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Impact of 5S Implementation on Operational Efficiency, Employee Engagement, and Cost Reduction in Small and Medium Enterprises: A Study of Madhya Pradesh

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ABSTRACT

The present research work is devoted to the investigations on impact of 5s implementation on operational efficiency, employee engagement, and cost reduction in small and medium enterprises. For this purpose, ANOVA assisted hypothesis testing technique was used 5-point Likert's scale based questionnaire was sent of four hundred SMEs of Madhya Pradesh out of which five hundred and fifty complete responses were obtained. Results of the research work indicated that there is a strong impact of 5s implementation on operational efficiency, employee engagement, and cost reduction in small and medium enterprises.

Keyword : - 5S, Operational efficiency, Employee engagement, Cost reduction, Small and medium enterprises, Hypothesis testing, ANOVA.

1. INTRODUCTION

According to Sharma (2025), 5S implementation refers to a systematic workplace organization method that enhances efficiency and safety through five Japanese principles: Seiri (Sort), Seiton (Set in order), Seiso (Shine), Seiketsu (Standardize), and Shitsuke (Sustain). The 5S methodology plays a critical role in enhancing operational efficiency and workplace organization. The implementation of 5S not only establishes a clean and organized work environment but also fosters a culture of continuous improvement, leading to increased productivity and reduced waste (Mukoma, 2023 and Mazur, 2024). Research indicates that 5S contributes to better space utilization and minimizes the time spent searching for tools and materials, thereby streamlining operations (Monnanyana & Gupta, 2021). Moreover, the integration of digital tools with 5S practices has been shown to further enhance efficiency, particularly in sectors like automotive manufacturing, where digital 5S applications have led to measurable improvements in productivity (Shahin *et al.*, 2023; and Mrabti, 2023). The methodology's effectiveness is also underscored by its ability to improve safety standards and employee morale, which are essential for maintaining a sustainable work environment (Aliaga-Parcco, 2023; Lite *et al.*, 2022). As industries increasingly adopt 5S, the evidence suggests that its systematic application not only supports operational goals but also aligns with broader lean initiatives, thereby reinforcing its importance in contemporary manufacturing practices (Martel, 2023). Considering these facts, the present research is devoted to the investigations on impact of 5s implementation on operational efficiency, employee engagement, and cost reduction. For this purpose hypothesis testing approach was used and small and medium scale enterprises of Madhya Pradesh were targeted.

1.1 Objectives of the Research

The following points represent the objectives of the research work:

a) To investigate the impact of 5s implementation on operational efficiency in small and medium enterprises
b) To investigate the impact of 5s implementation on employee engagement in small and medium enterprises
c) To investigate the impact of 5s implementation on cost reduction on cost reduction in small and medium enterprises

2. LITERATURE REVIEW

The implementation of the 5S methodology has garnered significant attention in various sectors, particularly for its role in enhancing operational efficiency, employee engagement, and overall workplace organization. The 5S framework, which stands for Sort, Set in order, Shine, Standardize, and Sustain, is designed to create a clean and

organized work environment that fosters productivity and reduces waste. Research by Kanamori *et al.* Kanamori *et al.* (2016) highlights the applicability of 5S in healthcare settings, demonstrating improvements in work processes and potential cost reductions, thereby underscoring its versatility across different industries. Similarly, Houa *et al.* Houa *et al.* (2018) emphasize that 5S is instrumental in optimizing productivity within manufacturing environments, noting that active participation from management is crucial for successful implementation. Furthermore, Lindskog *et al.* Lindskog *et al.* (2016) found that the integration of 5S practices positively affects job satisfaction among employees, suggesting that a well-structured 5S program can enhance employee engagement by creating a more satisfying work environment. In the context of continuous improvement, the 5S methodology has been linked to operational excellence, as evidenced by Srinivasan (Srinivasan, 2023), who notes that 5S contributes to waste reduction and improved safety, thus maximizing value delivery to customers. Additionally, the work of Randhawa and Ahuja Randhawa & Ahuja (2017) provides a comprehensive review of 5S implementation methodologies, highlighting its significant contributions to quality, productivity, and employee morale. Overall, the literature indicates that the systematic application of 5S not only streamlines processes but also cultivates a culture of engagement and efficiency, making it a vital strategy for organizations aiming to enhance their operational capabilities.

One of the primary objectives of 5S implementation is to improve workplace safety and productivity. Fardhosseini *et al.* (2021) emphasize that the foremost goal of 5S is to enhance the health and safety of workers, alongside improving productivity and reducing waste (Fardhosseini *et al.*, 2021). Similarly, Lite *et al.* (2022) argue that while the application of 5S may seem straightforward, its effective implementation requires integration with other quality tools such as Total Productive Maintenance (TPM) and Kaizen, which collectively contribute to sustainable operational improvements (Lite *et al.*, 2022). This integration is crucial as it fosters a culture of continuous improvement, which is essential for the long-term success of 5S initiatives.

The challenges associated with 5S implementation are also noteworthy. Mukoma (2023) identifies obstacles such as resistance to change and the need for a cultural shift within organizations to fully embrace 5S practices (Mukoma, 2023). Moreover, Houa *et al.* (2018) highlight that poor communication and lack of managerial support can significantly hinder the successful adoption of 5S in manufacturing environments (Houa *et al.*, 2018). These findings underscore the necessity of strong leadership and effective communication strategies to facilitate the transition to a 5S-oriented culture.

In specific case studies, the benefits of 5S have been quantitatively assessed. For instance, Prawira *et al.* (2018) demonstrate that the implementation of 5S in the heavy equipment sector led to substantial improvements in productivity and operational efficiency, indicating its potential as a competitive advantage (Prawira *et al.*, 2018). Furthermore, Singh *et al.* (2022) explore the application of 5S in healthcare settings, revealing that it not only enhances operational efficiency but also improves the overall quality of care provided (Singh *et al.*, 2022). These empirical investigations provide compelling evidence of the positive impacts of 5S across different sectors.

The role of digital tools in enhancing 5S implementation has also emerged as a significant trend. Mrabti (2023) discusses how digitalization can streamline the 5S process, making it easier to maintain organization and efficiency in industrial settings (Mrabti, 2023). This digital approach aligns with contemporary trends in industry 4.0, where technology plays a pivotal role in optimizing operational processes.

2.1 Gaps in the Literature

The following points represent the gaps in the literature:

a) There were very few research papers found which were focused on investigations on impact of 5s implementation on operational efficiency, employee engagement, and cost reduction
b) There were small research papers found which were focused on small and medium enterprises of Madhya Pradesh.

Based on these research gaps, the objectives of the research were deiced.

3. SOLUTION METHODOLOGY

In the present research work, ANOVA assisted research hypothesis testing, the details of which are presented in upcoming sub-sections.

3.1 ANOVA

The Analysis of Variance (ANOVA) is a statistical method widely employed in various research fields to assess differences among group means and their associated procedures. This literature review synthesizes recent findings on the application and implications of ANOVA, highlighting its significance in diverse studies over the past

decade. ANOVA is primarily used to determine whether there are statistically significant differences between the means of three or more independent groups. In the context of workplace dynamics, Um-E-Rubbab and Naqvi explored the role of employee voice behavior in organizational sustainability, employing ANOVA to analyze the impact of gender on various workplace behaviors (Um-e-Rubbab & Naqvi, 2023). Their findings indicated that gender did not significantly affect supervisor delegation, highlighting the importance of using ANOVA to uncover nuanced insights within organizational studies. Similarly, Bello's research on the glass ceiling barriers faced by women in the construction industry employed ANOVA to reveal that marital status significantly influenced perceptions of respect in the workplace (Bello, 2023). These studies illustrate ANOVA's effectiveness in examining demographic variables and their implications for workplace equity.

ANOVA (Analysis of Variance) is a statistical method used to determine whether there are significant differences among the means of three or more independent groups. It tests the null hypothesis that all group means are equal versus the alternative hypothesis that at least one group mean is different. Below is the step-by-step procedure for ANOVA-based hypothesis testing:

a) Formulate the Hypotheses
- **Null Hypothesis (H0H_0)**: The means of all groups are equal (μ1=μ2=…=μk\mu_1 = \mu_2 = \ldots = \mu_k).
- **Alternative Hypothesis (HaH_a)**: At least one group mean is different.

b) Set the Significance Level (α\alpha)
- Decide on a significance level (commonly 0.050.05) to evaluate the results.

c) Collect and Summarize Data
- Organize the data into groups.
- Compute descriptive statistics (means and variances) for each group.

d) Calculate the ANOVA Table Components
- **Total Sum of Squares (SST)**: Measures the total variability in the data. SST=∑i=1N(xi−x¯)2SST = \sum_{i=1}^{N}(x_i - \bar{x})^2 where xix_i is an individual observation, x¯\bar{x} is the overall mean, and NN is the total number of observations.
- **Between-Group Sum of Squares (SSB)**: Measures variability due to differences between group means. SSB=∑j=1knj(x¯j−x¯)2SSB = \sum_{j=1}^{k} n_j (\bar{x}_j - \bar{x})^2 where njn_j is the number of observations in group jj, x¯j\bar{x}_j is the mean of group jj, and x¯\bar{x} is the overall mean.
- **Within-Group Sum of Squares (SSW)**: Measures variability within each group. SSW=∑j=1k∑i=1nj(xij−x¯j)2SSW = \sum_{j=1}^{k} \sum_{i=1}^{n_j} (x_{ij} - \bar{x}_j)^2
- Total variability is split as: SST=SSB+SSWSST = SSB + SSW.

e) Calculate Degrees of Freedom
- **Between-Group (dfBdf_B)**: k−1k - 1, where kk is the number of groups.
- **Within-Group (dfWdf_W)**: N−kN - k, where NN is the total number of observations.
- **Total (dfTdf_T)**: N−1N - 1.

f) Compute the Mean Squares
- **Mean Square Between (MSB)**: MSB=SSBdfBMSB = \frac{SSB}{df_B}
- **Mean Square Within (MSW)**: MSW=SSWdfWMSW = \frac{SSW}{df_W}

g) Calculate the F-statistic
- The F-statistic is given by: F=MSBMSWF = \frac{MSB}{MSW}

h) Compare the F-statistic with the Critical Value
- Determine the critical F-value from the F-distribution table based on dfBdf_B, dfWdf_W, and α\alpha.
- If FF exceeds the critical value, reject the null hypothesis.

i) Interpret the Results
- If the null hypothesis is rejected, conclude that there are significant differences between group means.
- Otherwise, conclude that the group means are not significantly different.

4. CASE STUDY

Fig-1 presents the details solution methodology implementation used to solve the research problem, as follows.

a) After finalization, of the topic of research, gaps and research objectives, the hypotheses was created, the details of which are presented as follows.

[1] H_{01}: The implementation of 5S does not improve the operational efficiency of SMEs.

H_{A1}: The implementation of 5S significantly improves the operational efficiency of SMEs.

[2] H_{02}: 5S implementation does not affect employee engagement in SMEs by fostering a more organized and visually appealing workplace.
H_{A2}: 5S implementation positively impacts employee engagement in SMEs by fostering a more organized and visually appealing workplace.

[3] H_{03}: Training and involvement in 5S practices does not enhance employee commitment to organizational goals in SMEs.

[4] H_{04}: The adoption of 5S principles significantly does not reduce operational costs in SMEs by minimizing waste and optimizing resource utilization.
H_{A4}: The adoption of 5S principles significantly reduces operational costs in SMEs by minimizing waste and optimizing resource utilization.

[5] H_{05}: SMEs that implement 5S experience a reduction in costs associated with workplace accidents and equipment downtime.

H_{A5}: SMEs that implement 5S experience a reduction in costs associated with workplace accidents and equipment downtime

[6] H_{06}: The simultaneous improvement in operational efficiency and employee engagement due to 5S implementation directly contributes to overall cost reduction in SMEs.

H_{A6}: The simultaneous improvement in operational efficiency and employee engagement due to 5S implementation directly contributes to overall cost reduction in SMEs

In the next step, a 5-point Likert's scale based questionnaire was sent to the respondents. Table-1 shows the details of response received.

Table-1: Profiles of Experts consulted for providing opinions

S. No	Criteria	Value
1.	Number of SMEs covered	400
2.	Number of questionnaire sent	600
3.	Number of responses received	550
4.	Number of complete responses received	550
5.	Response ratio	91.67 %

In the next step, ANOVA based hypothesis testing was performed on different hypotheses, the results of which are presented as follows.

Table-2: ANOVA Analysis for Hypothesis 01

Sources of Variations	Sum of Squares	df	Mean Square	F	Sig. (p value)
Between Groups	14.568	399	0.037	3.158	0.000
Within Groups	0.578	50	0.012		
Total	15.146	449			

Since the p-value is below 0.05, the null hypothesis is rejected, indicating support for the alternative hypothesis.

Table-3: ANOVA Analysis for Hypothesis 02

Sources of Variations	Sum of Squares	df	Mean Square	F	Sig. (p value)
Between Groups	15.487	399	0.039	3.897	0.000
Within Groups	0.498	50	0.010		
Total	15.985	449			

Since the p-value is below 0.05, the null hypothesis is rejected, indicating support for the alternative hypothesis.

Table -4: ANOVA Analysis for Hypothesis 03

Sources of Variations	Sum of Squares	df	Mean Square	F	Sig. (p value)
Between Groups	14.989	399	0.038	3.683	0.000
Within Groups	0.51	50	0.010		
Total	15.499	449			

Since the p-value is below 0.05, the null hypothesis is rejected, indicating support for the alternative hypothesis.

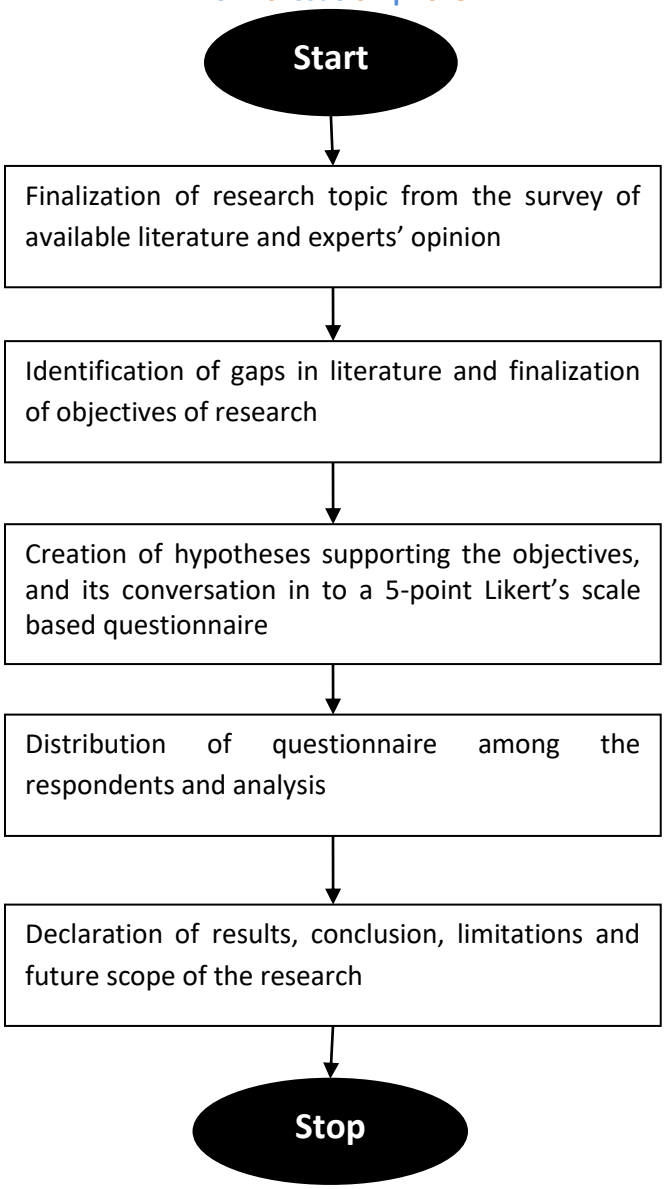

Fig-1: Solution Methodology Implementation to the Research Problem.

Table -5: ANOVA Analysis for Hypothesis 04

Sources of Variations	Sum of Squares	df	Mean Square	F	Sig. (p value)
Between Groups	13.898	399	0.035	3.576	0.000
Within Groups	0.487	50	0.010		
Total	14.385	449			

Since the p-value is below 0.05, the null hypothesis is rejected, indicating support for the alternative hypothesis.

Table- 6: ANOVA Analysis for Hypothesis 05

Sources of Variations	Sum of Squares	df	Mean Square	F	Sig. (p value)
Between Groups	12.899	399	0.032	4.276	0.000
Within Groups	0.378	50	0.008		

Total	13.277	449			

Since the p-value is below 0.05, the null hypothesis is rejected, indicating support for the alternative hypothesis.

Table -7: ANOVA Analysis for Hypothesis 06

Sources of Variations	Sum of Squares	df	Mean Square	F	Sig. (p value)
Between Groups	12.111	399	0.030	4.927	0.000
Within Groups	0.308	50	0.006		
Total	12.419	449			

Since the p-value is below 0.05, the null hypothesis is rejected, indicating support for the alternative hypothesis.

5. RESULTS AND DISCUSSION

The present section is devoted to the details of results of the research work, and its associated discussion, as presented in upcoming sections.

5.1 Results

The following are the details of results obtained from the research work.

a) The implementation of 5S does not improve the operational efficiency of SMEs.
b) 5S implementation positively impacts employee engagement in SMEs by fostering a more organized and visually appealing workplace.
c) Training and involvement in 5S practices enhance employee commitment to organizational goals in SMEs.
d) The adoption of 5S principles significantly reduces operational costs in SMEs by minimizing waste and optimizing resource utilization.
e) SMEs that implement 5S experience a reduction in costs associated with workplace accidents and equipment downtime.
f) The simultaneous improvement in operational efficiency and employee engagement due to 5S implementation directly contributes to overall cost reduction in SMEs.

5.2 Discussion

The following pints represent the discussion about the results.

a) From the first hypothesis, one can realize that by adopting 5S practices, SMEs can improve workplace layout, reduce time spent searching for tools or materials, and enhance overall productivity. Furthermore, a focus on regular maintenance and organization ensures that processes run smoothly with minimal disruptions. This hypothesis examines how implementing 5S enhances operational efficiency through systematic and continuous improvement in workplace organization and processes. Rejecting the null hypothesis in this context would provide evidence that 5S practices significantly contribute to operational efficiency in SMEs.
b) With the second hypothesis, one can realize that a well-organized and visually appealing workspace, achieved through 5S practices such as sorting, setting in order, and standardizing, can significantly enhance employee morale and engagement. Employees tend to be more motivated and efficient when their work environment is clean, structured, and free of unnecessary clutter. This hypothesis explores how the physical environment, improved by 5S, influences employees' emotional and cognitive connection to their work and organization.
c) On analyzing the third hypothesis, one can find that the 5S methodology emphasizes employee participation, training, and responsibility for maintaining workplace standards. Involving employees in 5S activities fosters a sense of ownership and accountability, leading to increased alignment with organizational goals. This hypothesis evaluates the role of training and active participation in enhancing employee loyalty and commitment, ultimately contributing to better overall organizational performance.
d) On analyzing the forth hypothesis, we can see that one of the core objectives of the 5S framework is waste reduction—both in terms of time and material resources. By systematically organizing tools, equipment, and processes, 5S reduces inefficiencies such as unnecessary movement, waiting times, and overproduction. This hypothesis examines how implementing 5S contributes to cost savings by enhancing resource utilization and eliminating non-value-adding activities.
e) From the fifth hypothesis, one can find that the safety component of 5S (the "Shine" and "Standardize" steps) plays a critical role in reducing workplace hazards and ensuring equipment is properly maintained. By fostering a culture of cleanliness and regular inspections, SMEs can lower the risk of accidents and mechanical failures. This hypothesis investigates the relationship between 5S implementation and the reduction in accident-related

and downtime-related expenses.

f) Finally, the sixth hypothesis explores the combined effect of operational efficiency and employee engagement on cost reduction. While operational efficiency minimizes waste and optimizes processes, employee engagement ensures sustained effort and innovation. Together, these factors can lead to significant cost savings, creating a synergistic effect that amplifies the benefits of 5S implementation. This hypothesis aims to highlight the interconnectedness of these outcomes in driving financial benefits for SMEs.

6. CONCLUSION, LIMITATIONS AND FUTURE SCOPE OF THE RESEARCH

The present section is devoted to the conclusion, limitations and future scope of the research, the details of which are presented in upcoming sub-sections.

6.1 Conclusion

On the basis of analysis made during the research work it may be concluded there is strong impact of 5s implementation on operational efficiency, employee engagement, and cost reduction in small and medium enterprises

6.2 Limitations and Future Scope of the Research

The following points represent limitations of the research work.

- The study focuses on a specific number of SMEs, which could limit the generalizability of the results to other industries or geographical locations.
- Employee resistance to change, varying levels of engagement, and differences in managerial support can influence the effectiveness of 5S implementation.
- The results may vary significantly across different industries. SMEs in manufacturing might see more tangible benefits compared to service-based SMEs.
- Many SMEs have limited financial and human resources to implement and sustain 5S practices effectively, which might impact the outcomes.
- External factors like economic conditions, market competition, or technological changes might confound the results, making it challenging to isolate the impact of 5S alone.

The following points represent the future scope of the research:

- Future research can focus on longitudinal studies to observe the long-term impact of 5S implementation on operational efficiency, employee engagement, and cost reduction.
- Conducting comparative studies between SMEs and large enterprises or across different industries could provide deeper insights into the scalability of 5S benefits.
- Investigating the integration of 5S practices with digital tools and technologies such as IoT or Industry 4.0 principles could reveal new efficiencies.
- Future studies can explore how organizational culture, leadership styles, or employee demographics influence the success of 5S implementation.
- Expanding the analysis to include indirect benefits, such as enhanced customer satisfaction or improved market reputation, can provide a holistic understanding of 5S's impact.
- Exploring the adoption of 5S in SMEs across different countries or cultural contexts could provide insights into its universal applicability and adaptability.
- Combining 5S with other operational methodologies such as Lean, Six Sigma, or Total Productive Maintenance (TPM) could reveal synergistic effects on SME performance.

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