



A Review on Kaizen Implementation in North Indian Manufacturing Industries

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ABSTRACT

In a competitive environment, lean manufacturing is one of the important factors in every industry. This lean manufacturing system is known as the Toyota production system. Kaizen is one of the lean manufacturing techniques which means "continuous improvement". This technique can be used at any place like home, industry, etc. Its small improvements which lead us to get maximum output. It is a zero investment or minimum investment tool. The approach of the research includes a literature review about lean manufacturing techniques specially kaizen. This tool can be used in various manufacturing industries. It was concluded that the Implementation of kaizen is useful in eliminating MURA, 3M-MUDA, and MURI which means inconsistency, inconvenience, and wastage. There are some hardware and software enablers for Kaizen. Hardware enablers include policies, essential rules and institutional management. Software enablers include training, incentives etc. Proper implementation of kaizen can improve quality reduce complaints etc.

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1. INTRODUCTION

The recognized main factor for the growth of the economy is manufacturing. With Globalization, increasing competition, and expanding the market, greater demands of customers are being placed on the manufacturer to reduce the cost and improve the quality of the product. At present, the major issue is regarding the on-time delivery of products and an increase in the variety of products. Manufacturing always focuses on embracing changes and improving key

activities to deal with the challenges. Being more efficient is one of the ways to stay in the competitive market [1, 2]. Lean manufacturing or lean production is a systematic method originating in the Japanese manufacturing industry for the minimization of waste within a manufacturing system without having any compromises in productivity.

1.1 Kaizen

It is a Japanese word that has two parts i.e. "kai" and "zen". "Kai" stands for "change" and "zen"

stands for “good” and together they make “kaizen” which stands for “change for the good”. Kaizen, in other words, can be said as continuous improvement. It is a process or concept referring to business activities which improve all functions continuously and involve each and every single employee from the CEO to workers. Kaizen aims to eliminate waste and increase quality [3].

The philosophy of Kaizen says that whatever we do can continuously be improved whether it is the home or any workplace. As a business philosophy, Kaizen is an approach which motivates people for the continuous improvement in the surrounding. Under kaizen, imperfections are searched by the workers and small changes are made in order to correct them as part of their routine work. And these small changes and steps over a long-time lead to a significant ongoing improvement. It is considered mostly to be applied in the manufacturing processes only [4, 5].

Traditional Western business practices are being used in the industries from centuries. Kaizen has the capability to challenge some of the practices and also provide a different philosophy or approach to the business organization. Kaizen is a tool which helps in eliminating the other three Japanese policies namely MURA, 3M-MUDA, and MURI which means inconsistency, inconvenience, and wastage [6, 7].



Fig. 1. Pan-Do-Check-Act [7].

Kaizen is used in two cycles. One is PDCA (Plan-Do-Check-Act) (Fig. 1), which is the first step in Kaizen. In this cycle the target for improvement is established, then the established plan is implemented, then inspection of the implemented plan is done according to the guidelines, then new standardised procedures

are performed. The other is SDCA (Standardise-Do-Check-Act) which is followed to stabilize an existing process before starting work on PDCA cycle. The SDCA cycle is used on the existing product where as PDCA is used for the development of new product. SDCA deals with the maintenance and PDCA deals with the improvement [3].

1.2 Functions of Kaizen

Two functions related to the Kaizen in Japan are distinguished below [8]:

- The maintenance of the existing condition depending on the operations related to complying with the current standard of management and technology.
- The improvement of existing condition-kaizen, being the function playing the main role while the procedures and instructions are strictly implemented.

1.3 Difference between Kaizen and Innovation?

Kaizen gives more importance to continuous improvement as compared to innovation, which is a one-time improvement. Its philosophy implies that anything can be improved continuously, whether it is home or any workplace. The Fig. 2 shows how kaizen attains high-performance levels at minimum or no costs, which opposes innovation. Innovation requires high investment and is a short-term process [9-11].

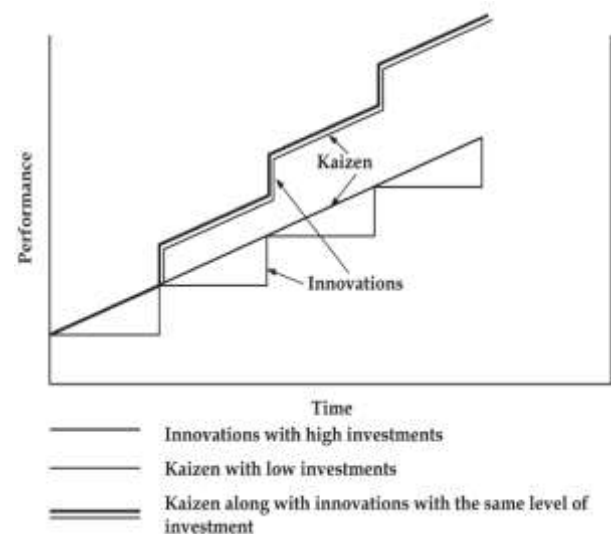


Fig. 2. Kaizen Vs Innovation [4].

2. LITERATURE REVIEW

Saleem et al. [3] studied a relationship between Total Quality Management and Kaizen. Both the tools deal with continuous improvement of process, management, the performance of the organization, and action of employees to achieve goals. For better understanding, TQM and Kaizen should be differentiated. The TQM feature is to satisfy the customer by improvement in quality. TQM is bottom bottom-up and top-down approach whereas Kaizen is a bottom-up approach and a focused process with small changes. Improvements are made by the available resources of an organization in Kaizen. Continuous improvement results should be conveyed to every employee for the success of improvement programs in the organization and the culture must be supportive of the effective implementation of Kaizen. The main focus is on the difference between TQM and Kaizen. Various tools and techniques under TQM and Kaizen were discussed. It was concluded that the Kaizen is the part of TQM of continuous improvement of performance, process, and quality of the organization. Both tools are of continuous improvement and can be compared. The implementation of the TQM technique is costlier than implementing Kaizen.

Singh and Diwalar [4] used the concept of 5S and Kaizen in the manufacturing industry to maximize its productivity by giving the best quality to the customers. Every manufacturer wants a good quality of products with minimum cost. It was observed that after implementation, the tools were seen at the proper position, and employees could easily find the required tool for machining which ultimately reduces the time. This further resulted in smooth and proper working. It was concluded that 5S and Kaizen can increase the efficiency of the employee and this increase in efficiency will increase industry output.

Srinivasan and Shah [7] reviewed the Kaizen and lean implementation in pharmaceutical industries. Basically, Kaizen is the word used in every industry and has been implemented in organization around the world. This process brings improvement that are incremental and small. The organizations which have implemented this technique have increased the efficiency of their supply chains, employee

morale and safety. Various pharmaceutical industries like Dr. Reddy, Piramal health-care, Glaxo smith Kline and Merk which implemented Kaizen were studied and the results were noted. For them it is very difficult to manage huge waste generations and errors which occurs while manufacturing. So, in order to reduce these, Kaizen was implemented. It was concluded that customer complaints, batch failures, regulatory pressure and waste got reduced after implementing Kaizen.

Jacubiec and Brodnicka [9] concerned the continuous improvement Kaizen process in quality improvement in the company. The elimination of waste and continuous improvement was analysed by the implementation of Kaizen. The study took part in two stages theoretical and cognitive. The cognitive part concerned with the implementation of kaizen in the automotive sector. It was concluded that Kaizen is a step by step method and it is the best method for regular day to day improvements. Low cost with maximum productivity can be achieved. It does not include any expensive investment but includes the efforts of each and every employee to reach the set goals. Also, Employees moral gets increased and individual skills are improved by implementing Kaizen.

Knechtges and Decker [11] stated that Kaizen can be very helpful in continuous quality improvement for a radiology department. Kaizen adds a human element with which every employee of the industry is involved in change. The changes involved are of small size in focus on human factors and management. It was concluded that these changes result in better quality. The Kaizen tool can-not be implemented on all types of quality improvement projects. Kaizen is most effective if applied to well defined and small components of the problem. PDCA cycle is important to be performed to sustain and monitor the change after implementing Kaizen.

Kumar [12] discussed the problems which are faced by an automobile manufacturing organization on the quality of interior parts mainly plastic and rubber. The technique used is "Global Customer Audit" which is a vehicle audit for interior parts. During the audit, different quality control tools were used to observe various defects. Check-sheets, Paetro-charts, and

Histograms were used in removing or eliminating the defects and also improved the production process and products. It was concluded that Kaizen helped in making the process simple, leaner, and fitter. Permanent solutions were suggested to the regular problems which increased the quality and profits. Kaizen solved the problems very effectively and the industry achieved new levels of profits.

Bellgran et al. [13] demonstrated the implementation of Green-Kaizen in a pharmaceutical manufacturing company to engage the operators or workers and the management in the improvement of the shop floor. The method involved the input-output visualization, identification of improvement, and a cost-saving approach. It was concluded that the improvement can be done by changing operations behaviour in production or manufacturing content. The environmental improvement in production can successfully be done by using green cost savings at the shop floor level and as well as at the management level.

Kumar et al. [14] investigated the opportunities for reduction in cost and improvement of quality and productivity in the present production system by applying the Lean-Kaizen concept using the Value Stream Mapping (VSM) tool at the workplace of a Small-Scale Enterprises (SSE). A map was made from the collected data. The current state map was modified after the Analysis for the development of a future state map. The identification of the gap area was done by comparing the future and current state map and also the calculation of takt time (TT) was considered. Kaizen was implemented or proposed to eliminate or overcome the gap. Technology for preference by the similarity of idea solution was used to select the exact Kaizen event for optimizing performance level. It was concluded that the Lean-Kaizen with the VSM-fuzzy technique was found to be more effective which assists in the elimination of waste in the organization and also motivated individuals to achieve the set goals of an organization.

Chan and Tay [15] highlights the lessons learnt in a printing company by implementing two Kaizens events for improvement. They also suggested that "in order to improve productivity the lean tools can be organised in a proper manner through Kaizen implementation. This Kaizen

event was conducted in order to meet the set targets. Basically, three specific tools used in Kaizen event i.e. standardized work, line balancing and standardized layout were studied. It was found that 10-30 percent improvement were observed by the mixed lean tools in the assembly area of printing factory. It was concluded that set of lean tools such as standardized work, line balancing and standardized layout can be used together to improve productivity. These results can be easily used to other assembly lines as well as which are similar to printing industry. It was further concluded that the proper implementation of Kaizen can bring about quality improvement, productivity advancement and reduction in cycle time.

Ma et al. [16] studied the role and linkage of quality check cycles and shop floor management in Kaizen. The questionnaire was filled up by 371 suspects in 9 different Sino-Japanese Automotive Joint ventures. The canonical correlation approach was used to analyze the collected data. It was indicated that all shop floor management tools could not help to identify improvement. Large problems can be effectively addressed by QCC. It was concluded that the implementation of the shop floor management tools should be a continuous and regular basis for the elimination of waste and reduction in variation. The employees should be motivated with more efforts for their participation in other improvement approaches because the QCC does not have the ability to promote individual learning.

Kumar et al. [17] implemented Lean- Kaizen on ten small scale fastener manufacturers to improve the quality system by DEA CCR Data Envelopment Analysis Charnes Cooper and Rhodes with constant returns to scale (CRS). The data was collected for three inputs (manpower, training of employees and maintenance) and two outputs (on-time delivery and quality) of their system. DEA CCR model was applied and used to identify scores of quality. To identify waste and non-value-added activities lean Kaizen approach was applied. Kaizen events were performed four times for the elimination of non-value-added activities and waste. The data were analysed by the DEA CCR model. The result was very effective as two fastener industries became 100% efficient and others improved in a range of 8-49% in the efficiency scores. The use of DEA with Lean-

Kaizen can be an effective approach for the improvement of the quality system. Also, Lean-Kaizen can be used to handle the inefficiencies in the organization. Benchmark can also be set to find new changes and improvements required by the organization. Kaizen is the tool that can easily measure the quality of industries, the performance of production, and maintenance producing a variety of products.

Patel and Patange [18] reviewed the benefits of implementing lean manufacturing. For and industry to survive in the competitive market continuous improvement in process is needed. To achieve this perfection value-adding process is compulsory and to sustain the organization must be implemented with a lean manufacturing system. Making a process efficient by increasing profit and elimination of several types of waste is possible by implementing lean manufacturing. The conclusion was, implementation of lean manufacturing can reduce waste, process improvement, reducing lead time for improving the supplier-customer relationship, and continuous improvement. Lean manufacturing is of various types that can be used for improving the performance and for an organization to stay or remain in this emerging market it's necessary.

Al Smadi [19] concluded that the Kaizen techniques or strategy is a major factor in the success of Japanese Business. Many companies implemented this strategy in their workplaces and got the best results in cost-saving and improved competitiveness. The best thing about kaizen is "there is a room for improvement always". In this competitive world, the Kaizen can put the organization one step ahead of others. The whole committee is required to implement this tool. Managers should Co-operate with the workers to have the proper benefits of this strategy.

Tiwari [20] aimed at challenges in implementation of kaizen in micro and small enterprises. To collect data researcher used both primary and secondary sources. Research design of concurrent triangulation with mixed approach was used by researcher. The data was collected in the form questionnaires, interviews and document review. Various analysis tests were used to analyse the collected data. It was concluded that Kaizen is not effective support in enterprises due to lack of training, trainer skills

and the poor systems. And on the other hand, it was also concluded that Kaizen implementation results in reduction of overproduction waiting, over processing and defects. Several benefits were observed including better space utilization, on-time delivery, increased customer satisfaction, safety and improved product quality. Due to various issues like management commitment, lack of skilled human resources, lack facilities etc. there occurs a problem of sustainability. In order to maintain this, benefits of overcoming the challenges should be improved.

Oropesa Vento et al. [21] analysed the effect of the professional development and managerial commitment of human resources on the benefits obtained at the planning stage on implementation kaizen in Mexican maquiladora companies. A questionnaire-based survey was done and 423 workers filled it. The results showed that managerial commitment has a positive impact on human resources and economic benefits. Variables concerning activities at the planning stage and variables involving benefits obtained by companies were studied. During the planning stage, the manager and adequate training of employees play an important role in the implementation of Kaizen. Benefits for human resources have the highest effect on economic benefits. The employees should be satisfied to provide more profit to industries.

Ma et al. [22] studied the benefits of implementing three Japanese improvement methods i.e. Kaikaku, Kaizen and Kaizen blitz etc. and also identified the key enablers for these methods. A process named Fuzzy Analytic hierarchy process was used to compare these methods. These methods were implemented in 28 Sino-Japanese joint ventures. It was concluded that the personnel factor enablers play an important role as one of the desired factors of kaizen, the second factor is whilst software enabler (training, incentives, shop floor management, improvement system and culture) and the third one is hardware factor (policies and essential rules). It was also concluded that kaizen is the best and appropriate method form all the three methods which supports long-term process improvement.

Maarof and Mahmud [23] reviewed regarding the challenges in implementation of kaizen. Small and medium enterprises contribute to the Malaysian economy and it's essential for them to stay in the competitiveness of Business. To improve this the kaizen strategy can be used. Some factors which successfully contribute to the implementation of kaizen and its challenges were reviewed. The factors clear corporate strategy, employee's improvement, good communication between top management and their workers, management with good knowledge, and an individual presence in an organization related to Kaizen were found very contributing in the successfully implementing Kaizen. The review concluded some challenges in the implementation of Kaizen and they were failure to motivate employees, resistance to change, lack of understanding, and difficulty in the management of continuous improvement. Small and Medium Enterprises (SME) have some similarities between them whereas Large Enterprises differ in contributing factors to kaizen. The organization challenges due to lack of motivation among employees because of the poor reward system, the resistance to changes and lack of ability to continuous improvement by itself. Early identification of the challenges and factors can help SME's to become aware about their weaknesses and capabilities.

Akter et al. [24] used the Lean-Kaizen in order to increase efficiency and productivity in a sewing floor through process standardization system simplification, incremental improvements, and reducing waste. Kaizen is considered as a building block of all the lean production methods or techniques. The line efficiency increased by 7% and defects also got decreased. Kaizen attempts to increase worker satisfaction, empower the workers, creates pride of work, and facilitates a sense of accomplishment. It eliminates waste and makes the manufacturing process fitter and leaner. Worker safety increased after implementing Kaizen. It was observed that the changes were done for production flow, machine tool arrangement, work environment, and labour skills. The highest profit levels were achieved by a Bangladeshi garment industry after implementing Kaizen and also Kaizen involved very little or an investment.

Dandin and Mench [25] implemented the lean manufacturing techniques in automotive

industry kaizen was used for continuous improvement in an automobile manufacturing firm. The study is about reducing the cycle time of a manual assembly line for only the first two stations. The four variants of the light commercial vehicle were manufactured at XYZ firm. to compete in the market lean manufacturing technique help the manufacturing firm. Kaizen is a gradual step towards making a work setting highly beneficial and boosts the productivity of the firm. It was concluded that usage of fastener tray by every operator and introduction of two kitting trolleys reduced the cycle time of required two stations for developing of four variants of vehicles. Elimination of metal to metal contact was successful for various parts. Enhancement of the operator's knowledge for all the four variants is the application of photographs of various parts with a certain number on kitting trolley.

Vieira et al. [26] presented a reflection of an automotive industry having a lean manufacturing system. In this, the positive and negative points of the methodology named "Kaizen" (continuous improvement) in relation to ergonomics are presented. Kaizen is used for continuous improvement and improving the working conditions of the workplace. Various interviews were conducted with workers and in loco to collect data. By applying this methodology, the company's results in better product quality, accidents, and level of absenteeism are less. It was found that the companies are concerned with the continuous improvement of the working accidents for workers. The company's accident rates were calculated and they were less as compared to earlier one. The performance level of the company produces more at low cost and fewer resources. The level of absenteeism dropped drastically as many activities were organized. Even workers used this methodology to improve their own jobs.

Smith et al. [27] examined the effect of applying lean principles and kaizen strategy in public health practice. The agency followed a lean kaizen strategy for the improvement in time scheduling for home health nurses which resulted in less operational cost, multiple organizational efficiencies, and improved working conditions. The results were very frequent. It resulted in increasing staff morale, faxing time, paperwork and expenses were reduced. Nurses gained more time to spend with

patients which increase in recovery of the patients. It was concluded that lean approaches helped the health care organizations to achieve their goals. It suggested that lean improvement methods are an effective approach for health agencies to optimize their existing resources.

Visuwan [28] carried out a pattern of investment involved in Kaizen to increase the overall profit. The Steepest Ascent Approach which is an optimization technique is employed to improve the experimental variables. The variables were time, the amount to decrease the rate of investment, the quantity of spending on appraisal and prevention activities which results in maximum profits of (Net present value). The model used was the simulation model which is based on the Thai Automobile Manufacturing industry. The conclusion was that the Kaizen investment is reduced economically if the process is controlled. Greater overall profit in a 'Stepwise Kaizen' is observed as compared to the constant spending. A 100% conformance economically was found along with time scale and also provides greater profits than the constant investment in Kaizen. The defects cannot be detected by constant investment in an early phase and it exceeds the economic level.

Karkoszka and Honorowiaz [29] focused on motivating and boosting the authority for implementing the kaizen system. This system can be applied to any type of organization that manages the area of improvement selecting the problem, improvement, planning for implementation, implementation of the idea, analysing, and comparing the results. The continuous improvement is the concept of TQM philosophies which states that increasing productivity with any change in the quality of the product. Kaizen is a kind of management and thinking which is used in companies as well as in the daily life of people of Japan. Usage of this strategy by each and every worker of the company can make the company the most modern and the best around the world. It concluded that the kaizen should have proceeded without any additional investment. Also, the proper involvement of each and every employee of the company can improve the workplace as well as the production process.

Wong et al. [30] investigated the adoption of lean manufacturing principles for an electrical and

electronics industry situated in Malaysia. A questionnaire-based survey was done to take a look at 14 key points of lean manufacturing and they were inventory, scheduling layout, quality, material handling, customers, supplier's safety and ergonomics, management and culture, product design, work process, equipment, techniques, and tools. The implementation of each area was rated by the suspects. The analysis was done on the calculated average mean score. It was concluded that many industries are committed to implement Lean manufacturing principle and most of the industries were 'moderate to extensive on Large-Scale' implementers. It increased and improved productivity and reduce costs. The surveyed have points have resulted in a significant relationship with success.

Lyu [31] stated that for improvement in performance of manufacturer Automation and Kaizen are the only approaches. To reengineer a manufacturing process Kaizen and automation are integrated. The study concluded that during the process of redesigning, the important step is to introduce or include animated simulation model. With streamlined manufacturing process almost 50% improvement in productivity can be done. Human factors should be considered carefully while redesigning because it can improve productivity and quality of product. In process, redesigning improvement performance can be very important.

3. CONCLUSION

It can be concluded that there is huge amount of literature available on Kaizen, which gives us a broad view of different past researches done across the competitive world. As Kaizen is widely accepted in manufacturing industries, it requires more researches to be done. The researchers felt that Kaizen can be applied to various areas like home, business, industries etc. Implementation of kaizen is useful in eliminating MURA, 3M-MUDA, and MURI which means inconsistency, inconvenience, and wastage. It also improves the supplier-customer relationship and on-time delivery. Adding that, kaizen can also be used with other strategies like TQM, TPM, JIT, and 5S for implementing performance and to exist in a competitive market. Various software and hardware enabler's effects Kaizen and Top management is one of them. Awareness among

employee is one the major factor involved in Kaizen. So, more research is required which could improve this and helps the top management to implement Kaizen in the particular industries. Further adding, future studies can be done to investigate that which type of industries are applicable for this tool. And also, research can be done on finding barriers of implementing Kaizen

REFERENCES

- [1] S. S. Sidhu, K. Singh, and I. S. Ahuja, "Ranking of implementation dimensions for maintenance practices in Northern Indian SMEs using integrated AHP-TOPSIS approach," *Journal of Small Business and Entrepreneurship*, vol. 34, no. 2, pp. 175-194, 2020, doi: 10.1080/08276331.2020.1809220.
- [2] Y. Umeda, J. Ota, S. Shirafuji, F. Kojima, M. Saito, H. Matsuzawa, T. Sukekawa, "Exercise of digital kaizen activities based on 'digital triplet' concept," *Procedia Manufacturing*, vol. 45, pp. 325-330, 2020, doi: 10.1016/j.promfg.2020.04.025.
- [3] M. Saleem, N. Khan, S. Hameed, and M. A. Ch, "An Analysis of Relationship between Total Quality Management and Kaizen", *Life Sciences Journal*, vol. 9, no. 3, pp. 31-40, 2012.
- [4] A. Singh and H. S. Diwalar, "Implementation of 5S and Kaizen concepts in medium scale metal working industry", *International Journal of Innovative Science and Research Technology*, Vol. 2, no. 5, pp. 204-206, 2017.
- [5] X. Zhu and Y. Lin, "Does lean manufacturing improve firm value?," *Journal of Manufacturing Technology Management*, vol. 28, no. 4, pp. 422-437, 2017, doi: 10.1108/jmtm-05-2016-0071.
- [6] J. S. Randhawa and I. S. Ahuja, "Examining the role of 5S practices as a facilitator of business excellence in manufacturing organizations," *Measuring Business Excellence*, vol. 21, no. 2, pp. 191-206, 2017, doi: 10.1108/mbe-09-2016-0047.
- [7] G. Srinivasan and N. Shah, "Kaizen and Lean implementation in Pharmaceutical industries: A review", *Asian Journal of Pharmaceutical and Clinical Research*, Vol. 11, no. 7, pp. 58-63, 2018. doi: 10.22159/ajpcr.2018.v11i7.24722.
- [8] B. Singh, S. K. Garg, S. K. Sharma, and C. Grewal, "Lean implementation and its benefits to production industry," *International Journal of Lean Six Sigma*, vol. 1, no. 2, pp. 157-168, 2010, doi: 10.1108/20401461011049520.
- [9] M. Jacubiec and E. Brodnicka, "Kaizen concepts in the process of Quality Improvement in the Company", vol. 1, no. 16, pp. 89-101, 2016.
- [10] K. Singh and I. S. Ahuja, "Effectiveness of TPM implementation with and without integration with TQM in Indian manufacturing industries," *Journal of Quality in Maintenance Engineering*, vol. 20, no. 4, pp. 415-435, 2014, doi: 10.1108/jqme-01-2013-0003.
- [11] P. Knechtges and M. C. Decker, "Application of Kaizen Methodology to Foster Departmental Engagement in Quality Improvement," *Journal of the American College of Radiology*, vol. 11, no. 12, pp. 1126-1130, 2014, doi: 10.1016/j.jacr.2014.08.027.
- [12] R. Kumar, "Kaizen a tool for Continuous Quality Improvement in Indian Manufacturing Organization", *International Journal of Mathematical, Engineering and Management Sciences*, vol. 4, pp. 452-459, 2019, doi: 10.33889/IJMEMS.2019.4.2-037.
- [13] M. Bellgran, M. Kurdve, and R. Hanna, "Cost driven Green Kaizen in pharmaceutical production – Creating positive engagement for environmental improvements," *Procedia CIRP*, vol. 81, pp. 1219-1224, 2019, doi: 10.1016/j.procir.2019.03.297.
- [14] S. Kumar, A. K. Dhingra, and B. Singh, "Kaizen Selection for Continuous Improvement through VSM-Fuzzy-TOPSIS in Small-Scale Enterprises: An Indian Case Study," *Advances in Fuzzy Systems*, pp. 1-10, 2018, doi: 10.1155/2018/2723768.
- [15] C. O. Chan and H. L. Tay, "Combining lean tools application in kaizen: a field study on the printing industry," *International Journal of Productivity and Performance Management*, vol. 67, no. 1, pp. 45-65, 2018, doi: 10.1108/ijppm-09-2016-0197.
- [16] J. Ma, F. Jiao, C. K. Lau, and Z. Lin, "The relationships between shop floor management and QCCs to support Kaizen," *International Journal of Quality and Reliability Management*, vol. 35, no. 9, pp. 1941-1955, 2018, doi: 10.1108/ijqrm-09-2017-0192.
- [17] S. Kumar, A. K. Dhingra, and B. Singh, "Implementation of the Lean-Kaizen approach in fastener industries using the data envelopment analysis," *Facta Universitatis, Series: Mechanical Engineering*, vol. 15, no. 1, pp. 145-161, 2017, doi: 10.22190/fume161228007k.
- [18] J. S. Patel and G. S. Patange, "A review on benefits of Implementing Lean Manufacturing", *International Journal of Scientific Research in*

- Science and Technology, vol. 3, no. 1, pp. 249-252, 2017.
- [19] S. Al Smadi, "Kaizen strategy and the drive for competitiveness: challenges and opportunities," *Competitiveness Review: An International Business Journal*, vol. 19, no. 3, pp. 203-211, 2009, doi: 10.1108/10595420910962070.
- [20] P. Tiwari, "Assessment of the Practices and Challenges of Kaizen Implementation in Micro and Small Enterprises: The Case of Manufacturing Enterprises", *International Journal of Engineering and Management Research*, vol. 7, pp. 313-322, 2017.
- [21] M. Oropesa Vento, J. L. García Alcaraz, A. A. Maldonado Macías, and V. Martínez Loya, "The impact of managerial commitment and Kaizen benefits on companies," *Journal of Manufacturing Technology Management*, vol. 27, no. 5, pp. 692-712, 2016, doi: 10.1108/jmtm-02-2016-0021.
- [22] J. Ma, Z. Lin, and C. K. Lau, "Prioritising the enablers for the successful implementation of Kaizen in China," *International Journal of Quality and Reliability Management*, vol. 34, no. 4, pp. 549-568, 2017, doi: 10.1108/ijqrm-12-2015-0173.
- [23] M. G. Maarof and F. Mahmud, "A Review of Contributing Factors and Challenges in Implementing Kaizen in Small and Medium Enterprises," *Procedia Economics and Finance*, vol. 35, pp. 522-531, 2016, doi: 10.1016/s2212-5671(16)00065-4.
- [24] S. Akhter, F. R. Yasmin and M. A. Ferdous, "Implementation of Kaizen for continuous improvement of productivity in garment industry in Bangladesh", *America Academic and Scholarly Research Journal*, vol.7, no. 3, pp. 229-243, 2015.
- [25] S. V. Dandin and R. G. Mench, "Development and implementation of Kaizen activities in an Automobile manufacturing firm", *International Journal of Innovative Research in Advanced Engineering (IJIRAE)*, Vol.2, pp. 60-65, 2015.
- [26] L. Viera, G. Balbinotti, A. Varasquin, and L. Gontijo, "Ergonomics and Kaizen as strategies for competitiveness: a theoretical and practical in an automotive industry", *Work*, vol. 41, pp.1756-1762, 2012.
- [27] G. Smith, A. Poteat-Godwin, L. M. Harrison, and G. D. Randolph, "Applying Lean Principles and Kaizen Rapid Improvement Events in Public Health Practice," *Journal of Public Health Management and Practice*, vol. 18, no. 1, pp. 52-54, 2012, doi: 10.1097/phh.0b013e31823f57c0.
- [28] D. Visuwan, "Stepwise Kaizen parameters improvement via the path of Steepset Ascent", *Proceeding of the International Multiconference of Engineers and Computer Scientists*, Hong Kong, March 17-19, 2010.
- [29] T. Karkoszka and J. Honorowicz, "Kaizen philosophy a manner of continuous improvement of processes and products", *Journal of Achievements in Materials and Manufacturing Engineering*, vol. 35, no. 2, pp. 197-203, 2009.
- [30] Y. C. Wong, K. Y. Wong, and A. Ali, "A study on Lean Manufacturing Implementation in the Malaysian Electrical and Electronic Industry", *European Journal of Scientific Research*, vol. 38, no. 4, pp. 521-535, 2009.
- [31] J. Lyu, "Applying Kaizen and automation to process reengineering," *Journal of Manufacturing Systems*, vol. 15, no. 2, pp. 125-132, 1996, doi: 10.1016/0278-6125(96)82337-5.