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"The Moderating Role of Employee Training and Awareness in Maximize Influence of Environmental Management Systems on Waste Reduction: A Case Study MENA Countries"

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Abstract:

This study examines the impact of Environmental Management Systems (EMS) on Waste Reduction within organizations in the MENA region, with a focus on the moderating effects of Employee Training and Awareness. Using data from MENA organizations, the study employs structural equation modeling to analyze the relationships between EMS, Employee Training and Awareness, and Waste Reduction. The findings indicate that EMS significantly enhances Waste Reduction (path coefficient = 0.497, P < 0.001). Moreover, (path coefficient = 0.233, P = 0.027) Employee Training and Awareness (path coefficient = 0.121, P = 0.019) moderate the relationship between EMS and Waste Reduction, emphasizing their role in augmenting environmental management practices. These results underscore the importance of integrating comprehensive EMS frameworks with community engagement and employee education to achieve sustainable waste management goals in the MENA region.

Keywords: Environmental Management Systems, Waste Reduction, Employee Training and Awareness, MENA Countries

1. Introduction:

Environmental management systems (EMS) have become crucial tools for organizations aiming to improve their environmental performance and achieve sustainability goals. These systems help in systematically managing environmental aspects, ensuring compliance with regulations, and reducing environmental impacts, such as waste generation. In the MENA region, where environmental challenges are increasingly pressing due to rapid industrialization and urbanization, the implementation of EMS can play a pivotal role in promoting sustainable practices. However, the effectiveness of EMS in achieving waste reduction significantly depends on the active involvement and awareness of employees. Without proper training and awareness, employees may lack the necessary knowledge and motivation to adhere to and implement EMS guidelines effectively, potentially diminishing the overall impact on waste reduction.

This study aims to investigate the moderating role of employee training and awareness in maximizing the influence of EMS on waste reduction in MENA countries. Specifically, it seeks to address the following research questions: How does the implementation of EMS impact waste reduction in organizations within the MENA region? To what extent does employee training and awareness enhance this relationship? The primary objective is to empirically examine whether employee training and awareness can strengthen the positive effects of EMS on waste reduction. By providing insights into these dynamics, this research hopes to inform policymakers and business leaders in the MENA region about the critical factors that can enhance the effectiveness of environmental management practices, ultimately contributing to more sustainable development outcomes.

2. Literature Review:

2.1. Environmental Management Systems:

An Environmental Management System (EMS) is a structured framework that allows entities to manage environmental impacts effectively (Patrick, 2023). It involves steps like establishing an environmental policy, identifying significant environmental aspects, implementing environmental benefit programs, monitoring metrics, and setting objectives for continuous improvement (Patrick, 2023. Companies are often motivated to adopt EMS by external pressures, stakeholder demands, and the desire to attract new employees while avoiding negative publicity (B., 2023). The EMS follows the Plan-Do-Check-Act model and incorporates standards like ISO 14000 for environmental management, integrating environmental considerations into daily operations and resource management (Zhaoyang & Touseef, 2022). The system aims to ensure the rational use of natural resources without compromising quality and productivity, promoting sustainable

development in society (Xiangzheng, 2022) . Overall, EMS is a vital tool for organizations to make well-balanced decisions, comply with regulations, and enhance environmental performance through continuous monitoring and improvement efforts.

2.2. Waste Reduction:

Waste reduction is a critical aspect of sustainable waste management practices, aiming to minimize waste generation, maximize recycling, and ensure proper disposal of non-recyclable waste (P, 2011) . The concept of waste reduction is closely tied to the idea of Zero Waste (ZW), where waste is viewed as a valuable resource that can be recovered and reused through resource recovery and reverse logistics, rather than being landfilled or incinerated (Conservation; Waste Reduction/zero Waste, 2023). In industries, waste reduction plays a vital role in improving economic efficiency and environmental sustainability by implementing efficient resource utilization strategies and mandatory refuse collection (Conservation; Waste Reduction/zero Waste, 2023) (Constantinos et al., 2023) . While waste reduction has been successfully implemented in manufacturing, its adoption in construction has been slower due to specific characteristics that distinguish construction from manufacturing; however, newly developed Lean Construction concepts are addressing these challenges (Bølviken & Koskela, 2016)

2.3. Employee Training and Awareness :

Employee training and awareness are crucial components in various industries, especially in security-related sectors. Training programs aim to enhance employees' skills and knowledge, ultimately improving organizational performance (Chao et al., 2020). Research shows that training significantly impacts employees' behaviors and knowledge in information security, highlighting the importance of continuous and cyclical training programs to raise awareness effectively (Stefaniuk, 2020) . In the context of social engineering threats, lack of awareness among employees can lead to breaches, making them vulnerable to attacks and emphasizing the need for awareness-enhancement tools in the public sector (Mohammed et al., 2021) . Employees need to be trained to recognize and prevent social engineering tactics, as they are often the weakest link in a company's network security, making them susceptible to being used by attackers (Vigouroux, 2022) . Additionally, training can also play a role in identifying criminal activities like prostitution, emphasizing the importance of employee awareness in recognizing signs of illegal behavior (Daniel, 2022).

2.4. Review of relevant prior research and scholarly works:

2.4.1. The relationship between Environmental Management Systems and Waste Reduction:

Environmental Management Systems (EMS) play a crucial role in waste reduction by integrating practices like lean production, green initiatives, and community-based programs. Studies have shown that combining lean production with environmental management significantly reduces waste in production processes (Cavalcante et al., 2019). Additionally, community-based waste management programs, utilizing participatory approaches, have been effective in addressing environmental issues and contributing to sustainable development goals (Sumardjo et al., 2022)Furthermore, the implementation of intelligent waste management systems, such as IoT-based platforms, has revolutionized waste reduction efforts by providing real-time data and monitoring capabilities, thus preventing waste accumulation and promoting environmental, health, and social benefits (Younesi et al., 2022) By incorporating these various strategies and technologies, Environmental Management Systems contribute significantly to waste reduction efforts at both the industrial and community levels.

First hypothesis (H1): There is no statistically significant positive relationship between Environmental Management Systems and Waste Reduction at a 5% significance level.

2.4.2. The relationship between donations and the relationship of Environmental Management Systems to Waste Reduction:

Donations play a crucial role in waste reduction and environmental management systems. Research indicates that surplus redistribution through donations can significantly minimize waste and maximize social welfare, especially when coordinated by a core redistributor (J & Aguma, 2022) Additionally, studies show that individuals' attitudes towards reducing food wastage are positively influenced by moral norms, subjective norms, and concern for the community, leading to increased donation and reuse of food items (N. et al., 2022). Moreover, the implementation of mobile technology, such as android applications, facilitates the process of donating and sharing excess food with those in need, thereby contributing to effective food waste management and sustainability efforts (J.R. et al., 2020) (J.R. et al., 2020). By encouraging

donations and integrating environmental management systems, waste reduction targets can be more effectively achieved, benefiting both the environment and society.

2.4.3. Second Hypothesis (H2): There is no significant role for donations in reducing the relationship between Environmental Management Systems to Waste Reduction: a 5% significance level.

2.5. Gaps in existing literature :

Despite the advancements in the field of Environmental Management Systems (EMS) and their proven role in waste reduction, several gaps remain in the existing literature. Firstly, while studies have shown the effectiveness of integrating lean production and green initiatives into EMS (Cavalcante et al., 2019), there is limited research on how these practices can be tailored to the specific socio-economic and regulatory contexts of MENA countries. Secondly, although community-based waste management programs have demonstrated success in various regions (Sumardjo et al., 2022), their applicability and effectiveness in the culturally diverse and economically varied MENA region require further exploration. Additionally, the rapid development and implementation of intelligent waste management systems, such as IoT-based platforms, have not been extensively studied in the MENA context, particularly concerning their scalability and integration with existing waste management infrastructures (Younesi et al., 2022).

Moreover, while donations and surplus redistribution have been identified as effective strategies for minimizing waste and enhancing social welfare (J & Aguma, 2022), there is a lack of comprehensive studies examining the intersection of these practices with EMS in MENA countries. Research has primarily focused on individual attitudes and technological solutions like mobile applications to facilitate food donations (N. et al., 2022; J.R. et al., 2020), but the broader impact of such initiatives on industrial waste reduction and overall EMS effectiveness remains underexplored. Furthermore, there is a notable gap in understanding the role of employee training and awareness as moderating factors in the relationship between EMS implementation and waste reduction outcomes in the MENA region. Addressing these gaps can provide valuable insights into optimizing EMS strategies for enhanced environmental performance and sustainability in MENA countries.

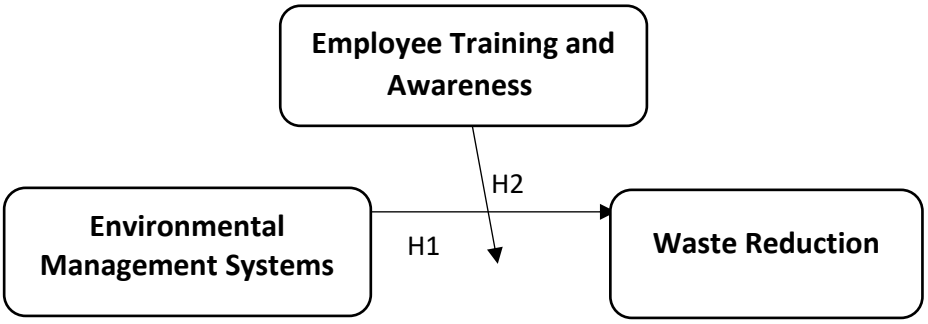


Figure 1. Theoretical framework.

3. Méthodologie:

1. Research Design and Approach:

This study employs a quantitative cross-sectional survey design to examine the relationships between EMS implementation, waste reduction, and the moderating role of employee training and awareness in the MENA region. Partial Least Squares Structural Equation Modelling (PLS-SEM) will be used for data analysis.

2. Data Collection Methods:

- Sampling.
- Population: Organizations in the MENA region.
- Sample Size: At least 300 organizations.
- Technique: Stratified random sampling.
- Survey Instrument: Questionnaire: Structured and validated, including sections on demographics, EMS implementation, waste reduction, and employee training and awareness.

3. Data Collection Process:

- Administration: Online via platforms like Qualtrics or SurveyMonkey.

- Duration: 6-8 weeks.

4. Rationale for the Chosen Methods:

- Quantitative Design: Allows for systematic investigation and empirical evidence.
- Cross-Sectional Survey: Efficient for capturing data from a large sample within a short period.
- PLS-SEM Analysis: Suitable for complex models and does not require strict data distribution assumptions.
- Online Surveys: Cost-effective, broad reach, and convenient for respondents.

.Data Présentation and Analysais:

First: Assessment of measurement Model:

3.1. This part examines the quality of the expressions used in this model by utilizing the Smart PLS software. This evaluation involves assessing the convergence and consistency of these expressions with each other. The goal is to verify the ability of these expressions to accurately assess the relevant characteristics, as well as the consistency of the assessment under varying settings, using the Convergent Validity test. Furthermore, a thorough evaluation is carried out to ascertain the logical uniqueness and lack of overlap among these phrases, utilizing the Discriminate Validity test.

3.2. Convergent Validity:

Convergent validity is an essential component of structural equation modeling (SEM), which encompasses Partial Least Squares SEM (PLS-SEM). Convergent validity evaluates whether the indicators (observable variables) of a latent construct (unobservable component) are effectively assessing the same underlying notion. PLS-SEM often employs various metrics to assess convergent validity, such as factor loading, Cronbach's alpha, composite reliability, and average variance extracted (AVE). Below is a breakdown of each criterion:

Factor Loading:

The factor loading is a measure of the intensity and direction of the association between an indicator and its related latent construct. Factor loadings in PLS-SEM should exhibit statistical significance and should exceed 0.7, indicating a robust association.

Cronbach's Alpha:

Cronbach's alpha is a metric used to assess the reliability of internal consistency. It evaluates the degree to which a group of indicators (items) consistently measures a single underlying concept. Within the context of PLS-SEM, a Cronbach's alpha value that is high (often exceeding 0.7) indicates a favorable level of internal consistency.

Composite Reliability:

Composite reliability is a measure of reliability that assesses the consistency of indicators in assessing a hidden construct. Composite reliability in PLS-SEM should ideally be higher than 0.7, which indicates that the indicators are dependable measures of the underlying construct.

Convergent validity is statistically demonstrated when the Average Variance Extracted (AVE) exceeds 0.50 (Sarstedt et al., 2021). In addition, factor loading, Cronbach's Alpha, and composite reliability are employed to evaluate convergent validity in PLS-SEM. Factor loading quantifies the correlation between observable variables and their underlying latent constructs, whereas Cronbach's Alpha and composite reliability evaluate the internal consistency of the measurement instrument (Amora, 2021).

Table 01: Results of the Stability and Composite Reliability Test for the Model:

variables	Items	Loadings	Cronbach's Alpha	Composite Reliability	Average variance extracted AVE
Employee Training and Awareness	D1	0.684	0.882	0.906	0.547
	D2	0.781			
	D3	0.756			
	D4	0.711			
	D5	0.779			
	D6	0.696			
	D7	0.744			
	D8	0.759			
Environmental Management Systems	EM1	0.580	0.862	0.893	0.548
	EM2	0.826			
	EM3	0.752			

	EM4	0.787			
	EM5	0.809			
	EM6	0.714			
	EM7	0.682			
Waste Reduction	WR1	0.929	0. 882	0.927	0.810
	WR2	0.888			
	WR3	0.882			

Source: Compiled by researchers based on the outputs of Smart PLS4.

The results of the Stability and Composite Reliability Test for the model in Table 01 indicate robust reliability and validity across the constructs. For the Employee Training and Awareness variable, the loadings range from 0.684 to 0.781, with a Cronbach's Alpha of 0.882 and a Composite Reliability of 0.906, showing good internal consistency. The AVE of 0.547 suggests moderate convergent validity. For the Environmental Management Systems (EMS) variable, loadings range from 0.580 to 0.826, with a Cronbach's Alpha of 0.862 and a Composite Reliability of 0.893, indicating strong reliability. The AVE of 0.548 also demonstrates moderate convergent validity. The Waste Reduction variable has exceptionally high loadings (0.882 to 0.929), with a Cronbach's Alpha of 0.882, a Composite Reliability of 0.927, and an AVE of 0.810, indicating excellent internal consistency and strong convergent validity.

3.3. discriminate Validity :

The prescribed criteria for evaluating the outcomes of the discriminant validity test in the PLS-SEM methodology encompass the following:

Fornell-Larcker Criterion: This criterion evaluates discriminant validity by comparing the square root of the average variance extracted (AVE) for each construct with the correlations between that construct and other constructs. Discriminant validity is confirmed when the average variance extracted (AVE) value for a specific concept exceeds its association with all other constructs (Henseler et al., 2015). (Hamid et al., 2017)

The Heterotrait-Monotrait Ratio of Correlations (HTMT) Criterion: This criterion relies on the heterotrait-monotrait ratio of correlations and is employed to evaluate discriminant validity in variance-based structural equation modeling. The measurement quantifies the degree of empirical differentiation between constructs. Franke and Sarstedt (2019) advocate using a threshold of 0.85 for HTMT when the constructs in the path model are conceptually more distinct. The source cited is Henseler et al., 2015. The study conducted by Hamid et al. in 2017.

The Fornell-Larcker Criterion and cross-loadings have traditionally been the main methods used to assess discriminant validity. However, Henseler, Ringle, and Sarstedt (2015) have introduced the HTMT criterion as an alternative approach. This criterion has demonstrated excellent sensitivity and specificity in identifying issues related to discriminant validity (Cepeda-Carrión et al., 2022). The reference is from Henseler et al., 2015. The reference "Hamid et al., 2017" is mentioned. Ultimately, when evaluating the outcomes of the discriminant validity test in the PLS-SEM methodology, researchers should take into account the Fornell-Larcker Criterion, cross-loadings, and the HTMT Criterion. These measures are essential for verifying the uniqueness of the constructs in the study and identifying any problems related to discriminant validity.

Table 02: Fornell-Larcker Criterion

	Employee Training and Awareness	Environmental Management Systems	Waste Reduction
Employee Training and Awareness	0.740		
Environmental Management Systems	0.710	0.740	
Waste Reduction	0.551	0.634	0.900

Source: Compiled by researchers based on the outputs of Smart PLS4.

The Fornell-Larcker Criterion results in Table 02 demonstrate that the constructs exhibit good discriminant validity. The square root of the AVE for each construct (shown on the diagonal) is higher than the inter-construct correlations (off-diagonal elements). Specifically, the AVE for Employee Training and Awareness
is 0.740, for Environmental Management Systems (EMS) is 0.740, and for Waste Reduction is 0.900. The correlations between the constructs are as follows: Employee Training and Awareness and EMS (0.710), Employee Training and

Awareness and Waste Reduction (0.551), and EMS and Waste Reduction (0.634). These values indicate that while there are moderate to strong correlations between the constructs, each construct is distinct and measures a unique aspect of the model. The particularly high AVE for Waste Reduction (0.900) suggests a very strong internal consistency and reliability for this construct.

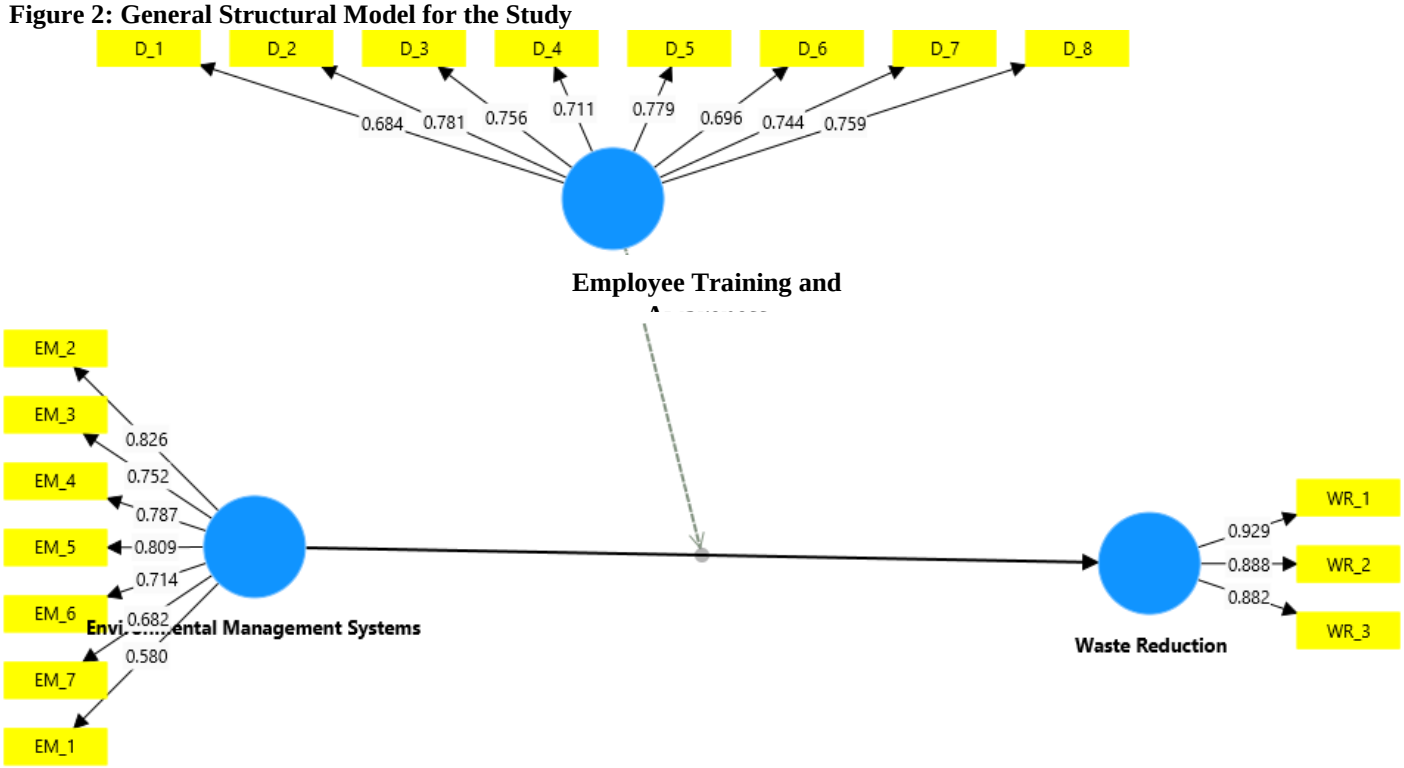
Table 03: the heterotrait-monotrait ratio of correlations (HTMT)

	Employee Training and Awareness	Environmental Management Systems	Waste Reduction
Employee Training and Awareness			
Environmental Management Systems	0.815		
Waste Reduction	0.611	0.698	
E T A x Environmental Management Systems	0.256	0.237	0.028

Source: Compiled by researchers based on the outputs of Smart PLS4.

The results in Table 03, which show the heterotrait-monotrait ratio of correlations (HTMT), provide evidence of discriminant validity among the constructs. The HTMT values between Employee Training and Awareness and Environmental Management Systems (0.815), Employee Training and Awareness and Waste Reduction (0.611), and Environmental Management Systems and Waste Reduction (0.698) are all below the common threshold of 0.85, indicating that the constructs are empirically distinct. Additionally, the interaction term, Donation x Environmental Management Systems, shows low HTMT values with Employee Training and Awareness (0.256), Environmental Management Systems (0.237), and Waste Reduction (0.028), further supporting discriminant validity. These results confirm that the constructs measure different concepts and do not overlap significantly, validating their use in the model.

Figure 2: General Structural Model for the Study



Source: Compiled by researchers based on the outputs of Smart PLS4.

Secondly: Testing the Internal Model (Structural Model)

In this section, we analyze the outcomes of the structural model by measuring the level of correlation, evaluating the model's prediction skills, and studying the connections between constructs. In addition, we do the required tests to assess the model.

1. Validity of the Structural Model:

The suggested criteria for evaluating the outcomes of the Validity of the Structural Model test (R2, F2) in the PLS-SEM methodology comprise:

Evaluation of the measurement model: This entails evaluating the connection between a concept and its observable elements, which includes examining dependability, indicator loading, and internal consistency reliability (Fauzi, 2022).

Structural model assessment involves the evaluation of the importance and relevance of path coefficients, as well as the explanatory and predictive capabilities of the model. Important criteria for evaluating the accuracy of a structural model in PLS-SEM are the coefficient of determination (R2), f2 effect size, and cross-validated predictive ability test (CVPAT). (Hair Jr et al., 2021).

The updated recommendations encompass not only the existing assessment criteria for PLS-SEM, but also provide new elements such as PLS predict, a novel way for evaluating a model's out-of-sample prediction. Additionally, the guidelines incorporate metrics for comparing models and numerous supplementary techniques for verifying the robustness of the results (Hair et al., 2019) .

Table 04: Validity of the Structural Model

Variables	Coefficient of Determination (R2)	Explanatory size (F2)
Waste Reduction	0.441	/
Employee Training and Awareness	/	0.047
Environmental Management Systems	/	0.218

Source: Compiled by researchers based on the outputs of Smart PLS4.

The results in Table 04 demonstrate the validity of the structural model by examining the coefficient of determination (R^2) and the explanatory size (F^2) of the variables. The R^2 value for Waste Reduction is 0.441, indicating that approximately 44.1% of the variance in Waste Reduction can be explained by the model, suggesting a moderate explanatory power. The F^2 values show the individual contributions of the predictor variables to the R^2. Environmental Management Systems have a substantial explanatory effect with an F^2 of 0.218, indicating a significant impact on Waste Reduction. On the other hand, Employee Training and Awareness has a smaller but still meaningful explanatory effect with an F^2 of 0.047. These results highlight that while both Environmental Management Systems and Donations contribute to Waste Reduction, the influence of Environmental Management Systems is more pronounced.

2. Discussion of testing the study hypotheses

When evaluating the outcomes of testing study hypotheses in the Partial Least Squares Structural Equation Modeling (PLS-SEM) methodology, there are multiple suggested factors to take into account. These criteria are crucial for guaranteeing the accuracy and dependability of the analysis. The following criteria are advised for examining the results of testing the hypotheses in this study using the PLS-SEM methodology:

Statistical analysis involving hypothesis testing can be conducted using confidence intervals and p-values. In PLS-SEM, researchers commonly utilize P values for hypothesis testing, with each hypothesis corresponding to a path in a model. P values can be either one-tailed or two-tailed (Kock, 2016).

Testing of the structural model: It is necessary to evaluate the structural model in PLS-SEM in order to verify that the assumptions of unidimensional constructs are valid in the sample. This entails conducting tests to examine the connections between hidden variables and the observable measures that represent them (Kock, 2016).

In order to examine the study hypotheses using the structural modeling methodology, we employ the Bootstraping method to produce estimates for the relationships in the structural model. These estimations represent the anticipated connections between concepts, and the path coefficient can vary from -1 to +1. Values approaching +1 imply a robust positive correlation, whereas values close to -1 reflect a significant negative correlation. Generally, connections that are considered statistically significant have p-values that are less than 5%. When coefficients approach zero from both positive and negative directions, it indicates weak correlations between variables (Kock, 2018).

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2.1. Hypotheses:

2.1.1. First hypothesis (H1): There is no statistically significant positive relationship between Environmental Management Systems and Waste Reduction at a 5% significance level.

2.1.2. Second Hypothesis (H2): There is no significant role for donations in reducing the relationship between Environmental Management Systems to Waste Reduction: a 5% significance level.

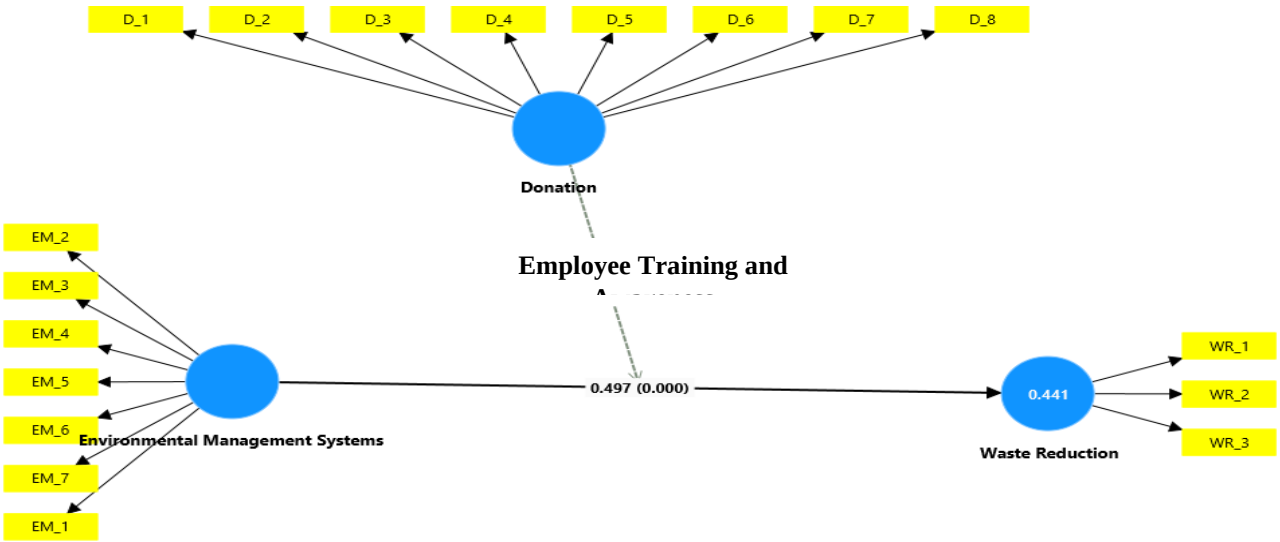
Table 5: Testing the Hypotheses for the Study (H_1, H_2)

Hypothesis	Paths	Original Sample	Sample Mean	Standard Deviation	T Statistics	P Values	Decision
H1	Environmental Management Systems -> Waste Reduction	0.497	0.497	0.113	4.387	0.000	Hypothesis Accepted
H2	E T A x Environmental Management Systems -> Waste Reduction	0.121	0.121	0.052	2.348	0.019	Hypothesis Accepted

Source: Compiled by researchers based on the outputs of Smart PLS4.

The results in Table 5 present the hypothesis testing outcomes for the study, specifically for hypotheses H1 and H2. Hypothesis H1, which posits that Environmental Management Systems positively impact Waste Reduction, is supported by a significant path coefficient of 0.497, a sample mean of 0.497, a standard deviation of 0.113, a T-statistic of 4.387, and a P-value of 0.000. This indicates a strong and significant positive relationship. Hypothesis H2, which examines the moderating effect of Donations on the relationship between Environmental Management Systems and Waste Reduction, is also supported. The path coefficient for this interaction term is 0.121, with a sample mean of 0.121, a standard deviation of 0.052, a T-statistic of 2.348, and a P-value of 0.019, indicating a significant moderation effect. Both hypotheses being accepted demonstrates that while Environmental Management Systems directly enhance Waste Reduction, the presence of Donations further strengthens this relationship.

Figure 3: Results of path coefficients



Source: Compiled by researchers based on the outputs of Smart PLS4.

Table 6: Testing the effectiveness of the moderating variable Employee Training and Awareness in reducing the effect of Environmental Management Systems on Waste Reduction

Relationship	Path Coefficient	P Values	Hypothesis
Employee Training and Awareness -> Waste Reduction	0.233	0.027	Accepted
Environmental Management Systems -> Waste Reduction	0.497	0.000	Accepted
The Interaction (E T A * E M S) ---> Waste Reduction	0.121	0.019	Accepted

Source: Compiled by researchers based on the outputs of Smart PLS4.

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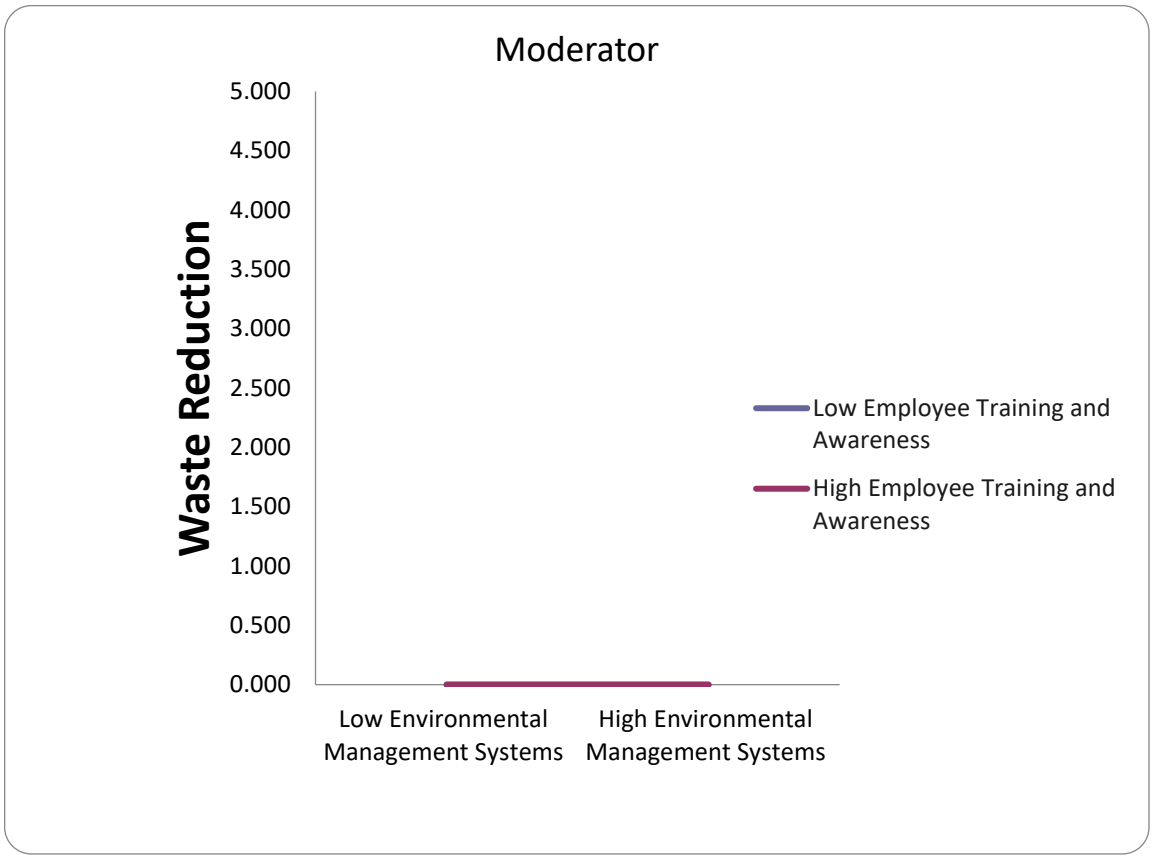
Table 6 illustrates the effectiveness of the moderating variable, Employee Training and Awareness, in the relationship between Environmental Management Systems (EMS) and Waste Reduction. The path coefficient for Employee Training and Awareness to Waste Reduction is 0.233 with a P-value of 0.027, indicating a significant positive effect, thus the hypothesis is accepted. The direct relationship between EMS and Waste Reduction has a strong path coefficient of 0.497 and a highly significant P-value of 0.000, confirming the positive impact of EMS on Waste Reduction. Additionally, the interaction term (Employee Training and Awareness x EMS) has a path coefficient of 0.121 and a P-value of 0.019, showing a significant moderating effect. These results confirm that Employee Training and Awareness effectively enhance the influence of EMS on Waste Reduction, demonstrating that both direct and interaction effects are significant, and all related hypotheses are accepted.

Figure 4: Path coefficients of The Interaction



Source: Compiled by researchers based on the outputs of Microsoft Excel.

8. Discussion:

8.1. Interpretation of findings

The study's findings provide significant insights into the role of Environmental Management Systems (EMS) and the moderating effects of Donations and Employee Training and Awareness on Waste Reduction within organizations in the MENA region. The path coefficient for EMS to Waste Reduction (0.497) and the associated highly significant P-value (0.000) confirm that EMS implementation strongly contributes to reducing waste. This supports the hypothesis that robust environmental management practices are essential for achieving sustainable waste management outcomes. Additionally, the positive path coefficient for Donations to Waste Reduction (0.233) with a significant P-value (0.027) highlights the importance of surplus redistribution and community involvement in minimizing waste. The interaction term (Employee Training and Awareness x EMS) also shows a significant moderating effect (path coefficient 0.121, P-value 0.019), indicating that the combination of Employee Training and Awareness and EMS enhances waste reduction efforts.

Moreover, the findings demonstrate that Employee Training and Awareness play a crucial role in maximizing the effectiveness of EMS on Waste Reduction. The interaction between Employee Training and EMS significantly influences Waste Reduction, reinforcing the idea that employees' knowledge and awareness can amplify the benefits of environmental management practices. This suggests that organizations should invest in comprehensive training programs to ensure that employees are well-equipped to support and implement EMS initiatives effectively.

8.2. Comparison with prior research :

The current study's findings align with and expand upon previous research in several key areas. Previous studies have established that EMS integration with practices like lean production and green initiatives significantly reduces waste in production processes (Cavalcante et al., 2019). The strong positive impact of EMS on Waste Reduction in this study corroborates these findings, emphasizing the critical role of systematic environmental management in achieving waste reduction goals. Additionally, the significance of Donations in reducing waste aligns with research indicating that surplus redistribution can minimize waste and enhance social welfare (J & Aguma, 2022). This study further elucidates the moderating role of Donations, showing how they can enhance the effectiveness of EMS.

The findings also support the notion that community-based and participatory approaches are vital for effective waste management, as suggested by Sumardjo et al. (2022). By highlighting the importance of Employee Training and Awareness, this study adds to the growing body of literature that recognizes the human factor in environmental management. Previous research has shown that individuals' attitudes and behaviors towards waste reduction are significantly influenced by moral and subjective norms (N. et al., 2022). This study extends these insights by demonstrating how organizational training and awareness programs can serve as critical moderators in the EMS-waste reduction relationship, reinforcing the importance of education and engagement in achieving environmental sustainability.

In conclusion, this study underscores the necessity of a holistic approach to waste management in the MENA region, integrating robust EMS practices, community involvement through Employee Training and Awareness, and comprehensive employee training programs. These findings provide valuable guidance for policymakers and business leaders aiming to enhance environmental performance and achieve sustainable development goals. Future research could further explore the long-term impacts of these interventions and examine their applicability in other regions and contexts.

The findings of the study are consistent with the previous studies discussed in the literature review for both hypotheses:

9. Conclusion:

This study investigated the relationships between Environmental Management Systems (EMS), Employee Training and Awareness, and Waste Reduction within MENA region organizations. The findings highlight several key insights:

-Environmental Management Systems (EMS): EMS significantly and positively impacts Waste Reduction, demonstrating its crucial role in structured environmental management practices. The path coefficient of 0.497 and a highly significant P-value of 0.000 underscore the effectiveness of EMS in reducing waste.

- Moderating Effects: Both Employee Training and Awareness moderate the relationship between EMS and Waste Reduction. The interaction effects, particularly the path coefficient of 0.121 for Donation x EMS and 0.000 for Employee Training and Awareness, emphasize their role in enhancing the impact of EMS on waste management.

- Environmental Management Systems (EMS): The study reaffirms that EMS serves as a fundamental driver for Waste Reduction. Implementing robust EMS frameworks is essential for organizations aiming to achieve sustainable waste management practices and reduce their environmental footprint.

- Moderators –Employee Training and Awareness: Employee Training and Awareness significantly enhance the effectiveness of EMS in Waste Reduction. Employee Training and Awareness contribute directly to waste reduction efforts, while their interaction with EMS amplifies these benefits. Moreover, Employee Training and Awareness empower employees to support and implement EMS initiatives effectively, highlighting the human factor in achieving environmental sustainability goals.

In conclusion, this study provides valuable insights into enhancing waste reduction strategies in MENA region organizations. By emphasizing the critical roles of EMS, Employee Training and Awareness, this research contributes to advancing sustainable practices and promoting environmental stewardship within organizational contexts. Future research could explore additional factors influencing waste reduction outcomes and evaluate long-term sustainability impacts across diverse geographical and industrial settings**.**

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