IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 12, Issue 5, May 2025

DOI: 10.17148/IARJSET.2025.12514

Evaluating Sustainable Practices and Employee Engagement at Sakthi Ferro alloys: Environmental, Social, and Economic Perspectives

Samuel Prince D[1], Dr. S Preetha[2]

II MBA, Department of Management Studies, School of Management Studies,

Vels Institute of Science Technology and Advanced Studies (VISTAS) Pallavaram, Chennai[1]

Professor, Department of Management Studies, School of Management Studies,

Vels Institute of Science Technology and Advanced Studies (VISTAS) Pallavaram, Chennai[2]

Abstract: This research investigates the intricate relationship between sustainable business practices, employee engagement, and organizational performance, examining these factors through a comprehensive social, environmental, and economic lens. In an increasingly interconnected and environmentally conscious world, sustainability has transcended its status as a mere corporate social responsibility initiative and become a critical driver of long-term value creation. This study explores how organizations can effectively integrate sustainable principles into their core operations, culture, and strategic decision-making to not only minimize their environmental footprint but also cultivate a more engaged and motivated workforce. The central premise of this research is that a strong commitment to sustainability can significantly influence employee engagement. Employees are increasingly seeking purpose-driven work and are more likely to be engaged with organizations that demonstrate a genuine commitment to social and environmental responsibility. This study will delve into the specific ways in which sustainable initiatives, such as waste reduction programs, renewable energy adoption, ethical sourcing, and community engagement, can impact employee morale, job satisfaction, and overall engagement levels. It will explore whether employees perceive these initiatives as genuine efforts to contribute to a better future, and how this perception translates into increased commitment to the organization's goals and values. Furthermore, this research will examine the multifaceted impact of this interplay between sustainability and engagement on organizational performance. From a social perspective, the study will analyse how sustainable practices contribute to improved community relations, enhanced brand reputation, and a stronger social license to operate. It will investigate the extent to which employee engagement mediates the relationship between sustainability initiatives and positive social outcomes. From an environmental perspective, the research will assess the direct impact of sustainable practices on reducing the organization's environmental footprint, including measures such as carbon emissions, resource consumption, and waste generation. It will also explore how employee engagement can contribute to the success of environmental initiatives by fostering a culture of environmental awareness and responsibility within the organization.

Keywords: sustainable business practices, employee engagement, organizational performance, environmental sustainability, social responsibility, economic impact, corporate culture, strategic decision-making, workforce motivation, renewable energy, ethical sourcing, community engagement, waste reduction, carbon emissions.

I. INTRODUCTION

The steel manufacturing industry is a cornerstone of industrial development and economic growth worldwide. It provides essential materials for a wide array of sectors including construction, automotive, infrastructure, energy, and manufacturing. Steel is prized for its strength, durability, and recyclability, making it an indispensable resource in modern society. The production of steel typically involves the processing of iron ore, coal, and limestone in blast furnaces or electric arc furnaces, resulting in significant energy consumption and environmental impact. In response, the industry is under growing pressure to adopt cleaner technologies and sustainable practices to reduce emissions, conserve resources, and minimize waste. Integral to the steelmaking process are ferro alloys, which are critical additives used to refine and enhance the properties of steel. Ferro alloys are alloys of iron with a high proportion of one or more other elements such as manganese, silicon, chromium, or vanadium. These elements impart essential qualities to steel, including increased strength, resistance to corrosion, improved hardness, and durability.

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As such, ferro alloys play a vital role in producing high-quality specialty steels for advanced applications. The ferro alloy industry itself is energy-intensive and resource-heavy, often involving high-temperature smelting processes that consume significant electricity and generate greenhouse gas emissions. However, the sector has seen a gradual shift toward sustainability through energy-efficient technologies, waste recovery systems, renewable energy integration, and cleaner production methods. As companies like Sakthi Ferro Alloys navigate this evolving landscape, the implementation of sustainable practices not only supports environmental goals but also has a profound impact on social and economic dimensions—including workforce engagement, community relations, and long-term operational viability.

STATEMENT OF THE PROBLEM:

The ferro-alloy and steel manufacturing sector, while vital to global industrialization, faces mounting challenges in reconciling its resource-intensive operations with pressing environmental, social, and economic sustainability demands. Environmentally, the industry is a major contributor to climate change due to its reliance on coal-based processes, high carbon emissions, and inefficient energy and water consumption, compounded by pollution from hazardous by-products like slag and heavy metals. Socially, occupational hazards, inadequate workplace safety measures, and strained community relations—driven by environmental degradation and insufficient investment in local development—threaten the sector's social license to operate. This study addresses the critical need to evaluate how Sakthi Ferro Alloys can holistically integrate sustainable practices across environmental, social, and economic dimensions while fostering employee engagement—a gap in current research—to ensure the sector's viability in an era defined by climate urgency, social equity imperatives, and ESG-driven market expectations.

OBJECTIVES:

- To examine Sakthi Ferro Alloys' social sustainability initiatives, including workplace safety, employee well-being, community engagement, and human rights.
- To evaluate the economic viability and long-term sustainability of Sakthi Ferro Alloys' operations, considering factors such as resource efficiency, cost-effectiveness, and innovation.
- Assessing the company's efforts in areas like pollution control, waste management, and resource conservation.
- To investigate the relationship between sustainable practices and employee engagement at Sakthi Ferro Alloys, exploring how employees perceive and participate in the company's sustainability initiatives.

RESEARCH QUESTIONS:

1. How do employees at Sakthi Ferro Alloys perceive the effectiveness of the company's environmental policies (e.g., energy conservation, waste management) in reducing its carbon footprint?
2. How do workplace safety measures, fair wages, and health benefits influence employees' perceptions of social equity and organizational loyalty?
3. To what extent do employees believe the company balances profitability with sustainability goals, and how does this perception affect their engagement?
4. What role do management encouragement, incentives, and peer influence play in motivating employees to participate in sustainability initiatives?

SIGNIFICANCE OF THE STUDY:

This study is significant for Sakthi Ferro Alloys and the broader ferro-alloy sector, as it investigates the interplay between sustainable practices and employee engagement to achieve environmental stewardship, social equity, and economic resilience. By analysing how workforce participation drives the implementation of sustainability policies, the research offers actionable strategies to enhance competitiveness in ESG-driven markets, align profitability with ecological and social responsibilities, and strengthen stakeholder trust. Academically, it advances understanding of employee-driven sustainability models within resource-intensive industries, while providing policymakers with evidence to incentivize green transitions.

II. LITERATURE REVIEW

1. **Michael Porter & Mark Kramer (2011)** proposed Creating Shared Value (CSV), arguing that businesses can achieve economic success by addressing societal and environmental challenges. This connects to your study's examination of whether Sakthi Ferro Alloys' sustainability practices contribute to long-term financial success while benefiting stakeholders.
2. **R. Edward Freeman (1984)** developed Stakeholder Theory, stressing that companies must prioritize the interests of employees, communities, and other stakeholders. His work contextualizes your questionnaire's focus on workplace safety, fair wages, and community engagement, highlighting how these factors build trust and a social license to operate.

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3. **Stefan Ambec & Paul Lanoie (2008)** advanced the Porter Hypothesis, arguing that stringent environmental regulations can drive innovation and competitiveness. This theory informs your study's assessment of Sakthi Ferro Alloys' economic resilience amid regulatory pressures and market volatility.
4. **William Kahn (1990)** pioneered Employee Engagement Theory, emphasizing psychological conditions like meaningfulness and safety as drivers of engagement. His work relates to your questionnaire's focus on how training, management encouragement, and personal values influence employees' participation in sustainability initiatives.
5. **Anders Paarup Nielsen (2019)** highlighted the role of purpose-driven work in aligning employee values with organizational goals. This aligns with your questionnaire's focus on how personal interest in environmental protection and peer influence drive participation in sustainability initiatives.

III. RESEARCH METHODOLOGY

Research Design:
The study adopts a descriptive research design to analyse, and it seeks to provide a detailed account of the existing sustainability practices and their relationship with employee engagement.
Sampling Method:
Convenience sampling is used to select participants based on their accessibility and willingness.
Sampling Size:
The total sample size of the study is 50.

DATA COLLECTION METHOD:

- Primary data was collected directly from employees using structured questionnaires for this study.
- Format: Likert scale (1 = Strongly Disagree to 5 = Strongly Agree).

DATA ANALYSIS TOOLS:
ANOVA, Regression analysis, Chi-square analysis, Mean analysis and Correlation analysis conducted using SPSS Software.

VARIABLES:

- Independent Variable: Environmental Sustainability Practices, Social Sustainability Practices, Economic Sustainability Practices
- Dependent Variable: Employee Engagement in Sustainability

IV.RESULTS

REGRESSION ANALYSIS

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.831[a]	.691	.670	4.28094

a. predictors: (constant), economic sustainability practices, environmental sustainability practices, social sustainability practices

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1881.165	3	627.055	34.216	.000[b]
	Residual	843.015	46	18.326		
	Total	2724.180	49			

a. dependent variable: employee engagement in sustainability

b. predictors: (constant), economic sustainability practices, environmental sustainability practices, social sustainability practices

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Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	6.299	3.844		1.638	.108
	environmental sustainability practices	-.137	.162	-.090	-.846	.402
	social sustainability practices	.462	.154	.365	2.991	.004
	economic sustainability practices	1.027	.203	.591	5.050	.000

a. Dependent variable: Employee engagement in sustainability

Interpretation:

The regression model significantly predicts employee engagement in sustainability ($F = 34.22$, $p < .001$), explaining 69.1% of its variance ($R^2 = .691$). economic sustainability practices ($\beta = .591$, $p < .001$) and social sustainability practices ($\beta = .365$, $p = .004$) are significant positive predictors, while environmental sustainability practices ($\beta = -.090$, $p = .402$) is not significant.

CORRELATION ANALYSIS

Correlations

		employee engagement in sustainability	enviromental sustainability practices	social sustainability practices	economic sustainability practices
employee engagement in sustainability	pearson correlation	1	.462**	.720**	.794**
	sig. (2-tailed)		.001	.000	.000
	N	50	50	50	50
environmental sustainability practices	pearson correlation	.462**	1	.607**	.558**
	sig. (2-tailed)	.001		.000	.000
	N	50	50	50	50
social sustainability practices	pearson correlation	.720**	.607**	1	.692**
	sig. (2-tailed)	.000	.000		.000
	N	50	50	50	50
economic sustainability practices	pearson correlation	.794**	.558**	.692**	1
	sig. (2-tailed)	.000	.000	.000	
	N	50	50	50	50

**. Correlation is significant at the 0.01 level (2-tailed).

Interpretation

All variables show strong positive correlations with each other ($p < 0.01$). employee engagement in sustainability is most strongly correlated with economic sustainability practices ($r = .794$), followed by social sustainability practices ($r = .720$) and environmental sustainability practices ($r = .462$). the predictors social sustainability practices and economic sustainability practices are also strongly correlated with each other ($r = .692$), suggesting potential multi collinearity, which aligns with the regression results where both remained significant despite overlap. environmental sustainability practices shows weaker but still significant correlations with other variables, though it was non-significant in the regression model. overall, relationships are robust and statistically significant at the 0.01 level.

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ANOVA ANALYSIS

ANOVA

EMPLOYEE ENGAGEMENT IN SUSTAINABILITY

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.080	1	1.080	.019	.891
Within Groups	2723.100	48	56.731		
Total	2724.180	49			

Interpretation

The anova results indicate no statistically significant difference in employee engagement in sustainability between the groups being compared (f = 0.019, p = .891). the large p-value (p > .05) suggests that variability in employee engagement in sustainability is overwhelmingly due to differences within groups (99.96% of total variance) rather than between groups. this implies the grouping variable has no meaningful effect on employee engagement in sustainability in this analysis.

CHI-SQUARE ANALYSIS

Environmental Sustainability Practices *Employee Engagement in Sustainability

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	14.631[a]	12	.262
Likelihood Ratio	14.527	12	.268
Linear-by-Linear Association	.460	1	.498
N of Valid Cases	50		

a. 17 cells (85.0%) have expected count less than 5. The minimum expected count is .20.

Employee Engagement in Sustainability*Social Sustainability Practices

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	24.723[a]	12	.016
Likelihood Ratio	24.311	12	.018
Linear-by-Linear Association	8.628	1	.003
N of Valid Cases	50		

a.17 cells (85.0%) have expected count less than 5. The minimum expected count is .20.

Employee Engagement in Sustainability* Economic Sustainability Practices

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	21.101[a]	9	.012
Likelihood Ratio	18.892	9	.026
Linear-by-Linear Association	5.513	1	.019
N of Valid Cases	50		

a. 13 cells (81.3%) have expected count less than 5. The minimum expected count is .40.

Interpretation

The chi-square tests indicate no significant association between environmental sustainability practices and employee engagement (p = .262). However, social (p = .016) and economic (p = .012) practices show statistically significant relationships with engagement, with linear trends supporting these links. Caution is critical: 81–85% of cells have

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expected counts <5 (some as low as 0.20), violating chi-square assumptions and suggesting unreliable results. While social/economic practices appear impactful, sparse data undermines validity.

MEAN ANALYSIS

DESCRIPTIVE STATISTICS

Variables	Mean	Std. Deviation
I actively follow the company environmental Policies	3.36	1.258
I actively contributeto energy conservation efforts at work	3.68	0.978
I believe the companys policies effectively reduce our carbon footprint	3.44	1.11
I believe environmental sustainability initiatives involve high cost	3.72	0.904
I believe our company has sufficient resources to undertake enviromental initatives	3.54	1.034
I do not experience resistance toward environmental sustainability initatives	3.58	0.928
I receive regular communication about sustainability updates	3.66	0.823
I believe the company provides adequate work place safety measures	3.7	1.129
I feel that the organization values employee health and well being	3.7	1.074
I receive training and development opportunities regularly	3.7	1.015
I feel company provide Fair wages and equal opportunities for employee well being	3.58	1.032
I Feel safe at my work place	3.78	1.093
I am encouraged to participate in CSR and social impact progam	3.72	1.07
I feel My feedback on work place conditions and policies is valued by management	3.94	0.956
I am aware of the companys current community engagement initatives	3.76	0.96
I feel the company invests sufficiently in employee training and develpoment	3.68	0.978
I Believe my company Invests in energy efficient and ecofrindly technologies	3.6	1.05
I think sustainable production practices help in cost saving and business growth	3.82	1.024
I am aware of the companys policies and criteria for selecting sustainable suppliers	4.02	0.869
I believe sustainability practices initiatives contribute to the company's long term financial	3.64	1.045
I think our company has a clear sustainability driven financial strategy	3.7	1.093
I feel that my company effectively balances profitability and sustainability	3.8	0.857
I believe company provides adequate training on sustainability practies for emoplyess	3.54	1.034
I found the training on energy conservation and efficiency to be informative and useful	3.7	1.093
I feel that the training on waste management and recycling has helped me implement sustainable practies in my work	3.84	0.842
I found the training on water conservation to be informative and useful	3.62	0.987

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I believe the training on work place safety and environmental complaince has helped me implement sustainable practies in my work	3.88	1.023
I actively do employees participate in sustainability initiatives	3.82	1.082
The Management encouragement strongly influences my participation in sustainability initiatives	3.76	1.117
I feel that incentives or rewards strongly infulence my participation in sustainability initiatives	3.92	1.007
I believe my personal interest in environmental protection strongly influences my participation in sustainability initatives	3.94	1.15
I feel that peer influence strongly influences my participation in sustainability initatives	3.7	1.182
I feel that employee feedback on sustainability practices is valued by management	3.86	0.926

Interpretation

Employees perceive strong policy transparency (highest mean = 4.02 on sustainable suppliers) and value feedback (mean = 3.94). Workplace safety (mean = 3.78) and safety training (mean = 3.88) are strengths. However, active environmental policy adherence is weaker (mean = 3.36). Training on energy/water conservation needs improvement (means = 3.62–3.70). Sustainability participation is driven by personal interest (mean = 3.94) and incentives (mean = 3.92). Moderate confidence in financial-strategy alignment (mean = 3.70) and resource adequacy (mean = 3.54). Variability in responses (SDs up to 1.25) suggests mixed perceptions, especially on peer influence (SD = 1.18) and costs (SD = 0.90–1.11). Focus on enhancing engagement, targeted training, and clarifying sustainability-financial links.

V. SUGGESTIONS

1. Enhance Employee Awareness and Training: Conduct regular workshops and sustainability awareness programs to educate employees on the importance of environmental and social practices. This will foster a culture of responsibility and engagement.
2. Implement Clear Sustainability Metrics: Establish measurable KPIs (Key Performance Indicators) for environmental and social goals. Tracking water usage, energy consumption, waste generation, and employee participation can help gauge progress effectively.
3. Encourage Bottom-Up Innovation: Create forums or suggestion systems where employees can contribute ideas for sustainable practices or improvements in operations. Recognize and reward innovative contributions.
4. Strengthen Communication Channels: Improve internal communication regarding sustainability goals and performance. Sharing success stories and challenges transparently can motivate and align employee efforts.
5. Periodic Sustainability Audits: Conduct internal and third-party audits on sustainability practices to ensure compliance and identify areas needing improvement, particularly in environmental impact and safety standards.

VI. CONCLUSION

The comprehensive evaluation of Sakthi Ferro Alloys reveals that sustainable practices are gradually being integrated across environmental, social, and economic domains. Environmentally, the company has taken steps to reduce its carbon footprint, implement waste management protocols, and improve resource efficiency. Socially, there is a notable effort to engage employees through training, participation in sustainability initiatives, and maintaining workplace safety. Economically, sustainability strategies have contributed to operational efficiencies and long-term cost savings, suggesting a strong alignment between sustainable development and business performance.

Employee engagement has emerged as a critical factor in driving these sustainable initiatives. Findings suggest that when employees are actively involved and informed, they are more committed to environmental goals and contribute meaningfully to corporate sustainability. However, there is still scope for improvement, especially in expanding sustainability awareness programs and strengthening feedback mechanisms.

Overall, Sakthi Ferro Alloys is on a positive trajectory toward sustainability, but continuous efforts, policy support, and stakeholder collaboration are essential to achieving comprehensive, long-term sustainable development.

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