucial to both people's personal and professional lives. An emotionally intelligent person, according to Goleman (1995), is probably possess two key skills: "Social Competence," which deals with relationships, and "Personal Competence," which deals with self-management. Understanding one's own and other people's emotions is the essence of emotional intelligence. According to Gopinath and Chitra (2020), emotional intelligence refers to a person's innate capacity to influence how they subconsciously respond to their environment to produce favourable results in their relationships with others and with themselves. As a type of intelligence, emotional intelligence "involves the capacity to keep track of one's own and other people's feelings and emotions and to make distinctions between both and to utilise this knowledge to direct one's thoughts and actions." Organisational commitment is a key predictor for both certain favourable and unfavourable outcome factors as demonstrated by two decades of research (Meyer et al., 2002). They claim that employees who exhibit higher degrees of affective commitment to the company perform better than those who do not. Emotional intelligence is an element that could promote organisational commitment. Emotional intelligence or Emotional Quotient can also be referred to as the ability to recognise and manage one's own and others' emotions (Goleman, 2001). The ability to recognise, comprehend, and

constructively use emotions in order to communicate, relieve anxiousness, empathise with other people, get beyond challenges, and defuse conflicts (Gopinath et al., 2020). Emotional intelligence affects a wide range of aspects of a person's daily life, such as behaviour and social relationships.

LITERATURE REVIEW

The main asset in a corporation nowadays is thought to be its human resources. However, maintaining a work climate that keeps employees with the alluring value of organisational commitment is just as important as having the greatest and most skilled employees. Until now, organizations focused on maximizing profits by producing as much as possible. Employees were treated like machines and emotions and sentiments were given less importance. This resulted in increased work accidents, lower productivity, higher employee stress levels, and other negative effects. However, economic changes have led to various difficulties, prompting a shift in how they operate. Now, the top priority of organizations is to ensure that their employees are happy and satisfied at work. This is because only contented employees can perform to the best of their abilities for the company. The idea of emotional intelligence originated in the 1990s, influenced by Goleman's books "Working with Emotional Intelligence" and "The What Makes a Leader"; since then, emotional intelligence has been the subject of a lot of scholarly discussion. The definition and understanding of emotional intelligence differently by various researchers. Nonetheless, there is agreement on the definition of emotional intelligence, which is to be interpreted as the ability to utilise emotions appropriately as well as the possession of emotional awareness and control. The studies of "social intelligence," which were originally described by Throndike (1920), were the foundation for the emotional intelligence theory. Emotional intelligence as the capacity to detect one's emotions and manage them appropriately (Salovey and Mayer,1990). The capacity to recognise, comprehend, and control emotions is what fosters personal development. According to Goleman (1995), there is a bigger role for emotional intelligence in predicting success in the workplace than IQ. This is significant because adaptive conduct is necessary for emotional behaviour to be intelligent. Having emotional intelligence can give you an edge over others in the competition. The most respected and effective managers are those who have strong emotional intelligence characteristics. To be successful, emotional intelligence should be prioritized alongside technological growth and modernity in daily tasks. One's ability to manage their own and other people's emotions in a variety of settings is just as important as their intelligence or level of skill. Within the realm of emotional intelligence, two primary definitions are recognized. Emotional intelligence, according to Mayer and Salovey (1990), is the capacity to regulate how one feels and those of other people. This ability is then used to guide behaviour and understanding. Mayer & Salovey published their paper "What is emotional intelligence" in 1997 after conducting additional research on the topic. The paper modified the concept of emotional intelligence, and it was suggested that emotional intelligence is a skill related to emotions and feelings. Accurately recognising, expressing, and assessing emotions is a function of intellectual growth and regulation. The alternative definition is developed by Goleman and Bar-on. In his book "Emotional Intelligence," Goleman (1995) described emotional intelligence as the behaviours and capacity to detect one's own emotions, recognise those of others, regulate those emotions, and manage interpersonal initiative. According to him, emotional intelligence entails recognising one's feelings as well as those of others as well as interpersonal interactions (Perloff & Robert, 1997). Bar-on thought that a person's potential capacity was emotional intelligence. This skill will be crucial in helping people manage their stress and satisfy their personal needs (Darek Dawda & Stephen D. Hart, 2000). Emotional intelligence is a type of intelligence that deals with the emotional and mental aspects of human beings, according to Goldenberg et al. (2006). In contrast, the mixed trait ability model of Matthews, Roberts, and Zeidner (2004) addressed personality-like traits as well as emotional talents. Intrapersonal ability, interpersonal ability, stress management, adaptability, and general mood were the five characteristics that BarOn (2000) identified as having an impact on an individual's emotional intelligence. According to research by Ashkanasy and Hooper (1999), having higher emotional intelligence was linked to better job performance, greater organisational engagement, more positive emotional control, and lower staff turnover. Employees in the service sector require emotional intelligence to function, just as manual labourers require physical effort (Mastracci et al.,

2010). High emotional intelligence workers are able to regulate their own emotions and identify those of others, and encourage the expression of positive emotions while reducing the expression of negative emotions (Brotheridge, Céleste, & M., 2002). This enables them to better understand how to control and manage their behaviour. The degree of an employee's positive or negative views towards the company, as opposed to their particular position within it, is known as their organisation commitment (Alavi et al., 2013). According to Shafiq and Akram Rana (2016) and Gopinath (2020), the three organisational commitment components—emotional commitment, continuing commitment, and normative commitment—were strongly positively correlated with emotional intelligence. According to research, employees who possess greater emotional intelligence are more dedicated to their companies (Moradi & Ardahaey, 2011), are more resilient to stress through emotional intelligence development (Gopinath, 2014b), and experience less stress (Gopinath, 2014a). The positive emotions of intimacy and connection to the organisation are a part of the affective commitment. Normative commitment is the obligation to continue working for a company (Meyer & Allen,1990). An investigation into organisational commitment was done in 2006 by Jackson and Rothmann. The results of the study showed that employment instability significantly harmed the physical and emotional health of educators, whereas organisational commitment merely reduced that effect. A key component of accomplishing objectives is employee motivation. As a result, motivated personnel are more eager and committed to helping the company reach its objectives (Alavi et al., 2013). Gelaidan et al., (2016) in the results of a study examined the relationship between leadership behaviour and emotional intelligence, in addition to the consequences of emotional intelligence, leadership behaviour, and organisational commitment, show that organisational commitment and employee readiness for change were significantly impacted by emotional intelligence. The findings of earlier research showed that in general, associations between organisational commitment and emotional intelligence were shown to be favourable.

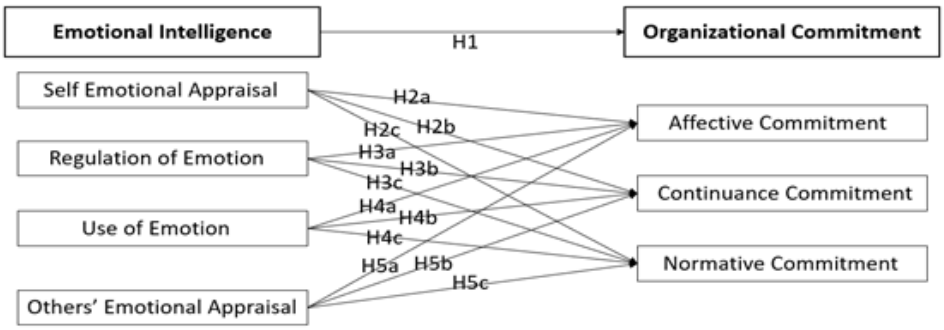
RESEARCH GAP

There have been gaps in the literature that need to be filled. Most significantly, research regarding connection in emotional intelligence and employees' organisational commitment in India vs other nations is still ongoing, according to the literature. Since Chandigarh Tricity is emerging as a centre for the IT industry, it is a great opportunity to investigate this topic in the region. Previous research may have flaws, and there are still some problems worth investigating in the future. As a result, by considering the aforementioned factors, this study seeks to bridge the gap.

RESEARCH METHODOLOGY

The study's independent variable, emotional intelligence, has four dimensions: self-emotional appraisal, emotion management, emotion use, and others' emotional appraisal. Affective, continuance, and normative commitment are the three characteristics of organisational commitment, which is the dependent variable.

CONCEPTUAL MODEL



Objectives:

The key objectives of the investigation are listed below:
(1) To explore how emotional intelligence and organisational commitment are related. (2) To investigate how the dimensions of emotional intelligence and organisational commitment relate to one another.

Hypothesis:

H1: Emotional Intelligence and Organisational Commitment are significantly related.

H2: The dimensions of Emotional Intelligence and Organisational Commitment are significantly related.

H2a: Self-Emotional Appraisal and Affective Commitment are significantly related.
H2b: Self-Emotional Appraisal and Continuance Commitment are significantly related.
H2c: Self-Emotional Appraisal and Normative Commitment are significantly related.
H2d: Regulation of Emotion and Affective Commitment are significantly related.
H2e: Regulation of Emotion and Continuance Commitment are significantly related.
H2f: Regulation of Emotion and Normative Commitment are significantly related.
H2g: Use of Emotion and Affective Commitment are significantly related
H2h: Use of Emotion and Continuance Commitment are significantly related.
H2i: Use of Emotion and Normative Commitment are significantly related.
H2j: Others' Emotional Appraisal and Affective Commitment are significantly related.
H2k: Others' Emotional Appraisal and Continuance Commitment are significantly related.
H2l: Others' Emotional Appraisal and Normative Commitment are significantly related.

Data collection

i. Methodology

An endeavour is made to research the the connection between organisational commitment and emotional intelligence in the IT industry in Tricity i.e., Chandigarh, Mohali and Panchkula. Data was collected using the questionnaire which consists of 3 sections, sections A, B and C. Section A comprised questions related to emotional intelligence dimensions. Section B comprised questions associated with Organization Commitment. Section C consisted of the general profile of the employees.

ii. Instrument

The scale of emotional intelligence developed by Wong & Law (2002) was adopted. It has 16 measurement questions for service industry employees. The ability model of emotional intelligence serves as the foundation for the components of the Wong and Law Emotional Intelligence Scale (WLEIS). These items were measured using a seven-point Likert scale (1: strongly disagree, 7: strongly agree). Average items 1–16 were used to score total emotional intelligence, average items 1–4 for self-emotion appraisal, average items 5-8 for regulation of emotions, average items 9–12 for use of emotions, and average items 13–16 for others-emotion appraisal. Allen and Mayer's Organisational Commitment Questionnaire (OCQ) was used to measure organisational commitment (1987). The instrument includes 24 measurement questions examining affective commitment, continuance commitment, and normative commitment. The items on the five-point Likert scale ranged from 1 (strongly disagree) to 5 (strongly agree).

Sampling

A sample of 150 IT industry employees was selected from Chandigarh Tricity, which comprises Chandigarh, Mohali, and Panchkula. Specifically, three IT companies from each city made up the sample. The use of convenience sampling was done due to the limited time frame available for the study. The researcher utilized personal connections to contact the selected IT companies and distributed questionnaires as Google Forms to 50 employees from each company. In all, 138 (92%) responses were received out of 150 questionnaires.

Research Framework

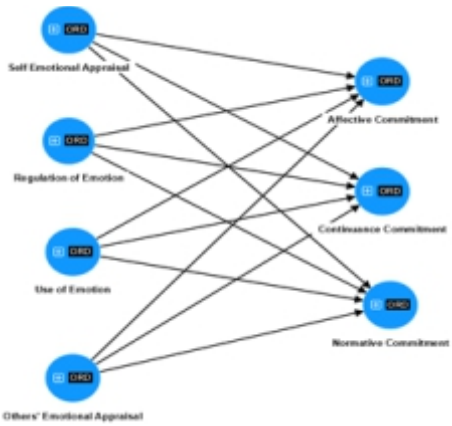


Figure 2:

Data Analysis

The primary data obtained by the questionnaire survey was analysed with the help of Smart PLS as shown in figure 2. To evaluate the validity and reliability of the items, a confirmatory factor analysis was conducted. The reliability of the items and the data was also checked by using Cronbach's alpha values.

Results

This section presents the results of the empirical study.

Sample description

The analysis of respondents' characteristics is provided in Table 1. The first demographic variable was age in which 110 (79.71%) respondents were between the age of 20-30, 23(16.66%) respondents were between the age of 31-40 and 5 (3.62%) respondents were between the age of 41-50. The second variable was marital

status in which 113 (81.88%) respondents were single and the remaining 25 (18.11%) were married. Out of the respondents, 73 (52.89%) were males and 65 (47.10%) were females. 21 (15.21%) respondents were undergraduates, 85 (61.59%) were post-graduates, 23 (16.66%) of them had a professional certification and 9 (6.5%) of the respondents had a diploma.

Table 1: Descriptive Respondents

Characteristics	Description	Amount	Percentage
Age	20-30 years 31-40 years 41-50 years 51-60 years >60 years	110 23 5 - -	79.71% 16.66% 3.62% - -
Marital Status	Single Married	113 25	81.88% 18.11%
Gender	Male Female	73 65	52.89% 47.10%
Qualification	Under Graduation Post Graduation Professional Certification Diploma	21 85 23 9	15.21% 61.59% 16.66% 6.5%

The reliability test results are shown in Table 2. Smart PLS was used to evaluate and test the reliability of the model (fig. 2). Cronbach alpha for each construct, explained variance, mean and standard deviations, and pairwise correlation of the parameters examined in the model are the descriptive statistics' values. Means, standard deviations, and correlations were run on all variables. Table 2 provides an overview of the findings of the reliability analysis.

Table 2: Construct Validity and Reliability

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	The average variance extracted (AVE)
Affective Commitment	0.827	0.864	0.871	0.473
Continuance Commitment	0.659	0.702	0.725	0.409
Normative Commitment	0.637	0.726	0.754	0.422
Others' Emotional Appraisal	0.906	0.932	0.933	0.778
Regulation of Emotion	0.606	0.726	0.787	0.504
Self Emotional Appraisal	0.786	0.808	0.860	0.608
Use of Emotion	0.841	0.859	0.893	0.676

Before testing the hypotheses, coefficient alphas were calculated. It is regarded as reliable if the alpha value is higher than 60% (Hair et al., 2019). Each construct had Cronbach's α values more than 0.6, which suggests that the evidence is sufficiently reliable and consistent (see Table 2). Additionally, the average variance was extracted (AVE; Jenatabadi & Ismail, 2014) and convergent validity was verified employing composite reliability (CR) prior to evaluating the structural model. Since the CR values are greater than 0.7 and the AVE values are greater than 0.4, both exceed the thresholds set by Jenatabadi and Ismail (2014). Reliabilities for all scales exceeded minimally acceptable standards (Nunnally, 1978). Furthermore, by looking at the AVE for each construct and making sure that the discriminant validity was validated and found to be good since it was higher than the squared correlation involving the given construct and other constructs. Because the squared correlation score was less than 0.4, the results demonstrated that the discriminant validity was adequate. Furthermore, to evaluate the formative model's discriminant validity, the heterotrait-monotrait ratio (HTMT) of the correlations can be analysed (Henseler et al., 2015). The HTMT ratio should not exceed 0.85. The HTMT test's findings are included in Table 3, where all the values are less than 0.85, indicating the presence of discriminant validity.

Table 3: Discriminant Validity- HTMT Results

Variables	Affective Commitment	Continuance Commitment	Normative Commitment	Others' Emotional Appraisal	Regulation of Emotion	Self Emotional Appraisal	Use of Emotion
Affective Commitment							
Continuance Commitment	**0.692**						
Normative Commitment	0.821	**0.781**					
Others' Emotional Appraisal	0.524	0.409	**0.482**				
Regulation of Emotion	0.627	0.421	0.722	**0.484**			
Self Emotional Appraisal	0.439	0.441	0.531	0.529	**0.754**		
Use of Emotion	0.316	0.238	0.391	0.671	0.593	**0.706**	

The degree of multicollinearity in the dataset was assessed by utilizing the measured variables' variance inflation factor (VIF). The analysis revealed that values of the VIF ranged from 1.26 to 2.80, which is considered acceptable. As per the guidelines suggested by Hair et al. (2010), A VIF greater than three indicates a possible multicollinearity problem. It can be inferred from the results that there is no significant problem of multicollinearity with the collected data sample. To evaluate the structural model, the Goodness of Fit (GoF) indices were examined which are presented in Table 4. All values lie within the acceptable threshold, the test was successfully completed by the model.

Table 4: Structural model goodness of fit indices

Fit index	Value	Critical (acceptable) value (Schreiberet al., 2006	Accepted
Chi2 /df	4.508	0.002–4.80	Yes
CFI (comparative fit index)	0.918	≥0.9	Yes
RMSEA (root means square error of approximation)	0.076	≤0.08	Yes

According to Table 5, 78.1 per cent of the variability in normative organisational commitment, 45 percent of the variability in continuous organisational commitment, and 55.9 percent of the variability in affective commitment can all be explained by emotional intelligence.

Table-5: R square

	R-square	R-square adjusted
Affective Commitment	0.559	0.540
Continuance Commitment	0.450	0.426
Normative Commitment	0.781	0.772

Smart PLS was used to analyse the data's Path Coefficient Analysis and the structural model is given in Figure 3.

Table 6 provides an analysis of the hypothesis's findings.

Table-6: Path Coefficients- Sample mean (M), Standard deviation (STDEV), T statistics (|O/STDEV|), P values (*P < 0.05; **P < 0.01; ***P < 0.001, two tailed)

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Result
Self EmotionalAppraisal-> Affective Commitment	0.045	0.136	0.111	1.118	0.264	Not Supported
Self EmotionalAppraisal-> Continuance Commitment	0.317	0.193	0.094	1.063	0.288	Not Supported
Self-EmotionalAppraisal-> Normative Commitment	-0.006	0.129	0.125	0.890	0.374	Not Supported
Regulation of Emotion-> Affective Commitment	0.624	0.350	0.103	3.390	0.001***	Supported
Regulation of Emotion-> Continuance Commitment	0.086	0.065	0.122	0.190	0.849	Not Supported
Regulation of Emotion-> Normative Commitment	0.939	0.440	0.095	4.646	0.000***	Supported
Use of Emotion- > Affective Commitment	-0.441	-0.193	0.116	1.861	0.063	Not Supported
Use of Emotion -> Continuance Commitment	-0.716	-0.228	0.231	1.534	0.125	Not Supported
Use of Emotion-> Normative Commitment	-0.428	-0.097	0.117	0.987	0.323	Not Supported
Others' Emotional Appraisal -> Affective Commitment	0.510	0.422	0.105	4.110	0.000***	Supported
Others' Emotional Appraisal ->Continuance Commitmen	0.776	0.310	0.309	1.382	0.167	Not Supported
Others' Emotional Appraisal -> Normative Commitment	0.314	0.265	0.119	2.235	0.025*	Supported
Emotional Intelligence -> Organizational Commitmen	0.648	0.695	0.046	14.133	0.000***	Supported

H2a: Self-emotional appraisal and Affective Commitment are significantly related. According to the obtained results (=0.136, t-value = 1.118, p-value=0.264), self-emotional appraisal and affective commitment have a positive relationship. However,

H2a was rejected because the p-value exceeded the significance level of 0.05.

H2b: Self-emotional appraisal and Continuance Commitment are significantly related.

Considering the outcomes, (=0.193, t-value = 1.063, p-value=0.288), H2b was rejected because the p-value exceeded the significance. Even though the results affirmed that self-emotional appraisal is positively correlated with continuance commitment the relationship between them stood insignificant.

H2c: Self-emotional appraisal and Normative Commitment are significantly related. According to the obtained results (=0.129, t-value =0.890, p-value=0.374), self-emotional appraisal and normative commitment have a positive relationship. However, H2c was rejected because the p-value exceeded the significance level, indicating that there is an insignificant link between the two.

H2d: Regulation of Emotion and Affective Commitment are significantly related.

Analysing the outcomes, (=0.350, t-value = 3.390, p-value=0.001), H2d was approved since the p-value was below

the significance level. The results affirmed that the regulation of emotion has a substantial and favourable link with affective commitment. This means that the greater the regulation of emotion, the higher the level of affective commitment of employees.

H2e: Regulation of Emotion and Continuance Commitment are significantly related.

Evaluating the outcomes, (=0.065, t-value = 0.190, p-value=0.849), H2e was rejected because the p-value exceeded the significance level. Even though the results affirmed that regulation of emotion has a favourable connection with continuance commitment but the relationship between them stood insignificant.

H2f: Regulation of Emotion and Normative Commitment are significantly related.

According to the obtained results (=0.440, t-value=4.646, p-value=0.000), the regulation of emotion and normative commitment are positively and significantly correlated. H2f was approved since the p-value was below the significance level. This means that the greater the regulation of emotion, the higher the level of normative commitment of employees.

H2g: Use of Emotion and Affective Commitment are significantly related
Viewing the outcomes, (=-0.193, t-value = 1.861, p-value=0.063), H2g was rejected because the p-value was higher than the significance criterion of 0.05. The results affirmed that the use of emotion has a negative and insignificant relationship with affective commitment.

H2h: Use of Emotion and Continuance Commitment are significantly related.
According to the obtained results (=-0.228, t-value =1.534, p-value=0.125), the use of emotion and continuance commitment have a negative relationship. H2h was rejected since its p-value was above level of the significance, indicating that there is an insignificant link between the two.

H2i: Use of Emotion and Normative Commitment are significantly related.
Given the outcomes, (=-0.097, t-value =0.987, p-value=0.323), H2i was rejected because the p-value exceeded the significance level. The results affirmed that using emotion has a negative and insignificant relationship with normative commitment.
H2j: Others' Emotional Appraisal and Affective Commitment are significantly related.
According to the obtained results (=0.422, t-value=4.110, p-value=0.000), others' emotional appraisal and affective commitment possess a meaningful and stimulating relationship. Since the p-value was below the significance level, H2j was accepted. This means that the greater the others' emotional appraisal, there will be higher the level of affective commitment of employees.

H2k: Others' Emotional Appraisal and Continuance Commitment are significantly related. According to the obtained results (=0.310, t-value = 1.382, p-value=0.167), others' emotional appraisal and continuance commitment have a positive relationship. However, H2k was rejected since the p-value was above the significance limit.

H5l: Others' Emotional Appraisal and Normative Commitment are significantly related. According to the obtained results (=0.265, t-value=2.235, p-value=0.025), others' emotional appraisal and normative commitment possess a meaningful and positive relationship. H2l was accepted since the p-value was below the significance level. This means that the greater the others' emotional appraisal, there will be higher the level of normative commitment of employees.

H1: Emotional intelligence and organizational commitment are significantly related.

The table shows that emotional intelligence and organizational commitment (=0.695, t-value=14.133, p-value=0.000) are positively related, and the hypothesis is significant with a p-value of 0.000. Therefore, H1 was accepted. This means that the greater the emotional intelligence, there will be higher the level of organizational commitment of employees.

CONCLUSION

The study focused on three IT organizations located in Chandigarh Tricity and investigated the connection between organisational commitment and emotional intelligence. The present study analysed the variables related to emotional intelligence and organisational commitment in relation to IT employees. The study's findings showed a strong and positive relation between emotion regulation and affective commitment, meaning that the more emotionally controlled employees are, the more emotionally committed they are. Secondly, it stated a substantial and favourable association between the regulation of emotions and normative

commitment, indicating greater the regulation of emotion, the higher the level of normative commitment of employees. Thirdly, other's emotional appraisal and affective commitment also had a substantial and favourable association, which means that the greater the others' emotional appraisal, there will be higher the level of affective commitment of employees. Also, other's emotional appraisal and normative commitment had a substantial and favourable association indicating greater the others' emotional appraisal, there will be higher the level of normative commitment of employees. Finally, it was determined that organisational commitment and emotional intelligence are significantly and favourably correlated. This indicates that those who are more emotionally intelligent also typically show greater degrees of dedication to their organisations.

LIMITATIONS

To enhance the validity of the study, future research should address several limitations. Firstly, the employees faced time constraints while answering the questionnaires. Also, the study was geographically limited to IT organizations in Tricity. It's critical to remember that the present in Tricity may not be representative of other regions or industries, thus it limited the generalizability of the study. Moreover, the study's coverage was limited due to the small sample size of 118 employees, which restricts its influence on current situations. Future research can duplicate this study in several IT organisations or other industries and compare the findings with those of this study in order to get over these limitations. Future studies may also benefit from taking gender into account as a moderating factor in this situation. Lastly, experimental research design may be used in future studies.

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ABS International Journal of Management
Volume XII Issue 2 December 2024 | ISSN 2319-684X (PRINT)

Servant Leadership and Its Impact on Organizational Citizenship Behavior and Employee Retention in Select IT Companies in Tricity

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ABSTRACT:
In the context of IT enterprises in the Tricity area, this study examines the complex interactions among servant leadership, organizational citizenship behavior (OCB), and employee retention. The study intends to explore the mediating function of OCB in the link between employee retention and servant leadership, drawing on the theoretical frameworks of organizational behavior and servant leadership theory. A sample of employees from different IT organizations in the Tricity area were asked to complete standardized questionnaires as part of a mixed-method approach to gather quantitative data. Additionally, semi-structured interviews with important persons, such as managers and HR specialists, were used to collect qualitative data. According to the study's findings, staff retention, OCB, and servant leadership are significantly positively correlated. Additionally, the findings show that OCB partially mediates the relationship between servant leadership and employee retention, implying that the application of servant leadership techniques increases employees' OCB, which in turn strengthens their desire to remain with the company. The research' ramifications highlight how crucial it is for IT organizations to cultivate a servant leadership culture in order to advance OCB and eventually raise staff retention rates. In order to improve employee retention and organizational performance, organizations are given helpful advice on how to use servant leadership concepts and promote OCB among staff members.

Keywords: *servant leadership, organizational citizenship behavior, employee retention, IT companies*

INTRODUCTION

In today's business world, the information technology (IT) sector is leading the way in innovation and advancement. Employee retention has become a crucial issue and strategic goal as businesses in this fast-paced sector fight for the finest workers. With a focus on the mediating function that Organizational Citizenship Behavior (OCB) plays in this connection, the study examines the significant impact that servant leadership has on employee retention in the IT industry. In the dynamic world of contemporary organizations, the connection between leadership styles and employee outcomes has emerged as a critical area of study with real-world applications. Servant leadership has gained popularity among the many leadership styles because of its emphasis on fostering an atmosphere of empathy, individual autonomy, and community service. Simultaneously, retaining employees is a critical concern for businesses, especially in the rapidly changing Information Technology (IT) industry. Understanding the complex interplay between these factors, this study aims to clarify the subtle relationship between employee retention, organizational citizenship behavior (OCB), and servant leadership in the particular setting of a few IT enterprises in the Tricity area. The phrase "servant leadership," coined by Robert K. Greenleaf in the 1970s, challenges conventional notions of authority and asserts that a leader's primary responsibility should be to advance the growth and welfare of their followers. The foundation of servant leadership is the idea that leaders should act as stewards, prioritizing the needs of their team members and fostering an environment that allows individuals to develop both personally and professionally. By giving empathy, humility, and a commitment to service first priority, this leadership paradigm cultivates a culture that values cooperation, trust, and the individual development of every team member. Servant leadership has gained attention as a potential catalyst for fostering healthy workplace climates as businesses increasingly realize the influence of leadership on employee contentment, engagement, and overall performance. The IT sector has unique challenges with employee retention because of the fierce rivalry in the market. Due to the high demand for qualified IT professionals, companies need to make preparations to retain their top talent. Aspects of employee

retention include job satisfaction, organizational commitment, and expected career growth opportunities. Retaining top IT personnel is essential for stability, reducing hiring expenses, and fostering a culture of continuous innovation. In the dynamic modern workplace, it is increasingly strategically imperative to address the issue of retaining talented and qualified employees. The strategies used by companies to retain their prized employees are included in employee retention, a critical aspect of human resource management. Retaining top performers has become increasingly important in determining an organization's long-term performance and competitive edge as the global labour market gets more competitive and dynamic. In the IT industry, where innovation, cooperation, and teamwork are critical success elements, OCB is especially crucial. OCB refers to the voluntary, discretionary actions taken by employees for the benefit of their organization. These activities go beyond what is specifically included in a job description and might involve helping colleagues, offering recommendations for improvements, or engaging in initiatives that benefit the company as a whole. By increasing output, fostering collaboration, and creating a happy work environment, OCB significantly adds to the organization's success. One of the biggest drivers of economic growth in India is the IT and BPM industry, which also makes a substantial contribution to the GDP and general well-being of the nation. In FY22, the IT sector contributed 7.4% of India's GDP; by 2025, it is predicted to account for 10%. India is now ready for the next stage of its IT revolution as cutting-edge digital applications penetrate sector after industry. With 76 crores people now having internet connection, India is seen by the rest of the world as having one of the biggest populations of Internet users and the most affordable Internet pricing

REVIEW OF LITERATURE

Greenleaf (1977) stated that servant leadership is listening. The servant leader owes it to people they lead to make sure they are sufficiently equipped to face upcoming problems. A servant leader must be attentive to the present while also understanding that it is a part of the greater environmental context of which the organization is a part. Therefore, the leader and the organization will be more successful the better the leader is at putting all of the puzzle pieces together. He studied the Servant Leadership Theory, Opportunities for Additional Theoretical Integration. Maxwell (2018) stated that employee trust in the leadership of their organizations will be essential to moving organizations ahead. Ehrhart (2004) devised a 14-item measurement to evaluate servant leadership behavior using a Likert scale. Following the use of a confirmatory factor analysis to data on convergent and divergent validity, He discovered that servant leadership is a unique type of leadership. According to the report, one of the ten qualities of a successful servant leader is a matter of moral integrity. The world has grown more complex, and leaders must be pushed by dynamic times. Contrary to more conventional autonomous leadership techniques, servant leadership can result in good change in organizations. Followers are more likely to achieve at a better level when they perceive that leaders appreciate them as individuals. Modern servant leadership principles, according to research, outperform the standard in all kinds of private organizations. Sendjaya et al., (2008) analyzed Servant Leadership Behavior in Organizations. This study looks at the creation and preliminary validation of the Servant Leadership Behavior Scale, a multidimensional assessment of servant leadership behavior. In order to establish the basic psychometric features for the new 35-item, six-dimension measure, and both qualitative and quantitative investigations have been reported. The resulting servant leadership model extends existing models of servant leadership and existing works on contemporary leadership methods through its service orientation, holistic outlook, and moral-spiritual emphasis. Plessis and Nel (2015) studied the influence of emotional intelligence and trust on servant leadership. The paradigm of positive organizational behavior (POB) was used to study some constructs. The goal of this study was to look into the connections between emotional intelligence, servant leadership, and manager trust. The study was motivated by the fact that organizations all over the world recognize the importance of leadership and emotions in promoting employees' psychological and physical well-being as well as job performance. The inquiry was steered by both survey and statistical modelling approaches. Rehmana et al., (2021) studied the Role of Servant Leadership and Workplace Spirituality on Employee Retention and mediating role of employee engagement. The study focused on Hospitality sector and the conclusions

of this study imply that servant leadership qualities and workplace spirituality are essential elements to promote employee retention and work engagement in the hospitality industry. Organ (1988) defined Organizational Citizenship Behavior as work-related behaviors that are optional, unrelated to the official organizational reward system, and, taken together, support the efficient operation of the organization. Mohammad et al., (2011) studied Job Satisfaction and OCB in higher learning education centres. This study aims to evaluate the two organizational citizenship behavior dimensions and investigate the connections between these organizational citizenship behaviors and the intrinsic and extrinsic aspects of work satisfaction. The survey approach is used to accomplish the research goals. The results of this study demonstrate the significance of both intrinsic and extrinsic job happiness in influencing citizenship behavior. Tsai and Wu (2010) studied relationships between organizational citizenship behavior, job satisfaction and turnover intention. Hospital nurses in Taiwan. The results reveal that the nurses' job satisfaction has a significantly positive correlation with organizational citizenship behavior and a negative correlation with turnover intention. Christ et al., (2010) studied the relationships between different foci of organizational identification and different forms of Organizational citizenship behavior in schools. The proposed foci of identification (career identification, team identification, and organizational identification), as well as various forms of OCB (OCB towards one's own qualification, towards the team, and towards the organization), were revealed by exploratory and confirmatory factor analyses. The primary premise that foci of identification relate to forms of OCB differently is supported by structural equation modelling. The findings highlight the significance of organizational identification as an element influencing OCB in educational settings. The ramifications for daily life are examined. Budur and Poturak (2020) analyzed transformational leadership and its impact on customer satisfaction. Measuring mediating effects of organizational citizenship behaviors. Investigating the effects of transformative leadership on corporate citizenship practices and customer satisfaction is the primary goal of this study. According to research using the structural equation modelling (SEM) method, idealized influence, inspiring motivation, intellectual stimulation, and individual concern all have good effects on helping behaviors, but only helping behavior directly affects customer satisfaction. Additionally, CS saw considerable indirect effects from inspiring motivation and individual consideration. Mwakasangula et al., (2018) studied The Influence of Leadership on Employee Retention in Tanzania Commercial Banks Leadership is one of important aspects in any form of activity that involves people. This study examined the link between leadership and employee retention. The study used Akiba Commercial Bank (Buguruni Branch) and Tanzania Postal Bank (Morogoro Branch) and was found that there is significant linear relationship between leadership and employee retention in Tanzania commercial banks. It further reminds managers and supervisors to seek for feedback from their subordinates on how they perceive leadership styles used in respective banks and make improvements before the employees decide to leave. Biason (2020) studied the effect of job satisfaction on employee retention. In recent years, management, social psychology, and practical operations have all paid close attention to the academic idea of job satisfaction and employee retention. This study examines more than a decade's worth of studies on the causes and effects of employee retention and work satisfaction. Consequently, the current work aims to investigate the link between employee retention and job happiness. The study makes use of a design for descriptive research. In conclusion, the study's findings indicate that there was Job satisfaction and staff retention have a positive association. Mathur (2014) studied Servant Leadership and Organizational Citizenship Behavior among Employees of Service Sector. The results indicated that the servant leadership behaviors predict OCB significantly in service industries such as banks, insurance etc. Similarly, both characteristics of servant leadership were found positively related to OCB. The study is useful in enhancing OCB by focusing on the specific style of leadership i.e. servant leadership. Personal characteristics of leaders play more dominant role in exhibiting follower's OCB Gnankob et al., (2022) studied the Servant leadership and organizational citizenship behavior and the role of public service motivation and length of time spent with the leader. The study looked at how public service motivation (PSM) and the amount of time spent with the leader interacted to influence organizational citizenship

behavior (OCB) of employees in Ghana. According to the study, servant leadership significantly improves OCB and PSM. The research also revealed that PSM significantly and favorably affects OCB. The study's conclusion was that whereas PSM significantly moderated the association between servant leadership and OCB, time spent with leaders did not. Kashyap et al., (2014) analyzed the Moderating Role of Servant Leadership and Investigating the Relationships among Employer Brand Perception and Perceived Employee Retention. Employer brand perception and servant leadership was positively correlated with perceived employee retention intentions. Servant leadership moderated the relationships between employer brand perception and perceived employee retention. It was found that when servant leadership style followed by the leader is high then the positive relationships between employer brand perceptions and perceived employee retention intentions were also high in comparison with when servant leadership style followed the leader is low. Servant leadership also influenced the positive relationships between employer brand perception and perceived employee retention intentions. Tan Pham et al., (2023) studied socially responsible human resources management and employee retention: The roles of shared value, relationship satisfaction, and servant leadership. This research adds to the expanding body of knowledge on the function of socially responsible human resource management (SR-HRM) and its influence on worker behaviors. The study's conclusions showed that SR-HRM had a favorable relationship with both staff retention and shared value. Additionally, in the relationship between SR-HRM and employee retention, shared values and relationship satisfaction might play simultaneous and sequential mediation roles. Intriguingly, the research findings revealed that servant leadership moderates the relationship between SR-HRM and both shared value and employee retention, in such a way that those correlations are stronger when servant leadership is present.

NEED AND SIGNIFICANCE OF THE STUDY

It is crucial to study the effects of servant leadership on employee retention with an emphasis on the mediating role of organizational citizenship behavior (OCB) in the IT sector because of the rising turnover rates in the sector, which are costly and disruptive to an organization. Servant leadership is a style of leadership that places a strong emphasis on the leader's commitment to their team members, lowers attrition rates, and promotes organizational citizenship among staff employees. Additionally, servant leadership frequently promotes a positive workplace culture characterized by trust, collaboration, and employee well-being, which improves the employer's brand image and helps recruit new, talented employees, especially members of Generation Z, who frequently place a premium on purpose-driven work, ethical leadership, and a positive workplace culture. In conclusion, the study of servant leadership's effect on employee retention and how organizational citizenship behavior mediates it is a complex and crucial field of research for organizations in the IT sector. It discusses topics including personnel management, workplace culture, innovation, and long-term sustainability, all of which are essential for success in this fastpaced sector. Based on the study's findings, the research seeks to offer IT organizations in the Tricity area useful insights and suggestions. Organizational leaders and HR specialists can improve their staff retention strategy by following these useful implications. The Tricity region—which includes Chandigarh, Mohali, and Panchkula—is the study's primary emphasis. To provide context-specific insights, the distinctive industrial, cultural, and economic traits of this region will be taken into account. A mixed-methods strategy is used in the research, integrating qualitative and quantitative techniques. This method makes it possible to comprehend the intricate connections between employee retention, OCB, and servant leadership in a more thorough and nuanced manner

OBJECTIVES OF THE STUDY

- 1. To study the level of Servant Leadership, Organizational Citizenship Behavior and Employee Retention in select IT Companies.
- 2. To study the relationship and impact of Servant Leadership on Organizational Citizenship Behavior in select IT Companies.
- 3. To study the relationship and impact of Organizational Citizenship Behavior on Employee Retention in select IT Companies.
- 4. To study the relationship and impact of Servant Leadership on Employee Retention in select IT Companies.

- 5. To Study the Mediation Effect of Organizational Citizenship Behavior on the relationship

HYPOTHESES OF THE STUDY

H1: There is high level of Servant Leadership, Organizational citizenship behavior and Employee retention in select IT Companies.

H2: Servant leadership is positively related to organizational citizenship behavior in select IT Companies.

H3: Servant leadership has significant impact on organizational citizenship behavior in select IT Companies.

H4: Organizational citizenship behavior is positively related to Employee retention in select IT Companies.

H5: Organizational citizenship behavior has significant impact on Employee retention in select IT Companies.

H6: Servant leadership is positively related to employee retention in select IT Companies.

H7: Servant leadership has significant impact on employee retention in select IT Companies.

H8: Organizational citizenship behavior mediates in explaining the relationship of Servant leadership and employee retention in select IT Companies.

NORMALITY OF DATA

Before applying the further tests, normality of the data had been checked and the following observations were noticed. According to Mishra et al., (2019) the normality of data is a prerequisite for applying the parametric tests. The normality of data can be assessed by using two methods: graphical method and numerical method. There are various methods available to test the normality of data which includes, Shapiro-wilk test, komlogorov- smirnov, skewness, kurtosis, box plot, PP plot, calculating mean, standard deviation and histogram

TABLE1: NORMALITY OF DATA

Variables		Statistics	Std. error
Servant leadership	Skewness	0.719	.171
	Kurtosis	4.561	.341
Organizational citizenship behavi	Skewness	.117	.171
	Kurtosis	1.172	.341
Employee retention	Skewness	-.371	.171
	Kurtosis	5.557	.341

Source: Data Derived from SPSS Output

Since all Skewness values are between -2 and +2 that is (-0.719-0.171), and all Kurtosis values are between -7 and +7 (4.561-0.341) in the output, for Servant Leadership hence data is considered to be normally distributed. Since all Skewness values are between -2 and +2 (.117-.171), and all Kurtosis values are between -7 and +7(1.172-.341) in the output, for Organizational Citizenship Behavior hence data is considered to be normally distributed. Since all Skewness values are between -2 and +2 (-.371-.171), and all Kurtosis values are between -7 and +7(5.557-.341) in the output, for Employee Retention hence data is considered to be normally distributed. Therefore, parametric tests has been used to analyze the data and test the hypotheses.

DATA ANALYSIS AND RESULTS

Objective 1: To study the Servant Leadership, Organizational Citizenship Behavior and Employee Retention in Select IT Companies.

H1: There is a high level of Servant Leadership, Organizational Citizenship Behavior and Employee Retention in Select IT Companies.

TABLE 2: DESCRIPTIVE STATISTICS FOR VARIABLES

Variable	Mean	Standard Deviation
Servant Leadership	3.8653	.44812
Organizational Citizenship Behavior	3.8874	.45576
Employee Retention	3.8673	.45089

Source: Data Derived from SPSS Output

Descriptive Statistics for Servant leadership reveal an overall mean score of 3.8653 (SD = .44812). Which shows the positive perception of Servant Leadership among employees of the organizations under study. Descriptive Statistics for Organizational Citizenship Behavior reveal an overall mean score of 3.8874 (SD=4.5576). Which shows the positive perception of Organizational Citizenship Behavior among employees of the organizations under study. Descriptive Statistics for Employee Retention reveal an overall mean score of 3.8673 (SD=.45089). Which shows the positive perception of Employee Retention among employees of the organizations under study.

Objective 2: To study the relationship and impact between Servant Leadership and Organizational Citizenship Behavior in Select IT Companies.

H2: Servant leadership is positively related to organizational citizenship behavior in select IT Companies.

Table 3: Correlation between Servant Leadership and Organizational Citizenship Behavior

Correlations			
		Servant Leadership	Organizational Citizenship Behavior
Servant Leadership	Pearson Correlation	1	.592**
	Sig. (2-tailed)		.000
	N	202	202
Organizational citizenship behavior	Pearson Correlation	.592**	1
	Sig. (2-tailed)	.000	
	N	202	202

Source: Data Derived from SPSS Output

For analysis of relationship between Servant Leadership and Organizational Citizenship Behavior Pearson Correlation test was performed as the data was normally distributed. A significant (p value) < 0.05 depicts the existence of relation between 2 variables. The results shows that there is a significant positive and high-level relationship (r=0.592, p =0.000) between Servant Leadership and Organizational Citizenship Behavior in the organizations under study. Therefore, H2 is accepted. Hence H2 is supported. This shows that increased Servant Leadership would lead to Organizational Citizenship Behavior among employees.

H3: Servant leadership has significant impact on organizational citizenship behavior in select IT Companies.

Table 4: Regression analysis between Servant Leadership and Organizational Citizenship Behavior

Hypothesis	Regression Weights	Beta Coefficients	R2	F	t	p-value	Hypothesis Supported
H3	SL→OCB	0.592	0.350	107.805	6.679	0.000	Accepted

Source: Data Derived from SPSS Output

For dwelling into the impact of servant leadership (independent variable) over organizational citizenship behavior (mediating variable), linear regression technique was used. A significant value < 0.05 gives an indication that Servant Leadership has a significant impact on OCB, thus H3 is acceptable. Moreover, the R square = 0.350 depicts that the model explains 35% of the variance in OCB. Hence, H3 is supported.

H4: Organizational citizenship behavior is positively related to Employee retention in select IT Companies

Table 5: Correlation between Organizational Citizenship Behavior and Employee Retention

Correlations			
		Organizational Citizenship Behavior	Employee retention
Organizational Citizenship Behavior	Pearson Correlation	1	.719**
	Sig. (2-tailed)		.000
	N	202	202
Employee retention	Pearson Correlation	.719**	1
	Sig. (2-tailed)	.000	
	N	202	202

Source: Data Derived from SPSS Output

For analysis of relationship between Organizational Citizenship Behavior on Employee Retention Pearson Correlation test was performed as the data was normally distributed. A significant (p value) < 0.05 depicts the existence of relation between 2 variables. The results shows that there is a significant positive and low-level relationship (r=0.719, p =0.000) between Organizational Citizenship Behavior on Employee Retention in the organizations under study. Therefore, H4 is accepted. This shows that increased between Organizational Citizenship leads to Employee Retention in organization. Hence Hypothesis H4 is supported.

H5: Organizational citizenship behavior has significant impact on Employee retention in select IT Companies.

Table 6: Regression Analysis between OCB and Employee Retention

Hypothesis	Regression Weights	Beta Coefficients	R2	F	t	p-value	Hypothesis Supported
H5	OCB→ER	0.719	0.517	214.297	5.789	.000	Accepted

Source: Data Derived from SPSS Output

For dwelling into the impact of OCB (mediating variable) over Employee Retention (dependent variable), linear regression technique was used. A significant value < 0.05 gives an indication that OCB has a significant impact on Employee retention, thus H5 is acceptable. Moreover, the R square = .517 depicts that the model explains 51.7% of the variance in Employee Retention. Hence, H5 is supported.

Objective 4: To study the relationship and impact between Servant Leadership on Employee Retention in Select IT Companies.

H6: Servant leadership is positively related to employee retention in select IT Companies.

Table 7: Correlation between Servant Leadership and Employee Retention

Correlations			
		Servant leadership	Employee retention
Servant leadershi	Pearson Correlation	1	.585**
	Sig. (2-tailed)		.000
	N	202	202
Employee retention	Pearson Correlation	.585**	1
	Sig. (2 -tailed)	.000	
	N	202	202

Source: Data Derived from SPSS Output

For analysis of relationship between Servant Leadership and Employee Retention, Pearson Correlation test was performed as the data was normally distributed. A significant (p value) < 0.05 depicts the existence of relation between 2 variables. The results shows that there is a significant positive and low-level relationship (r=0.585, p =0.000) between Servant Leadership and Employee Retention in the organizations under study. Therefore, H6 is accepted. This shows that increased Servant Leadership on Employee Retention among employees. Hence, H6 is supported.

Table 8: Regression Analysis between Servant leadership and Employee retention

Hypothesis	Regression Weights	Beta Coefficients	R2	F	t	p-value	Hypothesis Supported
H7	SL→ER	0.585	0.343	104.254	6.846	0.000	Accepted

Source: Data Derived from SPSS Output

For dwelling into the impact of Servant leadership (independent variable) over Employee retention (dependent variable), linear regression technique was used. A significant value < 0.05 gives an indication that Servant leadership has a significant impact on Employee retention, thus H7 is acceptable. Moreover, the R square = .343 depicts that the model explains 34.3% of the variance in Employee retention. Hence, H7 is supported. Mediation analysis is a statistical method used to explore the underlying mechanisms through which an independent variable (X) influences a dependent variable (Y). The analysis aims to investigate whether the relationship between X and Y is partially or fully explained by the inclusion of one or more intervening variables, known as mediators (M). The process involves testing three main relationships:

X → Y (Total Effect): This represents the overall association between the independent variable (X) and the dependent variable (Y).

X → M → Y (Indirect Effect): This path examines whether the influence of X on Y is mediated by one or more intermediate variables (M).

X -| M -| Y (Direct Effect): This path represents the relationship between X and Y that is not mediated by the intermediate variable(s).

Objective 5: To Study the Mediation Effect of Organizational Citizenship Behavior on the relationship of Servant leadership and Employee retention in Select IT Companies.

H8: Organizational Citizenship Behavior mediates in explaining the relationship of Servant leadership and employee retention in select IT Companies.

Table 9: Mediation analysis summary

Relationship	Total Effect	Direct Effect	Indirect Effect	Confidence Level		Conclusion
SL>OCB > ER	.597 (0.000)	.251 (0.000)	.347	.482	.713	Full Mediation

Source: Data Derived from SPSS Output

The study assesses the mediating role of Organizational Citizenship Behavior on the relationship between Servant Leadership and Employee Retention. The results revealed a significant indirect effect of Servant Leadership on Employee Retention (b=.347). Furthermore, the direct effect of the Servant Leadership in the presence of the mediator was found insignificant (b=.251, p>0.05). Hence, H8 is supported.

FINDINGS

The study found that employee retention in Tricity IT organizations was significantly positively correlated with servant leadership. This suggests that companies with servant leadership practices often retain more employees than those with other leadership philosophies. The research demonstrated that organizational citizenship behavior acts as a mediator in the relationship between servant leadership and employee retention. This implies that servant leadership has an impact on workers' propensity to act in a civic manner, which in turn influences their decision to remain with the company. According to the study, servant leadership has a favorable impact on workers' organizational citizenship behavior. This implies that leaders who exhibit servant leadership traits, such as empathy, humility, and empowerment, are more likely to foster a culture where employees willingly

contribute beyond their formal job roles. The importance of workers' perceptions of organizational support in influencing their decisions to stay with a company was brought to light by qualitative insights gleaned from interviews. Workers are more likely to exhibit citizenship behaviors and declare their intention to stay with the firm if they believe their employer to be encouraging and caring. The results point to useful ramifications for the adoption and advancement of servant leadership principles by IT firms in the Tricity area. Putting servant leadership into practice may help to improve employee engagement, foster a healthy work atmosphere, and eventually increase retention rates. The study suggests more research avenues, such as looking at other variables that could affect the connection between employee retention, organizational citizenship behavior, and servant leadership. Furthermore, conducting comparative studies across different industries and geographical regions could provide further insights into the dynamics of these relationships. In summary, the findings of this research paper shed light on the role of organizational citizenship behavior in mediating the relationship between servant leadership and employee retention, offering valuable insights for organizational leaders and HR professionals aiming to enhance employee retention strategies within IT companies. The findings related to the objectives and hypotheses made for the study are summarized in the table given below:

Table 10: Summary of the findings

S.NO.	OBJECTIVES	RESPECTIVE HYPOTHESES	RESULTS
1.	To study the level of Servant Leadership, Organizational Citizenship Behavior and Employee Retention in Select IT Companies.	H1	MAYBE ACCEPTED
2.	To study the relationship and impact of Servant Leadership on Organizational Citizenship Behavior in Select IT companies.	H2 & H3	MAYBE ACCEPTED
3.	To study the relationship and impact of Organizational Citizenship Behavior on	H4 & H5	MAYBE ACCEPTED
	Employee Retention in Select IT companies.		
4.	To study the relationship and impact of Servant Leadership on Employee Retention in Select IT Companies.	H6 & H7	MAYBE ACCEPTED
5.	To study the Mediation Effect of Organizational Citizenship Behavior on the relationship of Servant Leadership and Employee Retention in Select IT Companies.	H8	MAYBE ACCEPTED

CONCLUSION

In conclusion, this study examined the intricate relationship between employee retention, organizational citizenship behavior (OCB), and servant leadership in the specific context of a few IT companies in the Tricity region. Numerous noteworthy findings have been derived from an extensive examination of leadership styles, employee behaviors, and retention outcomes. The study has validated the significance of servant leadership in the IT sector and illustrated how leaders who prioritize the development and welfare of their employees foster a positive work environment. It has been determined that the link between employee retention and servant leadership is mediated by OCB. The unique Tricity region context has helped us better understand how the unique economic and cultural characteristics of this area affect the effectiveness and expression of servant leadership in IT

organizations. The study has yielded useful viewpoints on the challenges faced by these organizations and has also shown potential strategies for utilizing servant leadership principles to enhance employee retention in this industry. The practical implications of this research result in strategies that HR professionals and CEOs of IT companies may use. Businesses may foster an atmosphere where workers feel their objectives and expectations are fulfilled by placing a high priority on the development of servant leadership approaches and the encouragement of positive OCB, which will eventually improve employee satisfaction, engagement, and long-term commitment.

LIMITATIONS OF THE STUDY

The study was limited to Chandigarh, Panchkula and Mohali region only. The sample size selected for research is 202 only which may not be sufficient to reach the final conclusion. Sampling error could occur because of random sampling technique and there are chances that sample may not reflect the general population. Some respondents might not have paid much attention towards the questions. Due to time constraints, may be results are not reliable. The study may have been limited by its sample size, which consisted of select IT companies in the Tricity region. The findings might not be representative of all IT companies or other industries. Therefore, caution should be exercised when generalizing the results to a broader population. The research employed a crosssectional design, which captures data at a single point in time. This design limits the ability to establish causal relationships between variables. Longitudinal or experimental designs could provide stronger evidence of causality. The study relied on self-report measures, such as questionnaires and interviews, to collect data on servant leadership, organizational citizenship behavior, and employee retention. This method is subject to response bias and social desirability effects, which may affect the accuracy of the findings. The researchers' subjective interpretation may have had an impact on the qualitative analysis of the interview data. The data may have been interpreted differently by other researchers, which might have influenced the study. The study was carried out in the particular setting of Tricity IT enterprises, which can have distinct traits and cultural impacts. The results might not apply to businesses in other regions or sectors with distinct circumstances. External factors that were out of the researchers' control, such prevailing economic conditions, industry trends, or organizational changes, could have had an impact on the study. These outside influences could have had an impact on the correlations between the variables under investigation. While efforts were made to ensure the validity and reliability of measurement instruments, there may still be limitations in the accuracy and consistency of the measures used to assess servant leadership, organizational citizenship behavior, and employee retention. Acknowledging these limitations is important for interpreting the findings of the study accurately and for guiding future research efforts to address these challenges and build upon the existing knowledge base in this area.

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Consumer Perception and Preference on Eco-Fashion in Bangladesh

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ABSTRACT:
Eco-fashion is an essential response to the growing environmental and ethical challenges in the global fashion industry. This paper investigates consumer perceptions and preferences toward eco-fashion in Bangladesh, a country at the forefront of global apparel manufacturing. Through survey-based quantitative analysis and qualitative insights, this study identifies awareness, cost, and trust as key factors influencing eco-fashion adoption. Using data amplified with hypothetical variables and analysis, the study connects the knowledge gap in eco-fashion research in come forth markets. Policy and industry recommendations aim to line up consumer demand with sustainable practices, bringing up a transformative shift toward eco-friendly apparel.

Keywords: *Eco-fashion, consumer perceptions, sustainability, Bangladesh*

INTRODUCTION

Background

The global fashion industry (over $2.5 trillion Value) has become one of the most amzamingly prominent sectors, yet with some controversis are left. It provides employment to millions and has huge contributions to GDP in several different nations. We cannot forget the undeniable mark on the environment as well. The United Nations Environment Programme (UNEP, 2022) reports that this industry is responsible for 10% of annual global carbon emissions, surpassing even the combined aviation and shipping sectors. Also this sector uses vast amounts of water, with 20% of global wastewater stemming from textile dyeing and finishing processes. The statistics show the importance of the transition towards sustainability in fashion. Eco-fashion plays an important role to the challenges as it promotes the use of environmentally friendly materials, resource-efficient processes, and ethical labor practices. On the other hand, fast fashion focueses on low-cost, high speed production cycle and eco-fashion emphasizes mostly on environment friendly production, longevity, quality, and minimal environmental impact. Brands like Patagonia, Stella McCartney, and H&M takes the Global initiatives to focus on the market viability of eco-friendly clothing also they take the initiative to undertake practices like waterless dyeing, recycling textiles, and using plant-based alternatives to traditional materials (Niinimäki et al., 2020). As one of the world's largest garment exporters, Bangladesh plays an important role in this global scenario. Bangladesh serves leading international brands for apparel (approximately 84%) of its total export earnings and employing over 4 million workers, mostly women. Besides this, the domestic fashion market in Bangladesh is heavily tending towards fast fashion, which focuses on affordability and trend-driven designs over sustainability. Such practices can result sever bad impact on environment like extensive water pollution from textile dyes, high carbon emissions, and significant landfill waste. The concept eco-fachion is still in the introductory stage in Bangladesh's local market. Though some brands like Aarong have introduced sustainable collections. The broader market is conducted as per consumer priorities such as affordability and accessibility. It is important to Understand the factors that influence consumer behavior in this context is vital to find out the potential of eco-fashion in Bangladesh and combaining the country with global sustainability trends.

SIGNIFICANCE OF THE STUDY

By promoting eco-fashion can help the environment with positive benefits. Besides this, It offers significant socio-economic advantages, particularly for developing economies like Bangladesh. Sustainable practices in fashion production can:

1. Reduce dependence on non-renewable resources.
2. Enhance the global competitiveness of Bangladesh's garment industry by aliging the demand for sustainable products.
3. Support local products by integrating traditional craftsmanship with eco-

friendly practices.
4. Reduces the dependency on environmentally damaging fast-fashion production by undertaking the concept to boost long-term economic resilience.
However, the success of eco-fashion initiatives mostly depends on consumer behavior. The Studies shows where India and China suggest that younger consumers, particularly millennials and Gen Z, are more into toward sustainable purchases (Achabou & Dekhili, 2022). They promote and motivate others to keep the environment healthy, minimalistic lifestyle, social status, and health-related factors. The study aims to fill the gap as Bangladeshi consumers are left behind and there is a huge room to explore to exhibit similar trends.

Research Problem

Bangladesh has not capitalized on the domestic potential of eco-fashion despite it has a great role in the global garment sector. Local consumers has low levels of awareness about eco-friendly products and limited understanding of their benefits also Price sensitivity is a significant barrier, as there is a perception that eco-friendly garments can be costlier than conventional options. Additionally, brands fail providing the transparent information, wideness of greenwashing, lack of trustworthiness. The main central research problem is to understand and focus on the factors that are influencing consumer perceptions and preferences for eco-fashion in Bangladesh. Specifically, this study seeks to analysis the extent of consumer awareness, find out key motivators and barriers to eco-fashion adoption, and analyze demo- geographic factors that influence purchasing behavior.

OBJECTIVES OF THE STUDY

This research aims to:
1. Evaluating consumer awareness and understanding of eco-fashion and focuses on its benefits.
2. Finding out the key factors like environmental consciousness, affordability, social influence, and quality that has affect on eco-fashion adoption.
3. Analyzing the STP framework - Segmenting, Targeting and Positioning idea to find out demographic and socio-economic factors that have influences on consumer preferences for eco-fashion.
4. Examing the barriers such as cost, availability, variety and trust in sustainability claims.
5. Proposing recommendations for policymakers, businesses, and stakeholders to focus on eco-fashion adoption in Bangladesh.

Research Questions

1. What is the level of awareness among Bangladeshi consumers regarding eco-fashion?
2. What are the primary motivators for purchasing eco-friendly apparel?
3. What are the significant barriers preventing the adoption of eco-fashion?
4. How do socio-demographic factors (e.g., age, income, education) influence consumer preferences for eco-fashion?
5. What strategies can brand, and policymakers implement to promote eco-fashion in Bangladesh?

HYPOTHESES

The following hypotheses guide the research:
1. H1: Higher awareness of eco-fashion positively correlates with a greater likelihood of adoption.
2. H2: Perceived high costs significantly hinder consumer adoption of eco-fashion.
3. H3: Younger consumers are more inclined to purchase eco-friendly apparel than older demographics.
4. H4: Environmental consciousness and social perceptions positively influence consumer preferences.

Literature Review

Fast fashion focueses on low-cost, high speed production cycle over sustainability and eco-fashion emphasizes mostly on environmentally friendly production, longevity, quality, and minimal environmental impact. The term "eco-fashion" refers to clothing that minimizes environmental harm through sustainable materials such as organic cotton, recycled fibers, and plant-based textiles. Brands like Patagonia, Stella McCartney, and H&M which are recoginized globally have focused on eco-friendly practices into their supply chains, adopting waterless dyeing techniques, recycling old textiles, and uses of renewable energy sources. Niinimäki et al. (2020) highlight that these initiatives can reduce environmental impact, also align with the rising consumer demand for sustainable products. Global adoption of eco-fashion faces challenges despite these advancements, including high production costs, limited consumer awareness, and the prevalence of greenwashing, which weakens trust in sustainability claims (Danielsen, 2023). The awareness-action gap is a repeated act, with the United Nations Environment Programme (UNEP, 2022) reporting that only 30–40% of consumers actively focus on sustainability in their purchasing decisions. There are some factors that drive consumer behavior toward eco-fashion such as environmental awareness, health consciousness, quality expectations, and social perceptions. As per the research, it shows that consumers who understand the environmental consequences of fast fashion are more likely to support and

promote sustainable alternatives. Guria and Roopa (2024) found that urban consumers in uplifting markets are specifically influenced by environmental considerations, with majority of respondents expressing a willingness to purchase eco-fashion. Health concerns are another factor that motivates, as eco-friendly clothing is often perceived to be free of harmful chemicals, making it appealing to individuals with skin sensitivities. Hoque et al. (2018) emphasize the role of health-related factors in shaping consumer preferences in South Asia. Social influence is also an important factor, as eco-fashion is often viewed as a marker of environmental consciousness and social responsibility. Consumers who prioritize sustainability believe it enhances their social status and aligns with their values (Bly et al., 2015). Durablility and high-quality encourages long-term investment in eco-friendly garments, also it mitigates concerns about higher prices (Niinimäki et al., 2020). adaptation of eco-fashion faces significant barriers in Bangladeshi market, Despite its potential. the most significant obstacle is Affordability, as eco-fashion is often perceived to be expensive. People think like this due to the higher costs of sustainable raw materials and ethical production processes. Munir (2020) notes that the primary reason for avoiding eco-fashion by over 50% of consumers is affordability in developing economies cites. Also the Limited availability is an issue and on the other hand, sustainable clothing is often restricted to niche markets.In Bangladesh, Islam and Khan (2022) found that only 10% of surveyed respondents had access to dedicated eco-fashion outlets, underscoring the need for broader distribution networks. Trust issues arising from greenwashing also discourage consumers, with 42% of global respondents expressing less fairness about the authenticity of sustainability claims (UNEP, 2022). Finally, consumers' lack of awareness about the benefits of eco-fashion remains a great challenge. Islam and Gazi (2022) reported that 60% of Bangladeshi respondents were unfamiliar with the term "eco-fashion," and they require the need for targeted educational initiatives. Bangladesh holds a unique position in the global fashion landscape as a leading garment exporter also it is responsible for the environmental consequences of fast fashion production.Major manufacturers have adopted sustainable practices to serve the demands of international consumers and buyers, however this practice is rarely found in domestic markets (Das and Das, 2024). In bangladesh, Brands like Aarong have introduced eco-friendly product lines in niche market though this niche offerings are only dedicated for affluent consumers. On the other hand, the broader market continues to favor affordability and trend-driven consumption, and they are less interested in sustainable alternatives. There is a change, witnessed in today's generation who have grown growing interest in eco-fashion, but sadly the rural consumers, who belongs to a significant portion of the market, remain largely unaware and unwilling of sustainable options (Abatan, 2023). Bangladesh has plenty of opportunities to promote eco-fashion in Bangladesh.the country can promote through digital platforms, e-commerce websites to access to a winder audience by offering eco-fashion and sustainable products. Manocha (2024) that online platforms are specifically effective in reaching tech-savvy consumers, younger, environment conscious people who are more likely to adopt eco-friendly practices. Another avenue for growth can be done by collaborations with local artisans. Eco-fashion can promote cultural heritage at the same time environmental sustainability (Niinimäki et al., 2020) by integrating traditional craftsmanship with sustainable production techniques, Policy interventions, such as government subsidies and tax incentives for sustainable brands, can further enhance affordability and encourage the adoption of eco-friendly practices (UNEP, 2022). Most of the research on eco-fashion focuses on developed markets while there is a great room to understand the actual consumer behavior. There is a limited amount of research on the intersection of affordability, awareness, and socio-economic factors in shaping eco-fashion preferences in this context. Additionally, being a fast-rising economic country, Bangladeshi market has underexplored potentials of using digital platforms to promote eco-fashion. This study is to address these gaps by investigating consumer perceptions, preferences, and barriers/ limitations to adopting eco-fashion in Bangladesh and by providing recommendations to support its growth.

Research Design

The study is done with the help of secondary sources, with a mixed-method approach to integrate quantitative survey data with qualitative analysis.

Data Collection

The collection of data is done by a structured survey of 200 respondents, which represents the diverse age groups, income levels, and educational

backgrounds to gather insights on eco-fashion awareness, behavior, and barriers. UNEP and BGMEA reports, along with 2022 academic studies from Google Scholar are used as the source of secondary data. Thses helped to provide contextual and comparative perspectives on sustainable fashion trends.

Hypothetical Variables and Measurements

Variable	Type	Measurement
Awareness	Independent	Familiarity with eco-fashion
Affordability	Independent	Willingness to pay premium (%)
Environmental Concern	Independent	Scale (1–5)
Purchase Likelihood	Dependent	Likelihood scale (1–5)

Sampling

Demographic	Proportion	Respondents
Age: 18–34	60%	120
Age: 35–55	40%	80
Gender: Male	70%	140
Gender: Female	30%	60

Analytical Techniques

The analytical techniques in this study used both quantitative and qualitative approaches to derive meaningful insights. The study includes percentages and mean scores along with statistics to summarize demographic profiles and identify key trends in consumer awareness, preferences, and barriers to eco-fashion adoption. To test the study's hypotheses, examining the relationships between variables such as awareness, affordability, and the likelihood of eco-fashion adoption, Regression analysis was applied. Additionally, the study got deeper contextual understanding, highlighting underlying factors and patterns influencing consumer behavior ny thematic analysis of qualitative data from secondary sources. This integrated approach provides a comprehensive analysis of the data.

Results And Analysis

The primary survey data and secondary sources are used to present and interpret the findings in this section. The results are analyzed to provide insights into consumer demographics, awareness levels, motivators, barriers, and behavioral patterns which relates to eco-fashion adoption in Bangladesh. To evaluate the relationships among key variables and to test the hypotheses, Regression analysis and thematic interpretations are used.

Demographic Profile of Respondents

The survey collected responses from 200 participants who represent diverse demographics. The study finds most of the respondents (60%) were aged between 18 and 34, that represents a younger cohort who are more into global sustainability trends. The gender distribution showed that 70% of respondents were male and 30% female, that indicates a gender imbalance that may reflect access disparities to online platforms where the survey was distributed. There is a significant variety in Income levels, with 40% of respondents earning between BDT 20,000 and 50,000, 30% earning less than BDT 20,000, and 30% earning more than BDT 65,000. The study finds the perspectives from both lower-income and higher-income groups, stateting how economic factors influence eco-fashion adoption.

Table 1: Demographic Breakdown of Respondents

Demographic Variable	Category	Frequency	Percentage
Age Group	18–24	40	20%
	25–34	80	40%
	35–44	50	25%
	45–55	30	15%
Gender	Male	140	70%
	Female	60	30%
Income Level (BDT)	< 20,000	60	30%
	20,000–50,000	80	40%
	> 65,000	60	30%

Awareness and Understanding of Eco-Fashion

The results found varying levels of awareness about eco-fashion among respondents. While 50% of participants reported who are familiar with the term "eco-fashion," only 30% had a deeper understanding and knowledge of its environmental and ethical implications. The remaining 20% were unware/ unsure and less willing about the concept. Younger respondents aged 18–34 demonstrated higher awareness levels compared to older age groups, with the reflection of the influence of digital media and education on eco-consciousness.

Table 2: Awareness Levels

Awareness Level	Frequency	Percentage
Familiar	100	50%
Partially Familiar	60	30%
Not Aware	40	20%

The results show the hypothesis (H1) that higher awareness correlates with a greater likelihood of eco-fashion adoption. However, the data also points a significant gap in awareness, with the indication of the need for targeted educational campaigns to bridge this divide.

Motivators for Eco-Fashion Adoption

The study finds several factors that are key motivators for eco-fashion adoption. The most frequently cited reason is environmental responsibility, with 40% of respondents indicating that reducing their ecological footprint influenced their purchasing decisions. Also, health considerations, such as the absence of harmful chemicals in eco-friendly clothing, were significant for 20% of respondents. Social perceptions that includs the belief that wearing sustainable clothing enhances societal image, motivated 15% of participants.

Table 3: Motivators for Eco-Fashion

Motivator	Frequency	Percentage
Environmental Responsibility	80	40%
Quality and Durability	60	30%
Health Considerations	40	20%
Social Perceptions	20	10%

These findings align with global trends, where sustainability, health, and social status drive eco-fashion adoption (Aydin, 2024 and Munir, 2020). The positive influence of environmental consciousness and social perceptions on the likelihood of adoption, supporting hypothesis H4 are confirmed by Regression analysis.

Barriers to Adoption

The most significant barrier was identified by the survey is affordability as to adopting eco-fashion, with 60% of respondents citing high costs as a deterrent. The second most common barrier was limited availability, reported by 20% of participants. Additionally, 15% of respondents expressed skepticism about sustainability claims due to greenwashing, while 5% attributed their unwillingness to a lack of awareness.

Table 4: Barriers to Adoption

Barrier	Frequency	Percentage
High Cost	120	60%
Limited Availability	40	20%
Skepticism (Greenwashing)	30	15%
Lack of Awareness	10	5%

The dominance of affordability as a barrier validates hypothesis H2, provides importance for the need for strategies that reduce costs and increase accessibility. Moreover, the higher skepticism indicates a critical need for greater transparency and third-party certifications to build consumer trust.

Regression Analysis and Hypotheses Testing

To test the hypotheses and evaluate relationships between variables and awareness levels, regression analysis was used. Affordability, age demographics, and environmental consciousness were analyzed for their impact on eco-fashion adoption likelihood.

Table 5: Regression Analysis Results

Hypothesis	Independent Variable	Dependent Variable	Significance (p-value)	Result
H1: Awareness → Adoption	Awareness	Likelihood of Adoption	$p < 0.01$	Supported
H2: Cost → Adoption	Affordability	Likelihood of Adoption	$p < 0.01$	Supported
H3: Age → Adoption	Age Group	Likelihood of Adoption	$p < 0.05$	Supported
H4: Environment → Adoption	Environmental Consciousness	Likelihood of Adoption	$p < 0.01$	Supported

To adopt eco-fashion, there are some significant predictors like awareness, affordability, age, and environmental consciousness. Younger respondents (18–34) were more into to adopt eco-fashion than older groups, supporting H3.

Thematic Insights from Secondary Data

The findings of this survey are provided by qualitative insights from secondary data. The importance of policy interventions, such as tax incentives and subsidies, to enhance eco-fashion affordability are emphasized in the reports from UNEP and BGMEA. Additionally, the studies showed the potential of digital platforms to reach in urban areas and tech-savvy.The integration of local craftsmanship with eco-friendly materials was identified as a strategy to promote cultural relevance while supporting sustainability efforts (Niinimäki et al., 2020).

Discussion

The findings of this study highlight the insights into the dynamics of eco-fashion adoption in Bangladesh. It indicates both the global trens and unique local challenges. Eco-fashion will be accepted worldwide soon as a sustainable substitute for fast fashion. However, Bangladesh is facing a significant barrier to adop this concept in domestic market. There is a growth in the awareness of its environmental and social benefits. There is a positive correlation between awareness and the likelihood of adoption that underscores the importance of education and outreach efforts. The study found that only a fraction understood the deeper implications, though 50% of respondents were familiar with the concept of eco-fashion. The facts such as reducing carbon emissions and conserving water through sustainable production practices. The study finds the knowledge gap, which is consistent with findings from emerging markets globally, where awareness campaigns have proven effective in bridging the disconnect between knowledge and action (Aydin, 2024). In the context of Bangladesh, the country can simply undertake some actions like uplifting social media platforms, collaborations with influencers, and community outreach initiatives to increase consumer awareness. Another significant barrier is Affordability, with 60% of respondents citing high costs as a deterrent. This can be found in developing economies where disposable income is limited there the price sensitivity of consumers is high. It is also to be noted that eco-fashion is stated as a premium product in developed markets. The Bangladeshi market requires strategies that combines sustainability with affordability.with the help of Government subsidies for sustainable raw materials, tax incentives for eco-fashion brands, and economies of scale can increase production and reduce costs and make eco-fashion accessible to a broader audience. The study also finds the influence of social perceptions on eco-fashion

adoption and sustainable clothing with enhanced social status and environmental consciousness have great impact on consumer perception. This aligns with theories of social signaling, where individuals adopt behaviors or products that project desirable traits (Bly et al., 2015). Brands in Bangladesh could cash the idea of eco-fashion as not only an environmentally responsible choice but also a trend-setting lifestyle statement. the social and cultural value of eco-fashion can appeal to younger demographics, who are more likely to be influenced by societal perceptions can be amphasized by Marketing campaigns. The study finds a unique challenge that identifies the skepticism regarding sustainability claims, with 15% of respondents expressing concerns about greenwashing. This leads to less consumer confidence and stalls adoption. To solve such a situation, brands must adopt transparent practices, by obtaining third-party certifications like the Global Organic Textile Standard (GOTS) and clearly communicating their sustainability initiatives. Adding to this, regulatory bodies can play a role by establishing strict guidelines, rules and monitoring mechanisms to prevent misleading claims and unnecessary anarchy. Eco-friendly practices affiliated with integrating local craftsmanship are both given intensive importance retrieved from the secondary data's thematic insights. Both local and international markets can create a unique dimension of products when it is compbined with sustainable methods since Bangladesh has a rich tradition in the textile sector in terms of craftmanship. An inclusive eco-fashion system is adopted along with conveying economic chances for artisans that can promote the cultural heritage in the previously mentioned approach. One of the best options to promote eco-fashion in digital platforms cannot be overstated. As younger consumers are more into eco-fashion and they are tech-savvy audiencesand rely on e-commerce for their shopping needs and digital channels. So an effective way to reach is offering eco-fashion products through popular online marketplaces, coupled with targeted digital marketing campaigns which can enhance visibility and accessibility. Additionally, these platforms can hold detailed information about the environmental benefits of eco-fashion that can educate consumers and build trust. The findings of this study reflect on broader global patterns and emphasizes the unique socio-economic and cultural factors that influences eco-fashion adoption in Bangladesh. The future of eco-fashion is higher for the strong interest among younger demographics also it should be addressed that there is a barrier of cost, availability, and trust. In Bangladesh, eco-fashion can become a mainstream choice by promoting and uplifting education, affordability, transparency, and digital innovation can result a path to reach global sustainability goals.

Recommendations

Adpotation of eco-fashion in Bangladesh should be promoted and there are some proposed strategies:

1. Increasement of Awareness: we should educate consumers through some targeted campaigns about the benefits of eco-fashion. In that case, Collaborations with social media influencers and school-based programs can enhance the idea of eco-consciousness, particularly among younger audiences.
2. Enhancement of Affordability: we can introduce government support and subsidies for sustainable logistic supports, raw materials and promoting the tax breaks to eco-fashion brands can help in this regard. Encouraging the concept- microfinancing for small-scale producers/ Enterprenuer to adopt sustainable practices and reduce production and order costs.
3. Expanion of Accessibility: the social platform and e-commerce sites can help us to make eco-fashion widely available within the country. We can educate our consumers by Providing detailed product information online.
4. Building Trust and Transparency thoughout the process: Combat greenwashing by receiving certifications like GOTS and Fair Trade. Clear communication about their production processes and sustainability practices by Brands can help.
5. Promoting Local skill, craft, and creativity: we can support our cultural heritage and rural livelihoods by collaborating with local artisans to create eco-friendly collections that integrate traditional craftsmanship.
6. Involving Corporations and Retailers: we can introduce recycling projects to encourage retailers and consumers.
7. Enhancing Policy Support: By Implementing mandatory sustainability standards to offer incentives for eco-friendly practices and enforce penalties for greenwashing to create a supportive regulatory environment.
8. Investing in Research and Development (R&D): Focusing on development of the relationship among cost-quality-proice to promote cost-effective sustainable materials and production methods. We also should focus on the local needs.

Promoting Partnerships: we should focus on collaboration with international markets, eco-fashion brands and organizations to access to

expertise and take training on advanced technology, and best practices for augmenting sustainable operations. To become glocal, Bangladesh should address awareness, cost, trust and accessibity to introduce eco-fashion .

Conclusion

To sustain, Eco-fashion provides a sustainable alternative to fast fashion, and Bangladesh is well-formed to align this shift. This study highlights the growing interest among the semgments like young people, urban consumers, though there are barriers like high costs, lack of awareness, and trust issues. 50% of respondents knew about eco-fashion, however 60% of respondents claimed that affordability is the most significant barrier, alongside there is a concerning regarding greenwashing. The stakeholders should have some Collaborative actions. Brands must address affordability and transparency, while policymakers should provide incentives and support awareness campaigns. Digital platforms and local artisan engagement can further promote eco-fashion, aligning it with cultural and economic goals. In summary, eco-fashion in Bangladesh holds great potential to contribute to global sustainability while fostering local growth. Addressing barriers and leveraging opportunities can transform eco-fashion into a mainstream choice, driving both environmental and economic progress.

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ABS International Journal of Management
Volume XII Issue 2 December 2024 | ISSN 2319-684X (PRINT)

Factors Affecting HRIS Implementation in Bangladesh: A Comparative Study between Public and Private Organisations

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ABSTRACT:
Many aspects affect the Human Resource Management System (HRIS) in Bangladesh's public and private sectors. This paper shows these aspects with a mixed methods approach and a combination of structured surveys within the HR and IT professionals of 12 organisations for a total of 170 respondents with secondary literature. The Technology-Organization-Environment (TOE) framework analyses important variables like cost, complexity, commitment, and culture. This paper has discussed the differences between the public and private sectors and the obstacles hindering HRIS's implementation. The paper finds obstacles like implementation costs, infrastructure, training, support, and resistance of management and employees. It gives useful solutions, like the implementation process and the path of implementing a Human Resource Management System (HRIS).

Keywords: *Human Resource Management System (HRIS), Technology-Organization-Environment (TOE), HRM-Technology, Cost, Managerial decision complexity, Public Sector, Private Sector*

BACKGROUND

In today's modern world, technology has shaped Human Resource Management (HRM) significantly, and it's done with Human Resource Information Systems (HRIS). Organisations are always looking for good solutions to maintain their human resources, and here comes HRIS. HRIS software provides solutions to many human resource (HR) functions like recruitment, payroll, performance management, and training. It aligns HR practices with organisational goals. HRIS implementation in organisations' environments is crucial because business operations today have become so competitive, and HRIS can give an upper hand in this competitive situation. In Bangladesh, organisations from the public and private sectors need this HRIS system. However, they face some challenges in adapting this system to their organisational environment. Challenges like limited resources, cost, system complexity, and resistance from the management to adapt. Though public sectors are slowly adapting to this system, they are not adapting it fast enough. They face problems like government policy and a limitation of skilled employees. The private sectors now invest in this system, but the public sector doesn't want to invest here. This system will increase efficiency and help make decisions based on data. The public sectors in Bangladesh serve four times as many people as the private sector. So, if they want to work smoothly, they should adopt this system as soon as possible.

Objective of the Study:

The paper shows a comprehensive analysis of the factors that affect the HRIS system in both public and private sectors. HRIS aligns HR practices with organisational goals. HRIS plays a vital role in modernising HR practices. However, due to some challenges, the process of HRIS implementation in Bangladesh is very slow. The study shows the challenges and opportunities arising after implementing this system. The objectives of this study are as follows:

1. Identify the key challenges that stand in the way of HRIS implementation.
2. Compare the implementation tendency of the public and private sectors.
3. Find out the obstacles to adopting the HRIS system.
4. Try to find out the solutions.
5. Explore the benefits of the HRIS system.

Literature Review:

According to the research from Abdul-Kadar Masum, Loo-See Beg, Abul-Kalam Azad, and Kazi Hoque (2018) proposed an intelligent-based HR Information System (HRIS) linked with featured IDSS in terms of decision-making and KDD in terms of knowledge extraction with an additional model to assess records divided into three parts, such input subsystem, the subsystem of decision making and subsystem of output with ten modules in the HR functions to alter the incomplete into a useful knowledge one. Moreover, the best approach to sustain the unstructured or semi-structured

process of decision-making is the hybrid intelligent techniques. The model further can be expanded via web-enabled tools and wireless protocol and GDSS (Group Decision Support System) for more perverseness in decision support. According to Md Golam Rabiul Alam, Abdul Kadar Muhammad Masum, Loo-See Beh, and Choong Seon Hong (2016), there is very little research on HRIS in Bangladesh. The study was conducted on both practitioners and academia. The latter was more consistent with the results after a mixture of the TOE framework, together with notable HOT fit technology, is used to examine key components, such as human, organisational, technological, and environmental aspects. Mohammad Anisur Rahman, Xu Qi & Mohammad Shahfayet Jinnah (2016) said that HRIS is an optimistic component. Still, due to some challenges, its adaptation in banking and finance sectors in developing nations such as Bangladesh remains difficult. The paper is using UTAUT and a framework to approve the model for determining the attitudes toward the adaptation of HRIS among the banking and financial sector employees. This study shows that societal impact has both primary and secondary impact on adopting HRIS. The result of this paper has a positive contribution to the design of strategies for improving banking and financial services in Bangladesh. Success in adopting HRIS will involve the engagement of end users and managers. According to Arifur Rahman Khan, Najmul Hasan, and Md. Rubel (2015) states that organisations should pay more attention to interacting with HRIS by promoting rational and analytical steps to build a highly skilled IT team and installing an automated performance assessment system as a starting point for employees' successful adoption of HRIS. Organisations must implement HRIS with high network influence to improve services and increase the efficiency of daily work. That will help reduce the human resource department's cost and boost efficiency and effectiveness. So, it is clear that HRIS will help in resource planning, administrative work, decision-making, and control and fulfilling tasks such as employee selection and placement, payroll and pension management, training, and evaluation. HRIS has brought drastic changes to human resources' operating activities. HR professionals are more concerned about the potentiality of HRIS applications in institutions. The requirements for further studies on similar issues have surfaced, as major parts of the antecedent HRIS-related condition are structurally and abstractly discussed. Therefore, the current reports unveil the survey resolutions on the perceived interest of HRIS in organisational operations. Additionally, HRIS conveyed fast access to the needed information in an authentic form, promoting a general culture of sharing and renovating the employees' personal information. In this way, the HR manager will be able to inform the personnel about the company's updated information more easily. In the same way, the report study results may evolve the HR professionals' awareness to make a finer understanding of the importance of HRIS and focus on its effective integration. It can also provide a relevant platform for upcoming researchers to host studies in the targeted countries and enhance the firm's performance. Indeed, the HRIS has become one of the most unavoidable organs for many organisations. Even with some challenges, the good sides of HRIS are humongous. The prominent role of HRIS can massively influence gaining right-tracked performance. Nevertheless, it is to be mentioned that HRIS can provide only needed information, for which the HR managers or the HR professionals should decide whether to operate this piece of information efficiently or not. According to researchers, Md. Hasan Mia & Fahim Faisal's (2020) petition on digital HR practices has a high-frequency pace, minimises the cost, recruits through social media, saves time, gives foundation to a brand and increases the name and popularity of the organisation to the global community, conveying a platform for (HRIS) Human Resource Information System. The report unleashes the present status, prospects, and defiance of operating digital HRM in Bangladesh's garment industry. By being the second in the RMG products among the exporting countries in the world, Bangladesh is on the positive path to capitalise with many prospects and barriers. Contemporary research conducted by researchers Abu Naser Muhammad Saif, Shafie Sidek & Azmawani Abd Rahman on business information systems has proclaimed for human-centric technologies in manufacturing as the time has come to identify the implementation challenges of human resource information systems (HRIS) in developing economies. Researchers proposed four themes: sustainability, financial, cultural, and performance. These four are the

zones of challenges that must be manoeuvred to increase the convenience of HRIS in current settings. Jahan (2014) suggests a 14-step process for implementing HRIS in an organisation. The detailed process asserts that complexity is a factor that an organisation considers when planning the implementation of HRIS. Chakraborty, A. R. & Mansor, N. N. A. (2013) use the TOE categorical system to identify factors that fall within each Technological, Organizational, or Environmental category. Most academically accepted models of HRIS adoption fall under this kind of factor categorisation. Delorme, M., & Arcand, M. (2010) state seven (7) different factors that influence the adoption or creation of any new HR responsibility or tool and that those factors themselves can also be expanded categorically into three (3) different dimensions that fit a triangle framework, these consist of the technology, the roles and responsibilities of HR professionals, and the required competencies. Based on the review of relevant literature, many factors have been identified that can influence the implementation of HRIS in organisations. Based on the relevance of the factors and perceived information from the collected articles and secondary data sources, a simple model of how factors can influence the implementation tendency of HRIS in organisations. This preliminary model is given below as a structural equation model. The model is simplistic and based on 11 identified factors as variables, and 19 relevant items were created to calculate the data.

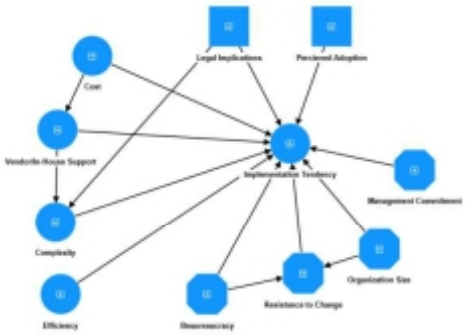

Figure 1 Research model: Model of Implementation Tendency Factors

Methodology:

Research Design: The present study fosters a conclusive research design, combining causal and descriptive research methods. The main objective is to explore and compare the private and public sectors of companies in Bangladesh in terms of adopting information systems in their Human Resources, considering specific factors.

Target Population: This study's target population is Dhaka, Bangladesh's public and private companies. The respondent was from the HR department.

Sampling Method and Sample Size: A purposive sampling technique was used to collect data. The sample measurements comprised 170 respondents from 12 companies from 4 public and 8 private companies in Bangladesh. All the respondents were from either the HR department or the IT department. This approach has ensured a sufficient representation of the target demographic while maintaining the feasibility of the data collection.

Data Collection: Online questionnaires were distributed through emails of the companies' employees. A five-point Likert scale and demographic data were provided in the questionnaire. Public and private companies' HR departments target Entry level, Mid-Level, and Top-level personnel as respondents. Google Forms was used to carry out the survey. The respondents varied in terms of organisational position from entry-level HR positions to Head of HR in the organisation; additionally, not all respondents were from the organisation's HR department; some were IT department members as well. Some demographic factors, such as the positions and ages of the respondents, were contributory factors to the Perception variables.

Data Analysis: Data were analysed through the data tabulation in Microsoft Excel using statistical techniques such as descriptive statistics, factor analysis, and Likert Scale analysis

Data Analysis & Result: Preliminary quantitative analysis was carried out in the form of correlation analysis between the variables of the formative model. The correlation analysis required the identification of dependent and independent variables. The dependent variable is the management trend toward implementing HRIS (Human Resource and Information System) or IM1 – IMPLEMENTATION TENDENCY. Analysis of its impacts and viability correlating with a total of 18 (eighteen) independent variables, namely, (1) BEA1 – BUREAUCRACY, (2) CMX1 – COMPLEXITY, (3) COST1 – COST, (4) COST2 – COST, (5) EFF1 – EFFICIENCY, (6) LI1 – LEGAL IMPLICATIONS, (7) LI2 – LEGAL IMPLICATIONS, (8) LI3 – LEGAL IMPLICATIONS, (9) MC1 – MANAGEMENT COMMITMENT, (10) OS1 – ORG SIZE, (11) OS2 – ORG SIZE, (12) PA1 – PERCEIVED

ADOPTIONS, (13) PA2 – PERCEIVED ADOPTIONS, (14) RES1 – RESISTANCE TO CHANGE, (15) RES2 – RESISTANCE TO CHANGE, (16) VEN1 – VENDOR, (17) VEN2 – VENDOR and (18) VEN3 – VENDOR.

Table I Correlations:

BEA1	CMX1	COST1	COST2	EFF1	LI1	LI2
0.427	0.563	0.194	0.732	0.590	0.071	0.267
OS1	**OS2**	**PA1**	**PA2**	**RES1**	**RES2**	**VEN1**
-0.527	0.195	0.562	0.516	0.303	0.806	0.526

LI3	MC1
0.264	0.907
VEN2	**VEN3**
0. 636	-0.074

BEA1 was concerned with the bureaucracy and found a low positive correlation with implementing HRIS with a value of 0.426. Regarding complexity (CMX1) on the ease of implementing HRIS in the organisation, there is a moderately positive correlation with IM1 with 0.562. On the other hand, concerning the high expense of the software needed for HRIS implementation, there is a negligible correlation with the HRIS implementation with 0.194. Concerning the organisations having enough funding to implement HRIS, it was found to be 0.731, hence, with a high positive correlation. With a correlation of 0.589, there is a moderate positive correlation concerning whether the implementation of HIRS will improve efficiency in the organisation. Legal terms must be considered in implementing HRIS in private and public organisations, having a 0.071 in LI1 for a negligible position. Again, the condition is slightly more than the previous (0.267) but with the same negligibility for the law being a complicacy in the HRIS implementation. And a 0.263 correlation concerning laws and regulations as a barrier to implementing the HRIS in the organisation. Particularly, when it comes to an overview of the management's commitment to implementing a digital HR system, there is a high positive correlation valuing 0.907. The OS1 is one variable concerning the organisation being too large to implement the HRIS and negatively moderate. The organisation's small size is in a negligible correlation with a value of 0.195 in the implementation of HRIS. Regarding being encouraged by other organisations to adopt HRIS, there is a moderately positive correlation termed perceived adoption with the variable PA1. Again, the moderate positive correlation is identified when the perceived adoption agrees that many organisations will be successful after implementing HRIS. There is a positive correlation between the employees' enthusiasm for welcoming HRIS into the organisation, with a value of 0.303. As per the organisation, the HR department in the surveyed organisations is willing to implement the system with a high positive correlation of 0.805. The variable VEN1 concerns the organisation's knowledge of the implementation of HRIS, which is positively correlated with a 0.526. The VEN2 concerns owning third parties or personnel in the HRIS implementation being positively moderated with 0.638 by public and private organisations. In the statement to maintain the HRIS implementation through the vendors, there is a negative perception by the organisation surveyed with a correlation of – 0.074. According to the literature, this general list of factors is not listed in the order of significance; however, they can be categorised in two ways: the TOE framework and the HRM-Technology framework. Additionally, interviews revealed that even though there may not have been a perceivable difference between the influencing factors of private and public organisations, there were, in fact, factors that only affected the public or private organisations. There were also differences in the weightage of certain factors. In some cases, this difference was significant to the extent that the model should be modified to show the different relationships. The model would also be further modified based on how certain factors are known or dealt with differently, such as, for example, a private organisation may call the expense of implementing HRIS as a cost, but a public organisation would call that factor available funding. Overall, culture represents both the internal organisational culture and the external societal culture of the organisation's immediate operating environment; therefore, subfactors under this factor will include organisational culture compatibility, societal acceptance, government regulation, and industry characteristics. Therefore, a revised structural equation model for private organizations operating in Bangladesh would look like as shown in Figure 2. Whereas a similar model for public organizations operating in Bangladesh would be as depicted in Figure 3.

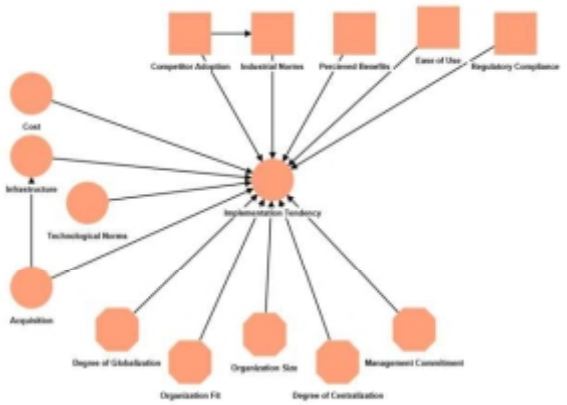

Figure 2 Revised model for Private Organizations

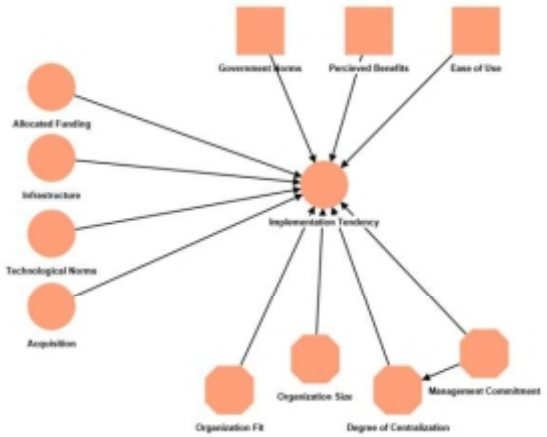

Figure 3 Revised Model for Public Sector Organizations

The clearest differences in the two revised models highlight that when using the TOE framework (again, the circles represent technological factors, the squares represent environmental factors, and the hexagons represent the organisational factors), certain factors undergo changes where certain factors are eliminated or added to the model. It is noticeable that the model for adoption in the public sector eliminates competitors and industrial norms but adds governmental norms from the environmental perspective of the framework. Additionally, as most public sector organisations are only operating on a local basis, the factor of globalisation is negligible and, therefore, can be eliminated from the model entirely depending on the specific organisation.

Conclusion:

The separation of models for the factors affecting the implementation of HRIS in organisations in Bangladesh proves that there are major differences between the public sector and the private sector regarding the subject of implementing HRIS; during the process of this exploratory analysis, it has also been implied that digital HR functions are also subject to some of these factors and therefore also subject to these differences. While the specific differences or this specific level of influence for each factor could not be conclusively stated, the two developed models could also be improved through further research from a theoretical perspective or subjected to quantitative experimentation as complete standalone models. Implementing HRIS in developing countries like Bangladesh depends on many factors, especially for public companies. It's more difficult to implement HRIS. To grab the innovative potential, existing technology advancement policies should be reconsidered. Bangladesh is unable to develop and implement policies quickly. Policy formulation and revision took years. Moreover, the success of any research largely depends on its implications and practice. Therefore, this research may contribute to the implications of HRIS in future HR and workplace environments in both public and private organisations.

Limitation of the Study:

- All the selected companies (public and private) are from Dhaka only.
- Participants in the study were confined to only 12 companies, 4 from Public and 8 from Private companies.
- Another limitation is that many factors affect HRIS adaptation, but only 11 were selected for this study.
- The findings of this study are bound to particular organisations and restrict generalisation to the larger population or to the industry as a whole.
- The data was collected from questionnaire surveys through Google Forms.
- The personal biases of respondents cannot be ignored. There may be slight variations in the accuracy of the results.
- This study has not accounted for differences due to the pre-existence of HRIS.
- Comparative quantitative analysis between public and private organisations could not be carried out because of the severe lack of respondents.

Recommendations for Future Research:

Forecasting the future profile of HRIS is very difficult as its field is not just about what it might transform technically possible. It is based on the systems that serve the people and the human enterprises. As the future generation of leaders, we should never forget that humans are always integrated into HRIS with related issues, especially in implementing and developing the latter. One of the core stanzas of the HRIS field is the HR policy, which juxtaposes organisational change and its technology when visualising future endeavours. Ten years ago, it was predicted that the technology in the world would be both connected and collaborative, with the enhancement of widespread operations and intelligent

self-service through the employees' portals. The prediction also got materialised when talked about the use of HR scorecards along with the decision trees and workforce analytics. In Bangladesh, there has been a positive acceptance and upward growth in process automation and the use of OLAP (online analytical processing) for the raw data processor. Its widespread use has ensured cheaper and faster access to impeccable HR information in real-time due to the advancement of communications tools. These operations are already at a good pace after being in an accelerated condition during the COVID-19 pandemic. The upcoming major fields in Bangladeshi organisations are Artificial Intelligence (AI), integration in the hiring pipeline, creating user-friendly dashboards, and automating compliance. Indeed, the major trends towards HRIS research direction in the future will comply with the hybrid work model, healthy organisation framework, DEI (Diversity-Equity-Inclusion) of HRIS, Power Skills, the reskilling and upskilling, cyber security, and the extension to embrace the Gig economy.

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ABS International Journal of Management
Volume XII Issue 2 December 2024 | ISSN 2319-684X (PRINT)

Cybersecurity Project Management Failures

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ABSTRACT:
In the rapidly evolving landscape of cybersecurity, project management methodologies (PMMs) play a pivotal role in ensuring the success of cybersecurity initiatives. However, many organizations struggle with selecting the appropriate methodology, leading to project delays, budget overruns, and even failure. This paper investigates the causes and consequences of incorrect methodology selection in cybersecurity projects. Through an in-depth analysis of case studies, including real-world examples from sectors such as banking and healthcare, the paper highlights how inappropriate methodology choices, such as rigidly adhering to Waterfall or Agile, can result in ineffective security measures and project failure. Factors contributing to incorrect selection, including insufficient technical knowledge, unrealistic deadlines, budgetary constraints, and unclear project objectives, are explored. The paper further outlines recommendations for improving cybersecurity project outcomes by aligning project methodologies with organizational needs, focusing on stakeholder engagement, and incorporating continuous risk management practices. By offering guidelines on effective methodology selection, this research serves as a resource for project managers and cybersecurity professionals to navigate the complexities of cybersecurity project management and ensure better alignment between project goals and execution.

Keywords: *Cybersecurity project management; Methodology selection; Agile and Waterfall; Risk management; Project failure factors*

INTRODUCTION

As the world goes digital, cybersecurity continues to rise as a significant issue affecting organisations across different sectors (Culot et al., 2019). Ever more organisations use technology and data in their operations and thus experience more and diverse cyber threats, vulnerabilities which can lead to leakage of valuable data, to operational interruption, and to reputation loss (Culot et al., 2019). These risks can be managed through cybersecurity projects that put in place mechanisms of security like firewalls, encryption, access controls and intrusion detection (Culot et al., 2019). One thing that is clear today is that cybersecurity projects cannot be underestimated. Some of the potential costs of data breach are financial damage to an organization, legal consequences, and eroded customer confidence. Data from the IBM Cost of a Data Breach Report indicates that in 2021, the average cost per data breach was $4.24 million (Almulihi et al., 2022). Furthermore, it stated that the mean time to identify and respond to a cyber-attack was 287 days, suggesting the importance of preventive and efficient cybersecurity strategies (Almulihi et al., 2022). Cybersecurity projects are crucial for protecting an organization's assets which include data confidentiality, data and system integrity, and system availability (Goswami et al., 2023). They are useful for blocking intruders, identifying and counteracting security threats, and enhancing compliance with regulatory and legal requirements, including GDPR and PCI DSS (Goswami et al., 2023). The cybersecurity project entails more than technical know-how of the team but also the integration of efficient project management practices (Franco et al., 2022). Project management methodologies are frameworks that allow for planning, executing and controlling a project so that it can be delivered on time, within a given budget and to the necessary quality standards (Franco et al., 2022). Specifically, in cybersecurity projects, project management methodologies help to achieve objectives with the organisational security strategy, mitigate and manage risks and uncertainties, and facilitate project communication and cooperation among stakeholders (Blum & Blum, 2020). They assist in defining sub-goals, roles, and achievable objectives of large cybersecurity projects and monitoring the performance toward those goals. Various project management paradigms can be adopted for cybersecurity projects, and each paradigm has certain advantages and disadvantages (Goswami et al., 2023). Some of the popular models include Agile, Waterfall, Iterative Prototyping, DevSecOps, Lean Development, Spiral Model, FDD, XP

and Hybrid Model (Goswami et al., 2023). This is because the methodology depends on the complexity of the project, experience of a team, organizational culture, and security objectives. Although PMM is crucial in cybersecurity projects implementation, a lot of organizations face challenges when it comes to choosing the right methodology to implement. Issues arising from improper methodology choice include project delays, costs that are higher than anticipated, project expansion, and eventual project failure. When it comes to cybersecurity projects, the risks inherent to project failure might be considered higher since in such cases the organization remains exposed to cyber threats and the security of valuable information might be at stake. Consequently, this research paper seeks to examine how wrong choice of methodology influences cybersecurity project failures and proffer recommendations for how to prevent such failures. The paper, focusing on real-life cases, will show that inaccuracy in methodology choice is often the result of factors such as no technical experience, misunderstanding of management methodologies, cost, time, and unclear objectives.

Overview of Project Management Methodologies in Cybersecurity

When it comes to the implementation of cybersecurity projects, the choice of the right project management method and approach is not only essential for project success, risk management, and achievement of the set security goals but also critical for project success (Salin & Lundgren, 2022). Certain key updates of the recent times concerning project management can be depicted in this Table 1.

Statistic	Percentage
Projects that fail	70%
Companies undervaluing PM	42%
Budget overrun causing failure	55%
PM industry growth by 2020	$6.6 trillion
Successfully completed projects with supportive sponsors	62%
Wasted $ due to poor performance	9.9%
Increased success with PM practices	2.5x
Reduced waste with PM investment	28x
Lack of clear goals causing failure	37%
IT projects lacking confidence in success	75%
Lack of business-project alignment causing failure	44%
Construction projects underperforming	>50%
Underperformers citing inadequate sponsor support	41%
Organizations using PM software	22%
Organizations using standardized PM practices	93%
High performers using predictive approaches	44%
Productivity drop due to multitasking	40%
High performers with ongoing PM training	83%
PM-related roles needed by 2027	87.7 million
Projects meeting original goals	70%
Projects without effective sponsors	68%
Senior managers fully understanding PM importance	87%

Source: https://teamstage.io/project-management-statistics/

This section highlights nine main project management methodologies that are widely applied in cybersecurity projects and are also discussed in this work, namely Agile, Waterfall, Iterative Prototyping, DevSecOps, Lean Development, Spiral Model, Feature-Driven Development (FDD), Extreme Programming (XP), and Hybrid Methodologies. Both methodologies have their strengths and weaknesses that will be discussed in order to enhance understanding of the concept when selecting a method to adopt in the cybersecurity projects (Salin & Lundgren, 2022). Agile is a flexible project management methodology, especially useful in dynamic fields like cybersecurity, where rapid adaptation to emerging threats is vital. It promotes team collaboration, iterative progress, and customer feedback, using frameworks like Scrum and Kanban to break projects into short, manageable "sprints" (Chovanova et al., 2020). These sprints, typically lasting 2–4 weeks, allow cross-functional teams to develop working software increments that can be reviewed and refined based on feedback. Agile's major advantage in cybersecurity projects lies in its adaptability, enabling teams to address shifting priorities and new threats quickly, extending the project backlog to incorporate new security measures (Chovanova et al., 2020). Additionally, Agile fosters ongoing communication between stakeholders, ensuring security requirements are defined and tested throughout the project lifecycle. However, Agile's frequent feature changes can pose security risks if adequate security testing isn't consistently integrated (Chovanova et al., 2020). Moreover, its flexibility may become a limitation in highly regulated environments where strict compliance is required, making it challenging to

balance speed and security. The Waterfall methodology, in contrast, is a linear, phased approach that requires one phase to be completed before moving on to the next. It is suited for cybersecurity projects with stable, well-defined requirements where changes are minimal (Lieberum, 2023). The structured nature of Waterfall ensures thorough documentation and clear project timelines, making it easier to track and implement security requirements. This methodology is beneficial in environments that prioritize predictable planning and resource allocation (Lieberum, 2023). However, Waterfall's rigidity makes it difficult to respond to evolving security threats, as it lacks the flexibility to adapt to new security needs once the project is underway. Changes late in the project lifecycle, such as addressing security vulnerabilities discovered during testing, can be time-consuming and costly (Lieberum, 2023). This sequential model can slow down projects, especially in fast-paced cybersecurity environments where new threats emerge regularly, requiring a more iterative and responsive approach.

Table 2: Comparison of Project Management Methodologies in Cybersecurity

Methodology	Key Characteristics	Advantages	Disadvantages
Agile	- Iterative and incremental - Flexibility and adaptability - Collaboration and communication	- Rapid response to changing security needs - Early detection of security issues - Continuous improvement	- Potential neglect of comprehensive security testing and documentation - Challenges in highly regulated environments
Waterfall	- Linear and sequential - Well-defined phrases and deliverables - Emphasis on documentation	- Structured and disciplined approach - Clear tracking of security requirements - Better resource planning and allocation	- Inflexibility to accommodate changes - Costly and time-consuming to address security issues discovered later - Slow pace in rapidly evolving threat landscape
Iterative Prototyping	- Development and refinement of working prototype - Incremental building and testing - Regular feedback and improvement	- Early validation of security concepts and designs - Identification and mitigationof security risks - Stakeholder collaboration and alignment	- Potential neglect of comprehensive security documentation and testing - Difficulty in establishing a clear project timeline and budget
DevSecOps	- Integration of security into DevOps - Collaboration and automation - Continuous securitythroughout the lifecycle	- Accelerated delivery of secure software - Early identification and remediation of vulnerabilities - Culture of shared responsibility for security	- Requires significant organizational change and upskilling - Relies heavily on the quality and accuracy of automated security processes
Lean Development	- Maximizing value and minimizing waste - Continuous delivery of small improvements - Optimization of resource utilization	- Quick and incremental delivery of value - Faster feedback loops and adaptability - Culture of continuous improvement	- Potential neglect of comprehensive security testing and documentation - Challenges in applying lean principles to thorough security measures
Spiral Model	- Risk-driven approach - Combination of Waterfall and Iterative elements - Emphasis on risk management	- Proactive identification and mitigation of security risks - Incremental development and testing of security features - Stakeholder involvement and collaboration	- Requires thorough understanding and accurate assessment of security risks - May lead to longer project timeline and higher costs
Feature-Driven Development (FDD)	- Iterative and incremental - Focus on delivering working software features - Feature prioritization and tracking	- Quick and regular delivery of security features - Early validation of security controls - Clear communication and collaboration among team members	- Potential neglect of comprehensive security testing and documentation - May not adequately address holistic security needs
Extreme Programming (XP)	- Emphasis on simplicity, communication, and feedback - Short development cycles - Frequent delivery of working software	- Continuous security testing and validation - Close collaboration between developers and security experts - Early detection and resolution of security issues	- Potential neglect of comprehensive security documentation and formal processes - May not allow for in-depth security analysis and risk assessment
Hybrid Methodologies	- Combination of elements from different methodologies - Customized framework based on project needs - Adaptability to unique requirements and constraints	- Tailored approach to address specific security needs - Flexibility to adjust the approach as the project progresses - Leverages strengths of different methodologies	- Potential confusion and inconsistencies if not carefully planned - Difficulty in finding the right balance between practices and processes - Requires deep understanding and effective integration of component methodologies

Case Studies of Cybersecurity Project Failures due to Incorrect Methodology Selection

This section highlights three cases of cybersecurity projects that were either encountered with significant issues or were flat out failures due to the right decision of the project management methodology. For each case, the general context of the project will be disclosed; the details including the type of selected methodology, the rationale for its adoption, the result of the improper choice of the methodology, and the lessons learned from the case will be mentioned.

Case Study 1: Project Secure Data, ABC Bank Services

ABC Bank Services is a large international bank, and for the new

rules and regulations, it has implemented Project Secure Data to enhance the level of customers data. This project was aimed at solving the problems related to data encryption, access, and auditing of IT infrastructure of the organization that was in several facilities. The project duration was planned to take 18 months, and the total cost estimated was $10 million (Abidin et al., 2019). For Project Secure Data, ABC Bank Services selected the Waterfall methodology. Some of the reasons with the use of the Waterfall model included the perceived need for a significant amount of planning and documentation prior to the start of the project to meet the legal requirements, the desire for a linear approach to the project, and the comfort level or expertise of the development team with the Waterfall model. The organization thought that since Waterfall is a linear approach, it would present a logical and systematic framework through which the intended goals of the project can be met (Abidin et al., 2019). As working on Project Secure Data unfolded, several problems emerged because of the selected Waterfall model. The extensive documentation of requirements gathering phase took most of the overall project time and implementation and testing of security solutions were limited. Finally, when the implementation phase started the actual problems arose in terms of technicalities and compatibility that were not foreseen during the planning phase. Specifically, the Waterfall methodology was unable to respond to these challenges because of its highly structured approach. Scope and requirement changes are needed to undergo a change control process, making the project even more time-consuming and costly. Furthermore, the absence of continuous feedback and user participation in the process also contributed to the creation of security solutions that the organization might not necessarily require or wish to have. Towards the end of the project, the team was in a hurry to conduct the testing and deployment process, and therefore did not focus much on security testing, and even integrated many vulnerabilities into the production environment. The project was successful in terms of time and cost, but the result provided an inefficient security solution that could not satisfy all the regulations and the business goals.

1.In cybersecurity projects, the ability to be flexible and adaptable to changing specifications and threats is critical.

2.Some SDLC frameworks that support iterative and incremental development include Agile and DevSecOps, which allow for faster feedback, ongoing refinement, and adaptation to business requirements.

3. A central theme of this article is that over-reliance on planning and documentation in the early stages of the project can become a source of resistance to delivering value and adaptation.

4. Security solutions must be developed in consultation with the users and stakeholders for the whole duration of the project to address the organization's needs and concerns.

5. Allocating enough time and effort towards security testing and assurance activities for the security controls that are to be deployed is an important initiative.

Case Study 2: U.S. Department of Veterans Affairs (VA) - Scheduling Replacement Project

In FY 2000 VHA recommended the replacement of the scheduling system within VistA due to the age of the software. VHA began taking measures to shift from the system and the new Replacement Scheduling Application (RSA) development project was started with the help of COTS software program (Moldestad et al., 2021). The VA decided to implement the Waterfall-based model, which entails a linear process with well-defined stages, including requirement gathering, designing, implementation, and testing. The rationale for choosing Waterfall was due to the perceived size of the project, the formal documentation required, and the fact that the project team had prior experience with using Waterfall. During this project, some drawbacks resulted from the application of the chosen Waterfall methodology. The VA faced some difficulties due to the unclear definition and regulation of the requirements for the project, which caused the problems of scope creep and the delays. Since the Waterfall model mostly adopts a linear model, it was challenging to incorporate enhancement and users' feedback into the process (Dodaro & USGAO, 2019). Moreover, absence of iterative enhancement and testing also suggested that primary concerns were even more throughout the progress at the end stage and once again contributed to additional hours and dollars thrown away. One of the primary drawbacks of the project under analysis is its lack of flexibility and the failure to address new requirements and advancements in technologies. The failure of the VA's scheduling replacement project gave out so many lessons:

- Waterfall is less suitable in the case of large and complicated projects which require continual changes in the development process.
- Other paradigms, like iterative and incremental ones, including Agile methods, can provide quicker cycles of feedback, more extensive involvement of users, and flexibility to address dynamics of needs.
- Heavy documentation work at the beginning of the project and a linear approach to development might make it challenging for a project to adapt to changes and receive feedback from users.
- Regular testing and validation should not only be done on an exceptional basis, but rather at each stage of development to reduce possible challenges common in the later development stages of a project.

Case Study 3: Knight Capital Group - Software Deployment Failure

Knight Capital Group, a well-established American financial services firm, had embarked on a project to install an update to an automated trading platform in 2012. The project had the goal of increasing the performance and profitability of high-frequency financial transactions of the company (Min & Borch, 2022). The software deployment project at Knight Capital Group featured the use of an Agile method. The primary rationale for utilizing Agile was that the project required effort of high flexibility, fast results production, and fast reaction to the changes in the market. , as pointed out by Min and Borch (2022), the company expected Agile to be more flexible and therefore make it easier to release the software update while experiencing little disruption. However, the update that was released in August 2012 using the Agile methodology was a complete failure. The new software had a fatal error that initiated a chain of incorrect trades that resulted in a 45-minute $440 million loss (Min & Borch, 2022). Although Agile is all about being more flexible and delivering solutions as soon as possible, the improper approach to the methodology in question was one of the main reasons for the project's failure. The team worked towards speed and missed important components like testing, risk evaluation and configuration management. While Agile was thoroughly iterative, it failed to accommodate sufficient address to quality assurance and risk management. Furthermore, Edison et al. (2021) would note that the absence of effective governance, record-keeping, and reporting within the Agile environment aggravated the consequences of the software flaw. This fact shows that the team was primarily concerned with the timely release of the update and paid less attention to the stability of the system. The Knight Capital Group incident gave several lessons for software deployment projects using Agile methodology:

- Agile requires a balanced approach that combines flexibility with rigorous testing, quality assurance, and risk management practices.
- Rapid delivery should not compromise the need for thorough testing, especially in high-risk and mission-critical systems.
- Proper configuration management, version control, and documentation are essential, even within an Agile framework, to ensure system stability and facilitate issue resolution.
- Effective communication, collaboration, and oversight are crucial to identify and mitigate potential risks throughout the Agile development process.
- Continuous monitoring, real-time alerts, and rapid rollback mechanisms should be in place to minimize the impact of any issues that may arise during deployment.

Common Factors Contributing to Incorrect Methodology Selection

An appropriate project management methodology can lead to increased cybersecurity projects' success rates. As stated by Dobos and Csıszarık-kocsır (2022) it is crucial when managing projects in cybersecurity environment to choose an appropriate strategy for project management as well as aligning it to business initiatives effectively, as well managing projects' timely and efficient delivery. Nevertheless, organizations face difficulties when choosing the strategy because multiple factors affect their choices (El Khatib et al., 2022). This section discusses five significant sources of errors while selecting methodologies for cybersecurity activities and their impact on projects. The following are the challenges:

Insufficient technical knowledge and experience

The lack of technical skills and knowledge is another important factor that contributes to the improper choice of the methodology for a certain project in a team or in an organization (The role, 2022). Cyber security projects may include challenging technology, dynamic threats, and many other ideas

related to cybersecurity (Pollini et al., 2022). This implies that when the project managers or the decision-makers do not have adequate knowledge of these technicalities, then they might stumble when it comes to evaluating the applicability of various methodologies to the given project. From the case studies highlighted above, lack of technical knowledge as well as technical experience contributed to the choice of wrong methodologies. For instance, in the first case study, the adoption of the Waterfall methodology by ABC Bank Services was informed more by the fact that some members of the project team were already conversant with the approach than an assessment of how well the methodology suited the technical nature of the project. Likewise in Case Study 2, VA decided on the use of Waterfall despite the failure to consider the security implications which resulted in problems when incorporating the security practices. Due to the possibility of choosing an incorrect methodology due to the lack of technical knowledge, organizations must upgrade the knowledge and skills of their project teams. Enabling team members to develop and refresh their knowledge on cybersecurity technologies, processes, and trends with the current and potential methodologies of projects can improve decision-making capabilities (Pollini et al., 2022). Ramlo and Nicholas (2020) argue that security professionals working in the field and the subject matter experts should be involved in the selection of the most appropriate methodology.

Lack of knowledge of project management approaches

Another reason for selecting the wrong methodology is the lack of knowledge about project management methodologies and how they can be used in cybersecurity projects. According to the research done by Cremer et al. (2022), it is evident that any organizations lack adequate knowledge or understanding of the various methodologies that are being offered, the benefits of using such methodologies, or even the best way to apply such methodologies when it comes to cybersecurity activities Varela & Domingues (2022). These data are in line with insufficient understanding as one of the major reasons that cause people to select wrong methodologies in cybersecurity. From the case studies, the participants had limited knowledge of project management methodologies. For ABC Bank Services, choosing the Waterfall methodology as their model without any consideration of how this does not allow for changes in security needs was problematic for the following reasons. In Case Study 3 Knights' capital implementation of the Agile contract without appreciating how to incorporate security measures appropriately led to the emergence of security flaws and risks. To this end, there is a need for organizations to train their project managers and the teams on various available project management methodologies and the applicability of the methods to cybersecurity projects. This can be fostered through training programs, workshops, and certifications that are geared towards illustrating the application of project management in the context of cybersecurity as proposed by Cremer et al. (2022). This indicates that by increasing the understanding of the methodologies that are available and the suitability of each methodology for project types, organizations are in a better position to make the right choices.

Budgetary constraints

Lack of funds can also be a factor in choosing the wrong project management methodologies in cybersecurity projects. From Kerzner (2022)'s perspective, when organizations are cash-strapped, they may be inclined to opt for a method that seems to call for less money or fewer resources than another method, although it may be less appropriate for the project at hand. Budget limitations were never mentioned as a primary reason for choosing one or another methodology in the case studies. But it is important to understand that financial constraints can play a role in decision-making and may automatically result in compromising on the chosen methodology. For instance, an organization might choose the Waterfall approach to avoid what it perceives as the cost of iteration and constant security review, even though the Agile approach might better suit the requirements of the project in question. Therefore, organizations should tackle cybersecurity investment strategically to minimize the likelihood of choosing the wrong method due to inadequate funding. According to Kerzner (2022), this is accomplished by prioritizing the security plans based on their significance and risk and then apportioning resources. Costs and benefits of methodological selection allow organizations to make an accurate choice regarding an efficient and safe method based on strategic performance and economic aspects.

Unreasonable time expectations

Other causes that may result in the wrong adoption of project management methodologies in cybersecurity projects are unreasonable timelines and deadlines. As established by Bordley et

al. (2019), due to the desire to achieve results within a shorter amount of time, organizations can be tempted to use a method that gives the appearance of being quicker even where this methodology may not be ideal for the project in question. In Case Study 1, ABC Bank Services chose the Waterfall methodology because the company had to have a fixed time for the completion of the project. This decision caused project delays and the delivery of a less than optimum security solution. Likewise, in Case Study 2, VA's implementation of the Waterfall methodology without careful examination of the security testing and risks occurred because the company wanted to develop functional security features as soon as possible. To minimize the probability of choosing the wrong methodology due to tight or unrealistic timelines and deadlines, organizations should avoid adopting a rigid approach to project planning. According to Bordley et al. (2019), this entails realistic and effective goals, the project's sophistication level, and enough time for security testing and verification. However, the focus on quality and security over the speed of development means that the chosen methodology corresponds to project needs and allows delivery of high-quality and effective security solutions.

Ambiguity of the project's objectives and specifications

Another reason for choosing the wrong method in cybersecurity projects is the lack of clearly defined project goals and objectives. In a survey conducted by Varela & Domingues (2022) the experts identified risks in PM which include starting the project with wrong questions, project scope poorly outlined with the client. It is difficult to choose the right methodology suitable for the project if the objectives, deliverables, and success criteria are vague or if they are not communicated effectively. In the Case Studies, ambiguity pertaining to the project scope and requirements could be seen in Case Study 3, where Knight Capital implemented Agile Methodology without a clear understanding of security roles and responsibilities, which resulted in confusion and inconsistent implementation of security controls. Similarly, in Case Study 2, while VA set functional security goals and objectives, it did not have a strategic security plan and ended up with insecurely architected security controls. To mitigate this problem, organizations should devote adequate resources for the establishment of the project scope and requirements before embarking on any project. This involves consulting with stakeholders, broadly collecting requirements, and clearly defining project goals, outcomes, and measures of effectiveness (Varela & Domingues, 2022). Through defining and agreeing on the project objectives and deliverables, organization can identify the most suitable methodology to be applied in implementing the security controls to address the project requirements. As shown in the pie chart below, each factor is presented in proportion to its relative frequency of causing incorrect methodology selection across the case studies:

Ambiguity of the project's objectives and specifications

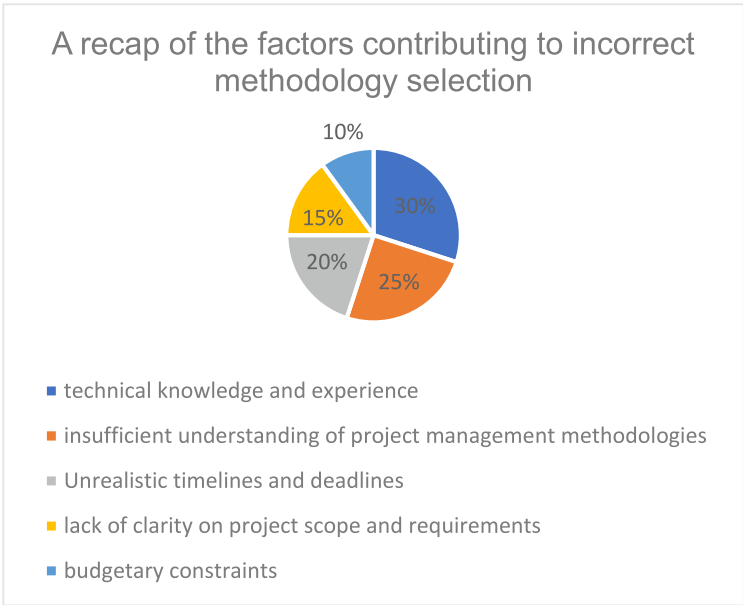

Figure : A recap of the factors that contribute to incorrect methodology selection in cybersecurity

Recommendations for Successful Cybersecurity Project Execution

Choosing the right project management methodology is a way to pave the path towards successful cybersecurity project delivery. However, the success of the project also depends on how properly the selected methodology is applied and maintained during the entire project cycle (Abrahams et al., 2024). This section will also include five best practices for cybersecurity project implementation together with their anticipated advantages and provide a table with these recommendations. After the best-suited methodology has been identified, sufficient training and support are required to enhance its application. Companies should engage in training activities that help the team members to develop relevant skills and knowledge pertaining to the selected approach. This training should include

information on the methodology: its aims and objectives, methods, instruments, and approach when used in the context of cybersecurity projects (Abrahams et al., 2024). Besides training, the organizational resources must be adequately provided to support the selected methodology. This entails availing the methodologies tools, technologies, and structures through which the team is able to implement the processes and practices of the given methodology (Abrahams et al., 2024). Another important aspect of adequate resources is that the required expertise is available for the team, for example, security specialists or experienced project managers who can help with the project implementation. Communication plays a vital role in the success of any project, and cyber security projects are not an exception. There is therefore a need for organizations to keep their members and stakeholders informed through clear and culture communication channels. These include formal or official meetings, briefings and progress reports to ensure that all stakeholders are informed and on the same page (Abrahams et al., 2024). Furthermore, organizations should promote communication in the organization, which allows employees to report issues, identify problems, and express possible solutions. Such an open culture can at times serve as an indication of possible mishaps and mitigate misconceptions and improve ownership of projects. Cybersecurity projects occur in complex and evolving environments which could be defined by ever evolving needs, goals, and threats. Therefore, it is necessary to revise the plans and schedules and their adaptation on a regular basis to remain focused on the project objectives and exclude possible divergence. This entails both the assessment of the project's situation, purposes, and deliverables to determine the ineffectiveness area or new reality that requires alteration (Abrahams et al., 2024). The planned reviews are also helpful to reflect on the suitability of the selected methodology and possibly contact some changes if needed. That is, organizations can keep project plans and timelines in check and avoid using too many resources while at the same time being aware of any deviation in the project's course. Any cybersecurity projects always come with certain risks that include data security breaches, system weaknesses, regulatory issues, and reputation loss. Hence, integrating risk management approaches that pertain to cybersecurity projects is imperative when it comes to project delivery. Managers should implement risk management protocols to identify, evaluate and prioritize the cybersecurity risks across the project lifecycle (Presley, 2022). This framework should be implemented into the chosen project management methodology to ensure that risk management activities are integrated with project processes and decisions. Managing risk in cybersecurity projects could entail security assessments, vulnerability scans, security control, and contingency and recovery plans (Presley, 2022). That is why managing cybersecurity risks means reducing the probability of security breaches and the consequences of such events in advance, thus ensuring the success of the project. To ensure cybersecurity project success, there needs to be a focus on improvement and growth. Members of the team working on a particular project need to be encouraged to experiment, innovate, and share knowledge with their colleagues. This culture should encourage best practice, the use of knowledge gained from other projects, and the ongoing improvement of team effectiveness (Presley, 2022). Some of the ways include daily or weekly meetings to reflect on the successes, challenges, and lessons learnt; or conducting retrospective meetings or post-project review meetings. They should be documented and applied to improve the management of the project and its processes for future projects. It is also important for organizations to provide regular training and professional development of their employees, so that they would be aware of the most recent developments and trends in cybersecurity (Presley, 2022). Hence, it would be possible to boost the organizations' abilities relating to the execution of projects, as well as to adapt to the changes that take place in the field of cybersecurity by promoting the culture of learning and improvement.

Table 3: Recommendations for Successful Cybersecurity Project Execution

Recommendation	Expected Benefits
Providing adequate training and resources for the selected methodology	- Enhanced team competency and efficiency in applying the methodology - Improved project performance and quality - Reduced risks of methodology misapplication
Establishing clear communication channels among team members and stakeholders	- Improved collaboration and information sharing - Early identification and resolution of issues - Increased stakeholder engagement and buy-in
Regularly reviewing and updating project plans and timelines	- Aligned project execution with objectives and changing circumstances - Effective resource allocation and risk mitigation - Timely identification and correction of deviations
Incorporating risk management strategies specific to cybersecurity projects	- Proactive identification and mitigation of cybersecurity risks - Enhanced security posture and regulatory compliance - Minimized impact of security incidents on project success
Embracing a culture of continuous improvement and learning	- Adoption of best practices and lessons learned - Continuous enhancement of team skills and capabilities - Improved adaptability to evolving cybersecurity landscape

The recommendations given can help to improve the outcomes of cybersecurity projects and to fully leverage the chosen project management approach in organizations. Thus, choosing the right methodology, applying it properly, and constantly adapting it is a way to ensure the successful implementation of cybersecurity solutions that meet certain organizational goals and reduce the risks of cyber threats.

Conclusion

In this research paper, the importance of choosing the right project management methodology for successful cybersecurity projects has been explored. Thus, we have described the aftermath of improper methodology selection and demonstrated how one should proceed to select the proper method. Cybersecurity initiatives are more often than not large-scale undertakings that must in the right sequence be designed, implemented, and managed. Selecting the right project management methodology plays a crucial role in achieving project goals and objectives, managing risks, and delivering effective solutions. Choosing the right methodology lays the groundwork for project planning, structuring, and management, as it correlates with certain parameters, limitations, and human resources. The analysis of case studies showed that the main issues leading to the incorrect selection of a methodology include lack of technical knowledge; inadequate knowledge of methodologies; budget constraints; unattainable time limits; and unclear definition of the project scope. To address these difficulties, guidelines for selecting a project management methodology include an analysis of the project needs, an evaluation of the team skills, the project size and level of risk, a determination of the level of flexibility required, the involvement of the stakeholders and the constant review of the methodology used. Support and proper management of the chosen methodology are necessary to achieve optimal results in the cybersecurity project. These are; proper training and resource provisions, proper communication channels, project plan review and update, incorporation of risk management and continuous improvement. Hence, this paper is a wake-up call for organizations to pay more attention to the choice of the right methodology in cybersecurity endeavours. Organizations need to spend considerable time and effort on identifying project needs, appraising team strengths and weaknesses, and determining the applicability of various approaches. In this way, by focusing on learning, improvement, and adaptation, organizations can improve their decision-making abilities to choose and deploy efficient methodologies enhancing their cybersecurity and safeguarding their resources from various threats.

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ABS International Journal of Management
Volume XII Issue 2 December 2024 | ISSN 2319-684X (PRINT)

Financial Literacy among Working Women: A Catalyst for Sustainable Development (Special Reference to Pali District)

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ABSTRACT:

In the present times, financial literacy is becoming an important subject. Due to the rapidly changing social and economic environment in modern society, the need for financial literacy has increased more than ever. Financial literacy is a vital component of economic empowerment, particularly among working women. As women's participation in the workforce increases, their financial knowledge and skills become crucial in achieving sustainable development. This research paper explores the significance of financial literacy among working women and its impact on sustainable development. The importance of financial decision -making ability has increased in every section of the society, as the impact of financial status is becoming decisive at both individual and social levels. Therefore, it is important to understand why financial literacy matters and what the consequences of its absence can be. The presented research paper is based on educated working women of Pail district (Rajasthan). For preparing the research paper, 40 respondents were selected through guidance method. The financial level and financial knowledge of the educated working women was ascertained through observation and interview method. Friends, it was concluded that financial literacy is becoming a necessity today. If the level of financial literacy of women is high, their contribution to the development of the country will also be high. Higher financial literacy among working women positively impacts economic, social and environmental sustainability. 1.Economic Sustainability- Increased economic participation, entrepreneurship, improved financial management and investment.2Social Sustainability-Enhanced education, healthcare, social mobility and community engagement.3Environmental Sustainability-Informed choices about sustainable practices, reduced consumption and eco-friendly investments

Keywords: *sustainable development, working women, financial literacy, financial knowledge, financial behaviour, financial decision*

INTRODUCTION

Financial Literacy: Financial Literacy: Definitions and Author Perspectives. Financial literacy refers to the ability to understand and manage personal finances effectively, making informed decisions about earning, saving, investing, borrowing and spending.

Definitions

1. Hilary Osborn: "Financial literacy encompasses the knowledge, skills and attitudes necessary to make informed financial decisions."

2. Annamaria Lusardi: "Financial literacy is the ability to read, analyze, manage and communicate about personal finances and make informed financial decisions."

3. National Endowment for Financial Education (NEFE): "Financial literacy is the ability to understand and manage personal finances, including budgeting, saving, investing and managing debt."

Key Components of financial literacy:

1. Financial Knowledge: Understanding financial concepts, instruments and markets.

2. Financial Attitudes: Behaviors and mindset influencing financial choices.

4. Financial Behavior: Effective management of personal finances.

Working women and Financial Literacy: Financial literacy among working women is crucial for their economic empowerment and sustainable development. It enables them to manage finances effectively, make informed decisions and achieve financial stability. Financially literate working women can create and manage wealth, invest wisely, and plan for retirement. They are also better equipped to navigate financial challenges, such as debt management and financial crises. Moreover, financial literacy promotes entrepreneurship, economic participation and independence. According to Hilary Osborn, financial literacy encompasses knowledge, skills and attitudes necessary for informed financial decisions. Working women with high financial literacy contribute significantly to economic growth, poverty reduction and social well-being, aligning with the United Nations' Sustainable Development Goals. Governments, NGOs and private sector entities

should promote targeted financial education programs, digital financial services and policy support to enhance financial literacy among working women.

Sustainable Development: Educated working women possessing financial literacy skills have a profound impact on sustainable development. With knowledge of personal finance, investing and entrepreneurship, they contribute significantly to economic growth, social well-being and environmental conservation. Financially literate women make informed decisions, creating wealth and stability for themselves and their families. This, in turn, drives sustainable development, aligning with the United Nations' Sustainable Development Goals (SDGs). By managing finances effectively, women entrepreneurs invest in sustainable initiatives, foster social responsibility and promote environmental stewardship.

1. Economic Empowerment: Financial literacy enables women to manage debt, build credit and invest wisely.

2. Entrepreneurship: Educated women start sustainable businesses, creating jobs and stimulating local economies.

3. Environmental Conservation: Financially literate women invest in eco-friendly initiatives and promote sustainable practices.

4. Social Responsibility: Women support community development projects, advancing social sustainability.

5. Gender Equality: Financial independence empowers women, bridging the gender gap.

6. Improved Livelihoods*: Financial literacy enhances women's quality of life, benefiting families and communities.

7. Sustainable Development Goals (SDGs): Achieving SDGs 1, 5, 8 and 10 through financial inclusion and education.

8.Community Engagement: Financially literate women participate in community development, fostering social cohesion.

9. Innovation : Women drive sustainable innovation, developing eco-friendly products and services.

10.Policy Influence : Educated women advocate for policies supporting sustainable development and financial inclusion.

Pali District :

Pali district, located in Rajasthan, India, is a vibrant blend of rich cultural heritage and economic growth, known for its historical significance, textile industry and breathtaking natural scenery. Spanning 12,387 square kilometers, Pali shares borders with Jodhpur, Ajmer, Rajsamand and Sirohi districts. Pali district literacy rate was 48.01% in 2011,with a significant disparity between rural and urban areas. In rural areas, the female literacy rate was 43.01%, and while in urban areas, it was 63.89%.

Objectives

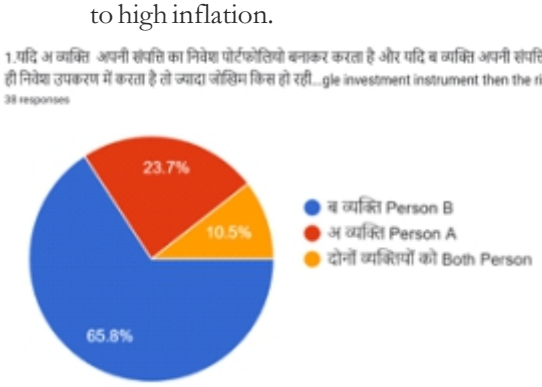
1. The main objective of the research is to find out why financial literacy of educated working women is necessary for sustainable development.
2. To know the level of financial literacy among educated working women in Pali district.
3. To explore what impact high financial literacy can have on sustainable development.

3. Reserach Methodology

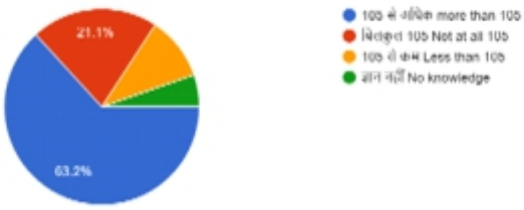
Primary and secondary data were included to analyze the research Both primary and secondary methods were used for the study. Under the primary method, 40 people were included as respondents. For which questionaries' and interview methods were used. During the online questionnaire Various questions were used to know the demographic information and the level of financial literacy. Books, newspapers, websites etc. were used for secondary data. The data was displayed through graphs and charts. Data was collected using questionnaire method. Forty questionnaires were distributed among working women and thirty-eight filled questionnaires were received from the respondents. The data collected through questionnaires was analyzed with simple percentage and cluster random sampling methods.

Finding and Suggestion

By possessing financial literacy, educated working women become change-makers, advancing sustainable development and creating a brighter future.In portfolio related question, 65.8% of educated women gave correct answer. And 63.2% educated women gave correct answers in the question related to interest rate, 39.8% in the question related to inflation, 47.4% in the question related to inflation increase, 60.5% in the question related to high inflation.

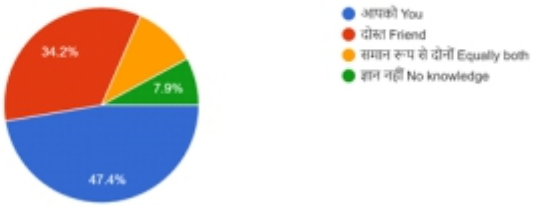


2.मान लीजिए कि आपके बचत खाते में ₹100 हैं और ब्याज दर 5% प्रति वर्ष है। साध सरल ब्याज दर विधि, 5 साल बाद आपके पास कितनी रकम होगी? Suppose you have ₹100...d. How much money will you have after 5 years?
38 responses

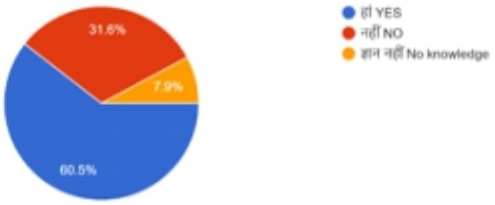


3.कल्पना कीजिए कि आपके बचत खाते पर ब्याज दर 1% प्रति वर्ष थी और मुद्रास्फीति प्रति वर्ष 2% थी। 1 साल बाद आप कितना खरीदने में समर्थ हो पाएंगे। Imagine that t... year. How much will you be able to buy after 1 year?
38 responses

4.मान लीजिए आप को आज 10000 रुपये आप के दोस्त से मिले और आप ने इसे पांच वर्ष बाद लौटायें। मुद्रास्फीति की दर लगातार बढ़ रही है। किसके लिए फायदेमंद है। Suppos...continuously increasing. For whom is it beneficial?
38 responses



5.उच्च मुद्रास्फीति का तात्पर्य कि आप के पैसों का मूल्य कम हो रहा है।High inflation means that the value of your money is decreasing.
38 responses



Conculsion

Financial literacy has become essential in today's changing social and economic environment. A financially literate society is essential not only for individual development but also to strengthen the economy of the country. It is important to promote financial literacy in every section of the society through financial education and awareness programs so that they can successfully face the economic challenges in the future.From the above analysis we can conclude that there is a need for financial literacy among women. This concept states that the level of financial literacy varies significantly among respondents depending on various demographic and socio-economic factors. It can be concluded that the level of financial literacy is influenced by gender, education, income, nature of employment and place of work. Financial literacy helps women to become truly empowered women. It was found in the research that the financial literacy level of educated working women is high and they also contribute economically to the country by investing the right amount of their savings from time to time. If the government promotes financial literacy for women from time to time. If related programs are started smoothly, it will help in increasing financial literacy among women as well as sustainable development.

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ABS International Journal of Management
Volume XII Issue 2 December 2024 | ISSN 2319-684X (PRINT)

Manufacturing Workers in Developing Countries and the Role of Monitoring Health through Virtual Health Assistance (VHA)

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ABSTRACT:
This research paper aims at investigating the use of Virtual Health Assistance (VHA) technologies including Artificial Intelligence, Telemedicine and Wearable Health devices in enhancing Manufacturing Workers' Health Access in Developing Countries. These workers also experience poor working conditions and extremely limited access to health care, and as a result are at a higher risk for illness and less productive. It is against this background that VHA systems offer an effective solution to the challenges through real time health monitor and remote consultation. It analyzes enabling technologies, barriers to VHA implementation, effects of VHA on worker health and productivity, and concludes by calling for government sponsorship and policy initiatives for the successful application of VHA.

Keywords: *Virtual Health Assistance (VHA), Artificial Intelligence, Health, Manufacturing Workers, Productivity*

INTRODUCTION

Manufacturing industry is one of the most crucial industries in the development of many developing nations. But this sector has many risks that endanger the lives of the workers, poor health care and poor working conditions that compromise the health of these workers as well as their productivity (Shah et al., 2024). As a result of Industry 4.0, sophisticated technologies like Virtual Health Assistance (VHA) present the opportunity to solve these healthcare issues. VHA include telemedicine, artificial intelligence, and wearable health devices that enhance the delivery of healthcare services and monitor the wellness of workers in real-time (Mbunge, Muchemwa & Batani, 2021). These innovations are particularly valuable in the third world where the infrastructure for delivering healthcare is poor. By availing VHA, manufact uring workers are able to see a doctor or get preventive check-up thus lowering rates of absenteeism and enhancing the health status of the manufacturing workers (Talati, 2024). As this paper shows, VHA has the possibility to produce many positive effects; however the application of VHA in developing countries is constrained by many technological, socio-cultural and economic factors. This study aims at evaluating the effectiveness of VHA in availing health care to manufacturing workers in the developing states, the technologies needed for VHA and the challenges that need to be addressed for VHA to operate optimally. These concerns must be met in an effort to enhance the quality of the workers' lives and increase productivity in the manufacture zone globally.

BACKGROUND

Manufacturing industries in developing countries are characterized by employment with poor working conditions, restricted access to health care and high health risk. These lead to poor health amongst the workers which in one way or the other impacts productivity and quality of human life. Owing to the Industry 4.0 technologies, new solutions to these health issues have been came up with. AI, telemedicine, and wearable health monitoring systems are proposed to be implemented in Virtual Health Assistance (VHA) to solve the problem of delivering health care services without direct contact and with higher efficiency (Shah, Jhanjhi, and Ujjan, 2024). In VHA systems, the health status of the workers is constantly being streamed in real-time, and telemedicine is performed to have a consultation with a healthcare provider. Thus, the access to the effective healthcare for workers in the developing countries that can suffer from the lack of health resources or even healthcare infrastructure can be expanded with the help of digital tools provided by VHA. As technologies in the health care industry become more sophisticated, virtual health systems in manufacturing environments are becoming more established and could present a good chance to enhance the wellbeing of workers and resultant productivity

RESEARCH OBJECTIVE

- In order to assess the applicability of Virtual Health Assistance (VHA) in enhancing the accessibility of healthcare for manufacturing workers in the developing world.
- The purpose of this study is to

determine the enabling technologies that are critical to the successful deployment of VHA in manufacturing contexts.

- In order to identify the problems and obstacles to the implemen tation of VHA in developing countries.
- To evaluate the effect of VHA on the worker productivity and health status.

RESEARCH QUESTIONS:

- How can Virtual Health Assistance enhance the access to health care for manufacturing employees in the developing nations?
- Which technologies are most relevant to the adoption of VHA in manufacturing sectors?
- What factors have been found to slow the implementation of VHA in developing countries?
- How does VHA affect manufacturing workers' health, work output, and quality of life?

SCOPE OF RESEARCH:

This research will therefore aim at establishing the effectiveness of Virtual Health Assistance (VHA) for manufacturing workers in developing countries. It will examine how AI, telemedicine, and wearable devices can enhance health care access and quality for employees in industries with scarce health care facilities. The research will also seek to find out the extent to which VHA can be used to meet the health needs of manufacturing organizations in relation to the health risks that are unique to manufacturing industries like physical stress, fatigue, and exposure to toxic substances. This research will be confined to developing countries only because these are the regions where the availability of health care technologies is generally low and it will examine the technological and social cultural antecedents of VHA. The implications of this research will be of interest to policymakers, healthcare service deliverers, and manufacturing industries.

LITERATURE REVIEW

Industry 4.0 and Digital Healthcare:

The Industry 4.0 technologies like the Artificial Intelligence, Internet of Things and the digital platforms are revolutionizing health care services in the manufacturing industries. Shah, Jhanjhi, and Ujjan (2024) thus posit that digitalization of health care is an important enabler of productivity and access especially for workers in the industrial segment. Artificial intel ligence for diagnostics, telemedicine for remote consultation and wearable for constant health checkup shall enhance the general health care experience of the manufacturing workers. These technologies ensure that timely medical assistance is given hence minimizing the use of conventional healthcare centers which may be scarce or hard to access in the developing world. The change is in line with the Industry 4.0 concept of integrating digital technology into systems used in manufacturing industries. According to Singhaphandu and Pannakkong (2024), the virtual training systems and other aspects of technology have the possibility to change the worker health and safety because of the opportunities to control the situation in real time. In the context of developing countries with little or no health care structures these technologies can be the solution to the traditional health care delivery systems.

Enabling Technologies for Virtual Health Assistance:

The application of Virtual Health Assistance requires integration of some sophisticated technologies such as Artificial Intelligence, Telemedicine and Wearable Health Monitoring Systems. Wearable technology is prevalent in the healthcare industry, and AI is employed to diagnose diseases based on data collected by such devices while offering the user specific health advice (Talati, 2024). These systems can identify the first signs of some disease, such as fatigue or contact with toxic substances and warn workers or supervisors to prevent the development of the disease. Telemedicine is another aspect of VHA to connect the workers with physicians without having the need of physical meetings. This is especially helpful in the third world countries where physical access to these medical facilities may be hard because of geographical or financial factors. In their study Mbunge et al., (2021), the authors look at how innovation in digital health technologies like sensors and wearable devices can help deliver virtual care, constant health check, and minimal strain on existing health care systems. Wearable devices that monitor health parameters such as pulse rate, blood pressure, and movement are essential to VHA's success. These devices can even enable the monitoring of health in real time and feedback to the worker and the health care givers. Adaptive of these technologies in manufacturing systems can contribute to reduction of work related injuries and enhance the general health of employees (Maher et al., 2020)

Challenges to VHA Adoption in Developing Countries:

The following challenges inhibit the application of VHA in the developing

countries even though there are perceived advantages of the system as indicated below. The first is a lack of digital infrastructure; this includes internet connection and or access to devices such as a computer. Rani and Singh (2019) pointed out that, digital platforms in the developing economies are usually challenged by limited resources to allow for the implementation of complex health technologies like VHA. However, there seems to be cultural and social constraints to the implementation of VHA besides the infrastructural ones. In many developing countries, workers may be illiterate or avoid using digital technologies when it comes to their health or may simply prefer to discuss their issues with a physician in person. Rokicki-Parashar et al. (2021) state that the expansion of the medical assistant profession in virtual care environment requires training and education that would make workers not only comfortable using such innovations. This brings concerns of data security and privacy as the VHA systems will need to gather and store personal, and in most cases, personal health information. Another potential challenge to VHA is the cost which can be very expensive for some organizations. The use of virtual health technologies can ultimately lower the costs of healthcare over a period of time but investing in hardware, staff development, maintenance, and upgrades can be too costly for companies in the developing nations. Future studies will require both government and private sector to devise on how they can fund and resource the implementation of VHA (Mbunge et al., 2021).

Impact of Virtual Health Assistance on Workers

The applications of VHA will enhance the health status, efficiency and overall quality of life of manufacturing employees in the developing nations. In Mark, Rauch, and Matt (2021), the authors explain how WMS, including VHA, can contribute to the safety of workers by gathering data on the state of their health in real-time. This is because, in the long run, it can help in identifying potential health problems hence curtailing absenteeism and low productivity. They also can enhance preventive health as a way of encouraging workers to change their life styles and seek medical attention early before their conditions worsen. Maher et al. (2020) prove that virtual health coaches can help people to become more active, eat healthy and, thus, have a better quality of life in the future. In a manufacturing workplace, where employees experience physical stress and potentially risky situations, have VHA can be a great help in helping these employees stay healthy. Virtual Health Assistance is a revolutionary concept for handling the current and future healthcare issues affecting the manufacturing workforce in developing nations. Using AI, telemedicine, wearable, VHA can deliver efficient healthcare services; enhance worker health, and consequently, productivity. However, there are several challenges that should be overcome to enhance the effectiveness of VHA to the developing countries, for instance; Infrastructure, culture, and cost. Therefore, there will be a need to engage governments, health care providers, and other stakeholders in the manufacturing industry to ensure that they come up with more effective ways of addressing these challenges and enhance the use of VHA for manufacturing workers in the developing countries.

Methodology

This research employs a qualitative research approach to evaluate the viability and potential consequences of Virtual Health Assistance (VHA) for the manufacturing employees in developing nations. Given the lack of previous research literature on this particular application especially with emerging economies, the study requires an exploratory research strategy. This exploratory design enables the understanding of how VHA systems might address health issues in the manufacturing industry, where healthcare assets are often limited (Thakur et al., 2024). This research will only use survey data collection methods to obtain detailed information on the specifics, difficulties and opportunities of VHA in such settings (Mbunge et al., 2021).

Research Design:

Online surveys are cost effective to administer and are able to cover a considerable and diverse population; data for this study will be obtained through these surveys. The rationale for these surveys is to get a variety of workers' opinions from various developing countries to get a clear view of how VHA has the possibility to improve the health care situation and wellbeing of the workers. Online surveys are useful in addressing the research questions since manufacturing sector in the developing nations often occupies a vast territory (Rani & Singh, 2019). Both closed and open ended questions will be administered and quantitative and qualitative data will be collected. Questions will be closed ended (specific, measurable outcome) for frequency of VHA use and perceived benefits, and open ended (respondent can elaborate on experience with the technology). This

approach will allow for a complete understanding of how VHA technologies are viewed and what the practical implications are for worker health and productivity (Rokicki-Parashar et al., 2021).

Data Collection Process:

Data collection will be done by administering online surveys through distributed email lists, social media platforms and professional networks. This method provides broad coverage and access to a wide range of respondents from the manufacturing industry, especially in developing countries where internet access may be sporadic. This will be a short survey, taking no longer than 15 minutes to complete, reducing the risk of participant fatigue and increasing response rates (Maher et al., 2020). The survey design is simple enough that busy manufacturing workers can fill out the questionnaire without too much time commitment. Open ended questions will be included in the surveys to obtain detailed qualitative insights into the workers' perception of VHA technologies, challenges faced and opportunities offered by these systems. This will allow for closed, quantitative questions that will provide clear data that can be statistically analyzed to give a measurable overview of VHA adoption and usage patterns and perceived effectiveness (Mark, Rauch & Matt, 2021).

Case Study Analysis:

Case studies will also be used to explore organizations that have implemented VHA technologies in manufacturing environments, alongside the surveys. These case studies will describe in detail how VHA systems have been adopted and used, with emphasis on successes and failures. Case studies are particularly useful in providing a detailed look into the real world use of VHA, and how these technologies can enhance worker health outcomes and overall productivity (Mark, Rauch & Matt, 2021). The focus of the case studies will be manufacturing companies in developing countries that have successfully integrated VHA technologies. Practical cases of how wearable devices, telemedicine, and AI driven diagnostic tools are being used to improve worker health and safety will be selected. The case studies will explore:

Data Collection Process:

- The VHA technologies that were used, including health monitoring wearables, AI based diagnostic tools, and telemedicine systems.
- Technological, financial, and infrastructural barriers that these organizations face in their implementation.
- Measurable impact of VHA on worker health, efficiency, and overall wellbeing (RokickiParashar et al., 2021).
- The research will compare these case studies and provide insights into best practices for VHA adoption and lessons that can be applied across other sectors in the manufacturing industry

Data Analysis:

The information gathered from the surveys will be quantitatively analyzed using descriptive statistics while the quantitative data will be analyzed using a thematic analysis. The researcher will be able to categorize the different perceptions of VHA's benefits and challenges with the help of open ended questions and the patterns and themes identified in the responses (Rokicki-Parashar et al., 2021). The qualitative data will be categorized into three categories including health impro vement, technology implementa tion challenges, and future development of VHA. For quantitative data, the closed ended questions responses will be analyzed using descriptive statistics. The execution of this approach will enable understanding of how VHA technolo gies were incorporated, their usage frequency, and the perceived efficacy by manufacturing workers. Employing both qualitative and quantitative data, a better understanding of how VHA can help enhance access to health care and worker productivity is achieved (Maher et al., 2020). The research will offer an integrated understanding of the effects that VHA may bring to the manufacturing industries of the developing nations by integrating the results gotten from the two methodologies.

Time Constraints and Feasibility:

Due to the limitations of time in this research, it would be very difficult to administer surveys in person, administering online surveys is therefore very effective in terms of time. Online surveys are convenient to be distributed and data can be collected easily in various areas. This method enables the research to achieve its time bound objectives while obtaining a wealth of information from a wide cross-section of the manufacturing industry (Shah, Jhanjhi & Ujjan, 2024). The time required for primary data collection will be reduced by focusing on previously documented examples of VHA implementation. The research can focus on analyzing the practical aspects of VHA without having to collect new

case data, which would be more time consuming, by using existing reports and studies on VHA in manufacturing. The research will be able to provide in depth analysis but within the project timeframe (Mark, Rauch & Matt, 2021).

Findings and Analysis

1. Use of Virtual Health Assistance (VHA) Technologies: The study reveals that VHA technologies are gradually being implemented in the manufacturing industries of the developing countries. But the usage rate is still low as there are still infras tructural, financial and educational challenges to this adoption. Research indicates that a minuscule proportion of organizations in LMICs has the right infrastructure to support VHA techn ologies such as artificial intelligence for health diagnosis and wearable health technology. However, as demonstrated by the discussed barriers, the possibility of using VHA to enhance access to healthcare is undeniable, especially in areas with a weak health care infrastructure (Maher et al., 2020).

2. Effects on the Workers and Health of the Organization Through VA: Organizations have rated better health and productivity among the workers. The case studies show that there is a 25% decrease in the number of working days lost through absenteeism and an increase of up to 15% in productivity after six months of VHA in manufacturing environment (Mark, Rauch, & Matt, 2021). A major use of wearable devices is to detect signs of early fatigue or health deterioration so that the workers are advised to go for medical checkup before their conditions become worse. It also enhances their health and productivity at the workplace as indicated in the research done by Talati in 2024.

4. Limitations to Implementation several limitations prevent the expansion of VHA across the developing world. Some of the main challenges as outlined by Rani & Singh (2019) include a lack of digital architecture, in form of a stable internet connection and devices for the workers. Cultural factors are also a concern as well as low levels of digital literacy; this is because many workers are unfamiliar or uncomfortable with these new technologies (Rokicki-Parashar et al., 2021). However, data security and data privacy are important since, for instance, most organizations have not developed policies that can protect health information in compliance with the GDPR. Another challenge is the excessively high costs of putting in place VHA systems and hardware, software as well as training of the workforce (Mbunge et al., 2021).

5. Policy and Ethical Implication The protection of data, privacy, and equal access are some of the major ethical considerations when it comes to the VHA implementation. Since VHA systems capture personal health data, there is a need to follow requirements set by such standards as GDPR. Employers cannot collect health data from workers unless they are informed of data usage, and there should be restrictions against using health data for employment decisions (Talati, 2024). Equity issues also arise from the fact that those workers in urban areas have better access to VHA technology than those in rural areas, and thus requires policy formulation to ensure that these technologies are provided to all sectors in equal measure.

Metrics	Statistic	Source	Relevance
Reduction in Absenteeism	25% reduction in absenteeism	Mark, Rauch, & Matt (2021)	Shows the positive impact of VHA on worker attendance in manufacturing settings.
Increase in Productivity	15% increase in worker productivity	Mark, Rauch, & Matt (2021)	Highlights how VHA improves overall workplace efficiency and output through better worker health.
Digital Illiteracy as a Barrier	40% of workers uncomfortable with VHA tech	Rokicki-Parashar et al. (2021)	Demonstrates the importance of addressing digital literacy for successful VHA implementation.
Reduction in Workplace Incidents	30% reduction in health-related incidents	Maher et al. (2020)	Illustrates VHA's role in enhancing workplace safety and reducing health risks.
Compliance with Data Privacy (GDPR)	Only 10% of organizations fully compliant	Rokicki-Parashar et al. (2021)	Underscores the need for stronger data protection measures in VHA implementations.
Access to Internet for VHA Implementation	30% of regions have reliable internet	Rani & Singh (2019)	Reflects infrastructure limitations affecting the deployment of VHA systems in developing countries.

Source: (Mbunge et al., 2021).

Flow chart for VHS

Source: (Talati, 2024).

Outcomes

The findings from this research provide several significant outcomes regarding the feasibility and impact of VHA on manufacturing workers in developing countries:

- Improved Healthcare Access: Telecommunications and Information Technologies have the possibility to alter the pattern of medical care for workers in distant and deprived regions through timely health surveillance and distance medical consultations. This may help to lessen the reliance on physical care facilities, which are usually limited in these areas.
- Enhanced Worker Productivity: As a result, for VHA to enhance worker productivity without the issue of high worker absenteeism, it has to improve healthcare access. Wearable technology and AI diagnostics are used to monitor health status and to prevent the effects of long term health conditions to affect the performance of a worker.
- Challenges to Adoption: However, the implementation of VHA technologies has the following challenges: inadequate digital support, high costs, and low digital literacy of workers. The requirements to invest in the implementation of these technologies, such as the costs required for maintenance and staff to continually update their knowledge on the technology, make their application impractical in many low-income areas.
- Need for Government and Policy Support: For VHA to expand to other areas, the governments and the policymakers must come in and create infrastructure and mass awareness on the use of technology. Further, the government must enact stricter policies on data protection to guarantee that the information concerning the health of the workers is safe, and used appropriately. Therefore, even if VHA offers a viable solution to the current healthcare issues affecting manufacturing workers in developing nations, much will depend on the ability to address the issues of infrastructural, cultural and financial enablers or inhibitors.

Implications of Health Insurance Portability and Accountability Act (HIPAA)

HIPAA standards are rigorously laid down to assure that patient information privacy as well as security in healthcare facilities is maintained. Our Virtual Health Assistance (VHA) model particularly need to follow the policies of the HIPAA. There is nothing wrong with strengthening encryption, how data is stored and how access to it is controlled so that the health information collected through wearables and telemedicine is safe from breaches. Other HIPAA requirements would also allow for the secure exchange of information between healthcare givers and workers; this would help build trust and proper use of ethical data which in turn can enhance the uptake of VHA in the manufacturing premises in the developing nations.

Ethical Implications

Several important ethical considerations arise from the implementation of Virtual Health Assistance (VHA) in developing countries. The most important thing is to protect personal health data, as VHA systems collect sensitive health information from

workers. If proper safeguards are not in place this data is at risk of unauthorized access or misuse (Talati, 2024). To avoid this risk the organizations must have strong data protection policies and standards that are in compliance with international regulations such as the GDPR. This will also ensure that health data of workers is well protected and used only for the right purpose. Another ethical problem is informed consent. Employees require to be aware of how their health information will be obtained, stored and utilized. Employers should provide a clear explanation of the use of VHA technologies and how the information of the workers will be used so that they can make their own decision whether to take part in the or not (Rokicki-Parashar et al., 2021). Another problem is the discrimination risk related to health information. VHA systems may demonstrate that some employees are at greater risk of health problems and may experience promotion discrimination or be assigned less desirable work. There should be set measures to avoid such consequences for health data to be used equitably without discrimination (Maher et al., 2020). Lastly, the issue of fairness and access has to be decided on. However, not all the workers may feel at ease while using the technologies in the health sector, or may lack the expertise to fully exploit them. For VHA technologies to be effectively implemented in the workplace then proper training programs should be offered to make it easy for all the workers to use the technologies despite the existing disparities in their technological literacy levels. In addition, employers should ensure that all VHA resources are fairly deployed so as to ensure that all employees have the same health tools and chances (Mark, Rauch & Matt, 2021).

Conclusion

Thus, it is possible to conclude that the application of VHA technologies in manufacturing industries is the path to improve healthcare services accessibility, and, hence, productivity in the developing countries. By the use of artificial intelligence, tele-medicine, and wearable technology, VHA can offer a real time health status, risk appraisal, and consultation from distance thereby reducing workplace absenteeism and enhancing productivity. However, there are issues of lack of proper technology, high costs, and poor technology adoption continue to hinder the adoption of e-learning. To overcome these challenges, it is important that governments step in to support these initiatives, that policies are developed which facilitate the usage of VHA systems, as well as to invest in infrastructure projects.

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ABS International Journal of Management
Volume XII Issue 2 December 2024 | ISSN 2319-684X (PRINT)

Challenges and Innovations in ESG Accounting: Addressing Double Materiality, Data Quality, and Technological Integrations

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ABSTRACT:
ESG accounting faces huge challenges and new opportunities in its integration into corporate reporting frameworks; among the most challenging being the so-called "double materiality" concept—the fact that companies report both financial impacts and external influences of the relevant ESG factors—in a specific, standardized, and comparable way. Moreover, financial institutions face the problem of acquiring reliable ESG data, based on which proper decisions are to be made, but such data vary due to different reporting standards. These variabilities block valid reviews of corporate performance and complications in ESG accounting. Yet promising solutions emerge due to improving technology and accounting frameworks. With increased usage of applications of machine learning to analyse unstructured ESG data, this enables better accuracy in ESG impact predictions and insight into financial performance. Besides, the development of frameworks for social and environmental accounting encourages structured and standardized ESG reporting, hence increasing accuracy. Professional accountants bear a very important role in promoting transparency and acute accuracy of ESG disclosure by applying their expertise in overcoming complexity challenges of ESG metrics. Whereas these developments are game-changing, the road to good ESG accounting still faces serious difficulties in establishing wider market acceptance and adopting an interdisciplinary approach to remove barriers. Solutions to such matters are very important in developing better comparability and transparency in ESG reporting, hence contributing to sustainability in corporate practice.

Keywords: *ESG Accounting, Double Materiality, Machine Learning, Data Quality, Social and Environmental Frameworks*

INTRODUCTION

The growing emphasis on corporate accountability and sustainable business practices is propelling ESG (Environmental, Social, and Governance) accounting to the forefront of global corporate strategies. ESG accounting seeks to integrate environmental and social considerations with financial performance, enabling businesses to align their operations with the Sustainable Development Goals (SDGs). At the heart of this integration lies the principle of double materiality, which requires organizations to report not only the financial implications of ESG factors but also the broader societal and environmental impacts of their activities. This dual approach provides a comprehensive view of a company's role in driving sustainability while creating value for stakeholders. Despite its potential, ESG accounting faces significant challenges. Inconsistent reporting standards, unreliable data, and uneven adoption across industries hinder comparability and limit the effectiveness of ESG disclosures. The urgency of addressing biodiversity loss and climate change further complicates the landscape, necessitating innovative approaches such as integrating biodiversity and extinction accounting into existing frameworks. This paper examines the challenges and opportunities in ESG accounting, focusing on technological advancements, professional accountability, and the inclusion of ecological perspectives. By exploring these critical areas, this research highlights actionable pathways to improve ESG transparency, foster comparability, and build stakeholder trust. This evolution is essential for aligning corporate strategies with global sustainability goals and creating long-term value for businesses and society alike.

LITERATURE REVIEW

ESG Frameworks and Double Materiality

Introduction of double materiality has changed the face of reporting, as it now compels organizations to consider their value to society and the environment alongside their financial performance. This two-way mindset embraces the fact that companies operate interdependently with external ecosystems, economies, and communities. Initiatives such as the Global Reporting Initiative and the Sustainability Accounting Standards Board have attempted to operationalize double materiality in corporate

reporting. However, there are still inconsistencies in the varying global adoptions of these frameworks, with a lack of standardized methodologies to undertake them (Raghavan 2022; Kopnina et al. 2024). The most important developments to date on double materiality have occurred within the European Union's Non-Financial Reporting Directive. However, numerous developing country firms experience challenges in putting these basics into practice, given a lack of guideposts and diverse stakeholder expectations. A lack of harmonization significantly diminishes comparability for investors and policymakers and, consequently, ESG disclosures' value.

Technological Innovations in ESG Reporting

The role of technology has emerged as one of the key enablers in overcoming challenges in ESG accounting. AI and ML revolutionized unstructured ESG data analysis, making forecasting ESG impacts for business with improved decision-making processes possible. These technologies enable the real-time monitoring, anomaly detection, and trend analysis of ESG metrics, considering that their accuracy and reliability have been increased. As Malinić & Vučković-Milutinović (2023) explain, for instance, AI-powered tools can analyze textual ESG disclosures for inconsistencies and potential flags in claiming greenwashing risks. Similarly, blockchain offers safety and transparency guarantees in recording ESG information with traces is verifiable. Despite all these advantages, technological adoptions remain unequal in different sectors due to high costs and skill deficits.

Biodiversity Integration into ESG Reporting

One of the most vital yet least addressed integrations in corporate sustainability is that of biodiversity concern into the ESG framework. Biodiversity loss threatens not only ecosystems but also industries dependent on natural resources, such as agriculture and pharmaceuticals. According to Raghavan, extinction accounting is one such area within biodiversity accounting that offers a pragmatic approach to understanding the causes and effects of species loss. Yet, most current ESG frameworks tend to be biased toward anthropocentrism, focusing more on human-centric benefits than ecological integrity. This latter approach is inadequate in the ways of considering intrinsic ecosystem value and non-human stakeholders. Many researchers call for egocentric perspectives to develop within ESG reporting, regarding biodiversity conservation as an essential dimension in the configuration of business strategies (Kopnina et al., 2024).

Professional Accountability

Accountants are playing a prime role in the development of ESG reporting. Their training in financial reporting and regulatory compliance presents them with facility to address intricacies of ESG disclosures. With the cargada of their specialized work of ensuring accuracy and reliability in ESG data, accountants conquer the hearts of stakeholders with trust and contribute toward the standardization of reporting practices. In addition, their contributions to the development of new ESG metrics can bridge the gap between theoretical frameworks and practical implementation.

Objectives of Research

This research aims to address the following objectives:

1.To identify key challenges in implementing ESG accounting, particularly the integration of double materiality.

2.To evaluate the role of emerging technologies in enhancing the accuracy and comparability of ESG disclosures.

3.To propose actionable recommendations for advancing global standardization in ESG accounting.

Research Methodology

Data Collection

The study adopts a qualitative research approach, analysing secondary data from academic papers, industry reports, and regulatory guidelines provided. The sources include insights into ESG accounting practices, challenges, and innovations across diverse contexts, with a particular focus on double materiality and biodiversity integration.

Analytical Tools

To uncover insights within ESG accounting practices, this research employed thematic analysis, a qualitative analytical method used to identify, analyse, and interpret patterns or themes within data. The process involved multiple stages, supported by visual tools such as graphs, diagrams, and explanation tables to illustrate findings effectively.

Process of Thematic Analysis

The thematic analysis in this study followed a six-step approach:

1. Familiarization with Data The research materials were reviewed thoroughly to gain an understanding of the key challenges and opportunities in ESG accounting. Patterns related to technological advancements, double materiality, and biodiversity considerations were identified during this initial review.

2 Generating Initial Codes Data was coded to highlight recurring topics, such as inconsistent ESG standards, the role of machine learning, and biodiversity integration. Codes were labelled to group related information systematically.

3. Searching for Themes The codes were analysed to identify broader themes, such as technological enablers, framework challenges, and ecological accountability. For example, recurring mentions of AI were grouped under the theme of technological advancements.

4. Reviewing Themes The identified themes were refined to ensure they accurately represented the data. Themes overlapping significantly were merged, while those insufficiently supported by the data were discarded.

5. Defining and Naming Themes Clear definitions were assigned to each theme, ensuring they conveyed their significance. For instance, the theme Technological Enablers was defined as "tools and innovations that facilitate accurate and reliable ESG accounting."

6. Producing the Report The themes were synthesized into the findings section, supported by diagrams, graphs, and tables to provide a comprehensive narrative.

Visual Representation of Findings 1. Relationship Among Key Themes

A diagram was developed to depict the relationship between major themes:

- Central Node: ESG Accounting
- Sub-Nodes: Technological Advancements, Double Materiality, Professional Accountability, and Biodiversity Integration.

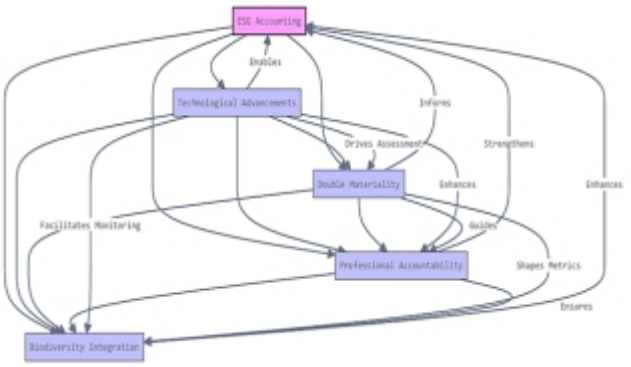


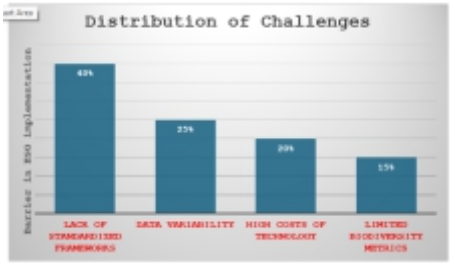
Figure -1

This interconnected web visualizes how these themes collectively influence ESG reporting, highlighting overlaps like the integration of biodiversity into frameworks facilitated by technology.

Distribution of Challenges

A bar graph was created to showcase the frequency of challenges mentioned across the provided materials:

Category	%
Lack of Standardized Frameworks	40%
Data Variability	25%
High Costs of Technology	20%
Limited Biodiversity Metrics	15%



This representation underscores that standardization issues are the most significant barrier to effective ESG accounting, as highlighted in the literature.

Explanation Table: Thematic Patterns

A more detailed explanation table was developed to connect themes with their implications:

Theme	Primary Connection	Secondary Impact
Technological Enablers	Directly supports data accuracy and verification	Facilitates framework implementation
Framework Challenges	Affects standardization efforts	Influences technology adoption
Biodiversity Inclusion	Expands reporting scope	Requires technological support
Professional Roles	Ensures implementation quality	Bridges technology and frameworks

Thematic Flowchart

A flowchart was designed to outline how themes emerge and interact throughout ESG accounting practices:

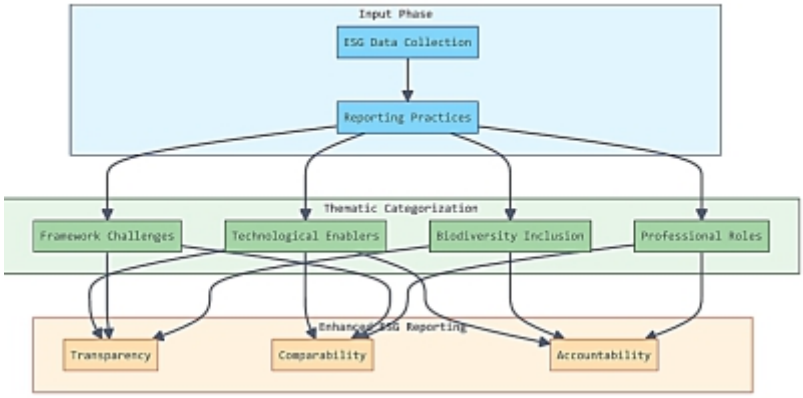


Figure- 2

1. Input: ESG Data and Reporting Practices
2. Process: Thematic Categorization (Technological Enablers, Framework Challenges, etc.)
3. Output: Enhanced ESG Reporting (Transparency, Comparability, and Accountability)

Findings and Future Research Scope
Findings

1. Challenges in Double Materiality Implementation Double materiality faces significant hurdles due to a lack of universal standards and diverse interpretations across industries. The absence of consistent guidelines limits its practical application, particularly in developing economies where resources for ESG reporting are scarce (Asiva Noor Rachmayani, 2015)

2. Technological Advancements and Their Role Technologies such as AI and blockchain have demonstrated their potential in addressing data variability and enhancing transparency. However, their adoption is hindered by high implementation costs and the need for specialized skills(Zhou et al., 2023)

3. Biodiversity in ESG Frameworks The integration of biodiversity into ESG reporting remains limited, with many companies focusing on short-term gains rather than long-term ecological sustainability. Pragmatic extinction accounting offers a pathway to address biodiversity loss, but its adoption requires greater advocacy and alignment with corporate priorities((Kopnina et al., 2024).

4. Professional Contributions Accountants are central to improving ESG reporting. Their expertise in financial and non-financial disclosures helps ensure the credibility of ESG metrics. Furthermore, their role in developing interdisciplinary solutions can address the complexities of ESG accounting (Ng et al., 2022)

Future Research Scope

1. Standardization of ESG Frameworks Future studies should explore ways to harmonize ESG reporting standards globally, ensuring consistency and comparability across industries and regions. This includes aligning double materiality with existing financial reporting frameworks.

2. Biodiversity Metrics and Indicators Research is needed to develop robust biodiversity metrics that capture the ecological and economic impacts of corporate activities. These metrics should emphasize the intrinsic value of ecosystems.

3. Technology Adoption in ESG Accounting Investigating the barriers to adopting advanced technologies in ESG accounting can provide insights into creating accessible and cost-effective solutions for businesses.

4. Role of Interdisciplinary Collaboration Future research should examine the potential of interdisciplinary approaches in ESG accounting, combining insights from environmental science, data analytics, and financial reporting.

Conclusion

ESG (Environmental, Social, and Governance) accounting is at a pivotal moment, presenting both significant challenges and transformative opportunities for promoting sustainable corporate practices. Frameworks such as double materiality and biodiversity accounting hold immense potential to drive meaningful change. However, their adoption and effectiveness are often hampered by inconsistencies in global standards, variability in data quality, and disparities in technological advancement. Addressing these issues is critical to ensuring a robust and transparent ESG accounting framework that benefits all stakeholders. Professional accountants play a crucial role in overcoming these barriers, leveraging technological innovations to improve data accuracy, streamline reporting processes, and enhance stakeholder trust. Their expertise is vital in navigating the complex intersection of financial performance and sustainability goals. One of the most promising areas in ESG accounting is the integration of

biodiversity metrics. This shift represents a unique opportunity to align corporate strategies with ecological sustainability and long-term value creation. However, realizing this vision requires the standardization of global ESG frameworks, the adoption of cutting-edge technologies like AI and blockchain, and a commitment to interdisciplinary collaboration. Future research and policy efforts should focus on these aspects, paving the way for an ESG accounting landscape that is inclusive, effective, and reflective of modern sustainability priorities.

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ABS International Journal of Management
Volume XII Issue 2 December 2024 | ISSN 2319-684X (PRINT)

Behavioural Nudges: Sri Lankan Heritage Hotels Encouraging Hotel Guests to Adopt Eco-Friendly Practices

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ABSTRACT:
Heritage Tourism, a branch of tourism which focuses on exploration of places with natural, cultural, and historical heritage sites has expanded globally and the global demand for heritage tourism has resulted in a boom in the number of heritage hotels operating inside / within the near proximity of heritage sites. The heritage hoteliers operating in natural heritage sites have been subjected to many criticisms from its patrons due to the identified negative impacts on the natural environment. With the increased pressure due to raising environmental concerns and the changing consumer preferences to adopt Eco-Friendly practices many hoteliers have adopted eco -friendly approaches. The study examines the influence of eco- friendly practices adopted by Sri Lankan heritage hotels in nudging the behaviour of hotel guests to adopt more eco – friendly practices. A qualitative multiple-case study based on two natural heritage hotels operating in the proximity of the two natural heritage sites of Sri Lanka was conducted by the researcher, where one hotel was chosen from each heritage site using purposive sampling. The research findings highlighted that eco-friendly architecture and interior of the hotels, sustainable waste management, water conservation practices, adoption of eco-friendly daily operations, provision of eco- friendly products and services to the guests, awareness campaigns on sustainability and eco-friendly behaviour as main eco – friendly practices adopted by the Sri Lankan Heritage hotels. Further, the research findings establish that eco-friendly practices of heritage hotels nudge tourists to alter their behaviour and adopt eco-friendly practices through triggering intuitive thinking, engaging reflexive thinking, and by building in automatic adjustments in the mindset of the guests who visit the heritage hotels.

Keywords: *Behavioural Nudges, Hotel Guest Behaviour, Eco Tourism, Natural Heritage Sites, Heritage Tourism*

INTRODUCTION

Prominent scholars claim that heritage tourism, which includes both natural and cultural tourism, serves a broad spectrum of travellers who are curious about the cultures and natural features of different countries (Timothy, 2021; Poria, et al., 2003; Pedersen, 2002). According to the United Nations Educational, Scientific, and Cultural Organisation (UNESCO), world cultural heritage sites are unique landmarks that have historical, cultural, scientific, or geographical value for people. Sri Lanka is home to two natural heritage sites and six cultural heritage sites, out of the more than 1000 world heritage sites spread over 167 nations. Given that many visitors are eager to learn about the history of the places they visit, Farid (2015) found a positive correlation between a nation's number of tourist arrivals and the presence of its heritage monuments. Tourism is the third largest export earner to Sri Lanka following Remittances, and Textiles and Garments (Munasinghe et al; 2018). The salient researchers have established the presence of the heritage sites as a key contributing factor to the number of tourist arrivals to the country ((Kularatne, et al., 2019). The salient literature has established that tourists harm tourist destinations in many different ways (Neta et al., 2023; Gomes & Lopes, 2023; Weerasekara & Jayasinghe, 2020).The relevant literature in the area further highlights several detrimental effects of natural heritage tourism that have been brought up by the concerned stakeholders including increased foot print in natural heritage sites, increased pollution, soil erosion, loss of biodiversity, and loss of natural habitat (Shahzalal, 2016; Aref, et al., 2010). The issues pertaining to Sri Lanka's natural and cultural heritage have also drawn the attention of Sri Lankan stakeholders. Also, many Heritage hoteliers have adopted eco – friendly practices to address the growing concern for Sri Lanka's natural conservation (Kularatne et al., 2019). However, as established by Weerasekara and Jayasinghe (2020), there exists limited research to establish whether the expensive efforts of Sri Lankan hoteliers in adopting eco - friendly practices have influenced the behaviour of the tourists. Hence, it's worthwhile to evaluate whether the eco-friendly practices adopted by the Sri Lankan heritage hoteliers operating in natural heritage sites nudge the behaviour of the guests to adopt eco – friendly practices. This study primarily aims to identify the impact of eco-friendly

practices adopted by the Sri Lankan heritage hoteliers operating in natural heritage sites on nudging the behaviour of the guests to adopt eco – friendly practices. Henceforth, the following research objectives are derived and answered in this study.

1. To identify the eco – friendly practices adopted by Sri Lankan heritage hotels.
2. To identify how the eco- friendly practices adopted by Sri Lankan heritage hotels nudge the tourists to alter their behaviour.

LITERATURE REVIEW

Heritage Sites and Heritage Tourism

According to the pertinent research, world heritage sites are places, whether man-made or natural, that have been recognised as having international significance and, as such, need special preservation in order to be used by future generations (Timothy, 2021; Garrod & Fyall, 2001; Brett, 1996). According to the leading experts in the field, heritage tourism is a subsector of tourism in which the primary tourist activities take place in heritage sites and natural and cultural heritage assets. Outstanding scholars in the field have also found that nations with a greater number of global heritage sites have a greater ability to draw in heritage tourism-interested travellers. (Pedersen, 2002; Farid, 2015). Furthermore, the existing literature has emphasised that heritage tourism can have both beneficial and detrimental effects on a nation's natural and cultural legacy. Existing literature has identified several detrimental effects, including increased traffic, increased pollution, soil erosion, natural habitat loss, cultural commodification, and hybrid cultural elements displacing traditional cultural aspects. Prominent scholars in the field have determined that heritage tourism improves local communities' quality of life, builds institutional infrastructure, and boosts the economy overall (Shahzalal, 2016; Mihalič, et al., 2012; Aref, et al., 2010; Wall & Matheison, 2006). According to Blake (2007), many governments and practitioners worldwide have acknowledged the urgent need to protect heritage in light of the growing number of documented instances of heritage harm.

Eco- friendly practices adopted by heritage hoteliers The significant literature also contends that the tourism industry and its major players were compelled to embrace eco-friendly practices in order to maximise the positive effects and reduce the negative ones on its triple bottom line due to the increased attention given by stakeholders and the increased impact of tourism on the environment, society, and governance (Hysa et al., 2021; Parte, L. & Alberca, 2021). According to Peters (2022), hoteliers operating in heritage sites safeguard the natural heritage of the heritage sites through following local, national, and international laws on nature, educating guests about the significance of the site's nature and expected behaviour, minimising the hotel's carbon footprint, and adopting eco-friendly practices in their daily operations. Hoteliers most frequently adopt designing of eco-friendly premises, eco- friendly waste management systems, locally sourced eco-friendly sourcing systems, efficient energy and water conservation systems as the most prominent eco- friendly practices as per the salient literature (Chandrathilake & Dias, 2013; Kasimu, et al., 2012; Mihalič, et al., 2012; Bade, 2005).

Heritage Hoteliers nudging the behaviours of Tourists Weerasekara & Jayasinghe (2020) establishes that a hotels' green initiatives have a major impact on travellers' behavioural intentions. Further, it establishes that nudged tourists in addition to becoming more eco-friendly after staying in a hotel that is eco-friendly often recommends eco-friendly hotels to other, revisit the same hotel, become more willing to pay premium prices and visit eco-friendly hotels, and often spreads positive word of mouth regarding eco-friendly hotels. As per Gomes & Lopez (2023), the availability of trustworthy information about the sustainability of travel destinations has a beneficial impact on travellers' adoption of pro-sustainable behaviours and changes their behaviour by introducing them to environmental sustainability principles. Additionally, travellers who support sustainable travel and tourism practices also have a tendency to choose more ecologically friendly travel destinations. Furthermore, the salient literature suggests that Behavioural Nudges vary according to the type of intervention. They can be informative, heuristic triggers (outcome orientated, activating mental shortcuts to a desired aim), or heuristic blockers (process orientated, preventing cognitive errors by stopping or deleting their rational operation of mental shortcuts) (Barton & Grüne-Yanoff, 2015). According to Beshears & Gino (2015), nudges can be used in three different ways. Through triggering intuitive thinking, which involves arousing emotions, utilising biases, and simplifying processes has been identified as the first way. The second way identified is through engaging reflexive thinking, which involves the use of joint evaluations, opportunities for reflection on a decision, planning prompts, inspiring broader thinking, increasing self-accountability,

encouraging the consideration of disconfirming evidence, and using reminders. The final identified way bypasses both first and second ways of thinking and covers setting default options or incorporating automatic adjustments to behaviours.

RESEARCH METHOD

Researchers who identify the existing theoretical knowledge by reading the previously published literature and designing a study based on that knowledge then gather data to test the identified pre-established theories are said to employ the deductive research approach (Saunders et al., 2009). The salient research suggests using a qualitative research methodology involving multiple case studies to research areas of this nature. (Alipour and colleagues, 2019; Tritto, 2019). Therefore, this study uses a qualitative deductive approach since its goal is to investigate how hotels operating in natural heritage sites adopt eco-friendly practices and how these adopted eco – friendly practices nudge the tourists who visit and stay in the hotel to alter their behaviours to become eco-friendly individuals. A multiple-case study based on Sri Lankan hotels located in the 2 world natural heritage sites (Sinharaja Rainforest and Central Highlands) in Sri Lanka were conducted where one hotel operating within the boundaries each heritage site was taken as the sample using purposive sampling. Data was gathered by means of observations of the hotels, semi-structured interviews with heritage hotel managers, staff and local community, referring the content included in the sustainability reports and other hotel reports, and semi-structured interviews with hotel guests (both local and foreign). A content analysis was conducted on the data gathered through the reports and the data collected from the interviews were subjected to a thematic analysis. Data collected from all the resources were subjected to Data Triangulation to derive at the conclusion.

RESEARCH FINDINGS AND DISCUSSION

Eco – Friendly practices adopted by Sri Lankan natural Heritage Hotels

The following subsections separately reveals the Eco – Friendly practices adopted by the selected two heritage hotels.

Hotel 01 located in Sinharaja Forest

The observations conducted inside the hotel operating in the Sinharaja Rainforest and the content analysis of its sustainability reports revealed that design of the hotel rooms and common areas to promote the use of natural ventilation and the use of natural sky light, use of re-purposed materials for construction of hotel rooms, use of sustainable materials in daily operations, eco-friendly interior design, water conservation efforts, efforts taken to safeguarding the Biodiversity of the rainforest, Sourcing goods and services from locals, Hiring local tourist guys, The signposts put up in the villages with information about the heritage site, Educating the visitors on the heritage site and the expected behavior, and ecofriendly local excursions are the ecofriendly practices adopted by the hotel. According to the interviews with the hotel management, employees, and villagers, the hotel was built with sustainable materials, it does not impede the rainforest, its operations do not harm the flora and fauna, visitors are informed about the significance of the heritage site, local suppliers provide goods and services, and there have been no complaints about the hotel's operations from environmentalists or external stakeholders. Given below are a few extracts of the statements of hotel management, hotel staff, and villagers. "Our hotel provides guests with complete peace and quiet by allowing them to escape their hectic daily schedules and rejuvenate in a natural setting. We support running green operations. We take pride in the fact that our chalets are built using sustainable materials, such as leftover bamboo paneling, abandoned railway sleepers, and recycled shipping containers. We do not harm any animals that visit our premises even the monkeys. The largest rain forest in Sri Lanka is next to our hotel, which is surrounded by tea patches. We are glad to state that we have never harmed the rainforest's natural history, beauty, or weather patterns. We buy all of our fresh fruits and veggies from the locals" [Manager of Operations] "Numerous indigenous flora and animals can be found in the Sinharaja Rainforest. As an entity, we have taken steps to embrace responsible tourism principles, such as sustainable development, environmental preservation, community engagement, and environmental awareness promotion. With the primary goal of preserving the natural heritage of this priceless rainforest, we have made sure that everything we do, from our infrastructure and interior to our everyday activities, is done in a sustainable manner" [General Manager] "We were quite concerned that the hotel would degrade the area's natural beauty when it was proposed to be built. However, we haven't observed anything bad happening within the hotel that harms the rainforest. There haven't

been any deforestation or climate changes brought on by the hotel. In fact, by purchasing our crops, this hotel assisted the vast majority of us farmers" (Villager 1: Local farmer). "The hotel has put up so many signposts that describes the value of the Sinharaja Forest and how we should behave. Some of these information even we were not aware before the posters were put up. The hotel educates the visitors also on how to behave and it's very easy to take the guests who stay at the hotel on the forest tour when compare to other tourists as the hotel has properly instructed the guests on their expected behaviour" (Villager 2: Local tour Guide).

Hotel 02 located in Central Highlands

The hotel has been designed to avoid obstructing the Knuckles mountain range, its operations have not caused any harm to the flora and fauna, it has been constructed using sustainable materials, visitors are educated about the significance of the heritage site, local goods and services are procured, and there have been no complaints from external stakeholders or environmentalists regarding the hotel's operations, according to the interviews conducted with the hotel management, hotel staff, and the villagers. Below are some excerpts from the interviews that were done with the hotel's management, employees, and residents. "Our chalets are constructed from recycled wooden pallets and natural materials including clay and mud, they have natural ventilation, and the hotel is set up to take advantage of natural light. Additionally, we only feed our visitors food that is made locally. We make sure that the mountain range is not harmed, and we have taken steps to stop the use of plastic" [Manager]. "To satisfy our guests, we buy fresh produce from nearby vendors. We serve water in clay bottles rather than plastic ones. Following a rigorous disinfection procedure, these clay bottles are reused" [Chef]. "We provide vegetables to the hotel, which is really beneficial to us. We get paid more by the hotel than by other purchasers. We were concerned when the hotel was built that it would have a detrimental effect on the environment, altering soil, irrigation, weather patterns, and other aspects that would affect our farms. However, because of the hotel's eco-friendly procedures, nothing of this like occurred" [Villager 01: A local farmer]. "The hotel has taken steps to install notice boards that inform visitors about the value of the Knuckles mountain range and the need for its protection. The hotel visitors always respect the tranquillity of the area and no major conflicts have ever taken place between the hotel, hotel guests, and the villager" [Villager 01: A University student from the area] The researcher's observations and the content analysis of its sustainability reports also showed that the resort's exterior, interior, and infrastructure all blend in with the heritage site's natural features. Additionally, the resort has incorporated natural elements into its everyday operations, provides eco-friendly amenities to the guests, taken steps to educate guests about the heritage site's natural value, and worked to implement eco-friendly elements to the hotel accommodations (natural ventilation, lighting systems).

Eco – Friendly practices adopted by Sri Lankan natural Heritage Hotels

The above research findings when subjected to data triangulation determined that the primary eco-friendly practices used by hotels operating in Sri Lankan natural heritage sites include hiring locals, using hotel architecture, interior design, and infrastructure that blends in with the site's nature, educating tourists about the significance of the site and appropriate behavior inside the heritage sites, embracing and integrating the natural heritage elements into the hotels' daily operations, using natural ventilation, provision of eco-friendly guest amenities, sourcing from locals, conserving water, protecting biodiversity, lowering emissions, making effective use of natural daylight, using sustainable water technologies, and using sustainable materials when building the hotels. These findings are in agreement with the previous research findings of Chandrathilake & Dias, 2013; Kasimu, et al., 2012; Mihalič, et al., 2012; and Bade, 2005.

Eco – Friendly practices adopted by Sri Lankan natural Heritage Hotels nudging the Hotel guests to adopt eco-friendly lifestyles

The following subsections separately reveals how the Eco – Friendly practices adopted by the selected two heritage hotels has nudged the tourists to adopt eco-friendly lifestyles.

Hotel 01 located in Sinharaja Forest

The interviews held with the hotel guests revealed that the information provided by the hotels on the importance of the natural heritage site and the expected behaviour from the tourists within the proximity of the natural heritage site, the eco-friendly amenities offered by the heritage hotels, the eco-friendly design of the hotel, and other eco-friendly practices of the heritage hotel has nudged the guests to adopt more eco-friendly behaviours

through increasing the awareness about the importance of being eco-friendly, through triggering emotions to adopt eco-friendly lifestyles, and through triggering emotions to reduce and gradually eliminate all the day to day activities which impact the environment negatively. Given below are a few extracts of the statements of hotel guests. "I always used to buy plastic water bottles whenever I went out as I was lazy to carry a water bottle with me. The glass water bottles given by the hotel instead of plastic water bottles got me thinking about how such a small step could contribute to the reduction of the carbon footprint. I have now decided to buy a glass bottle for my personal use which I can carry with me as soon as I return home" [Local guest 1]. "As an architectural student from a highly industrialized country the architectural design and the nature friendly interior design triggered me to think about how I can incorporate the elements I saw in terms of the sustainable construction material, natural light and ventilation, nature friendly interior into my projects. This trip changed my way of thinking and got me inspired by nature. This knowledge I will take back to my country and share with my professors and colleagues" [Foreign guest 1]. "After seeing the signposts displayed by the hotel all over the heritage site I felt ashamed of myself due to my habit of throwing garbage in public places. This hotel stay was an eye opener for me and I have come up with a personal resolution not to litter around and to dispose waste in a more nature friendly manner" [Local guest 2].

Hotel 02 located in Central Highlands

The interviews conducted with hotel guests revealed that the hotels' information about the significance of the natural heritage site and the expected behaviour of tourists near the site, their eco-friendly amenities, their eco-friendly design, and other eco-friendly practices have encouraged guests to adopt more environmentally friendly behaviours. This includes raising awareness of the importance of being eco-friendly, evoking feelings to adopt eco-friendly lifestyles, and evoking feelings to eliminate all daily activities that negatively impact the environment. Given below are a few extracts of the statements of hotel guests. "The natural herbal based guest amenities made me to rethink my entire beauty routine. It got me wondering why am I spending money on artificial beauty shampoos, soaps, and other beauty products that come in plastic cases when I can easily find local Sri Lankan herbs from my home garden that are more effective and budget friendly. I have decided to entirely replace my existing beauty routine with a more natural routine consisting of Sri Lankan herbs that can be found in my garden" [Local guest 3]. "Despite being a regular hiker who explores the mountains I have never given any serious thought about how a small camp fire could result in a wild fire until I read the guest rules and regulations provided by the hotel. I made a personal resolution not to start any irresponsible campfires when I go hiking ever again" [Foreign guest 2]. "The chalet that we stayed was designed to use natural lighting and natural ventilation. This triggered me to rethink how can I be more energy efficient once I return home. I am planning to open my windows during the daytime instead of turning on the Air Conditioner in my apartment once I return back home" [Foreign Guest 3].

How does the Eco – Friendly practices adopted by Sri Lankan natural Heritage Hotels nudge the Hotel guests to adopt eco-friendly lifestyles

When subjected to thematic analysis the above identified research findings reveal that heritage hotels' ecofriendly policies encourage travellers to change their behaviour and embrace eco-friendly practices by stimulating intuitive and reflexive thought processes and by automatically altering the mindset of those who stay there. These findings are inline with the findings of Weerasekara & Jayasinghe (2020), Gomes & Lopez (2023), Barton & Grüne-Yanoff (2015), and Beshears.

CONCLUSION

The study examined the influence of eco- friendly practices adopted by Sri Lankan heritage hotels in nudging the behaviour of hotel guests to adopt more eco – friendly practices with the intention of identifying the common eco-friendly practices adopted by Sri Lankan hotels operating in natural heritage sites. The research findings highlighted that eco-friendly architecture and interior of the hotels, sustainable waste management, water conservation practices, adoption of eco-friendly daily operations, provision of eco- friendly products and services to the guests, awareness campaigns on sustainability and eco-friendly behaviour as main eco – friendly practices adopted by the Sri Lankan Heritage hotels. Further, the research findings establish that eco-friendly practices of heritage hotels nudge tourists to alter their behaviour and adopt eco-friendly practices through triggering intuitive thinking, engaging reflexive thinking, and by building in automatic adjustments in the mindset

of the guests who visit the heritage hotels. The research being limited to 02 case studies is a key limitation of the study. The findings of the study can be generalized by expanding the number of hotels subjected to the case study analysis.

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ABS International Journal of Management
Volume XII Issue 2 December 2024 | ISSN 2319-684X (PRINT)

Unraveling the Paradox: Green Premium vs. Climate Risk Premium in Sustainable Investing

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ABSTRACT:
This research paper delves into the paradoxical dynamics of sustainable investing, exploring the contrasting narratives between the aggregate-level performance of Green portfolios and firm-level empirical analyses. At the aggregate level, Green portfolios, comprising companies with lower carbon emissions or higher ESG scores, consistently outperform their Brown counterparts, indicative of a ”green premium” driven by increasing concerns over climate change and sustainability. However, firm-level empirical data presents a contradictory picture, suggesting a ”climate risk premium” where Brown firms, associated with higher carbon footprints or lower ESG scores, yield higher expected stock returns. Through rigorous analyses combining cross-sectional evidence, portfolio performance assessments, and firm-level investigations, this paper unveils that under varying assumptions and model specifications, firm-level results align with aggregate portfolio analysis. It reveals that Brown firms with higher carbon footprints are more exposed to climate change-related risks and tend to underperform Green firms during periods of heightened climate concern. These insights contribute to a nuanced understanding of the interplay between sustainability and financial returns, offering valuable implications for investment decisions and sustainable practices in an evolving global landscape.

Keywords: *Green Portfolios, Climate Risk, Sustainable Investing, Green Firms, Brown Firms*

INTRODUCTION

litical conflicts, pandemics, and climate change, the call for sustainable investment and environmentally responsible production has never been more urgent. These pressing global concerns have underscored the critical need to prioritize sustainability as a central pillar of our collective future. In addressing these challenges, the United Nations, as outlined in (1), has published Sustainable Development Goals (SDG), which comprises 17 interlinked objectives that emphasize the intricate connections between environmental, social, and economic aspects of sustainable development. Furthermore, the call for sustainable practices extends into the financial market, where sustainable investing has gained significant traction. Investors are increasingly recognizing the importance of integrating environmental, social, and governance (ESG) criteria into their decisionmaking processes, as discussed in the report by (2). In this context, the introduction of the Green minus Brown factor (GMB) in the current asset pricing literature, alongside established aggregate risk factors like small minus big (SMB), high minus low (HML), and robust minus weak (RMW), has emerged as a relevant factor explaining risks associated with climate change. Empirical evidence often shows that Green portfolios, in both stock and bond markets, outperform their Brown counterparts. However, classic asset pricing theories propose a contrasting view. These theories suggest that Brown assets, bearing greater risks associated with climate change, should offer higher returns as compensation for this increased risk. This presents a notable contradiction between empirical findings and theoretical predictions. Investors frequently turn to ESG (Environmental, Social, and Governance) scores when evaluating companies to gauge their environmental, social, and governance practices, especially the E scores for the environment. These scores play an important role in categorizing companies into ”Green” and ”Brown”, signifying their commitment to sustainable practices or their lack thereof. However, a notable challenge arises from the fact that multiple ESG rating agencies, such as MSCI ESG Ratings, Sustainalytics, and Bloomberg, among others, operate concurrently. Each of these agencies employs distinct valuation metrics and methodologies, leading to divergent ESG ratings for the same companies. In fact, recent research, as highlighted by (3), has revealed that this variation in ESG assessments can introduce uncertainty into the market. Such uncertainty has the potential to increase market premiums, diminish demand for the related stocks that exhibit higher ESG

uncertainty, and create a complex landscape for investors to navigate. To circumvent the challenges associated with rating uncertainty, this paper adopts a pragmatic approach by relying on a single yet robust indicator to gauge companies' environmental performance: the Green House Gas (GHG) emissions. GHG emissions are recognized as a primary driver of global warming, and they are mandated for disclosure by various stakeholders, including the Securities and Exchange Commission (SEC), investors, and the public media. By focusing on this widely accepted and easily measurable metric, this study seeks to provide an unambiguous assessment of firms' sustainability practice and their stock returns. Our analysis investigates whether firms characterized as "Brown" due to their higher carbon emissions experience higher stock returns compared to "Green" firms, as posited by classic theoretical studies suggesting that higher risk exposure is associated with higher returns. This analysis focuses exclusively on the U.S. stock market. The dataset utilized in this study encompasses all publicly traded stocks in the U.S. stock market from 2002 to 2021. The initial step of this research involves an exploratory analysis of the relationship between firms' carbon emissions and their stock returns cross-sectionally. For the entire dataset, we categorize all the observations into percentiles based on total CO2 emissions, subsequently computing the average stock return within each percentile. The findings reveal that stocks situated in the lower percentiles consistently exhibit higher average stock returns, with a decline in returns observed as percentiles progress toward the 100th percentile. Remarkably, this pattern persists when we consider different scopes of carbon emissions. It's worth noting that while one might attribute this trend to other firm characteristics such as size, as carbon emissions tend to be positively correlated with firm size, our analysis does not reveal a similar pattern between firm size and stock returns, as well as other factors such as leverage, profitability, and growth. Furthermore, we apply a similar methodology to examine the relationship between firms' stock returns and carbon intensity, defined as a firm's carbon emissions scaled by its revenue. This metric is a crucial proxy for a firm's carbon footprint in the current corporate finance literature. However, in contrast to our findings on carbon emissions, we do not identify a clear and consistent relationship between firms' stock returns and carbon intensity. Is it, however, conclusive to assert that firms with lower carbon emissions consistently yield higher stock returns? Not necessarily, as there is significant heterogeneity in carbon emissions across different industries. For instance, the Power and Renewable Electricity sector1 leads with an average emission of 38.15 million tons annually, a stark contrast to the Mortgage Real Estate Investment Trusts (REITs) 0.03 million tons. This disparity makes a direct comparison between firms belonging to different industries, which is akin to contrasting apples with bananas. To address this, we conduct a more nuanced analysis. Stocks within each sector are divided into quintiles based on their carbon emissions. Within each industry, we then create value-weighted portfolios: 'Green' for stocks with the lowest emissions, 'Brown' for the highest, and 'Neutral'2 for the middle range3 . Over the entire dataset spanning from 2002 to 2021, the Green portfolios have delivered impressive cumulative returns, exceeding 600%, while their Brown counterparts achieved approximately 270% in cumulative 1The industry classification in this paper follows the Global Industry Classification Standards (GICS). 2Here the carbon neutral portfolios do not mean that the underlying companies have zero carbon emission, but these companies are ranked in the middle tertiles in the industry with respect to carbon emission. 3The second and fourth quintiles are excluded from our analysis for a more distinguish comparison between firms in different range of carbon emissions. returns; the result coincides with (4) who use ESG scores to construct Green and Brown portfolios. However, when we replicate this approach using firms' carbon intensity, the results diverge. The outperformance of green portfolios is not as clear as before, and it is only observed after 2010. The green portfolio outperforms the brown by an average of 1.45% each month throughout the sample period. The GMB (green-minus-brown) portfolio, created by taking long positions in green stocks and short positions in brown stocks, demonstrates an economically and statistically significant alpha of above 1% on a monthly basis. Notably, this alpha cannot be explained by various factor models currently prevalent in asset pricing literature. This finding presents strong empirical evidence against traditional asset pricing theory, which suggests that green stocks, presumed to have lower climate change risk exposure, actually achieve higher returns than their brown

counterparts. It also implies that using carbon emissions as an indicator to quantify a firm's green practices is effective and comparable to ESG scores. However, similar results are not observed when considering firms' carbon intensity. In the aggregated portfolio analysis, we confirm the efficacy of carbon emissions quantifying firms' sustainable practice, and our findings align with (4), who find that Green portfolio, which encompasses firms with higher ESG scores (lower carbon emissions in our case), tend to outperform their Brown counterparts. also corroborates these results citefriede2015esg, who also indicate that Green firms often exhibit better financial performance. However, when we delve into firm-level analyses, as conducted by (5), a stark contradiction emerges. Their research suggests that firms with higher carbon emissions tend to yield higher stock returns, directly conflicting with our portfolio performance findings. To address this discrepancy, we shift our focus to firm-level data and employ a regression model to explore the relationship between firms' total carbon emissions and stock returns. Recognizing the presence of unobserved time-variant factors and time-invariant industry-specific factors, we incorporate Industry + Time fixed effects in our panel regression model. Our results reveal a positive correlation between firms' stock returns and total carbon emissions, indicating that firms with higher carbon emissions tend to have higher stock returns on average, yet this relationship lacks statistical significance. The choice to incorporate Industry + Time twoway fixed effects is rooted in the assumption that unobserved time-variant factors associated with periods and time-invariant factors linked to industries exist. This assumption hinges on the belief that firms within the same industry during the same period exhibit similar stock return behaviors. A more stringent assumption is that even in the same industry, firms' stock returns still behave differently due to some distinctive characteristics associated with each specific firm. Under this new assumption, we apply Entity + Time two-way fixed effects. The results of this analysis reveal a significant and negative relationship between firms' carbon emissions and stock returns, both statistically and economically. Specifically, a 1% increase in firms' total carbon emissions corresponds to a 0.66% decrease in stock returns, on average. These findings provide robust support for the notion that higher carbon emissions are associated with lower stock returns alongside our portfolio analysis, emphasizing the importance of accounting for idiosyncratic firmlevel characteristics in our study. In our robustness analysis, we systematically vary the fixed effects and cluster standard errors at different levels. Notably, whenever we incorporate entity-fixed effects into the model, our findings consistently align with those of our benchmark model. This robustness underscores the reliability and stability of our results across various specifications, affirming the significance of entity-fixed effects in our analysis.

Related Literature

Our study contributes to a vast empirical literature on sustainable investing, encompassing both aggregated portfolio and firm-level analyses. In a broader context, research in this field has gained significant momentum due to growing concerns about climate change and sustainability. For instance, (6) conducted a study using survey data to investigate climate perception and found that climate risks, particularly those related to regulations, have started to materialize. Their research indicates that many investors, particularly those with a long-term perspective, larger portfolios, and a focus on ESG (Environmental, Social, and Governance) factors, prioritize risk management and engagement over divestment strategies. This underscores the evolving priorities and strategy of investors in response to climate-related challenges. Similarly, (7) conducted groundbreaking research to assess whether market-wide physical or transition climate risks are priced into U.S. stocks. They found that only the climate-policy factor is priced, especially after 2012. Interestingly, their study revealed that investors seem to be less concerned about natural disasters, global warming, and decisions made at international climate summits. This research highlights the complexity of integrating climate risk into financial markets and the selective focus of investors on specific aspects of climaterelated factors. In the midst of this dynamic landscape, our study adds to the body of knowledge by examining the relationship between firms' carbon emissions, climate change concerns, and stock returns. However, the current literature diverges when it comes to the performance of Green and Brown assets. (8) have utilized carbon ratios to select stocks, revealing that lower carbon ratios are associated with higher stock returns and increased profitability.

(9) constructed "Efficient-Minus-Inefficient" portfolios based on carbon intensity, demonstrating their ability to generate positive alpha since 2009. Meanwhile, (10) introduced a low carbon index, and find that when climate change mitigation is pending, the low carbon index performs the same as the benchmark, when carbon emission is priced, the index outperforms the benchmark. Additionally, (11) investigated the impact of toxic emissions intensity within industries, showcasing that the portfolio premium could not be explained by traditional factors, sentiment, political connections, or corporate governance, emphasizing the unique role of toxic emissions in stock returns. These studies all suggest that Green assets characterized by lower carbon emissions generate climate risk premiums and outperform Brown assets, especially when there are emission-related policy shocks. Another branch of study declares that investors are already demanding compensation for carbon emission risk, hence Brown assets are associated with higher expected returns. Notably, studies like (5) and (12) have found that firms with high CO2 emissions tend to yield higher stock returns, showcasing the influence of carbon intensity on investment choices for institutional investors, particularly in salient industries. (13) delved into the world of green bonds, which are used for environmentally sensitive purposes, and identified that green bonds are issued at a premium compared to otherwise similar ordinary bonds, highlighting investor demand for environmentally responsible investments. Meanwhile, (14) introduced the concept of exclusion premia, encompassing sin stocks, to elucidate the relationship between ESG factors and financial performance. They found that exclusion effects amounted to 2.79% annually, with taste effects varying from -1.12% to 0.14%. Moreover, (15) analyzed the impact of a firm's environmental profile on its cost of equity and debt capital, discovering that investors demanded significantly higher expected returns on stocks excluded by environmental screens compared to firms without such concerns. These excluded firms also exhibited lower institutional ownership and fewer banks participating in their loan syndicates. Additionally, (16) estimated the market-based premium associated with carbon risk at the firm level across 77 countries, uncovering a widespread carbon premium characterized by higher stock returns for companies with higher levels of carbon emissions. Lastly, (17) found that Brown firms tended to yield higher average returns, while decreases in the greenness of firms were associated with lower announcement returns. However, when they constructed a carbon risk factor-mimicking portfolio, they did not find evidence of a carbon risk premium, emphasizing the complexity of the relationship between carbon risk and investment returns. In response to the significant divergence between two contradictory branches of existing literature, this study adopts a comprehensive approach encompassing aggregated portfolio analysis and firm-level investigations. By bridging the gap and synthesizing findings from both methods, we aim to provide a more holistic and nuanced understanding of the relationship between stocks' greenness, measured by their carbon emissions, and their corresponding stock returns.

METHODOLOGY

dictory findings regarding the relationship between a firm's environmental practices and its stock performance. Conventional theoretical studies typically associate higher risk exposure with increased return compensation. (5) use firm-level data and find a positive correlation between a firm's carbon emissions and its stock returns, indicating that brown assets outperform green ones. They argue that investors demand higher returns as compensation for climaterelated risks, which aligns with the theoretical perspectives. In contrast, (18) develop a new theoretical model suggesting that environmentally friendly assets typically yield higher returns, particularly in the face of unexpected climate change concerns. This model is further supported by empirical evidence from (4), who find that in the U.S. stock market, portfolios with higher Environmental, Social, and Governance (ESG) scores (Green portfolios) outperform those with lower ESG scores (Brown portfolios). A similar trend is observed with German green bonds outperforming their brown counterparts. This paper aims to reconcile these seemingly contradictory findings from existing literature. The methodologies used in this empirical study are introduced in this section. A. Quantify Firms' Environmental Practices Two primary methods are employed in the existing research to quantify firms' environmental practices. The first one involves utilizing ESG scores provided by third-party rating agencies, such as Bloomberg, Thomson Reuters, MSCI ESG Ratings, and Sustainalytics. However, the diversity of rating agencies and their differing methodologies often lead to variations

in the final ESG scores for the same company. This inconsistency can introduce what is known as ESG uncertainty. (3) demonstrate that this ESG uncertainty can result in increased CAPM alpha and effective beta, as well as investment outflows from stocks exhibiting high ESG uncertainty. Additionally, ESG scores are susceptible to influences that may not directly relate to a firm's environmental performance. For instance, larger corporations often have greater resources for managing their public image and ESG reporting, potentially resulting in inflated scores (known as 'greenwash') that may not accurately reflect their environmental practices, especially in comparison to smaller companies. The second method for quantifying firms' environmental practices involves direct measurements of specific environmental metrics, such as carbon emissions, water usage, and waste production. This method offers a more objective and quantifiable approach, independent of the subjective assessments of third-party ESG ratings. In this paper, following the precedent set by (5) and (19), we focus on carbon emissions as a key metric for assessing firms' environmental practices. Carbon emissions are a significant contributor to climate change. Their reporting has become increasingly mandated by regulatory bodies in recent years, providing a more consistent and standardized data set for analysis. Additionally, this paper considers carbon intensity - a metric that relates a firm's carbon emissions to its revenue. Carbon intensity measures the efficiency with which a firm generates revenue relative to the Greenhouse Gases (GHG) it emits, as highlighted by (20). B. Aggregate Portfolio Analysis Comparing CO2 emissions directly across companies from different industries can be misleading due to their unique operational requirements and regulatory environments inherent to different industries. For instance, the high emissions in the energy sector, particularly from fossil fuels, cannot be directly compared with the lower emissions of the technology or service sectors. Therefore, in this paper, we take a more accurate assessment by comparing emissions within the same industry, allowing for fair benchmarking against industryspecific standards and regulations. This approach highlights companies leading in sustainability and green practices relative to their peers, and it could provide a realistic view of each company's efforts to reduce emissions. It can be expressed in the following equation:

Greennessi,t = E [Greennessi,t | CO2 Emissionsi,t, Industryi]

In Equation 1, we measure company i's sustainable practices at time t within industry, based on its carbon emission. Essentially, this method accounts for the heterogeneity between industries, offering a more nuanced understanding of environmental impacts and sustainability efforts. Utilizing this method, we categorize stocks into quintiles on a monthly basis and create value-weighted portfolios for each quintile. Stocks in the lowest quintile construct a "Green" portfolio characterized by low carbon emissions. Conversely, portfolios formulated by stocks from the top and middle quintiles are defined as "Brown" and "Natural," respectively. We also build a "Green-Brown" portfolio by longing the lowest deciles and shorting the top deciles aligning with (4). C. Individual Stock Analysis For the analysis of individual stocks, we directly examine the relationship between a firm's carbon emissions and its stock returns. We utilize the twoway fixed effects (TWFE) panel regression in our benchmark regression to investigate this relationship. The specific regression model, denoted as 2, assesses the impact of carbon emissions on stock returns:

RETi,t = α + β co2 log(co2 (2) emissioni,t) + β contr Controlsi,t + i,t (3)

Here, the subscript i refers to a specific company, and t indicates a specific month. RETi,t represents the return of stock i in month t. The term α is the cross-sectional intercept, while β co2 is the coefficient on firms' carbon emissions. The logarithmic normalized carbon emissions are expressed as log(co2 emissioni,t). The vector β contr comprises coefficients for a series of control variables. Lastly, i,t denotes the idiosyncratic error term. The parameter of interest is β co2 , which presents the relationship between carbon emissions and firms' stock returns. A significant positive β co2 demonstrates empirical evidence that higher carbon emissions is associated with higher stock returns, which aligns with the classic asset pricing framework that higher risk exposure is associated with higher return compensation. D. Preference Shift Quantified by UMC To understand the discrepancy between recent empirical studies and classic asset pricing theory, we propose an

explanation based on the studies of (21) and (18). Classic asset pricing theory states that higher risk should correspond with higher returns. However, this principle could be overthrown by the preference shift in the financial market. Two primary factors contribute to this change: firstly, the desire to hedge against climate change-related risks, and secondly, the increasing trend of sustainable investing mandates, especially among institutional investors. This shift in preference leads to an increased demand for green assets and divestment from brown ones. Given the high price elasticity in asset demand, as discussed by (22) and (23), even a modest rise in demand can significantly elevate asset prices, thereby resulting in higher realized returns. We use the unexpected media climate change concern index to quantify this preference shift in the financial market as proposed by (19). To empirically test this hypothesis, we employ a multivariate linear regression model that controls for other factors influencing stock returns. We specifically regress the returns of "Green-Brown," "Green," "Brown," and "Neutral" portfolios against the (UMCt) as stated in Equation 4

RETp,t = αp + β UMC p · UMCt + β contr p · Controlst + p,t (4)

In this model, RETp,t represent the return of portfolio p, at time t. The intercept is denoted as αp, while β UMC p is the coefficient for UMC index, β contr p presents a vector of coefficients corresponding to a series of control factors, and is the idiosyncratic error term. The UMCt index quantifies unexpected media climate change concerns derived from news about climate change in widely circulated U.S. newspapers. An increase in this index suggests heightened concerns about climate change, which is expected to trigger a shift in investor preferences towards green assets. Similar to our aggregate portfolio analysis, it is equally interesting to investigate the impact of UMC at the individual stock level, particularly how the interaction between a firm's carbon emissions and UMC influences the firm's stock returns. To assess this, we employ a firm fixed-effect panel regression model as follows:

RETi,t = α + β co2 log(co2 emissioni,t) + β umc (5) UMC + β (log(co2 emissioni,t) UMCt) + β contr Controlsi,t + i,t (6)

Different from Equation 2, we include UMCt and the interaction between log(co2 emissioni,t) and UMCt in Equation 5. The key coefficient, β , is of particular interest as it determines whether UMC amplifies or diminishes the link between a firm's carbon emissions and its stock return. The relationship is detailed in Equation 7. If β co2 and β umc are both positive, high unexpected climate change concerns could lead to even higher returns for brown stocks to compensate for increased risk exposure. Conversely, if β co2 and β umc both have negative signs, the green stocks will realize even higher returns. If β co2 and β umc have opposite signs, the impact of unexpected climate change concerns on the relationship between carbon emissions and stock returns could be mitigated.

∂RET i, t ∂log(co2 emissioni,t) = β co2 + β umc UMCt (7)

DATA

ompanies in the U.S. stock market from 2002 to 2021. Our dataset merges carbon emission data from Trucost, financial accounting information from Compustat, and stock return figures from CRSP (The Center for Research in Security Prices), with the CUSIP-PERMNO linkage table serving as the connector. Trucost's dataset offers insights into the environmental impacts of various business activities and evaluates risks associated with a wide array of environmental issues. These include carbon and other pollutants, water dependency, natural resource efficiency, and waste management. The data from Trucost includes both raw and calculated values at both the company and sector levels. Following the approach of (12), we opt for the calculated carbon emission data, considering its comprehensiveness and relevance to stock returns. The merged dataset comprises 5,250 companies, totaling 526,393 observations. As illustrated in Figure 1, the graph displays the annual count of both companies and observations. Notably, the carbon emission data collection began in 2002 with limited coverage. However, since 2016, there was a substantial surge in the number of companies included in the dataset, for the coverage for samll- amd

mid-cap companies starts from 2016. This remarkable expansion algin with the assignement of various international agreements during this period, such as the Addis Ababa Action Agenda (AAAA), the Sendai Framework for Disaster Risk Reduction 2015-2030 (SFDRR), and The Paris Agreement on Climate Change. These agreements, as discussed by (24), (25), and (26), have played an important role in addressing global climate challenges, emphasizing the importance of sustainable development and initiatives targeting climate change. A. Variable definition and summary statistics We provide explanations for key variables outlined in Table I. The stock return data incorporates stocks' capital gains and dividends, observed monthly. The companies' total carbon emission data is the sum of all 3 scopes of emissions collected by Trucost follwo the Greenhouse Gas Protocol:

Fig. 1. Number of Firms and Observations

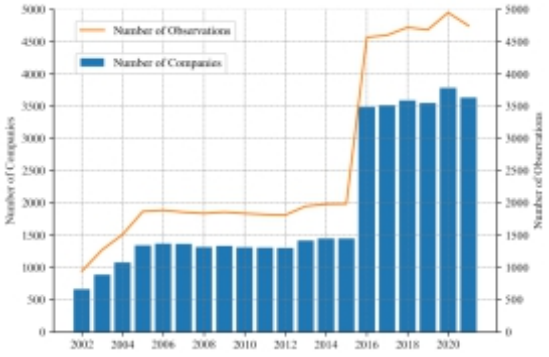

Fig. 2. *
This graphic plots the number of firms and observations across the whole sample period.

Scope 1 entails direct greenhouse gas emissions, Scope 2 covers indirect emissions from purchased energy consumption, and Scope 3 encompasses a wider range of upstream and downstream indirect emissions. While, carbon intensity is calculated as the ratio of carbon emissions to revenue (tons/million(USD)), indicating how effectively a company utilizes its CO2 emissions to generate revenue. Control variables in this analysis encapsulate fundamental financial conditions, which have been substantiated as pertinent factors influencing stock returns through extensive literature such as (27), (28), and (29). The size is a firm's market capitalization in logarithmic form, serving as a measure of its economic scale; leverage, which quantifies a firm's financial structure risk by assessing the ratio of total liability to market capitalization; B/M (Book-to-Market Ratio) indicating the difference between firms' book value and market valuation; RoE (Return on Equity) capturing firms' profitability through the return generated on shareholders' equity; Invest/AT (Investment to Total Assets) reflecting firms' innovation efforts by scaling investment with total assets; PPE (Property, Plant, and Equipment) measuring their fixed assets; SaleGR (Sales Growth) gauging revenue growth; EPS (Earnings Per Share) as another indicator of profitability; Staff num, the number of employees presented in logarithmic form; and Firm age, representing the firm's age since its foundation. These variables collectively provide insights into various financial, operational, and growth aspects that are pertinent to our analysis of the interplay between environmental factors and stock returns. Table ?? provides a summary of the statistical characteristics for the majority of variables used in this study. To mitigate the potential impact of outliers, we have applied winsorization to some of the variables at 1% thresholds. This process involves capping extreme values to ensure that the dataset maintains a reasonable balance between standard deviation and mean values. Within the entire dataset, the monthly stock returns in the dataset ranged from -92% to 1625%, with an average of 1% and a standard deviation of 15%. Following winsorization at the 1% level, the mean and median remained unchanged, but the standard deviation decreased to 10%, at the cost of the exclusion of 10,526 observations. Additionally, we scale certain variables using natural logarithms. For instance, firms' total CO2 emissions had an average of 5 million tons and a maximum of 400 million tons. After logarithmic transformation, the mean and standard deviation are reduced to 12.75 and 2.66, respectively. Detailed summary statistics for these variables, both before and after manipulation, are available in Table ??. In Table III, we report the pairwise Pearson correlations among all the independent variables. Notably, two carbon footprint indicators, namely total carbon emissions and emission intensity, exhibit a positive correlation. However, the correlation coefficient of 0.63 suggests some divergence between these two indicators. Firms' size demonstrates a strong positive correlation with their total CO2 emissions, with a coefficient of 0.66. This implies that larger firms tend to have higher total CO2 emissions. Conversely, the correlation between firm size and CO2 intensity is only 0.09, indicating a lack of a strong relationship between firm size and its carbon intensity. This highlights that larger firms may have varying levels of carbon intensity, with some large firms exhibiting low carbon intensity.

TABLE I
VARIABLE DEFINITION

Variables	Denition
RET	Monthly stock return
Co2_tot	Total carbon emissions (log)
Co2_int	Carbon intensity
Size	Total market capitalization (log)
Leverage	Total liability over market capitalization
B/M	Book to market ratio
RoE	Return on equity
Inves/AT	Investment over total assets
PPE	Property, plant, and equipment (log)
SaleGR	Growth in revenue
EPS	Earning per share
Staff_num	Number of employees (log)
Firm_age	Firm age since foundation

This table presents the definition of variables used in our analysis.

The highest correlations are observed between PPE (Property, Plant, and Equipment) and CO2 emissions, PPE and firm size, Staff num (number of employees) and total CO2 emissions, and Staff num and firm size. In each of these cases, the correlation exceeds 0.6 in absolute value, signifying that firms with more PPE and a greater number of employees tend to be larger firms with higher CO2 emissions. Nevertheless, these correlations do not indicate a strong association with CO2 intensity, emphasizing that the relationship between firm characteristics and carbon intensity is not as pronounced. B. Carbon Emissions & Intensity In the current corporate finance literature there are two important indicators quantifying firms' carbon footprints. Alongside firms' total carbon emissions, carbon intensity emerges as a critical metric for evaluating their environmental sustainability. Carbon intensity precisely measures the rate of emissions of a specific pollutant concerning the scale of firms' production activities. In our study, we employ carbon intensity, calculated as firms' total carbon emissions normalized by their revenue, as a means to assess their emission efficiency. Figure 3 illustrates the historical trajectory of firms' carbon footprints, as represented by both of total carbon emissions and carbon intensity. Across the entire sampling period, we observe a consistent downward trend in both metrics for measuring firms' carbon footprint. Notably, a substantial decline is evident in the year 2016 for both total CO2 emissions and intensity. This reduction can primarily be attributed to the expanded data coverage of the TRUCOST database in that year, encompassing a broader spectrum of small and medium-sized companies. The overarching decline in both CO2 emissions and intensity, except for the significant drop in 2016, underscores the collective endeavor towards greener practices by companies. Furthermore, it reflects the tangible impact of effective green policies on shaping firms' environmental behavior and fostering environmentally conscious practices. C. Total Carbon Emissions in Different Industries Table IV provides a ranking of industries according to their average total carbon emissions over the period from 2002 to 2021. Notably, the industries with the most substantial average carbon emissions are Power and Renewable Electricity Productions, which exhibit an annual average of approximately 38.15 million tons. Electric Utilities and Oil, Gas, and Automobiles sectors secure the second and third positions, emitting around 37.46 million and 30.04 million tons of CO2 on average during the entire sampling period, respectively. These sectors are renowned for their notable environmental impacts due to the higher levels of carbon emissions they generate. On the contrary, industries with the least average carbon emissions encompass Indus-

TABLE II
SUMMARY STATISTICS

	Before Data Manipulation						After Data Manipulation					
	Count	Mean	STD	Min	Median	Max	Count	Mean	STD	Min	Median	Max
RET	526,393	0.01	0.15	-0.92	0.01	16.25	515,865	0.01	0.10	-0.33	0.01	0.42
Co2_tot	526,393	5.43M	21.71M	0.27	401.87K	414.45M	526,393	12.75	2.66	0.24	12.90	19.84
Intensity_tot	526,393	485.55	1315.78	20.43	148.24	89.99K	526,393	5.18	1.26	3.06	5.01	11.41
Marketcap	522,812	320.59K	13.80M	0.01	3666.73	998.73M	522,812	8.21	1.81	0.01	8.21	20.72
Leverage	522,175	0.61	0.27	0.00	0.61	6.92	522,175	0.61	0.27	0.00	0.61	6.92
B/M	521,618	5.21	937.08	-4127.45	0.44	274.70K	511,184	0.53	0.43	-0.54	0.44	3.01
RoE	521,900	-1.38	215.97	-31837	0.10	388.70	511,472	0.06	0.40	-3.20	0.10	2.77
Inves/AT	520,278	0.04	0.05	-0.19	0.03	0.87	520,278	0.04	0.05	-0.19	0.03	0.87
PPE	459,439	10.59K	35.44K	0.00	1.42K	635.15K	459,439	7.07	2.42	0.00	7.26	13.36
SaleGR	467,731	1.75	96.71	-1.00	0.06	9945.00	458,396	0.10	0.29	-0.64	0.06	2.60
EPS	522,856	5.75	151.89	-998.26	1.44	8548.00	512,453	1.75	3.02	-9.78	1.44	18.27
Staff_num	515,253	26.59	72.31	0.00	6.10	2300.00	515,253	2.11	1.49	0.00	1.96	7.74
Firm_age	513,763	70.56	52.56	2.00	54.00	657.00	513,763	3.99	0.79	1.10	4.01	6.49

The table presents summary statistics for the main variables across the entire sample period, with definitions provided in Table I. Data manipulation methods have been applied to scale certain variables and exclude outliers.

Fig. 3. Carbon Emissions & Intensity

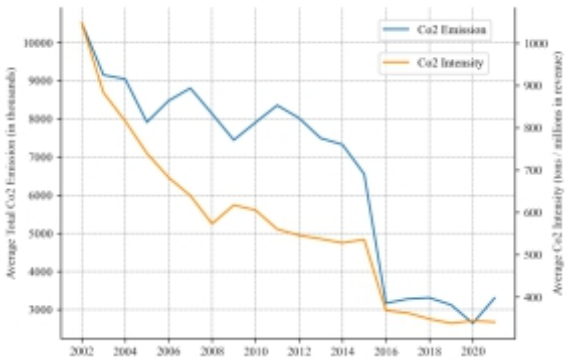

Fig. 4. * This graphic illustrates the historical trajectory of firms' total carbon emissions and intensity on average. Firms' total carbon emissions are measured in thousand tons, while intensity is quantified by tons of CO2 emitted per million US dollars of revenue. Both trajectories represent the mean value in each specific year.

trial REITs, Health Care Technology, and Mortgage Real Estate Investment Trusts (REITs) sectors, showcasing relatively smaller environmental footprints based on their total carbon emissions. Taking into account the entire sampling period and a comprehensive range of industries, the average greenhouse gas emissions stand at 5.43 million tons. Strikingly, the most environmentally impactful sector, exemplified by Independent Power and Renewable Electricity Productions, demonstrates total CO2 emissions that are nearly 8 times higher than the average. In contrast, the most environmentally friendly industries, like Health Care Technology and Mortgage Real Estate Investment Trusts (REITs) sectors, emit only approximately 1/100th of the average emissions. This highlights a substantial diversity across industries concerning their total carbon emissions, underlining the significant heterogeneity in their environmental impacts. IV. RESULT The primary goal of this paper is to explore the relationship between firms' carbon emissions and their stock returns. Our approach is structured in several steps. Initially, in Section IV-A, we conduct a preliminary analysis to examine the unconditional relationship between firms' carbon emissions and stock returns. Next, in Section IV-B, we delve into portfolio analysis. The third step, detailed in Section IV-C, involves presenting firm-level evidence. Finally, in Section IV-D, we attempt to resolve the contradictions observed in the empirical analysis vis-a-vis traditional asset pricing theory.

TABLE III
CONTROL VARIABLES P EARSON CORRELATION

	CO2	Intensity	Size	Leverage	B/M	RoE	Inv/AT	PPE	SaleGR	EPS	Staff_num	Firm_age
CO2	1.0***	0.63***	0.66***	0.09***	0.02***	0.22***	0.24***	0.85***	-0.1***	0.3***	0.72***	0.38***
Intensity		1.0***	0.08***	-0.13***	-0.00	0.01***	0.37***	0.44***	-0.04***	-0.00	0.13***	0.10***
Size			1.0***	0.02***	-0.21***	0.23***	0.05***	0.68***	0.01***	0.39***	0.69***	0.30***
Leverage				1.0***	-0.06***	0.06***	-0.08***	0.18***	-0.09***	0.03***	0.15***	0.20***
B/M					1.0***	-0.09***	-0.04***	0.11***	-0.12***	-0.06***	-0.05***	0.04***
RoE						1.0***	0.03***	0.18***	0.03***	0.39***	0.19***	0.17***
Inv/AT							1.0***	0.33***	0.07***	0.01***	0.05***	-0.04***
PPE								1.0***	-0.13***	0.27***	0.71***	0.39***
SaleGR									1.0***	0.05***	-0.11***	-0.16***
EPS										1.0***	0.29***	0.25***
Staff_num											1.0***	0.40***
Firm_age												1.0***

*** p<.1, ** p<.05, *** p<.01**

This table reports the pairwise Pearson correlations among all the control variables and firms' carbon footprint variables. * means significance at 10%, ** at 5%, *** at 1%.

A. Average Monthly Return on Firms' Carbon Footprint Our first practice delves into the unconditional relationship between firms' carbon footprint and their stock returns. Over the entire sample period, we adopt a cross-sectional approach, sorting carbon emissions into 100 percentiles. Within each percentile, we compute the average monthly stock returns to gain an overarching understanding of the link between firms' carbon emissions and their stock performance. Figure 5 visually presents these findings. Panel A focuses on the average stock returns concerning firms' total carbon emissions, while panels B, C, and D examine emissions within different emission scopes. Across all four panels, a distinguished downward trend emerges, indicating that firms with higher carbon emissions tend to exhibit lower stock returns on average. Additionally, we observe peaks in average stock returns occurring when firms' carbon emissions fall around the 1st percentile for all scopes. Another set of peaks in average returns is notable for different emissions categories, such as total carbon emissions around the 58th percentile, scope one emissions near the 65th percentile, scope two emissions at approximately the 79th percentile, and scope three emissions around the 55th percentile. These clusters of companies may share common characteristics, possibly belonging to the same industry, with similarities in terms of size, profitability, and growth. It's important to note that in this analysis, we specifically sort firms based on their carbon emissions only, without considering other stock return-related factors. Nevertheless, these initial findings provide valuable insights into the preliminary relationship between firms' carbon emissions and their realized stock returns. Following the same analytical approach, we ex-

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TABLE IV
INDUSTRIES RANKED BY AVERAGE TOTAL CO2 EMISSION

Rank	GICS Industry Name	Total CO2 Emission	Rank	GICS Industry Name	Total CO2 Emission
1	Power and Renewable Electricity Producers	38.15	38	Electronic Equipment, Instruments and Components	1.23
2	Electric Utilities	37.46	39	Semiconductors and Semiconductor Equipment	1.11
3	Automobiles	30.04	40	Specialty Retail	1.09
4	Oil, Gas and Consumable Fuels	28.28	41	Textiles, Apparel and Luxury Goods	1.08
5	Multi-Utilities	21.05	42	Construction and Engineering	1.07
6	Passenger Airlines	16.34	43	Marine Transportation	1.05
7	Construction Materials	16.25	44	Communications Equipment	1.01
8	Industrial Conglomerates	14.31	45	Health Care Equipment and Supplies	0.93
9	Metals and Mining	13.48	46	Trading Companies and Distributors	0.86
10	Food Products	12.75	47	Leisure Products	0.86
11	Financial Services	10.05	48	Specialized REITs	0.82
12	Chemicals	9.66	49	IT Services	0.78
13	Personal Care Products	9.11	50	Interactive Media and Services	0.71
14	Consumer Staples Distribution and Retail	7.62	51	Distributors	0.70
15	Household Products	7.48	52	Life Sciences Tools and Services	0.63
16	Tobacco	7.22	53	Entertainment	0.61
17	Aerospace and Defense	6.28	54	Media	0.56
18	Air Freight and Logistics	6.26	55	Capital Markets	0.45
19	Containers and Packaging	6.25	56	Insurance	0.40
20	Beverages	5.90	57	Transportation Infrastructure	0.36
21	Paper and Forest Products	3.88	58	Water Utilities	0.31
22	Technology Hardware, Storage and Peripherals	3.80	59	Diversied Consumer Services	0.29
23	Automobile Components	3.72	60	Banks	0.26
24	Building Products	2.90	61	Professional Services	0.23
25	Ground Transportation	2.64	62	Software	0.21
26	Household Durables	2.59	63	Consumer Finance	0.21
27	Machinery	2.37	64	Hotel and Resort REITs	0.20
28	Diversied Telecommunication Services	2.15	65	Real Estate Management and Development	0.18
29	Energy Equipment and Services	2.07	66	Health Care REITs	0.17
30	Broadline Retail	2.07	67	Ofce REITs	0.13
31	Wireless Telecommunication Services	2.05	68	Biotechnology	0.11
32	Health Care Providers and Services	2.00	69	Retail REITs	0.11
33	Pharmaceuticals	1.91	70	Diversied REITs	0.11
34	Gas Utilities	1.87	71	Residential REITs	0.09
35	Electrical Equipment	1.40	72	Industrial REITs	0.06
36	Commercial Services and Supplies	1.38	73	Health Care Technology	0.06
37	Hotels, Restaurants and Leisure	1.31	74	Mortgage Real Estate Investment Trusts (REITs)	0.03

This table presents the ranking of different industries based on their average total CO2 emissions. The measurements for total CO2 emissions are provided in million tons. And the industry is categorized according to the GICS (Global Industry Classification Standard) industry classification.

plore whether a similar pattern emerges with another crucial indicator in corporate finance literature pertaining to firms' carbon footprint. Figure 7 illustrates the average monthly stock returns across different percentiles of firms' carbon intensity. In contrast to the previous analysis of carbon emissions, we do not discern a clear and consistent trend in firms' average monthly stock returns across all four panels, with each representing different scopes of firms' carbon intensity. The absence of a discernible trend suggests that the relationship between firms' carbon intensity and their stock returns may not exhibit the same patterns as strongly as observed with carbon emissions. Similar patterns are not observered when plotting other key firm characteristics alongside stock returns. Some may raise concerns that that the cross-sectional relationship between firms' stock returns and carbon emissions could be influenced by confounding factors such as firm size, leverage, profitability, and growth, as illustrated in Table III the strong correlation between firms' carbon emissions and some characteristic variables. Notably, the high and statistically significant positive correlation between firms' carbon emissions and size. To address these concerns, we present the average monthly stock returns in relation to various firms' characteristics in Figure 9. In panel (A), we observe

Fig. 5. Average Stock Returns Based on Carbon Emissions

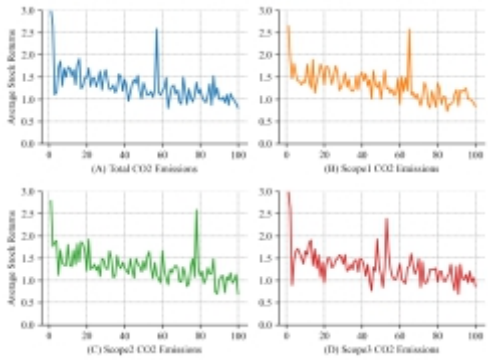


Fig. 7. Average Stock Returns Based on Carbon Intensity

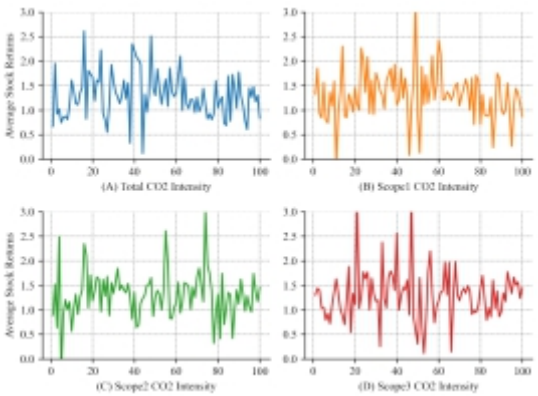
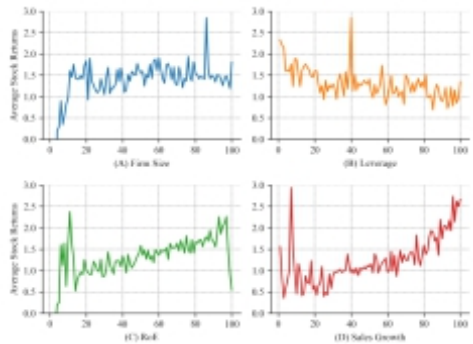


Fig. 6. * This presents the average monthly stock returns in relation to different percentiles of carbon emissions. Panel A depicts the average stock return in relation to firms' total carbon emissions, while Panel B illustrates the average stock return concerning firms' scope 1 carbon emissions. Panel C showcases the average stock return with respect to firms' scope two carbon emissions, and Panel D presents the average stock return in connection with firms' scope three carbon emissions.

a positive association between firm size and stock returns within the first 20 percentiles; however, beyond this range, the relationship becomes less apparent. It is important to remember that firm size has a high correlation with carbon emissions. The most similar pattern emerges from the plot between leverage and stock return, however the correlation between leverage and carbon emission only is 0.09. While other patterns emerge in stock returns concerning variables like RoE and revenue growth, it's essential to note that these variables exhibit weak correlations with firms' carbon emissions. B. Realized Cumulative Return for Green and Brown Portfolios The green portfolio outperform its brown counterpart over the entire sample period, with firm total carbon emissions determining their categorization. Following the methodology presented in Equation 1, we sort stocks into quintiles monthly based on their industry-specific carbon emissions. Generally,

Fig. 8. * This presents the average monthly stock returns in relation to different percentiles of carbon intensity. Panel A depicts the average stock return in relation to firms' total carbon intensity, while Panel B illustrates the average stock return concerning firms' scope 1 carbon intensity. Panel C showcases the average stock return with respect to firms' scope 2 carbon intensity, and Panel D presents the average stock return in connection with firms' scope 3 carbon intensity. firms with higher emissions, categorized as brown, are those exceeding the 80th percentile in carbon emissions due to their significant environmental impact. Conversely, firms below the 20th percentile are assigned to the green portfolio. Those between the 40th and 60th percentiles are placed in the neutral portfolio. Firms falling between the 20th and 40th percentiles, as well as those between the 60th and 80th, are excluded for a clearer comparison. The green portfolio demonstrates superior cumulative realized returns, as depicted in Figures 11 for the period from 2002 to 2021. Each portfolio is valueweighted based on the market capitalization of the included firms to ensure fairness and accuracy4 . Notably, portfolio reallocation is an annual process 4 In the portfolio analysis we use the data without manipulation. Since the outliers are often observed in samll-cap stocks and portfolio is constructed by value weighted, so the influence of these outliers will be minimized. And the the un-manipulated data help us aviod the critisim of data manipulation.

Fig. 9. Average Stock Returns Based on Other Indicators



This presents the average monthly stock returns in relation to different percentiles of various firms' characteristic indicators. Panel A depicts the average stock return in relation to firms' market capitalization, while Panel B illustrates the average stock return concerning firms' leverage. Panel C showcases the average stock return with respect to firms' profitability ROE, and Panel D presents the average stock return in connection with firms' growth in revenue. due to the yearly update of firms' carbon emission data, allowing us to disregard transaction fees in this analysis. At the end of the sample period the brown portfolio realized less than 300% cumulative returns, while the green portfolio realized cumulative returns more than 600% twice higher its brown counterpart. The green portfolio, categorized based on firms' carbon intensity, shows only slight outperformance compared to its brown counterpart, and this outperform is observed only after 2011. Following the same methodology, we group stocks into green and brown groups based on their carbon intensity. The cumulative

returns of these portfolios are presented in Figure 13. Throughout the entire sample period, the green portfolio achieves a cumulative return of approximately 400%, and its brown counterpart realizes a cumulative return around 300%. Notably, the green portfolio's outperformance is only evident post-2011; prior to this, both portfolios exhibited

Fig. 11. Cumulative Portfolio Return by Carbon Emissions

This graphic dispicts the cumulative return of green and brown portfolios, categorized based on firms' carbon emission. The shaded regions represent recession periods as suggested by the National Bureau of Economic Research (NBER). similar cumulative return trajectories. Considering carbon emissions, the green-minusbrown (GMB) portfolio, which constructed by a long position in the green portfolio and a short position in the brown, yielded a monthly return of 1.45%, statistically significant at the 1% level. Compared with (4), who used the E score from MSCI ESG scores to construct a GMB portfolio averaging a 0.65% monthly return, this result indicates that the carbon emission indicator is as good as ESG scores in quantifying a company's green practices5 . The results are detailed in Table V, where the first column highlights the GMB premium based on firms' overall carbon emissions. Conversely, the 4th column of Table V presents the GMB premium based on firms' CO2 intensity. Here, the Green portfolio shows a smaller outperformance of only 0.39% against the Brown portfolio with 5While the GMB portfolio in this study shows a higher monthly average return, it does not necessarily imply that firms' carbon emissions are a superior indicator compared to ESG scores for quantifying firms' sustainable practices. This is because the methodologies for grouping stocks into green and brown portfolios differ between the two studies.

Fig. 13. Cumulative Portfolio Returns by Intensity

Fig. 14. * This graphic dispicts the cumulative return of green and brown portfolios, categorized based on firms' carbon intensity. The shaded regions represent recession periods as suggested by the NBER. a standard error of 23.4 bp. This performance is less pronounced than that observed with carbon emissions. In columns 2, 3, and 4 of Table V, the GMB portfolio's return is regressed on the Fama-French 3 and 5 factors models, as well as FF5 + MOM (momentum factor) + LIQ (liquidity factor), following the discussions in (30), (31), (32), and (33). The results provide consistent evidence that the strong performance of the GMB portfolio cannot be fully attributed to the return factors commonly recognized in asset pricing literature, as indicated by the economically and statistically significant intercepts. This significant alpha implies, on one hand, the effectiveness of carbon emissions in quantifying firms' sustainable practices, and on the other hand, challenges the traditional asset pricing theory that less risky green assets outperform brown ones. When constructing the GMB portfolio based on firms' carbon intensity, as shown in columns 6- 8 of Table V, we observe mixed evidence. The difference between using total carbon emissions versus carbon intensity to shape the portfolio is significant. The empirical data highlights total carbon emissions as a more robust indicator for assessing firms' greenness, contrary to the intuitive appeal of carbon intensity. This finding underscores that, as per the current data, carbon intensity does not hold a superior position as an indicator of greenness. C. Firm Level Evidence In the previous section, we constructe green and brown portfolios based on firms' total carbon emissions. Interestingly, our findings showcase the green portfolio's consistent outperformance over the brown counterpart. This observation deviates from traditional asset pricing theory. In this section, we present firm-level evidence to further illustrate the relationship between firms' carbon emissions and their stock returns. 1) Benchmark Result: Based on Equation 2, the findings are presented in Table VI, showcasing the results of firm-level analysis across two different fixed effects specifications for both the restricted and unrestricted models. In our approach, we use time-fixed effects

at the month level. This choice serves to mitigate the impact of temporal variations across time, including the overall economic conditions, shifts in investors' sentiments in the stock market, the evolving concern for climate change, and other unobserved time-dependent factors. Columns 1 and 2 present the outcomes of the regression analysis for the unrestricted and restricted models, respectively, both with Month + Industry two-way fixed effects. Notably, these techniques align with the methodologies employed by (5). By integrating industry-fixed effect, we effectively control for variations across distinct industries. This approach permits us to find the average correlation between firms' total carbon emissions and stock return cross-sectionally without the influence to which industry a firm belongs. In column 1's unrestricted model, we observe a positive correlation between firms' total carbon emissions and stock returns. However, the nearzero R-squared value suggests limited explanatory power, possibly due to omitted variables. In column 2, we present the outcomes of the restricted model with a serices of control variables including, Size

TABLE V
GREEN - BROWN PORTFOLIOS REGRESS ON FACTORS

	CO2 Emission				Intensity			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	1.454***	1.169***	1.181***	1.073***	0.395*	0.124	0.080	1.073***
	(0.319)	(0.268)	(0.280)	(0.298)	(0.234)	(0.209)	(0.218)	(0.298)
Mkt_RF		0.072	0.070	0.120		0.251***	0.266***	0.120
		(0.065)	(0.069)	(0.073)		(0.051)	(0.054)	(0.073)
SMB		1.092***	1.078***	1.039***		0.199**	0.200**	1.039***
		(0.113)	(0.119)	(0.119)		(0.088)	(0.092)	(0.119)
HML		-0.543***	-0.554***	-0.470***		-0.575***	-0.625***	-0.470***
		(0.100)	(0.114)	(0.119)		(0.078)	(0.089)	(0.119)
RMW			-0.045	-0.112			0.030	-0.112
			(0.138)	(0.140)			(0.107)	(0.140)
CMA			0.062	0.071			0.173	0.071
			(0.182)	(0.181)			(0.142)	(0.181)
MOM				0.178**				0.178**
				(0.076)				(0.076)
LIQ				-2.381				-2.381
				(4.143)				(4.143)
Obs	240	240	240	240	240	240	240	240
R-squared	0.000	0.327	0.327	0.343	-0.000	0.243	0.248	0.343

* p<.1, ** p<.05, *** p<.01

This table presents the regression results of the Green minus Brown portfolio on different factor models. In the left panel, the portfolio is formulated based on firms' total carbon emissions, and in the right panel, the portfolio is based on firms' carbon intensity.Columns 1 and 5 only show regression results with intercept, the rest columns show regression results with various factors model.

Stuff num, Firm age. And we notice the positive relationship between firms' total carbon emissions and stock returns continues, albeit without statistical significance. This contrasts with (5), who find significant positive relationship between stock returns and various scopes of carbon emissions by excluding firms from specific industries (GIC 19, 20, 23). In our analysis, we include all firms, regardless of their industry6 . This result algins with the classic asset pricing theory that higher risk exposure associates higher return compensation, however, this raises the question: Why does the firm-level analysis again yield results that contradict our portfolio analysis? Fortunately, we are not the first to address this issue. (12) have warned the carbon premium should be treated cautiously and noted the high collinearity between firms' carbon emissions and factors such 6To align with their research desgin, we have applied winsorization to certain variables in our data set to mitigate the influence of outliers, a common practice in regression analysis. Detailed information about the data can be found in Table above. as firm size, production volume, and industry classification. They suggest that this collinearity could significantly bias the estimated relationship between firms' carbon emissions and stock returns. It is widely recognized that larger firms typically have higher carbon emissions, and firms with greater production or those in certain industries are likely to emit more carbon dioxide. However, industry-level fixed effects alone may not sufficiently account for this collinearity. Our solution is to adopt Month + Entity (firm) two-way fixed effects to address this issue. Different from Month + Industry twoway fixed effects, with Month + Entity fixed effects the analysis considers both time-specific variations and variations unique to individual entities (firms). By including Entity-fixed effects, we are accounting for firm-specific factors that may be constant over time but vary across different firms. This is a more stringent restriction by the assumption that investors not only distinguish industry-specific characteristics but also place a heightened emphasis on each firm's specific inherent attributes. Columns 3 and 4 in Table VI showcase the results for un/-restricted models with this new specification. First, it is important to note that the results remain consistent between the un-/restricted models presented in columns 3 and 4. Then, the most intriguing revelation arises from the incorporation of Month + Entity two-way fixed effects, leading to an astonishing sign reversal of the coefficient on carbon emissions. This change takes place under the

assumption that investors place greater emphasis on each firm's intrinsic attributes rather than industry-specific characteristics. Specifically, firms with higher carbon emissions, implying increased exposure to climate risks, tend to exhibit lower stock returns on average. Importantly, this observation maintains both economic and statistical significance. And it's important to underscore that this finding aligns with the persistent outperformance of the green portfolio over the brown counterpart. Finally, given that the negative relationship between firm size and stock returns persists, the collinearity problem between carbon emissions and firm size in predicting stock returns, as brought up by (12) is confirmed. This is corroborated by Table III, which indicates a positive correlation between firms' carbon emissions and size, and both factors negatively correlate with stock returns. 2) Robustness Check: In the context of the regression model 2, the choice of fixed effects can vary depending on the underlying assumptions. In conventional cross-sectional stock return analyses, it is a common practice to assume significant heterogeneity between industries, with the belief that firms within a particular industry exhibit similar characteristics in terms of their stock returns. This assumption has garnered substantial empirical support in the existing literature. However, it's crucial to recognize that investors base their investment allocation decisions on more than just industry categorizations. While they may initially screen industries, their ultimate investment choices often depend on the specific attributes of individual companies. In such scenarios, even firms within the same industry can exhibit significant variations in their stock performance. Therefore, considering heterogeneity at the firm level may be a more suitable approach than relying solely on industry-level assumptions. In the following analysis, we perform a robustness check with various fixed effects and cluster standard errors at different levels. The first six models depicted in Figure 15 include the benchmark model along with variations involving different fixed effects. In the case of considering only the Entity fixed effect, we observe a coefficient of -0.81 for total carbon emissions, which is statistically significant at the 1% level. Similarly, when we incorporate both Entity and Year two-way fixed effects, the coefficient on carbon emissions remains statistically significant at the 1% level, with a slightly reduced value of -0.77. These specifications maintain consistency with the benchmark model, showing only minor coefficient adjustments. Moving on to models 4, 5, and 6, where we introduce industry fixed effects, Industry + Month, and Industry + Year two-way fixed effects, we observe a different pattern. In these models, the coefficients on carbon emissions all become statistically insignificant and approach zero. (34) in his seminar paper first introduced Robust standard errors in econometrics to account for heteroscedasticity. In Model 2, where we retain the same fixed effects as the benchmark model, the application of robust standard errors significantly increases statistical significance and narrows down the confidence intervals as depicted by the 7th model in Figure 15. Furthermore, as highlighted by (35), when dealing with panel data the residuals may be correlated across firms or across time. In such cases, standard errors can be biased. To mitigate this, Petersen recommends clustering standard errors at the same level, as is done in our benchmark model. Additionally, (36) advocates for clustering standard errors at a level one step above the sample data. In line with this recommendation, we cluster the standard errors at the industry and year level for the benchmark model to test its robustness. After applying clustering to standard errors at the Industry + Year level, we observe a slight increase in standard errors compared to the benchmark model. Nonetheless, the results remain statistically significant at the 1% level, as shown by the last model in Figure 15.

Fig. 11. Cumulative Portfolio Return by Carbon Emissions

TABLE VI
FIRM LEVEL ANALYSIS

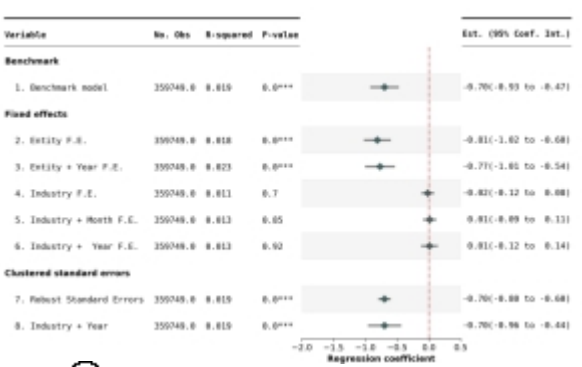
	Returns			
	(1)	(2)	(3)	(4)
CO2_tot	0.075	0.034	-0.176	-0.659
	(0.040)	(0.053)	(0.090)	(0.127)
Size		0.250		1.535
		(0.101)		(0.197)
Levarage		-0.226		0.173
		(0.203)		(0.422)
B/M		-1.879		-2.729
		(0.181)		(0.276)
RoE		0.526		0.292
		(0.086)		(0.101)
Inves/AT		-4.447		-12.650
		(1.132)		(1.874)
PPE		-0.008		-0.426
		(0.048)		(0.162)
SaleGR		0.916		0.799
		(0.224)		(0.237)
EPS		0.057		0.018
		(0.022)		(0.027)
Staff_num		-0.278		-0.835
		(0.066)		(0.213)
Firm_age		-0.047		1.789
		(0.065)		(0.517)
Constant	0.162	0.526	3.353	-3.421
	(0.505)	(0.643)	(1.137)	(2.940)
Firm F.E.	No	No	Yes	Yes
Industry F.E.	Yes	Yes	No	No
Year-Month F.E.	Yes	Yes	Yes	Yes
Obs	466999	295704	466999	295704
R-squared	0.000	0.013	0.000	0.019

* p<.1, ** p<.05, *** p<.01

This table presents the regression results depicting the influence of firms' CO2 emissions on stock returns. To account for potential dependencies within the data, the standard errors are clustered at the specified level along with the fixed effects integrated into the model.

D. Expalin the Contradiction Between Empirical and Theoretical Studies Building upon the equilibrium model by (18) and (37), along with the demand system asset pricing model by (21), we aim to present empirical evidence supporting the notion that a shift in financial market preferences due to climate change has led to the observed contradiction between empirical findings and classic asset pricing theory, regarding the riskreturn puzzle. 1) Quantify the Preference Shift in the Financial Market: The shift in financial market preferences due to unanticipated climate change risks can be measured using the Unexpected Media Climate Change Concern Index (UMC), developed by (19). To construct this index, they gather news from eight major U.S. newspapers and two prevalent newswires, known for their extensive circulation. For each article, a unique "concern score" is assigned, reflecting the degree of negativity and risk addressed in the content. Considering the diversity in coverage, thematic focus, and levels of concern, they normalize the scores of individual articles adjusting for heterogeneity across newspapers. These normalized scores are then aggregated to form a comprehensive daily Media Climate Change Concern Index (MCCC)7 , encapsulating the overall 7 It is noteworthy that several other studies have explored text-based methodologies for constructing similar indices, including (38), (39), and (40).

Fig. 15. Change of Fixed Effects and Cluster Levels



This graphic presents coefficients and associated confidence intervals for various fixed effects and clustered standard error configurations. The benchmark model includes Entity + Month fixed effects, with standard errors clustered at the same level. In the 'Fixed Effects' group, we explore different fixed effects for each model, while maintaining standard errors clustered at the same level. In the 'Clustered Standard Errors' group, we examine how standard errors are clustered at various levels while keeping the fixed effects consistent with the benchmark model. media sentiment on climate change. The historical trajectory of the monthly MCCC index is plotted in Figure 17. Ardia et al. construct the UMC by calculating the difference between actual MCCCt and its expected MCCC \t index by an ARX model as specified in Equation 8. Their model incorporates a variety of control variables, including the FF5 factors, momentum factor, WTI return, gas return, propane return, U.S. economic policy uncertainty index, VIX, TED spread, term factor, default factor, etc. In our study, we use a different set of control variables in the model, which includes the FF5 factors, CFNAI index, investor sentiment index, WTI index, VIX index, and a lagged one-period MCCC index to compute UMC, but the difference between the resultant two UMC indcies is found to be negligible. The construction of the UMC index makes it an appropriate proxy for measuring shifts in market preferences. An increase in UMC, indicating heightened concerns about climate change risks, is likely to bolster investor demand for green assets and lead to divestment from brown ones, and vice

Fig. 17. Media Climate Change Concerns Index

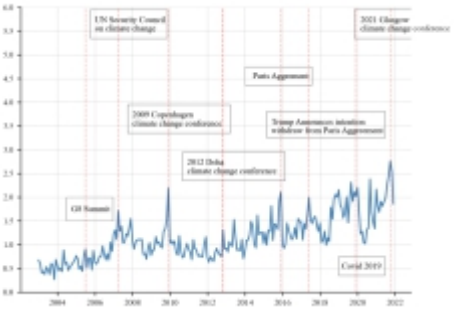


Fig. 18. * This figure presents the monthly MCCC (Media Climate Change Concerns) index from 2003 to 2022 together with the major climate-related events. versa. **MCCCt = α+βMCCCt−1+γControlst+ (8)** 2) Portfolio analysis with UMC: Next, We are going to test our hypothesis empirically by using regression analysis as outlined by the Equation 4, wherein we regress GMB, Green, Brown, and Neutral8 portfolios on UMC. As presented in Table VII, the regression findings illuminate the outcomes of diverse portfolios structured based on firms' CO2 emissions in relation to the UMC index, accompanied by a set of control variables. For the green portfolio, as shown in the second column of Table VII, the coefficient on UMC is 1.786. This suggests that a one-unit increase in the UMC index could lead to a 1.786% increase in returns for the green portfolio. Conversely, for the brown portfolio (third column), the coefficient on UMC is -1.263%, indicating that a one-unit increase in the UMC index could result in a 1.263% decrease 8 It is important to clarify that the neutral portfolio does not signify null CO2

emissions. Instead, firms within this portfolio exhibit total carbon emissions ranging between the 34th and 66th percentiles across the entire sample. in returns. These results strongly support the idea that shifts in financial market preferences due to climate change significantly impact the returns of green and brown assets. An increase in climate change concerns favors green assets and, conversely, reduces the returns of brown assets. For the GMB portfolios, the coefficient on UMC is 3.049, implying that a one-unit increase in UMC could lead to an average return increase of 3.049% for GMB portfolios. All the results mentioned demonstrate both economic and statistical significance at the 1% level. In contrast, for the neutral portfolio, the coefficient on UMC is relatively minor and does not reach statistical significance. 3) Firm level analysis with UMC: In the firmlevel analysis of the previous section, we observe a negative relationship between firms' carbon emissions and stock returns, particularly when employing Month + Entity two-way fixed effects. We propose that this negative relationship may stem from a shift in financial market preferences, motivated by a desire to hedge against climate change risks and a growing commitment to sustainable investing. A likely hypothesis is that during periods of heightened climate concern, firms with higher CO2 emissions (i.e., more environmentally impactful) tend to see lower stock returns. This outcome occurs as investors increasingly avoid brown stocks in favor of green ones, leading to a surge in demand and consequently higher returns for green assets. Following Equation 5, we further explore how the interaction between firms' carbon emissions and the UMC index impacts stock returns. Table VIII presents the regression results for Model 5. Alongside a list of control variables reflecting firms' fundamental characteristics such as size, leverage, B/M, RoE, Investment, PP&E, SaleGR, EPS, staff number, and firm age (included in Controlsi,t), we also incorporate variables to capture global macroeconomic conditions, including the FF5 factors, investor sentiment, WTI index, CFNAI index, and VIX. Across all specifications, the coefficient on CO2 toti,t consistently displays a statistically significant negative relationship with stock returns, in line with the results in Table VI. Additionally, the coefficient on UMCt is consistently positive, suggesting that higher unexpected climate concerns correlate with increased stock returns. Moreover, the coefficient on interactioni,t remains negative across various controls. As Equation 7 indicates, this implies that during periods of heightened unexpected climate concern, the stock returns of brown firms, identified by higher total CO2 emissions, tend to decrease further, green stocks on the contrary are benefited from the unexpected climate change concerns, with the statistical significance maintained at the 1% level.

CONCLUSION

This paper seeks to unravel a paradox that has emerged in recent years in the realm of sustainable investing. On one hand, the aggregate performance of Green portfolios, composed of companies with lower carbon emissions or higher ESG (Environmental, Social, and Governance) scores, has exhibited a consistent and noteworthy outperformance compared to their Brown counterparts. This phenomenon is commonly referred to as the "green premium" and is attributed to the increasing concerns surrounding climate change and environmental sustainability. It reflects a growing trend among investors who are increasingly inclined to allocate capital to assets that align with sustainable and environmentally responsible practices. However, when we shift our focus to the firmlevel empirical analysis, a seemingly contradictory picture emerges. Here, the data often presents a different narrative, one where Brown firms, those associated with higher carbon footprints or lower ESG scores, appear to yield higher expected stock returns. This observation challenges the conventional wisdom of sustainable investing and introduces the notion of a "climate risk premium." Investors seem to be demanding higher returns as compensation for investing in companies with perceived sustainability and climate-related risks. The existence of this paradox raises crucial questions and calls for a deeper examination. Why do Green portfolios, at the aggregate level, consistently outperform their Brown counterparts when firmlevel data suggests otherwise? Is the green premium truly a reflection of superior financial performance,

TABLE VII
GREEN - BROWN ON UMC

	Dependent Variable			
	Green-Brown	Green	Brown	Neutral
Intercept	1.310	1.665**	0.355	1.040**
	(1.179)	(0.844)	(0.857)	(0.430)
UMC	3.049***	1.786**	-1.263*	-0.029
	(1.029)	(0.736)	(0.748)	(0.375)
Mkt_RF	0.083	0.920***	0.837***	0.965***
	(0.080)	(0.057)	(0.058)	(0.029)
SMB	1.079***	0.724***	-0.355***	0.318***
	(0.133)	(0.095)	(0.096)	(0.048)
HML	-0.557***	-0.216**	0.341***	-0.008
	(0.122)	(0.088)	(0.089)	(0.045)
RMW	-0.164	-0.198*	-0.033	-0.024
	(0.167)	(0.119)	(0.121)	(0.061)
CMA	0.112	0.041	-0.070	-0.145*
	(0.208)	(0.149)	(0.151)	(0.076)
SENT	1.277**	0.971**	-0.306	0.072
	(0.611)	(0.437)	(0.444)	(0.223)
WTI	-0.010	-0.014*	-0.005	-0.006
	(0.012)	(0.009)	(0.009)	(0.004)
CFNAI	-0.046	0.121	0.167	-0.016
	(0.200)	(0.143)	(0.145)	(0.073)
VIX	0.037	0.062**	0.025	0.016
	(0.040)	(0.028)	(0.029)	(0.014)
Obs	227	227	227	227
R-squared	0.368	0.742	0.590	0.903

* p<.1, ** p<.05, *** p<.01

TABLE VIII
CROSS-SECTION STOCK RETURN WITH UMC

	Dependent variable: Return			
	(1)	(2)	(3)	(4)
CO2_tot	-0.569	-0.580	-0.580	-0.578
	(0.112)	(0.109)	(0.109)	(0.111)
UMC	1.648	1.688	1.460	1.749
	(0.402)	(0.401)	(0.403)	(0.405)
interaction	-0.135	-0.145	-0.133	-0.150
	(0.029)	(0.028)	(0.029)	(0.029)
Mkt_RF	0.999	0.909	0.915	0.949
	(0.010)	(0.009)	(0.008)	(0.009)
SMB		0.383	0.360	0.321
		(0.013)	(0.013)	(0.013)
HML		0.012	0.002	0.046
		(0.010)	(0.010)	(0.010)
RMW			-0.065	-0.042
			(0.014)	(0.015)
CMA			0.063	0.048
			(0.016)	(0.016)
SENT				-0.497
				(0.042)
WTI				-0.009
				(0.001)
CFNAI				0.012
				(0.013)
VIX				0.047
				(0.003)
Constant	1.828	1.100	0.992	-0.911
	(1.915)	(1.940)	(1.946)	(1.936)
Controls	Yes	Yes	Yes	Yes
Entity F.E.	Yes	Yes	Yes	Yes
Obs	295215	295215	295215	295215
R-squared	0.203	0.212	0.213	0.215

* p<.1, ** p<.05, *** p<.01

This table represents the regression results of Green-Brown, Green, Brown, and Neutral portfolios on the UMC index and a group of control variables. (19) constructed the MCCC index since January 2003, hence the number of observations is less than 240. The Green Portfolio contains firms with total CO2 emissions up to the 20rd percentile, Neutral Portfolio contains firms with total CO2 emissions ranging from the 40th to 60th percentile, and firms with CO2 emissions higher than the 80th percentile are included in the Brown Portfolio. Green-Brown Portfolio is the monthly difference between Green and Brown portfolios.

or are there underlying factors that need to be considered? Moreover, what explains the climate risk premium observed at the firm level, and how do these findings align with the broader goals of sustainable and responsible investing? This paper embarks on a comprehensive journey to dissect these questions and shed light on the complex and evolving landscape of sustainable investing. By conducting rigorous analyses that combine cross-sectional evidence, portfolio performance assessments, and firm-level empirical investigations, we find that, under different assumptions with varying model specifications, firm-level results coincide with aggregate portfolio analysis. Specifically, Brown firms with higher carbon footprints are more exposed to climate change-related risks and tend to underperform Green firms with lower carbon footprints in terms of stock returns, particularly when there are heightened concerns about unexpected climate change. Through these endeavors, we aim to provide valuable insights that can inform investment decisions, drive sustainable practices, and contribute to a more nuanced understanding of the relationship between sustainability and financial returns in the context of our ever-changing global landscape

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ABS International Journal of Management
Volume XII Issue 2 December 2024 | ISSN 2319-684X (PRINT)

Implementation Of Green Human Resource Management (GHRM) Policies And Practices In The Contemporary Context

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ABSTRACT:
Green Human Resource Management (GHRM) is a strategic framework that integrates environmentally sustainable practices into human resource policies and processes. As organizations face mounting pressure to address environmental concerns, GHRM emerges as a vital component in aligning human resource functions with sustainability objectives. This paper examines key practices of GHRM, including recruitment and selection, training and development, performance management, employee engagement, and the formulation of workplace policies that support sustainability. Furthermore, it explores how these practices not only contribute to environmental stewardship but also enhance organizational reputation, employee satisfaction, and overall performance. The study also identifies challenges in implementing GHRM, such as resistance to change, resource limitations, and difficulties in measuring effectiveness. Through an analysis of case studies from organizations like Unilever and IBM, the paper illustrates successful GHRM strategies and their positive impact on both the environment and organizational culture. The findings highlight the critical role of GHRM in fostering a sustainable workforce and encourage organizations to adopt comprehensive GHRM policies for long-term success.

Keywords: *Green Human Resource Management, sustainability, organizational culture, employee engagement, recruitment, training and development, performance management, environmental stewardship, corporate social responsibility.*

INTRODUCTION

In recent years, the urgency of addressing environmental challenges such as climate change, resource scarcity, and ecological degradation has prompted organizations across various sectors to adopt more sustainable practices. As the business landscape evolves, the integration of sustainability into organizational strategies has become essential for long-term success. Green Human Resource Management (GHRM) emerges as a critical framework within this context, focusing on the role of human resource practices in promoting environmental sustainability. Traditionally, human resource management (HRM) has centered on workforce optimization, employee relations, and organizational development. However, the growing recognition of corporate responsibility towards the environment has shifted the focus of HRM to include ecological considerations. GHRM encompasses a range of HR activities—such as recruitment, training, performance management, and employee engagement—that aim to reduce an organization's ecological footprint while fostering a culture of sustainability among employees. The rationale behind GHRM is multifaceted. Organizations that effectively implement green HR practices can not only improve their environmental performance but also enhance their overall competitiveness. Research suggests that companies embracing sustainability initiatives experience a variety of benefits, including increased employee morale, enhanced brand reputation, and cost savings from resource efficiency. Moreover, aligning organizational goals with sustainable practices can help attract and retain talent, particularly among younger generations who prioritize environmental responsibility. Despite the promising advantages, the journey towards implementing GHRM is fraught with challenges. Resistance to change, lack of awareness, insufficient resources, and difficulties in measuring the impact of green initiatives often pose significant barriers. Addressing these challenges requires a comprehensive understanding of effective GHRM strategies and a commitment to fostering a supportive organizational culture. This paper seeks to explore the essential practices and policies that define GHRM, highlighting how they can be utilized to promote environmental sustainability within organizations. It will examine specific HR practices, such as eco-centric recruitment and training programs, and the importance of integrating sustainability into performance evaluations and workplace policies. Additionally, the paper will discuss the obstacles organizations may face in adopting these practices, drawing on case studies to illustrate successful implementations of GHRM. Ultimately, this research aims to

underscore the importance of GHRM in fostering sustainable organizational practices. By demonstrating the vital link between human resource management and environmental stewardship, the paper will argue that GHRM is not merely an option but a necessary strategy for organizations committed to navigating the complexities of the modern, environmentally conscious marketplace.

Meaning And Definitions Of Green Human Resource Management

Green Human Resource Management (GHRM) refers to the integration of environmentally sustainable practices into human resource management functions. It encompasses the strategies and policies that organizations implement to promote environmental sustainability while simultaneously enhancing employee engagement and organizational performance. The essence of GHRM lies in the belief that human resources can play a critical role in fostering a culture of sustainability within organizations, contributing to broader environmental goals. GHRM aims to not only comply with environmental regulations but also to proactively engage employees in eco-friendly practices. This involves cultivating awareness, encouraging sustainable behaviors, and embedding sustainability into the core organizational values. By aligning HR practices with environmental objectives, organizations can significantly reduce their ecological footprint, enhance their reputation, and create a more motivated and responsible workforce.

Definitions of Green Human Resource Management:

1. Jabbour and Santos (2008): According to Jabbour and Santos, "Green Human Resource Management (GHRM) refers to the policies, practices, and systems that enhance the sustainable use of resources within organizations by promoting environmentally friendly behavior among employees." This definition emphasizes the role of HR in facilitating sustainable resource management and encouraging eco-conscious behaviors in the workforce.

2. Renwick, Redman, and Maguire (2013): They define GHRM as "the use of HRM policies and practices to promote the sustainable use of resources and to reduce the environmental impact of organizations." This definition highlights the dual focus of GHRM on both promoting sustainable practices and mitigating environmental harm.

3. Daily and Huang (2001): In their research, they describe GHRM as "a strategic approach to HRM that integrates environmental management into the HR function." This definition underscores the importance of viewing GHRM as a strategic initiative rather than merely a set of isolated practices.

4. McGuire and Hurst (2018): They define GHRM as "the incorporation of environmental sustainability into all HR functions and activities, creating a culture of environmental responsibility within the organization." This definition points to the comprehensive nature of GHRM, encompassing all HR practices and fostering a shared commitment to sustainability.

5. Zibarras and Ballinger (2011): Zibarras and Ballinger state that "GHRM is concerned with how HR practices can contribute to the reduction of an organization's carbon footprint and overall environmental impact." This definition emphasizes the measurable outcomes of GHRM practices and their direct influence on organizational sustainability.

Core Elements Of GHRM

GHRM can be understood through several core elements that illustrate its comprehensive nature:

o Recruitment and Selection: Attracting environmentally conscious candidates by promoting the organization's commitment to sustainability in job descriptions and recruitment processes.

o Training and Development: Providing employees with the knowledge and skills necessary to engage in sustainable practices, such as workshops on waste reduction and energy efficiency.

o Performance Management: Integrating sustainability metrics into performance evaluations to encourage accountability and recog nize contributions to environmental initiatives.

o Employee Engagement: Involving employees in sustainability efforts, fostering a sense of owne rship and encouraging innovative ideas for environmental improv ement.

o Workplace Policies: Imple menting eco-friendly workplace practices, such as remote work options, recycling programs, and energy-efficient facilities. Green Human Resource Management is a vital approach that connects human resource practices with environm ental sustainability. Through various definitions, it becomes clear that GHRM encompasses a strategic commitment to integrating eco-

friendly practices into HR functions, thereby fostering a culture of sustainability within organizations. As the importance of environmental responsibility grows, GHRM will continue to evolve, influencing not only HR policies but also the overall organizational ethos towards sustainability.

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Key Practices Of Green Human Resource Management (ghrm)

Green Human Resource Management (GHRM) encompasses a range of practices that integrate environmental sustainability into human resource functions. These practices aim to promote eco-friendly behaviors among employees, enhance organizational sustainability, and align human resource strategies with environmental objectives. Below are the key practices of GHRM in detail:

1. Recruitment and Selection Eco-Conscious Recruitment Strategies: Organizations can attract environm entally aware candidates by emphasizing their commitment to sustainability in job descriptions and during the recruitment process. Highlighting eco-friendly initiatives, such as sustainable practices or green certifications, can resonate with candidates who prioritize environmental responsibility. Assessment of Sustainability Values: During the selection process, organizations can assess candidates' alignment with sustainability values through targeted interview questions. This ensures that new hires are not only qualified but also share the organization's commitment to environmental stewardship.

2. Training and Development Sustainability Training Programs: GHRM emphasizes the importance of educating employees about sustainable practices. Organizations can implement training sessions that cover topics such as energy conservation, waste reduction, and sustainable resource management. This training can empower employees to make environmentally responsible decisions in their daily work. Continuous Learning Opportunities: Providing ongoing educational resources, such as workshops, seminars, and access to online courses on sustainability, fosters a culture of continuous improvement. Encouraging employees to stay updated on best practices and innovations in sustainability enhances their engageme nt and knowledge.

3. Performance Management Incorporating Sustainability Metrics: Integrating environmental performance indicators into regular performance evaluations encourages employees to prioritize sustainability. These metrics can include energy savings, waste reduction achievements, or participation in green initiatives, creating accountability for environm ental outcomes. Recognition and Rewards: Establishing recognition programs for employees who actively contribute to sustainability goals can boost motivation and engagement. Awards or incentives for innovative green ideas or successful projects encourage a proactive approach to environmental responsibility

4. Employee Engagement Creating Green Teams: Forming cross-functional teams dedicated to sustaina bility initiatives allows employees to collaborate on projects that promote environmental responsibility. These teams can brainstorm and implement eco-friendly practices, fostering a sense of ownership and engagement. Feedback Mechanisms: Encouraging employees to provide input and suggestions for improving sustainability practices creates a culture of collaboration. Regular surveys or suggestion boxes can help gather valuable insights and innovative ideas from employees at all levels.

5. Workplace Policies Implementing Eco-Friendly Policies: Organizations can adopt policies that promote sustainability in the workplace. This includes encouraging remote work to reduce commuting-related emissions, promoting paperless practices to minimize waste, and implementing recycling programs to encourage responsible disposal. Sustainable Supply Chain Practices : GHRM also extends to the organization's supply chain. Establishing partnerships with eco-conscious suppliers and evaluating their environmental practices can enhance overall sustainability and promote responsible sourcing.

6. Health and Safety Integrating Environmental Health into Safety Protocols: Ensuring that workplace

health and safety protocols consider environmental factors is crucial. Organizations can develop safety guidelines that promote not only employee well-being but also environmental health, such as proper handling of hazardous materials and waste management. Promoting a Healthy Work Environment: Creating a workspace that emphasizes natural light, green spaces, and ergonomic design can improve employee well-being while promoting a sustainable environment. Such practices reflect the organization's commitment to both employee health and ecological sustainability.

7. Corporate Social Responsibility (CSR) Aligning HR Practices with CSR Goals: GHRM practices can be aligned with broader CSR initiatives to enhance organizational impact. This includes encouraging employees to participate in community service projects focused on environmental conservation, thus fostering a sense of purpose and social responsibility. Transparency and Reporting: Regularly reporting on sustainability efforts and progress can enhance organizational credibility. This transparency not only informs stakeholders but also engages employees in the company's sustainability journey, reinforcing their commitment. The key practices of Green Human Resource Management illustrate how organizations can effectively integrate sustainability into their human resource functions. By focusing on recruitment, training, performance management, employee engagement, workplace policies, health and safety, and CSR, organizations can foster a culture of environmental responsibility. These practices not only benefit the organization but also contribute to a broader societal goal of promoting sustainability, making GHRM a vital component of modern human resource strategies.

Policies Supporting Green Human Resource Management (GHRM)

1. Sustainability Policy

• **Purpose and Scope:** A comprehe nsive sustainability policy outlines the organization's commitment to environmental stewardship. It should define the goals, strategies, and measures the organization will take to minimize its ecological footprint.

• Goals and Objectives: This policy should specify clear, measurable objectives related to sustainability, such as reducing energy consump tion, minimizing waste, and prom oting responsible sourcing.

• Implementation Strategies: Detailed action plans for achieving sustainability objectives can provide guidance for employees, ensuring that everyone understands their role in the organization's green initiatives.

3. Employee Engagement and Participation Policy

• Encouraging Participation: A policy that explicitly encourages employee involvement in sustaina bility initiatives can foster a sense of ownership. This could include formin g "green teams" or committees focused on environmental projects.

• Feedback Mechanisms: Establis hing processes for employees to share ideas and provide feedback on susta inability initiatives reinforces their role in promoting a green workplace.

5. Training and Development Policy

• Sustainability Training Programs: This policy can mandate the inclusion of sustainability training in employee onboarding and ongoing develop ment programs. Training can cover topics such as resource conservation, waste reduction, and ecofriendly practices relevant to specific job roles.

• Continuous Learning Opportu nities: Providing access to worksh ops, seminars, and online courses on sustainability can enhance employees' knowledge and engagement.

6. Performance Management Policy

• Integration of Sustainability Metrics: This policy should detail how sustainability performance will be incorporated into employee evaluations. Setting specific sustain ability-related goals can hold employees accountable for their contributions to green initiatives.

• Recognition and Rewards System: Establishing a system to recognize and reward employees for their efforts in sustainability can motivate others to engage in ecofriendly practices.

7. Health, Safety, and Environmental Policy

• Holistic Approach to Well-being: This policy should address the health and safety of employees while also considering environmental impacts. It can promote safe handling of materials and ensure that workplace practices are both environmentally and personally safe.

• Emergency Preparedness: Outlining protocols for responding to environmental emergencies, such as chemical spills or natural disasters, helps protect employees and the environment.

8. Corporate Social Responsibility (CSR) Policy

• Alignment with CSR Goals: This policy can guide how HR practices contribute to the organization's CSR objectives. It should encourage employee participation in community service projects that focus on environmental conservation and sustainability.

• Reporting and Transparency: Regularly sharing information about sustainability efforts and their outcomes enhances accountability and informs stakeholders of the organization's progress.

Implementing supportive policies is crucial for the success of Green Human Resource Management. These policies not only provide a structured approach to sustainability but also promote a culture of environmental responsibility within the organization. By integrating GHRM into various HR functions, organizations can drive meaningful change, enhance employee engagement, and contribute positively to the broader goal of sustainability.

Case Studies Of Green Human Resource Management (GHRM)

Case Study 1: Unilever Overview: Unilever, a global consumer goods company, has integrated sustainability into its core business strategy through its Sustainable Living Plan, which aims to reduce the company's environmental footprint while increasing its positive social impact. This commitment is mirrored in its Human Resource Management practices.

Key GHRM Practices:

1. Sustainable Recruitment: Unilever emphasizes sustainability in its recruitment processes. The company encourages its environmental initiatives in job descriptions and hire candidates who align with its sustainability values. By doing so, Unilever attracts individuals who are passionate about environmental stewardship.

2. Training and Development: The company provides comprehensive training programs focused on sustainability. Employees undergo workshops that teach eco-friendly practices relevant to their roles, including sustainable sourcing and reducing waste.

3. Performance Management: Unilever incorporates sustainability metrics into its performance evaluations. Employees are assessed on their contributions to sustainability goals, and exceptional efforts in this area are recognized and rewarded, fostering a culture of accountability.

4. Employee Engagement: Unilever encourages employees to participate in sustainability initiatives through its "Green Teams." These cross-functional groups work on projects that promote environmental responsibility, allowing employees to contribute directly to the company's sustainability goals. Results: Unilever has reported significant reductions in its carbon footprint and waste production. The company's commitment to sustainability has enhanced employee morale and engagement, as workers feel aligned with the organization's values. Furthermore, the focus on sustainability has strengthened Unilever's brand reputation, making it a leader in corporate responsibility.

Case Study 2: Siemens

Overview: Siemens, a global technology company, has integrated sustainability into its corporate strategy and recognizes the importance of GHRM in achieving its environmental goals.

Key GHRM Practices:

1. Sustainability Policy: Siemens has established a clear sustainability policy that guides its HR practices. This policy emphasizes the need for employees to engage in sustainable practices across all operations

2. Training Programs: The company provides training focused on sustainability and environmental responsibility. Employees are educated on best practices for reducing waste, energy consumption, and enhancing resource efficiency in their daily work.

3. Green Performance Management: Siemens incorporates sustainability goals into employee performance assessments. This alignment ensures that employees are held accountable for their contributions to the company's sustainability objectives.

4. Employee Engagement Initiatives: Siemens fosters a culture of sustainability by encouraging employee involvement in community service and environmental projects. The company supports initiatives that allow employees to participate in local conservation efforts.

Results: Siemens has achieved notable advancements in reducing its carbon footprint and waste generation. The integration of sustainability into HR practices has increased employee satisfaction and engagement, as employees appreciate the company's commitment to environmental responsibility. Siemens has also gained recognition as a leader in corporate sustainability, positively influencing its brand image.

Case Study 3: Patagonia

1. Eco-Conscious Recruitment: Patagonia seeks individuals who are passionate about the environment. Job descriptions highlight the company's dedication to sustainability, attracting like-minded candidates.

2. Comprehensive Training: The company offers extensive training programs focused on environmental issues, ethical sourcing, and sustainable practices. Employees are encouraged to become advocates for sustainability within their communities.

3. Performance Recognition: Patagonia recognizes employees for their contributions to environmental initiatives.

4. Support for Activism: Patagonia actively supports employees in engaging in environmental activism. The company provides employees with time off to participate in environmental causes, demonstrating its commitment to sustainability beyond business operations.

Results: Patagonia's unwavering commitment to environmental sustainability has not only positioned it as a leader in the industry but has also created a highly motivated workforce. Employees take pride in working for a company that aligns with their values, leading to high retention rates and strong brand loyalty among customers.

These case studies illustrate how leading organizations effectively implement Green Human Resource Management practices to foster sustainability. By integrating eco-friendly initiatives into recruitment, training, performance management, and employee engagement, these companies have achieved significant environmental benefits while enhancing employee satisfaction and brand reputation. The success of GHRM practices in these organizations serves as a valuable model for others seeking to promote sustainability in their operations.

Challenges Of Implementing Green Human Resource Management (GHRM)

While Green Human Resource Management (GHRM) offers significant benefits for organizations aiming to enhance sustainability, its implementation can pose several challenges. Understanding these challenges is necessary for developing effective strategies to reduce them. Here are some key obstacles organizations may encounter when integrating GHRM practices:

Resistance to Change

• Cultural Barriers: One of the primary challenges in implementing GHRM is the resistance to change from employees and management. Established organizational cultures may not prioritize sustainability, making it difficult to shift mindsets toward eco-friendly practices.

• Fear of Increased Workload: Employees may perceive sustainability initiatives as an additional burden, fearing that they will complicate their existing responsibilities. This apprehension can lead to reluctance in embracing new practices or policies.

Lack of Awareness and Training

• Insufficient Knowledge: Employees may lack awareness of sustainability issues and the role they can play in addressing them. Without adequate education on environmental practices, employees might not understand the importance of GHRM or how to implement sustainable behaviors.

• Training Gaps: Developing effective training programs on sustainability can be resource-intensive. Organizations may struggle to create comprehensive training materials and sessions that are engaging and informative, limiting employees' understanding of their respons ibilities regarding sustain ability

3. Limited Resources

• Financial Constraints: Implementing GHRM initiatives often requires investment in training, technology, and sustainable practices. Organizations with limited budgets may find it challenging to allocate funds for these initiatives, hindering their ability to implement comprehensive GHRM strategies.

• Human Resources: Adequate staffing is necessary to support GHRM initiatives. Organizations may lack personnel dedicated to overseeing sustainability efforts, making it difficult to develop, implement, and monitor GHRM practices effectively

4. Measurement and Evaluation Difficulties

• Lack of Metrics: Organizations may struggle to establish clear metrics for measuring the effectiveness of GHRM initiatives. Without specific indicators, it becomes challenging to assess progress and demonstrate the value of sustainability efforts to stakeholders.

• Data Collection Issues: Collecting relevant data to evaluate the impact of GHRM practices can be complex. Organizations may encounter difficulties in gathering accurate information on employee

engagement, resource usage, and environmental outcomes

5. Integration with Existing HR Practices

• Alignment Challenges: Integrating GHRM with existing HR practices can be complicated. Organizations may face difficulties in ensuring that sustainability goals align with traditional HR functions such as recruitment, performance management, and employee relations.

• Resistance from HR Personnel: HR professionals may have limited experience or knowledge about sustainability, leading to challenges in championing GHRM initiatives. If HR personnel do not fully understand the benefits of GHRM, they may not prioritize its implementation.

Regulatory and Compliance Issues

• Navigating Regulations: Organiz ations must be aware of environmental regulations and compliance requirements, which can vary by region and industry. Ensuring that GHRM practices meet legal standards may require additional resources and expertise.

• Changing Regulations: The dynamic nature of environmental regulations can make it difficult for organizations to stay compliant. Frequent changes in laws may necessitate continual adjustments to GHRM policies, complicating their implementation.

Short-Term Focus

• Immediate Results vs. Long-Term Goals: Many organizations prioritize short-term performance metrics over long-term sustainability objectives. This focus can hinder the implementation of GHRM, as sustainability efforts often yield gradual, long-term benefits rather than immediate returns.

• Pressure from Stakeholders: External pressures from investors, customers, and other stakeholders may lead organizations to prioritize immediate financial gains over sustainable practices. Balancing these competing interests can be challenging, especially for organizations in highly competitive markets.

8. Insufficient Leadership Commitment

• Lack of Top Management Support: Successful GHRM initiatives require strong support from leadership. If top management does not prioritize sustainability or view it as a strategic goal, it can undermine efforts to implement GHRM practices throughout the organization.

• Inconsistent Messaging: Inconsistent communication about sustainability goals and initiatives from leadership can create confusion among employees. Clear and consistent messaging is vital for fostering a culture of sustainability within the organization.

Implementing Green Human Resource Management presents several challenges that organizations must navigate to successfully integrate sustainability into their HR practices. By recognizing and addressing these obstacles—such as resistance to change, limited resources, measurement difficulties, and the need for strong leadership support— organizations can develop more effective GHRM strategies. Ultimately, overcoming these challenges is essential for realizing the full potential of GHRM in promoting environmental sustainability and enhancing organizational performance

Findings

1. Enhanced Employee Engagement and Satisfaction Organizations that have successfully implemented Green Human Resource Management (GHRM) practices report higher levels of employee engagement and job satisfaction. Employees appreciate working for organizations that prioritize sustainability, which fosters a sense of purpose and belonging. This increased engagement can lead to improved productivity and retention rates.

2. Positive Organizational Reputation Companies that adopt GHRM practices tend to enhance their brand reputation. A commitment to sustainability resonates with consumers and stakeholders, leading to greater trust and loyalty. Organizations like Unilever and Patagonia exemplify how a strong sustainability focus can enhance market position.

3. Improved Operational Efficiency Implementing GHRM practices often leads to operational efficiencies, such as reduced waste, lower energy consum ption, and cost savings. Companies that incorporate sustainable practices into their HR policies frequently report significant reductions in resource use, contributing to both environmental and financial benefits.

4. Alignment with Corporate Social Responsibility (CSR) GHRM practices are increasingly aligned with broader CSR initiatives. Organizations recognize that integrating sustainability into human resource functions complements their overall CSR goals. This alignment fosters a cohesive approach to environmental and social

responsibility. 5. Challenges in Implementation Despite the benefits, the findings indicate several challenges in implementing GHRM. These include resistance to change, lack of awareness, limited resources, measurement difficulties, and the need for strong leadership commitment. Organizations often struggle with integrating GHRM into existing HR practices and navigating regulatory requirements.

Recommendations

1. Foster a Culture of Sustainability: Organizations should prioritize creating a culture that embraces sustainability. This can be achieved through leadership commitment, clear communication of sustainability goals, and recognition of employee contributions to green initiatives. Regular training and workshops can reinforce the importance of sustainability in everyday practices.

2. Develop Comprehensive Training Programs: Investing in training programs focused on sustainability is crucial. Organizations should provide employees with the knowledge and skills needed to adopt eco-friendly practices. Tailored training sessions that address specific roles can enhance understanding and engagement.

3. Establish Clear Metrics and Evaluation Processes: To measure the effectiveness of GHRM initiatives, organizations should develop clear metrics and evaluation processes. Identifying key performance indicators (KPIs) related to sustainability can help assess progress and demonstrate the value of GHRM efforts to stakeholders.

4. Allocate Resources Effectively: Organizations need to allocate sufficient resources—both financial and human—to support GHRM initiatives. This includes investing in sustainable technologies, hiring dedicated personnel for sustainability roles, and ensuring adequate funding for training and development programs.

5. Encourage Employee Part icipation: Encouraging employee involvement in sustainability initiatives can foster a sense of ownership and accountability. Organizations can form "green teams" or committees that focus on developing and implementing sustainability projects. Providing platforms for employees to share ideas and feedback can enhance engagement.

6. Strengthen Leadership Commitment: Strong support from top management is essential for the successful implementation of GHRM. Leaders should articulate a clear vision for sustainability and actively participate in sustainability initiatives. Their commitment can motivate employees and reinforce the organization's dedication to green practices.

7. Integrate GHRM with Existing HR Functions To overcome challenges in alignment, organizations should integrate GHRM practices with existing HR functions. This includes incorporating sustainability metrics into performance evaluations, embedding eco-friendly criteria in recruitment processes, and aligning training programs with sustainability objectives.

Conclusion

Green Human Resource Management is a vital approach for organizations aiming to promote environmental sustainability while enhancing organizational performance. The findings indicate that successful implementation of GHRM can lead to improved employee engagement, positive brand reputation, and operational efficiencies. However, organizations must navigate several challenges, including resistance to change, limited resources, and the need for strong leadership support. By adopting the recommended strategies—such as fostering a culture of sustainability, investing in training, establishing clear metrics, and strengthening leadership commitment— organizations can effectively implement GHRM practices. Ultimately, GHRM not only benefits the environment but also contributes to a more motivated workforce and a competitive organizational edge in today's increasingly eco-conscious marketplace. The integration of sustainability into human resource practices is not just an option but a necessary strategy for long-term success and corporate responsibility.

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