How Does Transformational Leadership Enhance Sustainability Practices in Energy and Industry? The Mediating Influence of Environmental Awareness

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Abstract: - This paper explores the multidimensional interdependencies, namely, the links between the transformation of leadership, sustainable practices, and environmental awareness, generally, in the energy and industrial sector of Saudi Arabia. We aim to delineate transformational leadership as a tool that will help promote sustainable practices by mediating environmental awareness. Data was collected through a questionnaire distributed among 384 employees in four prominent Saudi companies: KSA (SAPCO) (SABIC) Company, Saudi Electric Company (SEC), and Petro Rabigh Company. Applying the Structural Equations Evaluation Model (SEM) to the data analysis, the results demonstrated the positive role of transformational leadership in sustainability practices with the role of environmental awareness to act as a mediator. Lastly, those transformational leadership dimensions we mentioned earlier – charismatic leadership, directional motivation, intellectual stimulation and individualized attention – are crucial for successful sustainability projects. The data revealed a need for the enterprise to think about the environment as the core of its values to link these values to the practice of sustainability. This assumes that the enterprise will seek to include sustainability practices in its main strategies.

Key-Words: - Transformational Leadership, Sustainability Practices, Environmental Awareness, Energy Sector, Industrial Sector, Saudi Arabia.

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1 Introduction

The new business environment becomes highly vulnerable due to the necessity to move against adverse environmental challenges, [1]. Companies, such as those in the energy and industrial industries, now conclude that to improve their profits is to follow ecological responsibility, [2]. Frankly, the leading role in creating sustainable practices is one of the most significant priorities for leaders, and thus, they gain paramount prominence, [3], [4]. Considering the multifaceted role of transformational leadership that spans its tendencies of empowering and inspiring, it has become apparent that this is a cornerstone that can help build sustainable organizations, [5]. In conclusion, transformational leadership, sustainability practices, and environmental awareness are exquisitely linked in a complex network requiring further investigation. The global economy's energy and industrial sectors are the 'crown jewels'. The vital place in the energy market occupied by Saudi Arabia, one of the key participants, is a case in point, [6]. The range of unsettling influences on the environment, society and economics at stake calls for a deep cognitive knowledge about how leaders' styles make a difference in the era of sustainable initiatives, [7]. This environmental consciousness can be achieved by following sustainable practices, for instance, cutting down the carbon footprint, resource optimization, and corporate social responsibility, which play a vital role in visioning long-term ultimate success, [8]. Transformational leadership, otherwise known as employee-centric leadership, which facilitates creativity, innovation,

and ethical values, appears to be the best-fit environment for these practices, [9]. Nevertheless, this research aims to identify specific mechanisms through which the power of transformational leadership can help address environmental issues, the intermediate role of environment awareness being one of the crucial parameters.

The prospect of Saudi Arabia's standing in the sidereal energy landscape could not be ignored. As a country where one of the world's leading oil producers and exporters is located, its leading role in creating international energy markets cannot be overlooked, [10]. The sectors of energy and industry of Saudi Arabia have been the mainsprings of the nation's economic growth and development, which provided the grounds for an economic boom over the past few years, [11]. However, However, the energy access facilitated via the use of energy resources has engendered environmental challenges like energy emissions and scarcity, depletion of resources, and environmental degradation, [12]. Henceforth, these industries need transformation to the sustenance stage based on the principles of balancing economic interests with the ecologic and social aspects, [13].

Indeed, in this, leadership occupies a critical position. The leadership that transforms and introduces innovation, employee engagement, and ethical conduct can be a key driver of sustainable energy and industrial sectors today, [14], [15]. Visionary leaders want to encourage and push employees to live sustainably, and they can influence not only their organization's income but also its ecological footprint, [16].

Furthermore, environmental consciousness is becoming another critical parameter in the sustainability world. Green-minded individuals who value environmental issues and their everyday actions' bearing on their quality become more likely to engage themselves in sustainable programs. Therefore, environmental consciousness becomes particularly relevant as environmental awareness is more sought as the link between transcendental leadership and green practices.

1.1 Objectives of the Study

- Assess the implications of the transformational leadership styles on implementing sustainability measures within the energy and industrial sectors of the Kingdom of Saudi Arabia.
- Create the relationship between environment awareness and transformational leadership; How transformational leadership leads to certain sustainability practices
- Identify concretely the features that will evoke the highest sensibility in environment and sustainability among leaders.
- Make recommendations about transformational leadership that apply to leaders and organizations in the power and industrial industry sector in Saudi Arabia and could help promote sustainability.

1.2 Importance of the Study

The importance of the research in many different ways has been strengthened to carry out this research. It makes manifest the elaborate linkage between transformational leadership, environmental awareness, and sustainability empathy in the energy and industrial sectors of Saudi Arabia. Identifying immediately related and otherwise related, the research will make us aware of how this process works, especially creating a place for environmental beliefs as a pivotal mediator. Scientists' dedication offers essential knowledge to key leaders and officials working with Saudi Aramco Power, the Saudi Electricity Company, SABIC, and the Petro Rabigh plant. Applying transformative leadership will enhance the ability to manage change for improved sustainability. Drawing not only from the practical dimension but also from unifying theory, this analysis becomes a call to act for the industry asking to implement leadership of a transcendental kind to initiate changes and bring environmental progress. The research clarifies the importance of leadership and awareness of a sustainable environment in achieving sustainable practices in the energy and industrial sectors. Therefore, it may lead to a greener future in Saudi Arabia.

Nevertheless, this green leadership and awareness model has been developing to make environmental practices possible, and we still need research related to the big picture about the function of the interplay between the two leadership roles to guide sustainability behaviors in various sectors of Saudi Arabia. This is because existing studies illustrate the various interactions of this system. However, the eventual implementation of these factors points to the necessity of more research that can explain this thoroughly.

2 Literature Review and Hypotheses

2.1 Transformational Leadership and Sustainability Practices

Organizations dealing with the dynamic nature of a business today appreciate the significance of how crucial transformational leadership can be and how

sustainable practices are in their journey to becoming successful over a long period. Furthermore, this literature review dissects the interplay of these two notions in which synergy brings out virtuous results for the corporation, the environment, and individuals.

At the heart of transformational leadership, [17]. lies the superpower of emotional awareness, where the leaders create an everlasting vision and strive to move people beyond their perspective. Transformational leadership style is defined by four dimensions namely, a still leader's ability to inspire and empower team members, articulate clearly and fusing innovative ideas, and the ability to offer both professional counseling and vocational assistance, [18], [19].These parts then impulse the staff to push on the sustainable processes that contribute to the profession's mission that considers social and environmental goals. The studies confirmed that such multilevel interactions viewable as organizational performance drivers first, and second, influence people to embrace social entrepreneurship activities, and finally, impel them to have more job satisfaction, [20], [21], [22]. Green transformational leadership is a novel approach to addressing pressing environmental issues and promoting sustainability. It is of great significance for environmental performance and is considered the main factor after [23] and [24] and studies such as [25]. One of the most evident fields of study is the positive influence of green transformational leadership on the environment through the implementation of green human resource management by such leaders, [26] and by also helping to build resilience among green teams, [27], [28]. It can undoubtedly ensure the latest green products inventing and company improvement, as presented in the construction supply chain, [29], [30].

The power of transformational leadership to enhance green practices no one can dispute; nevertheless, permitting the difficulty of the matter and the ongoing debates about it is a necessity. On the other hand, some investigation reports indicate that it can only be effective in some industries and specific cultures, [31]. Moreover, many unresolved issues exist, such as the performance and dynamics of environmentally specific transformational leadership versus non-specific transformational leadership, [32], [33].

Nonetheless, one of the drawbacks surrounding the phenomenon of financialization is that considerable trade-offs may exist between short-term profits and long-term sustainability, [34], [35]. Others may highlight that adopting green practices might carry certain extra costs with it; thus, if such steps are put into practice, they may have a detrimental impact on the competitiveness of businesses in a market, [36].

Moreover, although leadership is a vision sharing avenue requiring differentiation of leadership styles, the involvement of transformational leadership as a practical approach in supporting sustainability implementation across multiple sectors is irrefutable. Green innovation and sustainability performance should be the leader's transformational focus to make the companies that wish to engage with the social and environmental challenges succeed in the new world order. The following hypothesizes can thus be derived: The following hypothesizes can thus be derived:

H1: Transformational leadership positively influences sustainability practices in KSA's energy and industry sectors.
H1a: Charismatic leadership (CL) positively influences sustainability practices (SP) in KSA's energy and industry sectors.
H1b: Individualized Consideration (IC) positively influences Sustainability Practices (SP) in KSA's energy and industry sectors.
H1c: Inspirational motivation (IM) positively influences sustainability practices (SP) in KSA's energy and industry sectors.
H1d: Intellectual stimulation (IS) positively influences sustainability practices (SP) in KSA's energy and industry sectors.

2.2 The Role of Environmental Awareness

The key contribution of environmental awareness to making sustainable behavior possible and recognizable is unanimously confirmed, [37], [38]. It is the base for developing a knowledge system that embraces values, beliefs, and behaviors that aim to preserve the environment, [39]. Many studies have identified that environmental consciousness and pro-environmental behavior are strongly correlated as most aware people have demonstrated a tendency to purchase eco-friendly goods, adopt environment conservation habits, and so on [40] and [41]. That alignment brings out the significance of education and giving information to create environmentally conscious actions. Future environmental concern tendencies will be more likely to have a deeper understanding of environmental problems and entirely conducive to pro-environmental behaviors, [42].

This includes the maintenance of a favorable or positive viewpoint about nature, which, in turn, affects personal habits and decision-making, [43].

Eco-conscious college students are prone to engage in sustainable behaviors like waste management and energy use reduction Verbalization, [44]. The consequences of raising environmental awareness relate to individual actions. However, it can provide a driving force for collective efforts and generate law and policy decisions. A tolerance sector also fuels advocacy for environmental conservation and shaping sustainability practices in organizations, [45].

Consequently, environmentally recognized individuals are more likely to back and participate in environmental activities, which impels the sociocultural changes needed to lead to responsible treatment and widespread environmental care, [46].

Recognizing environmental awareness as essential for promoting sustainable behavior has already been on the spot. From there on, new discussions are about the proper and sane approaches to foster and maintain it. The first controversy is the best methods with different approaches, such as formal education, experiential learning, or community engagement, [47]. However, another significant discourse raises the issue of environmental awareness value as a driver of sustainable environmental responses, systemic transformations, and creating necessary environmental changes.

The strong and well-documented correlation between sustainability practices and environmental awareness has been shown in numerous studies, [48]. Promoting environmental education at diverse levels is instrumental to substantial outcomes toward an advanced green future, i.e [49]. report a directly proportional relationship between the extent of recognition among secondary school students of environmental issues and the manner they do sustainable development activities. This points out that ecological learning in the form of responsible behavior in young people can be the basis for a sustainable future due to the building on mesocycle. Furthermore, out of personal knowledge, corporate ecological duty plays a significant part in changing public interest to eco-friendly products. The authors. reported that the behavior of consumers can be changed towards more ecological purposes if corporate sustainability issues are exposed to them, [50]. This is where businesses come into play with a key role in encouraging consumers to make sustainable decisions by introducing and promoting green practices.

Moving to complexity other than linear relationships, [51]. suggest that the dynamic nature of internal L commitment can foster the gearshift to the organization's environmental awareness. This case study conducted in eco-industrial parks (EIPs) suggested that managerial environmental awareness can be a determinant factor in the EIPs' success in achieving environmental sustainability tasks. It points to the leadership aspect that should be adequately informed on environmentally related issues while simultaneously pushing the organizations toward the right path.

The subject requires multiple-style environmental discourses and practices to help overcome different local difficulties, as highlighted by [52]. One of the cases they discussed was the placement of the natural zones in different districts of the country, which proved that social and environmental factors are closely related and sway from one another. Such suggests a context-based vision that precisely adjusts global environmental awareness efforts to handle challenges from different regions.

While it is indisputable that ecological knowledge, regard, and a positive attitude toward green products are essential factors, [53], [54]. believe they are insufficient. His research on SMEs seeks to create awareness about the importance of knowledge management policies in developing green innovations. The solution lies in the implementation of a multifaceted approach. It blends environmental awareness, a knowledge management system, and an organizational culture that must have a built-in sustainable approach. The following hypothesis can thus be derived:

H2: Environmental awareness positively influences sustainability practices in KSA's energy and industry sectors.

2.3 Mediating Role of Environmental Awareness

Transformation leadership, seen as inspiring for innovation and the cause of a better organizational culture, has a vital role to play when it comes to building sustainability within the organization. On the contrary, the study held that the green factor, regarded as a moderator, might enhance this effect enormously.

Environmental consciousness falls somewhere in the middle of leadership and sustainable practices. It influences individuals physically and emotionally, and often, their perspectives become oriented on socioecological responsibility. Although employees are essential components, who help to carry out day-to-day operational activities, organizational leaders should use their capability to create an environmental awareness culture amongst staff. Hence, its green initiatives embed sustainable

practices into the organization's operational fabric. This mediation process is essential for developing environmental understanding and a more substantial incorporation of responsible practices into such an organization. The commitment may become more profound and considerably last longer, leading to a better organizational sustainability influence, [55], [56].

In addition, environmental consciousness, such as a mediator, matches unity in consistency values with green responsibility, so sustainable practices are a part of the fundamental business strategies. This extensive and integrative strategy that looks into all of the environmental, social, and economic dimensions will set the context for a complete framework of sustainability that should go far beyond mere compliance and embrace responsible leadership, [57].

Though evidence does exist as to how transformational leaders can directly contribute to sustainability, [58]. empirical findings have brought into focus how environmental awareness is an intermediate condition. There is evidence that supportive leaders when molding environmentally conscious team members, exhibit such a profound behavioral change of green attitude that leads to better environmental performance, [59], [60], [61].

Summarizing, using environmental wellbeing as an intermediary agent makes for a scenario in which transformational leadership can be delivered with greater effectiveness by pushing through sustainability. Through cultivating ecological awareness concurrently with efficient management, businesses can form an ethical environment that brandishes responsible and sustainable behavior, which would then ensure that organizations stay on track with what is best for both society and the environment, [62], [63], [64].

Based on the information provided above, it is possible to develop the subsequent conjectures.

H3: Environmental Awareness (ENVA) mediates the relationship between Transformational Leadership and Sustainability in KSA's energy and industry sectors.

H3a: Environmental Awareness (ENVA) mediates the relationship between charismatic leadership (CL) and sustainability practices (SP) in the energy and industry sectors in KSA.

H3b: Environmental Awareness (ENVA) mediates the relationship between Individualized Consideration (IC) and Sustainability Practices (SP) in the energy and industry sectors in KSA.

H3c: Environmental Awareness (ENVA) mediates the relationship between intellectual stimulation (IS) and sustainability practices (SP) in the energy and industry sectors in KSA.

H3d: Environmental Awareness (ENVA) mediates the relationship between inspirational motivation (IM) and sustainability practices (SP) in the energy and industry sectors in KSA.

3 Methodology

The energy sector in Saudi Arabia acts as a noteworthy energy source, embracing oil products, natural gas, and petrochemicals. It is overseen by the Ministry of Energy, Industry, and Mineral Resources, and Saudi Aramco Energy (Sabek) is responsible for exploration, refining, and related activities. It is the largest company in the world by market capitalization and the seventh-largest natural gas market. Saudi Arabia has been exporting energy products to the world since 1939, and Saudi Aramco is a shareholder in many companies operating in Saudi Arabia's energy sector.

The study focuses on the energy and industrial sectors. Therefore, the focus was on companies operating in the field of energy and energy-related industries in Saudi Arabia, according to Table 1.

Table 1. Sample Companies in the Energy and Industrial Sectors

No	Company Name
1	Saudi Aramco Power Company (SAPCO).
2	.Saudi Electric Company (SEC)
3	SABIC Company.
4	Petro Rabigh Company.
5	Jazan Integrated Gasification Company for electricity production (JIGPC).
6	Company.Sudair PV IPP
7	Company.Marafiq
8	.Fadhili Plant Cogeneration Company (FPCC)
9	.Power Cogeneration Plant Company (PCPC)

Table 2. Distribution of the study sample according to the number of employees in each company

No	Company Name	Number of employees	Sample size
1	Saudi Aramco Power Company (SAPCO).	70000	192
2	Saudi Electric Company (SEC).	33437	92
3	SABIC Company.	32721	90
4	Petro Rabigh Company.	3500	10
Total employees		139658	384

Table 3. Demographic information

Category	Variable	Frequency	Percentage (%)
Gender	Male	219	57
	Female	165	43
Age	From 20 years to less than 30 years.	61	16
	From 30 years to less than 40 years.	123	32
	From 40 years to less than 50 years.	154	40
	From 50 years and over.	46	12
Education	Less than bachelor	54	14
	Bachelor	238	62
	Masters	54	14
	Ph.D	38	10
Experience	Less than 5 years	177	46
	From 5 years to less than 10 years.	138	36
	From 10 years to less than 15 years.	38	10
	From 15 years and over.	31	8
Company Activity	In the field of energy	284	74
	In the field of industry	100	26

A questionnaire was designed to investigate the relationship between transformational leadership and sustainability practices in the energy sector. The questionnaire consisted of four sections:

Section 1: Measured the independent variables of transformational leadership, which are intellectual stimulation, individualized consideration, inspirational motivation, and charisma.

Section 2: Measured the dependent variables of sustainability practices, which are environmental sustainability practices, social sustainability practices, and economic sustainability practices.

Section 3: Measured environmental awareness.

Section 4: Included demographic variables, such as gender, age groups, educational qualification, experience, organizational role, work area, and job title.

The questionnaire was confidently distributed to a total of 384 employees working across four energy companies operating in Saudi Arabia, as indicated in Table 2.

Table 3 in the study presents demographic information about the participants, offering information into the composition of the research sample. The table reveals a relatively balanced gender distribution, with 57% of participants being male and 43% female. Age-wise, most respondents fall within the 30 to 49 age range, indicating that the study sample primarily comprises individuals with significant work experience. Regarding education, most hold bachelor's degrees, and there is a notable presence of participants with master's and Ph.D. qualifications. The years of experience vary, with a significant portion having less than 5 years of experience but also substantial representation in the 5 to less than 10 years category. Lastly, the participants are categorized based on their company's primary activity, with a majority working in the energy sector and the remainder in the industrial sector. This demographic information underscores the diversity and relevance of the sample to the study's exploration of leadership, environmental awareness, and sustainability practices in the energy and industrial sectors in Saudi Arabia.

Table 4 provides descriptive statistics and information on the normality test results for the key variables and demographics in the study. These statistics offer valuable insights into the data's central tendency, variability, and distribution.

In terms of the critical variables, it can be observed that the mean scores for transformational

leadership components (CL, IM, IS, IC) and sustainability practices (EnSP, SSP, EcSP) all fall in the range of approximately 3.87 to 4.16, indicating that, on average, the respondents perceive these variables positively.

Table 4. Descriptive Statistics and Normality Test (Mean and SD)

Name	Mean	Standard deviation	Excess kurtosis	Skewness
CL	4.163	0.887	0.071	-0.893
IM	4.073	0.973	-0.394	-0.793
IS	4.081	1.001	-0.365	-0.855
IC	3.967	1.043	-0.831	-0.63
EnSP	3.927	1.037	0.737	-1.002
SSP	4.008	1.108	1.524	-1.36
EcSP	3.87	1.082	-0.314	-0.713
ENVA	3.854	1.152	0.088	-0.903
Gender	1.13	0.336	3.006	2.227
Education	2.228	0.774	0.323	0.645
Industry Sector	1.431	0.495	-1.952	0.283

However, there are variations in standard deviations, with some variables showing higher variability (e.g., SSP) than others (e.g., EcSP), suggesting differences in how respondents perceive these aspects.

The normality test results, indicated by kurtosis and skewness values, insights into the data distribution. Generally, the values for excess kurtosis and skewness for most variables fall within acceptable ranges, indicating that the data approximates a normal distribution.

4 Results

Ensuring a research model's validity and reliability is essential to enhance its suitability for estimation purposes and alignment with the demands of a research context. Consequently, we analyzed the connections between the constructs using Smart PLS 4 software. This analysis involved the computation of trajectory models, specifically employing PLS algorithms. These algorithmic procedures estimate trajectory models, utilizing latent variables as foundational components.

Table 5 and Figure 1 summarize the reliability and convergent validity of the measures for different designs examined. Such imprints are MN: Charm Leadership (CL), Environmental Conscientiousness (EC), Individualized Attention (IC), Inspiration Motivation (IM), Intellectual Stimulation (IS), and Sustainable Operations (SO). Every construct measures several items, as shown in the table, and the column represents those items' loadings, VIF, Cronbach's Alpha, and AVE values, respectively.

The factor loadings show a result above 0.5, thus indicating the significance of items well within this range. This demonstrates that the items used are appropriate indicators of the various constructs. All the VIF values, which are in charge of identifying multicollinearity, are under the benchmark of 5, and hence there is no severe multicollinearity among the items.

Cronbach's Alpha quantifies the varying results, and outputs above 0.7 exhibit reasonable internal consistency using all constructs, which means the measure is reliable in the result. The AVE evaluates the percentage of the variance explained rather than the amount due to error, and values above 0.5 are desirable. A majority of constructs have passed this cut-off point that substantiates the good convergent validity of which are Charismatic Leadership and Inspirational Motivation, only both are just below the threshold of 0.5.

Table 6 in the image displays the Heterotrait-Monotrait (HTMT) ratio for assessing discriminant validity among several constructs: Charisma Leadership (CL), Individual Environmental Awareness (ENVA), Emotional Inspiration (IC), Individualized Motivation (IM), intellectual Stimulation (IS), and Sustainability Practices (SP). Through all these HTMT ratios, the threshold of 0.85 is met, revealing that each construct is considered distinguishable from the others, as expressed in the table, which shows the discriminant validity of the constructs.

Table 7 applies the Fornell-Larcker criterion to assess discriminant validity among constructs. The diagonal bold values represent each construct's square roots of the Average Variance Extracted (AVE). They must exceed the corresponding off-diagonal values (the correlations between constructs) in their row and column. All bold diagonal values in this table are higher than the non-diagonal ones for each construct, confirming good discriminant validity per the Fornell-Larcker criterion.

Table 8 provides metrics on the structural fit of a study model. R-Square values for Environmental Awareness (ENVA) and Sustainability Practices (SP) are high, indicating that the model explains a significant portion of the variance in these variables. The R-Square Adjusted values are slightly lower but still indicate a strong fit. The Explanatory Power (F2) values for various predictive relationships in the model (CL to ENVA and ENVA to SP) range from moderate to high, suggesting that these predictors significantly impact the outcomes.

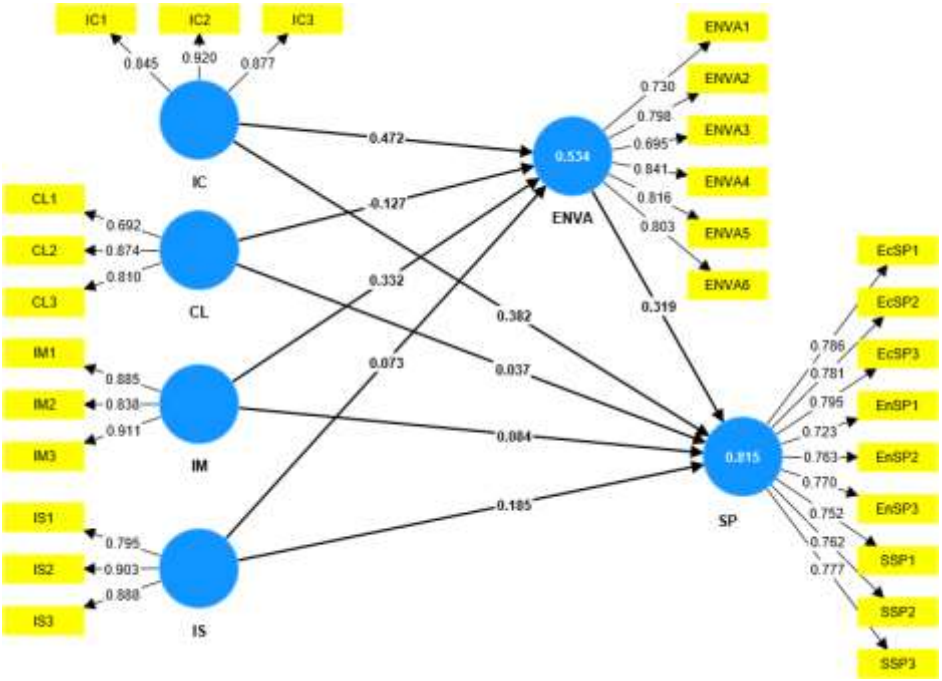

Fig. 1: Output loading of factors

NOTE: Charismatic Leadership (CL), Inspirational Motivation (IM), Intellectual Stimulation (IS), Individualized Consideration (IC), Sustainability Practices (SC), Environmental Awareness (ENVA)

Table 5. Convergent validity and reliability of constructs

Constructs	Items	Loadings	VIF (<5)	Cronbach's Alpha (>0.70)	rho_A	Average Variance Extracted (AVE) (>0.50)
charismatic Leadership (CL)	CL1	0.692	1.334	0.710	0.738	0.633
	CL2	0.874	1.713			
	CL3	0.810	1.421			
Environmental Awareness (EA)	ENVA1	0.730	1.996	0.873	0.883	0.612
	ENVA2	0.798	2.385			
	ENVA3	0.695	1.761			
	ENVA4	0.841	2.605			
	ENVA5	0.816	2.369			
	ENVA6	0.803	2.078			
Individualized Consideration (IC)	IC1	0.845	2.440	0.856	0.862	0.777
	IC2	0.920	2.383			
	IC3	0.877	2.395			
Inspirational Motivation (IM)	IM1	0.885	1.924	0.852	0.862	0.772
	IM2	0.838	2.232			
	IM3	0.911	2.277			
Intellectual Stimulation (IS)	IS1	0.795	1.986	0.827	0.833	0.745
	IS2	0.903	2.809			
	IS3	0.888	2.143			
Sustainability Practices (SP)	SSP1	0.752	2.188	0.913	0.913	0.590
	SSP2	0.762	1.867			
	SSP3	0.777	2.476			
	EcSP1	0.786	1.520			
	EcSP2	0.781	2.531			
	EcSP3	0.795	2.404			
	EnSP1	0.723	2.376			
	EnSP2	0.763	2.794			
	EnSP3	0.770	2.304			

Table 6. Discriminant validity (HTMT Ratio)*

	CL	*ENVA*	*IC*	*IM*	*IS*	*SP*
CL						
ENVA	*0.659*					
IC	*0.767*	*0.800*				
IM	*0.692*	*0.766*	*0.745*			
IS	*0.680*	*0.723*	*0.786*	*0.822*		
SP	*0.666*	*0.833*	*0.667*	*0.814*	*0.812*	

*Note: *A HTMT Ratio < 0.85 is considered valid*

Table 7. Discriminant validity (Fornell-Larcker criterion) *

	CL	*ENVA*	*IC*	*IM*	*IS*	*SP*
CL	***0.896***					
ENVA	*0.546*	***0.782***				
IC	*0.761*	*0.707*	***0.881***			
IM	*0.782*	*0.675*	*0.818*	***0.878***		
IS	*0.750*	*0.626*	*0.819*	*0.777*	***0.863***	
SP	*0.706*	*0.682*	*0.827*	*0.784*	*0.794*	***0.888***

*Note: *Following the Fornell-Larcker criterion, the bold value is accepted when it exceeds its row and column values*

Table 8. Criteria for the study model structural fit

Variables	R-Square	R-Square Adjusted	Variance Explained	Explanatory Power F2
ENVA	0.534	0.518	High	N/a
SP	0.815	0.807	High	N/a
CL -> ENVA	N/a	N/a	N/a	0.211
CL -> SP	N/a	N/a	N/a	0.202
ENVA -> SP	N/a	N/a	N/a	0.257
IC -> ENVA	N/a	N/a	N/a	0.110
IC -> SP	N/a	N/a	N/a	0.163
IM -> ENVA	N/a	N/a	N/a	0.162
IM -> SP	N/a	N/a	N/a	0.109
IS -> ENVA	N/a	N/a	N/a	0.103
IS -> SP	N/a	N/a	N/a	0.150

Table 9. *Results of GOODNESS-OF-FIT*

	Saturated model	Estimated model
SRMR	0.076	0.076
d_ULS	2.155	2.155
d_G	1.492	1.492
Chi-square	904.553	904.553
NFI	0.989	0.989

Overall, the table suggests a well-fitting model with strong explanatory power.

Table 9 presents the goodness-of-fit indices for a saturated and an estimated model, showing that both models have identical fit statistics across all measures. The SRMR value is within the acceptable range, and the NFI is very high, close to 1, indicating a good fit for both models. The identical values across both models suggest that the estimated model fits the data and the saturated model.

Figure 2 showcases the structural model exploring how transformational leadership impacts sustainability practices in energy and industry, with a focus on the mediating role of environmental awareness.

Table 10 presents the results of direct hypothesis testing, examining the relationships between various independent variables (Charismatic Leadership, Inspirational Motivation, Intellectual Stimulation, Individualized Consideration, and Environmental Awareness) and the dependent variable, Sustainability Practices (SP). These systems of assessments play a vital role in discerning how leadership styles, as well as environmental perception, have an impact on the implementation of sustainable policies in the energy and industry sectors.

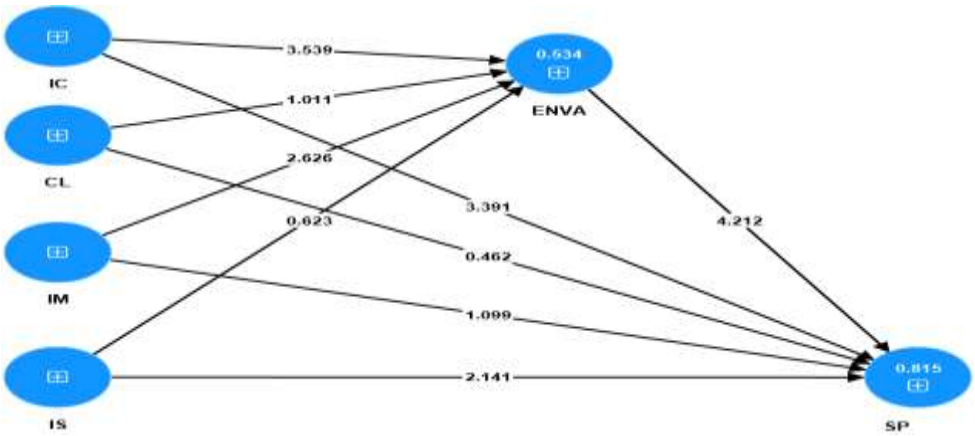

Fig. 2: Structural Model (Bootstrapping @5000)

Regarding the first hypothesis (H1a: CL -> SP), which was aimed to support the proof that Charismatic Leadership (CL) significantly affects Sustainability Practices (SP), the results demonstrated no significant relationship. The β value was 0.037, and the t-value was 0.464 with a p-value of 0.644.

In contrast, the second hypothesis (H1b: Ante, suggested that there is a direct cause-and-effect relationship whereby Individualized Consideration leads to the acceptability of Sustainability Practices. The results show a statistically significant relationship tested with a beta (β) is 0.382, with a t-value (t) is 3.391, and a p-value (p) is 0.001. As this conclusion demonstrates, the above hypothesis is deemed accurate, meaning that Individualized Consideration positively contributes to creating Sustainability Practices.

For the third hypothesis (H1c: Indirect motivations by Inspirational Motivation (IM) to the Sustainability Practices (SP), the analysis did not show any relationship with significance. The beta value (β) was 0.084 with a t-value of 1.099 and a significance level (p) of 0.272, which does not support the hypothesis that Inspirational Motivation (IM) affects Sustainability Practices (SP).

The fourth hypothesis (H1d: IS -> SP) showed that the application of both Intellectual Stimulation (IS) and sustainability Practices (SP) would directly affect the performance of the organization positively. The result of the t-test (t-value) of 2.141 with a beta coefficient of 0.185 and p-value of 0.032 is quite critical as it discloses the existence of a statistically significant relation. Therefore, the plausibility of this hypothesis results from the fact that Intellectual Stimulation is a strong confidence builder, henceforth leading to more sustainable practices.

The fifth hypothesis (H2) was finally investigated to examine the impact of Environmental Awareness (ENVA) on Sustainability Practices (SP). The regression equation supported the hypothesis, showing a significant relationship with β = 0.319, t = 4.212, and p = 0.000. This finding suggests that Environmental Awareness has the potential to accelerate sustainability.

Upon observing Table 10, it becomes apparent that Individualized Consideration, Intellectual Stimulation, and Environmental Awareness play a crucial role in energy and industry sustainability. Although Charismatic Leadership and Inspirational Motivation do not directly impact Sustainability Practices in this context, their influence must be more consistent. Consequently, these outcomes illuminate the significance of leadership style and environmental awareness in fostering sustainability within these sectors.

Table 10. Direct Hypotheses testing

Relationship	B	t-Value	Significance level P	Decision
H1a: CL -> SP	0.037	0.462	0.644	Rejected*
H1b: IC -> SP	0.382	3.391	0.001	Accepted**
H1c: IM -> SP	0.084	1.099	0.272	Rejected*
H1d: IS -> SP	0.185	2.141	0.032	Accepted*
H2: ENVA -> SP	0.319	4.212	0.000	Accepted**
Significant at P** =< 0.01, p*<0.05				

Table 11. Indirect Effects

Relationship	Indirect Effect			Bootstrapped Confidence Interval		Decision
	Path Coeff	t-Value	Significance level P	2.5%	97.5%	
H3a: CL -> ENVA -> SP	-0.041	0.043	0.342	-0.041	-0.131	No mediation
H3b: IC -> ENVA -> SP	0.151	0.056	0.007	0.058	0.277	Partial mediation
H3c: IM -> ENVA -> SP	0.106	0.048	0.029	0.021	0.211	Full mediation
H3d: IS -> ENVA -> SP	0.023	0.039	0.025	0.048	0.110	Partial mediation
Significant at P** =< 0.01, p*<0.05						

In Table 11, the 1 is the depiction of the antilog of dependant variables (Sustainability Practices, SP) through the distribution of five key variables (Charismatic Leadership, Individualized Consideration, Inspirational Motivation, Intellectual Stimulation) against the mediator (Environmental awareness, ENVA). These findings have opened up a new angle of leadership styles and their relation with environmental consciousness levels that exist in different energy sectors and industries and drive them into following sustainable practices.

The first hypothesis (H3a: Empowered leaders (CL) mediate environmental awareness (ENVA), influencing the followers' commitment to a sustainable lifestyle. The coefficient is 0.041, the t-value is 0.043, and the p-value from the t-test is 0.334, which is not statistically significant.

In contrast, the second hypothesis (H3b: Based on the construct utilized by ICC (SP) (IEA -> SCA -> PC) ascertains the mediating influence of Environmental Awareness (ICA) on the relationship between Individualized Consideration (IEA) and Sustainability Practices (SCA) (IC -> ENVA -> SP). The researcher discovers indulgence of mediation, with a path coefficient equal to 0.151, p-value equals to 0.056, and significance level equal to 0.007. Breach of the Believability Interval, which spans the range of 0.058 to 0.277, obtained from the bootstrapping analysis, further suggests that mediation is at play in this relationship.

The third hypothesis is H3c: (IM -> ENVA -> SP). One of the “links” is examining the relationship between Inspirational Motivation (IM) and Sustainability Practices (SP), including Environmental Awareness (ENVA), A 0.106 path coefficient, a good p-value of 0.029, and a good t-value of 0.048, suggesting the mediation role. The symmetric percentile confidence interval obtainable (0.021-0.211) portrays complete mediation. The fourth hypothesis (H3d: (IS – itself is indirect to the development of Environmental Awareness, while that 'IS' à SP) aims to find out how the two are connected via Environmental Awareness (in the framework of the IS – SP study). Eq. (1) (get it= 0.023), get it= 0.039; p= 0.025 were significant overall concerning the mediation effect of older age, health-oriented lifestyle habits, and health status. A broad 95% Confidence interval between 0.048 to 0.110 indicates that job success is partially mediated through a sense of wellbeing. Last, Tab. 11 brings to attention that Environmental Awareness (ENVA) bridges leadership styles and sustainable practices. Leadership conduct does not appear to be an intermediary factor of CL. While IC and IS leadership behaviors differ in mediation, for instance, I/M leaders were found to contribute more to the CL than their I/S counterparts.

5 Discussion

Table 10 displays the results of the direct hypotheses testing, which examined the connections between the independent variables (charismatic leadership, inspirational motivation, intellectual stimulation, individualized consideration, and environmental awareness) and the dependent variable, sustainability practices (SP). This analysis is crucial as it enhances our understanding of how leadership styles and environmental awareness directly impact sustainability practices in the energy and industrial sectors.

The outcomes of the exploration partially reinforced the research postulates. The null hypothesis H1a, which suggested that people with a magnetic personality can be markedly separated from sustainability practices, was rejected. Hereby results in line with research literature which is shows that sustainable characteristic leadership is just to a certain extent related to sustainability practices, [65].

From the generalization of this study, charismatic leadership and sustainable practices link can lead to different results than this research was able to show. This because a leader should be quick in establishing himself/herself as trustworthy and a visionary in the sustainability field.

Analyzing the conclusion, I can say that hypothesis H1b which stipulated that individualized

consideration towards growth in sustainability practices was true. This result contrasts with the previous studies' findings which did not disclose the participation of individual responsibility as a motivating force to engage employees in the development of sustainability, [66], [67], The leader's key focus was on helping employees to develop their own sustainability career paths, thus, developing a culture of employees-first, a primary step for business sustainability.

The hypothesis (H1c), super Ed, was wrong as irrational motivation would not be helpful to procrastinating sustainability practices. In this context, previous research has shown a similar pattern - the fact that people do not always act sustainably when under inspiration, [68], [69]. While promoting these initiatives, the managers are required to balance a well-conceived vision of sustainability, with the need to excite employees to act following these practices. The confirmed empirical data proves the CSR's devotion (H1d) not only to sustainable ideas but also to further ones. This is analogous to studies that found innovative projects could arise when there was intellectual stimulation generating more employee initiative and creativity. This has an extended impact that can apply to any sustainability projects that will be implemented, [70], [71], [72]. In this case, managers have proven acts of individual thinking and logic on the part of employees who write off that the environment is transparent which when comes to redressing the act becomes one of the creative incentives.

The second primary hypothesis (H2: ENVA -> SP) delved deeper into examining the direct impact of environmental awareness (ENVA) on sustainability practices (SP). The analysis revealed a highly significant relationship. This can be attributed to the employees of the studied companies who comprehensively understand various aspects of environmental issues affecting the organization. They demonstrate a vague understanding of the sustainability practices embraced by the company, overlook the insignificant environmental impact of its activities, have poor knowledge of the environmental regulations the company must adhere to, and need to be more knowledgeable about the unsustainable initiatives and projects it implements.

This discovery aligns with countless studies that underscore the crucial role of environmental consciousness in promoting sustainable behavior and practices, [73], [74]. As [75] point out, "Corporate sustainability exposure leads to greener consumption practices among consumers," underscoring the impact of awareness on shaping individual and organizational choices toward sustainability.

Table 11 provides an analysis of the indirect impacts of the primary independent factors (Charismatic Leadership, Individualized Consideration, Inspirational Motivation, and Intellectual Stimulation) on the dependent factor, Sustainability Practices (SP), with a particular focus on their mediation through Environmental Awareness (ENVA). This assessment may deliver the common view on the subject of the impact of leadership styles and environmental awareness and they influence sustainability methods in the energy and industrial industries.

For the first hypothesis (H3a): C->ENVA->SP, longitudinal research aims to determine the potential indirect influence of Charismatic Leadership (CL) on Sustainability Practices (SP) through the concern (ENVA) regarding the environment. The findings suggested that the relationship between the independent and dependent variables, however, is not statistically significant. Conversely, this could be interpreted as the fact that the kind of Charismatic Leadership found within the exemplary companies does not necessarily promote the use of energy-saving technologies or actively encourage the adoption of sustainable procurement practices.

Conversely, the second hypothesis (H3b): (IC -> ENVA -> SP) suggests that Individualized Consideration firstly raises Environmental Awareness (ENVA), then consequences into Spread (SP). The evaluation yields the result of a noticeably significant indirect effect. This could be because it is a result of a leader who engages in personalized decision-making coupled with sustainable supply practice. Suppliers are evaluated based on their environmental recognition and employees are trained on sustainability. As well, social and environmental initiatives are encouraged to participate in.

The third hypothesis (H3c): The extensive process (H3c: IM -> ENVA -> SP) of excogitating the indirect effect of Inspirational Motivation (IM) on Sustainability Practices (SP) through the mediating influence of Environmental Awareness (ENVA) is alluded to in this study. The analysis shows a statistically significant zero-order correlation from stress to happiness and a zero-order correlation from stress to happiness through optimism. This is because the inspirational leadership by the organizations studied in this topic is considered to be a catalyst for employees to take part in community development by setting up awareness programs and charitable activities.

Similarly, the fourth hypothesis (H3d): I argue that Sustainability Practices (SP) are affected by the indirect influence of Intellectual Stimulation (IS) (data-top) environment awareness (ENVA). Results show a statistically significant treating effect. This probably relates to the dissemination of the Intellectual leadership style in the studied companies, which as a result has become an effective tool for encouraging effective waste management programs such as recycling projects and carbon offsetting.

Therefore, Environmental Awareness is vital as a connector in the relationship between leadership practices and Sustainability Measures in the energy and manufacturing sectors. However, Charismatic Leadership does not directly influence sustainability culture in the study context, whereas some other leadership types such as Considerate Individualization, Motivation Inspiration, and Intellectual Stimulation produce varying levels of indirect influence on Eco-Awareness measures. This, therefore, brings out the fact that the job of leadership in the matter of shaping sustainability practices is quite complicated, which makes it imperative to develop an environmental consciousness within the organization so that in the future it can be more sustainable, [76], [77].

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Declaration of Generative AI and AI-assisted Technologies in the Writing Process

During the preparation of this work, the authors used QuillBot in order to improve the readability and language of the manuscript. After using these tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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