Research article

Implementation of 5S methodology in feed mills, Punjab, Pakistan

Shah Zaib Noor[1*], Mohsin Khan[1], Hafiz Usama Noor[2], Muhammad Muazzam[3], Ahmar Jaleel[4], Burhan Aleem[1], Ahmed Javed[5], Asad Ansari[5], Muhammad Tayyab Abbas[6], Muhammad Faizan[6]

[1] Department of Agricultural Engineering, MNS of Agriculture, Multan, Punjab, Pakistan; Email: 2019-uam-1611@mnsuam.edu.pk
[2] Post-Harvest Research Centre, Ayub Agricultural Research Institute, Faisalabad, Pakistan; Email: usamanoor1600@gmail.com
[3] Institute of Plant Breeding and Biotechnology, MNS University of Agriculture, Multan, Punjab, Pakistan; Email: muhammadmuazzamsaroya@gmail.com
[4] Department of Food Science and Technology, MNS University of Agriculture, Multan; Email: ahmarjaleel313@gmail.com
[5] Department of Botany, Govt. Emerson University, Multan; Email: ahmadjaveed4596@gmail.com; muhammadasad855819@gmail.com
[6] Institute of Plant Protection, MNS University of Agriculture, Multan, Punjab, Pakistan; Email: ranafaizanmnsuam@gmail.com
[*] Correspondence: 2019-uam-1611@mnsuam.edu.pk

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Abstract

In industry, the 5S methodology is a process to improve efficiency, workplace cleanliness and safety at work, organized around five guiding principles: Sort, Set in Order, Shine, Standardize, Sustain. Applying 5S can help to enhance the logistics management, good hygiene, efficient flow of work and optimize the overall production processes. The 5S methodology can be applied effectively in the feed mills to ensure product safety, minimize material waste and increase the efficiency in the works. This also helps to provide quality assurance and adherence to hygienic requirements in animal feed production. The results show that although the basic 5S practices, such as cleaning and organization, are being applied in different sites, they are not being fully embraced due to less managerial support and limited resources, which suggests that there are still challenges in sustaining 5S practices

Keywords: Operational Improvement[1]; System Efficiency[2]; Waste Reduction[3]; Workflow Efficiency[4]

Introduction

The field of industrial management is constantly evolving and methods for continuous improvement are essential for achieving high worker productivity, workplace safety, and improved working efficiency. The 5S system is a Japanese method that has been adopted by many industries for its systematic working. The 5S's are designed to create a neat, orderly and efficient work area that would eventually enhance production and reduce waste. As industries face increasing pressure to meet safety and quality

standards and to curb inefficiencies in their operations, the integration of 5S is becoming more vital than ever (Moi & Sing, 2021). In recent years, 5S has been used beyond the traditional manual application of the method, as companies implement digital transformation. Technology enabled 5S monitoring has broadened workplace management, such as cloud-based reporting tools, mobile audit applications, and IoT sensors. These innovations contribute to the effectiveness of implementing 5S and, additionally, enhance the decision-making, traceability and real-time monitoring. Digitalization of tools for increased 5S compliance is timely and relevant, particularly in manufacturing industries such as feed mills where discipline in the process, equipment maintenance and cleanliness are key (Vitale, 2023). The growing feed mill industry plays a significant role in the livestock and poultry production in Punjab, Pakistan. Some of the areas that are plagued in this industry and which directly affect the safety of workers and product quality include lack of adequate housekeeping, improper equipment handling, dust accumulation, and lack of established procedures. Despite the growing consciousness, many area feed mills still employ outdated and non-standard work place management practices. The need is to explore the potential impact of organized methodology such as 5S, in conjunction with the latest technology, on the workplace culture and operational outcomes (Muotka et al., 2023). There are several international case studies on the effectiveness of 5S describing its application in manufacturing industries (Ahire et al., 2021; Ashraf et al., 2017). but studies and empirical data that really reflect its application in the agro-industrial context in Pakistan are very scarce. There have been fewer studies that have focused on digital technologies to enhance or streamline 5S processes in such settings. To bridge that gap, this study aims to evaluate the use of 5S technology in feed mills of Punjab. The research method adopted was survey method and industry personnel were involved. The aim of this research is to investigate the level of 5S implementation, the use of digital monitoring technologies, and the effectiveness of digital monitoring technologies based on the views of supervisors and shop floor employees. The study provides important and direct perspectives, which are often missing from “top down” evaluations by management, by capturing the first-hand experiences and learning points of practitioners in the industry (Vitale, 2023).

The current Longitudinal Study is an investigation of the status of 5S implementation in all Feed Mills of the Punjab, Pakistan with the following objectives: 1. To review about and recommend the best current practices for implementing 5s in the context of the Punjab feed mills; 2. To explore how far technology can be used to aid and supervise 5S activities; To compare these results with the results of benchmark international standards to determine the factors that favour or hinder the implementation. This study employs the quantitative approach of data collection by survey to collect data from a representative sample of feed mill workers from different regions of Punjab. Worker engagement, the use of mobile audit apps or monitoring devices, the frequency of 5S training, and perceived results in terms of workflow, safety, and cleanliness are all included in the study. The acquired information will be compared to findings of past studies to provide meaningful inferences and provide practical recommendations. The value of the research is its contribution of providing

insight into the implementation of 5S and the role technology can play in assisting and sustaining these practices in an industry where they have not traditionally been embraced. These evidence-based solutions can guide industry leaders, shape policy and contribute to bigger plans for workplace and productivity improvement in the path of Pakistan's agro-industrial modernization.

Materials and Methods

Questionnaire development A structured questionnaire was designed according to Frary (Frary, 1998). at the Faculty of Agricultural Biosystem Engineering and Technology MNS University of Agriculture, Multan, Pakistan to carry out the study. The questionnaire had six sections to evaluate organizational profile, awareness, and adoption, implementation level, benefits, challenges, and future prospects of the 5S methodology in feed mill operations as depicted in table1.

Sites selected for study

The study was conducted in different feed mills located in different areas of Punjab, Pakistan. Major district among them were Multan (30.2° North latitude, 71.48° East longitude), Phool Nagar (31.21º North Latitude, 73.94ºEast longitude), Lahore (31.55º North latitude, 74.34º East longitude), Bhagalpur (25.25º North latitude, 86.99º East longitude), Okara (30º North Latitude, 73ºEast longitude), Dunyapur (29.80º North latitude, 71.74º East latitude) and Gujranwala (32.18 North latitude, 74.19 East longitude). These locations were specifically chosen because most feed mills are located in these sites. The maximum number of people answered from Multan (n=20) followed by Phool Nagar (n=3), followed by Lahore (n=1) followed by Bhagalpur (n=1) followed by Okara (n=1) followed by Depalpur (n=1) followed by Dunyapur (n=1) and from Gujranwala (n=1).

Data collection

For data collection, a structured Google Form was designed, comprising relevant questions associated with the survey objectives. The form was distributed to targeted respondents through WhatsApp, allowing participants to submit their responses. This method ensured ease of access, convenience for respondents, and efficient data compilation for analysis (Garimella and Chauchard, 2025).

Statistical Analysis

The data collected were first entered into the SPSS software and then subjected to statistical analysis. These were summarized using a frequency analysis of the respondents' demographic and organizational characteristics, and their answers to all the questions in the questionnaire. The results of the frequency analysis were expressed in the form of counts and percentages to describe the distribution of responses familiarity with 5S, training frequency, observed benefits, workflow efficiency, digital tool usage, and employee participation strategies.

Table 1. Questionnaire on the Implementation of 5S Methodology in Feed Mill Operations

Section	Question No.	Description	Response Options
A. Organizational Profile	A1	Name of feed mill	Open-ended
	A2	Location (City/Country)	Open-ended
	A3	Primary feed products produced	Poultry; Livestock; Aquaculture; Pet food; Other
	A4	Annual production capacity	<10,000 MT; 10,000–50,000 MT; >50,000 MT
B. Awareness and Adoption of 5S	B1	Familiarity with 5S methodology	Yes / No
	B2	Mode of introduction of 5S	Internal training; External consultants; Conferences/workshops; Academic literature; Other
	B3	Frequency of 5S training	Quarterly; Biannually; Annually; Onboarding only; Never
	B4	Duration of 5S implementation	<6 months; 6 months–2 years; >2 years
C. Level of 5S Implementation	C1	Extent of practice of 5S principles	Rank 1–5 (1 = Most practiced, 5 = Least practiced): Sort; Set in Order; Shine; Standardize; Sustain
	C2	Motivation for adopting 5S	Improve safety; Reduce waste; Enhance productivity; Regulatory compliance; Customer demand (Top 3)
D. Benefits and Performance Outcomes	D1	Benefits observed after 5S implementation	Rank 1–5: Reduced downtime; Fewer accidents; Faster retrieval; Improved quality; Higher engagement
	D2	Estimated reduction in raw material waste	>15%; 5–15%; <5%; No change
	D3	Impact on workflow efficiency	Significant improvement; Moderate improvement; Minimal/no change

Table 1. Questionnaire on the Implementation of 5S Methodology in Feed Mill Operations

Section	Question No.	Description	Response Option
E. Current Challenges	E1	Barriers to effective 5S implementation	Employee resistance; Lack of management support; Insufficient training; High cost; Sustainability issues
	E2	Methods of monitoring 5S compliance	Audits; Digital systems; Visual management; No formal system
	E3	Strategies to enhance employee participation	Recognition programs; Incentives; Team competitions; Training workshops
F. Future Prospects	F1	Digital tools supporting 5S	IoT monitoring; Mobile audit apps; ERP/CMMS; None
	F2	Visual management tools used	Floor markings; Shadow boards; Color coding; None
	F3	Frequency of 5S review and updates	Monthly; Quarterly; Annually; Never
	F4	Planned expansion of 5S	Warehousing; Offices; Logistics; No plans
	F5	Other lean tools used	Kaizen; Six Sigma; TPM; None

A nominal regression model (multinomial logistic regression) was used to model the relationship between the most important research question related to the type of primary feed product and the other variables. The dependent variable in this model was the major feed product category and the outcome groups were poultry, livestock (cattle and swine), and pet food. The influence of the predicted variable, annual production capacity, on the probability of producing various feed products was examined. Likelihood ratio tests and pseudo R-squares (Cox and Snell, McFadden, and Nagelkerke) were used to assess model fit. Associations are interpreted by the direction of the associations (Exp(B) > 1, < 1) and the strength of the associations (95% CI). A binary logistic regression analysis was then performed to gain deeper insights into the relationship between the main feed product and the important dimensions of the 5S implementation. In this model, the dependent variable was the main feed product used, and the independent variables were: the 5S steps practiced, the observed benefits following 5S implementation, the effect on workflow efficiency, the key barriers to the successful implementation of 5S and plans to implement 5S to further other areas. Logistic regression was implemented in a step-wise manner starting with the null model (Step 0) and sequentially adding the predictors to the model (Step 1) and making all the predictors to be entered at once. The significance of logistic regression model was evaluated by the Omnibus Tests of Model Coefficients and the goodness of fit was evaluated by Hosmer and Lemeshow test (Hosmer and Lemeshow, 2000). To assess which predictors, contribute to the model, regression coefficients (B), standard errors, Wald statistics, significance values (p), and odds ratios [Exp(B)] were reported for each predictor. The score statistics were also used to examine the variables that were not included in the equation at Step 0 to determine their preliminary relevance. The statistical tests were performed at $\alpha = 0.05$ level of significance. The results were discussed to find out the association level between production factors and 5S factors with the type of primary feed product and the results of 5S implementation. This analytical framework guaranteed a systematic and consistent analysis of frequency distributions, categorical relationships, and predictive effects based on the study's goals.

Data management:

Data were coded on a scale ranging from a minimum of 1 to a maximum of 5 for ordinal variables. A reverse-scored 5-point Likert-type scale was employed, where 1 represented "most significant" and 5 represented "least significant." All data management and subsequent statistical analyses were performed using SPSS software (version 27; Hosmer & Lemeshow, 2000).

Results

The present study was carried out in 8 urban centres namely Multan, Phool Nagar, Lahore, Bhagalpur, Okara, Depalpur, Dunyapur and Gujranwala. In each location there was a significant tendency towards selecting one of the response options, with relatively little variation in the other options. The pattern was more mixed in the case of Multan, while the other cities (Phool Nagar, Okara, Depalpur, Gujranwala, Bhagalpur, Dunyapur and Lahore) had high concentration of responses in one category. The fourth response option was not well-supported at any of the sites.

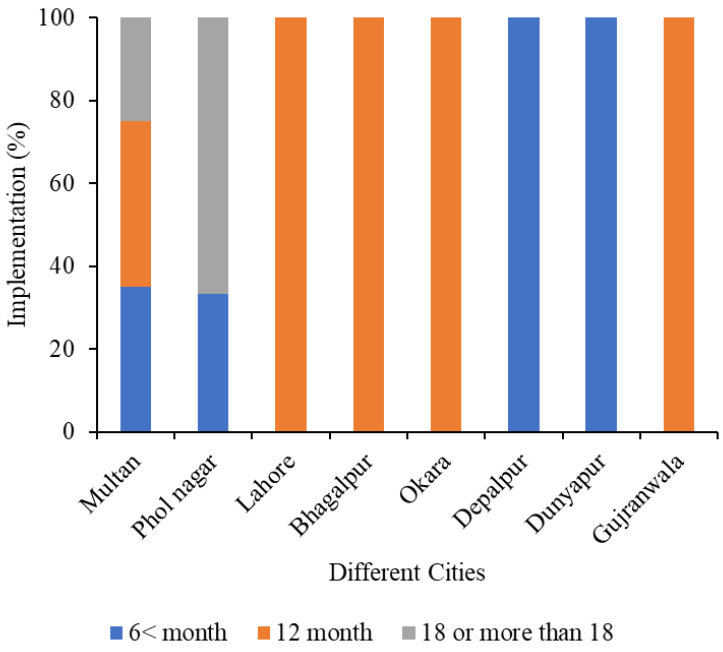

Figure 1. Implementation duration for the 5S system

In Figure 1, there are feed mills in Lahore, Bhagalpur, Okara, and Gujranwala that have been established using the 5S approach and have had a similar duration. It seems that the process is going slowly in Multan and has great variation between mills. Some early adoption of Phool Nagar has been observed, and there was a relatively long period after implementation. The results indicate that Depalpur and Dunyapur seem to be late adopters given the brief time span for implementing the 5S methodology.

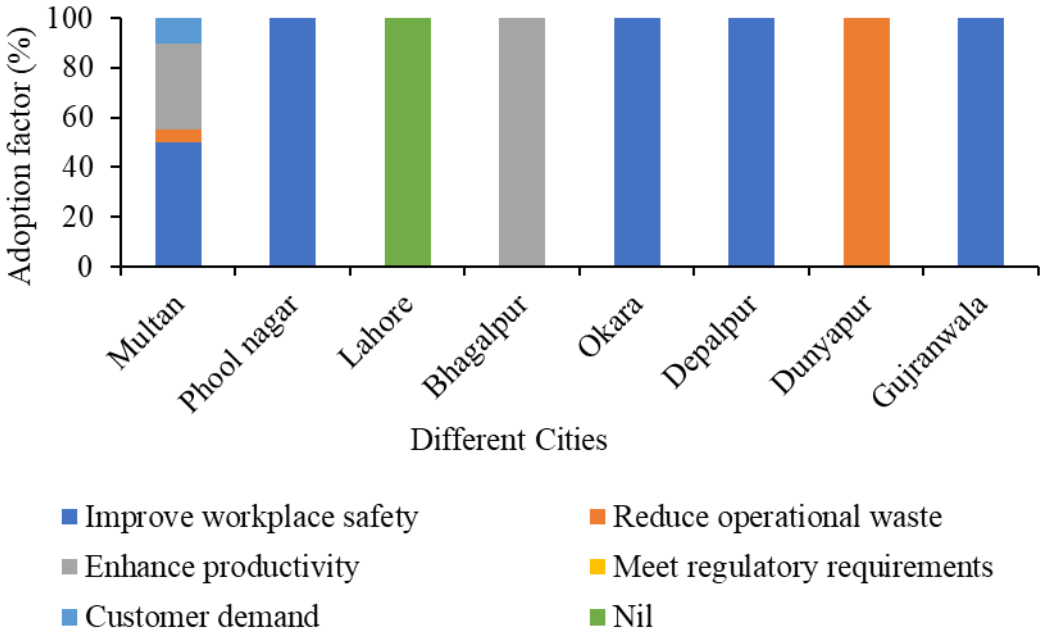

Figure 2. Motivation behind 5S implementation

As illustrated in figure 2, there is a great variety of reasons for the implementation of 5S system in an urban context. In Multan, only a few production units were completely converted to technology and most of them said that the technology was partially adopted. At Phool Nagar, the numbers were quite different: while many buildings had been fully engaged, there was still a large number in the process of half-way. There was no complete implementation in Lahore, all the units were implemented partially. On the other hand, Bhagalpur, Okara, Depalpur, Dunyapur and Gujranwala had universal adoption, that is; no unit had any partial adoption.

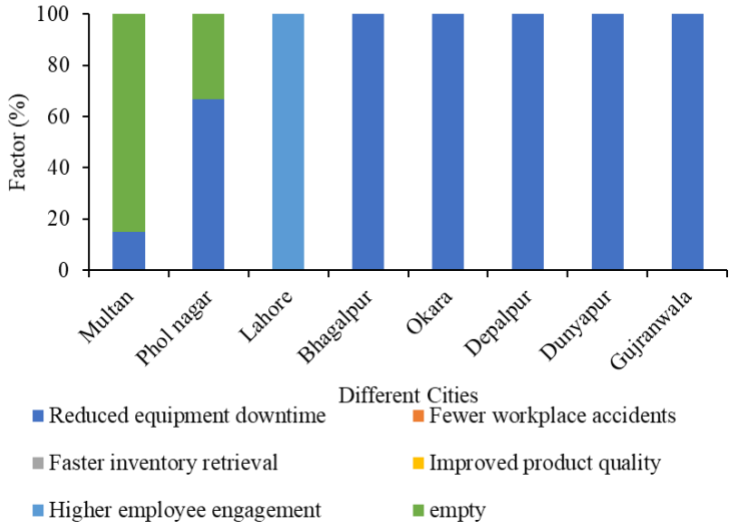

Figure 3. Benefits of 5S implementation

The practice of applying 5S in production is found in several cities, and there is a great difference among them (Figure 3). The implementation led to increased employee engagement in Bhagalpur, Okara, Depalpur, Dunyapur and Gujranwala. Although in Pakistan, the 5S program is partly being applied in the various fields of Multan. In some places the information that advanced technology has used in the example of Phool Nagar has been used in a suitable way. Bhagalpur and Lahore, too, can only be talked about in its entirety in relation to one category. Okara, Depalpur, Gujranwala have adopted 5S system in general areas and Dunyapur has adopted total system in different areas. All these case studies together demonstrate the non-homogeneity of the trend, as most localities did not invest in the holistic approach, but rather in the subsystems as the focus area.

The variables involving difficulty in adopting 5S are presented in Figure 4, where 5S is used selectively and circumstantially in particular cases in Lahore, Bhagalpur, and Dunyapur, but in other cases in Phool Nagar and Multan, it is used only quite infrequently. The Pakistani companies used a few of the 5S, which seemed to fit best in the available resources, and leadership in a manufacturing setting reported a gain in productivity after partial 5S implementation but recognized that it would not be possible without commitment to implementing all the 5S.

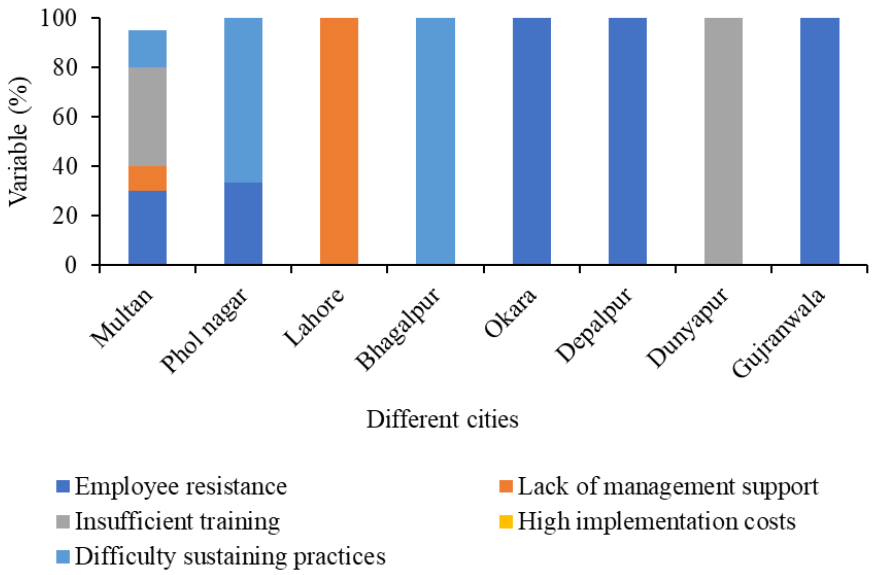

Figure 4. Hindrances in 5S adoption

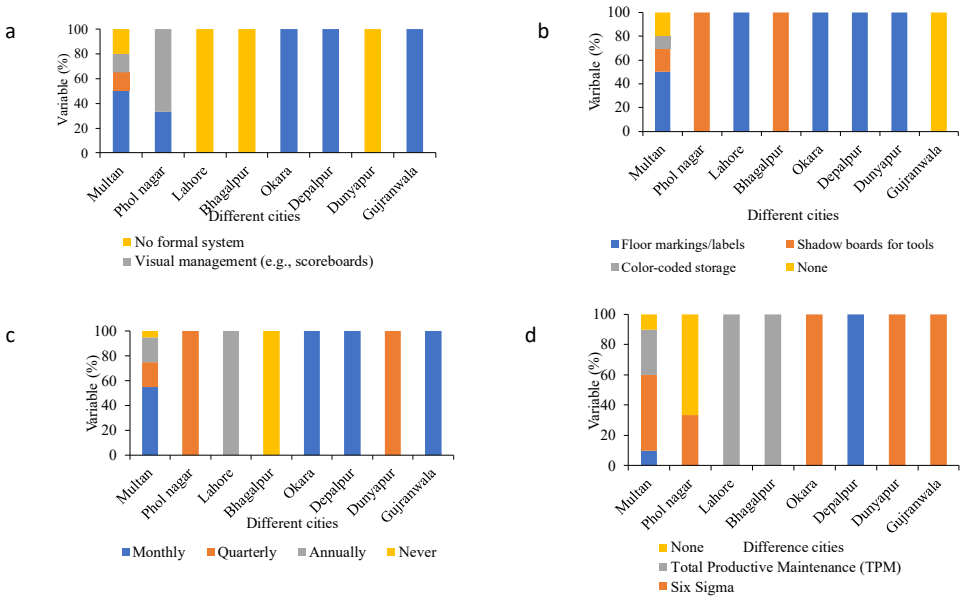

Figure 5. a) Compliance monitoring, b) Visual management, c) Review frequency, and d) Use of lean tools

The eight cities of Multan, Phool Nagar, Lahore, Bhagalpur, Okara, Depalpur, Dunyapur, and Gujranwala were involved in the compliance monitoring, visual management, review frequency, and the use of lean tools. As per Figure 5, the progress of the implementation of Multan in the various stages has been presented. In one of the early stages, Phool Nagar showed complete implementation. Lahore, Okara, Depalpur, and Dunyapur concentrated primarily on the first stage with no progress seen in the latter stages. In one of the early stages, Bhagalpur has also been fully implemented. Conversely, Gujranwala had a 100% rate of complete implementation in a later stage.

The results indicate that the majority of the cities focused on the early stages of the 5S, and a few cities were getting toward the later stages. A 2024 study of a Malaysian cement plant revealed that the implementation of standardization and discipline tends to follow the initial stages, which help significantly improve the operational efficiency and employee satisfaction. The findings of this study indicate that the implementation of 5S in industries is not uniform across the cities as limited resources and leadership have been cited as a reason for the partial implementation of 5S in industries of Karachi. This variation indicates that full adoption of 5S is currently difficult without sufficient support and training. The 5S Implementation Status for the surveyed cities is not uniform. In Multan, second and third categories were focused primarily while first and fourth categories were given less attention. The second and fourth categories were targeted in Phool Nagar, and the first and third categories were not targeted. In both Lahore and Bhagalpur, only the third category was targeted while no development was seen in other categories. In Okar a concerted effort was focused exclusively on the second type. Depalpur only focused on the first category, Dunyapur only on the second category. Overall, it suggests that some cities are focusing more on a certain class of 5S and other cities are under-implemented. Matches indicated that Shine was the most frequently used category, because it was easy to perform and was visible.

Discussion

The 5S implementation done by the feed mills of Lahore, Bhagalpur, Okara, Gujranwala, Phool Nagar, Depalpur, and Dunyapur is in line with the previous research that 5S is implemented in a phased manner and differs according to the organizational state and culture. Newer adopters demonstrate that they are beginning to lean, and mature sites demonstrate that they have witnessed the benefits of lean over the long term, such as workplace organization and productivity. Research on the importance of management commitment, employee participation, and ongoing improvement for the successful implementation of 5S is aligned with this incremental approach and the maturity stages of 5S implementation (Bora et al., 2024). The findings of my poll of the primary motivations for implementing 5S in a city are different from the research available, which indicates that 5S is implemented by businesses for a range of similar, but not identical, reasons, regardless of geographical location, such as to reduce waste, to increase productivity, to make workplaces safer, and in response to regulations (AlMadi *et al*., 2024). The findings agree with previous research that found that regional variations are common for adopting technology in the feed mills or agro-industrial sector. Research shows that urban and industrially developed regions, such as Bhagalpur and Gujranwal (in your case) tend to be more complete and faster in adopting the innovations, than areas such as Multan and Lahore, where there may be organizational inertia, financial constraints, or lack of skills (Kamble et al., 2020). My findings, that implementation of 5S technology is not consistent across cities, align well with previous research, which showed that in developing cities, it is often hard to implement 5S technology successfully and in a

uniform way, because of various contextual barriers. In addition, the level of 5S adoption within industrial clusters may also differ from each other, depending on their level of operational maturity, leadership vision, and customer pressure (Shaikh et al., 2015). The fact that I noticed that in some parts of the country, like Okara, Depalpur, Gujranwala, and Dunyapur, 5S implementation was more complete, which resonates with Rogers' Diffusion of Innovation theory (2003), which explains that in some parts, 5S could be implemented fully, but in other parts it was not due to some resistance to change or shortage of resources. The results of my study indicate that rates of 5S adoption vary from city to city: all 5S in Multan, some 5S in Phull Nagar, around 60% in some categories in Lahore, 10% in Bhagalpur, and 1% in all other cities. These results confirm the recent findings that 5S implementation is often selective and context-dependent. For instance, in the garment industry in Pakistan, firms took only some of the 5S elements that fit well with their resources and the focus of their leadership, and reported improvements in productivity after some of the 5S elements were deployed, but claimed that implementing all 5S elements requires organizational commitment from all 5S pillars. The present study showed that 5S implementation is largely focused on the first five S in most of the cities, including Lahore, Okara, Depalpur, and Dunyapur, while the cities such as Multan and Gujranwala have progressed towards the latter 5S. These results are in line with the previous ones, which have emphasized that organizations have a hard time getting the last 5S implemented and maintained because of a lack of training, management support, and cultural opposition (Akram et al., 2023). Findings from this study indicate a heterogeneous profile of 5S implementation by the cities, a pattern similar to earlier studies that showed local context, resources and leadership have an impact on the level of 5S implementation. This partial adoption of 5S, reported in the industries of Karachi, was because of the limited resources. This variation indicates that full 5S implementation is difficult when there is no support and training to achieve it (Hanif et al., 2023) “Sort” is the most common, and most active, application of 5S, and it is the first and most easy-to-do application that can be implemented in the workplace. The studies conducted, like (Dighe & Kakirde, 2014) argue that organizations start their 5S implementation projects with sorting activities because there is an immediate visible effect achieved by cleaning, and spaces are created. Most of the time I get a good response for the third answer “Shine”. The next steps in the process such as Sustain and Standardize are less frequently used because they require ongoing efforts and a cultural change. This trend is in line with the current study's results, which indicated that “Sort” is the step most often used. In the same way, (Masoud et al., 2025) mentioned that year-on-year review and training are effective to maintain the improvement in structured 5S implementation. Quarterly training is most desirable, but annual refresher training is also a practical and research-based method, especially in combination with continuous assessments. For the present survey, the majority of respondents indicated that the main benefits of the practices implemented were “significant time savings” on workflow efficiency. This suggests a positive change in the performance of the operation, which could be due to the streamlining of process, the less time spent searching for information and improved organization in the

workplace. The result is consistent with other research, including (Gupta, 2022). that highlights the importance of the use of lean techniques (such as 5S) and the resulting significant improvement in wasted time and wasted motion, which in turn can increase productivity. Likewise, highlighted the significance of well-maintained workplace systems in order to consistently complete tasks on time and smoothly. In this research, it was found that the most important obstacle that hinders the success of the 5S implementation is the lack of training. This result is similar to the earlier studies which had focused on the importance of employee understanding of 5S principles and procedures is limited by the lack of appropriate education and skill training. If staff have not received sufficient training, then they may be neglecting or misapplying important steps, resulting in an inconsistent approach and lack of maintenance of improvements. So, structured and regular training programmes are crucial in developing competence, maintaining engagement and helping to achieve long-term 5S success.

Conclusions

The results of the survey on 5S implementation were different in each of the 8 cities. The adoption was steady and sporadic in Multan while the implementation was early and complete in Phool Nagar. Lahore and Bhagalpur embraced only a few aspects, primarily the third one. Only individual 5S steps were highlighted by Okara, Depalpur, Dunyapur, and Gujranwala; in some cases, the 5S steps were fully adopted. In general, many cities highlighted the early stages (Shine and Set in Order) with less progress in the later phase. The response in Multan was mixed, and consistency was observed in others with a localized response. Leadership, training and resources were significant factors in the partial adoption of the intervention. Future studies are needed to evaluate long-term sustainability and implementation outcomes of using the 5S methodology. Furthermore, the incorporation of digital lean tools to gain a deeper insight into the organizational and technological aspects that affect the successful implementation of 5S methodology.

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