Project of Lean implementation in India's SMEs

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ABSTRACT

PROJECT OF LEAN IMPLEMENTATION IN INDIA'S SMES – CASE STUDY

The global competition has forced SMEs in India to introduce Lean strategy to improve competitive potential. Top managements in SMEs have examined the introduction of lean to ensure its effective implementation. This Thesis aims to analyze the introduction and implementation of lean production to the India's SMEs. Two distinct modeling approaches will be employed to examine the contextual relationship among the lean introduction and implementation, and to rank them regarding key performance areas, respectively. Lean implementation and performance indicators will be identified through literature review and opinion of experts from industry and academia. 3M Approach, Ishikawa and Pareto Chart tools will be used to understand the mutual influences among the lean barriers and then classify these barriers based on their driving and dependence powers. As is obvious, its implementation with high driving power and dependency need more attention than others. Development of 3M, Ishikawa for introduction of lean implementation will be considered as one of the major contributions of this study. The novel Kaizen and VSM methodology will be used to examine the dominance relationship and ranks the barriers with respect to key performance indicators related to SMEs. This Case study moreover centers on the audit of writing in lean Manufacturing to comprehend its advancement also, recede and flow research issues. To accomplish the destinations of the proposed research, the accompanying carried out are to be done: An exhaustive survey of writing on lean assembling. Advancement of lean assembling drivers and boundaries through writing survey what's more, exchange with specialists from industry. Evaluation of obtainable lean manufacturing implementation frameworks to find the research gap.

It is normal that the exploration will be vital to the supervisors in the business and analysts in the field of lean Management. The learning and comprehension of lean drivers and boundaries will help the administrators in the business to use the drivers and moderate obstructions successfully before actualizing lean Manufacturing. The proposed system of lean Management usage will likewise be valuable for the business to adequately actualize lean assembling for the enhancements in the presentation to increase focused edge. The Case study is likewise critical for Managers in the field of lean Manufacturing as the examination gives a broad writing audit of lean definitions, patrons, sort of research procedures utilized, kinds of enterprises executing lean, lean devices and strategies, and lean usage systems.

Key Words: Lean Management, Lean Implementation, Kaizen, VSM, 3M approach

STRESZCZENIE

PROJEKT WDROŻENIA LEAN W INDYJSKIM PRZEDSIĘBIORSTWIE SEKTORA MŚP – STUDIUM PRZYPADKU

Globalna konkurencja wymusiła na sektorze MŚP w całych Indiach wprowadzenie strategii Lean w celu zwiększenia potencjału konkurencyjnego. Najwyższe kierownictwo wielu firm MŚP zbadało możliwość implementacji koncepcji Lean, aby zapewnić jej skuteczne wdrożenie. Celem pracy jest przeanalizowanie możliwości wprowadzenia i wdrożenia Lean w indyjskich MŚP. Zostaną zastosowane dwa różne podejścia do modelowania, aby zbadać kontekstualny związek pomiędzy uproszczonym wprowadzeniem i wdrożeniem oraz uszeregowaniem ich w odniesieniu do odpowiednio kluczowych obszarów wydajności. Wdrożenia Lean i wskaźniki wydajności towarzyszące temu procesowi, zostaną zidentyfikowane na podstawie przeglądu literatury oraz opinii ekspertów z przemysłu i środowiska akademickiego. Podejście 3M, diagram Ishikawy i

wykres Pareto zostaną wykorzystane do zrozumienia wzajemnych relacji między występującymi barierami wdrożenia Lean. Następnie bariery te zostaną sklasyfikowane na podstawie ich stopnia ważności i siły zależności. Wykorzystanie wymienionych narzędzi w celu wprowadzenia i wdrożenia Lean będzie uważane za jeden z głównych elementów tego badania. Metodologia Kaizen i Mapowanie Strumienia Wartości (VSM) zostanie wykorzystana do zbadania relacji dominacji i ustalenia barier w odniesieniu do kluczowych wskaźników wydajności związanych z MŚP. Studium przypadku zawarte w pracy koncentruje się ponadto na audycie tworzenia Lean Manufacturing, aby zrozumieć jego powstawanie, a także problemy związane z badaniami. W celu realizacji planu badań, należy m.in.: opracować ankietę dotyczącą „szczupłego" montażu. Dzięki utworzeniu ankiety, a także jej wypełnieniu przez specjalistów z branży, możliwe stanie się określenie postępu w zakresie „szczupłego" montażu sterowników. Ocena możliwych ram wdrażania Lean Manufacturing pomogła w zdefiniowaniu luki badawczej.

To normalne, że eksploracja wyników badań będzie miała zasadnicze znaczenie dla organów nadzoru w branży i analityków w dziedzinie Lean Management. Poznanie i zrozumienie pracy sterowników oraz granic implementacji Lean umożliwi pracownikom z powodzeniem korzystać ze sterowników oraz ograniczać przeszkody związane z aktualizacją Lean Manufacturing. Proponowany system wykorzystania Lean Management będzie również cenny dla firmy, aby odpowiednio zaktualizować montaż w celu ulepszenia prezentacji wyrobów, co pozwoli na zwiększenie przewagi konkurencyjnej. Studium przypadku może mieć również kluczowe znaczenie dla menedżerów w dziedzinie Lean Manufacturing, ponieważ wyniki badania umożliwiły otrzymanie obszernego audytu pisemnego dotyczącego: definicji Lean, patronów, rodzaju zastosowanych procedur badawczych, rodzajów przedsiębiorstw wdrażających Lean, urządzeń Lean oraz strategii i systemów Lean.

Słowa kluczowe: Lean Management, wdrażanie Lean, Kaizen, VSM, podejście 3M

INTRODUCTION

Research Background

The issue of Small and Medium Enterprises (SMEs) has been present in India for a very long time. It is critical to define the Indian market at the current level of focus as an emerging market. That has been long coming because most of the country economy has long been defined by smaller businesses as noted by Garza-Reyes and Kumar, (2014); Gurumurthy and Kodali (2011); and Thanki, Govindan and Thakkar, (2016). According to Gurumurthy and Kodali (2011), it was not until 2006 that the government came on to recognise the existence of SMEs by setting up the Micro, Small & Medium Enterprises Development Act of 2006 (MSMED Act). Based on this act, the SMEs started being defined by the fixed assets investments that ranged in value from $0.04 million to $1.6 million. From this definition, it is clear that the government was focussed on determining the aspect of SME as based on the size of the investment as well as the nature of the economic activities that are involved in (Gandhi, Thanki and Thakkar, 2018, p. 198). After the act was enacted, enterprises came to be defined by two aspects; manufacturing aspects and services aspects. The respective categories also had the issue of there being a strong focus on the level to which they can be defined on the basis of whether they will be determined by size at micro-level of SME- level (Prasanna and Vinodh, 2013, p. 17). If any business organisation is not classified under any of the two categories (micro and SME), it is defined to have the characteristics of a large scale company. To that level, it is determinate that India has all along focussed on economically benefitting from the presence of many SMEs as opposed to the larger companies. This, according to Vinodh, Kumar and Vimal (2014) is an economic characteristic of businesses found in any country in the world. It is natural noting that there are likely to be more SMEs and micro-level businesses than the large scale companies (Panizzolo et al, 2012; Caldera, Desha and Dawes, 2019; Parnell, Long and Lester, 2015; Dave and Sohani 2019).
One of the issues that are defining of the Indian SME system is therefore the very fact that there was no official definition of an SME prior to the MSMED Act in 2006 (Raghunath and Jayathirtha, 2014, p. 65). According to Gandhi, Thanki and Thakkar, (2018) the reason why the law in the country focussed on developing a difference between the larger and smaller companies is that there was need to protect the

smaller companies from the larger ones especially when it comes to market dominance and exploitation in which case the market benefits would still be extended to the smaller companies as well. This created a ceiling upon which the development of the SMEs was assured to the level of the benefits being exhibited today (Thanki, Govindan and Thakkar, 2016, p. 213).

According to Gandhi, Thanki and Thakkar, (2018) changes in the economic environments in India have made the SMEs experience many highs and lows. However, there are great strides that have been made to the ideal fact that the Indian economy is expected to reach a value of around $5 trillion by the year 2025 and the major impetus has been a focus on SMEs (Garza-Reyes and Kumar, 2014; Gurumurthy and Kodali 2011; and Thanki, Govindan and Thakkar, 2016). In the recent past therefore, there has been value that has been focussed on the level to which the SME sector in the country can help support the overall government systems in the country. For instance, according to Gurumurthy and Kodali (2011) from the year 2015, the SMEs have been the major boost to the economy of India.

Many reforms have been implemented from then and these have been able to help in the progressive development of the sector as a whole which in the end leads to the fact that government is gradually focussing on the value of the sector to the economy (Singh, 2011, p. 87). The sector has benefitted from the progressive strategies that have been launched in the recent past by the government such as the Public Procurement Policy, the Pradhan Mantri MUDRA Yojana, Make in India policies and Skill India and Start-Up India. The aim of these aspects was to effectively increase the manufacturing sector growth by 12-14% per year as well as progressing as the share of the sector to the GDP to 25% (Jain and Jain, 2019, p. 176). In discussing the issue of SMEs in India, it is also notable that there is need to discuss the trends that have happened in different parts of the country and the effective impacts on the economy of the country (Panizzolo et al, 2012; Caldera, Desha and Dawes, 2019; Parnell, Long and Lester, 2015; Dave and Sohani 2019). The government focus on SMEs has led to the need to have the sector capitalise on that support and increase the levels of creativity and focus on technology to be able to increase the advancement levels (Prasanna and Vinodh, 2013, p. 62). For instance, there was the focus on SMEs on B2B businesses. When the advent of technology was considered to be a viable part of business development, it was notable that it could be able to open newer channels for the SME businesses across many of the sectors of the economy away from just services and manufacturing as observed by Garza-Reyes and Kumar, (2014); Gurumurthy and Kodali (2011); and Thanki, Govindan and Thakkar, (2016). According to Gurumurthy and Kodali (2011), and Gandhi, Thanki and Thakkar, (2018) technology has been able to increase the level to which SMEs operate with a focus on smoothening the transactions, procurement practices as well as bettering the levels of connection in existence between these smaller firms and the larger well established businesses (Matt, 2014, p. 43). The SMEs in India are then touted to record a level financial score of $25.8 billion by the year 2020 based on the economic projections, it is notable that the level of progress of the sector has been overly rampant (Khatri and Metri, 2016, p. 67).

Garza-Reyes and Kumar, (2014); and Thanki, Govindan and Thakkar, (2016) noted that one of the other aspects worth of mention on the development of the sector is that of determining that it is the backbone of the Indian economy based on the national economic statistics given that it significantly contributes to the GDP of India. According to Gurumurthy and Kodali (2011), and Gandhi, Thanki and Thakkar, (2018), in 2017, the government implemented the GST bill. The bill was meant at implementing a tax structure that is simpler on the basis of 'one nation one tax' approach system. This is a strategy that allowed the SMEs to venture into new markets with little or no entry barriers that would make sure that the growth is assured (Haleem et al, 2012, p. 119).

As stated by Gurumurthy and Kodali (2011), and Gandhi, Thanki and Thakkar, (2018), the present global scenario presents SMEs with a different problem altogether are identified as challenges from two very distinct directions. First, it is clear that there advanced philosophies in manufacturing that are emerging in the current world systems. That means that the methods that have been in existence for a longer time are becoming more and more obsolete. The other issue is that there is a changing trend in the consumption trends that are driving the level ratio of price-performance (Garza-Reyes and Kumar, 2014; Gurumurthy and Kodali 2011; and Thanki, Govindan and Thakkar, 2016). Essentially, Mason, Williams and Found, (2015), and Kumar, Antony and Tiwari, (2011) note that the reason India focussed on introducing technological leverage to the SMEs is because technologically savvy products have the capacity to

dynamically change with the changing trends in the market systems.

The mitigating strategies to this fact are that of reduction of wastes while at the same time increasing the values accorded to the customers. It is therefore notable that the companies are noting the changes in the level of completion in the market and then matching that with the need to adapt to the systems that have to support the same changes (Garza-Reyes and Kumar, 2014; Gurumurthy and Kodali 2011; and Thanki, Govindan and Thakkar, 2016).

Based on the findings of Mason, Williams and Found, (2015), and Kumar, Antony and Tiwari, (2011), SMEs in India have henceforth been able to adapt to lean manufacturing as one of the ways of cutting on the waste and increasing the value of the products. On the basis of the productive aspects associated with the reason for introduction of lean manufacturing, it is determinate that this method has been adapted as it uses less of everything in terms of the applicable resources. Efficiency is increased and the cost decreased. In the case of India, it has been notable that the aspect of lean manufacturing has been useful in continuous improvement of the processes associated with making sure that there is an absolute level of sufficiency in the end levels of production. In a country where there are lesser levels of financial capabilities than would be useful in developed economies. It is therefore clear that lean production with application to SMEs is the main factor that would be useful in definition of production as posited by Garza-Reyes and Kumar, (2014); Gurumurthy and Kodali (2011); and Thanki, Govindan and Thakkar, (2016).

It is therefore clear that several decades of changes in the process of lean production has largely been a concept that has dynamically shaped the process of defining production as a process. It is therefore necessary that the process of implementation of SMEs in India is an issue that needs to be further investigated in such a research as this so that sufficiency is obtained from the level to which there is contribution to the economy of the country (Garza- Reyes and Kumar, 2014; Gurumurthy and Kodali 2011; and Thanki, Govindan and Thakkar, 2016).

Problem Statement

Chowdary and George (2011) noted that there are so many firms that have been misapplying the application of lean management. The main reasons for this have been that which focuses on lack of the right knowledge and techniques in making the lean management practices work with the different sectors especially at the SME level. It is therefore determinate that there are lean cultural practices, skills and applications that are very practical in making the entire process work (Gandhi, Thanki and Thakkar, 2018, p. 114). The application of lean management has therefore been an issue that needed sufficient research levels that will be useful in making decisions on many of the future practices in the industry. Gnanaraj et al (2012) noted that most of the SMEs seem to be faced with much the same problem when making applications to the application of lean management.

Some of the factors that need to therefore be applied at this level are that of determining the different aspects that will need to be put to task to ensure success of the lean practices. SMEs have been noted by many studies to therefore use the wrong tools in solving the same problems which, when sustained leads to many losses (Godinho, Ganga and Gunasekaran (2016) that are sustained over an elongated period of time. There is also use of the same tools to solve all the problems affecting their performance as well as using the same tool to solve each of the problems. These are traits that are particularly peculiar with SMEs in India and the changes in the dynamism levels have been able to effectively determine the ideal fact that there is need to have a clear understanding of the situation as it is in the country (Gurumurthy and Kodali, 2011, p. 41). The Indian market has been one that can be defined by very few entry barriers but again the same SMEs have very little power to dictating what the suppliers need to supply to them. The inception of various protocols by the government is an issue that has been very important leading to progressive development of the SMEs in the country (Haleem et al, 2012, p. 81). It is therefore expressed that SMEs, especially in India are very vulnerable. There is therefore an identified level of conflict between the lean management principles and the operational capacities of SMEs in India, largely based on the flow of the information and the effective lack of expertise in dealing with such trends in the market due to lack of

experience on the same matter (Mason, Williams and Found, 2015,p. 76).

Research on SMEs in the UK as a sample indicated that the success rate after application of lean management was found to be very low at just 10%. There is therefore continued conflict between the levels to which lean management has impacted the SME sector. In the case of India, the practices that have been set up by the government are seen to be the start of a sustained move to improve the value of the SMEs with a focus on lean management (Khatri and Metri, 2016, p. 76). Quite a number of issues will then be realized on the basis of focus to India. One of them is whether the sector will just need to embark on productivity and quality programs to increase the level of competitiveness in the marketGurumurthy and Kodali (2011); and Thanki, Govindan and Thakkar, (2016) are of the view that this is a method that has been adapted by larger organizations in the country band there is need to establish whether it also applies to the SMEs in the same country. While the SMEs may want to focus on such a step, it is also practical that they will need to develop aspects that are based on defining the level to which they can sustain themselves in the long run, given that the larger organizations will do so because they are able to sustain long run costs and eventual benefits (Kumar, Antony and Tiwari, 2011).

Few studies, such as those of Mason, Williams and Found, (2015), and Kumar, Antony and Tiwari, (2011), have been done on the basis of the relationship between lean management and SME applications and the results create a research gap that has to be filled with such a research as this. The empirical attempt by the research process is based on the fact that there will be a focus on the two major business systems in the country; manufacturing and service industry that have taken over the application of SMEs. It is also plausible that understanding is determined on the basis of the level to which lean management will suffice to acclaim the created values (Mason, Williams and Found, 2015, and Kumar, Antony and Tiwari, 2011).

CHAPTER 1. THEORETICAL FRAMEWORK OF LEAN

Lean Manufacturing is an incorporated socio-technical framework, which involves a bundle of the board rehearses that can be applied to take out the waste and lessen the inconstancy of providers, clients and inner assets and procedures (Anvari, Zulkifli, Yusuff, Ismail, and Hojjati, 2011 Anvari, A., Zulkifli, N., Yusuff, R. M., Ismail, Y., and Hojjati, S. H. (2011). A proposed dynamic model for a lean guide. African Journal of Business Management.; Shah, Chandrasekaran, and Linderman, 2008 Shah, R., Chandrasekaran, An., and Linderman, K. (2008). In quest for usage designs: The setting of Lean and Six Sigma. Worldwide Journal of Production Research. . Lean idea has been generally acknowledged in the administration and assembling ventures. Various literary works have considered the lean advantages and applications. The term lean was first authored by Krafcik (1988 Krafcik, J. F. (1988). Triumph of the lean creation framework. Sloan Management Review, Thusly, Womack, Jones, and Roos (1991 Womack, J. P., Jones, D. T., and Roos, D. (1991). The machine that changed the world: How Japan's clear-cut advantage in the worldwide auto wars will reform western industry (first ed.). New York, NY: Harper Perennial. utilized the term lean generation to portray the Toyota creation framework (TPS).

Womack, J., and Jones, D. (2003). Lean reasoning: Banish squander and make riches in your enterprise. London: Free Press. expressed that lean standards can be applied in any industry. Various sorts of associations have executed lean assembling. In any case, Marvel and Standridge (2009 Wonder, J. H., and Standridge, C. R. (2009). Reproduction improved lean structure process. Diary of Industrial Engineering and Management contended that not many associations accomplish noteworthy enhancements by applying lean. As the upgrades stay confined, those associations can't support the ceaseless enhancements. Pastry specialist (2002 Bread cook, P. (2002). For what reason is lean so far away? Works Management, revealed that the achievement level of UK associations on lean execution is under 10%. It is accepted that the primary explanation of unattainability of lean advantages is the inadequate comprehension of the lean idea and the reason for the lean practices. A few organizations twist the lean practices. The primary reasons of the misapplications are as: 'utilization of wrong device to take care of an issue', 'utilization of single device to take care of much of the issues' and 'utilize a similar arrangement of apparatuses on every issue' (Pavnaskar, Gershenson, and Jambekar, 2003 Pavnaskar, S. J., Gershenson, J. K., and Jambekar, A. B. (2003). Order conspire for lean assembling instruments. Universal Journal of Production Research Erroneous utilization of lean idea prompts misuse of the

hierarchical assets and decrease in workers' trust in rehearsing lean (Marvel and Standridge, 2009Wonder, J. H., and Standridge, C. R. (2009). Reproduction upgraded lean plan process. Diary of Industrial Engineering and Management, it is recommended that extension and substance of lean assembling ought to be comprehensively checked preceding any lean execution (Crute, Ward, Brown, and Graves, 2003 [1]

Crute, V., Ward, Y., Brown, S., and Graves, A. (2003). Executing Lean in aviation – Challenging the presumptions and understanding the difficulties. Technovation, A few supervisors and workers assumed that the factor behind Toyota achievement was about the social roots, yet not lean practices. Despite analysis raised by other hierarchical administration, Toyota as a fruitful driving association in lean application has exhibited

[1] https://www.tandfonline.com (05/06/2019).

superior with its creation framework built up in all global assembling locales (Wafa and Yasin, 1998Wafa, M. An., and Yasin, M. M. (1998). A calculated system for successful usage of JIT: An observational examination. Global Journal of Operations and Production Management, Albeit lean advantages are broadly perceived from Toyota's examples of overcoming adversity, the current guides and structures look immense from the perspective on experts. Intricacies of lean usage are accepted to be driven by official, social, administrative, execution and specialized hindrances (Flinchbaugh, 1998 Flinchbaugh, J. W. (1998). Actualizing lean assembling through manufacturing plant configuration (Master). Massachusetts Institute of Technology. Along these lines, the point of this paper was to propose a far reaching venture based usage system for lean progress in a down to earth way. The proposed system was worked as a venture based execution approach of definite four stages. The paper foresees improving the lean change process through the usage structure proposed.

1.1. LEAN PHILOSOPHY

Lean creation depends on worth age which is gain by decreasing squanders and non-value including exercises in assembling process. The entire creation framework is overseen so that it gives an incentive to end client. It focuses on absolute time and cost of the task as opposed to individual time and cost of exercises drew in with the venture. Every movement is composed by one calendar and it is trailed by individuals from association who sets the venture target and execution.[2] Incentive for clients, for the procedure and single progression of data towards the conclusion is the fundamental objective in Lean Production hypothesis. Koskela outlined after standards which guarantees increment in productivity to control and improve the stream in Lean Production hypothesis. These standards have been ad lobbed and advanced in different fields to control the stream plan and procedure.[3]

1. Reduce non-value adding activities.
2. Organize production as a continuous flow.
3. Increase output value through systematic consideration of customer requirements.
4. Reduce Variability.
5. Simplify by minimizing the number of steps, parts and linkages.
6. Increase output flexibility.
7. Increase process transparency.
8. Focus control on complete process.
9. Build continuous improvement into the process.
10. Reduce cycle time.
11. Benchmark.

[2] Liker, 2004.
[3] Koskela, 1992.

Every one of these standards are applied for ceaseless improvement structure for assessment of generation process. Prior development was utilized as an assessment of creation which is increasingly redirected towards changes inverse to nonstop improvement where the objective is stream. There were a few issues in conventional measures.

- They don't lead to continuous improvement and do not give incidental cost sources which diverts focus point[4].

- They measure after the fact and they accumulate too much statistics particularly in computerized system.

- They lead to indigenous ideals instead of global optimum[5].

In lean hypothesis, new estimation was created to help this new guideline which incorporates following Measurement necessity.[6]

- Waste to backing waste decrease.

- Added value in each step to reduce non-value accumulation movement.

- Variability and defects to diminish variability.

- Cycle time of all main and sub-processes.

- Simplicity/complexity.

Transparency to make visible all the methods so people can obtain direct feedback at both global and local level.

1. Organisation obligation for introductory ways for change.

2. Improvable and quantifiable focus for specimen cycle time for continuous improvement.

3. Operative involvement.

4. Learning tools, techniques and principles of development organisation by small tests.

Attention on causes then results. Status and rate of development, to implement the probable for improvement, trends are more valuable than fix numbers to finish up, Lean hypothesis is stream procedure of material and data which are controlled for insignificant variety and process duration, improved consistently in regards to waste and esteem and occasionally for effectiveness by actualizing new technology

[4] (Johnson & Kaplan, 1987) in (Koskela, 1992).
[5] (Umbel & Srikanth, 1990, p. 270) in (Koskela, 1992).
[6] (Plossl, 1991, p. 189) in (Koskela , 1992).

1.2. TYPES OF WASTE IN LEAN

A centre guideline in lean philosophy is the evacuation of waste inside an activity. Also, in any business, perhaps the heaviest channel on gainfulness is squander. Lean burn through can come as time, material, and work. In any case, it might likewise be identified with the use of ranges of abilities just as lack of foresight. In lean assembling, squander is any cost or exertion that is used yet which doesn't change crude materials into a thing the client is eager to pay for. By enhancing procedure steps and wiping out waste, just obvious worth is included at each period of generation. Today, the Lean Manufacturing model perceives 8 kinds of waste inside an activity; seven initially imagined when the Toyota Production System was first considered, and an eighth included when lean philosophy was embraced inside the Western World. Seven of the eight squanders are creation procedure situated, while the eighth waste is straightforwardly identified with the board's capacity to use work force.[7]

Figure 1. 8 waste of Lean methodology Source: www.bing.com (05/06/2019).

[7]www.machinemetrics.com (05/06/2019)

Table 1 . 8 Wastes of Lean Manufacturing with Examples from Service Organizations

Type of waste	What is it?	Examples
Waste of Over-production	Processing too soon or too much than required	• Information sent automatically even when not required • Printing documents before they are required • Processing items before they are required by the next person in the process
Waste of Defects	Errors, mistakes and rework	• Rejections in sourcing applications • Incorrect data entry • Incorrect name printed on a credit card • Surgical errors
Waste of Inventory	Holding inventory (material and information) more than required	• Files and documents awaiting to be processed • Excess promotional material sent to the market • Overstocked medicines in a hospital • More servers than required
Waste of Over-Processing	Processing more than required wherein a simple approach would have done	• Too much paperwork for a mortgage loan • Same data required in number of places in an application form • Follow-ups and costs associated with coordination • Too many approvals • Multiple MIS reports
Waste of Transportation	Movement of items more than required resulting in wasted efforts and energy and adding to cost	• Movement of files and documents from one location to another • Excessive e-mail attachments • Multiple hand-offs
Waste of Waiting	Employees and customers waiting	• Customers waiting to be served by a contact center • Queue in a grocery store • Patients waiting for a doctor at a clinic • System downtime
Waste of Motion	Movement of people that does not add value	• Looking for data and information • Looking for surgical instruments • Movement of people to and fro from filing, fax and Xerox machines
Waste of Un-Utilized People	Employees not leveraged to their own potential	• Limited authority and responsibility • Managers common • Person put on a wrong job
Waste of Over-production	Processing too soon or too much than required	• Information sent automatically even when not required • Printing documents before they are required • Processing items before they are required by the next person in the process
Waste of Defects	Errors, mistakes and rework	• Rejections in sourcing applications • Incorrect data entry • Incorrect name printed on a credit card • Surgical errors

Source: www.processexcellencenetwork.com (05/06/2019).

1.3. INTRODUCTION OF METHOD & QUALITY MANAGEMENT

1.3.1. VALUE STREAM MAPPING

The harmony among free market activity is in a steady condition of motion. In any case, it won't be a long way from reality to state that supply has been consistently developing in numerous businesses quicker than the interest. As the market is getting progressively immersed continuously, clients are ending up progressively self-absorbed and hard to persuade that you will give the worth they are searching for.

Fortunately, Lean has an approach to stretch out beyond the challenge by imagining and improving the worth stream you are conveying to your customers. The Value stream mapping procedure enables you to make a natty gritty representation of all means in your work procedure. It is a portrayal of the progression of merchandise from provider to client through your association. For instance, the worth a product organization conveys to its clients are programming arrangements and all highlights inside. A worth stream guide puts in plain view all the significant strides of your work procedure important to convey an incentive from beginning to end. It enables you to envision each errand that your group deals with and gives single look status reports about the advancement of every task. It is imperative to explain that as indicated by Lean, esteem is everything that the client would pay for. In any case, with regards to mapping a worth stream, there are steps that may not carry direct an incentive to your client but rather help to guarantee that you will probably convey the last item/administration.

A reasonable case of such advances are the quality investigations that are a vital advance in each generation procedure. Your client isn't paying you to do these checks however on the off chance that you convey a last item that doesn't fulfil their quality guideline or desires, they will be less ready to purchase from you ever again. The main role of making a worth stream guide is to demonstrate to you the spots where you can improve your procedure by imagining the two its worth including and inefficient advances. You simply need to put in plain view each significant advance of your work process and assess how it carries an incentive to your client. This enables you to break down your procedure top to bottom and gives you indicate where you should make changes to improve the manner in which you work. Value stream mapping turned into a famous practice with the ascent of Lean in the second 50% of twentieth century. It was one of the establishments that made the Toyota Production System an assembling sensation in spite of the fact that, at that point, the term VSM was not present. However, it is a typical misguided judgment that Toyota concocted the training related with mapping a work process in a visual manner. As a general rule, there are records of outlines demonstrating the progression of materials and data contained in a 1918 book called Installing Efficiency Methods, by Charles E. Knoeppel.

By the 1990's, the worth stream mapping procedure turned out to be a piece of the lives of numerous western supervisors. Its ubiquity began to exceed assembling and in the long run spread into information work ventures, for example, programming improvement, IT activities, advertising and numerous others. Value stream mapping is picking up prominence in learning work since it permits groups that work in a soloed domain to picture their work and team up better. Indeed, even individual patrons can have a 10,000-foot outline of how the cooperation is advancing. Thus, groups can expand the effectiveness of work handoffs, which are a noteworthy guilty party for collecting hold up time in your framework. Holding up is one of the 7 squanders of Lean and in this manner it ought to be everybody's needed to limit it. Mapping your procedure can enable you to envision where handoffs happen so you can likewise find where the bottlenecks (lines) of your procedure are and concocted an approach to limit their harm to your group's profitability.[8]

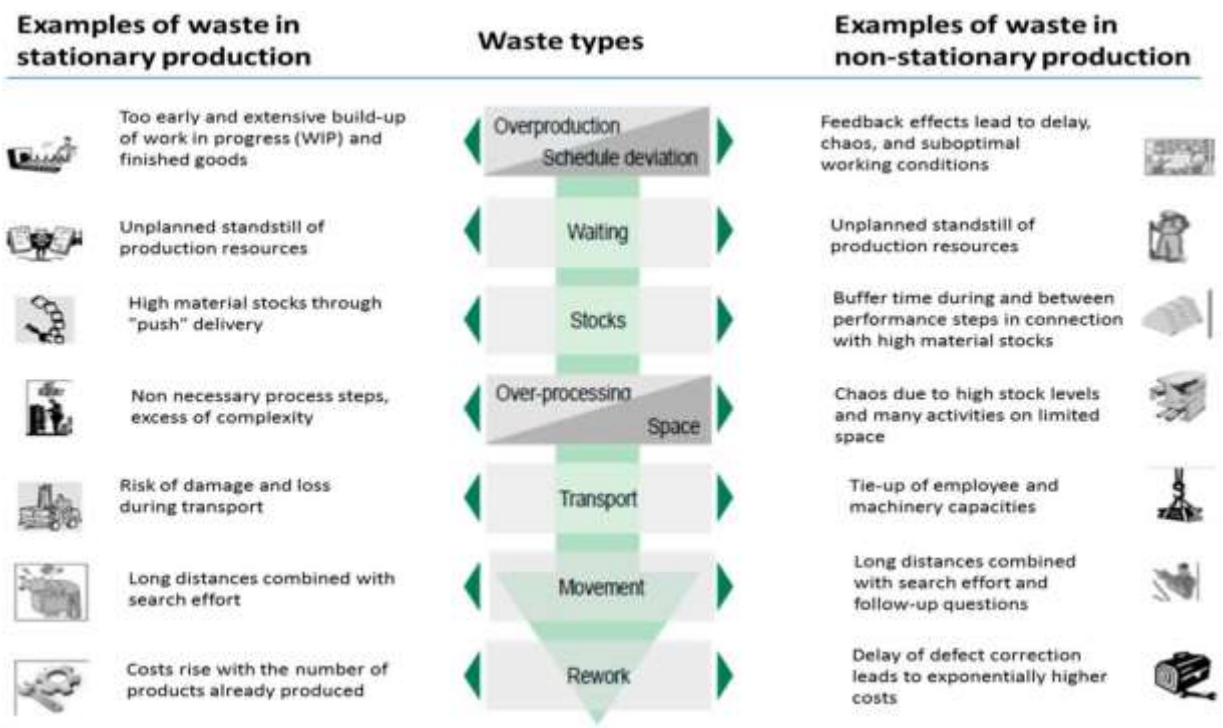


Figure 2. Example of Value Stream Mapping

Source: https://www.mdpi.com/2071-1050/9/12/2184 (07/06/2019).

1.3.2. KAIZEN

Over 30 years ago, Masaaki Imai sat down to pen the groundbreaking book 'KAIZEN™: The Key to Japan's Competitive Success' (McGraw Hill). Through this book, the term KAIZEN™ was introduced in the western world. Today KAIZEN™ is recognized worldwide as an important pillar of an organization's long-term competitive strategy. Since introducing this term as a systematic approach for business improvement, companies that implement KAIZEN™ have continually yielded superior results.

[8] https://kanbanize.com/lean-management/value-waste/value-stream-mapping/(07/06/2019).

"KAIZEN™ means improvement. Moreover, it means continuing improvement in personal life, home life, social life, and working life. When applied to the workplace KAIZEN™ means continuing improvement involving everyone – managers and workers alike." Masaaki Imai, Founder of Kaizen Institute[9]

Kaizen is a way to deal with making nonstop improvement dependent on the possibility that little, continuous positive changes can procure significant upgrades. Ordinarily, it depends on participation and duty and stands as opposed to approaches that utilization radical changes or top-down orders to accomplish change. Kaizen is center to lean assembling, or The Toyota Way. It was created in the assembling segment to lower surrenders, dispose of waste, support efficiency, energize specialist reason and responsibility, and advance development. As an expansive idea that conveys horde elucidations, it has been embraced in numerous different ventures, including human services. It tends to be connected to any region of business, and even to individual life. Kaizen can utilize various methodologies and apparatuses, for example, esteem stream mapping, which records, dissects and improves data or material streams required to create an item or administration, and Total Quality Management (TQM), an administration system that enrolls laborers at all levels to concentrate on quality enhancements. Despite philosophy, in a hierarchical setting, the effective utilization of Kaizen lays on picking up help for the methodology over the association and starting from the ceo.

Kaizen is a compound of two Japanese words that together decipher as "great change" or "improvement," yet Kaizen has come to signify "ceaseless improvement" through its relationship with lean procedure. Kaizen has its inceptions in post-World War II Japanese quality circles. These circles or gatherings of

laborers concentrated on counteracting abandons at Toyota and were grown halfway in light of American administration and efficiency experts who visited the nation, particularly W. Edwards Deming, who contended that quality control ought to be put all the more legitimately in the hands of line laborers. Kaizen was brought toward the West and promoted by Masaaki Imai by means of his book Kaizen: The Key to Japan's Competitive Success in 1986.

Likewise, with lean, Kaizen is correlative to Six Sigma. Ten standards of Kaizen

Since executing Kaizen requires empowering the correct mentality all through the organization, 10 rules that address the Kaizen attitude are ordinarily referenced as center to the way of thinking. They are[10]:

1. Let go of assumptions.
2. Be proactive about solving problems.
3. Don't accept the status quo.
4. Let go of perfectionism and take an attitude of iterative, adaptive change.

[9] https://www.kaizen.com/what-is-kaizen.html(07/06/2019).
[10] www.searcherp.techtarget.com (07/06/2019).

5. Look for solutions as you find mistakes.
6. Create an environment in which everyone feels empowered to contribute.
7. Don't accept the obvious issue; instead, ask "why" five times to get to the root cause.
8. Cull information and opinions from multiple people.
9. Use creativity to find low-cost, small improvements.
10. Never stop improving.

Try not to acknowledge the undeniable issue; rather, ask "why" multiple times to get to the main driver.

Winnow data and suppositions from different individuals. Use inventiveness to discover minimal effort, little upgrades.[11]

Improve constantly. How Kaizen functions

Kaizen depends on the conviction that everything can be improved, and nothing is the present state of affairs. It additionally lays on a Respect for People rule. Kaizen includes distinguishing issues and openings, making arrangements and moving them out - and after that burning through the procedure again for different issues or issues that were deficiently tended to. These following seven stages make a cycle for ceaseless improvement and give a methodical technique for executing this procedure.

Kaizen cycle for consistent improvement:

Get workers included. Look for the association of workers, incorporating gathering their assistance in recognizing issues and issues. Doing as such makes purchase in for change. Regularly, this is composed as explicit gatherings of people accused of social event and transferring data from a more extensive gathering of workers.

Discover issues. Utilizing far reaching input from all workers, assemble a rundown of issues and potential chances. Make a waitlist if there are numerous issues.

Make an answer. Urge representatives to offer innovative arrangements, with all way of thoughts empowered. Pick a triumphant arrangement or arrangements from the thoughts introduced.

Test the arrangement. Actualize the triumphant arrangement picked above, with everybody taking an interest in the rollout. Make test cases projects or find a way to test out the arrangement.

Figure 3. Kaizen Cycle of Continuous Improvement Source: https://searcherp.techtarget.com (07/06/2019).

Break down the outcomes. At different interims, check advance, with explicit designs for will's identity the purpose of contact and how best to keep ground-level laborers locked in. Decide how fruitful the change has been.

Institutionalize. On the off chance that outcomes are certain, receive the arrangement all through the association.

Rehash. These seven stages ought to be rehashed on a progressing premise, with new arrangements tried where suitable or new arrangements of issues handled.[12]

1.3.3. 3M APPROCH VALUE ADDED

Toyota has built up its creation framework around taking out three adversaries of Lean: Muda (squander), Muri (overburden) and Mura (unevenness) (Liker, 2004).

Muda is the immediate impediment of stream. As composed beneath, there are 8 particular kinds of muda which all lead to holding up times, and accordingly longer lead times in a procedure. Basically taking out the muda does not work. Typically, there is an inspiration driving why the muda is there and this reason every now and again has to do with the other two enemies: muri and mura. This suggests the three adversaries of Lean are interrelated and should thusly be considered simultaneously.

The three enemies of lean can be found in both age and office structures. I even set out to express that they can be found more in office structures than in progress strategies. One clarification behind this is creation strategies are unquestionable. Everybody who walks around a mechanical office can see the stock clutching is managed. In the work environment condition in any case, structures are much of the time concealed inside our PCs, in letter boxes and IT-systems. Notwithstanding the way that it is the target of safe house lessen

[12] https://searcherp.techtarget.com/definition/kaizen-or-continuous-improvement (08/06/2019).

every one of the three adversaries of Lean, it most likely won't be possible to absolutely clear all of them (Panneman, 2017). To the extent muda, aside from if your handling plant is put next to your customer, there will reliably be a sort of vehicle critical to get the thing to your customer. We should focus on reducing

the vehicle time and costs as much as we can; anyway 100% lessening isn't handy.[13]

Comparative holds for muri. There can for the most part be the place machines or people need to give that little extra effort or time to guarantee the customer solicitation is fulfilled. There is nothing out of order with this when you can thusly get an enormous solicitation of extra things or sway another client. The issue exists when you are expecting this from your machines or people continually, in a specific way where a machine will catch fire or a partner wears out. Finally, even mura can't for the most part be diminished with 100%. When you are conveying different things, they will without a doubt require different materials, a substitute technique for working or even uncommon methodology times. This is significantly more so in errand work, where each adventure is novel, or in the budgetary world, where a money related report ought to be passed on around the completion of every month. The following three articles clarify in more detail how we can discover and dispense with the three foes of lean from our procedures, here is a short outline of what's in store:

MUDA, squander, can be characterized in eight kinds, 7 characterized by Toyota and 'non used abilities'. These are: Defects, Overproduction, Waiting, Non-utilized Talent, Transport, Inventories, Motion and Excess preparing. As Mnemonic gadget, the main letters of these squanders structure the abbreviation DOWNTIME (Panneman, 2017). There are various instruments accessible to distinguish and expel squander from your procedure, which incorporate Poke Yoke, Kanban, Takt Time, SMED and One-Piece stream. The most widely recognized device that improves profitability by evacuating each of the 7 squanders, be that as it may, is 5S (Panneman, 2019). In the article Finding Muda (squander) in your procedure every one of the sorts of waste are portrayed and connected to instruments which can be utilized to dispose of them methodically.

MURI, overburden, can result from Mura, and from expelling an excessive amount of Muda (squander) from the procedure. Whenever administrators or machines are used for over 100% to complete their errand, they are overburdened. This implies breakdowns with regards to machines and non-attendance with regards to workers. To streamline the utilization of machines and ensure they work appropriately, safeguard and self -sufficient upkeep can be executed (source: www. searcherp.techtarget.com 07/06/2019).

Figure 4. Relationship between Muda , Mura , Muri Source: www.mudamasters.com (07/06/2019).

To avert exhausted representatives; wellbeing ought to be the focal point of all procedure structures and all standard work activities. For more data about Muri, go legitimately to the article: Finding Muri (overburden) in your procedure.

MURA, unevenness, can be found in vacillation in client request, process times per item or variety of process durations for various administrators. Underway situations with low- volume, high item variety, adaptability could really compare to in high-volume, low-item variety conditions. At the point when Mura isn't diminished, one expands the likelihood for Muri and in this manner Muda. Mura can be decreased by making receptiveness in the inventory network, change product design and make standard work for all administrators. These are portrayed in the article: Finding Mura (variety) in your procedure.

1.3.4. ISHIKAWA DIAGRAM

Kaoru Ishikawa needed to change the manner in which individuals consider work. He encouraged chiefs to oppose getting to be content with only improving an item's quality, demanding that quality improvement can generally go above and beyond. His idea of far reaching quality control called for proceeded with client administration. This implied a client would keep accepting administration even in the wake of getting the item. This administration would reach out over the organization itself in all degrees of the board, and even past the organization to the regular daily existences of those included. As indicated by Ishikawa, quality improvement is a ceaseless procedure, and it can generally be made one stride further. With his circumstances and logical results outline (additionally called the "Ishikawa" or "fishbone" chart) this administration head made huge and explicit progressions in quality improvement. With the utilization of this new chart, the client can see every single imaginable reason for an outcome, and ideally discover the foundation of procedure flaws. By pinpointing root issues, this chart gives quality improvement from the "base up." Dr. W. Edwards Deming
- one of Ishikawa's associates - embraced this chart and utilized it to show Total Quality Control in Japan as right on time as World War II. Both Ishikawa and Deming utilize this graph as one the principal devices in the quality administration process.

Ishikawa likewise demonstrated the significance of the seven quality devices: control outline, run graph, histogram, disperse outline, Pareto diagram, and flowchart. Furthermore, Ishikawa investigated the idea of value circles- - a Japanese way of thinking which he drew from lack of clarity into overall acknowledgment. .Ishikawa put stock in the significance of help and authority from top level administration. He ceaselessly encouraged top level officials to take quality control courses, realizing that without the help of the administration, these projects would eventually come up short. He focused on that it would take solid responsibility from the whole progressive system of representatives to arrive at the organization's potential for progress. Another region of value improvement that Ishikawa underscored is quality all through an item's life cycle - not simply during creation. Despite the fact that he accepted emphatically in making measures, he felt that guidelines resembled persistent quality improvement programs - they also ought to be always assessed and changed. Principles are not a definitive wellspring of basic leadership; consumer loyalty is. He needed chiefs to reliably address purchaser issues; from these requirements, every single other choice should stem. Other than his very own advancements, Ishikawa drew and explained standards from other quality masters, including those of one man specifically: W. Edwards Deming, maker of the Plan-Do-Check-Act model. Ishikawa extended Deming's four stages into the accompanying six:[14]

- Determine goals and targets.
- Determine methods of reaching goals.
- Engage in education and training.
- Implement work.
- Check the effects of implementation.
- Take appropriate action.

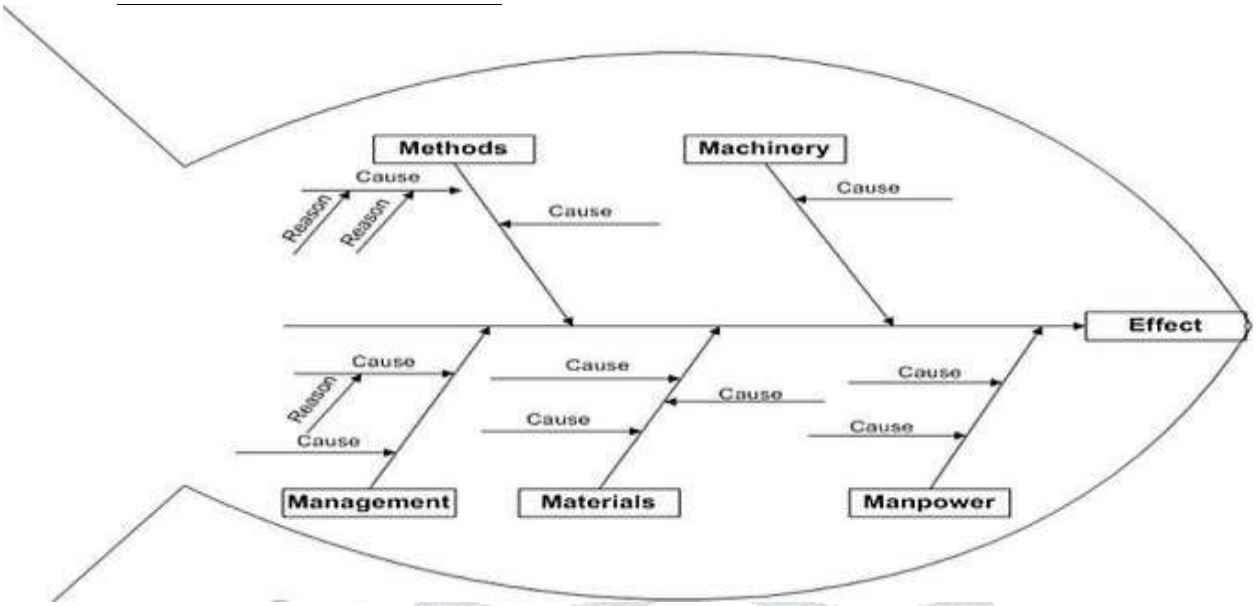


Figure 5. Ishikawa Diagram

Source: https://www.investopedia.com.(09/06/2019).

Process to Make an Ishikawa Diagram

To make an Ishikawa Diagram, a group will need a white board, flip chart and some marking pens.

1. The group should agree on a problem statement (effect).
2. Write the problem statement at the center right of the flipchart or whiteboard, box it and draw a horizontal arrow running to it.
3. Brainstorm the primary categories of causes for the problem. For instance, it might make sense to start with these generic headings: methods, machines (equipment), people (manpower), materials, measurement, and environment.
4. Write the categories of causes as branches from the main arrow.
5. Brainstorm possible causes. Ask: "Why does this happen?" As each idea is given, the facilitator writes it as a branch from the appropriate category. Causes can be written in several places, if they relate to several categories.
6. Ask the question "why does this happen?" again. Write sub–causes branching off the causes. Continue to ask "Why?" and generate deeper levels of causes. Layers of branches indicate causal relationships.
7. When the group runs out of ideas, focus attention to areas in the chart where ideas are thin.[15]

[15] https://asq.org/quality-resources/fishbone (07/06/2019).

1.3.5. PARETO CHART

In some cases, it is trying for you to comprehend the issues and their causes. Rather than concentrating on the underlying driver, you invest your energy, taking care of issues, which were affecting the venture least. The Pareto graph can enable you to beat this circumstance. The Pareto chart can enable you to isolate the imperfections and their motivation. When you get this data, you can concentrate on the reason which is creating the most deformities. The Pareto outline depends on the Pareto Principle, which was created by an Italian financial expert named Vilfredo Pareto while dissecting the riches dissemination of individuals in the public eye. He discovered that generally 80% of the riches were held by 20% of the populace. Thusly, this guideline is otherwise called the 80/20 standard. Later on, further examinations

demonstrated that a similar marvel could be seen in different territories also, for example,

80% of your business originates from 20% of your items on the off chance that you have numerous items.

80% of client issues identified with 20% of the issues.

80% of the imperfections are because of 20% of the issues. 80% of the objections are because of 20% of

the deformities. 20% of the deformities cause 80% of the issues.

All in all, this marvel can be translated as pursues: Roughly 80% of the issues will be because of 20% of the causes, or most of issues will be because of few causes.[16]

In any case, remember that the above guideline is a general principle and the proportion isn't outright. The Pareto outline is one of the key apparatuses in quality administration and Six Sigma. This diagram encourages you to discover most of the issues and their main drivers. You would then be able to put your exertion in those causes and tackle most of the issues.

The most effective method to draw a Pareto Chart

Drawing a Pareto outline is exceptionally simple. The significant advance is to gather the right information. The means to drawing a Pareto diagram are as per the following:

Select the classification of causes you need to gathering issues in. Decide the measure, for instance,

recurrence, cost, time, and so forth.

Decide the period to gather the information; for instance, one cycle, at some point, or multi week.

Gather the information.

Isolate the information per their classifications.

Draw a bar diagram with causes on the x-pivot and number of events on the y-hub.

Presently, draw the bar with the most noteworthy number of events at the extreme left and name the classification. Rehash the method until you complete every single recognized classification.

The classification with the most minimal number of deformities will be at the extreme right.

The Pareto diagram is prepared, and now you draw a combined aggregate line. The method to draw this line is as per the following:

Discover the level of every class.

Include the level of the first and second bar and put a spot on the subsequent bar.

Presently, include the level of the third bar and spot a dab at the highest point of the third bar. Proceed

with the procedure until all bars are secured.

Interface every one of the specks.

Presently, the combined total line is drawn. Ensure that the bar at the extreme right has a level of 100%.

In outline, to draw the Pareto graph, you gather the issues in your procedure and order them by their sort and draw a bar diagram according to their classification. The most usually happening issues will be kept on the left side and minimal basic on the extreme right side.

Presently, you can isolate the causes creating most of the issues, break down them, discover the answer

for their main drivers, and expel the issues from your procedure.

When You Should Use a Pareto Chart

It is principally utilized in quality administration related procedures. Alongside quality administration, this apparatus can likewise be utilized with different circumstances, for example,

When you have a ton of information and you need to dissect it.

When you need to recognize the fundamental driver for the greater part of the issues. When discussing

information with partners.

When you need to organize undertakings (Source: https://pmstudycircle.com). When you need to see the

overall significance of information.

Advantages of Pareto Analysis

Coming up next is a couple of advantages of Pareto investigation: Drawing a Pareto outline is simple.

This outline encourages you isolate the issues and their causes. It encourages you center around unraveling the few causes which are producing the most extreme measure of issues.

It demonstrates to you the issues to center and get the hugest improvement. This diagram imagines issues rapidly, so this is a fantastic visual specialized apparatus also.

Confinements of Pareto Analysis Coming up next are a couple of impediments of Pareto examination:

The Pareto standard is a standard guideline which is definitely not a general law and can't be connected in all cases. It doesn't enable you to discover the underlying driver of the issue, so you will require another instrument, for example, main driver examination to utilize it adequately. On the off chance that there are numerous issues, you may require more sub- Pareto graphs to isolate, which now and again might be awkward. In spite of the fact that a Pareto outline can demonstrate to you the recurrence of an issue, it can't demonstrate to you the seriousness. The Pareto examination centers around past information which probably won't be huge to present or future situations. The Pareto diagram is a visual outline which has vertical bars and a line chart. The bars speak to the individual estimations of the issue (in diving request), the line speaks to the total aggregate, and the bars are isolated in slipping request from left to right. This outline encourages venture administrators to recognize the reasons for a large portion of the issues the procedure is confronting. It likewise enables the board to organize assignments and exercises. Being a variation of a bar diagram, it is easy to draw, use, and impart issues to partners.[17]

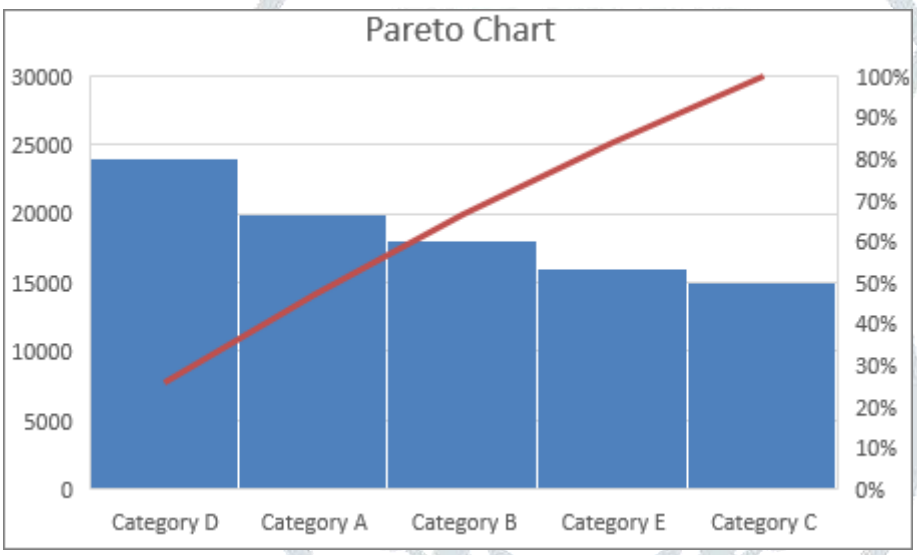


Figure 6. Pareto Chart

Source: https://support.office.com (09/06/2019).

[17] https://pmstudycircle.com/2015/06/pareto-chart/(09/06/2019).

1.4. ORGANIZANAL CULTURE AND CHALLENGES AFFECTING LEAN PRODUCTION

A case reference to Bangladeshi firms indicated that there was lean manufacturing that was applied in the garment industry. It is first clear that the different methodologies will be applied at different levels of production which in effect leads to the overall performance that is highly effective for the company. Garza-Reyes et al (2018) noted that there are some layout processes that were used in creating valuable aspects of the production processes at different levels in time. The company also focussed on utilising the available manpower so that they make use of the floor in which case an optimal number of employees was to be used in the end process. While this was used in Bangladesh, it has been noted from the basis of George (2011) that similar problems, challenges and complications are bound to be experienced. There are also five manufacturing firms that were studies in Iraq as reported by Harash, Al-Timimi and Alsaadi (2014) that while there are many advancements that will be useful in the process, there are also a few factors that can be considered as challenges in the process of making sure that sufficiency is obtained. It can therefore be notable that lean manufacturing underscores to reduce the length of the processes while at the same time increasing the value of the products that have been realised and obtained (Jayathirtha, 2014). The theoretical perspective of The Seven Wastes as defined by Khatri and Metri (2016) considered that while a company in any production or manufacturing industry has the value of benefitting from the process of application of lean manufacturing, there will still be challenges. The basis of the seven wastes is an issue that can be applied in view of making sure that sufficiency is obtained from each of the applicable areas that was strategized and due for application (Dhingra and Singh, 2018; Caldera, Desha and Dawes, 2019; and Abobakr and Abdel-Kader, 2017; Dave and Sohani 2019). The seven wastes in this case make reference to overproduction, waiting, transporting, processing that is inappropriate, unnecessary inventory and excess motion as well as the effective defects. In every case, any of these is likely to be directly applied to the production process as would successfully be useful to making sure that sufficiency is met in the process (Yadav et al, 2019). There are clear aspects that are defined as being the challenges of implementing lean management in the respective companies, especially the SMEs. One of the biggest challenges associated with implementing lean manufacturing is that of the cultural issues (Wamba and Carter, 2016). First, there are companies in any given industry that have well established cultural perspectives. When there is a revolutionary shift that has been introduced, it focuses on the fact that there is likely to be a reduction in the number of employees for example in which case some may be fired while the remaining will have to take in extended levels of responsibilities. This has the characteristic of blurring the lines between the traditional cultural practices that have been used in the company and the ne changes that are needed at the current level of view (Yadav and Desai, 2017). In implementing waste reduction, there will be a high sense of the level to which the company focuses on waste reduction as well as reducing the production costs as well as increasing the production process. There are many cases in which the traditional cultural perspectives have been met which in the end is likely to create a strong focus on the level to which the company makes all the stakeholders adapt to the overall developmental cultural changes (Wach, 2014). The other challenge that is likely to be experienced is that of the supply chain issues. One of the issues that are clear to this aspect is that lean management has the capacity to eliminate some of the storage aspects that are normal with the SMEs dealing in various aspects of production. The time difference between inbound and outbound logistics is very short (Dhingra and Singh, 2018; Caldera, Desha and Dawes, 2019; and Abobakr and Abdel-Kader, 2017; Dave and Sohani 2019). When the JIT aspect of lean management is introduced to the process, there is supply of resources and materials just at the time they are supposed to be used for the production process. There is therefore no time for storage. Naturally, that eliminates the issue of storage and the many processes that are involved in the process of supply. According to Upadhye, Deshmukh and Garg (2010), it is a taxing activity that will ultimately be useful in making sure that sufficiency is met in making sure that the products are made available in the market at the time they are needed. The recipient company must be at constant coordination with the supplying company to make sure that the supplies are made at exactly the right time (Thanki and Thakkar, 2018). This is a sensitive process that allows for application of different aspects of trade to be done at the same time. For instance, in case there is little or no demand for a product, the JIT aspect of lean management is likely to be considered obsolete (Sindhu, Nehra, V., Luthra, S. (2016).

It was noted that SMEs do not have the right financial muscle to make sure that they succeed in dealing

with new inventions and making the appropriate investments (Shakoor et al, 2017). SMEs applying the use of this aspect may be required to make use of different systematic technological investments such as automated production systems, statistical data analysis tools as well as the systems that would be used in measuring the required improvement in the assembly lines of the products being developed for sale. It is therefore clear that sufficiency will only be achieved in high level investment in technology that would automate most of these processes. The costs of doing this can be very high for SMEs to manage (Shrimali, Soni and Pawar, 2018). It is also notable that the technological infrastructure that is required to meet the demands in the market as relating to the aspect of implementing the issue of lean management. Therefore, lean management has its own challenges that have to be taken up in making sure that sufficiency is met and implemented if the SME has to successfully defend its position in the market amidst the usually strong competition (Sharma, 2018).

CHAPTER 2. CRUSIAL IMPORTANCE OF SMES TO INDIA'S ECONOMY (SUPPORTING BY LEAN PRODUCTION TO INDIA'S SMEs)

While research on the development and progress of SMEs in India is still developing, it has been noted that there is a very close connection between the lean processes used in India and the effective success factors that are associated with the process (Chowdhury, Dey, Ghosh, 2018). In India, there are very specific tools that have been used by the SMEs to implement lean production and overall processes. It is also notable that the lean processes are likely to be used at different levels of production which in the end leads to the fact that sufficiency can be obtained and met at the level to which the company makes value to its overall processes (Cortez et al, 2019). In application of quite a number of lean processes, it is notable that there are quite a number of factors that will successfully be used in making sure that the Indian SMEs are useful to the overall process of creating value to its operating systems (Yadav et al, 2019). The specific methods that have been used in the Indian case are as determined from different perspectives. A collection of researches have determined that there are many tools of lean applications that are used in the case of India. In literature compilation consisting of 25 journal papers in contemporary literature done on the Indian SMEs over a span of 15 years, it was notable that the results on application of lean practices in the SMEs in India is quite diverse. This information was collected and compiled by Yadav and Desai (2017) and Verma (2018) indicated vast collections of applications to the Indian market. From a large section of the tools that are used in the lean process in India, it can be considered that there are very specific methodologies that have been put to practice in the Indian case of SME application; value stream mapping, the 5S, the Kaizen method and the visual work place as well as JIT. It has also been notable that others such as mistake proofing have also been used in some of the SMEs. Research over the years has therefore shown that the use of the above tools has directly led to practices inside the organisations that pointed to the need to change methods and practices associated with the process as a whole (Vinodh and Joy, 2012). A case reference to how lean management has been able to help the wood industries in the Indian SME sector can be categorised on the basis of the tabular representation below;

From the research, it is clear that the stated tools were able to give rise to the 15 methodologies that were used in the respective SMEs in the case of India and the effective applicable (Batra, 2016). For instance, the research indicated that when there was application of the tools, the workplace organisation was able to be improved by 73% in application of the 5S methodologies. Error proofing was able to increase its value in the SMEs by 23% and standardisation value was able to increase its value by 40%. These are results that were realised from the basis of the SMEs in the wood manufacturing industry. This is clearly indicates that the results have overly been impactful on the basis of the applied requirements (AlManei, Salonitis and Xu, 2017). For instance, it can be noted that 5S eliminates waste in the process by reorganising the resources in the respective areas that the tools are located. That means that the area has a strong focus on the level to which every tool in the organisation is located. When the tool is located at a place that is accessible by all the people that need it, they will save time looking for it which in the end has positive impacts on the overall running of the company (Centobelli, Cerchione and Singh, 2019).

Lean has also helped the companies make use of the technological processes that have been advancing their values by helping in production automation. While some companies can make use of partial automation, others have the capacity to use complete automation which in the end is largely based on the ideal fact that there is a value in the level to which the production process will be made shorter (Chowdhury, Dey and Ghosh, 2018). The Indian SMEs have therefore benefitted to a large process from

the application of lean production which is a situation that has led to reduced operating and production costs and at the implementation in the process. Total productive maintenance is also a practice that is supposed to keep the running of the entire equipment okay on the basis fact that maintenance practices will be supposed to be carried out regularly through the lean leadership so that there is avoidance of waste by virtue of the production equipment being in derailed form for a period of time. The same period will naturally be useful in making sure that continued production is kept and there is also no change to the level to which there will be a drop in the process as a result of equipment that is broken down (Cortez et al, 2019).

2.1. INDIA'S ECONOMY (THE GENERAL ECONOMY)

India is one of the fastest growing economies in the world (Parnell, 2019). Data from the Central Statistics Office indicate that the economy will be growing by 6.9% at the close of the FY2019. Moreover, the foreign direct investment in the country at the first half of 2019 stood at US$ 44.36 billion. This is a value that is comparatively very high when compared to the other countries that stand at the same economic level of position (Jain and Jain, 2019). Moreover, at the close of May 31st 2019, the country's foreign exchange reserves stood at

$419.99 billion which was seen to be an improving figure by comparable valuation to the immediate previous periods as held by Mason, Williams and Found, (2015), and Kumar, Antony and Tiwari, (2011). There are many other different statistical factors that define the country at its current level of operation. According to Nagaraj and Chaterji (2019), India is the seventh largest economy with reference to its GDP ($4.06 trillion) and also ranks in third position with respect to its purchasing power parity. Much of this purchasing power emanates from the ideal fact that it has a very high population of around 1.2 billion people. One of the turning points that have clearly defined the economy of India is that of the 1991 economic liberalization with the country achieving an economic growth of around 6-7%. However, after 2014, the country has been able to achieve one of the highest growth rates in the world (8.2%) among the major economies as reported by Vijayabaskar and Viswanathan (2019). The biggest driver to this economic growth is the younger workforce with 60% of the population being younger and 40% of the population being within the populations that can be employed (Garza-Reyes and Kumar, 2014; Gurumurthy and Kodali 2011; and Thanki, Govindan and Thakkar, 2016). Mason, Williams and Found, (2015), and Kumar, Antony and Tiwari, (2011) establish that the growth has however been slowed down on the basis of anti- economic factors such as bureaucracy, poor infrastructural levels, labour laws that are inflexible. In terms of the service sectors, India is one of the fastest growing also and the annual growth rate exceeds 9% and this sector has been able to contribute to more than half of the economy of the country (Nagaraj and Chaterji, 2019). The country also has different sectors that contribute differently to the economy. According to Jain and Jain (2019), agriculture accounts for 23% of the GDP and has an employment contribution of 59% of the workforce of the country. The manufacturing industry also contributes to 26% of the GDP and contributes to an employment rate of 22% of the workforce based on the World Bank statistics 2018 (Nagaraj and Chaterji, 2019; Garza-Reyes and Kumar, 2014; and Gurumurthy and Kodali 2011).

Based on the findings of Kumar, Antony and Tiwari, (2011) and the study of Vinodh, Kumar and Vimal, (2014), the economy of India can be categorised from a collection of points depending on the level to which each sector contributes to the GDP. However, as has been stated, the Indian economy can be tracked from the basis of three main sectors, agriculture, industry and service. According to Godinho, Ganga and Gunasekaran (2016), it is necessary that this type of discussion is shelved on the basis of the level to which it has the characteristic nature of bringing focus to the aspect of SME and lean management. Moreover, discussing the different sectors that make up the economy of India is an issue that needs to be considered from a wider perspective as the level of contribution largely depends on the level to which the younger population has majored on it (Vinodh, Kumar and Vimal, 2014).

The Agricultural Sector

Agriculture and other allied sectors in the economy (logging, forestry and fishing) contributes to about 17% of the national GDP and currently employs around 50% of all the people in the country's workforce (Thanki,

Govindan and Thakkar, 2016). Independently, agriculture alone had a 23% contribution rate to the GDP, employing around 59% of the national total workforce. However, it is also notable that the contribution of the agricultural sector to the GDP of the country dropped over the period 1951-2011 with the aspect of the changes in the level of government investment in industrialisation (Upadhye, Deshmukh and Garg, 2010). Even with this decline, it is still the biggest contributor to the GDPO of the country. Ideally, one of the factors contributing to this sustained contribution value is that many of the industries in the manufacturing sector that developed largely source their raw materials from the agricultural sector and industry. According to Vinodh and Joy (2012), it is notable that the sector has largely remained important based on the fact that there has been a large scale investment and further discoveries and investments in technology, irrigation and development of the agricultural practices, findings that have been corroborated by Kumar, Antony and Tiwari, (2011) and the study of Singh, (2011). Indeed, it is observed that there is the green revolution that happened in India and was the starting point in advancing the level improvement in the level to which the country benefits from this sector (Singh, 2011). There are also ten specific states that have been known to contribute to the agricultural sector in the country with Punjab which is to say that the agricultural sector is not evenly distributed. However, as long as the sector provides enough for the economy, it is clear that the country is bound to remain as sustainable as possible in terms of the contributory development (Thakkar, Kanda and Deshmukh, 2012). One of the striking features about agriculture is that India is the world's largest milk, jute and pulses producer according to the research as recorded by Raghunath and Jayathirtha (2014) and Jain and Jain (2019). It also ranks among the highest producers of rice, sugar, cotton and groundnuts in which case it also accounts for around 10% of the world fruit production. While there are vast pieces of land available for agricultural production, it is also notable that the production in the country has naturally lagged behind its level potential, as further established by Thakkar, Kanda and Deshmukh, (2012); Prasanna and Vinodh, (2013); Nagaraj and Chaterji, (2019). The World Bank report (2017) which was corroborated by Wamba and Carter (2016); D'souza and Naik, (2018) also shows that the Indian agricultural sector has very large government subsidies in the sector. The impact of this subsidy is that it has been able to hamper the productivity enhancing investments. This is the same contradiction that has been levelled before as determined by the different aspects in view of reference to the aspect of the level to which different sectors are to grow (Thakkar, Kanda and Deshmukh, 2012; Prasanna and Vinodh, 2013; Nagaraj and Chaterji, 2019). For instance, Panwar et al (2018) noted that when there is a high level of regulation as it is in the Indian sector, there is also likely to be a counterproductive factor of progressive investment being hampered. For instance, when there is overregulation, there will also be an increase in the costs, uncertainties as a result of price risks among many other issues coming up (Nagaraj and Chaterji, 2019). On the same basis, it becomes clear that infrastructure and retail markets remain as unstable as possible, land holdings reduce, the facilities for irrigation remain very inadequate and many other challenges (Panizzolo et al, 2012). However, it is also notable that the government has sought to increase the level of production in the sector by coming up with practices such as Accelerated Irrigation Benefit Programme. However, regardless of all these efforts, it is clear that one third of all the foodstuffs in India are wasted because of lack of specialised facilities for storage (Saboo et al, 2014).

Manufacturing Sector

The manufacturing sector is the other most important sector in the Indian economy. According to the World Bank report (2017) on the country, the industry employs 22% of the workforce and contributes to 26% of the GDP. It has been noted from the basis of Vijayabaskar and Viswanathan (2019) that in 2015, India's industrial manufacturing GDP output was 6th largest in the world at $599 billion. Moreover, from the 1991 economic reforms, there was a developmental growth in which case the government removed import restrictions increased the presence of foreign direct investment in the country which naturally and largely increased the number of foreign investors in the country (Thakkar, Kanda and Deshmukh, 2012; Prasanna and Vinodh, 2013; Nagaraj and Chaterji, 2019). For instance, there was a strong competition from cheaper Chinese products but after the government squeezed the costs, revamped management and increased the value of cheap labour, observations that have been corroborated by Thakkar, Kanda and Deshmukh, (2012); D'souza and Naik, (2018); Nagaraj and Chaterji, (2019). That in essence helped change the impacts that were created by the cheaper products that were coming from the foreign countries to the economy (D'souza and Naik, 2018). This also means that the manufacturing sector has not been able to

develop progressive employment opportunities in the country as a result of the increased levels of regulation.

Other Sectors of the Economy

Findings by Wamba and Carter (2016) and D'souza and Naik, (2018) show that India has a vast level of investment in many other sectors of the economy. There is an engineering sector that is also well established and is the third largest sub sector with reference to the level of contribution to the national GDP (Verma, 2018). This is a subsector that contributes to excess of $70 billion annually in exports. It is in this section of the economy that there are aspects such as progressive infrastructural aspects, textile, pulp and paper and all the other related sectors. While these can be considered from an independent perspective, it is also clear that they are a very important factor to the development of the economy of India (Sharma, 2018).

The services industry is, on the other hand very broad. According to Afridi (2018), this is the sector that has the highest level of contribution to the GDP of India with a 57% GDP input and provides employment to 27% of the workforce in the country. It is clear that India has one of the highest growing IT sector in the world at the moment. The service sectors that are well developed in the country are; aviation, banking, information technology, insurance, tourism and the media (Francis, 2018).

While India is developing at a rate that is high, it is also notable that the country still has balance of payments deficits in its budgetary systems (Parnell, 2019). That means it is borrowing more than it is generating within its operational capacities with respect to the economy. This is an issue that should encourage the government to invest more in income generating activities that would boost its economy in the long run (Jha, 2018).

2.2. THE SCENARIO IN INDIA

Small and Medium Enterprises (SMEs) are enjoying a crucial role within the economic process of Republic of India. As per accessible information SMEs are tributary eighteen within the value growth of Republic of India (FY 2014-2015). SMEs are a supply of employments for the five hundred of Indian population. Nowadays SMEs are flourished in well-organized clusters based mostly manner (Mandar et al., 2014). SMEs are those industrial organizations whose variety of staff and also the annual turnover falls below a particular limit. in keeping with fresh enacted MSME Development Act 2006, that is effective from Gregorian calendar month two, 2006; the enterprises are classified in keeping with the subsequent criteria (Rodriguez et.al. 2007). The most barrier within the growth of SMEs is that the optimum utilization of accessible resources. Even National manufacturing Competiveness Council (NMCC) has planned the varied schemes for developing the worldwide fight of Indian SMEs however still they're facing large losses because of wastage of accessible resources.[18]

The dangerous news is that in spite of all the higher than edges, lean producing in India continues to be within the infancy stage and also the Indian companies are remote from enjoying its complete edges. the attention level of Indian companies on lean producing is incredibly low. The thought is essentially adopted solely by the large companies. One such example is Tata Motors that has created successful story by launching Nano implementing lean producing. Lean philosophy helped to cut back the value while not compromising on size and luxury. Recently several attire companies have additionally opted for lean producing due to the reduction in order-to-delivery time from European importers.

But small and Medium-Sized companies (SMEs) in India are still largely unaware of lean principle. The lean principles can't be enforced precisely the same in each trade and thus the Indian companies ought to selected correct tools and techniques in step with the work culture, infrastructure accessibility and dealing conditions of the particular trade. Further, most Indian companies lack the human resources committee on acceptance of a replacement philosophy. The implementation of lean philosophy demands a impelled and trained work-force and committed high management that isn't obtainable in most Indian SMEs even these days. The competition is incredibly robust and lean principles will prove very helpful for the Indian producing companies to contend globally. It'll facilitate them to

[18] http://www.iosrjournals.org (09/06/2019).

enhance upon product quality and scale back the prices at the side of dashing up the delivery.[19]

Table 2. Classification of SME's in India

Type of enterprise	Investment in plant and Machinery engaged in production of goods	Investment in equipment engaged in providing or rendering of services
Micro enterprise	Does not exceed 25 Lakh rupees	Does not exceed 10 Lakh rupees
Small enterprise	More than 25 Lakh rupees, but does not exceed 5 Crore rupees	More than 10 Lakh rupees, but does not exceed 2 Crore rupees
Medium enterprise	More than 5 Crore rupees but does not exceed 10 Crore rupees	More than 2 Crore rupees but does not exceed 5 Crore rupees

Source: https://www.tandfonline.com/doi/full/10.1080/08276331.2015.1132513 (06/06/2019).

2.3. INTRODUCTION OF LEAN PRODUCTION TO INDIA'S SME

In the studies conducted by D'souza and Naik, (2018) and Nagaraj and Chaterji, (2019), it was established that the issue of lean production in companies has been a great focus for many companies. Lean transformation has been an issue that has been focussed on for some years now. On that basis, the overall application is meant to reduce the costs while at the same time increasing the level of output in each of the companies it is applied in. Yadav et al (2019) focussed on the need to establish a better understanding of the concept of lean production in many of the companies in different parts of the world. The conclusive factor was that of reducing the time periods in which there was a focus on production as well as cutting down on the cost involved. Studies have been able to determine that there seven different types of wastes that do occur in companies. These are the correction, overproduction and motion at the first instance as would be determined by Wamba and Carter (2016). Movement of materials, inventory processing and wasting are the others as would be determined from the position of Wach (2014). It is therefore notable that the analytical view of lean production on the parameters of performance can as well be considered a process through which sufficiency is met with reduction in lead time and costs as noted by Wamba and Carter (2016); D'souza and Naik, (2018); Nagaraj and Chaterji, (2019). Therefore, in lean production, each of the people in the organisation is a thinker and the involvement levels promote thinking capacities in which case they acquire the required levels of agility that would be useful in achieving the market Tripathy et al (2016). Research has therefore been useful in helping understand the level to which lean production is applicable to the issue of SMEs in different parts of the world. Wamba and Carter (2016); D'souza and Naik, (2018) are of the view that given the issue of lean management have not been in use for an elongated period of time, it is clear that there is a strong focus on the level to which there is research that has to help unearth the required practices at that level. It simply means that if the lean production practices are part of the overall system, then there will be a clear understanding of the level to which this is applicable in the SME systems in India and in other parts of the world (Thakkar, Kanda and Deshmukh, 2012; Prasanna and Vinodh, 2013; Nagaraj and Chaterji, 2019). Having understood that India has a developed system of managing production with respect to the number of young people in the population, it is clear that the entire perspective shifts to there being the need to focus on the level to which the lean practices can be useful in the case of India (Thanki and Thakkar, 2018).

[19] https://www.projectguru.in/publications/lean-manufacturing-in-india/ (05/06/2019).

In India, there are several lean models that have been used in the process to make sure that sufficiency is met in developing the right practices that would be part of the overall systems (Sraun and Singh, 2017). For instance, there are SMEs in the whole sale sector that has been successfully noted to use value stream mapping to get the best from the customers in the market. Moreover, there have also been those that apply the 5S organisation of the work place, total productive maintenance as well as the set-up production process as posited by Wamba and Carter (2016); D'souza and Naik, (2018). All these are a

useful process that allows for substantial development processes through which there is sufficient application of the right models that would enhance lean practices at various times in the company (Sohani, 2019). India has been at the developing level and process for longer and while its economy cannot be said to be catching up with that of the US for now, it is notable that the level of reluctance in applying lean production in the SMEs is an issue that is still in progress. SMEs that are found in both developing and developed countries are defined by a collection of factors such as their size, location, management structure and all the other aspects that would be used in defining a business at its operational level (Singh, Singh and Singh, 2018). However, according to Shrimali, Soni and Pawar (2018), the manufacturing sector in India can be said to be classified into three main categories. While this has already been defined at the introductory level of this research, it is clear that the same level of classification remains to be applied at this level according to Wamba and Carter (2016); D'souza and Naik, (2018); Singh, Singh and Singh, (2018).

According to the study by Mbonyane and Charles, (2017), the SMEs in other markets of the world especially in the developed systems have clearly set out characteristics that need to be focussed on. The investment in technology has however been the main factor that has to be undertaken (Shakoor et al, 2017). The Indian SME sector is also very competitive if measurements are to be based on the values created by the various players. The contribution of the SMEs to the GDP of India is around 22% which is very low as compared to the impacts created in other countries that can be considered to have a developed system (Sannajust, 2014). Even with this level of share of the market, it is clear that the SMEs in India play a very vital role in the progress of the GDP of the country. While that is happening, it is clear that the global level of SME application and use is strongly remaining very competitive which in the end focuses on the fact that there will be need to develop systems that would make them more productive (Raja Sreedharan et al, 2018). Raja Sreedharan et al, (2018); D'souza and Naik, (2018); Singh, Singh and Singh, (2018) state that one of the other aspects that have defined the Indian SMEs is the level to which they relate with the larger multinational firms in the country as well as outside. India is now considered to be the place that will successfully be considered as the epitome of SMR value because of the development of the manufacturing sector that is increasingly becoming very vital to the growth of the region as a whole (Pinto et al, 2018). The creativity of the Indian SMEs has been a very important factor in practice towards development of a process that would clearly be substantial to the process of making sure that sufficiency is met in dealing with both local and international multinational companies. Companies in places such as the USA, European Union and Japan have largely considered Indian market as one of the best which has added in the value created by the supply chain in the country (Thakkar, Kanda and Deshmukh, 2012; Prasanna and Vinodh, 2013; Nagaraj and Chaterji, 2019). It therefore stands to reason that the companies in India are adding their value to the global market. According to Pearce Pons and Neitzert (2018), it is important noting that sufficiency that is obtained from this connection has a direct level of benefit to the applications made by the SMEs in the country. The SMEs at the manufacturing level can successfully be useful in creating raw materials for offshore multinational companies. In the past one decade, it has been noted that the SMEs in India have progressively made it possible for themselves to produce what can be considered acceptable in the global market (Prasanna and Vinodh, 2013; Nagaraj and Chaterji, 2019). There is however still more that the market can add to the system. For instance, the creativity of the SMEs in designing, implementing and expanding of the lean practices in the market is vital in making sure that the extended connections are met as observed by Raja Sreedharan et al, (2018); D'souza and Naik, (2018); Singh, Singh and Singh, (2018). India as a country has manufacturing sector as a trading weapon that is very competitive as was determined at the introductory section. It is therefore clear that while this is happening, the country has a way of making the focus of the SMEs more productive both to the local GDP and to the international business world (Parnell, Long and Lester, 2015). This has also been necessitated by the local government policies. The Indian government instituted laws that would be useful in increasing the level of manufacturing competitiveness for the SMES in the country. The new laws have been useful in making sure that the sector develops on the basis of having process flows that are improved, (Thakkar, Kanda and Deshmukh, 2012; Nagaraj and Chaterji, 2019)better utilisation of the spaces that are available for operation, inventory management practices that are scientifically determined and reduced time for the engineering practices. Ideally, it was noted that the country has one of the most promising engineering and IT systems in the world when reference is made to the current levels of progress (Panizzolo et al, 2012). While there are few studies that have settled on determining the score of

SMEs in India, it is also plausible noting that the available information has been very important from an overall perspective as noted by D'souza and Naik, (2018); Singh, Singh and Singh, (2018).

Just like any other country, it is determinate that the distribution of the practice of SME in the industries in India is not uniform. According to Nayak et al (2017), lean manufacturing as is applicable in the Indian economy is predominantly applicable to various industries such as automotive, pharmaceutical and metal engineering industry. That is to say that lean production is soon becoming much more applicable to the system of SMEs in India. The SMEs are however not certain about the cost of estimated involvement in the process of implementing the systematic processes. That therefore means that there is very little knowledge that the SMEs have on the plans associated with the future (Murphy, 2016). They are also not sure about the required level of tangible and intangible assets that needs to be considered so as to continue expanding the scale of production (Mbonyane and Charles, 2017; Prasanna and Vinodh, 2013; Bhatti and Singh, 2014). Many of the companies in the western world that were operating at SME level two decades ago are now large multinational companies because of the issue that considered the presence of knowledge on that matter (Munyai, Mbonyane and Charles, 2017). Manu of the companies that have not been able to implement lean manufacturing fear that it will become costly as well as time consuming. The other factor that causes this level of reluctance is that there is also lack of efficient levels of training for those involved in the process of implementing the practice of production. There is lack of lean experience in the country at the moment which in the end leads to there being successful trends that would efficiently be used in advancing their progress levels (Matt, 2014).

As can be noted from the above findings, it is clear that the Indian SMEs up and trying to improve their levels of operational efficiency. While this is yet to be realised, it is also recognisable that the SMEs have made very big steps towards making sure that the industry is working as successfully as possible (Mason, Williams and Found, 2015). The SMES in India have clearly focussed on the ideal fact that they need to revamp their structural, managerial as well as the cultural changes to be able to benefit from SMEs' presence in the economy. One of the mistakes that is being done by the SMEs in India is that they are focusing on just one line of production and therefore not able to apply a wider perspective of the required use of as many available resources as possible (Mbonyane and Charles, 2017). However, through gradually, the dealers in the SME industry in India are soon starting to realise the importance of the new shift in attention which would automatically lead to there being a successful application of the lean practices. For instance, the Six Sigma aspect has been handy in determinately helping out SMEs in some of the management positions of the various companies (Malesios et al, 2018).

According to Mbonyane and Charles, (2017); D'souza and Naik, (2018); Singh, Singh and Singh, (2018), when consideration is put to the aspect of the level to which SMEs contribute to the GDP of different countries. According to the World Bank report of 2016, it can be considered that the SMES from the world perspective contribute to around 45% of the SMEs. It also contributes to around 33% of the GDP of the growing economies in the world (Mbonyane and Charles, 2017; Prasanna and Vinodh, 2013; Nagaraj and Chaterji, 2019). While the rate in India keeps changing, there is a progressive value attached to its growth and the ideal aspects point to the fact that they can make up to 50% of the GDPs of the world (Mbonyane and Charles, 2017) as was determined by the Economic Times periodical in the year 2016. In India, the SMEs operate in different industrial clusters; utilising different resources, infrastructure and a good geographical distribution in the country. This is an aspect that was initiated and promoted by the government of India. The government has therefore been able to start creating the industrial clusters successfully. For instance, in the manufacturing industry, there are a total of around 50 clusters. Within these clusters, it is clear that the government has tried to make each part of the system work systematically to help deal with the issue of all the SMEs being profitable (Mbonyane and Charles, 2017; Prasanna and Vinodh, 2013; Bhatti and Singh, 2014). For instance, within these clusters, and with application of lean production and management, it has been notable that the Indian machine tool industry has shown a great deal of growth and development over the years to a level extent that is almost reaching among the top 10 in the world. For instance, Coimbatore has been able to house one of the best and most progressive machine tools in the country (Luthra and Singh, 2018).

There are several realisations that have come up to make develop systems associated with making sure that sufficiency is met (Logeshwaran and Nachiappan, 2018). That is why the government has been able to drastically increase the level of competitiveness in the industry with a clear focus on making sure that the SMEs stand the test of time. Lean thinking has therefore been able to help the different category groups of companies in the Indian economy to directly focus on making sure that sufficiency is met in improved scope and value (Lucherini and Rapaccini, 2017). Systematic and scientific processes have been the epitome of every part of the economic system in the country as a way of trying to develop the level and way that would help the economy and GDP also depend on the aspect of SME (Bhatti and Singh, 2014; Prasanna and Vinodh, 2013; Mbonyane and Charles, 2017). Lean management can therefore be very effective at all levels of focus. It helps in determining the fact that a company can progress to the next level of focus and effectively determine its future in the competitive business world occupied by the other big players such as international multinational companies(Kumar and Kumar, 2017). The scientific production processes are meant to reduce the wastes in the companies and increase the level of focus through which there is addition to the process.

The government of India in doing all it can to make sure that lean management has been used effectively in the process. However, the ultimate aspect lies with the ideal fact that there is a complete link between lean management, production and the value that SMEs get from the respective cluster industries that they are operating in (Knol et al, 2018

2.4. THE IMPLEMENTATION OF LEAN PRODUCTION IN INDIA'S SMEs

According to Mbonyane and Charles, (2017); Prasanna and Vinodh, (2013); Bhatti and Singh, (2014), manufacturing and production are largely being impacted by changes in the technological changes that also defines the level to which different companies implement the different the way to survive the competition onslaught is to determinately focus on getting a strong, determined and sustained system of development that would be successfully applied to the systems that require progressive changes. If any company can effectively reduce the cost of production by improving the process, then the end point is that of having to deal with a powerful system that would be useful in making the company more profitable (Khatri and Metri, 2016). The company will have the process of trying to maintain the value of the customers through perfecting the production process. Having professional group of people who are also competent is a way of making sure that there is a strong value to the case in which the company is focussing on being the best. This value creation can ultimately be done through the process of lean management as proposed by Kale, Banwait and Laroiya (2010) and Mbonyane and Charles, (2017). Lean management and lean production are processes that have to be considered on the basis fact that there has to be progressive and continuous development. Every company that focuses on lean management must be aware of the competition ahead and in the industry so that it is able to remain in a sustainable situation for a longer period of time. According to Jin and Jung (2016), there is a direct difference between the way SMEs operate and the way the other larger multinational companies operate. While the larger companies will operate from economies of scale and benefit from all the aspects that emanate from expanding the scale of production, the SMEs are not able to operate at such a level and will therefore be required to increase their levels of creativity to be able to sustain competitive advantage (Jain, et al, 2018; Prasanna and Vinodh, 2013; Mbonyane and Charles, 2017). Adaptation of the lean philosophy is one of the methods that the companies have been able to use at the current levels of operation (Jain, et al, 2018). In lean production, there is a focus on many aspects away from the normal methods that have been used by the company over many years. That may take the form of an improved level of flow of production, continuous improvement as well as manufacturing products on the Just- in-Time (JIT) basis (Bhatti and Singh, 2014). According to Harash, Al-Timimi and Alsaadi (2014), the aspect of lean management developed from the automobile industry with specific focus on Toyota Company. When Henry Ford considered the application of mass production, there was Taiichi Ohno that considered the Toyota production system (TPS). Some of the aspects that were considered on the basis of this application are that there are the customer requirements that keep changing, competences of the employees and effective aspects of teamwork. The two most important aspects that are definitive of lean production are the JIT and TPS (Bhatti and Singh, 2014; Prasanna and Vinodh, 2013; Mbonyane and Charles, 2017).

While lean adds value and eliminates waste, it is important that there is a strong focus on all the different aspects that have to be considered on the basis of being able to meet the needs of the customers. As noted by Bruynooghe, Verhaeghe, and Bracke, (2008); Mbonyane and Charles, (2017); and Dhingra and Singh, (2018), a combination of all the good practices in production can be able to sufficiently lead to the fact that a company can continue to operate well and remain successful and profitable in the industry it is operating in. One example is taken from the Toyota where the lean model focussed on the PPT Model (People, processes and tools). This is also a practice that can be used in the case of SME setting in which case there is a focus on substantially long and focussed aspects of focusin g on how the people in the company make use of the available resources to increase production (Haleem et al, 2012). It also means that there is a focus on the processes in the company that will improve the level to which the company operates at the ideal level and point in time. Ideally, according to Harash, Al-Timimi and Alsaadi (2014) an SME that is able to increase the value of its processes will ultimately be also having the capacity to change the values attached to its systems. The other practices that can be used in defining g lean management are the continuous improvement and standardisation where there is a focus on continually changing the processes progressively so that the company is able to gain from good quality products (Harash, Al-Timimi and Alsaadi 2014; Gurumurthy and Kodali, 2011; and Garengo and Sharma, 2014). Standardisation and the issue of pull controls can be done by use of the aspect of Kanban cards. According to Gupta, Narayanamurthy and Acharya (2018), the use of the aspect of the Kanban cards can categorically point to the fact that it is a system in knowledge work that represents the progressive aspects that would be used in generating value for the individual items in the respective industries in which an SME may be operating (Jain, et al, 2018; Prasanna and Vinodh, 2013; Mbonyane and Charles, 2017). It leads to the fact that if the company will have to focus on improving the steps, then the steps will succinctly be improved individually to make sure that sufficiency is obtained and gotten (Gnanaraj et al, 2012). Therefore, it is notable that lean production with reference to the SMEs will be done on the basis of the fact that the respective companies will be able to use either of them or combine any of them in dealing with the challenges that are being faced or strategizing on making improvements (Harash, Al-Timimi and Alsaadi 2014; Gurumurthy and Kodali, 2011; and Garengo and Sharma, 2014).

The SMEs can also make use of the 5S method which, according to Ghosh (2012) was also developed in Japan. 5S takes to account processes in production such as sorting, simplify, shine, standardise and sustain. Quite clearly, each of the respective practices as would add value to a company will significantly be used in making sure that waste is reduced and value added to the products. George (2011) noted that waste can be produced through over-production, waiting, transport, inventory, over-processing as well as producing goods that have defects. From the basis of the human resource management, it is also clear that sufficiency can be obtained from the company not making full utilisation of the creativity of the employees (Harash, Al-Timimi and Alsaadi 2014; Gurumurthy and Kodali, 2011; and Garengo and Sharma, 2014). It is conceivable that while there is a strong focus on the level to which development is added to any aspect of the SME process, the same process can be considered to be successfully useful in adding value to the operation of the systems at the company that is the SME. It is notable from the basis of Garza-Reyes et al (2018) that the SMEs are limited by the financial capability and is therefore also not relatable to the large multinational companies that are using their financial capability to influence the market. Even if their products may not be able to satisfy the customers, the same will ultimately be used in creating a better support for the way the marketing strategies will be done (Bruynooghe, Verhaeghe, & Bracke, 2008; Basu, Ghosh and Dan 2018; and Dhingra and Singh, 2018). This is not the same advantage that will be enjoyed by the SMEs as they lack the financial capability associated with the process (Garengo and Sharma, 2014). If an SME is able to make use of the principles of value, it has the ability to make use of the aspects associated with intense value addition such as having products that are well differentiated in the market. Such a process and the associated value created will be added when the SMEs are able to collect data from the market, analyses it, design the change and then measure all the associated benefits in the process (Ganga and Gunasekaran, 2016). The government of India has been able to support the processes associated with helping the SMEs access knowledge and access resources to expand their operations. It is conceivable therefore that different SMEs will use different strategies to implement their lean production and management practices (Harash, Al-Timimi and Alsaadi 2014; Gurumurthy and Kodali, 2011; and Garengo and Sharma, 2014). Lean based development conceives that there is a direct and factored focus on the strategy of the company, focus on the value streams and then effectively develop all

issues associated with making sure that sufficiency is met by utilizing these to increase the level to which the same company will be able to add value to its processes (Gandhi et al, 2018). All the production processes and the effective value streams are all added to the process through which companies are able to define the way forward to benefiting from the current strategies that are adapted (Dhingra and Singh, 2018). Every SME must use the lean process to identify its bottlenecks as well as the challenges associated with the industry in which it is operating. It is from these that the developmental proposals will be developed and in the end, there will be sufficiency in the level to which the SME will be able to adapt to the systems in the market (Antony and Tiwari, 2011; Bruynooghe, Verhaeghe, & Bracke, 2008; Basu, Ghosh and Dan 2018; and Dhingra and Singh, 2018).

2.5. USING LEAN PRODUCTION TO IMPROVE QUALITY OF SMEs PRODUCT

According to Panizzolo et al, (2012); Caldera, Desha and Dawes, (2019); and Parnell, Long and Lester, (2015), there are several ways through which lean management can be implemented to improve the quality of products with reference to SMEs. This is a situation that can only be implemented through the process of making sure that the application strategies are applied in the right way and at the right time (Raghunath, 2018). Quality can be improved by improving the processes involved in production. The improvement is based on the fact that there are aspects initiated, aimed at adding values to the same system. For instance, the use of 5S can be used in promoting value of the product by systematically taking part and considering all the procedures that would be used in implementing 5S. For instance, sorting requires that all the unneeded tools are removed and only the required materials are there as are needed by the system (Psomas, 2018). Setting in order means that everything is in place and the company that is manufacturing will make sure that the product will be made available within a much shortened period of time. This however does not jeopardise the quality of the product given that there is an increased value to the systematic applications (Dhingra and Singh, 2018; and Abobakr and Abdel-Kader, 2017; Dave and Sohani 2019). In this case, the aspect of specialisation makes it possible for the company to only deal with the product that it can best produce. Standardising also makes sure that the products are standardised in such a way that they meet only the best market requirements. While the SMEs may be limited by the financial requirements as applied, it is clear that sufficiency can be obtained from determinately specialising on the values that the customer needs in the market (Raja Sreedharan et al, 2018).

Quality can be improved in any business if the business management will be able to determine the aspect of quality if the root of the problems that have been causing lower quality products can be determined. From the basis of reference to the Japanese case of lean management, there is the issue of *Jidoka* which is translated as “automation with human touch”, according to Psomas (2018). In this aspect, there is discovery of abnormalities in a product or any of the issues that may be causing lowered levels of products value. Discovering an abnormality, fixing the problems and investigating the correct causes. This is the basic aspect that can be used in creating a strong focus on the level to which value will be determinately applied (Prasanna and Vinodh, 2013). Using the right technology can therefore be a useful feat that would be used in making sure that a product will be part of the company legacy and the eventual developments associated with it. Apart from that, Parnell (2019) introduced the issue of the *poka yoke* (mistake proofing). The SMEs in India can also directly make use of this process in view of determining the fact that a company can make use of a tool that can be used in detecting problems and defects in the products that are produced or manufactured by the company (Panizzolo et al, 2012). It can be noted from that basis that mistake proofing allows for the next time in which there will be an eventual improvement in the process of determining a strong focus on the way forward to making a successful tool for product valuation and improvement (Panizzolo et al, 2012; Caldera, Desha and Dawes, 2019; and Parnell, Long and Lester, 2015; Dave and Sohani 2019). There are several ways in which lean practices can help the Indian SMEs to make an improvement on the quality of the products. While almost all of them can have an impact on the product produced, it is also notable that value will be created when there is a strong focus on the level to which there is the strategy of the company being realised as well as the requirements of the customers (Parnell, Long and Lester, 2015).

2.5.1. IMPACT LEAN PRODUCTON HAS ON SMEs

Lean production, from the respective perspectives created has had overwhelming value to the development of SMEs in the respective markets and industries it is applied. In the process of the production process, it can be noted that sufficiency is created in the respective aspects that are determinate with the different values brought to the industry (Dave and Sohani, 2019). Considering an aspect like flexibility in manufacturing as posited by Dhingra and Singh (2018) brings to focus a collection of practices applicable in lean manufacturing and also valuable to the cause of actions useful in making sure that an impact is created. Therefore, one of the lean practices is that if manufacturing flexibility. According to Cortez et al (2019), it is notable that this is the ability of the production process to handle different variables in the process as related to the need to have some of the best practices being put to action and implemented. As the conditions of operation change, the production system also changes. The changes are done respectively with the need to add value to the process in response to the external factors that would affect the operation of the company from the beginning to the end (Harash, Al-Timimi and Alsaadi 2014; Gurumurthy and Kodali, 2011; and Garengo and Sharma, 2014). However, the case of SMEs might have very little abilities to respond to external forces because of lack of financial capabilities. However, it is also notable that the SMEs are likely to come together in many cases, led by the government support initiatives to make sure that there is sustained success at the level to which there is successful application of the same to make sure that success is guaranteed (Chowdhury, Dey Ghosh, 2018). When an SME acquires the ability to operate flexibly, there will always be an impact on the overall performances due to the customisation created hence helping to reduce the costs of production and increasing the value of the products in the market. The overall value of increasing the product value in the market is that of having the customers meet their demands as well as making sure that sufficiency is met as effectively as possible in the end when delivering the same level of quality. In line with this type of adaptation, it can be considered from the basis of Ceptureanu et al (2018) that the competitiveness of a firm can greatly depend on the level of customisations and adaptations that have been put in place to meet the different dynamic changes in the market requirements as defined by the tastes and preferences of the customers (Antony and Tiwari, 2011; Bruynooghe, Verhaeghe, & Bracke, 2008; and Basu, Ghosh and Dan 2018). For instance, the recent past has seen drastic changes in the level of customisation that are levelled towards creating better products and supply them to all parts of the world. Social media has also made marketing to become more customised than it used to be before. Technology has also made it possible for faster delivery of goods through faster delivery of communication (Caldera, Desha and Dawes, 2019; Harash, Al-Timimi and Alsaadi 2014; Gurumurthy and Kodali, 2011; and Garengo and Sharma, 2014). All these are aspects of lean manufacturing that has made it possible for SMEs to also compete at the global level, just like any other company that has the capacity to deliver its products worldwide. For instance, logistics companies have made delivery very easy which means that an SME dealing in beauty products (not bulky) can have them shipped to the destination address for very low costs. This is only possible if the respective companies will be able to adapt to these techniques of production and implementation of the process of selling to the final consumer (Centobelli, Cerchione and Singh, 2019). When the SMEs are flexible, they acquire the ability to respond promptly to the requirements of the customers in the market. According to Batra (2016), this is one of the areas that the multinational companies have been able to take advantage of based on the ability to operate in large scale. The same applies to the lower level companies that can adapt through a flexible operating system. One of the other methods that companies can operate from a flexible perspective is that of product customisation. According to Basu, Ghosh and Dan (2018), customer demands are ever changing. There are SMEs that will get involved in highly customised products which in the end lead to the fact that they target very specific customer segments in the market (Antony and Tiwari, 2011; Bruynooghe, Verhaeghe, & Bracke, 2008; Basu, Ghosh and Dan 2018; and Godinho, Ganga and Gunasekaran, 2016). In the end, it can be considered that the companies are able to serve the specific customer segment successfully and then expand on the same in the external markets outside the local countries of operation (Antony and Tiwari, 2011). Flexibility is therefore not a free good for that matter because the respective companies shave to invest huge sums of money to make sure that the strategy works in the market. However, it is also notable that there are economies that have the government focussing on bringing up many laws and regulations that would be useful in making sure that sufficiency is obtained from the same process and that there is also a strong focus on the level to which the local companies operate (Caldera, Desha and Dawes, 2019; Harash, Al-Timimi and Alsaadi 2014; Gurumurthy and Kodali, 2011; and Garengo and Sharma, 2014). For instance, in India, there have been programmes such as the “One India” initiative that has been at the forefront in developing presentable and defensible practices that would be useful in helping the companies adapt to the productive systems in the market. SMEs are challenged by budgets and they will therefore effectively succeed in that process as well as successfully defending the level to which they can adapt in the current operational systems (AlManei, Salonitis and Xu, 2017; Bruynooghe, Verhaeghe, & Bracke, 2008; and Godinho, Ganga and Gunasekaran, 2016).

It has already been noted that lean practices were first applied in the Japanese car making systems with the main being that of burning waste and increasing the productivity of the processes. It is therefore clear that lean manufacturing will have impacts that are very sustainable to the process of increasing production (AlManei, Salonitis and Xu, 2017). Consider an SME that applies cellular manufacturing. The company will make sure that its production system is structured into workable cells. Each cell is a single working unit that deals with specific products that the company may be dealing with (Caldera, Desha and Dawes, 2019; and Garengo and Sharma, 2014). Due to the aspect of specialisation and division of labour, the concentrated production is likely to advance the production situation into highly valuable products made through highly mechanised processes (Abobakr and Abdel-Kader, 2017). The end aspect is that the customers are able to get very high quality products created through a simple system but through highly qualified individuals in the respective cells.

The other issue applicable to this situation of lean management impacting SMEs is that of using the Just-in-Time methodology (Alhuraish, Robledo and Kobi, 2017). In this case for instance, the suppliers will deliver the right products at the right time and right place. In that case, the SMEs are able to save on the determinate time and resources lost at the process of procurement (Abobakr and Abdel-Kader, 2017). The SME develops the right type of relationship with the supplier which in the end leads to the fact that the SME is able to meet the demands in the market at a very convenient period. Demand matches the supplies in the market. Therefore, JIT contributes to an improvement in the quality of the products in the market especially when reference is made to those companies that apply it as a process (AlManei, Salonitis and Xu, 2017; Bruynooghe, Verhaeghe, & Bracke, 2008; and Godinho, Ganga and Gunasekaran, 2016).

Value Stream Mapping (VSM) is another method that has proven the level to which lean production has been able to impact the production capability of SMEs in any given market. In VSM as a method of learn production, the management teams of the SMES will only focus on activities that add value to the products in the market (AlManei, Salonitis and Xu, 2017; Caldera, Desha and Dawes, 2019; and Abobakr and Abdel-Kader, 2017). That also points to the ideal fact that sufficiency will be maintained from the basis to which the products are produced at the shortest possible route to the end process and that which increases value to the original products (Alhuraish, Robledo and Kobi, 2017). A company will draw a current state map which allows it to understand all the conditions in the market as per the current situations and levels. The current state map defines the level to which aspects are performed at the company. In the case of the SMEs, it is determined that they will understand their positions in the market through a comprehensive environmental scan which allows them to draw conclusions on the processes that need to be followed at the company (AlManei, Salonitis and Xu, 2017). To make changes to the current systems, the company will therefore be able to make changes to the Future State Maps that helps in identification of the improvements that need to be done to make sure that the operations have fully progressed (AlManei, Salonitis and Xu, 2017; Bruynooghe, Verhaeghe, & Bracke, 2008; and Godinho, Ganga and Gunasekaran, 2016). The impacts created by this lean method are that the company will be able to deal with any major or minor progresses that will have to define the required future of the company (Al-Tamimi and Al-Timimi, 2014). Moreover, in VSM, the company is able to effectively define the Key Performance Indicators (KPIs). It is a works-in- progress inventory that allows for the progressive developments aspects to be identified, mapped and then developed so that the future is made valuable to the company (Caldera, Desha, Dawes, 2019). According to Chavez et al (2019), the current changes in technological systems have been able to determinately define aspects that would simulate the future. In simulating the future, it is clear that the company is able to determine its future through the established systems in its operational capacities (AlManei, Salonitis and Xu, 2017; Caldera, Desha and Dawes, 2019; and Abobakr and Abdel-Kader, 2017).

Therefore, lean production is a process that has the capacity to impact the production process as positively as possible. To that regard, it is clear that sufficiency will be met in having to deal with the situation as it is and then focussing on the future in the most comprehensive manner as determined by Caldera, Desha, Dawes (2019). The impacts are all progressive. They define the level to which a company has the ability to develop its systems to the future level where it will focus on defining its future within the competitive prospects that are required (AlManei, Salonitis and Xu, 2017; and Abobakr and Abdel-Kader, 2017).

2.5.2. CRITICAL SUCCSESS FACTORS OF LEAN IMPLEMENTATION TO THE SMEs

According to Chowdhury, Dey and Ghosh (2018), the critical success factors make reference to the results that will be realised so that it is considerate that there is an increased level of competitive advantage to the company. This makes application to respective individuals, departments in the organisation as well as among different organisations. In the aspect of critical success factors, it is clear that the things have to go right (AlManei, Salonitis and Xu, 2017; Caldera, Desha and Dawes, 2019; and Abobakr and Abdel-Kader, 2017). Risk management is an issue that must be undertaken to make sure that the company develops the highest level of efficiency. These factors have been used in many other companies in the world and the success factors emanating from the same area are useful as the comp0any that is planning to carry out progressive moves. According to Dave and Sohani (2019), there are many critical success factors that will make sure that sufficiency is met through making sure that the identifiable traits are effectively transfected to practicality when realised at the company. There are six categories of the critical success factors that have been applicable to the situation in SMEs (Bruynooghe, Verhaeghe, & Bracke, 2008; and Godinho, Ganga and Gunasekaran, 2016). They are also classified in twos and are clearly determinate on the basis of leadership and management, skills and expertise and then finance and culture (Dhingra and Singh, 2018). Actually, there are many papers that have been published defining the different critical success factors to be associated. The critical success factors are useful to the process of making sure that there are many determinants of success in the company (Dhingra and Singh, 2018; Caldera, Desha and Dawes, 2019; and Abobakr and Abdel-Kader, 2017; Dave and Sohani 2019).

The determinate critical success factors applicable to this process can clearly be classified on the basis of the different factored issues that happen in companies and are therefore useful in defining the level to which they play a role in making sure that they are very helpful, according to Flick (2018). The first is the level commitment of both the middle level and top level management commitment. Leaders are a very important factor in the management of a company and the level to which the company will succeed depends on their expertise (Bruynooghe, Verhaeghe, & Bracke, 2008; and Godinho, Ganga and Gunasekaran, 2016). Employee commitment and effective communi9cation is an issue that will need to be considered on the basis of it being an indicator of management follow up on the different developmental factors (Garengo and Sharma, 2014). A company will also have measurement of the standards required at operational level which have to be considered on the basis of making sure that the company remains operational regardless of the different aspects of operation are determined. Changing the culture of the SMEs is a way of determinately finding the cultural perspectives that will be useful in making sure that sufficiency is met (Dhingra and Singh, 2018; Caldera, Desha and Dawes, 2019; and Abobakr and Abdel-Kader, 2017; Dave and Sohani 2019).

Critically, as posited by Dhingra and Singh, (2018); Caldera, Desha and Dawes, (2019); Abobakr and Abdel-Kader, (2017); and Dave and Sohani (2019), it can be notable that the critical success factors do target a collection of factors in the SMEs. There is need to have a clearly set out management system that will make sure that the right processes are undertaken to make sure that the SMEs are connected to the right applicable and competent management team and the management focuses on having a lower number of highly qualified teams to deal with the management issues (Al-Tamimi and Al-Timimi, 2014). According to Alhuraish, Robledo and Kobi (2017), a highly competent manager in a company is far much valuable than having five less competent management teams. The top management also has to work in liaison with the lower management teams in the company to make sure that waste is cut done in the production process and then there is elevation of each of the steps that need to be applied to make sure that sufficiency is met (Batra, 2016). As posited by Bruynooghe, Verhaeghe, and Bracke, (2008); and Godinho, Ganga and Gunasekaran, (2016), the same lean impact is created when there is application of the right training to the staff and management teams in line with established lean methods of production. Ideally, it can be noted that when a company is able to have the right training among its staff members, the same will be considerate of the fact that there will be creativity in the production process (Bauer, 2014). In retrospect, it can therefore be noted that the impacts of lean management to an SME company are quite diverse and cuts across the entire internal and external orientations of the same company. That, in the end

leads to the fact that sufficiency is met in creating a strong focus on the level to which there are beneficial aspects to the overall company systems (Caldera, Desha and Dawes, 2019).

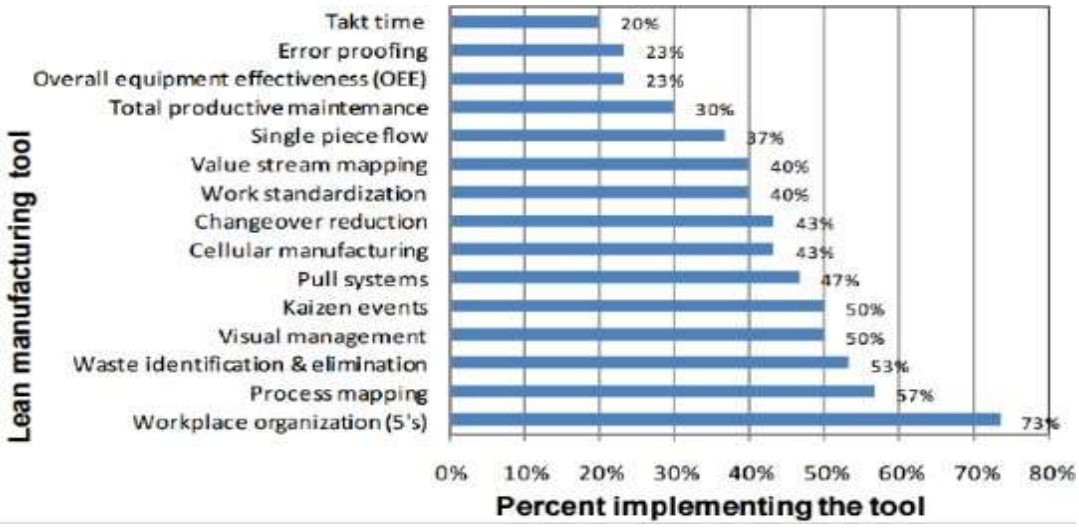


Figure 7. Categories of Lean manufacturing Source: Wamba and Carter (2016).

CHAPTER 3. CHARACTRISTICS OF COMPANY

3.1. INFORMATION ABOUT COMPANY

Current Insulators constrained is the main porcelain encasing producer in India. It is an arm of the Modern gathering of Industries and was set up in 1985 in a joint effort with Siemens, Germany. Present day Insulators is likewise India's biggest producer and exporter of porcelain encasings and is intently connected with National and Regional Utilities, Indian Railways, OEMs and EPC organizations around the world. Present day is an ISO 9001 and ISO 14001 Certified Company and furthermore India's biggest exporter of porcelain separators with fares surpassing USD 15 million to in excess of 50 nations.

Consistent with our driving way of thinking of being the best, we center on persistent developments and upgrades and this thusly prompts new items with improved execution, upgraded levels of electrical and mechanical attributes and more qualified to meets the advancing prerequisites and necessities of the utilities and clients. Our plant has likewise experienced broad modernization to guarantee our items meet the wellbeing and life cycle prerequisites of utilities, ventures, and OEMs all inclusive. We were the primary organization to present porcelain long bar protectors in India – a better option than circle encasings with a phenomenal contamination execution. MIL likewise presented an elite aluminous body for porcelain covers demonstrated for its improved mechanical and electrical quality.

Present day Insulators' assembling plant is arranged in Abu Road, Rajasthan and has an as of now introduced limit of 26,000 metric tons for each annum and fares record to about 30% of its yearly turnover. Current has the most modern assembling plant with apparatus imported from Germany alongside the required testing and review offices and an in-house R&D arrangement perceived by the Government of India for advancement of new items and procedure enhancements.

Our endeavors to continually develop and improve our items and administrations is perceived by the Indian government a seemingly endless amount of time after year by method for fare grants from the Ministry of Commerce, Government of India for some back to back years.

Table 3. Company's Basic Information

Company Name	**Modern Insulators limited**
Address Rajasthan (307026) Talheti, Abu Road Dist. Mount Abu. (INDIA)	Mo.:+912974228044
Email	E-mail: milabu@moderninsulators.com

Website	Web: www.moderninsulators.com

Source: https://www.moderninsulators.com (05/06/2019).

3.2. COMPANY PRODUCT

These encasings being of empty development are exposed to an inner band (weight) worry notwithstanding the mechanical twisting pressure. This requires mastery in the structure, produce and testing of these encasings. The empty porcelain covers are made utilizing high quality aluminous porcelain and exposed to exacting procedure and dimensional controls. The drying and discharging procedure are fit to guarantee legitimate and complete verification of the shells. The shells are then sliced and ground to the particular prerequisites. The chamfer of the inward and outer width assumes a basic job in the mechanical exhibition of the empty porcelain covers and subsequently specific consideration is taken to guarantee legitimate chamfering of the finishes. The surface completion is another such basic factor that forestalls gas/oil spillage and consequently is basically controlled. [20]

Figure 8. Hollow Insulators

Source: https://www.moderninsulators.com/products/hollow-insulators/(05/06/2019).

Hollow porcelain insulators are basically used as weather shields that protect the internal components from being exposed to the vagaries of the weather. They are used in:

- Current transformers
- Voltage transformers
- Capacitive voltage transformers
- Circuit breakers – SF6 & Non-SF6
- Surge (Lightning) arresters.
- Power transformer bushings
- Wall through bushings

Every one of the shells is exposed to ultrasonic test before get together. The separators are then amassed with the metal parts as required utilizing Portland bond with the guide of exactness get together installations. The concrete is restored under states of temperature and moistness. They are then exposed to routine and conformance tests in accordance with client necessities, IS or IEC measures as required.

[20] https://www.moderninsulators.com/products/hollow-insulators/ (05/06/2019).

Solid Core Post Insulator

These separators are intended to give an unbending help bookkeeping to the bowing and torsion loads. Current's Solid core protectors are not just intended to meet the fundamental mechanical and electrical properties yet in addition to adequately meet the heaps emerging out of short out, seismic, wind, warm, ice and some other powerful loads. The protectors are made of high caliber aluminous porcelain meeting the

prerequisites of C130 as per the IEC: 60672. Aside from the visual and dimensional checks, the solid core post cover shells are exposed to ultrasonic tests preceding gathering. Exactness machines are utilized to cut and pound the end appearances to accomplish the required surface completion and chamfer of the finishes.

Figure 9. Solid Core Post Insulator

Source: https://www.moderninsulators.com/products/solid-core-insulators/(05/06/2019).

Solid core post Insulators are used in substations as support insulators. They are basically used in:

- Isolators (Disconnectors)
- Pantographs
- Bus bar support
- Wave trap support
- Capacitor bank supports.
- Transmission & distribution as Line post insulators (Horizontal & Vertical).

The metal spines (equipment) are made in-house disposing of the reliance on outer providers for consistency in quality and conveyance. They are aroused utilizing Zinc of 99.95 % virtue with a base normal covering thickness at the very least 85 microns (610 g/m2). The sand segment of the solidcore shells and the internal bit of the ribs are covered with a uniform layer of bituminous paint to balance the impact of differential warm development among bond and metal parts. The encasings are collected utilizing amazing Portland concrete in specific installations that guarantee the stringent dimensional prerequisites are met. They are exposed to restoring under controlled conditions. These encasings are then exposed to the imperative routine and acknowledgment tests preceding dispatch. Further visual investigation and irregular measurement looks at are likewise conveyed before pressing the covers in wooden containers/boxes/beds. Current Insulators is the biggest maker of Solid Core Insulators in the nation and has introduced more than 10 million separators in different tasks over the world. in voltages running from 33kV to 1200kV.

Long Road Insulator

Long bar encasings are utilized in high voltage transmission lines and have been the famous decision crosswise over Europe since 1960. Studies uncover that porcelain long bar covers have unrivaled electrical and mechanical properties, control circular segment and impedance voltage conduct contrasted with the customary top and stick type circle encasings. Porcelain long bar separators are of solidcore type "A" development and are totally cut confirmation. These encasings are intended to give an adaptable help simultaneously guaranteeing that the elastic burden necessities in administration are met. The long bar protectors are exposed to static and dynamic burdens including wind load, ice load, conductor jogging, cut off and so on and are intended to withstand such loads always and constantly for a considerable length of time.

Figure 10. Long Road Insulator

Source: https://www.moderninsulators.com/products/long-rod-insulators/(05/06/2019).

The covers are made of high caliber aluminous porcelain meeting the necessities of C130 as per the IEC: 60672. Aside from the visual and dimensional checks, the long bar separator shells are exposed to ultrasonic tests before gathering. Exactness machines are utilized to cut and crush the end appearances to accomplish the required surface completion and chamfer of the finishes. The metal tops of Spheroidal Graphite Iron are made in-house wiping out the reliance on outside providers and in this way, guarantee further consistency in quality and conveyance. They are excited utilizing Zinc of 99.95 % immaculateness with a base normal covering thickness at the very least 85 microns (610 g/m2). The inward bit of the tops is covered with a uniform layer of bituminous paint to balance the impact of differential warm extension among concrete and metal parts. The covers are gathered utilizing excellent Portland concrete in specific merry go rounds that guarantee the stringent dimensional prerequisites are met. They are exposed to relieving under controlled conditions. These separators are then exposed to the essential routine and acknowledgment tests before dispatch. Further visual investigation and arbitrary measurement looks at are likewise conveyed before pressing the separators in wooden boxes/boxes/beds. Present day Insulators is the main maker of porcelain long bar separators in India and has provided over a million encasings to different activities everywhere throughout the world in voltages going from 33kV to 1200kV.

Railway Insulator

Covers for railroad footing applications are a class separated from the customary protectors as they request very stringent execution and security necessities. Current encasings has set the gauges in the plan, assembling, testing and supply of covers for railroad footing application. We make different classes of 25kV railroad covers tending to each requirement for the charge of rail route lines. Following types of insulators are being manufactured by Modern insulators for railway applications:

- Stay arm insulators
- Bracket insulators
- 9 Tonne insulators
- Sectioning insulators
- Post insulators and
- Operating rod insulators

Figure 11. Railway Insulator

Source: https://www.moderninsulators.com/products/railways-insulators/(05/06/2019).

The encasings are fabricated to meet as well as surpass the requests spread out by the RDSO, the overseeing body for electric footing cover applications. The protectors produced are exposed to routine and acknowledgment tests in accordance with the RDSO models. The example size is incredibly expanded to demonstrate the consistency in item execution.

These tests and the stringent control of assembling process and exacting adherence to quality control has made Modern railroad protectors stand separated from the challenge. Present day keeps on holding a notoriety of being the single biggest provider of separators for railroad application in India. Present day Insulators supplies about 70% of the Indian Railway's needs.

Subsequent stage was the choice of the basic result of the organization for the pilot venture. Volume of production cost of low quality (COPQ) and measure of income produced by every one of the four kinds of encasings (solid core, railroads, long bar and hollow) were recorded.

3.3. PRODUCTION PROCESS

The procedures to fabricate a strong center cover were arranged into three stages specifically; pre-oven, furnace and post-furnace forms. The pre-oven procedure begins with ball processing where two kinds of blends are arranged bauxite and non-bauxite by blending of crude material and water for further handling. The fluid blend item (slurry) from this stage goes in blending tank for proportion control where semi strong piece (scrap reuse from downstream exercises) is likewise included. There is isolated line to gather the semi strong pieces from various procedures of pre-furnace organize. There is one piece blending tank at shaper office and through funnels scrap goes back to the crisp blending tank. One footer machine is associated through an underground belt transport framework to the piece blending tank. The slurry so gathered goes to channel squeezing in the wake of going through the sieving and ferro-filtration to expel the water. In channel press, cakes are set up by expelling water from slurry and afterward cakes go in to pug processing where pugs are shaped by expulsion. Pre-Electric Driers (PED) are utilized to lessen the dampness in the pugs to a specific incentive before the forming procedure.

Pugs are turned on machine machines to give them the required shape pursued by drying activity to expel the dampness substance of the turned protectors for giving them quality. The coating and gravelling division comprises of four procedures – dry getting done with, plunging, gravelling, and moving. The last procedure of the semisolid item or pre-oven activity is the furnace stacking in the vehicles for warmth treatment in the oven. Any piece up to semisolid state can be reused in the blunger. Next the separators are terminated in the oven. The post-furnace procedure establishes the irreversible hardening of these covers by warming and move to the cutting and crushing office where the finishes of the terminated encasings are sliced to their appropriate length and granulated for simple manual taking care of. Ultra-sonic testing is done after crushing. Crushed separators at that point goes to gathering division where the remainder of the procedures (concrete relieving, use of installations at the finishes, and joining of at least two protectors together agreeing to requirement) are done. The covers are tried lastly reviewed. Parallelism, whimsy, visual deformities, full measurement, and generation explicit necessity tests are

completed during the last assessment. The quality control passed covers are stuffed in break confirmation wooden packs. The last procedure is stacking and dispatching by the promoting office to the clients.[21]

[21] https://www.researchgate.net/publication/276899206_Reduction_of_Post-kiln_Rejections_for_Improving_Sustainability_in_Ceramic_Industry_A_Case_Study#pf2 (05/06/2019).

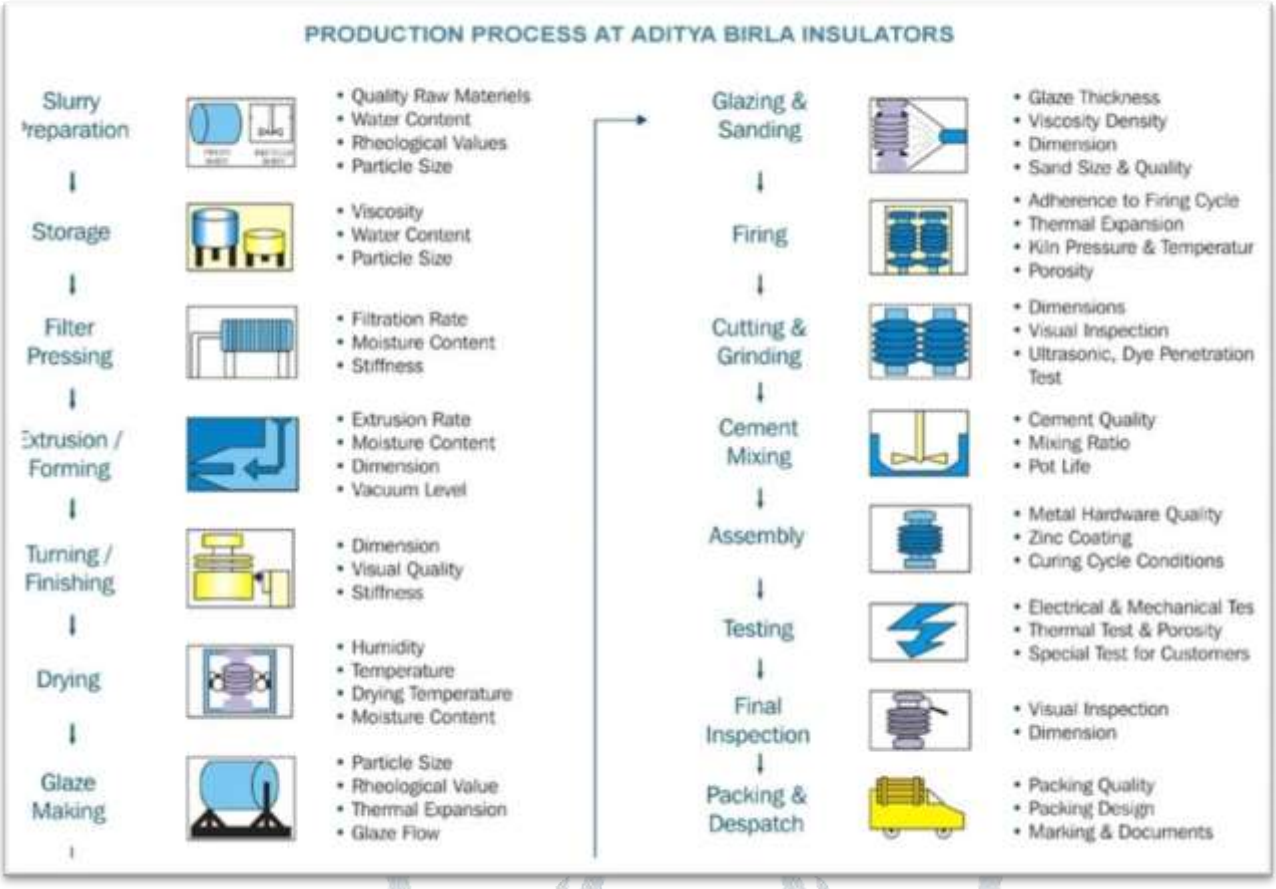


Figure 12. Production Process of Insulator

Source: http://adityabirlainsulators.com/(05/06/2019).

Material Testing (Row – dampness testing)

Testing solid pieces for overabundance dampness has turned into a typical development prerequisite, especially where ground surface or impermeable films are to be introduced over the section. In any case, while a few standard dampness test techniques are accessible, no single test uncovers everything that ought to be considered in choosing when ground surface can be introduced, or a covering connected.

Coating and Angop Making

Expel the delicate earth tile from the form. Before applying the principal coat, liberally splash the bisque-terminated tile with water and hold up until it's everything assimilated. This is a significant advance as the water-immersed bisque takes into account a smoother dispersion of coating as its being connected. Fill a bulb syringe with a metal tip connected to the part of the arrangement coat. Test your coating thickness to ensure the coating leaves the tip at a controllable rate and doesn't stop up the tip and after that crush the coating to pool it into the restricted regions portrayed by the raised lines.[22]

Dirt Bricks Making (Pressing)

The underlying advance in delivering block is pounding and granulating the crude materials in a separator and a jaw smasher. Next, the mix of fixings wanted for every specific bunch is chosen and separated before being sent on to one of three block forming forms—expulsion, embellishment, or squeezing, the first is the most versatile and in this manner the most widely recognized. When the blocks are framed and any consequent systems performed, they are dried to expel abundance dampness that may somehow cause splitting during the resulting terminating process. Next, they are terminated in stoves and after that cooled. At long last, they are separated—naturally stacked, wrapped with steel groups, and cushioned with plastic corner defenders.

Essential (Heating in Kiln)

Coal based direct decrease procedure depends on the strong diminishing specialist which is non-coking coal. The response happens at high temp (1000 deg C to 1100 deg C). Coal assumes a double job in the oven. Some portion of coal is utilized as fuel to supply the ideal warmth in order to take the crude materials to the ideal temperature. In any case, fundamental job of coal is to supply carbon for the decrease procedure. Dolomite is utilized as sulfur scrounger which at last turns out with the singe. Roast contains fiery remains of coal and different polluting influences of iron metal. The responses inside the furnace occur in a few phases during the decrease of iron metal to DRI. Iron metal experiences the accompanying last decrease response.

Covering (Glaze)

A blend of powdered materials that frequently incorporates a preempted glass made into a slip and connected to a clay body by splashing or plunging and fit for intertwining to lustrous covering when dried and fired Printing and Draying

Optional Heating (in kiln)

To set up the coating, comparable strategies are utilized with respect to the tile body. After a clump plan is determined, the crude materials are gauged, blended and dry or wet processed. The processed coatings are then connected utilizing one of the numerous strategies accessible. In radial coating or disking, the coating is encouraged through a turning plate that indulgences or tosses the coating onto the tile. In the chime/cascade technique, a surge of coating falls onto the tile as it passes on a transport underneath. In some cases, the coating is essentially showered on. For numerous coating applications, screen imprinting on, under, or between tiles that have been wet coated is utilized. In this procedure, coat is constrained through a screen by an elastic squeegee or other gadget. [23]

[22] https://www.concreteconstruction.net/products/decorative-concrete-surfaces/how-to-moisture-test-concrete- floors_o (05/06/2019).
[23] https://www.block (05/06/2019).

Dry coating is additionally being utilized. This includes the use of powders, squashed frits (glass materials), and granulated coatings onto a wet-coated tile surface. Subsequent to terminating, the coating particles soften into one another to deliver a surface like rock. [24]

Capacity

On the off chance that you have a great deal of material with various hues and choices that prerequisites to be warehoused in one zone you have to keep it straightforward so you can discover everything progressed on. For all time store tile with the labels on the prevalence of the cases confronting external. What's more, put thicker tiles on the base and lighter, more slender tiles. A general pyramid style stack works best past three or four vertical columns if conceivable.

Arranging and Packing

The fired tile assembling procedure closes with arranging and pressing. Arranging is finished by in voluntary arrangements with power-driven tackle and tile outer examination. The outcome is a deliberate item with regard to dimensional evenness, surface coming and mechanical and synthetic appearances.[25]

Raw Material

Clay Raw Material

Generally, the most important component of a ceramic tile body is clay. Clay is a term for naturally occurring mineral aggregates consisting mainly of the hydrous silicate of alumina.

There is considerable variation in the clay's mineral content and degree of purity. Clay serves various functions such as a binder, a suspension aid and an inexpensive source of alumina and silica.

From a geologist's viewpoint, kaolin is produced from feldspar and on feldspar crystals under the influence of weathering or acidic water. The term weathering means wearing down of all exposed masses of rock tending to reduce the land surface to sea level by different agencies such as water, wind or glacial. It is either a mechanical or physical process. Water in the form of rain or waves continuously wearing down the surface of rocks is a mechanical process. Wind moving at a high velocity can be destructive as well. The formation of clay is a chemical process that is assisted by mechanical breakdown and the separation of fine particles from coarse grains .[26]

Ball Clay

Ball clay is an extremely rare mineral found in very few places around the world. Its name dates back to the early methods of mining when specialized hand tools were used to extract the clay in rough cube shapes of about 30 cm. As the corners were knocked through handling and storage these cubes became rounded and 'ball' shaped. It also is sometimes referred to as plastic clay.

[24] https://www.neos-ceramics.com/wp-content/uploads/2014/09/Innovation-Fluorine-Fluor.pdf (05/06/2019).
[25] https://innovatile.com (05/06/2019).
[26] http://www.ceramic-research.com/articles_02.html(05/06/2019).

Ball clays are sedimentary in origin. Ancient rivers and streams washed kaolinite (formed from decomposed granite) from its parent rock. As the streams flowed from upland area they mixed with other clay minerals, sands, gravels and vegetation before settling in low-lying basins to form overlaying seams of ball clay. Ball clays usually contain three dominant minerals: from 20-80% kaolinite, 10-25% mica, and 6-65% quartz. In addition, there are other 'accessory' minerals and some carbonaceous material (derived from ancient plants) present. The wide variation both in mineral composition and in the size of the clay particles results in different characteristics for individual clay seams within a deposit.[27]

China Clay

China clay, as the name suggests, is a material known as kaolin, which was first used in China more than ten thousand years ago to make fine white porcelain. Some of this eventually made its way to Europe, where the gentry still had to make do with crude earthenware pots, and porcelain was highly sought-after. Noticing a gap in the market, a Plymouth apothecary called William Cook worthy began to research the porcelain-making process and spent several years searching for a material that resembled the kaolin that had been used for so long in China. In 1745 he eventually found it, at Tregonning Hill, near Germoe, in Cornwall, where a rare type of decomposed granite, finer than most talcum powders, arises naturally.

This material was known locally as Moonstone, Growan and Growan Clay. Cookworthy found a way to separate the material, using water to remove impurities, and then spent another twenty years developing his own recipe for making porcelain, which he successfully patented in 1768. Cookworthy immediately established the Plymouth Porcelain Factory, and began making fine china to sell to the gentry. He also began to sell the raw material to other English potteries.[28]

[27] https://www.ima-na.org/page/what_is_ball_clay(06/06/2019).
[28] https://www.cornwalls.co.uk/history/industrial/china_clay.htm(06/06/2019).

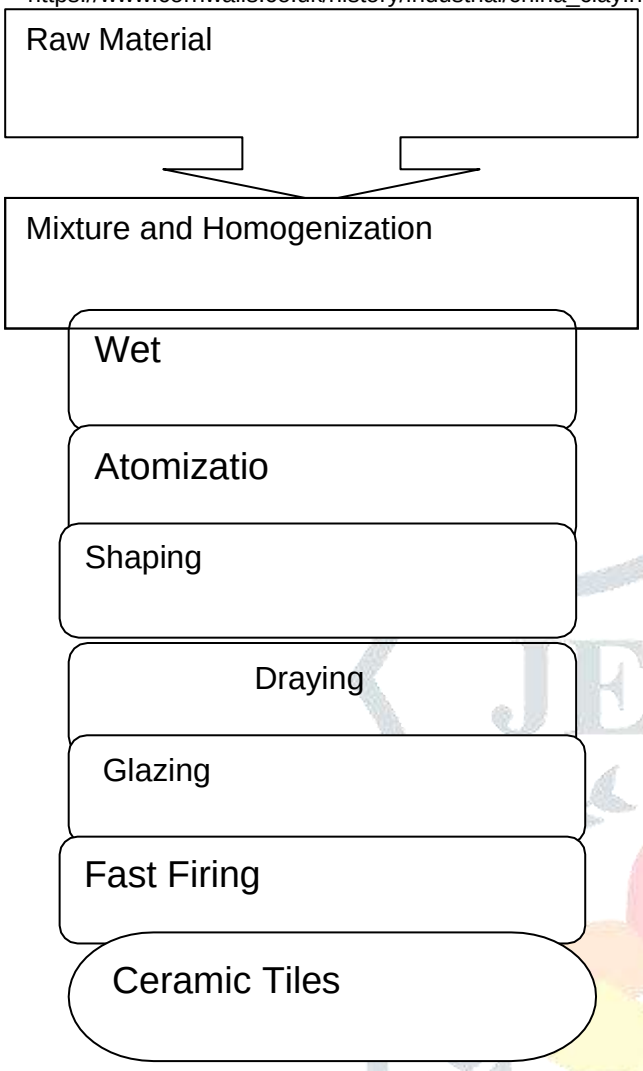


Figure 13. Manufacturing process diagram of glazed tiles according to a single firing process Source: https://www.researchgate.net/publication/225719990_GlassCeramic_Glazes_for_Ceramic_Tiles_A_Review (09/07/2019).

3.3.1. SELECTION OF CRITICAL PRODUCT

400 tons per month of solid core insulator 300 tons per month of long rod insulator 350 tons per month of hollow insulator 150 tons per month of railway insulator

Normal client request was assessed 1200 tons for every month, and the in-process normal month to month dismissals of a wide range of covers came about in COPQ of INR 25.35 Lakhs in the year 2018. The normal COPQ for different encasings in the year 2018 is displayed in figure. As observed from table and figure, the strong centre cover has most extreme COPQ because of greatest number of dismissals, along these lines; this item was picked for pilot venture. Further, task astute dismissal information was gotten for strong centre cover to know the commitment of different imperfections.

Table 4. COPQ of a range of insulators

S. No.	Name of insulator	Average rejections after post Kiln	Average rejections after post Kiln (MT)	COPQ (INR 115 per Kg)	COPQ in Percentage
1	Solid Core	2.50% of 400 MT	10	15,00,720 INR	59.20%

2	Long Rod	1.75% of 300MT	5.25	7,64,049 INR	30.14%
3	Hollow	0.50% of 350 MT	1.75	2,45,641.5INR	09.69%
4	Railway	0.15% of 150 MT	0.23	24,589.5 INR	00.97%
	Total	-	17.23	25,34,999 INR	100%

Source : Own elaboration.

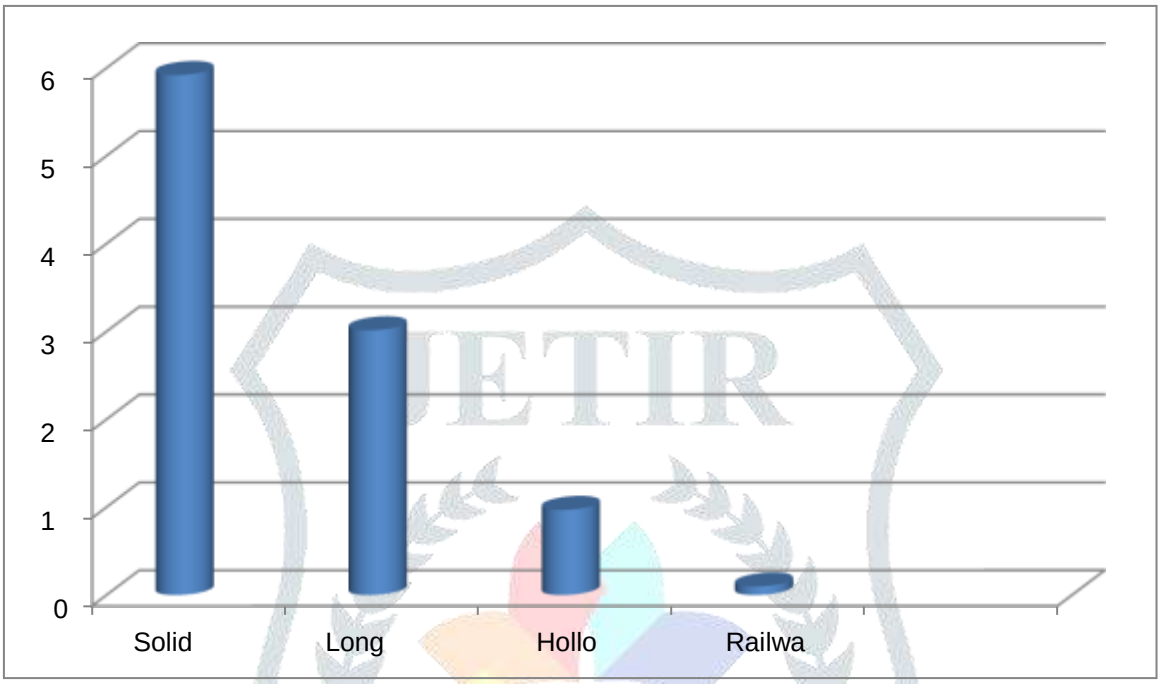


Figure 14. COPQ (monthly) in proportion for different insulators Source: Own elaboration.

3.3.2. PRODUCTION PROCESSES AND PROCESS LAYOUT

Next, the generation procedure was comprehended, and a procedure design was made as appeared in figure 12. The procedures for strong centre separator begin with ball processing where two sorts of blends are arranged to be specific bauxite and non-bauxite by blending of crude material and water for further handling. The fluid blend item (slurry) from this stage goes in blending tank for proportion control where semi strong piece (scrap reuse from downstream exercises) is additionally included. There is discrete line to gather the piece from various procedures beginning from pug factory to oven stacking. There is one piece blending tank at shaper office and through channels scrap goes back to the crisp blending tank. For legitimate bits of semi-strong piece cover one footer machine is associated through an underground belt transport framework to the piece blending tank.

The slurry at that point goes to channel squeezing in the wake of going through the sieving and Ferro-filtration to expel the water. In channel press cakes are set up by expelling water from slurry. And afterward cakes go in to pug processing, pugs are framed by extrusion PEDs are utilized to diminish the dampness in the pugs to a specific incentive before the forming procedure. PED is significant in such a case that the dampness is excessively high or too low then appropriate turning of encasings in the moulding division can't happen. Next, pugs are turned on vertical machine machines to give them the required shape. After this procedure, the covers are secured with polythene sheets to keep away from introduction to remote materials. Dryers are utilized to diminish the dampness substance of the went separators to give them quality. The coating and gravelling office comprises of four procedures – dry completing the process of, plunging, gravelling, and moving. Residue is expelled in dry wrapping up. Plunging encouraged the covering of coating material on the encasings. In gravelling, both the closures of the protectors are covered with paint and paste and rock is blown over. The covers are stepped with client ID name and

moved to the furnace office. The last procedure of the semisolid item or pre-oven task is the furnace stacking in the autos for warmth treatment. Up to semisolid express any piece can be reused in the blunzer.

Figure 15. Production process and layout Source: Own elaboration.

The principal procedure after pre-furnace is the warming or terminating of encasings in the ovens at a specific temperature. The post oven procedure comprises the irreversible cementing of these encasings by warmth treatment and move to the cutting and granulating division where the closures of the terminated separators are sliced to their appropriate length and granulated for simple manual dealing with. The crushed protectors at that point goes to gathering division where the remainder of the procedures (concrete restoring, use of installations at the closures, and joining of at least two encasings together as indicated by requirement) are completed. The subsequent last procedure in the post furnace is trying and last examination. Tests like malleable, shear, twisting, and so forth are done before conclusive assessment which incorporates parallelism, unpredictability, visual deformities, full measurement, and generation explicit necessity tests. The quality control passed covers are pressed in break confirmation wooden packs. The last procedure is stacking and dispatching by the showcasing office. At XXX the showcasing office gets requests from household and remote clients. At the point when a request arrives, the generation arranging and control (PPC) office enters it into the arranging framework, gauges the date by which it tends to be finished and make a timetable of conveyance on month to month and week after week premise to share it with the creation office. Creation office breaks this week after week plan into day by day calendar and screen the generation step by step, step by step and step by step. Various kinds of in-house material taking care of modes, in particular, bed trucks, battery worked vehicles and manual trucks/autos. The plant takes a shot at a nonstop reason for 24hr per day, 365 days a year (aside from real shutdowns) in three movements (except for cutting and granulating, get together and bundling divisions keep running in two movements). Each move is 8hr long with 45 moment breaks.

3.3.3. RESEARCH AND ANALYSIS OF PRESENT VALUE STREAM MAPS(CVSM)

A CVSM fills in as a beginning stage to help each individual in the assembling framework to distinguish squander. Worth stream point of view means dealing with a major picture and attempting to improve the entire procedure, not simply individual procedures. It helps in envisioning future state when

upgrades/changes are consolidated in the framework. After choosing the basic item, current condition of significant worth stream was mapped as pursues:

- An A3 size (or 11×17 inch) record size paper was taken, and symbols were drawn speaking to client, provider and generation control.

- Shipping and accepting information were entered alongside the symbols for trucks utilizing directional bolts for the development.

- Entries were made to set up an information box underneath the symbols to catch the month to month/day by day prerequisites of every item subsequent to understanding the general stream.

What's an additional form?

- Both electronic and manual data stream bolts were drawn between the gatherings concerned.

- Next, stock symbols were drawn alongside the amounts.

- The last real advance was drawing of course of events at the base of the worth stream map.

What additional, aggregate up all the handling time and note them toward the finish of the course of events. Essentially, holding up time was summed up and noted on the course of events scale. Time study was completed to catch the individual procedure exercises and timings for the equivalent. The present worth stream guide is appeared in figure 5.6. Further, the CVSM was created by demonstrating the gathered information as per the methodology as suggested by Rother and Shook (1999). Information gathering for the material stream began at the shipping office, and worked in reverse right to the ball plant process, gathering preview information, for example, process duration of each procedure, number of specialists and number of movements. There are two inventories referenced underneath the stock triangle in the present state map in which top information speak to the stock of strong centre and beneath one shows the inventories of a wide range of covers.

The accompanying perceptions and investigations can be produced using the present condition of the association:

- The preparing time is around 13 days (18702.07 minutes), while the holding up time is about 24.84 days. Aside from this, there is part of stock heaped up before drying, oven arranging, cutting and pounding, get together and last investigation forms/workstations.

-There is overabundance stock in the entire inventory network. This incorporates the stock of 90 days bolted at approaching material stores for the dread of inaccessibility of rough material.

- There is a huge WIP before significant procedures/workstations because of dread of inaccessibility of right amount of completed products. This likewise causes abundance pausing time (24.84 days) and results expanded lead time. This can be decreased by making extraordinary accentuation to decrease different imperfections, particularly after oven activity.

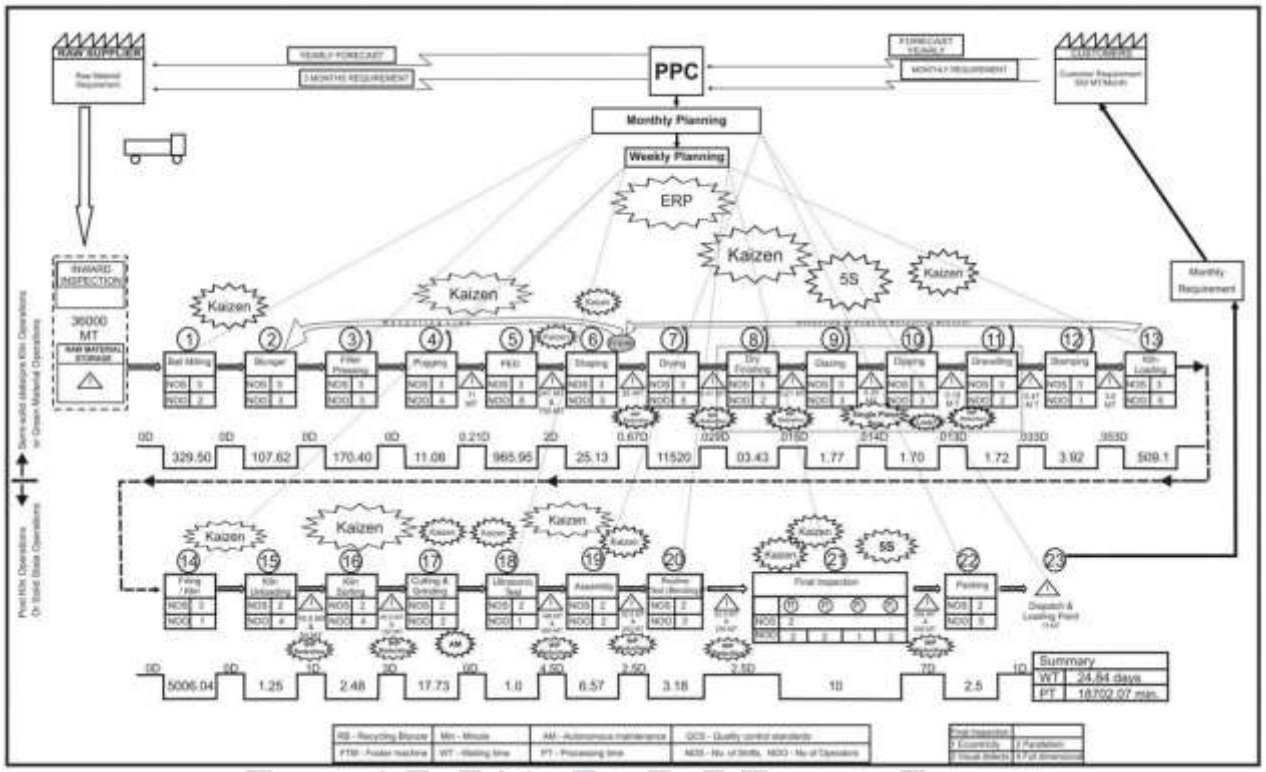


Figure 16. Present Value Stream Map (CVSM) Source: Own elaboration.

CHAPTER 4. METHODOLOGY OF LEAN RESEARCH

3M Approach

Writing survey in section 2 demonstrates that the most extreme quantities of distributions in lean assembling are identified with transportation part (car and aviation industry). Lean assembling execution began in car industry and before longing its application was embraced by different businesses including material, development, nourishment, restorative, electrical and hardware, administrations, and so forth. LM has been embraced by all sorts of assembling frameworks – item format, process design, and fixed design; group generation and large-scale productions; discrete creation to consistent creation.

It has discovered applications from assembling to support segment; large scale manufacturing to high assortment and little volumes creation; work serious enterprises to innovation concentrated businesses; development industry to get together industry; therapeutic human services to correspondence industry. In any case, the execution of lean assembling in the constant procedure industry or nonstop items industry have been less mostly considering specific troubles in the execution in these sort of ventures (Jimenez et al 2011). Use of lean assembling in clay industry is too testing as a large portion of the procedure is consistent sort and the other half is discrete part producing.

In India, the artistic business has seen quick development sought after principally due to development in development and lodging area. This has prompted thriving interest for clean product, floor and divider tiles. Progressing changes in the power part and development of dissemination framework has brought about interest for protectors, particularly high pressure covers (for 33kv or more). This is probably going to speak to a hostage market and expected to develop relentlessly for at any rate 5-10 years as to an ever-increasing extent states get into power division change (Rajasthan framework Agenda "2025", Price Water Cooper house report). Rajasthan represents 25% of the generation of sterile what's more, electric encasings [29]Regardless of, being a crude material rich district, the artistic business is still to a great extent immature in this area. There is part of waste in the creation framework and this makes a great deal of income misfortune the organizations. LM gets improvement the quality of items and brings down costs which are basic for contending at national and global level.

4.1. SELECTION OF THE ORGANIZATION/CASE COMPANY

After the fundamental exchanges with numerous associations, the case organization, called Modern Ltd to look after classification, was chosen basically because the top administration was happy to execute lean assembling to improve efficiency, quality and adaptability. There were two officials who knew about lean assembling and its benefits. These administrators persuade the top authority that authoritative difficulties can be met by LM usage effectively. The Modern Pvt. association is a chief unit in the field of assembling high voltage and additional high voltage alumina porcelain insulators; required for transmission lines, dispersion lines, sub-station, railroad charge, and electrical shift gear and control hardware in

[29] http://www.ceramics-india.com (09/06/2019).

India. By and by organization is creating 1650MT of separators with a turnover of INR 350 cores and 2600 workers. It is perhaps the biggest exporter in the nation and has been respected with different fare grants from service of trade. It makes protectors in the scope of 33KV to 1200 KV. XXX is prestigious for the activity in its R&D, item quality and consumer loyalty and an ISO guaranteed organization. They have made huge interests in foundation, labour preparing, and improvement rehearses in accordance with the best in the world. The plant is worked by qualified specialized faculty, designers and experts who have been uniquely prepared in their individual fields. XXX fares its items to nations like Poland, Antigua, Iran, Iraq, Cyprus, South Africa, and other Gulf Countries. The principle results of the association are appeared in figure.

4.2. PRE-IMPLEMENTATION PHASE

The pre-usage stage is the starting period of the lean execution process. It is fundamentally lean mindfulness or duty creation stage among all workers and the executives. It comprises of three levels to be specific, lean way of thinking, lean essentials and lean arrangement. In this the administration and workers understand the lean way of thinking, show initiative duty, contribution, and so forth. This stage makes a stage for lean usage and in the meantime, wipes out the suspicion encompassing its execution and advantages.

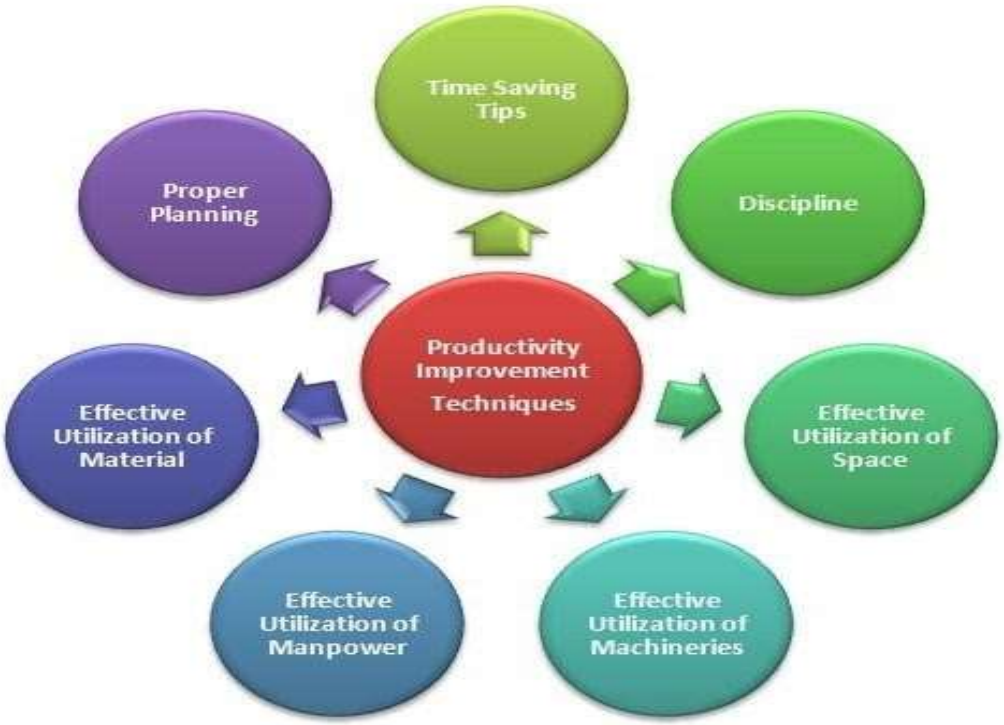


Figure 17. Continuous Improvement for Productivity Improvement Source: www. http://ordnur.com (08/06/2019).

4.3. LEAN THINKING

It comprises of the consciousness of lean way of thinking (recognizable proof and end of waste, constant improvement, supportability in procedures and client centre) among the board and workers.

(i) Classification and elimination of waste

Lean is about making of significant worth for the end client by disposing of squanders and non-esteem included exercises from the framework. Lean is prestigious for its emphasis on decrease of eight squanders to improve by and large client esteem. The eight squanders featured in LM are overproduction, pausing, movement, over preparing, abundance stock, development, absconds, and unused representative imagination (Liker, 2004). Be that as it may, these days there is a ninth waste as natural or vitality squander, which infers the superfluous or exorbitant use of assets just as substances discharged to air, water, or land that could hurt human wellbeing or condition (Gehin et al., 2008; Millet et al., 2007). During this stage, mindfulness about these squanders and their impact on association is made. Improving correspondences among all divisions is the way to decrease in squanders. So as to decide the general squanders influencing the association, there is having to deal with the assessments of the different shop administrators and segment in-charges. Since, almost certainly, their feelings might be conflicting in nature; there is need to advance a strategy to adapt to such circumstances. To defeat such issues, multi property utility hypothesis has assumed a key job (Winston, 2004; Mallacoota and Raman, 2000) in choosing the trade-offs between the clashing variables.

(ii) Continuous improvement

Actualizing "lean" inside the association requires a critical progressing exertion so as to improve the quality, efficiency, adaptability, and so forth. It is basic to support this exertion and understand the advantages of a long-haul duty to make a quality culture. On the off chance that once lean has been executed, it's anything but an end in itself, however a way to build up the association for Improvement.

(iii) Sustainability in process

There has been profoundly changed accomplishment in executing incline toward the processing plants transcendently due to issue in supportability. Certain practices are executed and actualized well with the executive's consideration, yet as the board consideration is evacuated or even diverted, execution in the underlying achievement drops. There are two unmistakable purposes behind the trouble in manageability; one is the structure, arrangements, and training execution in the processing plant (the job of plant the executives). The subsequent one is the help capacities, for example, advance assembling building or item designing (Flinchbaugh, 1998). In this way, to make lean assembling fruitful vertically and on a level plane along the time skyline, appropriate lean administration structure is advanced plainly determining the job of people in the structure.

(iv) Customer focus/customer involvement

Client centre is fundamental to lean way of thinking. In this, organizations accentuate client communicated needs and create answers for address these issues. Client centre rotates around the thought of "characterizing an incentive from client point of view", which requires continuous and standard correspondence with clients on all viewpoints including their encounters with the item. In their book „Lean Thinking", Womack and Jones (1996) talks about the job of client centre as "lean reasoning must begin with a cognizant endeavour to accurately characterize an incentive as far as explicit items with explicit abilities offered at explicit costs through a discourse with explicit clients". Richards (1996) features one of the unmistakable standards of lean creation is that the buyer and the challenge should never be neglected. The client must be offered items that are more engaging than the aggressive items in the market, generally, in spite of the organization being proficient and able, stock will develop quickly.

4.4. LEAN RESEARCH

This incorporates lean planning as instruction and preparing. Any sort of progress requires instruction and preparing to embrace it and it is the same if there should be an occurrence of lean execution. In a lean generation condition, instruction and preparing is required to create multi-talented specialists who can perform in excess of a solitary occupation and to make a domain wherein labourers have the right stuff and capacity to push for constant improvement. It is generally conceded that most of modern mishaps are caused legitimately by explicit hazardous demonstrations of people or presentation to explicit mechanical or physical dangers. Managers, hence, acknowledge undeniably more obviously that mishap avoidance is a beneficial mix of philanthropy and great business strategy, and in this manner organize security training (Heinrich, 1931). Waste, quality and lean devices mindfulness shapes a significant piece of instruction of workers to improve their presentation. As Liker (2004) clarified, these inefficient exercises extend lead times, cause additional development to get parts or devices, make abundance stock, or result in a pausing. Subsequently, evacuating these squanders is a basic advance to improve productivity. In many associations, the top administration goes about as an introducer (Arawati and Abdullah, 2000) and the quality division goes about as a secretariat for observing the usage. Occupation preparing and group learning are likewise required for improving an employee's execution and at last contributing towards the development of the association. Another significant part of instruction and preparing is the powerful and proficient administration of 7M (Man, Machine, Material, Motion, Method, Motivation, and Measurement).

Powerful and productive administration of 7M

Lean can't be executed in an association except if and until there is soundness and/ or then again improvement in the traits like man, machine, movement, technique, inspiration, estimation, and material. Machine can be improved with the assistance of 5S and TPM. Repetitive movement can be diminished by arranging design all the more productively. Strategy must be institutionalized yet ought to likewise be consistently improved. Material stream can be made smooth by one-piece stream and stock can be diminished by force framework. Specialists are inspired by the compensation framework and remunerating them for their quality proposals. There are bunches of execution parameters which can be estimated with appropriate estimation framework so change can be found in LM usage. A short depiction of 7M is given straightaway.

Man/Human asset (HR): It is the most significant asset for any sort of industry regardless of how robotized it might be since no organization can work without this. There are different elements identified with human asset that guide in actualizing lean reasoning in an association as appeared in table

Table 5. HR related essential factors for successful lean performance

Culture (societal and organizational)	Dealing with Constraints
Commitment	Performance Feedback
Recruiting, Hiring & Training	Policy Focus & Deployment
Communication	Employee Development
H.R. Systems	Quality Leadership
Diffusing Knowledge into Decision Making	Multifunctional Teams
	Roles and Responsibilities

Source: Own elaboration.

Machine: It is absurd to expect to fabricate anything without machine which is a vital segment of assembling. As lean underscores on without a moment to spare creation, the stock levels are in every case low at each stage. Machine breakdown, set up and alteration postponements, lingering and minor

stoppages, diminished speed, process deserts, decreased yield would prompt a calamity in the association. Lean aides in diminishing these losses to improve machine viability.

Motion: Motion is viewed as a loss as it doesn't increase the value of the item. The fundamental reason of squandered movement is identified with poor work environment ergonomics. This in turn causes decrease in profitability, nature of items and wellbeing of specialists. Cell based design decreases the squandered movement, as it were, (Ahlstrom and Karlsson, 1996).

Method: With quick mechanical advancement, worldwide correspondence and heightened rivalry, old strategies can neither give similar outcomes nor can react to the quick evolving circumstance. Lean can't be effectively executed except if and until there is dependability in strategy. There are different ways by which improvement in strategy can be accomplished like SMED, institutionalization, and so forth. In a lean creation framework, it is critical to move towards a higher level of procedure control.

Motivation: Motivated specialists are an indispensable piece of lean association and that can be accomplished at certain level with due consideration towards the labourers by the executives. Specialists are never again considered as the variable resources which can be terminated whenever, rather labourers are viewed as fixed resources like the apparatus of the association, and just distinction being that hardware deteriorates with time though the aptitudes and information of the labourers increment with time and experience. A significant inspirational factor is appropriate compensation framework. This framework assumes a significant job in the lean execution (Karlsson and Åhlström, 1995). A portion of the motivating forces might be profitability reward, if the specialist has helped in decreasing the standard process duration of the procedure; quality reward, for zero deformities in the predefined timeframe; time exactness reward, if all requests are conveyed on schedule, and so on.

Material: Less stock levels have their very own preferences as far as lower holding cost and effective use of the extra room. Draw framework helps in decrease of stock and furthermore improves the procedure productivity. Lean expands the asset use including the less utilization of material.

Measurement: The lean execution acquires enhancements the exhibition parameters. To know the enhancements, there are rules to think about for a successful execution estimation framework. Much of the time, associations utilize conventional measures with little thought of their significance (Bhasin, 2008). On the off chance that improperly arranged, the measures can run counter to the methodology and support the off-base sort of conduct in the lean change venture. Table 4 is a compelling layout to assess the effect of incline toward an association.

Table 6. Financial Measurement of Development

Financial Future	**Customers**	**Process**	**People**	**Market Measure**
Profit after interest and Tax	Customer satisfaction index	NPD lead time	Health and safety per Employee	Depth and Quality
	Customer retention	Cycle time		of strategic plan Anticipating
		Time to market for New Product		
Rate of return on capital	Rate	Quality of new project	Accident	Future changes
	Service Quality	Development and Project	Absenteeism	New Market
	Responsiveness		Labour turnover	Development
Current employed Development Ratio	(customer defined)	management processes,	Relation of top Employees	
	On-time delivery	Quality costs	Quality of professional/Technical Development	New Technology
		Quality ratings		

Earnings per share		Defects of critical products/components,		Percentage of Sales from New Product
		Material costs ,	Quality of leadership Development	
		Manufacturing costs		
		Labour productivity		
		Space Productivity		
		Capital Efficiency		
		WIP inventory		
		Raw Material Inventory		
		Finished goods inventory		
		Finished goods inventory		
		Stock Turn over		

Source : Bhasin, 2008.

4.5. WASTE ANALYSIS

During the examination of the present worth state map, the losses of lean were recognized in each procedure/workstation. Underlying driver examination was completed for each loss as appeared in figures. The procedures/workstations are shading coded for our benefit. The outline of squanders and their main drivers are given in table. It is beneficial to refer to that the assistance of the shop floor representatives was of incredible worth.

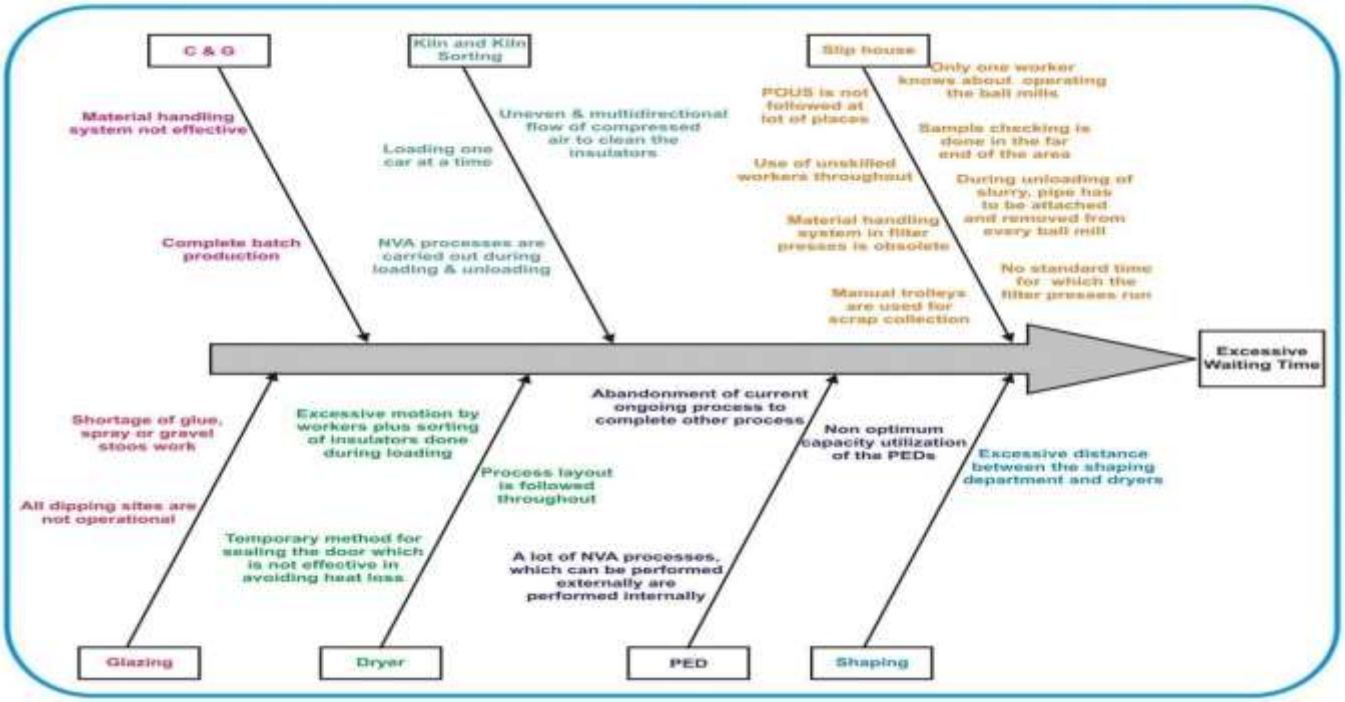


Figure 18. Ishikawa diagram of waiting time Source: Own Elaboration.

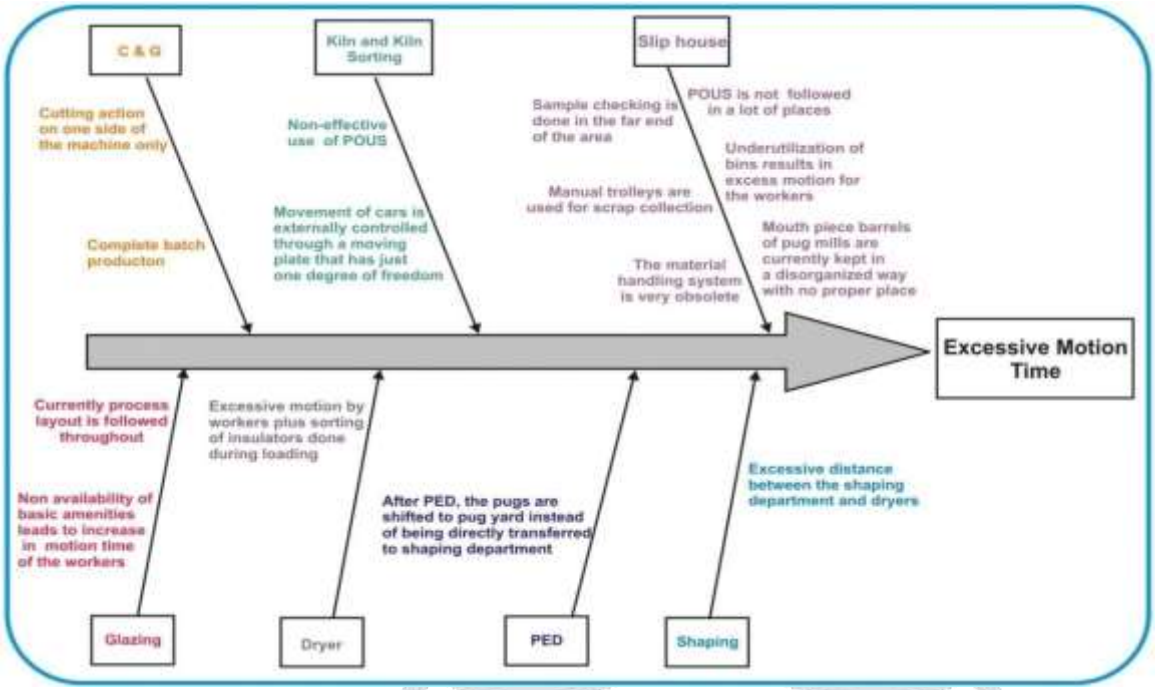


Figure 19. Ishikawa diagram of motion time Source: Own Elaboration.

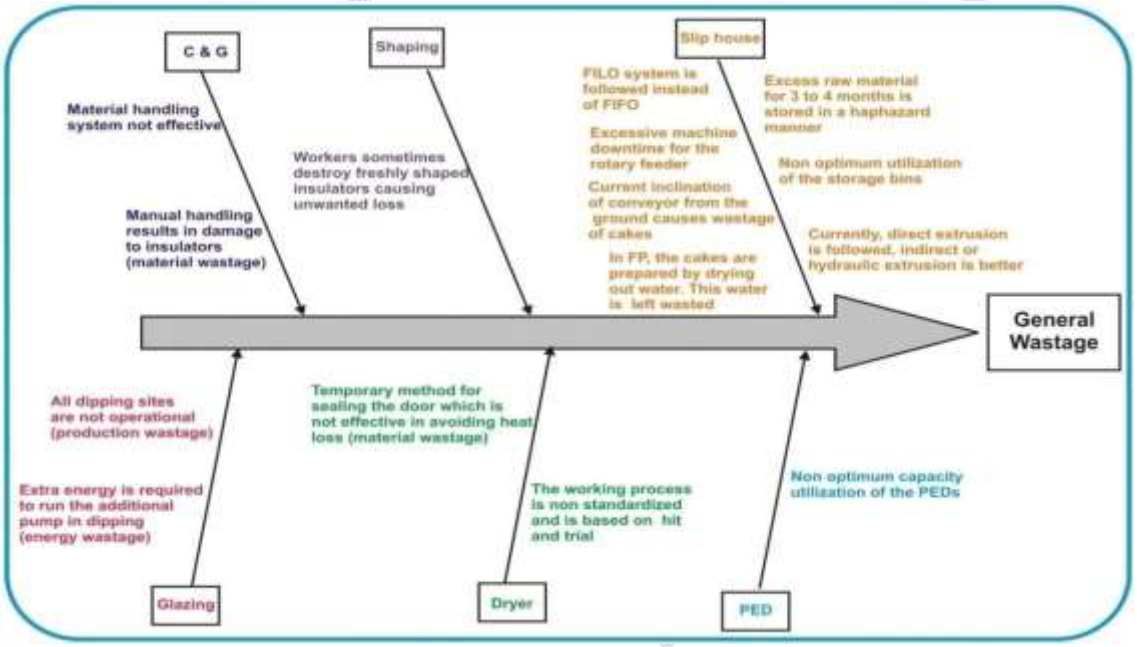


Figure 20. Ishikawa diagram of general waste Source: Own Elaboration.

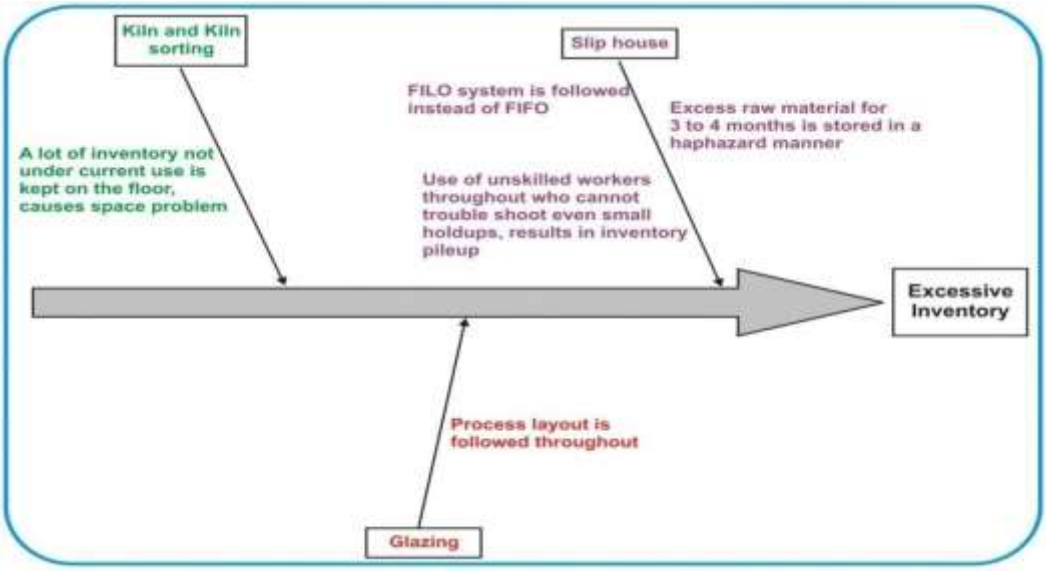


Figure 21. Ishikawa diagram of excessive inventory Source: Own elaboration.

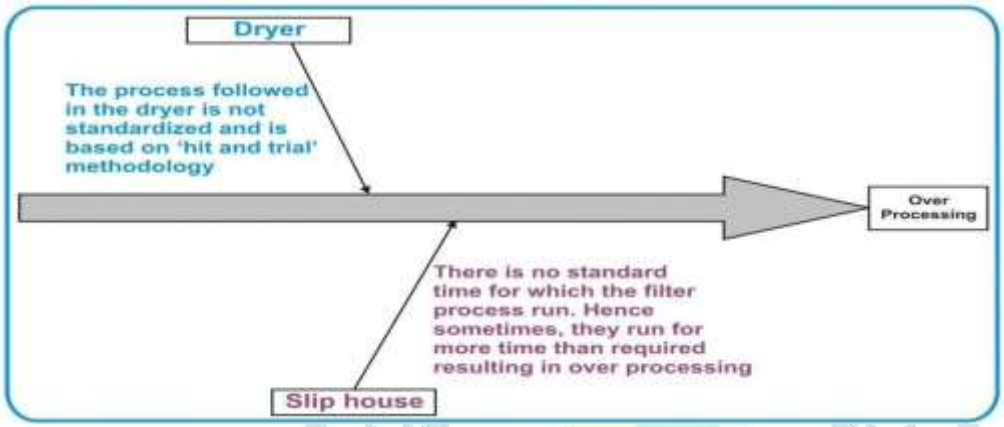


Figure 22. Ishikawa Diagram of over processing Source: Own elaboration.

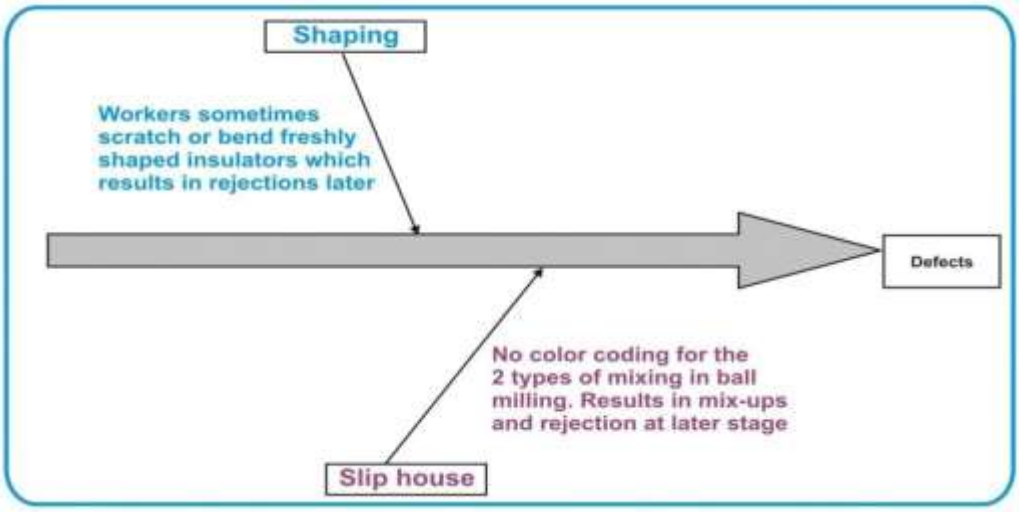


Figure 23. Ishikawa diagram of Defect Source: Own elaboration.

Table 7. Wastes and their root causes at different processes/workstations

Waste/Processes/Work Station **Slip house**	**Root cause(s)**
Inventory	- First in, last out system followed in the storage area as the Storage bins are open from only one side - Excess raw material for 3 to 4 months is stored in a haphazard fashion
Defects	No color coding for the 2types of mixing in ball milling. Results in mix-ups and rejection at later stage
Motion time and general wastage	Underutilization of bins. Results in more number of bins and hence movement of workers
Motion time and Waiting time	- POUS (point of use system) is not followed. All ball mills are used for normal as well as bauxite mixing. Results in a huge spread of raw materials. - For sample checking, the sample is taken to the far end of the area by a worker on foot. - Manual trolleys are used for scrap collection - The location of oil tanks is very random. They are not kept at their point of use - The mouth piece barrels of pug mills are currently kept in a disorganized way with no Proper place - Use of unskilled workers throughout the plant. They perform job mindlessly and can't troubleshoot even little problems. Results in inventory pileup and increase in waiting time. - Waiting timeCharging of ball mill with water and RM is done separately. - And the cap of the ball mill is tightened using nuts and bolts Which wastes a lot of time? - During unloading of slurry, the pipe has to be attached and removed from every ball mill - Path of movement of racks of pugs is currently very cluttered and haphazard. A lot of times, wastage of time is there due to collisions
Waiting time and untapped human talent	Only one worker knows how to work the ball mills. This increases the waiting time for the ball mills when the worker is busy with some other job.
Motion time	Before the ball mill can start to work, the worker has to travel. Water wastage in filter press, the cakes are prepared by drying out water. This Water is left wasted.
Wastage and untapped human talent	Cycle time of filter press is around 2.5 hours while rotary feeder is a continuous process
Waiting time or over processing	There is no standard time for which the filter presses run
Energy wastage† Defects and waiting time	Currently the process followed for extrusion is direct Extrusion. This requires a much higher power input and energy Compared to indirect or hydraulic extrusion -The machine downtime of the rotary feeder is much because the workers just sit idle a lot of the time

Low space utilization†	A lot of area which can be used otherwise for other used by the workers to put their personal belongings
PED	
Waiting time	A lot of processes internal in nature are performed which Wastes a lot of time. These are processes whi ch can be performed before the main process starts -Sometimes during the process of loading or unloading the work is left in the middle because the workers need to tend to some processes else where
Underutilization of resources and waiting time	The PED' share not being used to their optimum capacity .Most ofthePED"sareatleast25to50percentempty
Motion time	After PED, the pugs are kept in the pug yard for a certain Interval of time
Shaping Department	
Defects	Workers sometimes destroy freshly shaped insulators causing unwanted loss for the company Transportation time. - Motion time and Waiting Time Motion time, waiting time and the distance between shaping and dryer is much more than required. This causes a lot of time wastage. Energy Wastage and waiting time - Energy wastage and over processing for loading the workers have to move around a lot plus they have to sort through the racks to find out which insulators are to be taken. - The application of mitt on the door for sealing purposes is very old, wasteful and temporary. Plus, it is not very effective to avoid heat loss. -The process followed in the dryer is not standardized and is based onhit andtrial methodology. This givesrise to non- value added activities Also lot of wastages of energy due to

Source: Own Elaboration.

4.6. PARETO CHARTS ANALYSIS OF DEFECTS IN EACH PROCESS

In each procedure, Pareto graph examination, has been done to realize the month to month normal dismissal patterns for various sorts of deformities in pre-furnace and post oven tasks as appeared in tables and furthermore attracted figures. After main driver examination improvement activity, has been taken to decrease equivalent to talked about in the following (segment 4).

1. Slip house rejections

Table 8. Examination of defects in slip house

Defects Reason	Monthly average rejection (MT)	Percentage	Cumulative percentage
Round Crack	0.098	64.13	64.13
Damaged Pug	0.026	17.11	82.24
Bore Crack	0.012	06.59	88.83
Fallen	0.007	04.69	93.49
Ovality	0.006	04.60	98.01
Bend	0.005	01.99	100.00

Total	0.154	100.00

Source: Own Elaboration

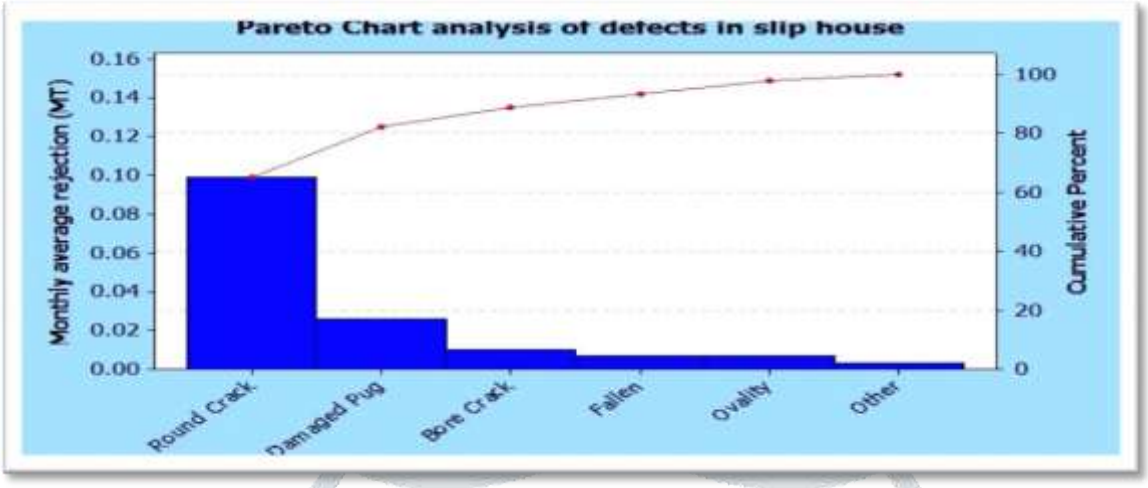


Figure 24. Pareto Chart study of defects in slip house Source: Own elaboration.

2. PED loading rejections

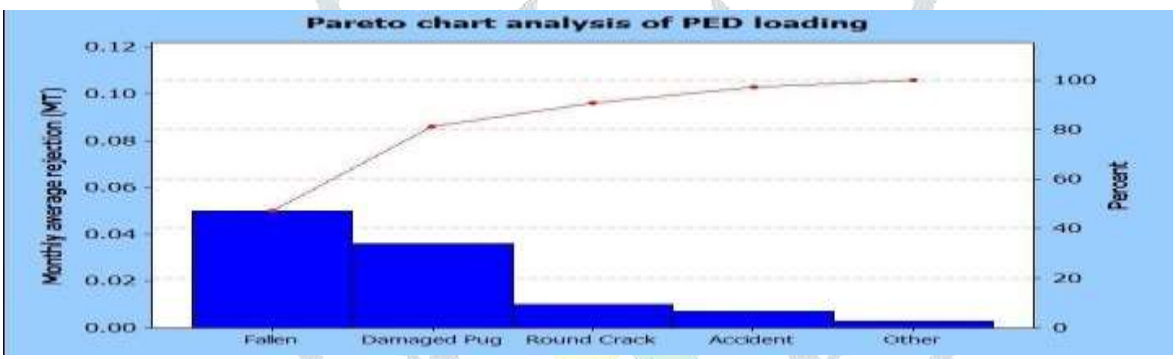


Figure 25. Pareto Chart analysis of PED loading Source: Own elaboration.

Table 9. Analysis of PED Loading

Defects Reason	Monthly average rejection (MT)	Percentag e	Cumulative percentage
Fallen	0.051	47.20	47.20
Damaged Pug	0.035	33.94	81.11
Round Crack	0.012	09.42	90.52
Accident	0.005	06.62	97.19
Hard Pug	0.002	02.83	100
Total	0.105	100	

Source: Own elaboration.

3. PED unloading rejections.

Table 10. Analysis of defects in PED unloading

Defects Reason	Monthly average rejection (MT)	Percentage	Cumulative percentage
Damaged Pug	0.098	40.73	40.73
Fallen	0.074	30.05	70.79
Round Crack	0.045	20.13	90.91

Soft Pug	0.014	04.17	95.12
Bore Crack	0.003	01.23	96.31
Blank Rejection	0.003	01.23	97.54
Accident	0.002	01.22	98.76
Hard Pug	0.004	02.47	100
Total	0.243	100	

Source: Own elaboration.

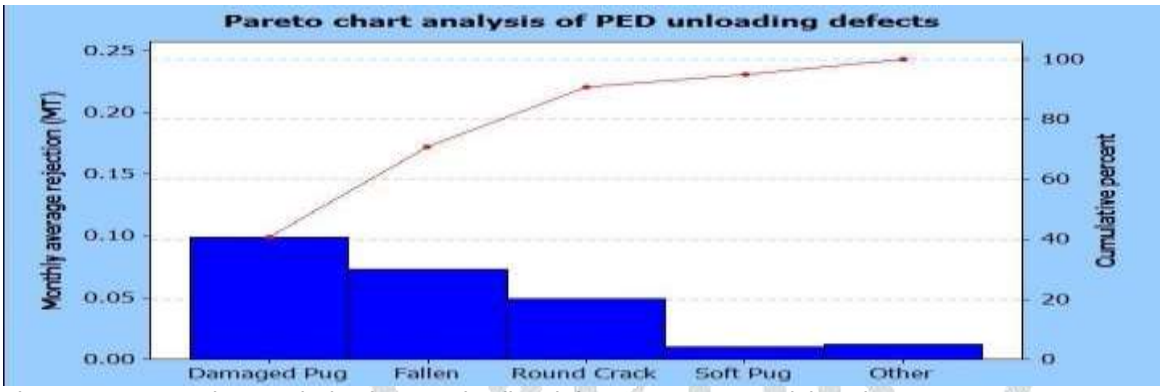


Figure 26. Pareto Chart analysis of PED unloading defects Source: Own elaboration.

4. Dryer loading rejection

Table 11. Defects analysis in dryer loading

Defects Reason	Monthly average rejection (MT)	Percentage	Cumulative percentage
Shed Band	0.377	37.73	37.75
Shed Cut	0.207	20.45	58.19
Shaping Handling	0.176	17.44	75.61
Others	0.085	08.29	83.89
Bad Shaping	0.066	06.57	90.44
Handling	0.048	04.89	95.33
Shed Cut	0.032	03.00	98.35
Chipping	0.010	01.00	99.32
Accident	0.007	00.68	100
Total	1.004	100	

Source: Own elaboration.

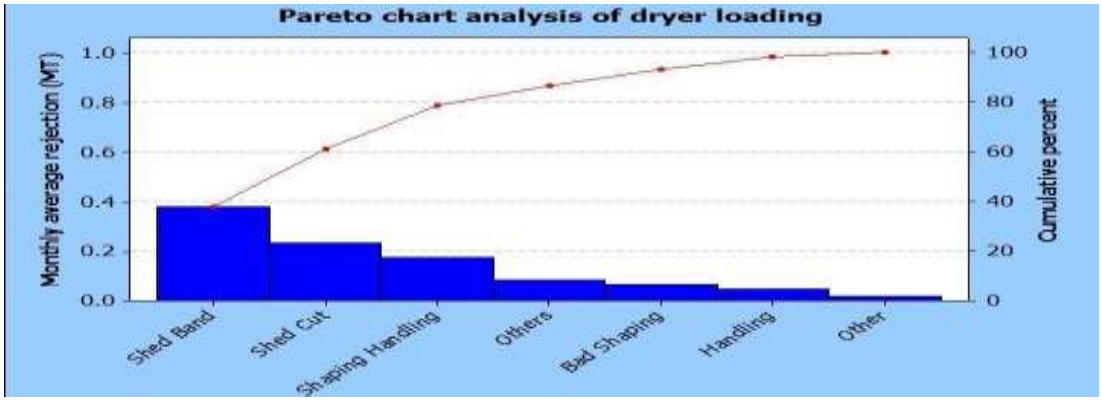


Figure 27. Pareto chart analysis of dryer loading Source: Own elaboration.

5. Dryer sorting rejections

Table 12. Defects analysis in dryer sorting

Defects Reason	Monthly average rejection (MT)	Percentage	Cumulative percentage
Petticoat Crack	1.285	76.89	75.29
Shed Bend- SB	0.355	20.82	96.13
Shed Cut	0.067	02.29	100
	1.707	100	

Source: Own elaboration.

6. Kiln rejection

Table 13. Defects analysis in kiln

Defects Reason	Monthly average rejection (MT)	Percentage	Cumulative %
Round Crack	0.247	30.87	64.62
Chipping	0.270	33.75	33.75
Petticoat Crack	0.056	07.00	80.25
Accident	0.125	15.63	87.25
Handling	0.046	05.75	94.25
Shed Crack Rejection	0.056	07.00	100
Total	0.800	100	

Source: Own elaboration.

7. Kiln sorting rejections

Table 14. Defects analysis in kiln sorting

Rejection reason	Monthly average rejection (MT)	Percentage	Cumulative percentage
Petticoat Crack	1.63	86.24	86.24
Shed Cut	0.26	13.76	100
Total	1.89	100	

Source: Own elaboration.

8. Other post kiln rejections

Table 15. Defects analysis in other post kiln rejections

Rejection reason	Monthly average rejection (MT)	Percentage	Cumulative %
Handling/Chipping	0.233	41.02	41.02
ERP stock adjustment at packing/RTST	0.140	24.65	64.67
Inside Bottom/Inside Top	0.075	13.20	79.52
Broken	0.044	07.75	85.62
Inside Crack/Surface Crack	0.040	07.04	94.00
Cavity/CMV	0.037	06.51	100
Total	0.568	100	

Source: Own elaboration.

4.7. RECOMMENDATION FOR DEFECTREDUCTION

Pre-kiln defect reductions

It can be seen in the Pareto investigation that key defects/green rejections are in the grouping of Shed Bend, Shed Cut, Round Crack, Damaged Pug, Petticoat Crack (PC), Shaping and handling rejections. The subsequent (Table) measures were taken to decrease these defects.

Table 16. Corrective/preventive events planned for some minor rejections

Type of rejection	Probable causes	Corrective/ Preventive actions
		Blank must be free of charge from bend. Nozzle / Table set, while loading identical pushing
	Blank Blend	While transferring for PED loading should Bend, damage, short length wooden plank should not use
		Storage due to more rack stock in pug yard / pugging yard
SDC	Blank Damage	Keep the rack in a fashion which does not damaged the blank in pug yard / pugging yard.
SHED CUT		FIFO to be followed in pug yard
	Pug position while load on machine.	Pug to be loaded in centre of machine keep away from turning of damage pug
	Taper cutting	Cutting wire must be fixed Cutting momentum should be fast
	Fewer gaps between shed	Study was done and set the correct diameter of blank for different size of insulators
	OD to blank OD	
	Sticking of empty through Drying process in PED	Separator (made of plastic) was provided between two or blanker.
	QC cutting of all mandrills items in each shift	For WVT Cutting use the pistol Caliper
QC Cutting	QC cutting of boring items in each setting of taper items	Check the top & bottom boring dimension and taper only uncertainty then only cut the material

	Flat surface on the blank Small lot size of tapper boring item Blank situation	Table nozzle setting One item must be extruded constantly as per planning on one time as per shaping machine requirement.
	Centre out of machine	Blank of correct PMR to be use for turning.
	Centre out of machine	linking centre of machine must be in line Pug cutter must be in alignment
Failing	Toper cutting In appropriate support in “C” Clamp	Cutting wire must be tightened. “V” frame made for big solid core insulators
	Improper rack setting whilst dryer pushing Neck crack due to taper cutting from base	appropriate rack down to be done at the time dryer pushing Turned with particular footer at shaping
Neck Crack(NC)	Rack down time cone get damage due to fewer stem length	Stem length improved by 25mm
	Inappropriate rack setting though dryer pushing	Proper rack down to be ended at the time dryer pushing
	rising pug stock	Pug stock to be maintaining 250 MT to 300 MT in Shaping pug yard to avoid over stock which Causes defects.
	Improper rack position	Racks to be kept with accurate gap Essential 50% skilled men and remaining 50%
Dp(Damaged pug)	Unskilled men power	unskilled men to go on standard training so they learn job
	Angle touching while loading in racks	Appropriate packing must be there if not then, to be fixing at equally sides of pugs.
	Space constraint	Proper 5S execution for some space construction
	Manpower shortage	Joint affords of dept and personnel dept is essential
	Table setting with mouthpiece	Ought to be proper.
	De-airing Moisture variation of cake	To be make sure after setting up. Avoid hard or soft cakes.
RC(Round Neck)	Smaller wet pug length	Planks to be apply as per Size
	Smaller pug lifting hook	To use essential size lifting hook
	Trapping While Extrusion	Power trapping to be avoid as far as possible by Electrical division.

	Oil application on pugs	Correct oil application with gauge.
	Improper application of stopper mass	Stopper to be loose after PED loading mainly for solid core insulators.
BC(Bore Creak)	Soft Plugging	Soft cakes if any to be split & scrap it
	Loose stopper mass	before loading/unloading in PED verify stopper mass
	Floor condition	Floor condition be develop, floor repairing is must
Fallen(FL	Unskilled manpower	Provide training after that give the tasks

Source: Own elaboration.

Shed Bend defects elimination

- Shaping yard stock to be kept up zero roughly as there is no confinement of maintenance period for dryer.
- First start things out framework to be favored for example first turning protectors' racks to be kept front side of dryer to maintain a strategic distance from various taking care of.
- Chanel was given inside the dryer to maintain a strategic distance from divider contacting.
- No covering of turned product framework to be presented by setting up 140,165,187 hrs. cycle.
- Area indicated and rack keeping course of action done by giving railing.
- Application for manual stepping stool during revealing before dryer.
- To maintain a strategic distance from shed attacking which happened 2 to multiple times it is proposed to fix camera.
- Binding for newer/painting/galvanization of boards.

General kiln loading rejections

Floor situation is better at kiln and glazing area

Congestion at floor due to empty racks and sorted goods in kiln area is better Facility was provided to glazing section to transfer the material in K-8 side area

BDC rejections

Removed centre out & jerking during TPM

Insulator to be kept through in rack after unloading from machine

PMR to be improved by 0.1 i.e. 1.3 – 1.5 instead of 1.2-1.4 (depend upon design)

PC rejections

Signal of damper opening to be operated by customized method. Immediate loading after turning to maintain wares regularity.

Introduction of fresh air damper before grow to maintain uniformity of humidity inside the dryer.

Good finishing for Bauxite body so that it might be dipped directly with no finishing preventing delay in PC.

Cake rejections

Malleable filter pressing to be avoided
Adjust the filter cloths after 800cycles

Cakes falling while cake releasing to be avoided Keep away from cake hardening

Cake falling white feeding to rotor feeder to be avoided

Body mass leakages from rotor feeder to be reduce. This is a key problem.

Some general suggestions to reduce the pre kiln defects

Controlling of both the dampers through 4-20mA controlled straight servo engines for fine control of damper opening and SCADA will indicate us precise opening of dampers at PC. This will help in controlling of undesirable opening of natural air damper comparatively buildup of water inside the dryer will be stayed away from. Do opening of outside air from introductory stage alongside fumes.

Bigger size fumes dampers have been given in a portion of the dryers to deplete out the mugginess according to necessity to maintain a strategic distance from buildup.

Use "V" groove board for huge strong center covers. Gunny string ought to be tight appropriately in molding itself. Legitimate rack setting ought to be done prompt subsequent to molding.

Loose blasts/rings from the highest point of separators ought to be expelled prompt after taken out from dryer.

Automatic shutting of dampers quick after power disappointment

Post kiln defects: root cause analysis and procedures to reduce the major defects

Post oven dismissals were significant, as in pre furnace arrange every one of the separators were in a semi strong stage and any waste or surrendered encasing can be tossed once again into the framework for reuse. It tends to be found in the Pareto outline examination of pre-oven arrange that a large portion of the imperfections are because of inappropriate taking care of, ill- advised capacity and muddled working environment. All the real green/semisolid deformities can be diminished through appropriate usage of 5S and making upgrades in material taking care of framework. After the oven task the encasings take a total strong structure and any loss after this goes into the dumpster bringing about an immediate misfortune for the organization. It has been additionally seen that in furnace activity roughly 60% of by and large assembling expense is related so post oven abandons investigation has given most astounding need because of gigantic cost inclusion.

Ishikawa graphs have been attracted for dismissals each procedure after post oven as appeared in figures to Dismissals reasons and moves were made as needs be which were recorded in the tables . The real

dismissal was; an INBT/INST and bond hole dismissal, PC and Shed curves in the post oven.

Table 17. Action strategy to remove INBT/INST rejections.

	Reasons	Actions
MAN	inappropriate tightening of bolts at testing No apply of spring washer Unskilled men in towel application. Unskilled men in cement groundwork. Use of extra cork sheets. Unloading with Jerk.	Awareness given to testing and assembly workers for testing process, injection process. Witnesses in critical processes. elimination follow up and Analysis. Monitoring of critical process. Unloading on rubber sheet
MACHINE	Table is not clamped to the organization. Load variation in M/C and computer. Air bubble in injection M/C. Situation of cement preparation M/C and bowl.	Inspection of M/C before starting the shift. Testing method awareness. standard maintenance schedule has been started for cement preparation M/C and bowl.
METHOD	Testing by due date Proper spring washer is not Used. No correct air curing No correctly timely of unloading of insulators from jig. No correct injecting. Before injecting, wet rope not correctly tied. Proper and timely wet towel covering is not there. Cutting surface and chamfering is not proper.	Information of proper process to be displayed in concerned departments. Spring washers to be altered at regular interval. PRC is also implemented. Work instruction has been displayed at shop floor. Injecting from lower hole. Alertness given to the all contractors as well as worker about wet towel covering & proper rope tightening before injecting.
MATERIAL	No homogenous addition of Cement mixture. Lumps in cement baggage. More water addition in cement mixture. Cork sheet thickness and Bituminous paint quality.	Min. 10 min. for mixing of cement and observer it by QC Continuous stirring of cement by wooden plank at the time of injection. 100% incoming check up.

Source: Own elaboration.

4.8. OTHER GENERAL IMPROVEMENTINITIATIVES

Autonomous upkeep was begun which is fundamentally support performed by the machine administrator instead of the support staff. It incorporates the seven stages - starting cleaning, preventive cleaning measure, improvement of oil and cleaning guidelines, general assessment, self-governing investigation, Process order, and free self-ruling maintenance(Source: http://elsmar.com/Planned Maintenance/sld033).Autonomous support was done in three workstations according to initially calendar up to eighteenth Nov. 2018 were; the machines C&G area (C.G. M/C 1 to 7, T.C. M/C 1 to 7, and Lapping M/C 1 and 2), the machines in the forming area (Machine – 1 to 26, ZEIDLER-2 and 4, CNC-1 and 2, TI-1 and 2, VACKS and MIM-9), and the machines in the testing segment(bowing testing machine, shear

testing machine, pressure testing machine, mechanized substance adjusting machine and programmable exactness general testing machine).

As a piece of our lean activity, with the assistance of the organization staff every one of the elements of ERP programming was actualized well inside the organization. ERP diminished the measure of data between procedures like moving various sections of the items in printed copies at each procedure. This framework was helped in scaling down the stock levels and better interdepartmental coordination. It likewise improved conveyance calendars and bottlenecks during the generation forms. Different advantages incorporate; reports have been exhibited on schedule, a great deal of paper sparing was done, significant decrease in labor and movement time.

The significance of HR in the lean execution is pivotal. Specifically, inclusion of laborers in the nonstop quality improvement programs, development of their self-governance and duty, the nearness of multifunctional laborers has all, been critical for enhancements in the firms‟ exhibitions. So as to elevate worker commitments and to expand their strengthening and obligation, organization reasonably put resources into representative preparing, as a way to confer them performing various tasks abilities. Thus, it additionally helped the resolve of the representatives by giving them a feeling of self-sufficiency and obligation. In the XXX, shop floor managers were widely prepared to distinguish bottlenecks and take restorative activities to decrease the piece and adjust.

The rack accompanies over the top boards. Rather than ordinary boards, it was proposed to have V-shape boards to convey pugs. Thusly the moving of the little pug pieces from boards was killed to a limited degree.

The machine personal time of the rotating feeder was checked. A great deal of the time it has been seen that the laborers simply sit inactive a ton of the time. So TPM was utilized here to diminish the vacation. Fundamental offices, for example, drinking water and latrine ought to be given inside the workstation zone as laborers accept this as a reason to dillydally around. Workers irate with their chiefs here and there vent out their dissatisfaction by guilefully pulverizing a crisply formed protector. This causes undesirable misfortune for the organization. Establishment of CCTV all through evaded this issue in addition to it imparts dread in the laborers minds that they are being viewed. Improved correspondence among representatives through courses/workshops/gatherings.

Some of the quality control benchmarks (Table) for C&G, get together and testing procedures were arrangement. Some Kaizen (Table)are as yet going on or somewhat executed.

Table 18. Quality control standards Developed

No.	KPM	Standards
	Cutting & Grinding	
	Carriage condition	Carriage must be free of charge from shake, play and vibration
	Mandrill preparation for Hollow	Rubber bush hardness must be proper Bush size should be as per ID of insulators correct placement of bush
	Cutting of sorted insulator as per specified cutting drawing	Cutting face must be flat, parallel, and free from pits and projection. correct gravel length and cutting length in S/C Cutting surface must be flat, parallel, and free from pits and projection. Proper cutting of length and cone radius must be maintained in Railway and long road.
	Chamfer of cutting edge	Chamfering must be as per specific drawing.
	Assembly	
	Bituminous paint application on gravel portion	identical and proper coating of bituminous paint on Gravel portion, and then on surface also of solid core and dry it completely
	Selection of metal part	standardized and proper coating of bituminous paint inside metal part, dry totally and do Greasing on all aluminum M/P before injecting.

Selection of shell (insulator)	Shell OD, Height and T/B gravel should be as per specific Drawing
Checking of jig/dowel pin/bolts	Dowel pin must be spaced as per PCD. Bolts must be correctly tightened
Wet rope tightening Concentricity	Fiber rope should be enough wet and tight it before injection. Shell OD should be in center to keep equivalent cement gap
Injecting process	Injecting must be done from lower hole (injecting hole) and puts the finger on upper hole to eliminate air pocket. make sure no leakage of cement from wet rope.
Cement mixture	Homogeneous combination and no extra % of water added
Injecting time	ensure the cement injecting time.
Cleaning, leveling, cavity and concentricity checking	Cement must be properly leveled and cleaned by sponge, and check cement hole and cement concentricity.
Unloading on Rubber sheet	Hollow insulators must be unloading on rubber-sheet to avoid exterior chipping and M/P damage Solid-core insulators must be unloading on rubber-sheet to keep away from cement rejection (CR)
Wet towel tightening	Wet towel must be applied correctly on cementing portion and plastic covering to be done for proper curing within half an hour after injecting
Curing chamber temp	55 to 68 *Cg
Curing chamber (including loading and unloading)	least 48 Hrs
Testing	
Before due date testing	Testing timetable (procedure) display on shop floor.
Air curing	Testing to-do list (procedure) display on shop floor
Sticker	Assy. Date and shift sticker accessible for all insulators
Load	Routine load applying on insulators as per Drawing/Customer necessity

Source: Own elaboration.

Table 19. Kaizen partially implemented

S. No	Kaizen/Improvements	Process/Division
1.	Template hanging stand must be portable for simple search and anticipation of bending	Shaping
2.	Partition in beam trolley to keep entity size beam safely	KILN
3.	More gap in line track (transfer trolley alignment with track) to keep away from defects	KILN
4.	Cost saving by fixing added adopter in pug mills	Maintenance
5.	Cost reduction by removing 1 HP cooling pump motor from feed pump Hydraulic power pack of filter press	Maintenance
6.	Rejected Pilot truck has been improved to hollow shifting truck in such a approach that the handling rejection has been minimized to half	Assembly
7.	Providing extra beam guider in the top of the additional huge hollow epoxy assembly area in such a manner that it arrests vibration during Crane movement and hence reduces chipping of extra-large insulators results increases workers confidence and satisfaction	Assembly
8.	Applied polythene sheet through bituminous painting among insulators and there by arrested the extra spillage of paint.	C&G
9.	Pallet truck painted with a single number to detect the breakdown frequency	C&G

Source: Own elaboration.

4.9. IMPROVEMENT OF THE FUTURE VALUE STREAM MAP(FVSM)

As a final point, the future value stream map is constructed as publicized in figure (28), which reported a significant reduction in defects, inventories, processing time, waiting time, and manpower reduction as discussed in next fragment.

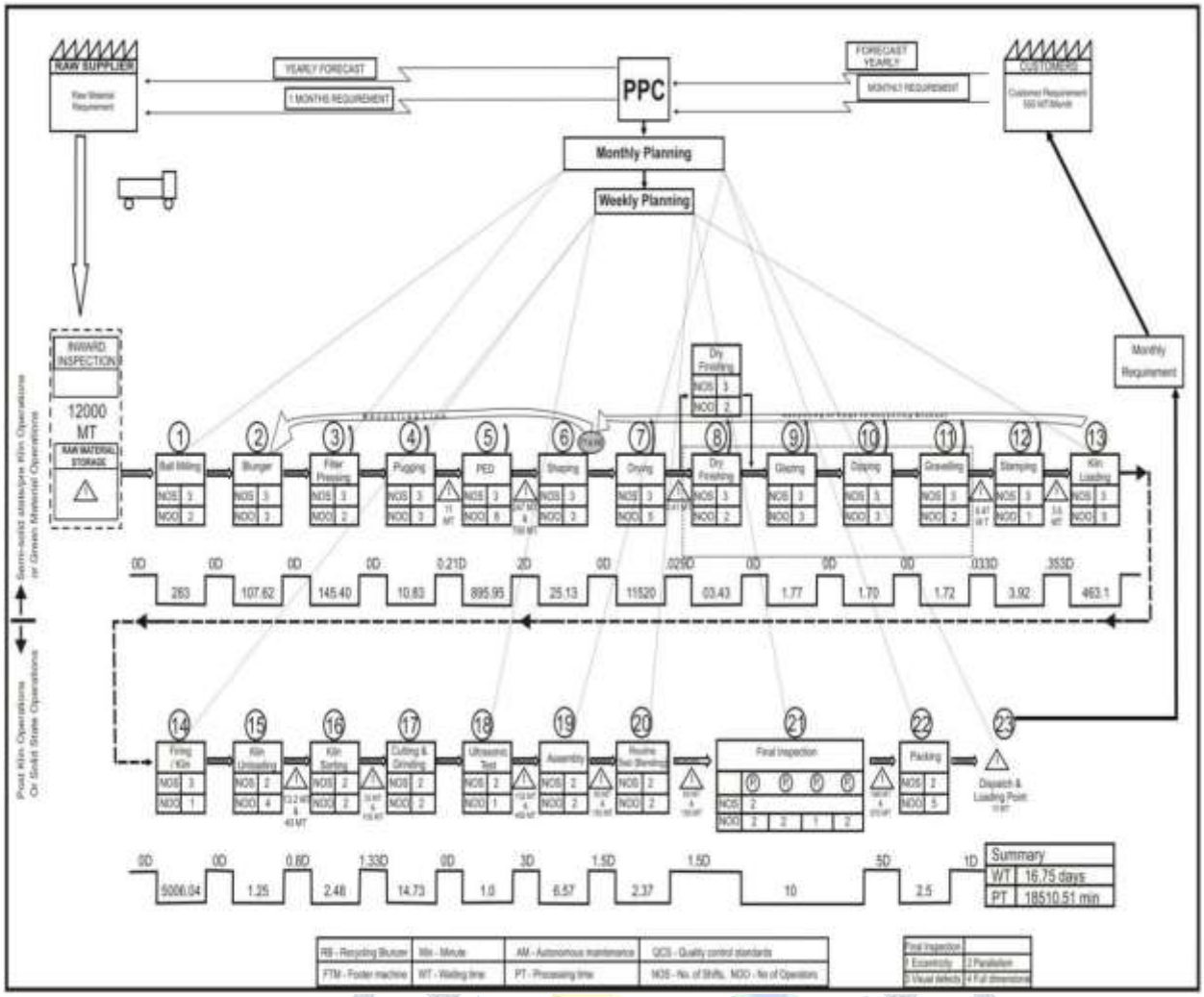


Figure 28. Future Value Stream Map Source: Own elaboration.

CHAPTER 5. ECONOMICAL AND TECHNICAL ANALYSIS

5.1. POST IMPLEMENTATION SEGMENT

This segment essentially consists two important levels namely, results and review which are discussed as follows:

Results

The information composed before and after lean manufacturing implementation is compared to demonstrate improvements in performance parameters. This segment also shows the improvements and net financial savings to the corporation due to lean manufacturing. Several of the performance constraint improvements are given below:

Processing time(PT)

The implementation of the planned kaizen and reduction in wastes has resulted in diminishing the processing time from 18,700.07 minutes to 18,500.51minutes i.e., a fall of 199.56 minutes as shown in figure.

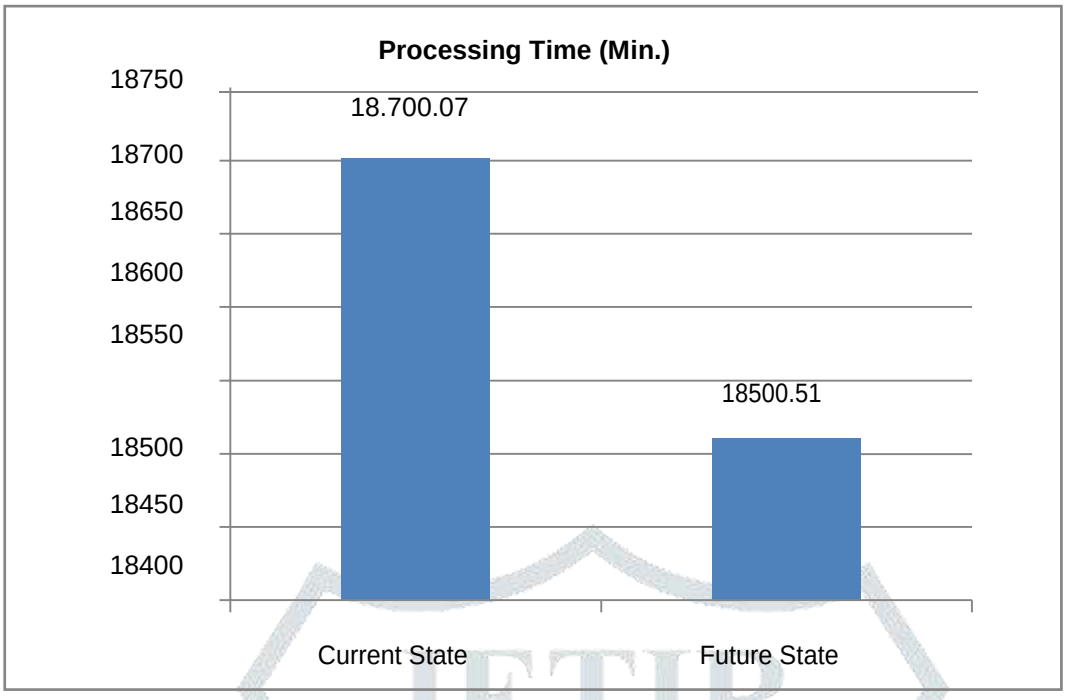


Figure 29. Processing time Current and Future State Source: Own elaboration.

Waiting time (WT)

Decrease in defects resulted in reduction of raw material inventory and WIP inventory at numerous workstations. The introduction of one-piece flow from workstation 8 (dry Finishing) to 11 (gravelling) brought downward the waiting time. in general waiting time is reduced from 25.84 days to 15.75 days, i.e. improvement of 10.09 days (39.04%) which is very significant as shown in the

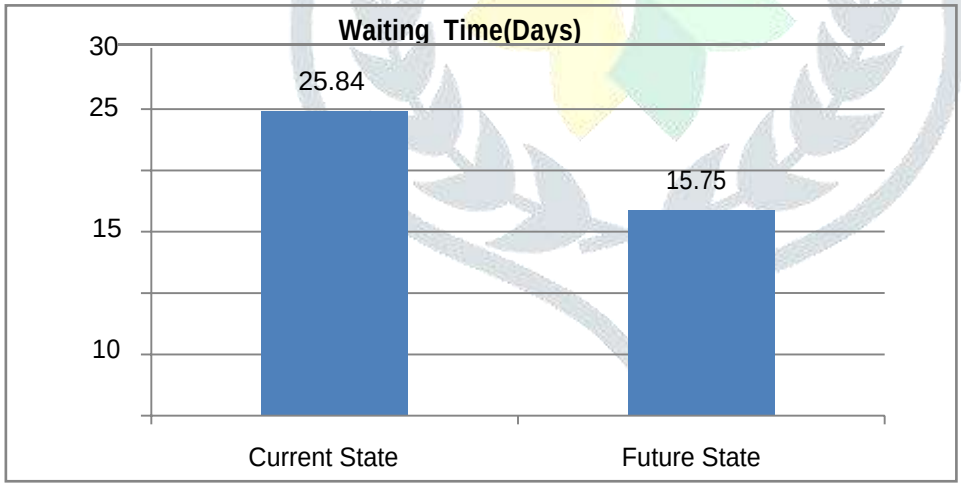


Figure 30. Waiting Time Current and Future State Source: Own elaboration.

5.2. FINANCIAL SAVINGS

Savings through autonomous maintenance (AM)

This demonstrates the relationship of the machine spares cost before and after autonomous maintenance was applied to a few workstations (Shaping, C&G and Testing) as shown in tables.

Table 20. Savings through autonomous maintenance

S. No.	Name of machines	Maintenance date	Before AM machine spares cost (3months)	Average maintenance cost/month	After AM machine spares cost (3 months)	Average maintenance cost/month
1	Zeidler No. 2	31-Dec-18	142600.08	47,533.36	94900.98	31633.66
2	Zeidler No. 4	10-Feb-19	55445.62	18,481.87	10555.85	3518.61
3	CNC No. 1	03-Jan-19	139910.54	46,636.84	15151.03	5050.34
4	CNC No. 2	01-Jan-19	23835.73	7,945.24	17444	5814.66
5	MIM No. 9	29-Jan-19	13138.55	4,379.51	1688.55	562.85
6	TI No. 2	7-Dec-18	5766.04	1,922.01	2299.46	766.48
	Total		3,80,696.56	1,26,898.83	1,42,039.87	47346.58

Source: Own elaboration.

Actual savings: INR2, 38,656.69

Table 21. Autonomous maintenance savings in testing

S. No.	Name of Machines	AM done date	Before AM machine spares cost (3 months)	Average maintenance cost/month	After AM machine spares cost
1	Bending M/C No. 2	11-Jan-19	4500.59	1500.20	Nil
2	Bending M/C No. 3	19-Jan-19	3800.35	1266.78	Nil
3	Bending M/C No. 4	24-Jan-19	511	170.33	Nil
4	IBP Testing M/C No. 1	14-Jan-19	1755.7	585.23	Nil
	Total		10567.64		Nil

Source: Own elaboration.

Actual Saving: INR 10,567.64

Table 22. Autonomous maintenance savings C&G

S. No.	Name of machines	Maintenance date	Before AM machine spares cost (3 months)	Average maintenance cost/month	After AM machine spares cost (3 months)	Average maintenance cost/month
1	C & G No. 1	12-Jan-19	9100.20	3,033.4	5999.65	1999.88
2	C & G No. 2	10-Jan-19	22452.58	7,484.19	4899.9	1633.3
3	C & G No. 3	21-Jan-19	18045.33	6015.11	3999.44	1,333.15
6	C & G No. 6	27-Jan-19	10777.55	3,592.51	385.33	128.44
7	C & G No. 9	25-Jan-19	345.48	115.16	Nil	Nil
8	TC No. 2	10-Feb-19	44444.33	14,814.78	9,998.88	3332.96
9	TC No. 3	18-Jan-19	55444.88	18,481.62	2999.44	999.81
10	TC No. 4	30-Jan-19	44544.15	14,848.05	10111.55	3370.51
11	TC No. 5	15-Jan-19	225555.77	75,185.25	6545.33	2181.77
12	TC No. 6	20-Jan-19	1999.99	666.66	752.77	250.92
13	TC No. 7	7-Jan-19	58888.55	19,629.51	13584.45	4528.15
	Total		4,91,598.81	1,63,199.58	59,276.74	19,758.89

Source: Own elaboration.

Actual savings: INR4, 32,322.07

5.3. DEFECTS REDUCTION AND SAVING DURING IMPROVEMENTS INITIATIVES

The entitlement reduction in defects and the financial savings gained throughout the improvement initiatives discussed in section and shown in table.

Table 23. Defects reduction and financial saving through improvement initiatives

Project Name	Area	% defects (March 2018)	% defects (March 2019)	Actual saving April'18 to Mar'19 (lacs)
To reduce PC rejection	Dryer sorting	7.11%	3.33%	5.15
To reduce Shed bend rejection	Dryer sorting	1.40%	0.77%	14.48
To reduce Shed crack rejection	Dryer sorting	0.55%	0.22%	4.24
To reduce SDC rejection	Dryer sorting	0.77%	0.27%	2.33
To reduce VC rejection	Dryer sorting	2.55%	0.54%	23.58
To reduce Chipping(CP) rejection	Dryer sorting	0.85%	0.57%	2.15
To reduce ACC rejection	Dryer sorting	1.44%	0.75%	0.89
To reduce WF rejection	Dryer sorting	1.55%	1.22%	0.85
To reduce BDC rejection	Kiln sorting	1.99%	0.77%	17.51
To reduce Falling rejection	Kiln sorting	1.86%	0.44%	89.99
To reduce Post Kiln rejection	Post kiln	7.58%	2.55%	166.5
Total				327.67

Source: own elaboration

5.4. OVERALL FINANCIAL BENEFITS REAP FROM IMPROVEMENT INITIATIVES

Table below shows the overall financial increase of INR 344.27 lacs in the financial year 2018- 2019. The overall gain is the sum of savings in section (A) and (B) over plus gains through 5S with kaizen

Table 24. Overall Financial Benefits From Improvement Initiatives

S. No. Improvement Initiative	Actual saving in the financial year 2018-19
Kaizen in Kiln sorting (To reduce BDC at kiln sorting st apply in core and then insulators are dry completed disappeared)	024.30
Saving through QIP initiatives (Defects reduction)	327.67
Autonomous Maintenance	004.55
TOTAL	356.52

Source: Own elaboration.

Space Creation

Lean initiatives (5S implementation) permitted an improved apply of the physical space and machinery at XXX and created 717 square meter space from the project.

Breakdown analysis of machines

The increase in break down time in shaping, C&G and testing processes/workstations after autonomous maintenance implementation is shown in tables.

Table 25. Standard breakdown in the shaping workstation

S. No.	Name of machines	AM done date	Before AM average breakdown 3 months(hours)	After AM average breakdown 3 months(hours)
	Zeidler No.2	31-Dec-18	15	3.5
	Zeidler No.4	10-Feb-19	7	5
	CNC No. 1	03-Jan-19	2.5	4.3
	CNC No. 2	01-Jan-19	5	3
	MIM No. 9	29-Jan-19	6.78	2.3
	TI No. 2	7-Dec-18	1.3	4.4
	Monthly Average	Break down	7.15	4.80

Source: Own elaboration.

Table 26. Average breakdown in the C&G workstation

S. No.	Name of machines	AM done date	Before AM average breakdown 3 months (hours)	After AM average breakdown 3 months (hours)
1	C & G No. 1	12-Jan-19	5.6	1.7
2	C & G No. 2	10-Jan-19	4.1	1.48
3	C & G No. 3	21-Jan-19	7	4.38
4	C & G No. 4	30-Jan-19	4	4
5	C & G No. 5	8-Feb-19	8.9	3.11
6	C & G No. 6	27-Jan-19	9.5	1.55
7	C & G No. 9	25-Jan-19	2.1	0.9
8	TC No. 2	10-Feb-19	11.1	7.5
9	TC No. 3	18-Jan-19	09.22	5.44
10	TC No. 4	30-Jan-19	9	7
11	TC No. 5	15-Jan-19	8.33	3.4
12	TC No. 6	20-Jan-19	11.45	7.89
13	TC No. 7	7-Jan-19	8	11.9
	Monthly average breakdown		9.40 hours	4.80 hours

Source: Own elaboration.

Table 27. Average breakdown in the testing workstation

S. No.	Name of machines	AM done date	Before AM average breakdown 3 months (hours)	After AM average breakdown 3 months (hours)
1	Bending M/C No. 2	11-Jan-19	8.11	2.8
2	Bending M/C No. 3	19-Jan-19	9.9	5.9
3	Bending M/C No. 4	24-Jan-19	8.8	4.7
4	IBP Testing M/C No. 1	14-Jan-19	9.19	2.99
	Monthly average breakdown		8.99hours	3.99 hours

Source: Own elaboration.

Defects reduction analysis in kiln and post kiln processes

An amount of action/improvement initiatives have been taken as discussed in the segment to reduce the defect rejection rates. The improvements of these initiatives are shown in tables and figures

Kiln rejection

Table 28. Monthly average rejections in kiln

Defects reason	Monthly average rejection before lean implementation (MT)	Monthly average rejection after lean implementation(MT)
Round Crack	0.290	0.207
Chipping	0.225	0.111
Petticoat Crack	0.139	0.079
Accident	0.066	0.022
Handling	0.066	0.033
Shed Crack Rejection	0.054	0.031
Total	0.850	0.428

Source: Own Elaboration.

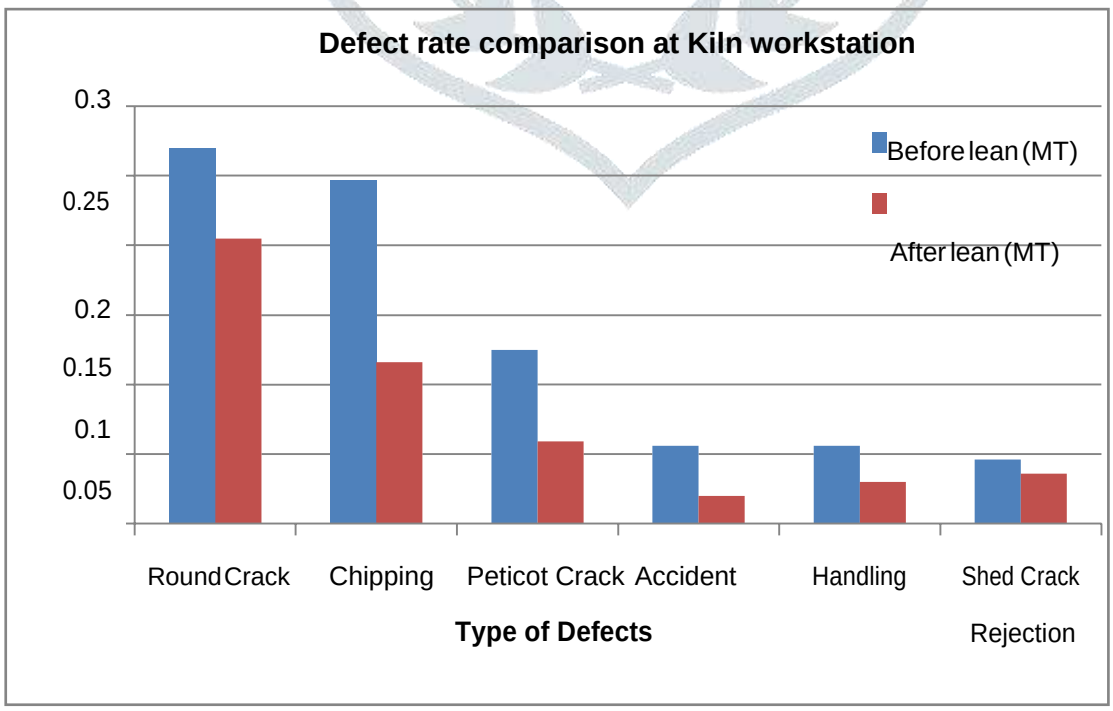


Figure 31. Defect Rate Comparison Kiln workstation Source: Own elaboration.

Kiln sorting

Table 29. Monthly average rejections in kiln sorting

Rejection reason	Monthly average rejection before lean implementation (MT)	Monthly average rejection after lean implementation(MT)
Peticot Crack	1.65	0.926
Shed Cut	0.29	0.217
Total	1.94	1.143

Source: Own elaboration.

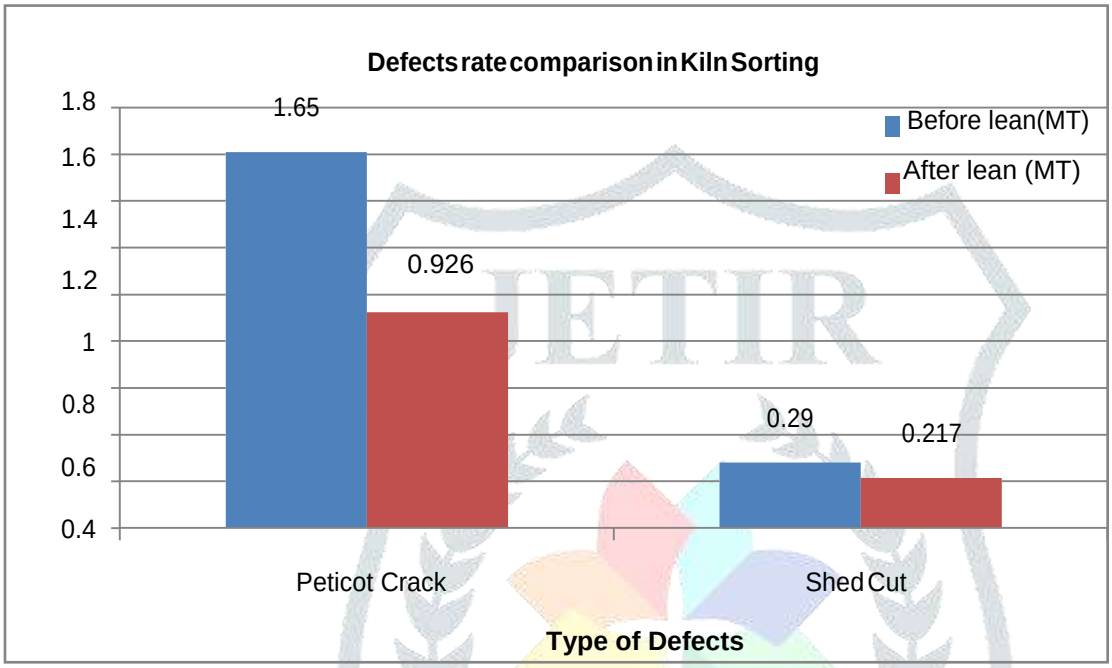


Figure 32. Defects rates Comparison in Kiln Sorting Source: Own elaboration.

Post kiln rejections

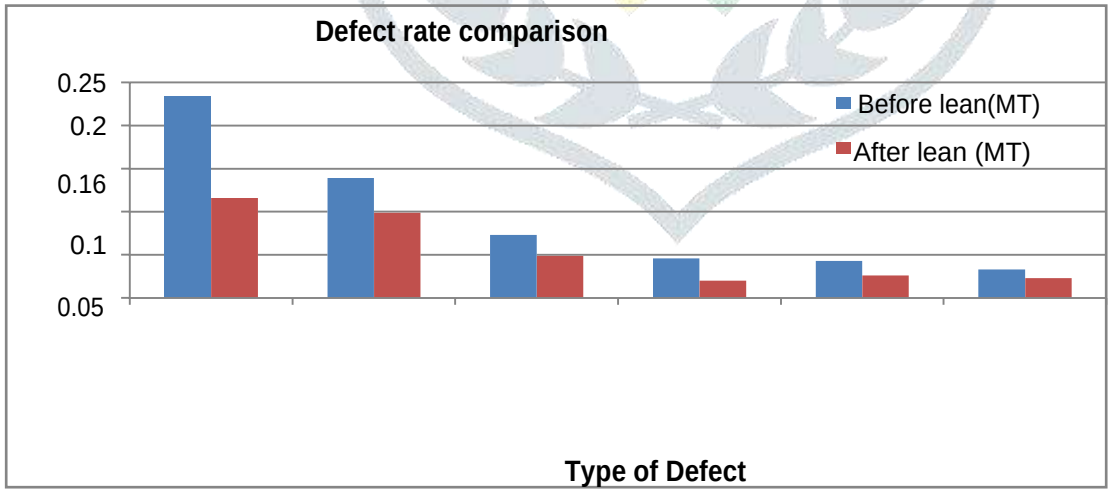


Figure 33. Defect Rate Comparison Source: Own elaboration.

Material handling rejection

Table shows the handling rejections. It knows how to be observed that handling rejections have been reduced.

Table 30. Handling Rejection

Stages	Status for the period from 01/10/2018 To 15/01/2019 (%)	Status for the period from 16/01/2019 To 30/04/2019 (%)	Difference
Dryer Sorting	1.69	1.47	0.22
Glazing	0.38	0.28	0.10
Kiln Loading	0.37	0.33	0.04
Kiln Sorting	0.58	0.27	0.31
Cutting & Grinding	0.06	0.05	0.01
Assembly	0.15	0.04	0.11
Testing	0.32	0.15	0.17

Source: Own elaboration.

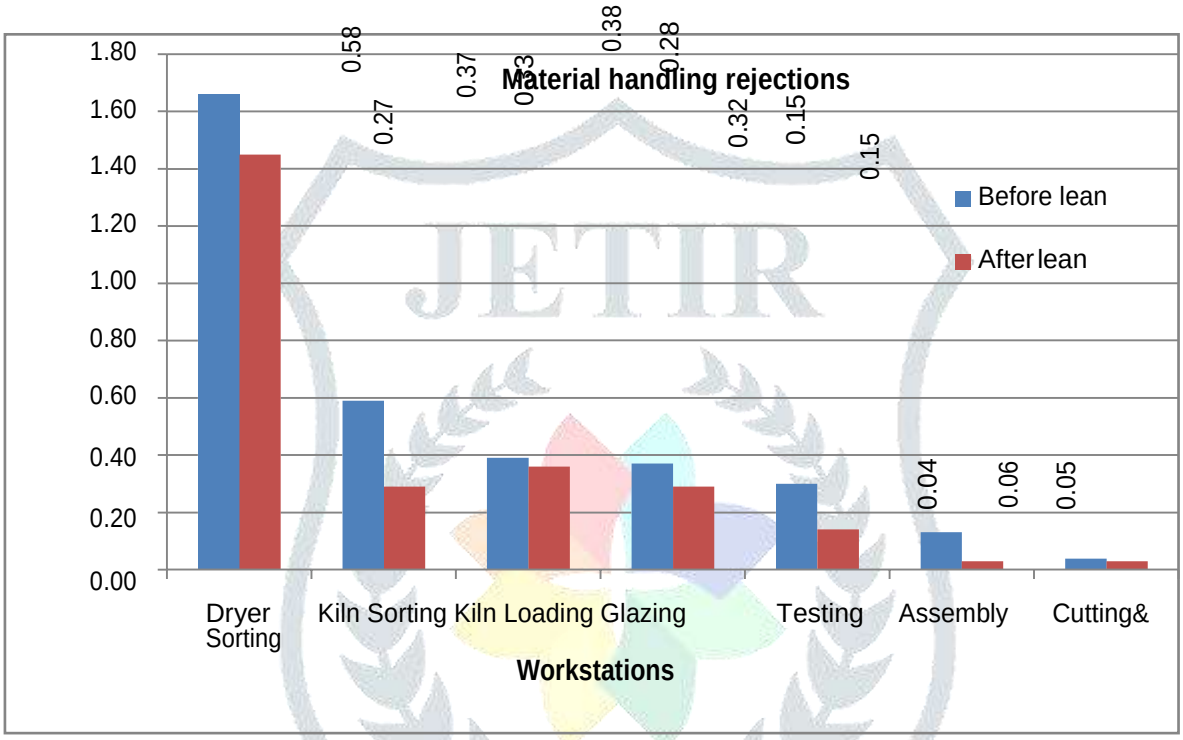


Figure 34. Material handling rejections Source: Own elaboration.

Prior to lean manufacturing accomplishment, overall monthly post kiln rejections were 3.260 MT and after LM implementation it is 1.940 MT, i.e. an improvement of 59.51%. These calculations are based on monthly average defects in the tables.

5.5. WIP REDUCTION AT DIFFERENT PROCESSES/WORKSTATIONS

WIP has been reduced in the Company by reducing different defects. Table shows the WIP reduction at various processes/workstations.

Table 31. WIP at different processes/workstations

S. No.	WIP Before Workstation	WIP Before Lean (MT)	WIP After Lean (MT)
1	Dryer	37.00	**00.00**
2	Glazing	00.22	**00.00**
3	Dipping	00.21	**00.00**
4	Gravelling	00.20	**00.00**
5	Kiln Sorting	16.47	**13.18**

6	Cutting & Grinding	50.51	**34.00**
7	Assembly	199.0	**133.0**
8	Line Testing	83.53	**51.03**
9	Final Inspection	83.53	**51.03**
10	Packing	266.0	**188.0**
	Total	**736.67**	**470.24**

Source: Own elaboration.

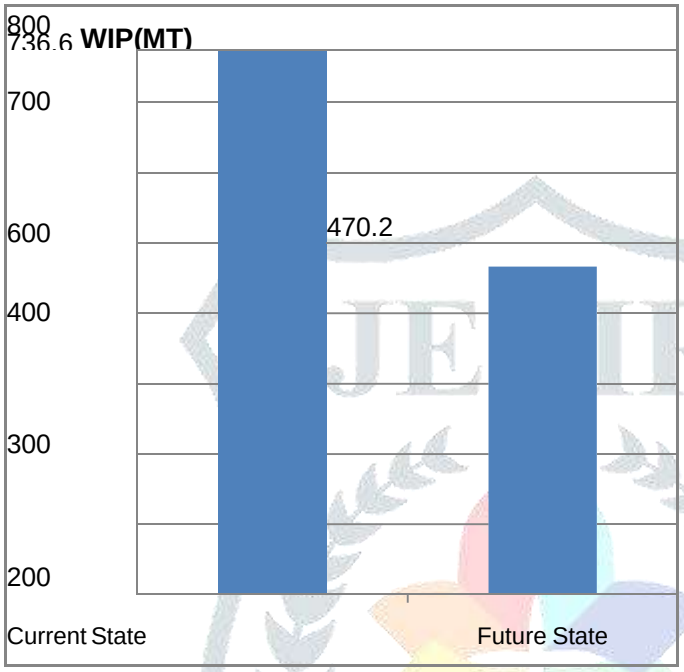
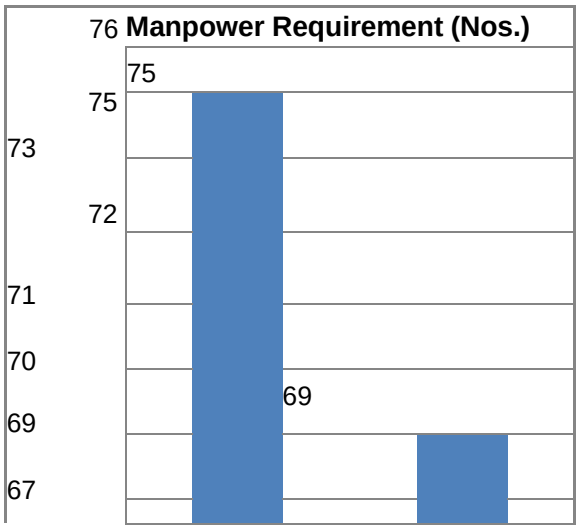


Figure 35. WIP reduction Source: Own elaboration.

Generally, WIP is reduced by 38% initial from ball milling to packaging as shown in figure.

Reduction in manpower

One-piece pours in dry finishing, glazing, dipping and gravelling reduced manpower in transferring of products. Moreover, kaizen in testing and changing the position of tools in pugging, kiln etc., resulted in reduction of manpower. The overall reduction in manpower is 6.89% as publicized in figure. It is potential to reduce manpower additional by adopting leveled and balanced workloads at various workstations.



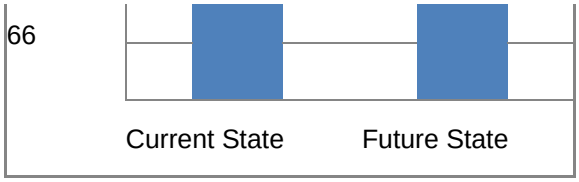


Figure 36. WIP reduction manpower Source: Own elaboration.

Evaluation (recognition & awards, and customer satisfaction)

'Kaizen grants' was presented for employee(s) proposing kaizen for the improvement. The honor is in term of money/reward/pay additions relying on the significance of the kaizen and the representatives associated with recommendation. Acknowledgment of good work is additionally done through yearly declarations/mementoes to inspire the representatives which are a definitive procedure to battle burnouts. Pay update framework has been connected with the presentation of the laborers.

The association has begun recording numerous objections from clients and furthermore keeps up a focal grumbling enlistment framework. After client grumblings are gotten, the "crucial couple of" grievances are examined inside and out to find their fundamental causes by promoting/quality control division. Normal consumer loyalty studies was begun to follow client impression of the nature of the firm and its rivals. This data will be utilized to improve the nature of items and administrations in future.

5.6. CONTINUOUSIMPROVEMENT

It is the continuous improvement concept in the system which involves an extended journey, gradually building up skills and capabilities within the organization to find the new problems/wastes in the system and solving them with the help of different tools and techniques. There is always room for improvement and looking to improve every day is the spirit of lean teams.

CONCLUSIONS

The contextual investigation in this part demonstrates the approval of the lean assembling execution structure proposed in section. The execution of the contextual investigation has been partitioned into pre usage, execution and post execution stages according to proposed system. It has demonstrated that the outside lean experts/facilitators are progressively compelling in evacuating the opposition of the representatives to change. The investigation has demonstrated the significance of significant worth stream mapping, 5S, kaizen, and TPM in lean assembling execution in artistic industry. The profitability and nature of the case association has improved. The association has additionally turned out to be adaptable by taking out squanders at different procedures/workstations and reacts to

Fluctuating client requests rapidly and proficiently. The significant devices utilized for the contextual analysis in execution stage are VSM, TPM, 3M, Ishikawa, Paretto and kaizen.

The pre-usage and post execution measure approve the lean assembling benefits. The different quantitative advantages of lean assembling usage for the case association are:

- Waiting time reduction by 39.04%,
- Processing time reduction by 199.56 min.(1.95%),
- Reduction in inventory/WIP by 38%,
- Defects reduction (average) by 59.51%,

- Space creation for further use is 717 square meters,
- Reduction in manpower by 6.89%,
- Cost saving of Rs 357.4 lacs in the financial year 2018-19.

Qualitative benefits have also been observed in term of skill up gradation, teamwork, multi skilling and improved morale of the employees.

In this research, the main recommendation that need to be done is that the methodology used pointed to secondary applications. There is need to carry out such a research and then make applications of the same to a few SMEs in different industries to make sure that the latest information has been gained in the industry.

The other recommendation is since the research is very wide given that it considered factors impacting the stated situation in the stated setting. One of the clearly set out factors is that there is need to narrow down the research to a small connected environment to make sure that sufficiency is met and made good use of at every level requirement. The qualities of these applications need to make it possible for there to be leaner method of application to the existence of the company. The recommendations seem to inform any other related future in the research process successfully.

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