Impact of 5S on productivity and quality in an Indo-Japanese auto-component manufacturing company: an empirical study

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Abstract. The present work probes the relationship between 5S vis-a-vis productivity and quality. 5S is an extraordinarily economical yet highly effective method of business management. Two hypotheses were formulated for testing with the random sample survey with a reliable and valid questionnaire on the targeted population. The collected data were analyzed using the statistical software SPSS Statistics V23. The statistical tests, namely, multiple correlations, regression analysis, and Pearson-Correlation analysis, were performed. The results show a strong positive correlation between productivity and 5S. The relationship between quality and 5s was also positively related but had moderate significance. This study was limited to a single joint venture Indo- Japanese auto-joint venture situated in the Delhi-NCR region. Further enlarged studies must be performed on more such companies in this location and various geographical regions of India.

1 Introduction

In the current scenario of unfettered competition and the perpetually volatile economic environment, coupled with globalization and resource crunches, and shrinking margins, it has become a great challenge for organizations to remain relevant by maintaining quality, productivity, and timely delivery and at the same time keeping production costs as low as possible to sustain profitability. Lean manufacturing has become the buzzword for over three decades to achieve these goals in the production world. The credit for this word goes to Krafick, who mentioned "Triumph of the Lean Production System" in his article, and after that, this term came into vogue [1]. A complete account of how the word "Lean" was coined is explained by Holweg [2].

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Lean, the final avatar of the Toyota Production System (TPS), is a set of tools and techniques that facilitate the identification and steady elimination of wastes of all kinds and thus streamline the whole enterprise. In the Toyota Production System or TPS, everything is evaluated on its effect on value addition, and all those expenses or resources which do not add value to the customer are delineated as waste, and the target is their elimination. Lean classifies wastes into eight categories, known by the acronym TIM WOODS. These are transportation, inventory, motion, waiting, overproduction, over-processing, defects, and skills [3]. All types of waste involve hidden costs. There are 40 tools identified to date to eliminate wastes, among which a few prominent ones are 5S, Kaizen, JIT, Poka-yoke, Kanban, and SMED.

What we know as 5s, in the management jargon, was created by Osada [4]. It is an acronym of 5 Japanese words: Seiri, Seiton, Seiso, Seiketsu, and Seitsuke. Translating words from one language to another is always challenging since they may lose contextual meaning due to cultural variation. Still, Various researchers [5–7] have loosely translated it into English, maintaining the continuity as 5-S, with interpretation as follows:

i. **Seiry (Sort):** Seiry means disposing of waste and unrequired material from the working location, which will differentiate between wanted and unwanted materials, tools, or machinery at that place [8,9].
ii. **Seiton (Set in order):** Seiton means earmarking a place for every tool, material, or machinery and putting it at that designated place so that these can be found within no time, as and when required [10–13].
iii. **Seiso (Shine):** Seiso means cleaning all tools, machinery, and the workplace to the best possible level, which will make the workplace safe, secure, and desirable. Also, it will make tools and machinery readily available for other employees [14,15].
iv. **Seiketsu (Standardize):** Seiketsu means setting simple yet noticeable rules for sorting, setting in order, and shining. The aim is to make these activities a routine [14–17].
v. **Shitsuke (Sustain or self-discipline):** Shitsuke means complying with the rules made under the 4th S to sustain the level achieved under the first 3 Ss by default [18].

The strength of 5-S lies in its simplicity, as it does not require any knowledge of higher technology. It brings forth the problems of the organization, which remain invisible or ignored for a long time. The available literature shows that it has been used for a variety of purposes by organizations viz, optimizing the utilization of available space [19,20], reducing waiting time in hospitals [21], improving health care performance [22], workplace improvement [23,24], workplace safety [25], employees performance and productivity [26–33] for cost reduction [34], enhancing the quality of service [35] and energy efficiency [36], creating world-class standards [37,38], implementing of ISO [39], TQM[40], Lean [41], kaizen [42–46], and lean six-sigma [47–50], in the construction industry [51], textile Industry [52–54], and TPM [55,56] for managing libraries [57–59], in agriculture industry [60], for project management [61], education and training [62].

Since its articulation, the 5S has been discussed as a solution for many problems in various industries. Still, there are some conflicting opinions and results regarding the way it is understood and implemented by the Japanese people vis-a-vis people from other parts of the world. Even within Japan, there are two schools of thought. Osada [4] conceived it as a philosophy for life and business based on Japanese tradition and ancient culture. On the other hand, Hirano [63,64] visualized it merely as a tool or technique. Various researchers [17,65] have found that it is thought of as another name for housekeeping in Western managerial thinking. Scholars have emphasized that 5-S remains underutilized in the USA, the UK, and India [7,37,66–69]. There is enough literature [18,70–74] singing its success story in Japan, and a few cases, to some extent, in US and UK, but there are also instances of its failure in Spain and Mexico [75–77] or underutilization [5,9,78,79]. Researchers

[68,80] have also reported that its implementation in India is a very recent phenomenon. The available literature could be more extensive, and the picture of its implementation in India could be better.

1.1 Factors under consideration, theoretical model, and hypotheses to be tested

As of now, India is the 5th largest economy in the world, and the Indian Automotive industry is predicted to attain the size of $250-280 billion (by combining both OEM and auto component manufacturing) in yearly turnover by 2026 [11]. So, it is imperative to incorporate world-class manufacturing practices on the whole hog. Delhi-NCR (Gurugram, Ghaziabad, NOIDA, Greater Noida, etc.) is the biggest hub in northern India for the Indo-Japanese Auto-component manufacturing industries. These joint ventures may set the benchmark for implementing 5S and other Japanese management practices for other industries to follow in the surroundings. Although a few papers are available on empirical studies from Indian MSME, no paper was found on studies, specifically on Indo-Japanese joint auto-component manufacturing industries, which were started as family-owned Indian ventures, but later on became Indo-Japanese joint ventures. This research will contribute to filling up the gap in this regard.

1.1.1 Factors under consideration

This study will empirically investigate the influence of the implementation of 5S on productivity and quality by survey method.

i. **Productivity:** It measures the efficiency of the utilization of resources by any enterprise to earn profit by creating goods or services to satisfy the customers' needs [81]. It can be measured by taking the ratio of the number of goods and services produced and the total resources utilized, both in terms of revenue [82]. It has been found that eliminating waste enhances productivity and, thereby, profitability [83].

ii. **Quality:** The word quality is most frequently used, discussed widely by quality gurus, understood intuitively, and acquires various meanings depending on the context but is very difficult to quantify. It has been defined as "fitness for intended use" [84], "the combined attributes that are inherent in a product through the elimination of deficiencies, and thereby enhancing the customer satisfaction"[85], "an economic measure of output per unit input" [83], where input is the combined cost of labor and capital. The enhancement of quality can be quantified by the reduction in rework [86].

1.1.2 Theoretical Model and Hypotheses to be tested

This research is based on the theoretical model in which three variables were identified, one independent and two dependent variables. The independent variable (cause) is "5S level," and the dependent variables (effect) are "Productivity" and "Quality." Figure 1 is a schematic representation of this model.

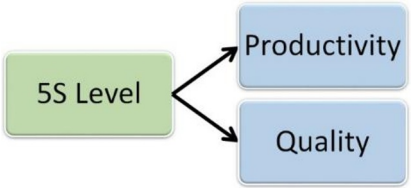

Fig. 1. Theoretical Model for Study.

Based on the literature reviewed and the objectives of this research, only two hypotheses were formulated for testing. These are:
H1: Implementation of 5S will significantly improve productivity.
H2: Implementation of 5S will significantly improve quality.

2 Methodology:

This empirical study was conducted by the survey method in an Indo-Japanese joint venture, an auto-component manufacturing plant in the Delhi-NCR region. Because of an undertaking regarding confidentiality, the company's name (say ABC) cannot be revealed. This company is a leading supplier and manufacturer of automobile plastic components like link bush, spring bush, O-rings, gaskets, and rubber parts. The company is 14 years old, of which 10 years were as a fully Indian company and the last 4 years as a 55:45 Indo-Japanese joint venture. The company exports 40% of its products and intends to double its share of earnings from export by the end of 2022. The total number of employees as of March 2019 is 320. The implementation of 5S has been partially done right since its inception, but more stress has been applied since the Japanese collaboration. However, it is still a work in progress. Each employee, who joined at the time of starting the company, was first trained in the 5S methodology by the Japanese collaborator. A selected group among them has been assigned to educate and train the successive generation of employees. The company now firmly believes that many small changes yield significant outcomes.

Every Saturday, 30 minutes is dedicated to 5S activities all around the company. Once a month, the 5S audit is carried out in the company. The employees, who sustain the established standards, are duly rewarded financially. The company has been bettering its results since 2010 as the outcome of implementing the 5S methodology.

Based on the available and validated test questions in the literature, a questionnaire was prepared to conduct this survey. This questionnaire was translated into Hindi and was made bilingual to make it convenient for people. Further, this translation was checked by three professors of production and industrial management and 4 senior managers of different companies, and their suggestions were incorporated. A pilot study was conducted to verify the employees" understandability, which was found to be spot-on. The questionnaire has two parts. Part-I is about the general information of that person to capture the demographic characteristics of respondents, and part -II has questions concerned with the variables of this study. Finally, it was distributed among employees of the company up to the level of managers. They were asked to respond on a 7-point Likert scale about 5S activities to capture data more vividly, having the following meaning:
1-Never, 2- Very rarely, 3-Rarely, 4- Occasionally, 5-Frequently, 6-Very Frequently, and 7-Always.

Two hundred questionnaires were distributed, of which 160 were returned. Eight of the returned forms were incomplete, and so rejected, and only 152 were taken for analysis. The response rate is 47.5% which is a representative size of the population. The correlation analysis was performed in the second step. The collected data was collated in an Excel sheet and fed into SPSS Statistics V23 software for statistical analysis.

3 Results and Discussion

3.1 Descriptive Statistic Analysis

To capture the data more objectively for testing hypotheses, the demographic data were extracted, which is tabulated as follows; Table 1 provides sample demography based on age, and the same has been presented graphically in Fig. 2. This shows that all age groups

are in the sample, so there is no age bias. Table 2 presents the sample demography by age, which is depicted graphically in Fig. 3. This data shows that the ratio of males to females is approximately 10:1, which was clearly visible even with a cursory look inside the company. Table 3 presents the sample demographic data based on education, illustrated graphically in Fig. 4. The overwhelming majority of the sample demography has less than a university degree, clearly showing that operators outnumber the others, which is valid for any manufacturing company.

Table 1: Demographic Variable - Age

Age	Frequency	Percent	Percent (Cumulative)
25 years and below	23	15	15
25 years to 35 years	56	37	52
35 years to 45 years	62	41	93
More than 45 years	11	7	100

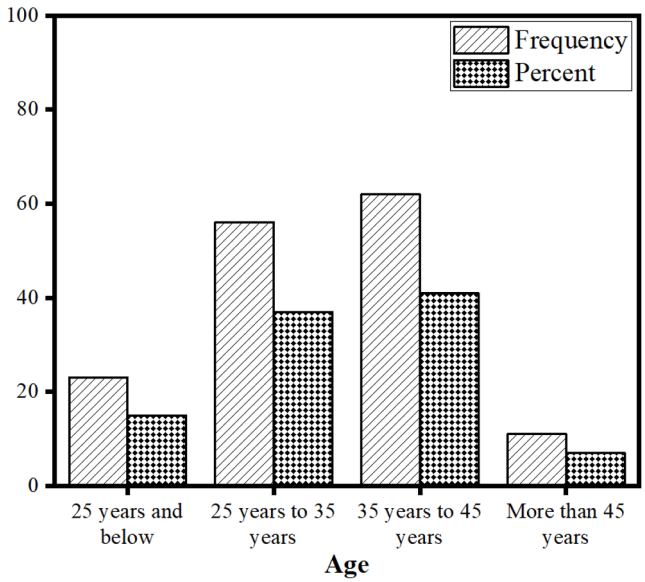

Fig. 2: Demographic Variable - Age

Table -2 Demographic variable – Gender

Gender	**Frequency**	**Percent**	**Percent (Cumulative)**
Male	139	91	91
Female	13	9	100
Total	152	100	100

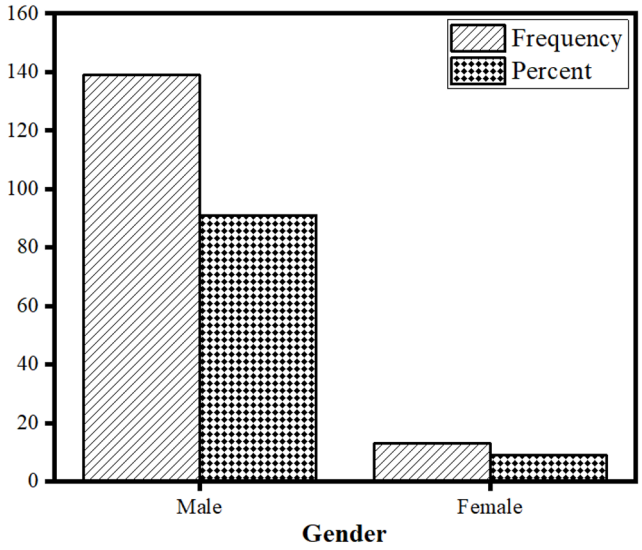

Fig. 3: Demographic Variable - Gender

Table 3: Demographic variable – Education

Education	Frequency	Percent	Percent (Cumulative)
Secondary Education	111	73	73
Intermediate Education	29	19	92
University	11	8	100
Total	152	100	100

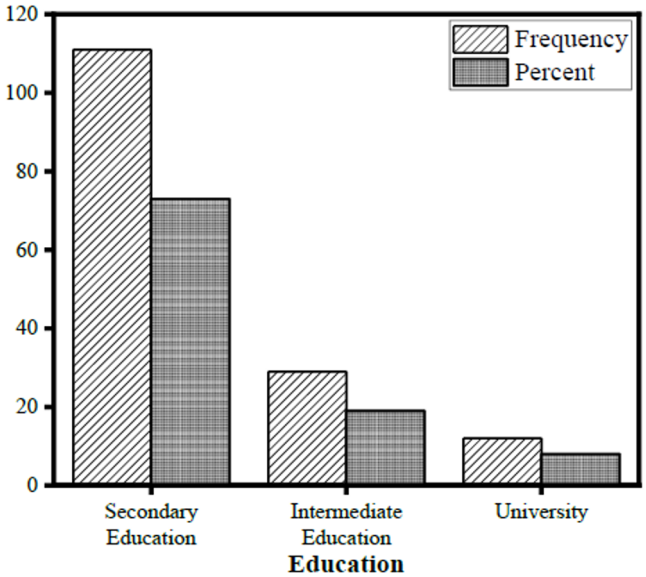

Fig. 4: Demographic variable - Education

Cronbach alpha, used to confirm the reliability, was found between 0.821 and 0.796, ensuring the data's reliability. Table 4 presents the maximum, minimum, and mean of the variables taken for this research, i.e., productivity and quality. N is the frequency representing the number of responses received and used for this analysis. The values in the Table 4 show a good correlation.

Table 4: Results of Descriptive Analysis

Variables	N	Minimum	Maximum	Mean
Productivity	152	4.7	7	5.85
Quality	152	3.9	7	5.45

3.2 Pearson correlation analysis:

The relationship between the independent variable (5S) and dependent variables (productivity and quality) is presented in Table 5, and it can be observed that 5S has a strong positive Pearson correlation (0.73) with a significance of 0.023 with productivity and moderately (0.46) with a significance of 0.031 with quality.

Table 5: Pearson Correlation Data

Independent variable (5S level)			
Dependent variables	**Pearson Correlation**	**σ (two-tailed)**	**N**
Productivity	0.73**	0.023	152
Quality	0.46**	0.031	152
**p=5%			

3.3 Multiple Regression Analysis

Table 6 presents the results of multiple regression analysis to ascertain the relationship between independent and dependent variables. As seen in Table 6, the results support the strong relationship between 5S and productivity and quality at a 5% confidence level.

Table 6: Multiple regression analysis of the relationship between 5S (independent variable) and dependent variables (productivity and quality)

Independent variable	**Dependent variables**	
(5S)	**Productivity**	**Quality**
R	0.411**	0.291**
R2	0.168	0.084
Adj.R2	0.16	0.42
Std. Error of Estimate	1.529	1.529
F-change	9.423	8.326
**p=5%		

4 Conclusion:

This research presents the results of empirical research from an Indo-Japanese joint venture, auto-ancillary, situated in Delhi-NCR. The empirical investigations are few and far between. The novelty of this study is that it is the first research of its kind for this type of company and in this geographical area and fills up the research gap. This research started with the theoretical modeling for the effect of 5S on quality and productivity, and two hypotheses were formulated, which were intended to be tested. Both hypotheses were found to have a significant correlation at a 5% confidence level, which aligns with the other investigations [27,28,79,87]. Further research needs to be carried out with more companies of this type in Delhi-NCR and at different geographic locations in India.

References

1. FJ. Krafick , Sloan Manage Rev 1988; 30:41–52.
2. M. Holweg, J Oper Manag 2007; 25:420–37.
3. L. Wilson L. HOW TO IMPLEMENT LEAN MANUFACTURING. vol. 148. Mcgraw-Hill, NewYark; 2010.
4. T. Osada, The 5S's: five keys to a total quality environment, Asian Product Organ 1991.
5. M. Imai M. GEMBA KAIZEN: A common Sense, low cost Approch to Management. 1997.
6. S.K. Ho, S. Cicmil, C. K. Fung,. Train Qual 1995; 3:19–24.
7. J. Bicheno, M. Holweg, The Lean Toolbox, 5th edition. A handbook for lean transformation. Dismantling relational contracting at Nissan View project Build-to-order View project. 2016.
8. J Michalska, D Szewieczek, J Achiev Mater Manuf Eng 2007; 24:211–4.
9. P.M.Sánchez , C.M.Rodriguez , U.Maruyama , F.Salazar. Impact of 5S on quality, productivity and organizational climate - Two Analysis Cases. Proc 2015 Int Conf Oper Excell Serv Eng 2015:748–55.
10. K. Kumar, IJMIE,2(6), 2012;402–16.
11. S.H. Zala, A.V. Gohil , K.G. Dave, V.B. Patel, Mater Today Proc 2020; 33:4501–8.
12. V. Bharambe, S. Patel, P Moradiya , Multidiscip Int Res J Gujarat Technol Univ 2020; 2:12.
13. M. Mateus, Metodologia de trabalho de projecto: Nova relação entre os saberes escolares e os saberes sociais. EduSer - Rev Educ 2011; 3:3–16. https://doi.org/10.34620/eduser.v3i2.32.
14. Rojasra PM, Qureshi MN. Performance improvement through 5S in small scale industry: a case study. Int J Mod Eng Res 2013; 3:1654–60.
15. Korkut DS, Cakicier N, Erdinler ES, Ulay G, Doğan AM. 5S activities and its application at a sample company. African J Biotechnol 2009; 8:1720–8. https://doi.org/10.4314/ajb.v8i8.60370.
16. Khedkar SB, Thakre RD, Mahantare Y V, Gondne R. Study of Implementing 5S Techniques in Plastic Moulding Industry. Int J Mod Eng Res 2012; 2:3653–6.
17. Becker JE. Implementing 5S: To promote safety & housekeeping. Prof Saf 2001; 46:29.

18. Saad Shaikh P, Alam AN, Ahmed KN, Ishtiyak S, Hasan SZ. Review of 5S Technique. Int J Sci Eng Technol Res 2015; 4:4.
19. Albarico AJA, Aringalan APB, Lirag AL, ... Extent of 5S Implementation At Batelec Ii–Area 3: Inputs To Its Office Management Program. … Account J 2016; 1:26–41.
20. Dilek AG rel. A conceptual evaluation of 5S model in hotels. African J Bus Manag 2013; 7:3035–42. https://doi.org/10.5897/ajbm2013.7098.
21. Ishijima H, Eliakimu E, Mshana JMH. The "5S" approach to improve a working environment can reduce waiting time: Findings from hospitals in Northern Tanzania. TQM J 2016; 28:664–80. https://doi.org/10.1108/TQM-11-2014-0099.
22. Zeferino ACS, de Souza Ramos JR, Santos AB, Satolo EG, Neto OB, Bourguignon SC. Kaizen Implementation, 2022, p. 20–40. https://doi.org/10.4018/978-1-6684-5185-4.ch002.
23. Islam MS, Samad M, Islam T. Implement Kaizen Tool 5S to Improve Workplace Condition and Pave Way for Lean Management at a Selected Pharmaceutical Factory. Int Conf Eng Res Educ 2019:1–6.
24. Warwood SJ, Knowles G. An investigation into Japanese 5-S practice in UK industry. TQM Mag 2004; 16:347–53. https://doi.org/10.1108/09544780410551287.
25. Diaz-garay B, Teresa Noriega Aranibar M. Benefits of Applying the 5S Model To Industrial Companies in Peru 1. Proc Conf Int Conf 2020:1–8.
26. Katare S, Yadav TK. Implementation of Lean Manufacturing Tool 5S To Improve Productivity in Btirt Campus. Int J Eng Appl Sci Technol 2019; 04:55–62. https://doi.org/10.33564/ijeast.2019.v04i04.009.
27. Yoshifumi H, Sammogram S, Manzuma-Nd NM. Effect of Productivity and Perceived Quality on Organizational Performance from Lean Management Practice Perspective. Res J Bus Manag 2017; 12:1–9. https://doi.org/10.3923/rjbm.2018.1.9.
28. Ezzeddine R, Aoun M. The effect of 5S on Employee Performance: An Empirical Study among Lebanese Hospitals. Int Bus Account Res J 2020; 4:44. https://doi.org/10.15294/ibarj.v4i1.119.
29. Ho SK, Cicmil S. Introduction: what is the 5-S? The 5-S in detail. Japanese 5-S Pract 1996; 8:45–53.
30. Dobi S. The KAIZEN and the Productivity. 5th Int. Conf. Manag. Enterp. Benchmarking June 1-2, 2007, Budapest, Hungary, 2007.
31. Ghodrati A, Zulkifli N. The Impact of 5S Implementation on industrial organizations' performance. Int J Bus Manag Invent 2013; 2:43–9.
32. Reza A, Swarna SS, Aktar R, Rashid KM, Dola DR, Tasnim L, et al. Kaizen in Improving the Productivity of Garment Sewing 2023. https://doi.org/10.19044/esipreprint.5.2023.p401.
33. Shehzad Hanif M, Batool F, Yaseen H, Professor A. Effectiveness of Implementation of Kaizen 5S and its Impact on Industry Performance, Original Article. vol. 2. 2023.
34. Implementation of Kaizen on a Basic Shorts Manufacturing to Reduce Cost and Accelerate Productivity. Aust J Eng Innov Technol 2023:26–34. https://doi.org/10.34104/ajeit.023.026034.
35. Rouf MA, Debnath SC, Haque ME, Chowdhury ZMR, Hasan DMM, Zannat T, et al. Quality of hospital services in 5S-KAIZEN-TQM implemented secondary level hospital: a cross-sectional study. Asian J Med Biol Res 2017; 3:335–40. https://doi.org/10.3329/ajmbr.v3i3.34522.

36. Androniceanu A, Enache IC, Valter EN, Raduica FF. Increasing Energy Efficiency Based on the Kaizen Approach. Energies 2023;16. https://doi.org/10.3390/en16041930.
37. Gapp R, Fisher R, Kobayashi K. Implementing 5S within a Japanese context: An integrated management system. Manag Decis 2008; 46:565–79. https://doi.org/10.1108/00251740810865067.
38. Tortorella GL, Vergara LGL, Ferreira EP. Lean manufacturing implementation: an assessment method with regards to socio-technical and ergonomics practices adoption. Int J Adv Manuf Technol 2017; 89:3407–18. https://doi.org/10.1007/s00170-016-9227-7.
39. Kamińska B. Kaizen as a Method of Management Improvement in Small Production Companies. Przedsiebiorczosc i Zarz 2015; 16:157–70. https://doi.org/10.1515/eam-2015-0024.
40. Kumar MR, Sankaran S. Indian culture and the culture for TQM: A comparison. TQM Mag 2007; 19:176–88. https://doi.org/10.1108/09544780710730014.
41. Yamamoto Y, Bellgran M. Fundamental mindset that drives improvements towards lean production. Assem Autom 2010; 30:124–30. https://doi.org/10.1108/01445151011029754.
42. Suárez Barraza MF, Rodríguez González FG, Miguel Dávila JA. Introduction to the special issue on Kaizen: an ancient operation innovation strategy for organizations of the XXI century. TQM J 2018; 30:250–4. https://doi.org/10.1108/TQM-06-2018-180.
43. Farris JA, Van Aken EM, Doolen TL, Worley J. Learning from less successful kaizen events: A case study. EMJ - Eng Manag J 2008; 20:10–20. https://doi.org/10.1080/10429247.2008.11431772.
44. Higuchi Y, Nam VH, Sonobe T. Sustained impacts of Kaizen training. J Econ Behav Organ 2015; 120:189–206. https://doi.org/10.1016/j.jebo.2015.10.009.
45. Kiran DR. Kaizen and continuous improvement. Work Organ Methods Eng Product 2020:155–61. https://doi.org/10.1016/b978-0-12-819956-5.00011-x.
46. Raid A. Al-Aomar. Applying 5S Lean Technology: An Infrastructure for Continuous Process Improvement. Int Sch Sci Res Innov 2011; 5:2645–50.
47. Chakravorty SS. Six Sigma programs: An implementation model. Int J Prod Econ 2009; 119:1–16. https://doi.org/10.1016/j.ijpe.2009.01.003.
48. Sharma A, Chouhan A, Pavithran L, Chadha U, Selvaraj SK. Implementation of LSS framework in automotive component manufacturing: A review, current scenario and future directions. Mater Today Proc 2021; 46:7815–24. https://doi.org/10.1016/j.matpr.2021.02.374.
49. Zhang Q, Irfan M, Aamir M, Khattak O, Zhu X, Hassan M. INTERDISCIPLINARY JOURNAL OF CONTEMPORARY RESEARCH IN BUSINESS Lean Six Sigma: A Literature Review. 2012.
50. Nunes IL. Integration of Ergonomics and Lean Six Sigma. A Model Proposal. Procedia Manuf 2015; 3:890–7. https://doi.org/10.1016/j.promfg.2015.07.124.
51. Shaqour EN. The impact of adopting lean construction in Egypt: Level of knowledge, application, and benefits. Ain Shams Eng J 2021. https://doi.org/10.1016/j.asej.2021.07.005.
52. Malviya R. Agile manufacturing. Lean Tools Appar Manuf 2021:399–421. https://doi.org/10.1016/B978-0-12-819426-3.00011-4.

53. Jana P, Tiwari M. Lean management in apparel manufacturing. Lean Tools Appar Manuf 2021:1–16. https://doi.org/10.1016/B978-0-12-819426-3.00014-X.
54. Mohan Prasad M, Dhiyaneswari JM, Ridzwanul Jamaan J, Mythreyan S, Sutharsan SM. A framework for lean manufacturing implementation in Indian textile industry. Mater Today Proc 2020; 33:2986–95. https://doi.org/10.1016/j.matpr.2020.02.979.
55. Ahmad N, Hossen J, Ali SM. Improvement of overall equipment efficiency of ring frame through total productive maintenance: a textile case. Int J Adv Manuf Technol 2018; 94:239–56. https://doi.org/10.1007/s00170-017-0783-2.
56. Ranjith Kumar R, Ganesh LS, Rajendran C. An entropy based approach to 5S maturity. Mater Today Proc 2021; 46:8103–10. https://doi.org/10.1016/j.matpr.2021.03.048.
57. Xu CJ. Research on implementation plan of 5S management. Appl Mech Mater 2013;380–384:4440–3. https://doi.org/10.4028/www.scientific.net/AMM.380-384.4440.
58. Bahadorpoor Z, Tajafari M, Sanatjoo A. Implementation of 5S Methodology in Public Libraries: Readiness Assessment. 2018.
59. Biranvand A, Ghaffari S, Haghirosadat SJ. Analyzing the effect of delighting services on the loyalty of public library users: A case study. Libr Philos Pract 2019;2019.
60. Singh Sidhu B, Kumar V, Bajaj A. The "5S" Strategy by Using PDCA Cycle for Continuous Improvement of the Manufacturing Processes in Agriculture Industry. Int J Res Ind Eng J Homepage 2013; 2:10–23.
61. Sousa P, Tereso A, Alves A, Gomes L. Implementation of project management and lean production practices in a SME Portuguese innovation company. Procedia Comput Sci 2018; 138:867–74. https://doi.org/10.1016/j.procs.2018.10.113.
62. Pinto L, Nunes E, Sousa S. A framework to improve training and development of workers' technical skills: Effects on operational performance during company relocation. Procedia Manuf 2020; 51:1806–13. https://doi.org/10.1016/j.promfg.2020.10.251.
63. HIRANO H. 5S FOR OPERATORS: 5 pillars of the visual workplace. 1996.
64. Hirano H. 5 Pillars of the Visual Workplace. 1995. https://doi.org/10.4324/9781482278057.
65. Chin KS, Pun KF. A proposed framework for implementing TQM in Chinese organizations. Int J Qual Reliab Manag 2002; 19:272–94. https://doi.org/10.1108/02656710210415686.
66. Khanna VK. 5 "s" and TQM status in Indian organizations. TQM J 2009; 21:486–501. https://doi.org/10.1108/17542730910983407.
67. Jiménez M, Romero L, Domínguez M, Espinosa M del M. 5S methodology implementation in the laboratories of an industrial engineering university school. Saf Sci 2015; 78:163–72. https://doi.org/10.1016/j.ssci.2015.04.022.
68. Ghosh M. Lean manufacturing performance in Indian manufacturing plants. J Manuf Technol Manag 2013; 24:113–22. https://doi.org/10.1108/17410381311287517.
69. Randhawa JS, Ahuja IS, Singh Randhawa J, Singh Ahuja I, Randhawa JS, Ahuja IS. 5S implementation methodologies: literature review and directions. vol. 20. 2017. https://doi.org/10.1504/IJPQM.2017.080692.
70. Berger A. Continuous improvement and Kaizen: Standardization and organizational designs. Integr Manuf Syst 1997; 8:110–7. https://doi.org/10.1108/09576069710165792.

71. Brunet AP, New S. Kaizen in Japan: An empirical study. Int J Oper Prod Manag 2003; 23:1426–46. https://doi.org/10.1108/01443570310506704.
72. Styhre A. Kaizen, ethics, and care of the operations: Management after empowerment. J Manag Stud 2001; 38:795–810. https://doi.org/10.1111/1467-6486.00259.
73. Inoki M, Fukazawa Y. Software product line evolution method based on kaizen approach. Proc ACM Symp Appl Comput 2007:1207–14. https://doi.org/10.1145/1244002.1244266.
74. Glover WJ, Doolen TL, Ellis KP, Koelling CP. Critical Success Factors for Sustaining Kaizen Event Outcomes. 2010.
75. García CJ, Dueñas RM, Tanco RM, Diez EV, García JS. Sostenibilidad de los sistemas de mejora continua en la industria: Encuesta en la Comunidad Autónoma Vasca y Navarra. Intang Cap 2010; 6:51–77. https://doi.org/10.3926/ic.2010.v6n1.p51-77.
76. García JL, Rivera DG, Iniesta AA. Critical success factors for Kaizen implementation in manufacturing industries in Mexico. Int J Adv Manuf Technol 2013; 68:537–45. https://doi.org/10.1007/s00170-013-4750-2.
77. Suárez-Barraza MF, Ramis-Pujol J. Implementation of Lean-Kaizen in the human resource service process: A case study in a Mexican public service organisation. J Manuf Technol Manag 2010; 21:388–410. https://doi.org/10.1108/17410381011024359.
78. Lamprea EJH, Carreño ZMC, Sánchez PMTM. Impact of 5s on productivity, quality, organizational climate and industrial safety in caucho metal ltda. Ingeniare 2015;23:107–17. https://doi.org/10.4067/s0718-33052015000100013.
79. Bayo-Moriones A, Bello-Pintado A, de Cerio JMD. 5S use in manufacturing plants: Contextual factors and impact on operating performance. Int J Qual Reliab Manag 2010; 27:217–30. https://doi.org/10.1108/02656711011014320.
80. Garza-Reyes JA, Parkar HS, Oraifige I, Soriano-Meier H, Harmanto D. An empirical-exploratory study of the status of lean manufacturing in India. Int J Bus Excell 2012; 5:395–412. https://doi.org/10.1504/IJBEX.2012.047906.
81. Tikkala S. Master' S Thesis Lean Six Sigma in a Manufacturing Lead Time. Lappeenranta Univ Technol 2014.
82. Keitany P, Riwo-Abudho. EFFECTS OF LEAN PRODUCTION ON ORGANIZATIONAL PERFORMANCE: A CASE STUDY OF FLOUR PRODUCING COMPANY IN KENYA. vol. 2. 2014.
83. Bums JS. Chaos Theory and Leadership Studies: Exploring Uncharted Seas. J Leadersh Organ Stud 2002; 9:42–56. https://doi.org/10.1177/107179190200900204.
84. Juran JM. JURAN'S QUALITY HANDBOOK. 1990.
85. Shewfelt RL. What is quality? Postharvest Biol Technol 1999; 15:197–200. https://doi.org/10.1016/S0925-5214(98)00084-2.
86. Syverson C. What determines productivity. J Econ Lit 2011; 49:326–65. https://doi.org/10.1257/jel.49.2.326.
87. Sánchez PM, Ballesteros NR, Olaya DF. Impact of 5S on productivity, quality, organizational climate and IS at tecniaguas S.A.S. Lect Notes Eng Comput Sci 2014;3:247–55. https://doi.org/10.1007/978-3-319-14078-0_28.