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Article information:

To cite this document:
Amit Kumar Arya, Suraj Choudhary, (2015) "Assessing the application of Kaizen principles in Indian small-scale industry", International Journal of Lean Six Sigma, Vol. 6 Issue: 4, pp.369-396, https://doi.org/10.1108/IJLSS-11-2014-0033
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Assessing the application of Kaizen principles in Indian small-scale industry

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Received 11 November 2014
Revised 1 January 2015
Accepted 17 January 2015

Abstract

Purpose – This study aims to represent Kaizen implementation in a machine vice manufacturing company. Kaizen has shown tremendous impacts on the production techniques and lead times. A large number of small-scale industries have shown their existence in India. It has been difficult for small industries to survive due to tough competition among them. All are facing problems like low production and poor-quality products.

Design/methodology/approach – The methodology applied to implement Kaizen in Indian small-scale industry. Fishbone diagrams have been used to represent cause and effects. The result has been shown as savings in terms of money and time.

Findings – Inventory access time is reduced up to 87 per cent and total distance travelled and total time taken by product is reduced up to 43.75 and 46.08 per cent, respectively. A habit to maintain a clean workplace has been developed in workers.

Research limitations/implications – ISO could be integrated with Kaizen for more improvements.

Practical implications – The paper should assist those practitioners and consultants who have the desire to understand a better way of Kaizen implementation in small-scale industries of India.

Originality/value – This paper yields lots of values for practitioners to understand the need, impacts and significance of Kaizen implementation in small-scale industries of India. Also, it bridges the gap between theory and practice of Kaizen implementation in real working conditions in Indian industries.

Keywords Kaizen, Lean, Small scale industry, Principles, Waste

Paper type Case study

1. Introduction

Today, in the era of combative and dynamic markets, it is very tough for a small industry to survive. Indian small-scale industries have contributed a vital role in economic growth of the country. To bring these small industries at the level of the world, it has been necessary to adopt new brain waves in these industries. Lean Manufacturing have proved to be an impactful tool for refining the working culture and production approach of large industries. Lean can prove its endowment in small industries too. Lean is dynamism that eliminates/reduces the misapplications in human efforts, inventory and lead time. As a result, the speed to market increases and organizations become more sensible to the calls of dynamic markets while producing superior-quality products in the most efficient, effective and economical way. The Lean approach consists of various practices that aim to improve efficiency of the production process, product quality and responsiveness according to the customer demand. A large number of small-scale industries exist in India. These are facing huge competition from large industries. To

International Journal of Lean Six Sigma
Vol. 6 No. 4, 2015
pp. 369-396
© Emerald Group Publishing Limited
2040-4166
DOI 10.1108/IJLSS-11-2014-0033

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prevail in Indian markets, it has been mandatory for an industry to provide high-quality products at low price. It is a frightful stage for those small industries of India which are lagging behind in terms of speed of response, price and quality of the products. So it is necessary to make practitioners aware about how Lean can ensure the successful survival of small-scale industries in India. Tools like Poka-Yoke, Visual control, one-piece flow, Value Stream Mapping (VSM), cellular manufacturing, inventory management, standardization of work, scrap reduction and workplace organization have been used for reducing wastes in manufacturing. Kaizen is an excellent tool for any enterprise that aims to be Lean (Russell and Taylor, 1999). Historically, Kaizen has been applied to not only the production field but also to service business field (Emiliani, 2004b). The waste has been found in the service sector too (Ohno, 1988). A rise has been achieved in the online degree programs in graduate business school education due to Kaizen (Zimmerman, 1991; Grey, 2004). People, especially part-time working professionals, have been shifting toward online degree programs (Emiliani, 2005). Japanese manufacturing companies are experts of Kaizen in the field of automobiles. Indian industries have to learn many facts from the Japanese manufacturers. Early learning of Kaizen has been the basic reason of Japanese success (Pfeffer and Fong, 2002). Kaizen principles have been taught in schools, such as how to continuously cultivate things and how to do more with less in the most efficient manner. So, there are no worrying factors for Japanese industries because they are already familiar with Kaizen. The Japanese can adopt changes very easily (Watanabe, 2011). The working culture of Indian industries is extremely different from that of Japanese industries. Now, there is a need not only for learning Kaizen concepts but also discovering the ways to implement it in Indian industries (Oliver and Delbridge, 2002). A firm which is providing poor-quality products cannot survive in such tough competition. To produce and deliver good-quality products at a reasonable cost, it has become necessary to eliminate wastes from the manufacturing systems and culture. The Indian small-scale industries are suffering from quality issues, longer lead times, old and poor working methods and unsafe working conditions. The case study represents ways to tackle the factors that add no value to the end product, reduce production and quality but increase the cost of the products. This paper represents the methodology to implement Lean and how to "Do more with less in Indian industries".

2. Literature review

Kaizen has been a fundamental part of an entire business philosophy named as "Lean" (Ohno, 1988). Kaizen has been linked with Toyota Production System (TPS). TPS aims to increase the production by elimination of wastes in manufacturing systems. Kaizen aims to continuously improve the production process by eliminating the Non-Value-Adding factors from the production methods. TPS has been the origin of "Lean". It has been signified by Ohno that TPS is not developed just in a single night but it has taken 30 years of stepped-up developments and improvements. Womack *et al.* (1990) described Kaizen as a tool of "Lean Philosophy" that transformed the manufacturing world. Lean has been generated in the manufacturing fields and can be implemented in management fields, HRD, hospitals and other areas too (Stone, 2012). The collaboration of Kaizen with Value Stream Accounting has been demonstrated by the research of Chiarini (2012). In 2011, Chiarini (2011) compared six important systems and found nine important factors like end results, style of the management, system

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deployment, managing employee, customer needs, IT, tools, technology, regularly analysis of the conditions and stabilizing the system. These can be achieved successfully under the shadow of Kaizen. Imai (1989) described Kaizen as a means to continuously enhance personal life, social life, home life and the working life. Kaizen has been adopted successfully by South African Automobile industries (Charles and Chucks, 2012). Some authors described Kaizen as a life philosophy which improves the way of personal circle, family circle, social circle and working circle (Wittenberg, 1994; Gondhalekar, 1995). The word "KAIZEN" evolved from two Japanese words "KAI" and "ZEN". "KAI" means "Change" and "ZEN" means "Better" (Donaldson, 2002). "KAIZEN" means "Change for the better" (Doria *et al.*, 2003). The gap between existing state and proposed state of any manufacturing and servicing system can be bridged by using VSM (Singh *et al.*, 2010). VSM can eliminate waste activities from the value stream (Ruiz *et al.*, 2013). Kaizen can be collaborated with VSM successfully (Canel, 2000; Brunet and New, 2003). VSM can identify the waste activities in the process (Ruiz *et al.*, 2013). If the wastes are identified and eliminated continuously and systematically, it leads organizations toward improved quality, high production, high efficiency and high competitive edge (Cuscela, 1998).

The time when the Japanese economy climbed the success ladder, the way of working of the Japanese Management has now been adopted by European and American manufacturers (Karkoszka and Honorowicz, 2009). Today, a customer decides the price of the product in the market. The elimination of misapplication of resources and implementation of Lean manufacturing are key strategies to reduce the manufacturing cost (Chauhan and Singh, 2013). Manufacturers face an increasingly uncertain external environment as the rate of change in customer expectations, worldwide competition and variety of technology (Huber, 1984; Eroglu and Hofer, 2011). Achieving higher levels of productivity in this complex and dynamic environment requires the manufacturing system to quickly adjust itself to complexities, uncertainties and changes of the markets (Demeter and Matyusz, 2010; Karlsson and Ahlstorm, 1996).

2.1 Principles of Kaizen

2.1.1 Process-oriented system. The manufacturing processes has to be improved continuously for better output and best quality (Chiarini, 2012). Management has to provide an initiating force for continuous improvements in the manufacturing processes (Donaldson, 2002). To improve any process, the relationship of that process with the other activities should also be considered (Smadi, 2009). This requires the direct involvement of the employees because nothing can be improved without that. Management has the responsibility to provide them adequate training to improve their skills and mindset (Schroeder and Robinson, 1991; Berger, 1997).

2.1.2 Continuous improvement and maintenance of standards. This principle integrates the innovations with the ongoing efforts. An improved standard has to be maintained continuously (Priestman, 1985; Gondhalekar, 1995). It is the responsibility of the management to continuously observe whether everything is going within desired limits of established standards (Toni and Eileen, 2008; Watanabe, 2011). If there is any deviation from the defined standards, correction should be made on time. That organization is called "The Disciplined Organization" (Evans and Jukes, 2000; Turney and Anderson, 1989). The manufacturing process can be improved easily using the

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PDCA cycle. Routine standardizing work and improvements can be linked together (Imai, 1989).

2.1.3 People-based culture. Every individual of the company should be involved in the improvement process, whether its management or a worker on machine (Motwani, 2003). People's desires and beliefs design the platform for successful implementation of Kaizen. The management has to look and realize the importance of Kaizen because it is the guarantee of the long-run success in the future (Karapetrovic, 1999). There are basically three types of activities involved in Kaizen. Every activity has its own focus and point of view in the improvement process (Etzioni, 2002). The first activity rotates around the management. The management has to make decisions regarding planning, implementation, scanning and control of information system (Handy, 2002). The second activity revolves around the group of workers and mainly focuses on the working methods and manufacturing processes. The third important activity forces "on-the-spot improvement". Every individual of the company first has to improve his/her own work, attitude, routine, working methods and the ways of utilization of resources. A well-disciplined and undisputed nature of the manager can motivated a large group of workers toward continuous improvement movement (Berger, 1997). Kaizen helps to detect the hidden wastes in the manufacturing processes, targeting their root causes and finding their solutions (Stone, 2012). This collectively results in good-quality products, quick service, low manufacturing cost, high speed to market and better working culture inside the company (Roffe, 1998).

In India, people are not so much aware about Kaizen. A proper awareness and training is to be given to the workers. The company has to spend on the training and awareness programs for the workers regarding Kaizen (Jorgensen, 2003). That expenditure is investment, not the waste (Gondhalekar *et al.*, 1991). In Indian industries, the involvement of every individual in improvement activities has not been considered yet. Kaizen should be developed as a habit and routine-work of the workers (Pomlett, 1994). On-the-job-training plays a vital role regarding the growth of Kaizen in Indian small industries (Lam, 2000; Edwards *et al.*, 1998). Kaizen helps in eliminating the social barrier between various working forces (Lam, 2000). Aoki (2008) signified that Kaizen has been adopted routinely and successfully all over the world. It received attention of the entire world (Bateman and David, 2002). It develops a habit inside a system to learn and improve continuously from an existing system, thus pursuing improvements. The habit of learning from the mistakes leads the company on the way of new improvements (March, 1991). It helps to develop the dynamic abilities of the company such as quick adjustment with dynamic demands and environments of the markets and to cope with changes in working culture inside and outside of the organization (Teece and Pisano, 1997). The aim of the Kaizen is to attain a competitive advantage by establishing continuous learning and improvements (Lewis, 2000). Japanese workers individually developed the capabilities to learn and improve their own work independently (Koike, 1994). Self-initiation plays a vital role here (Cole, 1994). The implementation of the Kaizen approach in India can open new opportunities for the long-term successful survival of small scale industries (Edwards *et al.*, 1998).

The bottom-line of Kaizen approach is to minimize or complete elimination of those activities which do not adds value to end product. To increase the competitive edge and to compete in today's dynamic markets, US manufacturers understood that the conventional mass production approach has to be adopted and the new improved ideas

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of Lean manufacturing have to be integrated with it (Ahlstrom, 2000). US manufacturers' sleep was broken by Womack in 1994. Lean Manufacturing rewarded great success to large industries and it bridged the gap that existed among Japanese and US manufacturing companies. The idea of improvements by Lean implementation was successfully adopted by US companies because the successful journey of the Japanese companies has been viewed by world. The Japanese were producing and distributing the products by using half or very low human effort, less capital investment, using lesser floor space, lesser tools, lesser materials, in less time and lower expenditure (Capelli, 1994). Lean can be implemented successfully in small-scale industries of India. The small industries largely contribute to the economic growth of India (Hines, 2004; Womack and Jones, 1994).

2.2 What is waste?

The activities that do not add value to the end product but increase the cost of the product are called wastes (Ibrahim, 2005). These activities are necessary to perform which may or may not support the production activities directly or indirectly (Hines, 1998). There are the following types of wastes:

- *Waste of over production*: If products are manufactured more than the required numbers and those that are not needed in the immediate future are forms of waste. It leads to locked inventory, extra material handling, aging and finally expenses.
- *Waste of waiting*: When a machine is running idle or a machine is busy and inventory to be processed is waiting for its operation, it is termed as waste of waiting. It is of two kinds, that of the operator and of the material.
- *Waste of transportation*: Moving the components from one station to another station just adds cost and not the value to the end product, and hence, should be reduced as far as possible. It may be possible to perform any process during movement of a material from one to another station.
- *Waste of stocks*: Storing the inventory only adds costs and needs to be reduced.
- *Waste of unnecessary motions*: Waste is added if the method of working is followed by the operator needs of unnecessary motions like searching for tool and walking, which are all wastes of motion (Brunet and New, 2003).
- *Waste of making defects*: Producing defective products is other type of the waste which increases expenses and also interrupts the flow of production. Sometimes, a complete lot could be rejected due to poor quality of the products, the costs of which are much higher and need to be eliminated (Pheng, 2001).
- *Waste of processing itself*: When a particular product should not be made or any particular process should not be used. The best process is the one that consistently makes the product with an absolute minimum of scrap in the quantities needed (Pheng, 2001).

The sources and causes of the various wastes are interrelated to each other, so if one waste is eliminated, it might result in complete elimination or reduction of the other (Womack and Jones, 1994). It is not wrong if the inventory is considered as the major source of the wastes. Work-In-Process inventories and finished inventories do not add any value to the final product but add expenses in handling them, and there is the need

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to eliminate or reduce them. If the level of the inventory is reduced systematically, then hidden problems can be targeted and eliminated successfully. There are so many ways to reduce the levels of the inventory. Reducing the lot size is one of them and is an impactful way. To reduce and make cost per unit constant, the reduction in lot size should be followed by reduction in setup times (Arya and Jain, 2013). Single Minute Exchange of Dies (SMED) is a concept to decrease the setup times which was developed at Toyota by Shingo. SMED is used for reduction in setup times in large-punch presses. Production lot size can be reduced up to great extent by this method. There is another effective way to decrease the level of the inventory which focuses on reducing the machine downtime. Preventive maintenance plays a big role in this. It has been cleared that if the level of inventory is reduced, then other causes and sources of wastes linked to it can be reduced. It has been illustrated with the help an example of space inside the factory. If the level of inventory is reduced, then the space which is used to place the inventories could be used to place some other useful things to increase the capacity of the factory. If machine setup time is reduced, it can reduce the levels of inventories (Arya and Jain, 2013). It is necessary to reduce the unnecessary movements of the materials so as to reduce the time associated with this component within the production process.

One simple way to eliminate this kind of problem is utilizing a layout based on cellular manufacturing so as to ensure that the flow of products remains smooth and continuous. From here it can be seen again that elimination of one of the sources of waste reduces or completely eliminates the other sources of wastes. Non-value-adding activities can be eliminated if the machines and workers are grouped together into the cells, which is termed as cellular manufacturing (Newitt, 1996). Now, because a team or a group of workers can be completely dedicated to only that cell, this is going to eliminate the waste associated with excess human utilization. The defects, rework and scraps combined form another big source of waste (Hays, 1986).

2.3 Implementation of Kaizen

How a company should implement Lean Production? What should they focus on? Which time perspective should they have? and How should they plan and arrange the work? These are some important factors which should be looked over by the companies. The staff have been educated about two courses: "Lean game" and "5S" course. Not all companies did it in this order and some companies developed improvement groups before the different courses to the group together underwent training, some afterwards. They all followed almost the same concept, train first, let the concept to be understood and then implement it in an easy visible area of the company so that everybody can see that something is happening (Mintzberg, 2002).

They also divided big goals into small steps, and they also looked back to find out what they have achieved. All the companies have an implementation plan regarding future works, customer requirements, price, market changes, resource management and capital management. Companies should develop future state plans to get the work sustainable because "the time limit is to focus on the eternity". Improvement should be done in all the sections of the company whether it is the manufacturing section or the administration department (John *et al.*, 1996). The company should have a weekly meeting in the factory in which at least one member from every group should be involved. These members have to report back to the group to which he/she belongs. It

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will ensure that everyone in the company knows what is going on inside the company, which are the latest orders, how the results from various analyses have been created and which group is focusing on some particular improvement job (Melcher and Acar, 1990). If the company wants to sustain in today's tough and dynamic market, all the employees of the company have to work together. The company has to be one step ahead of its competitors. It can be possible only when the system of a company is improved continuously.

2.3.1 Success factors in implementing Lean. There are following factors significant for Lean implementation.

2.3.1.1 Targeted and holistic change strategy. It has been argued that Lean philosophy and techniques require adoption in the entire system in a holistic manner rather than applying techniques in a piecemeal fashion. Womack and Jones (1996) suggested that managers have drowned in techniques as they tried to implement isolated parts of the Lean system without understanding it entirely. On the other hand, a piecemeal approach is generally adopted mainly as a result of resistance from the employees to the new ideas (Mckenna, 1991). A more focused training gives evidence for a better understanding among personnel of the key principles of waste elimination and flow of value.

2.3.1.2 Company culture. Changes of mindset have given people an aim in their working life and have the potential to change attitudes so that the employees begin to think differently. They became more willing to contribute to company's improvement initiatives (Manuel and Barraza, 2012b). Sometimes, the management's strong control makes the organization structure bureaucratic, which makes it difficult to change from the existing ways of doing things.

2.3.1.3 Product focus. The focus should be on the specific product value stream also, so that the utilization of resources could be free from wastages (Angelis *et al.*, 2012).

2.3.1.4 Senior management commitment. Consistency in management commitment is emphasized as an important element in effective implementation of improvements in the organization (Styhre, 2001).

2.3.1.5 Timing for performance improvements. It is also considered as a significant factor for change in the organization (Manuel and Barraza, 2012a). The companies need to be prepared for the Lean transformation.

2.3.2 Challenges in applying Lean thinking. There are so many factors that create barriers in implementation of Lean thinking. The first factor is time spent on working and capability, which has been used as the "physics" of process improvement (Bessant *et al.*, 1995). Even if time is added for improvements, it takes time for the problem in the process to be identified, then the cause of the problem is to be discovered, solutions to be found out and problems to be eliminated. Unfortunately, it happened that even after such efforts, Lean thinking faces challenges in implementation. Another question is that even the improvement activity does not lasts forever; for example, it is applied to technical equipment that is amortization and getting obsolete or where the products are changing often (Grant, 1991). It seems to be connected with the management decision regarding reaching the desired goal. This could be performed in two ways – work harder or work smarter. If the management pushes workers to work harder so as to meet the target, or just add more working hours, which, in most cases, leads to great pressure and high levels of stress. The alternative is to increase the capability of the process and that is the best way to improve performance. Smart working situations gives the employees

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the possibility to experiment with new ideas and to find a solution for performing work better. If an organization puts enough efforts in improving its process capability, then its performance will rise. In the situation of working harder, cutting the investments for process improvements decreases the performance in the long term. Because of the pressure to meet the high target, from beginning the performance comes higher than in general, which deludes the work. Later on, the performance declines (Emiliani, 2004a). When working smarter, actual performance time decreases when the time spent in working decreases and the time for improvements increases. In a long run, capability increases apparently. As a result, work becomes less and performance becomes higher due to the increase in process capability (Emiliani, 2001). One of the most daunting challenges for every CEO of global firms is to keep their firm competitive in the long term (Mefford, 2009). They face pressure for keeping the costs low and profitability high, and, at the same time, they have to innovate and improve the product design, so as to compete with the global market. A decision for lower costs and higher profitability could increase the productivity of the firm. A challenging job for the managers is the effective communication of the vision and plan for Lean implementation for the workforce. To understand the new vision, new order and new communication at organization levels seems to be a difficult task for the management as well. Sometimes even when the CEO of the company is fully committed to the organizational improvement program, it still appears that the organization faces some problems with the implementation of the new approach. People resists to bring changes on their working place even if the management is dedicated and enough efforts in training programs and explaining the values of the new practice, especially when veteran workers encounter the change. Many negative attitudes can turn into a great resistive force (Mefford, 2009). There may be hard times when decisions have to be taken to let go some of the employees who do not want to adopt new ways of doing work and do not want to support the implementation efforts (Hoerl and Gardner, 2010). Another challenge for the managers in the beginning of the implementation process comes in the form of rollback of the system to the previous stage. Another challenge for companies is the departure of the employees from the companies in the advanced level of Lean implementation (Wittenberg, 1994).

Employees' skills, knowledge and experience necessary for performing some specific tasks throughout the company are difficult to copy and hence provide a platform for sustainable competitive advantage (Watanabe, 2011). When the key members of the staff become headhunted by other larger organizations that offer them substantial benefits, it becomes difficult to retain those staff members. It becomes time-consuming, expensive and can have a major impact on the morale of single-status firms (Lyu, 1996). The human resource policy in the observed company is based on low levels of staff turnover and the experience of facing a struggle to replace key workers after they have left the company (Falk *et al.*, 1993). Even though that staff expresses loyalty to the company in all surveys conducted, in the face of such incentives, they still leave (Pheng, 2001; Gondhalekar, 1994).

2.4 Indian small-scale industries

The Ministry of Medium and Small Enterprises (MSME) Act 2006 described a small-scale industry in which the total investment in terms of rupees does not exceed beyond the limit of 10 million. It may be the service sector or manufacturing sector.

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Small-scale industries play an important role in the Indian economy. These industries are run directly by the owner of the industry with a small group of the workers (Arya and Jain, 2013). These workers are mostly untrained and working conditions are unsafe. Still, these industries are helping to provide new employment opportunities for many workers, contributing hugely to both rural and urban areas. But these industries are facing some resisting factors that restrict their growth, reduce product quality and increase manufacturing costs. These factors involve lack of motivation, old working methods, poor working culture and lack of improvement activities (Jain, 2012a). These industries are lagging behind in terms of the documentation of the work. All the information just remains in the head of an individual. At least there should be an operator who is maintaining the data and work in files or in a computer system. These industries are using old methods and techniques, which is another worrying factor. With modern technologies, a product can be manufactured very fast, in good designs and at a lower cost. Old technology is unable to do so. Large industries are giving huge competition in terms of quality and cost of the product. Large industries using latest technologies in production and quality standards are much higher than those of small industries. Small industries are not able to provide good-quality product in markets at cheaper rates (Arya and Jain, 2013). The future of the Indian small-scale industries needs to be secured and the competitive edge of these industries needs to be increased so as to secure the future of India. And this can only be done by implementing Lean in the small industries of India.

3. Research methodology

The methodology applied to implement Kaizen in Indian small-scale industry. First of all, the literature related to Lean Manufacturing has been reviewed. After that, a small-scale industry has been selected where Kaizen has to be implemented. Visits to industry were carried out on a weekly basis. During the visits, the information regarding conditions from different work locations, before implementing Kaizen has been collected from the small-scale industry. Then assistance of cause and effect diagrams was taken for analysis of working conditions without Kaizen. After analysis, the corrective action plans for each activity and work location were designed. The action plan has been implemented at different work locations and regularly practiced in the company. After the implementation of Kaizen, again the information from improved working conditions from different work locations with Kaizen was collected, analyzed and then the conclusion was drawn. The methodology applied at various work-locations and is explained in much better way by case studies Figure 1 shows various steps involved:

3.1 Kaizen implementation in safety

3.1.1 Observation of past conditions. The inventories that were lying on the floor could cause injury to any worker. The inventories were occupying useful space that could be used somewhere for some fruitful assignment.

3.1.2 Analysis of past conditions. Safety depends upon the working method, material, operator attitude, working environment, routine, safety rules, precautions and, most important, the habit to follow those rules. Figure 2 showing the cause and effect diagram for safety.

3.1.3 Action plan suggestion and implementation. Table I showing the action plan suggested for safety.

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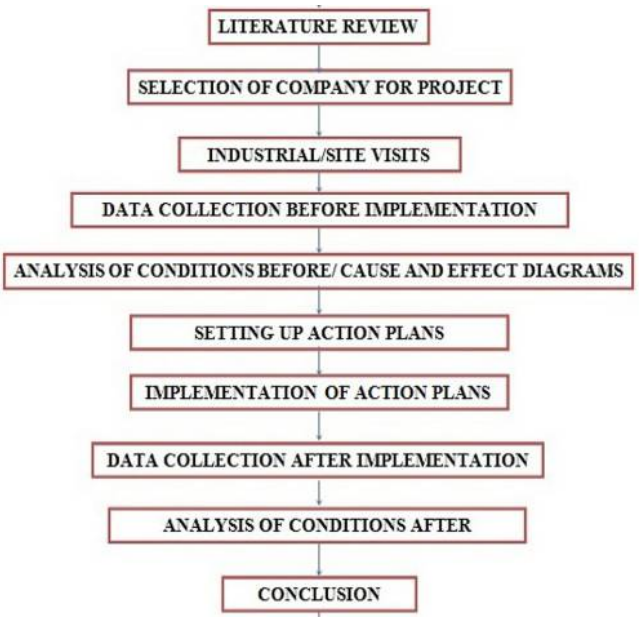

Figure 1.
Methodology adopted for implementing Kaizen

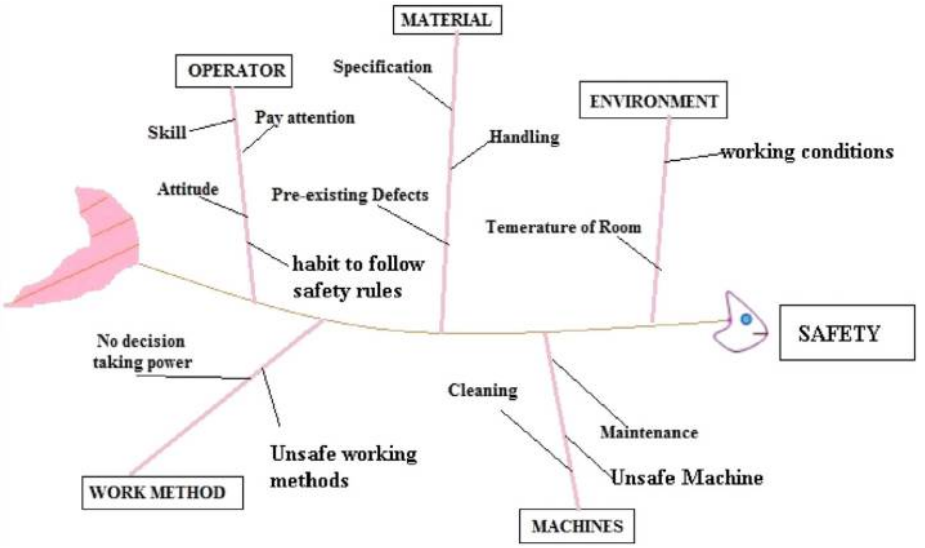

Figure 2.
Fishbone diagram for safety

3.1.4 Conditions after implementation and comparison before and after. Before taking action plans, the conditions were unsafe for working. The inventories were lying in the path of traveling. Those inventories were blocking the path of walking.

Here Plate 1 shows the past conditions and Plate 2 represents the improved conditions after implementation of the action plan. The habit of the workers to place the

inventories anywhere on the floor created erratic operating conditions which could cause injuries to any worker. Those inventories has been given a separate space inside a rack and the pathway has been cleaned. An area of "5 square feet" is saved by removing inventories from the floor.

3.1.5 Analysis after implementation. Cost of 1 square feet area = Rs 900.

Area saved = 5 square feet.

Savings = Saved area (Sq ft.) × Cost per square feet = 5 × 900 = Rs 4,500.

Type	Action plan suggestion for safety
Method	Working method should be safe
Machine	Machine should be rigid. The preventive maintenance ensures the machine always in good condition. It should be safe to use
Operator	Operator should be attentive, skilled, trained. He/she should fully concentrate on process and safety. He should follow the safety rules properly
Environment	Environment should be clean, safe for work. A thermometer should be kept to check the temperature
Material	Material should be handled carefully. There should not be any inventory on the floor or in the pathway

Table I.
Action plan for safety

Plate 1.
Inventories lying on floor (past conditions)

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Plate 2.
Clean and proper place given to inventories (improved conditions)

3.2 Kaizen implementation in tool/Inventory access time

3.2.1 Observation of past conditions. The presence of undesired items makes the worker spend an average of 10 minutes in search of tool/inventory every time. The objective is to reduce tool/inventory retrieval time from the store room.

3.2.2 Analysis of past conditions. Inventory access time relies on conditions of store, labeling of boxes of inventory, attitude and attention of the worker, environmental conditions and visibility in the store room. Figure 3 shows the cause and effect diagram for tool access time.

3.2.3 Action plan suggestion and implementation. Table II shows the action plan suggested.

3.2.4 Conditions after implementation and comparison before and after. Plate 3 shows the scenario of the store before Kaizen implementation. The inventories in the store were dislocated and spread here and there. The unnecessary items in the storeroom were creating troubles. It was difficult to find out the desired inventory from the store. The worker was spending an average of 10 minutes in search of tool/inventory every time. There was a huge wastage of time, every time a worker visits the store. In the action plan, different boxes have been provided to keep the inventories and tools. Proper labels are provided on boxes so as to ensure that the worker picks the right item from the right box in the minimum time. Undesired items like covers, clothes sticks, etc. are eliminated. After the implementation of the action

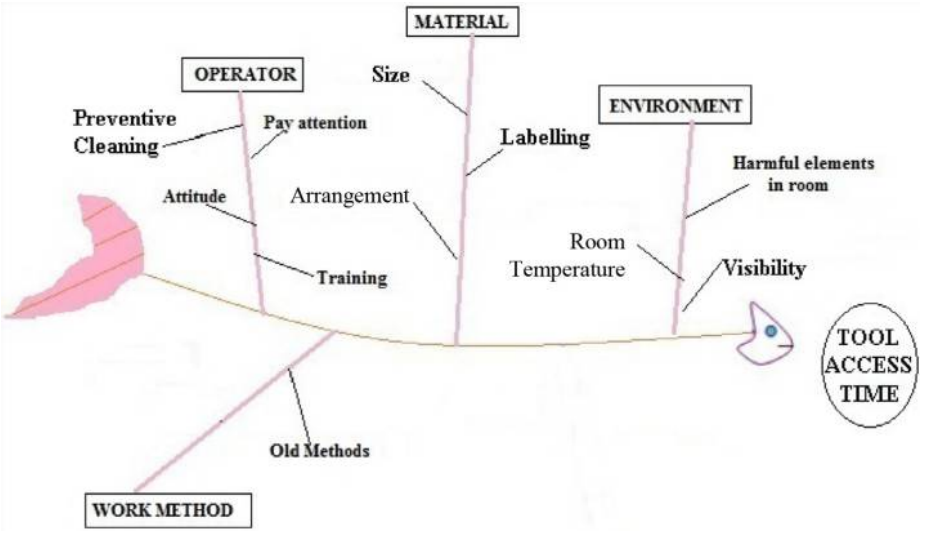

Figure 3.
Fishbone diagram for tool access time

Type	Action plan suggestion for inventory access time
Method	Working method should be safe and quick
Operator	Operator should be attentive, skilled and his attitude should be towards completion of work successfully at proper time. A habit of preventive cleaning should be developed in the workers
Environment	Environment should be clean, safe for work. Visibility inside the store room should be good so as to avoid difficulty in reading the labels of the boxes. Unnecessary items should be eliminated from the store so as to avoid any interference
Material	Inventory should be properly arranged and should be kept inside boxes and each box should be labeled properly so as to ensure that the worker straightaway access the right inventory box without wasting crucial time

Table II.
Action plan for tool/ inventory access time

plan, workers are now able to find the required inventory in just 1.3 minutes. The improved conditions are shown in Plate 4. The time for searching and taking the inventories from the store has been reduced up to 87 per cent. Comparison of the time taken inside the store is shown in Figure 4.

3.2.5 Analysis after implementation. Average pay of a worker per month = Rs 9,000.

Average working hour per day = 8.

Average labor rate per minute = 9,000/(30 × 8 × 60 ×) = Rs 0.62.

Saved minute per worker = (10-1.3) = 8.7 minutes.

Total money saved per worker = 8.7 × 0.62 = Rs 5.394.

It means that there is a saving of Rs 5.394 every time workers makes a visit to the store.

Average visits of the worker to the store per day = 5.

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Plate 3.
Past conditions of store

Saving per day per worker = 5 × 5.394 = Rs 26.97.
Total number of workers in the industry = 12.
Total saving per day = 12 × 26.97 = Rs 323.64.
Per month saving = 323.64 × 30 = Rs 9709.2.

3.3 Kaizen implementation in inventory safety

3.3.1 Observation of past conditions. Earlier, the inventories were not given appropriate place, due to which inventories were covered with a layer of rust. There was a need to protect the inventories from damage.

3.3.2 Analysis of past conditions. The deficiency in inventory depends upon various factors such as worker's attitude, skills and work handling approach. The environmental factors are moisture content, chemicals and heat which affect the safety of the inventory. The defective machine and wrong working/handling method can introduce defects in products. The type of work material and pre-existing defects in the casting also affect the safety of the inventory. Figure 5 shows the cause and effect diagram for inventory safety.

Plate 4.
Store after implementing action plans

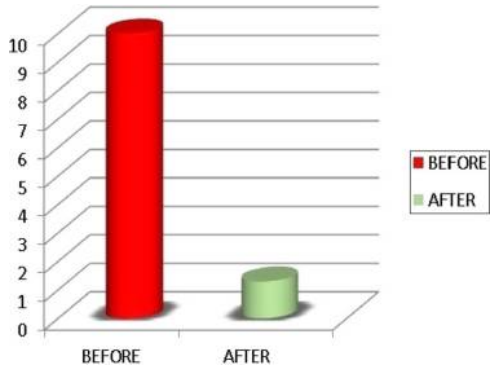

Figure 4.
Comparison of inventory access time before and after action plan implementation

3.3.3 Action plan suggestion and implementation. Table III shows the action plan suggested.

3.3.4 Conditions after implementation and comparison before and after. Earlier, the habit of the workers to place the inventories anywhere has created lots of troubles as

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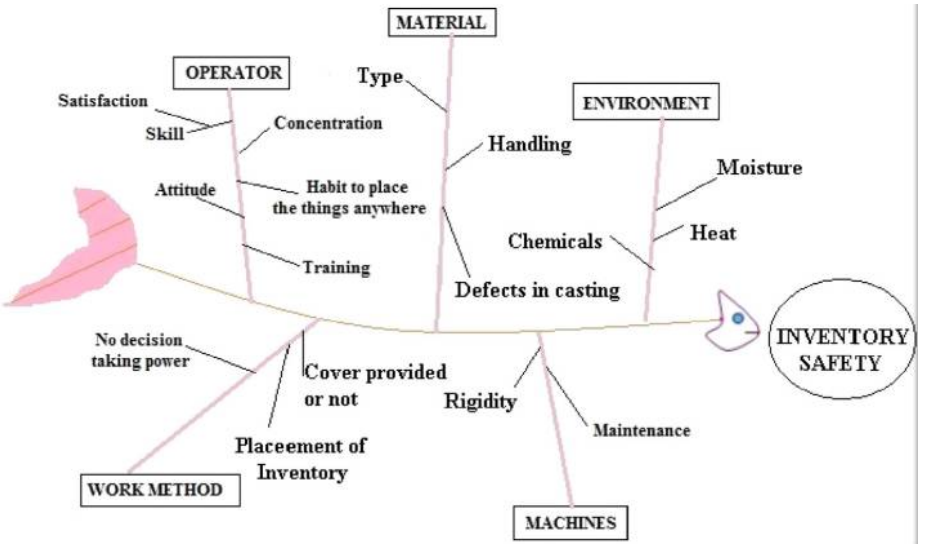

Figure 5.
Fishbone diagram for inventory safety

Type	Action plan suggestion for inventory safety
Method	Inventories should not be kept on the floor
Machine	Machine should be rigid, preventive maintenance ensures the machine in good condition always
Operator	Operator should have a habit to place the inventories at defined space, not at floor
Environment	Environment should be clean, moisture and heat should not be high
Material	Material should be handled carefully. Covers could be provided on inventory so as to prevent it from the dust

Table III.
Action plan for safety of inventory

shown in Plate 5. The lot of inventories got damaged due to rust and mishandling. That problem has been solved by providing awareness regarding inventory safety to the workers. The company has to pay for defective items and it affects the company's earnings and its name too. After implementation of Kaizen, workers were more aware regarding proper care and safety of the inventory, which has been shown in Plate 6.

3.3.5 Analysis after implementation. After implementation of Kaizen, workers' habit has changed. They realized the value of proper material handling.

3.4 Kaizen implementation in layout improvements

3.4.1 Observation of past conditions. By observing the past layout, it has been found that the layout was suffering from backtracking, large distance between workstations and disarrangement of the machines. The layout has been shown in Figure 7. Symbols L_1, L_2, L_3 and L_4 represent Lathe Machines; G_1, G_2, G_3 and G_4 represent Surface Grinding Machines; M_1, M_2, M_3 and M_4 represent Vertical Milling Machines; HM_1 and HM_2 are used for Horizontal Milling Machines; "T" is the Tapping Machine; D_1 and D_2 are the Drilling Machines; "F" is the Filing process; "A" is the Assembling process; "I" is the

Plate 5.
Inventories lying on floor covered with layers of rust

Inspection process; and "P" is the Packing process. Flow between work-stations is explained further:

- The flow of work (SCV) has started from workstation "1". It is represented by L_4 in layout. Facing operation has been performed there.
- The Second work-station is M_1. The Sizing operation has been performed there. It was situated at 28 ft. away from workstation "1". It takes 38 sec to cover that distance.
- The third workstation is M_3, where machining of sides of the work was performed. It was 40 ft. away from M_1, and it takes 52 sec to cover that.
- Next station is "M_4". It was situated at 4 ft. distance from workstation "3". A time of 6 sec was taken to reach workstation "4". Flange cutting operation was used to be performed on workstation "4".
- After moving 22 ft. from workstation "4", workstation "5" was situated, where sizing of the slot was performed on Horizontal Milling machine (HM_2). A time of 29 sec was taken to reach workstation "5" from workstation "4".
- Cutting of slot was performed on workstation "6" (HM_1). For that, 6 ft. distance has to be covered in 8 sec.
- Drilling operation was performed at workstation "7". It was situated at 32 ft. from workstation "6" and 42 sec was taken to reach there.

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Plate 6.
A proper place given to the inventories

- Tapping was performed at workstation "8" which was situated at 8 ft. from workstation "7". A time of 11 sec was taken to reach there.
- At 14 ft. from workstation "8", workstation "9" was situated, where filing has been performed manually. A time of 19 sec was taken to reach there.
- At workstation "10" Surface grinding on the front side of work piece used to be performed. It is represented by "G_2". It was situated at 20 ft. from workstation "9" and 26 sec was taken to cover that.
- Surface grinding on backside of the work piece was performed on workstation "11", which is represented by "G_1". It was situated at 4 ft. from workstation "10". A time of 6 sec was taken to reach there.
- At 16 ft. from there, workstation "12" was situated and 21 sec has taken to reach there. Workstation "12" has to perform the assembling operation.
- Inspection was performed at workstation "13", which was situated at 16 ft. from workstation "12". A time of 21 sec was taken to reach there.
- The packaging of product was performed on workstation "14", which was situated at 12 ft. away from workstation "13". A time of 16 sec was taken to reach here.
- The store was situated at 18 ft. distance from the packing section and 24 sec was taken to reach there.

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- In whole, the flow of material from workstation "1" to the store, a total of 224 ft. distance was covered and 319 sec was taken to cover that distance. The flow of material along with the distance covered is shown in Figure 6.

Figure 7 shows the past layout of the industry, and Table IV shows the distance and time taken between the workstations before the implementation of Kaizen.

Due to poor layout, the product had to travel a lot between workstations and it consumed more time too.

3.4.2 Analysis of past conditions. The lead time and distance travelled by a product relies upon the working method, machine rigidity, worker's attitude, training, skills, working conditions, defects and rework. Figure 7 shows the cause and effect diagram for distance travelled by a product.

3.4.3 Action plan suggestion and implementation. Table V

- Workstation L4 is used to perform facing. L1 is nearest to workstation "2" as compared with "L4". An idea has been provided to change workstation "1" from L4 to L1. It reduced the distance from 28 to 14 ft. and the time is been reduced from 38 to 19 sec.
- Workstation M3 is been replaced by M2, which reduced the distance between workstations "2" and "3" from 40 to 4 ft. and the time is reduced from 52 to 6 sec.
- Workstation M3 is placed between M2 and HM1. It reduced the distance from 22 to 4 ft. and the time is reduced from 29 to 6 sec. The drilling operation is

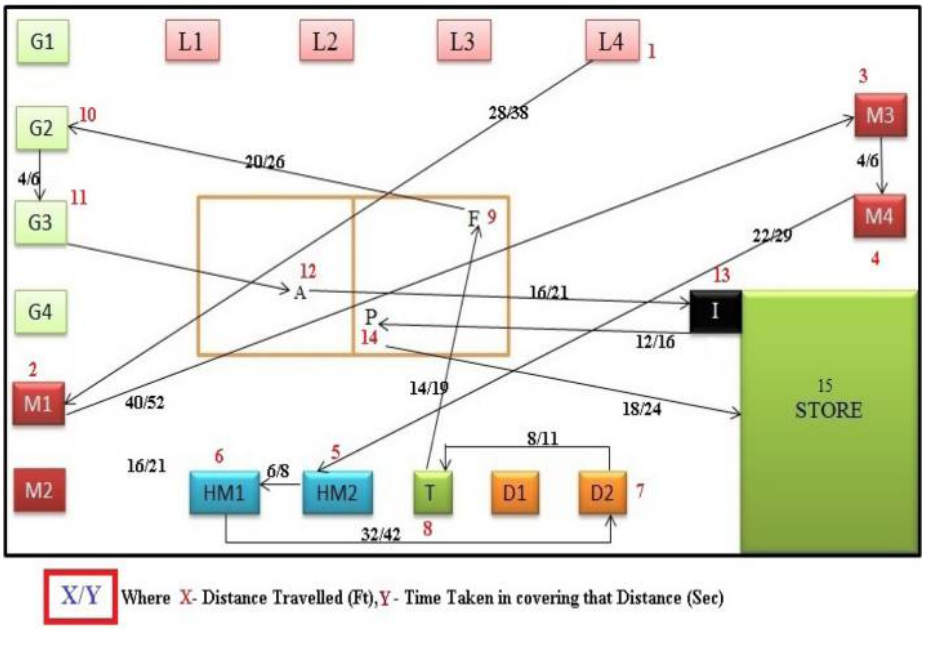

Figure 6.
Layout before the implementation of the Kaizen

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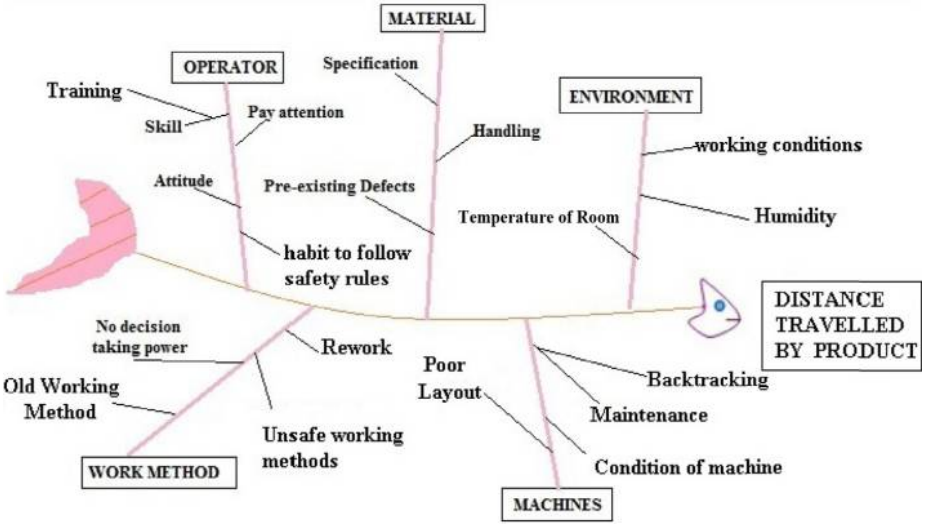

Figure 7.
Fishbone diagram for distance travelled by product

S. No.	Material flow	Distance (ft)	Time (sec)
1	Station 1 to 2	28	38
2	Station 2 to 3	40	52
3	Station 3 to 4	4	6
4	Station 4 to 5	22	29
5	Station 5 to 6	6	8
6	Station 6 to 7	32	42
7	Station 7 to 8	8	11
8	Station 8 to 9	14	19
9	Station 9 to10	20	26
10	Station 10 to 11	4	6
11	Station 11 to 12	16	21
12	Station 12 to 13	16	21
13	Station 13 to 14	12	16
14	Station 14 to15	18	24
Total		224	319

Table IV.
Distance & time taken B/W workstations (Before implementation)

shifted from D2 to D1. It reduced the distance from 32 to 4 ft. and time is reduced from 42 to 6 sec. It reduced the distance from 8 to 4 ft. between workstations 7 and 8. The time reduced from 11 to 6 sec.

- The Inspection table is shifted near the assembly table. It reduced the distance from 16 to 6 ft. and time reduced from 21 to 8 sec. It reduced the distance between workstations 13 and 14 from 12 to 6 ft. and time reduced from 16 to 8 sec. Between the packaging station to store 15, the distance is reduced from 18 to 16 ft. and time reduced from 24 to 21 sec.

Type	Action plan for improvement in layout
Method	Inventories should not be kept on the floor
Machine	Machine should be arranged properly, partition lines should be provided so as to ensure the walking area and machining area. Backtracking can be avoided by appropriate arrangement of the machines
Operator	Worker should place the inventories at defined space
Environment	Environment should be clean, moisture and heat should not be high
Material	Material should be handled carefully

Table V.

- Total distance reduced from 224 to 126 ft; this reduced by 43.75 per cent. The time reduced from 319 to 172 sec; this reduced by 46.08 per cent. Earlier there was an obdurate flow of the work between the workstations. It has been eliminated from the layout. Figure 8 shows an improved layout after action plans' implementation

Figure 8 shows an improved layout of the industry, and Table VI shows the distance and time covered by the product in improved conditions.

Figure 12 shows the comparison of time taken by the product between different workstations.

Figure 9 shows the comparison of total distance before and after the implementation of Kaizen.

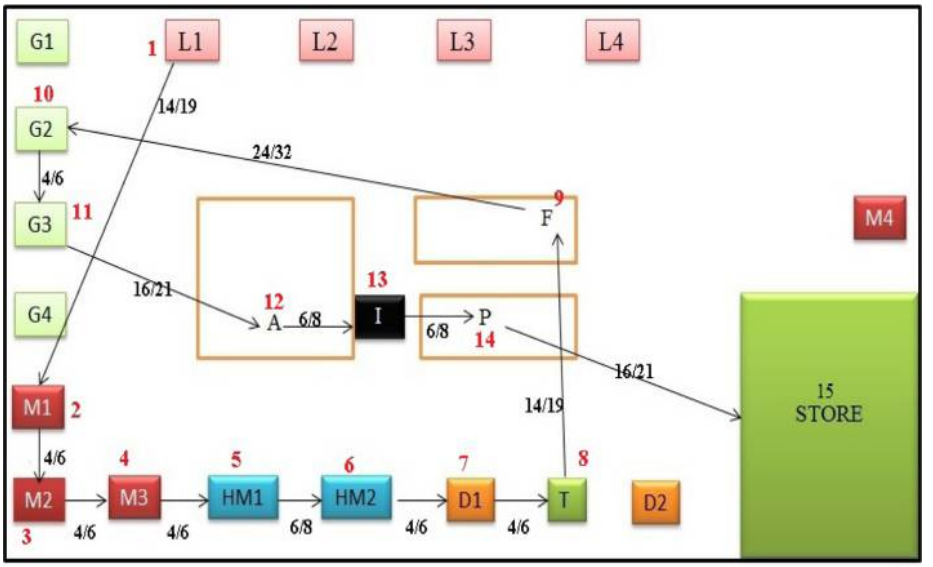

Figure 8.
Improved layout

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S. No.	Material flow	Distance (ft)	Time (sec)
1	Station 1 to 2	14	19
2	Station 2 to 3	4	6
3	Station 3 to 4	4	6
4	Station 4 to 5	4	6
5	Station 5 to 6	6	8
6	Station 6 to 7	4	6
7	Station 7 to 8	4	6
8	Station 8 to 9	14	19
9	Station 9 to10	24	32
10	Station 10 to 11	4	6
11	Station 11 to 12	16	21
12	Station 12 to 13	6	8
13	Station 13 to 14	6	8
14	Station 14 to15	16	21
Total		126	172

Table VI.
Distance travelled and time taken by product between workstations (after implementation)

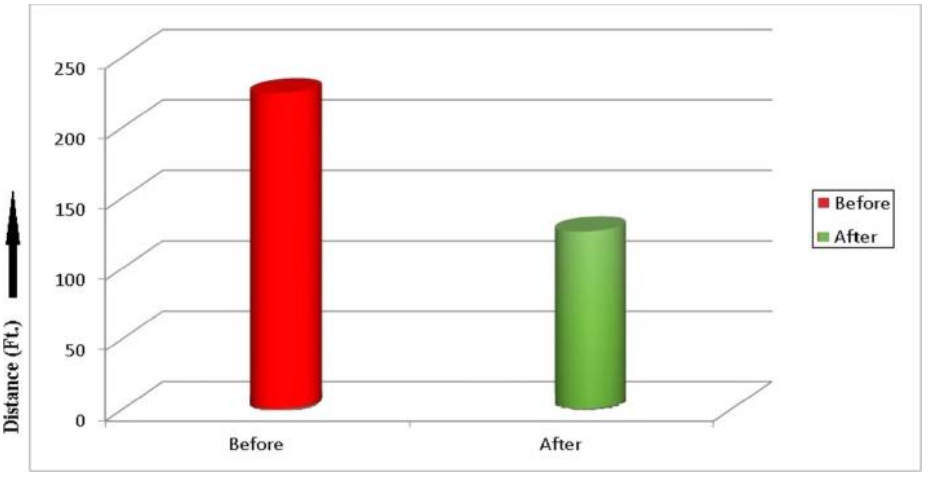

Figure 9.
Comparison of total distance covered by the product before and after

Figure 10 shows the comparison of total time taken before and after the implementation of Kaizen. Figure 11 shows the distance travelled by products between different workstations (Figure 12).

3.4.4 Results

- Implementation of Kaizen reduced the total distance between workstations from 224 to 126 ft; this reduced by 43.75 per cent.
- The time taken to cover the total distance reduced from 319 to 172 sec; this reduced by 46.08 per cent.
- Earlier there was a problem of backtracking and congestion between the workstations, but that problem has been eliminated, and the layout of the industry is modified and simplified.

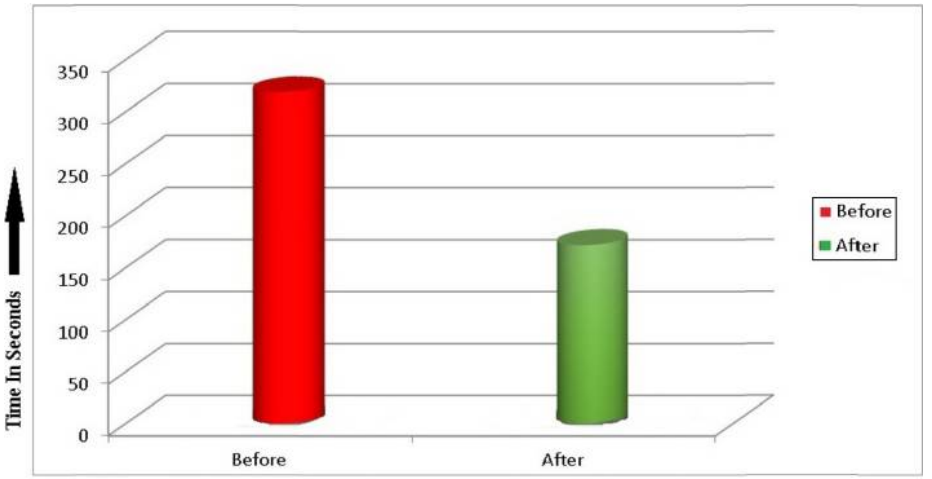

Figure 10.
Comparison of total time taken by the product

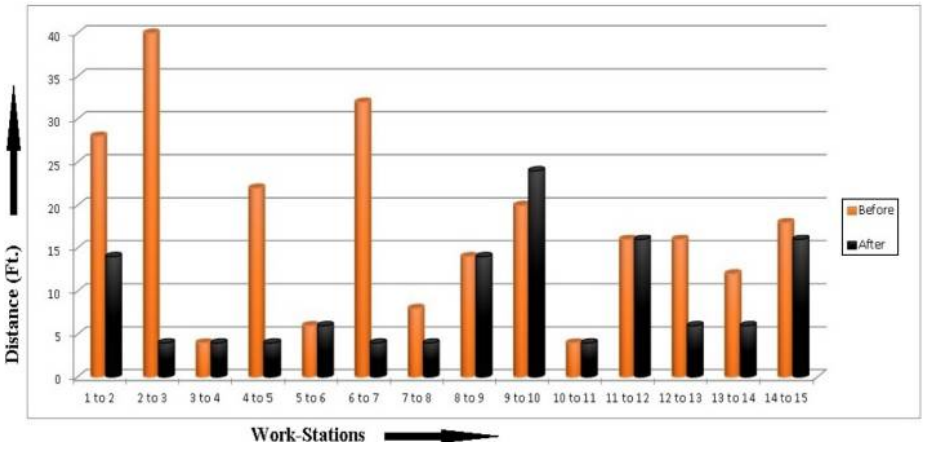

Figure 11.
Comparison of the distance traveled at different workstations

4. Conclusion and implications for research in future

Today, a competitive scenario has been prevailing in the world in every field. The field of manufacturing has largely been influenced by competitions. For a firm, it is difficult to survive successfully in such competitive situations. In this study, the implementation of Kaizen made lots of savings to the Indian small-scale industry, which has been shown in terms of money and time. Implementation of Kaizen has reduced the inventory access time for the store from 10 to 1.3 minutes and, by doing this, an amount of Rs 9709.2 has been saved per month over 12 numbers of workers. The layout of the industry has been modified and total distance travelled by the product between workstations has been reduced from 226 to 126 ft. The time taken in covering the total distance has been reduced from 319 to 172 sec. An area of 5 square feet has been recovered and thus Rs 4,500 has been saved. A habit to place inventories at defined place has been developed in the workers.

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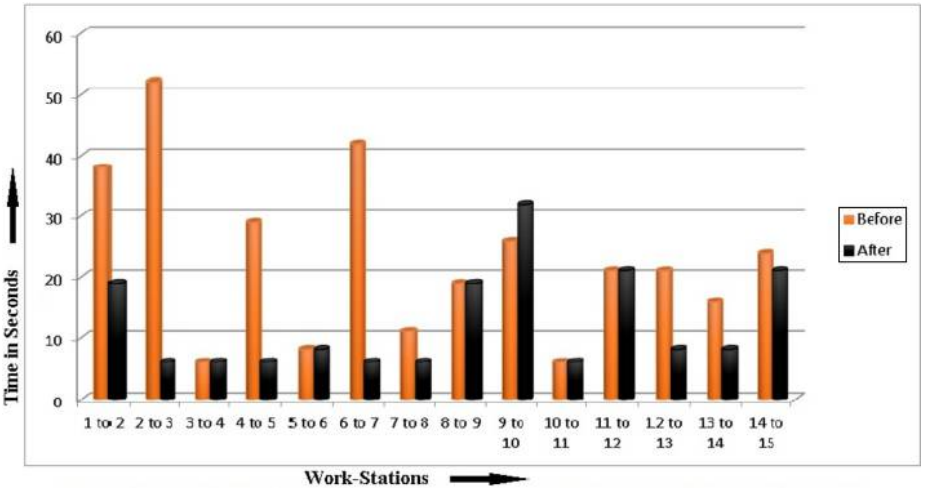

Figure 12.
Comparison of time at different workstations

This paper will inspire practitioners to implement Kaizen in Indian small-scale industries. This paper highlights how Kaizen can reduce the cost of products by removing wastes from the processes, how to create a safe workplace, how to develop the habit of cleanliness in the workers and how to find the ways to increase the capacity of the industry. These improvements have been necessary to ensure bright future of an Indian small-scale industry.

Future research can be focused on reduction of product lead time by implementation of ISO, VSM and creation of such a supportive environment in which implementing Lean can become easy so as to get more meaningful results.

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