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# Lean Concept Implementation Practices in Small and Medium Scale Pharmaceutical Industry- A Case Study

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***Abstract:*** ***This paper describes an exploratory study of lean techniques and an extant of its implementation in a pharmaceutical industries. The main purpose of this paper is, at how much extant adoption of lean techniques and elimination of wastage and non-value added activities in a pharmaceutical industries. A questionnaire survey is prepared to know the extent of lean techniques implementation. Questionnaire survey send to the respondents of various department (production and planning, human resources, quality and control, transportation, inventory control etc.) of an organization and asked to rate the each of these areas. This study also inspect the drivers and barriers that affect the adoption of lean techniques. The mean value for each area is obtain after calculations on SPSS and statistical analyses were performed for each area. Further, this study also examined different subjects related with lean techniques adoption for example its comprehension among the respondent organization, its advantages and impediments, the techniques and tools used, etc. The outcomes from this study also revealed the hindrance that forestall or postpone the lean execution. The main obstacles in adoption of lean technology are the absence of understanding lean ideas and shop floor representative's attitude.***

***Keywords: lean manufacturing, lean barriers, SPSS, mean score, driving forces***

## I. INTRODUCTION

During the time of pandemic (Covid -19) ,pharmaceutical companies are responding to the quick challenges.in time of pandemic. Manufacturers in the pharmaceutical companies faced heightened challenges such as increases customers' expectation, unstable demand, and competition among the other competitors in market. Increasing difficulties in the present worldwide contest have provoked many firms to take on new executive's methodologies to improve the firms' productivity and intensity. Manufacturing firms has taken lean assembling (LM) framework as an incredible the executive's instrument and a considerable lot of them have taken on lean methods in various structures and names.

Now, Lean Manufacturing has become a popularly acceptable and adoptable best manufacturing techniques across all the organisation and countries [11]. The final achievement of a lean industry is to create a smooth and top quality industry which is able to produce finished products pertain to the customers demand in the quality looked-for with no waste be that as it may, in all actuality, numerous organizations can't change themselves to a lean manufacturing organisation towards making the top notch organizations. In reality the change towards lean manufacturing is filled with considerable difficulties, most especially to comprehend the genuine embodiment of lean manufacturing idea and theory [16].One method for remaining competitive in this globalized market is to turn out to be more Productive. Lean practices has been getting a great deal of considerations in the business. The impacts guaranteed in the wake of carrying out it are tremendous. Lean manufacturing utilizes less of everything compared with large scale manufacturing- half the human exertion in the plant, half the manufacturing space, half cost of tools, and engineering hours to cast an another item (Womack et al., 1990)[19]. It has presently become a creation strategy for some makers to seek after. This exploration was started with a concentration to examine the adoption of lean manufacturing instruments and strategies in the pharmaceutical industry.

This paper starts with an overall outline of lean manufacturing tool and techniques and methods furthermore the key regions that describe its adoption. This is trailed by a blueprint of the methodology utilized for leading the study. Findings of the study along with the after effects of some measurable investigations that were applied are introduced in the next section. At last the paper closes with conclusion.

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## II. LITERATURE REVIEW

The idea of Lean manufacturing was spearheaded by a Japanese automotive organization, Toyota, during 1950's which was broadly known as Toyota Production System (TPS). The essential objective of TPS were to diminish the expense and to improve usefulness by taking out squanders or non-esteem added exercises [17]. During 1980's there was an extraordinary interest on lean manufacturing execution among the western producers as a result of developing Japanese imports. It turned into a genuine concern toward the western makers [11]. LM is a manufacturing methodology that expected to accomplish smooth creation stream by disposing of waste and by expanding the exercises value. A few examiners even pointed out that assuming an association overlooks the LM methodology, the organization would not have the option to have a potential for success against the current worldwide contest for better calibre, quicker conveyance and lower costs [17].

Panizzolo [18] isolated the lean practices into six regions which are process and equipment; manufacturing, planning and control; HR; product plan; supplier connections; and client relationships. The initial four regions are assembled as internal orientation lean practices, while supplier connections and client connections are under outer situated lean practices. Achanga et al.[12] proposed that the achievement of lean practices execution relies upon four basic elements: administration and the executives; finance; abilities and skill; and strong hierarchical culture. Effective timetables work on the capacity to meet client orders, drive down inventories by permitting more modest part measures, and diminish work in processes (Heizer furthermore Render, 2006)[13]. Effective planning techniques can enhance the utilization of resources. The execution of lean manufacturing are to accomplish objectives, for example, decreased holding time to deliver item to the market, decrease manufacturing waste, improve correspondence with end clients, and improve the level of value both in the creation and in research facility testing (Pavlovic and Bonanic 2012)[9].

Table -01 Findings from various research paper

| S. No. | Author (year) | Title | Contribution |
|---|---|---|---|
| 1. | Anup kumar, kamapan mukhergee (2020)[1] | Lean manufacturing in pharmaceutical closes-loop supply chain | In this study, a lean methodology has been embraced to investigate the waste involving framework elements as an instrument model a stock control framework |
| 2. | Priya harikumar and P.G. saleeshya (2018)[2] | Suitability and adoptability of lean manufacturing in Indian pharmaceutical sector | In this study the scope of a successful lean based manufacturing strategy implementation in this sector |
| 3. | Felix sieckmann & Hien Nguyen Ngoc & Rene Helm (2018)[3] | Implementation of lean production system in small and medium sized pharmaceutical enterprises | Improving the efficiency of pharmaceutical production through lean production system provides a way to advance the sustainable supply of affordable medicine. |
| 4. | V. jaiganesh & Clement sudhahar (2015)[4] | Study the influence of lean principles which enhance the operational excellence in the pharmaceutical industry | A persistent exertion is fundamental to recognize and execute the lean practices and standards in pharmaceutical area to guarantee the operational excellence. |
| 5. | V. jaiganesh & Clement sudhahar (2015)[4] | Study the influence of lean principles which enhance the operational excellence in the pharmaceutical industry | A persistent exertion is fundamental to recognize and execute the lean practices and standards in pharmaceutical area to guarantee the operational excellence. |
| 6. | Rakesh kumar & vikas kumar (2015)[5] | Significance of lean manufacturing element related to Indian manufacturing industry | Benefit's gained, major obstacle's faced, and identifies the adverse impact such as exceptionally low , inventory, product quality |
| 7. | Abhishek Dixit & Vikas Dave & Alakshendra Pratap Singh (2015)[6] | Lean Manufacturing: An Approach for Waste Elimination | Lean manufacturing is a successful device for continuous improvement in an industry. It trusts in utilizing little continuous Enhancements rather than fast improvement. |
| 8. | Maria Elena Nenni,& Luca Giusttiniano & Luca Pirolo (2014)[7] | Improvement of manufacturing operations through a lean management approach – a case study in pharms industry | Provides an opportunity to perform a continuous production flow rather than batch flow in order to control the production flow. |
| 9. | Y Sujatha & K Prahlada Rao (2013)[8] | A study on lean manufacturing tools and Techniques implementation in the Andhra Pradesh silk production industry | moderate-to-extensive" adopters of lean implementing key areas, but the degree of implementation varies among organizations. |
| 10. | Norani Nordin, Baba Md Deros and Dzuraidah Abd Wahab (2010)[10] | A Survey on Lean Manufacturing Implementation in Malaysian Automotive Industry | results shows that most of the firms have adopted lean manufacturing practices up to a certain extent, main barrier is lack of understanding of lean concept among employees. |

## III. METHODOLOGY

Methodology is characterized as the set of methods which could be applied in the specific space of study to examine the information gathered and to arrive at a conclusion of the study. Technique utilized in the current study is questionnaire survey technique, which comprises of set of inquiries and ended up being a significant exploration instrument to gather information from various respondent**.** This examination intends to find the adoption of lean manufacturing techniques and elimination of wastage and non-value added activities and strategies in the in pharmaceutical industry. To accomplish this, information were gathered through a questionnaire review. This strategy appears to be the best information assortment strategy in exploratory investigations since it empowers a bigger measure of information to be accumulated in a brief period of time. A questionnaire had been prepared to gathered Information from various organisations. After that, IBM Statistical Package of Social Sciences (SPSS) had been used to analyse and examine the gathered data.

### *A. Questionnaire Framing*

The choice made in this review depends on the investigations done by Shah and Ward [15], Bonavia and Marin [14].From their studies it is shown that little manufacturing firms are more averse to execute Lean manufacturing ideas because of specific constraints and hindrances. The personnel involved in the study were those from manager and supervisor from various department such as production, inventory control, quality control, human resources, customer and supplier relations, and finance etc. managers managing directors, and also quality managers and executives. The questionnaire consists in two parts, fist part is about information about respondent such as name of respondent, organisation name of respondent , contact no and email id, and second part consist Set of 30 question which is categorised in six groups and it was send to respective industries respondent to collect data from the question. Nature of question was multiple choice question on scale of one to five, for each question there are five choices such as 1 = strongly disagree, 2 = disagree , 3 = neutral, 4 = agree, 5 = strongly agree. For increasing the response rate, various techniques are used such as making telephonic conversation, visit to an organisation physically, follow up mails are used. After getting responses from various respondent, (SPSS) IBM Statistical Package of Social Sciences has been used to analyse and examine the gathered data. Reliability and validity tests was performed on SPSS software to satisfy that the questionnaire survey was valid and reliable. Reliability tests was conducted for each principal area and Cronbach's Alpha with a lowest value of 0.60 was acceptable for this study. Because a value of 0.6 of alpha is satisfying for a relatively new estimation instrument (Sakakibara et al., 1997) while 0.7 is adequate.

Table – 2 Cronbach's Alpha values for reliability and validity test

| S. No. | Description | No of item | No of item deleted | Alpha value (α) |
|---|---|---|---|---|
| 1. | Mode of wastage | 8 | - | 0.702 |
| 2. | Process , equipment and planning | 3 | - | 0.733 |
| 3. | Human resource, Supplier and customer relationship | 3 | - | 0.723 |
| 4. | Lean implementing techniques | 6 | - | 0.796 |
| 5. | Quality and cost | 2 | - | 0.698 |
| 6. | Role of leadership | 2 | - | 0.772 |
| 7. | Lean barriers | 5 | - | 0.699 |

Cronbach's Alpha values for all the parameter is greater then 0.65, so it is valid and reliable and the further examination and calculation can be done for this data.

## IV. RESULTS AND DISCUSSION

In this paper questionnaire is categorised in seven category and the soul purpose of this study is to identify the mode of waste and non-value added activates which can have a high impact in any organisation. There are mainly seven wastage such as waste due to over production, due to idle time/waiting time, due to transportation, due to more inventories, due to processing, due to manufacture defective product, due to underutilized worker.by analysing data following information's obtained.

*A. Mode of Wastages*

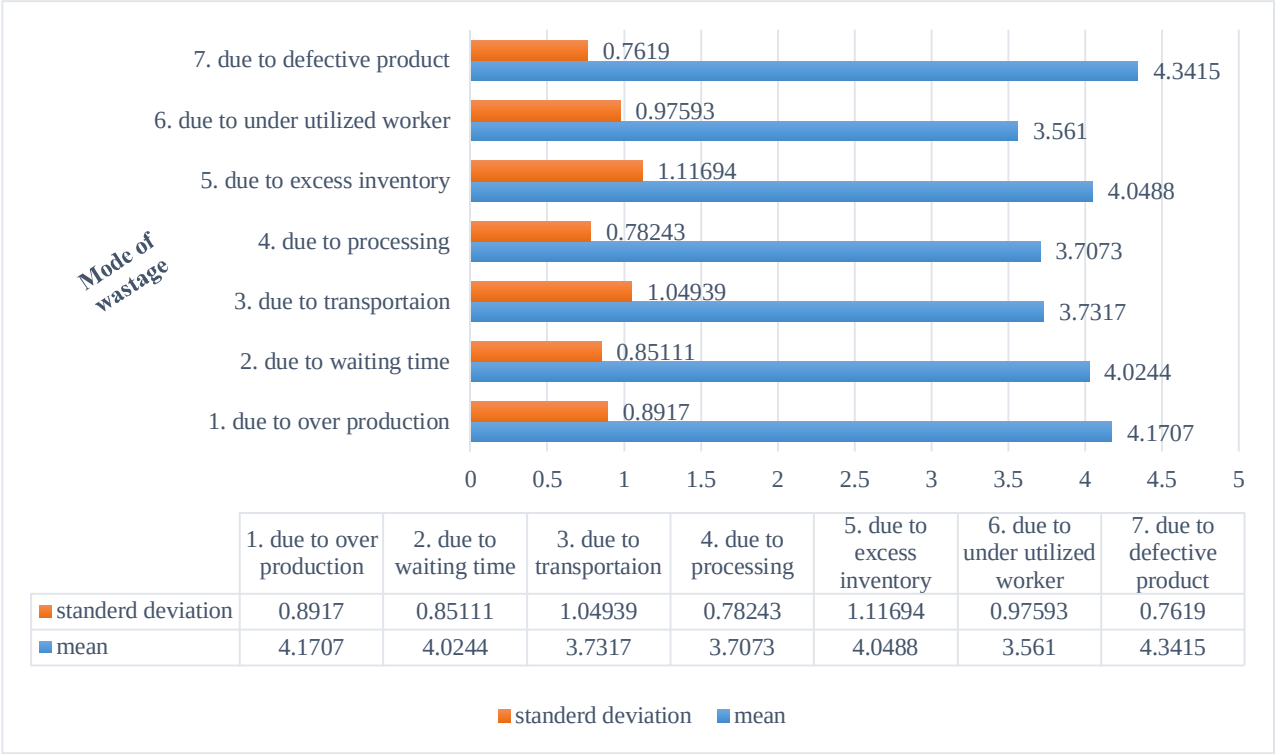
Table – 3 (obtain from SPSS

| | Summary Item Statistics | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean | Minimum | Maximum | Range | Maximum / Minimum | Variance | Cronbach's Alpha | N of Items |
| Item Means | 3.994 | 3.561 | 4.366 | .805 | 1.226 | .090 | 0.702 | 8 |

Table – 4 individual mean, median, standard deviation

| Items | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| N | Valid | 41 | 41 | 41 | 41 | 41 | 41 | 41 |
| | Missing | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mean | | 4.1707 | 4.0244 | 3.7317 | 3.7073 | 4.0488 | 3.5610 | 4.3415 |
| Median | | 4.0000 | 4.0000 | 4.0000 | 4.0000 | 4.0000 | 4.0000 | 4.0000 |
| Std. Deviation | | .89170 | .85111 | 1.04939 | .78243 | 1.11694 | .97593 | .76190 |
| Variance | | .795 | .724 | 1.101 | .612 | 1.248 | .952 | .580 |

Graph – 1 mode of wastage vs mean value and standard deviation




| | 1. due to over production | 2. due to waiting time | 3. due to transportaion | 4. due to processing | 5. due to excess inventory | 6. due to under utilized worker | 7. due to defective product |
|---|---|---|---|---|---|---|---|
| standerd deviation | 0.8917 | 0.85111 | 1.04939 | 0.78243 | 1.11694 | 0.97593 | 0.7619 |
| mean | 4.1707 | 4.0244 | 3.7317 | 3.7073 | 4.0488 | 3.561 | 4.3415 |

Table 4 also shows the distribution of mean value for various mode of wastage practice From the above table no 4 & graph no 1 clearly shows that, the mean value is highest (4.3415) for waste due to manufacturing defective product, and mean value is lowest (3.561) for waste due to under-utilized worker. Most of the organisation believes that waste due to making defective product is more concerned of them.by eliminate making defective product is step moving towards lean manufacturing.

*B. Lean Techniques*

To achieve lean implementation there are various technique's such 5S, kaizen, kanban, JIT, cellular manufacturing etc. This techniques are taking into consideration for questionnaire, and following results are obtained from collected data from various respondent of organisations

Table – 5 distribution of total mean and variance

| | Mean | Minimum | Maximum | Range | Maximum / Minimum | Variance | Cronbach's Alpha | N of Items |
|---|---|---|---|---|---|---|---|---|
| Item Means | 3.634 | 3.268 | 3.854 | .585 | 1.179 | .048 | 0.796 | 6 |

Table – 6 distribution of individually mean median and slandered deviation and variance

| Items | | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| N | Valid | 41 | 41 | 41 | 41 | 41 |
| | Missing | 0 | 0 | 0 | 0 | 0 |
| Mean | | 3.5122 | 3.7561 | 3.6098 | 3.2683 | 3.8049 |
| Median | | 4.0000 | 4.0000 | 4.0000 | 3.0000 | 4.0000 |
| Mode | | 4.00 | 4.00 | 4.00 | 3.00 | 5.00 |
| Std. Deviation | | 1.22723 | 1.06725 | 1.18064 | 1.04939 | 1.18784 |
| Variance | | 1.506 | 1.139 | 1.394 | 1.101 | 1.411 |

Graph-2 comparison among lean technology

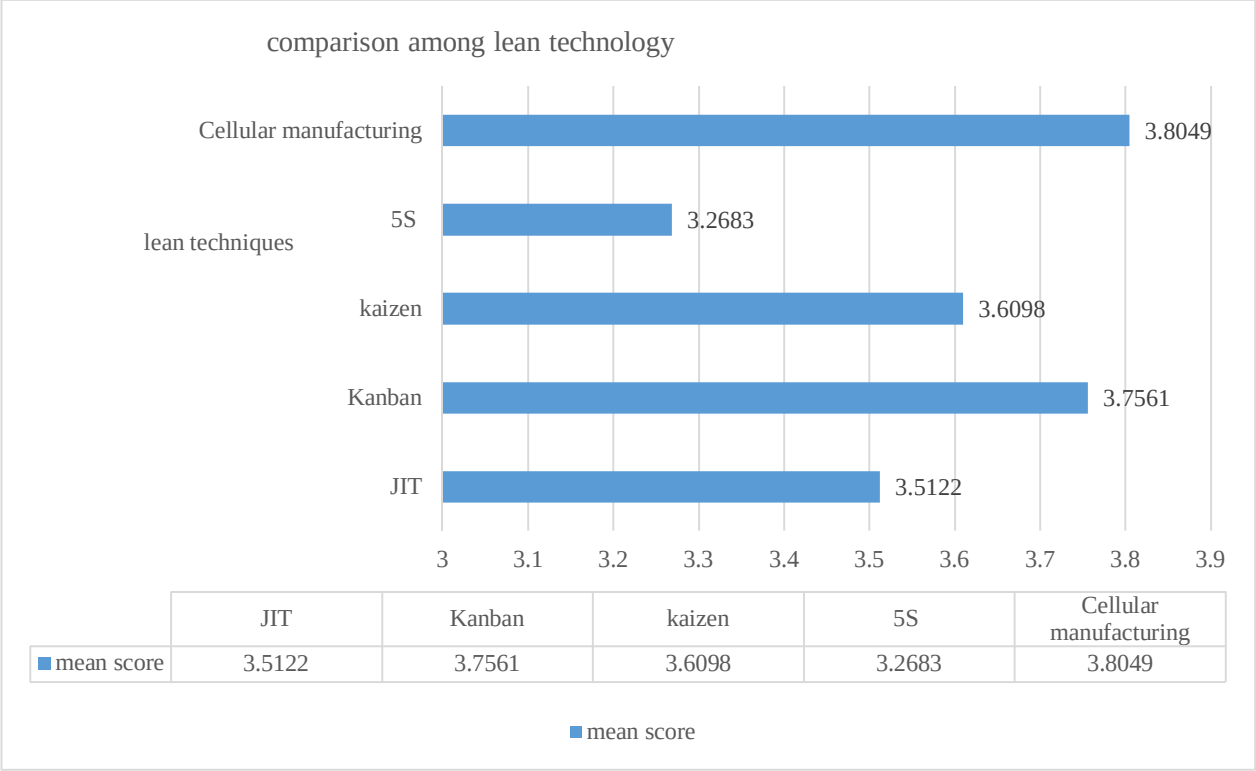



Table- 6 illustrate distribution of individually mean median and slandered deviation and variance for collect data. From the above table and graph -2, it is clearly shows mean score is highest for (3.8049) cellular manufacturing among all the manufacturing techniques and mean score is lowest (3.2683) for 5S.that means most of the organisation thinks that cellular manufacturing technology is best suited for implementing lean manufacturing technology for elimination of waste and minimising non value added activities, and it leads to increase in productivity and overall growth for n organisation.

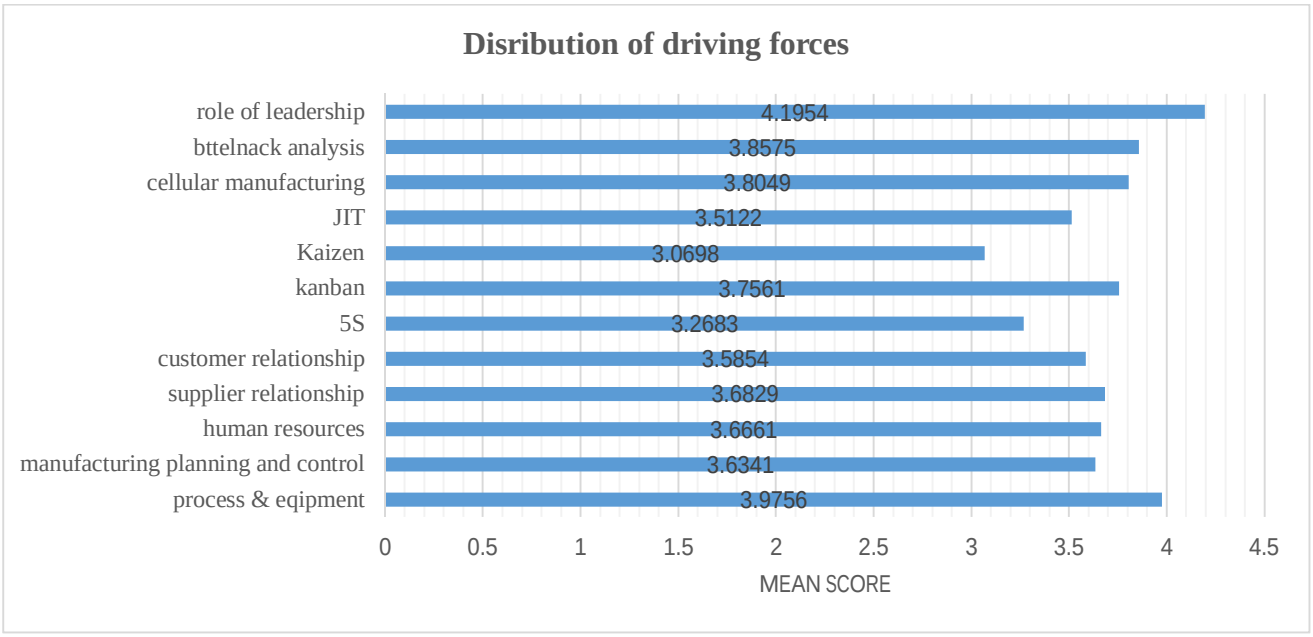
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*C. Driving Forces to lean Techniques Adoption*

To get the idea about the Lean manufacturing adoption driving forces in Pharmaceuticals industries, respondents were asked to mark the forces that affected their decision to implement lean manufacturing, there are various driving forces taking into consideration for this study.

Graph -3 distribution of driving forces to implement lean technology with their mean scores.



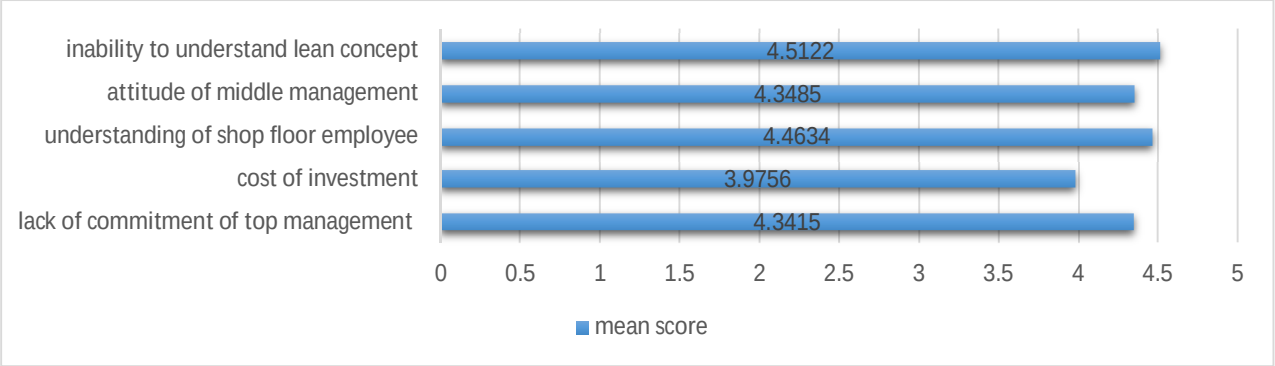

To investigate the driving force needed in organisation for lean implementation this analysis done in SPSS and Above from graph no 3, it is clearly seen that the highest value of mean score (4.1954) is for role of leadership, that means leadership plays a vital role for implementing a lean culture in an organisation. Most of the organisation were thinking that role of leadership is very concerned for their organisation for elimination of non-value added activities and adopting a lean concept. Besides role of leadership it was observed that bottleneck analysis and process and equipment also plays an important role for implementation of lean culture in an industries. Bottleneck Analysis is device which assists a group with distinguishing process steps where stream is obliged, observe the underlying drivers of those imperatives, and address the underlying drivers that have been recognized. It tends to be utilized when cycles are not measuring up to expectation, not staying aware of interest, or clients are disappointed.

*D. Barriers for Implementing Lean Culture*

To execute lean culture framework is not a simple task. For any adjustment in industry to grab hold and achievement, the obstruction powers or hindrances should be recognized and perceived. Inability to get to authoritative and person change availability might result the administration to spend critical time and energy. The lean boundaries are dependent on the situation with lean execution by the respondent organizations the three primary Hindrances in non-lean firms are the absence of lean understanding, absence of senior administration and middle management executive's mentalities. Then again firms which are experiencing significant change towards lean framework, the vast majority of their boundaries are in the absence of lean understanding and workers' mentality. Again for lean firms, absence of lean arrangement is recognized as the principle barrier to execute lean culture framework effectively. Curiously, all organizations perceive the principle barrier is the lack of lean culture understanding. This is on the grounds that lean technology requires new information and cultural change during the changing process. The capacity of individuals to react and adjust is basic when they face any change in circumstance. Fitting correspondence and preparing on the idea and fundamental standards of LM framework would give more noteworthy degree of comprehension about the framework and energize inspiration and development in the work culture and workers perspectives[20].following are the barriers which are asked to rate the respondents of an organisations.

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Graph – 4 distribution of lean barriers with mean score




Above graph 4 clearly shown that lean barriers with respective mean scores, according to distribution highest value of mean score (4.5122), which is for inability to understand lean concept in an organisation, after that second highest value is obtain for understanding of shop floor employee towards the lean concepts. Apart from both of that, lack of commitment of top management towards the adoption of lean culture and behaviour of middle management is also very significant barrier with mean score of (4.3415),(4.3485) respectively, to implement lean culture in an organisation. The representatives reverted to the old methods of working most likely on the grounds that lean producing drives may have troubled them with extra work. Obstruction from workers may be due to the "fear element" that they would lose their positions if they cannot attain the elimination of wastage and not perform value added activities, since lean producing is tied in with disposing of non-worth added activity. Along these lines, it is significant that top administration must give abundant help also gives job and their position stability to the employee. Top management should proving freedom and flexibility at some extant to their employees, so the motivation in employees goes up for adopting lean culture.

The primary goal of this study was to investigate the extant of lean culture execution and find the main driving force and lean barriers for implementation in a pharmaceutical organizations. The main key areas on which this whole study is caring out are shown below in a table with their distribution of mean score. This mean score for each key areas are obtain after analysing from SPSS.

| S. No. | Description | Mean score |
|---|---|---|
| 1. | Mode of wastage | 3.994 |
| 2. | Process , equipment and planning | 3.675 |
| 3. | Human resource, Supplier and customer relationship | 3.650 |
| 4. | Lean implementing techniques | 3.634 |
| 5. | Quality and cost | 3.878 |
| 6. | Role of leadership | 3.866 |
| 7. | Lean barrier | 4.327 |

Table – 7 Average mean score for each key area

From table 7 we can see that mean score value is highest 4.327 for lean barrier to adopting lean culture, and second highest 3.994 for Mode of wastage, that is waste is very concerned for organisations, other factors process and equipment have a mean score of 3.675, quality and cost have a mean score of 3.878 and a role of leadership have mean score of 3.866.high score of mean value is indicate that it is more concerned or the orientation of thinking of respondents towards those key area is more.

## V. CONCLUSION

From this study we can concluded that, regarding mode of wastage, waste due to making defective product is highly concerned in respondents organisation. Defective products leads to increase in non-value added activities and increases cost of production. Apart from wastage, lean barriers are also outcome of this study which are resistance in implementing lean culture in an organisation. Basically all barriers are obstacles in lean implementations but out of which lack of understating of lean culture in shop floor employees and inability to understand lean concept is very serious concerned for respondent organisation.

Lack of commitment of top management and behaviour of middle management also create hindrance to implant lean culture in respondent's organisation. From this study it's clarify that respondents organisation are in transient to adopting lean culture, none of the respondent organisation is fully lean cultured. We can also concluded there are some driving forces which can help in adopting lean culture out of which respondent organisation thought, role of leadership , process and equipment , bottleneck analysis are very crucial for them which may leads to helping in adoption of lean culture. Finally we can concluded that the seven key areas which are considered for this study out of which lean barriers and source of wastage and process and equipment play vital role for making a organisation with lean culture. So the elimination of wastage and right selection of process helps to adopting a lean culture.

## VI. FUTURE SCOPE

This study explores the extent of lean barriers, driving forces for lean implementation and source of wastage further this study has future scope for searching the methodologies and techniques which can eliminate the wastage, enhance the capability of driving forces for lean implementation and eliminate the barrier.

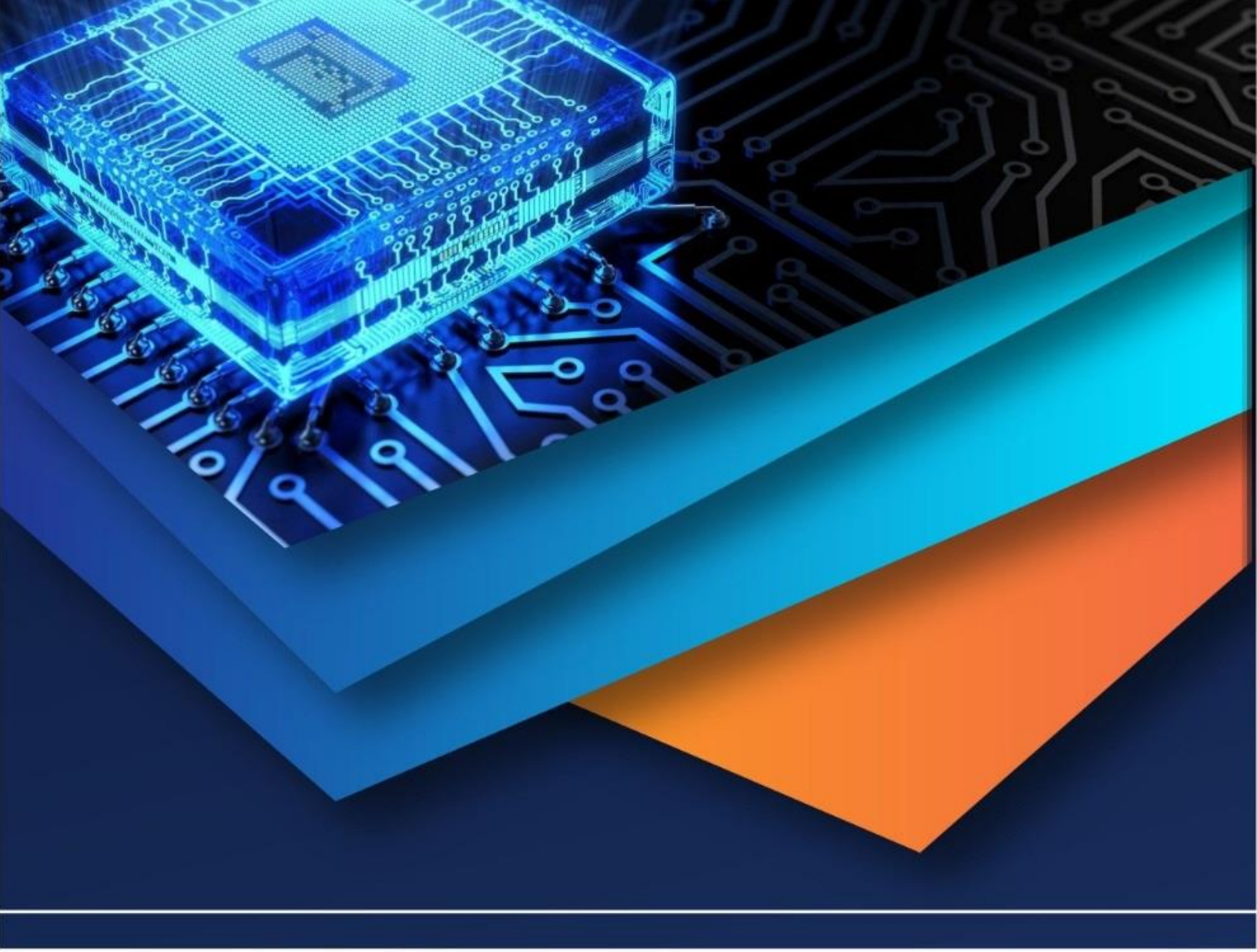
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