



## PRODUCTIVITY IMPROVEMENT BY KAIZEN: A CASE STUDY IN A TYRE COMPANY

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### Abstract

*Today intense competition conditions in the market and customers expectation increasing continually. So companies have required to increase the product quality continually, insure profitability, decrease the cost in all process and improve productivity in all process. Productivity shows to the how efficiently the resources are transforming into useful goods and services. The automobile sectors today using to the kaizen process for continuous improvement, where "KAI" (change) and "ZEN" (better) called by Japanese, which means better change. The kaizen approach eliminates to the unnecessary activities and it improves to low performance activity. This study describes a kaizen application in tyre building process during bead setting operation in production department of a CEAT tyre company. The effect of kaizen implementation in a tyre company during the bead setting process is that, the number of scrap reduced and breakdown time reduced from 20.02 hrs /month to 9.88 hrs/month as a result production of product improved by 608 tyres/month. After the implementation of kaizen approach productivity improved by 1.45%.*

**Keywords:** Kaizen, Productivity, Tyre Building Process, Bead Setting.

### 1. INTRODUCTION

Productivity is a common term which use in automobile industry. It is define is the ratio of output produced to the resource consume. The ratio of output quantity index to the input quantity index is the measuring tool for productivity change, Balk [1]. Thus productivity affect by both input and output.

It is important for every manufacturing company to increase productivity for sustain in market. There is required to reduce the every small to large losses in manufacturing company. It can be achieved by addressed to each problem individually to eliminate this losses. There is kaizen method use as a important tool to identify and eliminate this losses.

Now increasing the popularity of kaizen study as a process improvement. The kaizen case study literature has also increased Glover et al. [2] because kaizen implementation in any company always improve to process. In Toyota company continuous improvement have done through kaizen For example in Toyota it has been find out not only the working team but also product / process design engineers involve in kaizen and it is important to good coordination between the design and engineering department [3].

This study was performed in tyre manufacturing company, in tyres productions include following process first is raw material storage, mixing, extrusion, calendaring, tyre building, curing, final finish and finished goods storage. In this study problem was find out during tyre building process. Causes of this losses increased and breakdown time increased to solve this problem a interdisciplinary team required.

By this team implement the kaizen approach losses reduced and breakdown time reduce so cycle time also reduced and productivity improved. Productivity can be increased by reduce the cyclic time and controlling the process statically, Sheth and Sisodia, Sharma et al. [4,5].

The result of research that find out the problem during bead setting in tyre building operation is a cause of loss of time and breakdown in process. In order to solve this problem required to make a interdisciplinary team and provide training to team.

### 2. LITERATURE REVIEW

The many factors which affects the implementation of kaizen is, communication between the management and its employees, clear strategy, need of personnel who can champion the implementation of kaizen in company having a good knowledge and prove employee with certain level of empowerment are important to ensure a successful kaizen implementation, Mohd Ghazali Maarof, Fatimah Mahmud [6]. So required interdisciplinary and trained team.

In a tyre manufacturing company problem identify during curing process called "vulcanization" in production department of tyre manufacturing company for solve this problem applied the kaizen approach with a trained team, Cagin Karvicak [7]. This is the next step of bead setting during tyre building operation so this study helpful in our research work.

In a tyre company operation in India a waste management study was conducted to reduce the harmful effect by using lean manufacturing and kaizen approach technique [8].

Slack defines kaizen as the participation and mobilization of the works in process improvement by creating a main channel for employees to contribute to the development and success of the organization [9].

Satbir Singh and Sandeep Singhal perform the clustering technique to improve the productivity and reduce the cyclic time. Because of clustering the number of machine reduce 8 to 6[10].

The cause of insufficient result of kaizen implementation in micro and small enterprises Addis Ababa city was the lack of consistency kaizen training, lack of knowledge of trainers and

improper following of system [11].

In a small company successful implementation of productivity improvement strategies, it is required to support of top management for continues improvement, so can expect that the continues improvement. There is a need of improvement which must be business driven and it should be improve to company's strategies, and it should be involve dependability and flexibility. Finally for successful implementation of process required a clear and explicit communication system and objectives [12].

For the improvement productivity of employee, it is required to give the more responsibility and accountability, by the employers. So employee can work efficiently to achieve the target[13].

For the successful implementation of kaizen, it is essential to the choice of subject, commitment of managers and team, identification of factors in the course of work. Impossible to achieve the goal without commitment of staff and leaders motivation. For any changes there is necessary a commitment of managers. For successful implementation of kaizen it is required to clears objectives and goals and action that must be performed[14].

B. E. Narkhede, In there study they have try to measure the effect of information source and functional orientation, resource related view of manufacturing, organizational knowledge and global orientation on the manufacturing practices which involves to the advance manufacturing strategy. In there study they have find the some things like, evaluate the industry's competitive priorities, order winner for industry, key areas for decision or improvement practices and measured the importance of organizational knowledge on the manufacturing practice and they try to isolate to the conventional manufacturing techniques and grow to SMEs industries why the exploration of advance manufacturing technologies. This paper involves to SMEs sector for adopt AMTs, good business strategies and provide the knowledge for there competitiveness. In there study they have measured all the SMEs industries which are transformed with the advance manufacturing technologies and gain the firm performance. The limitation of there study is that, the knowledge of the organization and learning evaluated on the basis of manufacturing only, all plants located in India consider for there study and plat which produces different products with different manufacturing process consider. The result of this research finely can consider as it work for productivity improvement and it help to compete the market [15].

Now the manufacturers led to accept the new manufacturing approach like advance manufacturing technology because the customer expectation increasing and changing and the efficiency of convention manufacturing technology is decreasing. It allow to high quality and high flexibility with low cost. Many practitioner's focusing on understand the relation between performance and manufacturing strategy. (Vickery et al., 1993; Ward and Duray, 2000 ) [16,17].

Rajesh Gautam, Sushil Kumar, Dr. Sultan Singh, The Kaizen Implementation in assembly line of the industry which produces the rear and front axle of medium and heavy vehicles. Kaizen

technique affect on the operation of industry like marketing, design, distribution etc and at the all level of management. In there study used PDCA cycle including the 5 why's technique for root cause analyses and find out the problem, in the one problem the series of root causes can be find out by fishbone diagram. They have try to do some change in the axle manufacturing company in previous six month by the implementation of kaizen. There is a problem which is reduced by the kaizen implantation is work in process, the work in process is reduced by the allocation of the relevant task to the operator who have less work assign so he can perform the another task at a same time which relevant to there work, as a result the work in process is reduce the and production is improved. The effect of this is the minimum cost and improvement in the productivity [18].

Shubham Sharma and Vikas Ucharia et al. In there study they have used the quality control tools for find out and analyses the casting defect in casting industry. The casting defect is a remedial measures because, if the previous defect is not eliminate then new defect introduces. In this study for find out the defect in casting used some tools like Pareto charts and cause and effect diagram which is very helpful to identify the reason for defective casting production and the lower productivity. The objective of this study is to identify and study the defect of trumpet housing casting by the using quality control tools the defect reduction and minimization is helpful for improve profit and performance of a organization. By the using of Pareto diagram find out that the major rejection due to blow holes and sand drop then the cause effect diagram is drawn for the sand drop and same major causes as wet sand, more binder, less venting. After the implementation of the quality control tools they have reduce the defect in casting and productivity has improved [19].

### 3. MATERIAL AND METHODOLOGY

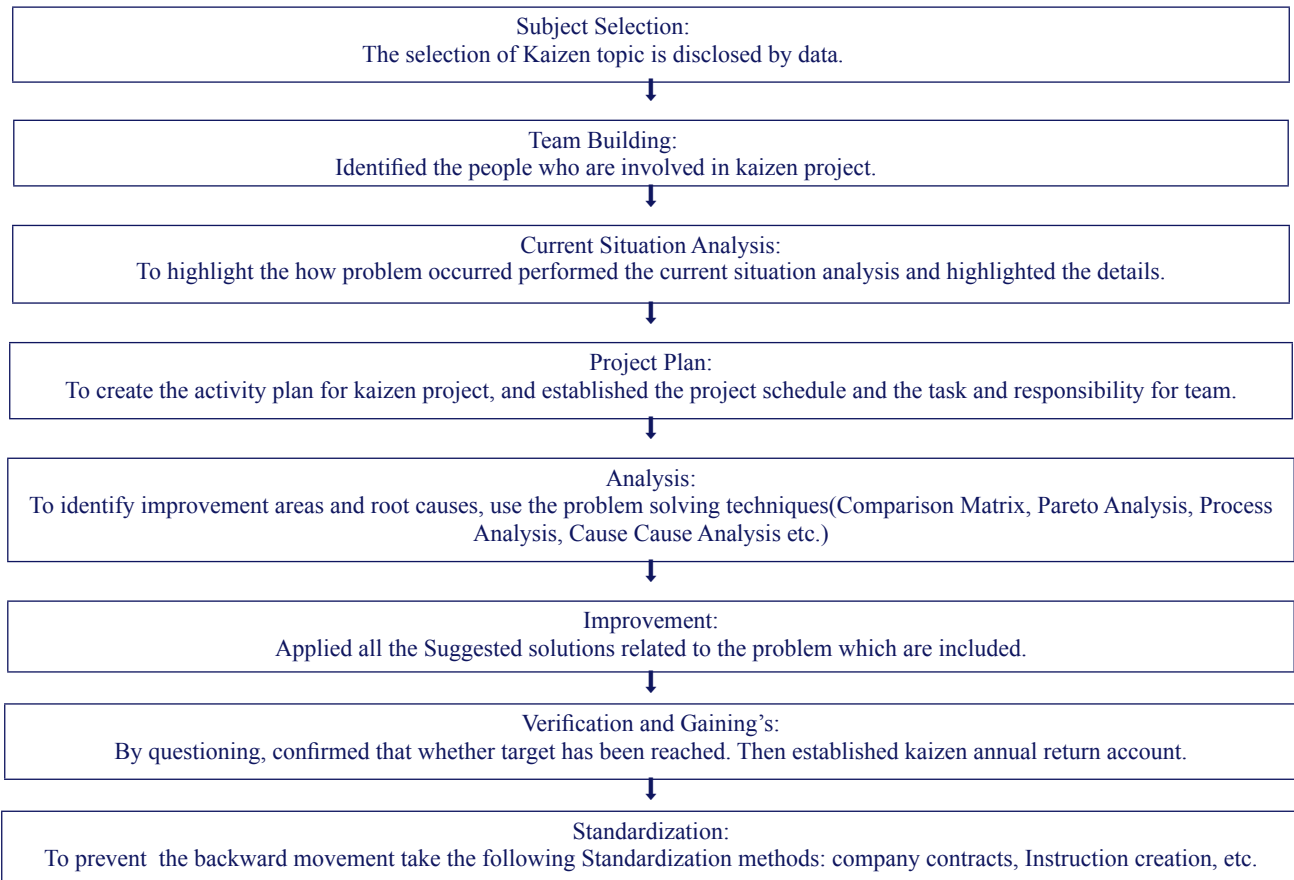
Kaizen is the term which comes from Gemba kaizen means continuous improvement. Continues production is a good strategy in production and it is more important in today competitive environment. Kaizen process called where everyone include in organization for continues improvement [20,21].

Kaizen is become by two terms "KAI" (Change) and "ZEN" (Better) means better change. Kaizen shows every time better than before that include every time find out better process, reduce problems and rejections with the help of every member of working team.

In Japan kaizen approach use as a slow and continues improvement with time. In America is know as "kaizen, Blitz" or "kaizen event" mean gradual, regular schematic approach for improvement[22].

Wumack and Jones[23] define kaizen is a part of lean production and indicated it includes to schematic approach to reduce waste. Kaizen approach complete in six steps which include discovers, improvement, potential, analyse the current method, generate original ides, develop an implementation the planes, implement the plan and evaluate the new method.

For implement kaizen approach there are sequential steps.



Above given steps sequence applied in this work, by application of this following steps, the tyre building process during bead setting improved and breakdown reduced after implementation kaizen process. For move this improvement work forward utilise the basic problem solving tool.

#### 4. APPLICATION

In this study included to the quality, maintenance, manufac-

turing department staff and researchers to reduce the breakdown in tyre building process during bead setting in this study used 4W+1H, Ishikawa diagram, Pareto chart and Histogram tool.

For problem identification there is used DEMING CIRCLE.

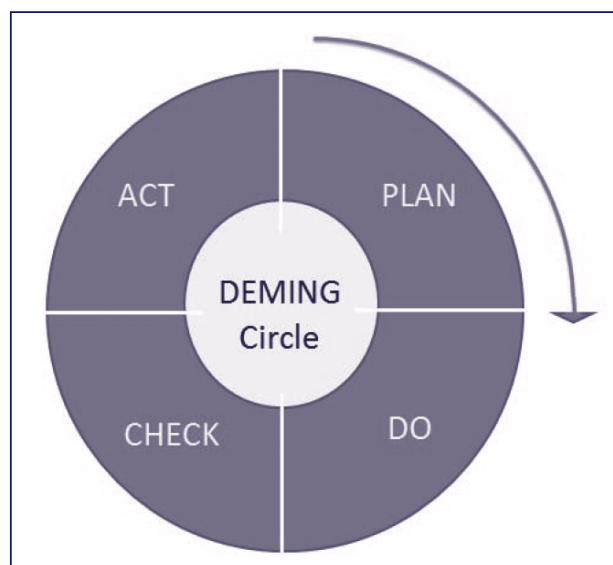


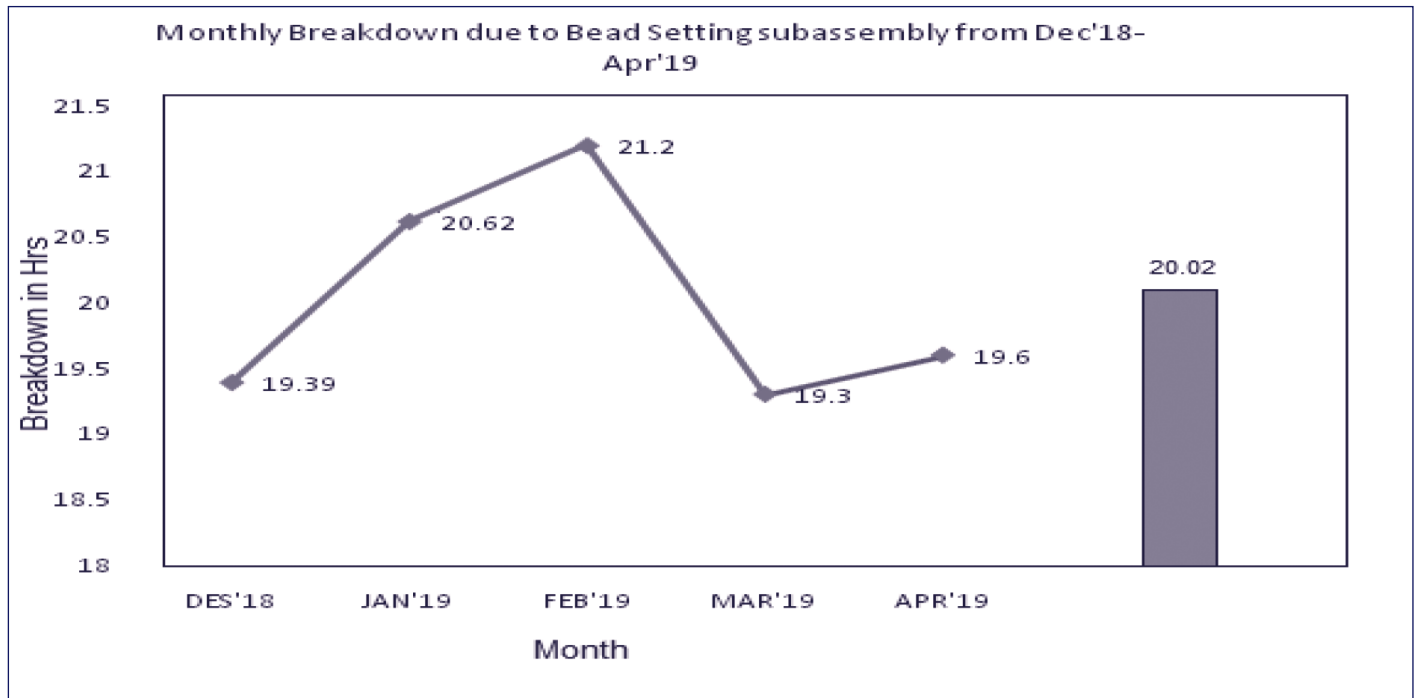
Fig. 1. Deming Circle. Source: [www.tallyfy.com](http://www.tallyfy.com)

For fined out the problem, causes of problem and develop the solution used DEMING CIRCLE.

Where sequential process is

- PLAN - Identification work related problem, selection of problem, defined the problem.
- DO - Analyse, identify causes, identify root causes, data analysis, develop solution.
- CHEACK - Forces resistance and prepare trial implementation.
- ACT - Regular implementation, following up review.

According to this process many number of problem identify then these problems categories on the basis of SQCDMP (Safety, Quality, Cost, Delivery, Morale, Productivity) then maximum number of problem comes under the productivity category then problem select on the basis of rating so there is highest rating problem is increase breakdown due to bead setting sub assembly during tyre building process. It occurs on the tyre building machine during the function is to hold bead in position during drum expand operation for play turn up. Because of this problem the current breakdown (hrs/ month) of previous five month is given bellow:



**Fig. 2. Breakdown Hrs/month.**

Source: Chart is prepared by MS Excel.

Above trend shows breakdown due to Bead setting sub-assembly with average breakdown of 20.02 Hrs/ Month.

#### 4.1. Goals:

- ❖ Developing a solution to reduce the breakdown due to Bead setting sub assembly by 30% in average i.e. from 20.02 hrs/ month to 14.01 hrs/ month.

#### 4.2. Objectives:

- ❖ To reduce in consumption of spare.
- ❖ To reduce of repetitive correction activity.
- ❖ Increase to life of spare.
- ❖ Safe working by removing unsafe conditions and unsafe act in process.

#### 4.3. Analysis Of Problem By 4W+1H

1. What : High breakdown in Bead setting assembly.
2. Where : Bead setting unit.
3. When : During Bead setting and turn-up operation (after loading spool)

4. Who : Man, Machine, Method, Material.

Who is affected:

- ❖ Bead blister a defect in tyre after curing.
- ❖ Bead is not setting in green tyre.
- ❖ Associate has to be bend in uncomfortable position at the time of correction in Bead setting assembly frequently due to repetitive breakdown.

5. How: Solve the problem by using QC tool.

#### There Is 7 QC Tool:

1. Process Flow charts, 2. Fishbone diagram, 3. The Pareto charts, 4. Check lists. 5. Scatter plots. 6. Histogram 7. Control charts analysis.

1. Process flow chart: it provides the information related to relation of process units.
2. fishbone diagram: this diagram shows the relationship between contributing factors and the defects and it identify to the problem.

3. The Pareto chart: this the diagram which arrange the all items in the order of there contributing magnitude and it identify the items which show the maximum influence.
4. Check list: This list help to collect to data and analyses them and it also focus the area by the frequency of location, defects cause or type.
5. Scatter plots: This plot is helpful for represent the relationship between two variables. By the help of this plot the positive, negative or no relationship of variables can identify.
6. Histogram: It shows visually the frequency versus number of defects which given in this the histogram. The height of bar always equal the value of defects frequency occurrence. The histogram diagram shape show to the nature of flow of the data.
7. Control chat analysis: it helps in this ways it help to monitoring of quality of process, detect to the non-ran-

dom variability of process, identify to the assignable cause.

The application of this specific tools in this study is based on the use of this tools by Japanese in there companies. This tools were helpful to find out the cause and effects and find out the unique solution for particular problem in very less time.

There is used the 4W+1H tool for analysis of the problem because it helps to understand the details, analyses to assumptions and perceptions to get the basic facts and to guide the statement to achieve the abstraction.

The use of fishbone diagram because the many causes which are responsible for this problem so find out the possible cause why brain storming and separate the idea in beneficial categories. The use of Pareto chart because the number of problems which are responsible for breakdown, so find out the problem which have more frequency used this tool.

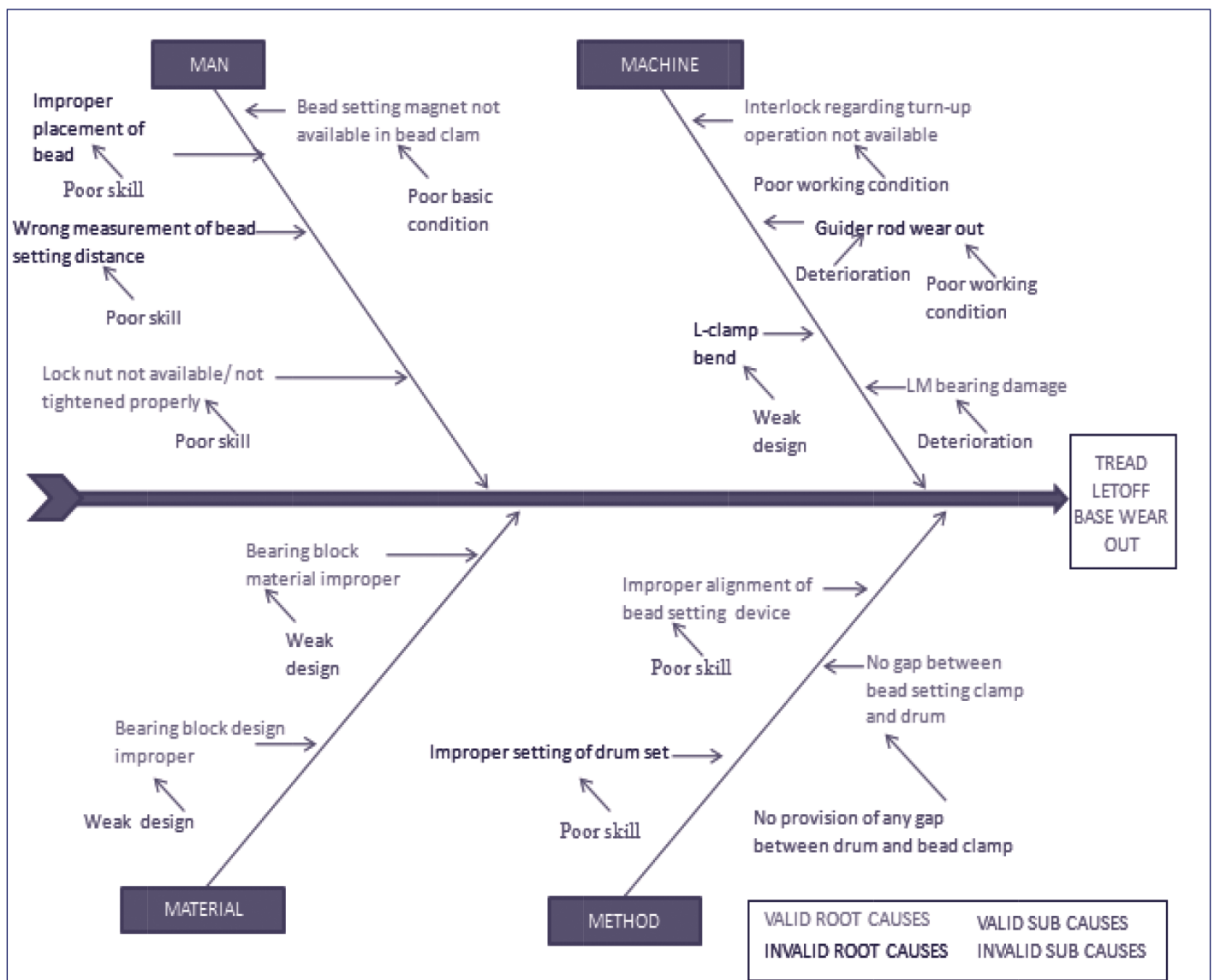


Fig. 3. Fishbone Diagram

Source: MS Power point.

### Identification of the cause and effect on the basis of 4M condition.

On the basis of analysis of Pareto chart it can be observed that the Bead setting assembly not ok is the highest retting problem among all the problem with 100 hrs from Dec'18 to Apr'19.

#### 4.4 Development of the Solution:

There is use tool and techniques for develop solution which is Brainstorming and Solution Selection Matrix. Then find out the many number of root causes and corrective action. By the use of solution section matrix on the basis of solution priority number to the block material change thus the priority is given.

For reduce the problem of Bead setting assembly breakdown required changes is

1. Bearing block design modified for better load carrying capacity and avoid breakage on sudden load. (to avoid break-

ing or deformation of Bead clam bracket)

2. Bearing block material change from aluminium to mild steel. (To avoid washing out of threads)

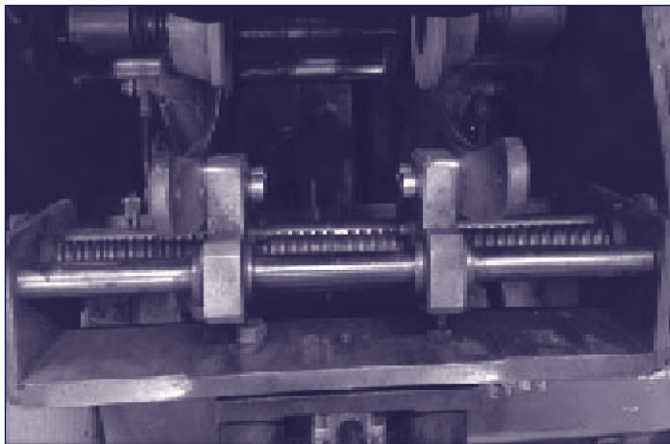
3. Additional proxy added to sense the return of Bead setting assembly in its home position before carrying out turn up. (To sense Bead setting assembly instead of Bead setting position rod before turn up operation)

4. LM 16UU bearing replaced by brass friction bearing to reduce bear of guiding rod and consumption of LM 16UU bearing. (To reduce consumption of bearing LM 16UU and Bead setting guider rod.)

5. A proxy added and inter lock provided for sensing bead setting assembly before turn- up.

6. Two lock nut added in bead setting assembly for better locking.

#### Bead setting bearing block design change.



**BEFORE**

In this figure the block and clam are two Piece assembly because of this distortion In bead setting distance happens a lot.



**AFTER**

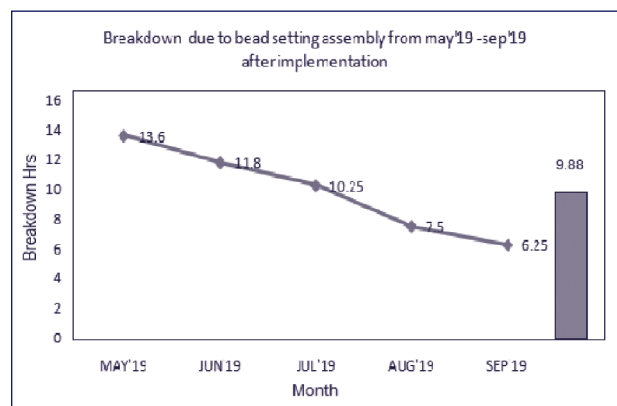
In this figure design of block is changed and it is made in single piece assembly to avoid distortion in distance.

**Fig. 4. Bearing Block Design Change**

### 5. RESULT

After the above changes for a consecutive months seen that continuous reduction in breakdown time (hrs/month), reduction

in the losses of bearing and reduced in the failure of product. After implementation breakdown due to bead setting assembly from May'19 to Sep'19.



**Fig. 5. Breakdown Hrs/month**  
Source: Chart is prepared by MS Excel.

The above graph shows that the continuously decreasing the breakdown hrs/ month from 13.6 hrs/ month to 6.25 hrs/ month for five consecutive month from may'19 to sep'19 and the average breakdown hrs/month is 9.88 hrs/month.

Then as a result the average breakdown time reduced from 20.02hrs/ month to 9.88 hrs/month. Because of this reduction in breakdown (hrs/month) and improvement in production of product.

**Table: Time saving by breakdown reduction.**

|                    | Average breakdown( hrs)                           | Average breakdown (in minutes) |
|--------------------|---|--------------------------------|
| Before improvement | 20.02   | 1201                           |
| After improvement  | 9.88  | 593                            |
|                    | Breakdown reduction per month<br>(Before – After) | 608                            |

In above table as a result the time save in minute is 608 minute per month and the cyclic time of production of a tyre is 1 minute. So the 608 more number of tyre can be produced 608 in a month.

Than we can say that the production of the tyre manufacturing company is increased by 608 tyres more in one month.

The monthly production of tyre before rectification is 41999 tyres and after the rectification production of tyre of per month is 42607 tyres. So due to the implementation of kaizen approach, improvement in the productivity is 1.45% and the saving in cost is 40.12 Lack.

#### CONCLUSIONS AND LIMITATIONS OF STUDY:

Now very hard competition in market place and the customer expectation also very high. In this condition manufacturing company required to reduce waste, efficient utilisation of the resources, improve quality and improve the productivity. So can reduce the cost of production and can compete the market easily. For achieving all the targets and continuous improvement in business and for best result required to apply the kaizen approach.

In this study applied the kaizen approach in tyre manufacturing company to find out the problem and reduce the breakdown which occurs during the Bead setting. For identify the problem make a interdisciplinary team which include workers, department as well as researches.

The result of this study that the breakdown time is reduced from 20.02 hrs/month to 9.88 hrs/month as a result number of production of tyre increased by 608 tyre/month and productivity calculated is improved by 1.45% then total saving cost is 40.12 lack. And intangible benefits is communication skill development, team work improved, development of ability to think with, thinking in same direction and feeling if achievements.

The contribution of this study, this study is based on the solution of the problem in a company by the implementation of the kaizen approach and this problem is different type. So this study will be helpful for every researchers to how can handle this type problem or related to this problem.

#### LIMITATIONS:

The limitation of this study is following

1. The number of research paper related to this problem is limited.

2. The part design have used which can made at a place.
3. There is a limitation of cost for solve the problem because it is required to solve this problem at low cost.
4. There is breakdown can reduce at a certain level but can't achieve completely reduction in breakdown because of wear and tear in a machine parts during the operation on machine and they have certain life.

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