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IMPROVING PRODUCTIVITY AND MAINTAINACE EFFICIENCY OF AN AUTOMOBILE INDUSTRY THROUGH LEAN - PRODUCTION CUM MAINTANCE SYSTEM

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Abstract— A production practice that aims to minimize shop floor inventory and maintenance related losses in a Lean Developed production model. To achieve as close to minimum inventories means stockless production, with minimum maintenance losses.

As possible its origins extending deep into developed works on tight material control policies. By eliminating the costs of storage and capital tied up in inventory it is possible to eliminate seven wastages like zero defects, setup time, breakdowns, handling, lead time and surging. Goals of Lean production is, all the efforts directed for achieving zero inventory by producing the components or assembly parts when exactly it needed, and such tight scheduling is possible only by an efficient maintenance system . This thesis introduces the development of Lean based maintenance system and their immediate effects on the productivity of industry. In an exploring automobile industry many techniques are invented and implemented to discover to know how an automobile manufacturer can bring down his costs, using the advance production management theories, in their existing processes.

This research work discusses the combined issues and solution of lean thinking and maintenance in a way to improve performance indicators. The impacts of lean thinking focus maintenance in an organization. The need of maintenance to align itself with the business objectives in relevant of any organization performance measures are important inputs to improvement the productivity of organization, and maintenance in particular, through lean tools and activities.

Keywords— Lean production, Lean maintenance, stockless production, JIT, Impact of lean thinking, Zero inventories, and Performance indicators.

Introduction

Today, the organizations must be flexible in their operations, capable of producing quality products and delivering the products to the customers with competitive price. These demands highlight the need for high levels of overall system trustworthiness that include the reliability of human resources, machines, tools, material handling systems, other value adding processes. Low efficiency, downtime, and poor machine performance is often linked to incomplete plant repairs, which in turn can lead to reduced manufacture levels, increasing costs, market opportunities, and lower profit. These factors have given firms the inspiration to explore worldwide with proactive modern management methods.

Maintenance: As per EN 13306 “Combination of all technical, administrative and managerial actions during the life cycle of an item intended to retain it in, or restore it to, a state in which it can perform the required function (function or a combination of functions) of an item which are considered necessary .The key purpose of maintenance is “total asset life cycle optimization” and this purpose should be attained in a cost - valuable way and in according with environment and safety guideline. Hence, that maintenance management must align with business activities at strategic, tactical, and operational levels.

Maintenance management: Maintenance management is described as activities in order to ensure the efficiency, effectiveness and cost-effectiveness in the maintenance area and where the overall goal is to contribute to company’s profitability and competitiveness.

Lean Thinking and Maintenance: Production units are expecting to gain economical cost, quality, and service and on time deliveries. The effect of preservation on these variables has provoked increased attention to the preservation areas as an combine part of competence improvement.

Lean maintenance: The systematic approach to identify, analyze and eliminate waste through proper management and continuous improvement. In industry, lean approach is as same the concept of efficient maintenance by eliminating waste in maintenance is Lean maintenance.

Parts of Lean maintenance: Proactive - This is not similar to tradition system of maintenance in which reactive action are taken after break down occurrence, in which maintenance operation take place on equipment failures by performing repairing works. In proactive lean maintenance system prevention are more important than repair and follow before the equipment failures. By the execution of preventive and predictive maintenance repairing in the form of maintenance can be eliminated.

Planning and scheduling - Planned maintenance give the comfort zone to do the work with a predefined strategy that identify task, steps of process, labor selection as per skill, availability of parts and materials, suitable time to perform maintenance, and technical expertise. Scheduled maintenance is the issuance of a work order with a designed time frame to perform the task coordinated among the different departments.

Total productive maintenance - TPM is the main pillar of lean maintenance. For optimizing the reliability and effectiveness, it is an initiative of lean maintenance. TPM is proactive maintenance based on team work , based, utilize every level employees of the organization. TPM prepare for a shop floor maintenance system to save from kinds of

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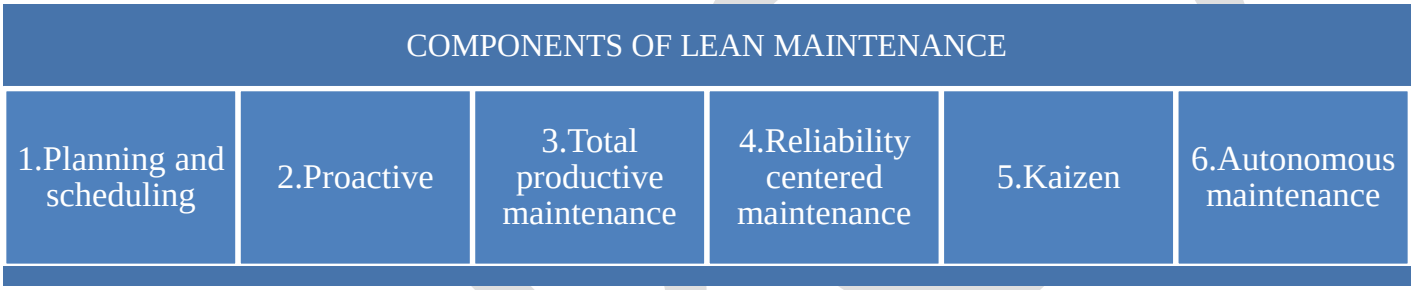

FIGURE-1: PARTS OF LEAN MAINTENANCE

Reliability centered maintenance - To determine the maintenance requirements of physical damage (break down) in present operating context. While TPM objectives is to maintain equipment effectiveness with reliability, RCM concept is based on optimizing maintenance effectiveness.

Kaizen - Kaizen is a methodology of continues improvement whether it is small in volume or importance. Kaizen in the kaizen methodology every process should be evaluated at the regular basis in terms of different parameters like required time, required resources, in form of quality etc.

Autonomous maintenance - This is system of periodic maintenance examples equipment lubrication, cleaning, Vibration check and noise difference etc.

Waste: Waste is defined as any resource or activity related to the process that is not contributing value to the end "product", in this case defined as equipment availability.

Laws of Simplicity:

Reduce – To simplify the process best way is to reduction in steps.

Organize – Organizing the working and process in a well know system is key step to simplify the work.

Time – Saving of time give the more comfortable situation, as it provide more time to perform efficient work.

Knowledge & Skill – An overall view (knowledge) and skill about the subject make the work simpler.

Differences - Ease and difficulty require each other.

Emotion – Getting the emotions are very good.

Trust – Trust on self and team make the work feel simple.

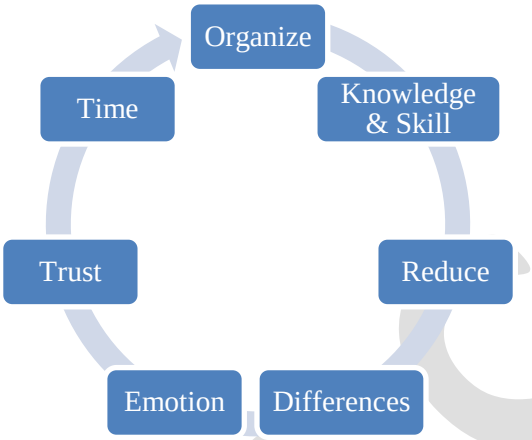

FIGURE 2: LAWS OF SIMPLICITY

5S Workplace Organization: There five '5' which guide to follow lean tools these 5s are Short, Set in order, Shine, Standardize, and Sustain.

Sort – Shorting is the step which ensure only required and useful tools and raw and components are available at work place and no unnecessary items in any form available in the work place and un-useful process is being follow in the work place so only the fruitful, really required tools, components, instruments and process are shorten and available at the work place

Set in order - Optimization of work place is possible just by a simple way of arranging the tools and instruments and all other working facilities like files, drawings, manuals in a manner that all these are set in order in which these will be used. For identification nominate the items to make easier to find them and use.

Shine – At work place each items must be in clean status which help to develop a positive attitude for working so keep a habit of swiping and cleaning on every day.

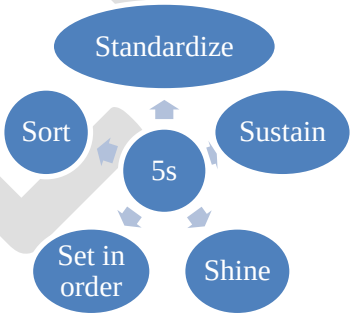

FIGURE - 5S WORKPLACE ORGANIZATION

Standardize - By making the stands for each step of process all over work become the standardize and each staff can perform the same efficiency in a standardize work system which will leads the quality production in lower cast with minimum possibilities of defects.

Sustain - All 'four - S' describe above must be maintain same position on regular bass and due to this the result will become a success-full implementation of 5S.

Literature review: Maintenance is considered as an activity that contributes to improving the availability, efficiency and productivity of each piece of equipment. The maintenance in the industrial sector has increasingly gained importance in enterprises. The current

demands of today's companies require the maintenance and management responsible to seek new forms of organization, using innovative techniques and methodologies to manage in the most efficient way. Maintenance shares significant operating costs in an organization. It is considered as a main pillar of the organizational performance. The combined issues of lean thinking and maintenance in particular performance is applicable as indicators to identify the impact of lean thinking within maintenance. Lean practices in manufacturing involve the elimination of wastes. Lean manufacturing are widely used by industries to eliminate waste and make the process more efficient. Concepts Lean manufacturing is a widely discussed and applied manufacturing philosophy, in a variety of industries across the globe. The fundamental concept of lean manufacturing is to provide a quality product while also ensuring that the product does not cost too much to the customer. Lean Manufacturing has become a worldwide phenomenon. It is quite successful in drawing the attention of companies of all sizes.

PROBLEM FORMULATION:

1. Breakdown Maintenances issues.
2. Lack of integrated maintenance planning and production scheduling.
3. Lack of fundamental production concept, Trick & techniques.
4. Lack of work efficiency.
5. Unawareness about the practice TPM.
6. Unnecessary loads.
7. Uncontrolled Waste formation.
8. Process Waste: Wastes due to long setup time, waiting time of inventory, waiting time of machinery, waiting time of man force, long Set-up Times, unskilled handling, Zero Lead time.
9. Absence of standardize target and Performance records.
10. Miss assumption.

PROPOSED METHODOLOGY:

1. Preventive maintenance - It is a form of maintenance practice where machine conditions controlled by performing maintenance preferably before failures to decrease the number of breakdowns.

   Implement: To implement preventive maintenance better than corrective or breakdown maintenance, we use a schedule maintenance plan for machines. Suggested preventive schedule maintenance plan format has shown below.

INTEGRATED MAINTENANCE PLANNING AND PRODUCTION SCHEDULING								
Allocate machine	Pre-Check	Observation (Failure / PI)		Operate the M/C	Plan Mant. in prod. breaks	Ensure parts Ava.	Follow Maint. sch.	Obs. and Per. Fb.
		Ok	Sch. Maint.					
Area 1								
Area 2								
Area 3								
Area 4								
Area 5								
Area 6								

TABLE1: SAMPLE FORMAT FOR INTEGRATED MAINTENANCE PLANNING AND PRODUCTION SCHEDULING

2. Integrated maintenance planning and production scheduling- In the case of a preventive maintenance strategy, both maintenance and production decisions are relevant. Determining maintenance decisions individually based only on the state of machines.

INTEGRATED MAINTENANCE PLANNING AND PRODUCTION SCHEDULING								
Allocate machine	Pre-Check	Observation (Failure / PI)		Operate the M/C	Plan Mant. in prod. breaks	Ensure parts Ava.	Follow Maint. sch.	Obs. and Per. Fb.
		Ok	Sch. Maint.					
Area 1								
Area 2								
Area 3								
Area 4								
Area 5								
Area 6								

TABLE 2: SAMPLE FORMAT FOR INTEGRATED MAINTENANCE PLANNING AND PRODUCTION SCHEDULING

Where: Sch. - Schedule, Maint. – Maintenance, Fail. - Failure, PI - Pre indication, M/C – Machine , Obs. – observation, Fb. – feedback, Per. – performance, Prod. – Production, Ava. – Availability

3. Apply fundamental concept of Lean maintenance like -

• Reduce all resource needs (inputs) to the lowest possible level consistent with achieving the desired level of equipment reliability (output).

• Developed Reliability (loss in quality, stop times, loss in speed).

• Storage (reduce the store value at the same time as you protect service level to preservation)

• Use of new technology like Ensure less need for maintenance, better maintainability achieves the best operation means quality and value at the least possible cost.

4. Implementation of 5S methodology: To develop enthusiasm, avoid slow working, and to organizing process, it is suggested to implement 5S in following steps.

Departments ……XY Z…	**Implementation format of 5S methodology**					Date dd/mm/yy
Form No. -	**00X**	**Sort**	**Set in order**	**Shine**	**Standardize**	**Sustain**
Work space						
Machines/ Equipments						
Work bench/ Table/ panel						
Process						
Quality Checks						
Feed back						
Others/ Miscellaneous						
Remarks						

Sign.	……..	…..……	……	……
Name	……..	………..	……	..……
	Prepared by	**Filled by**	**Checked by**	**Approval / Authority**

TABLE 3: TABULAR FORMAT OF 5S FOR IMPLEMENTING, CONTROLLING AND COLLECTING FEEDBACK.

5. TPM Implementation
6. Ergonomics –

ERGONOMICS PARAMETERS OBSERVATION FORMAT					
Parameters	OBS.	Parameters	OBS.	Parameters	OBS.
Observation date		Exertion Posture		Asked correction	
Location Department		Exerted body part		Suggested correction	
Machine		Exertion in minutes		Approved corrections	
Operator		Operators complains		Remarks (if any)	

TABLE 4: FORMAT FOR ERGONOMICS PARAMETERS OBSERVATION

7. Just In Time Manufacture (JIT): JIT will lead the organization to producing the necessary units, in the necessary quantities at the necessary time with the required quality.
8. Performance indicators - The system of performance indicators it is required to use the tools like score board. Performance indicators tools must have with the criteria which restricted to shaping the appropriate standards or result of work in practice.

Score Board - Performance indicators Format For a Day				
Name	X	Y	Z	B
Performance indicators range				
Sectors				
Participants Departments				
Actions				
Review				
Standard				
Aims/ Target				
Time				
Previous measure				
Organizational goals				

TABLE 5: SCORE BOARD - PERFORMANCE INDICATORS FORMAT FOR A DAY

9). Re-configurability: TO eliminate the situation of miss assumption in the work cell or stores required the ability to change the process and check each and every single machines for the process go from good part to good part as quickly as possible. The absences of such practice result in manufacture time lost. Such practice will avoid the disturbance of the mechanic to check a number of unlike maintenance parts or components in the work shop at the time of maintenance it will also result in form of saving of time for selection of actual requirement.

RESULT & DISCUSSION

I). Result of implementation of Preventive maintenance.

1. Reduction in disturbance in work plan improved by 30 %.
2. Improvement in availability of repairing parts and components 30%.
3. Maintenance efficiency improved by 30%.
4. Growth observed in production flow 10%.

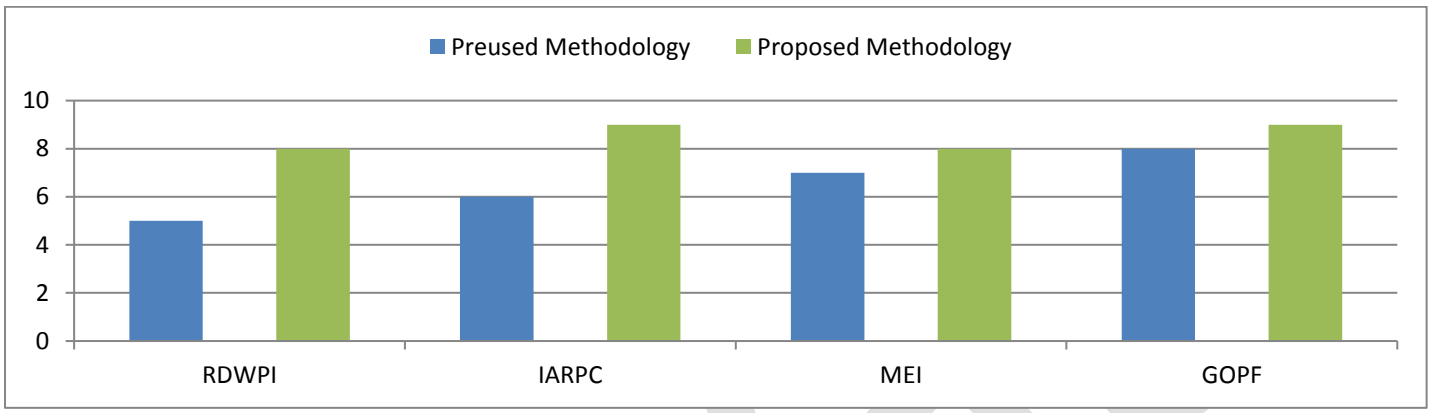

Figure: Result of implementation of Preventive maintenance

II). Effect due to integrated maintenance planning and production scheduling:

1. Efficiency of control and planning 20 % improved.
2. Control on uncertainty 30 % improved.
3. Systematic Plan for maintenance 50% improved.
4. Reduction in clashing of production and maintenance plan 10% better.
5. Problem solving approach 0% changes.
6. Effective Problem shooting 10% improved.
7. Achieving the target of scheduled repair 10% improved.
8. Improvement in repair parts inventory management 10 % improved.

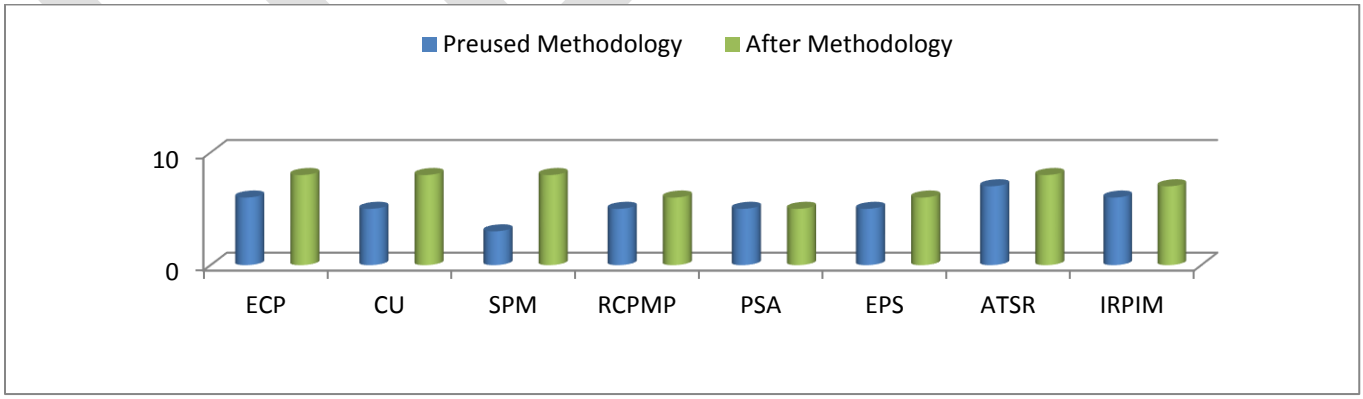

Figure: Effect due to integrated maintenance planning and production scheduling

III). Lack of fundamental production concept, Trick & techniques:

1. Control on equipment and parts inventory 20% improved.

2. Stop times 10%decline.
3. Storage issue 0% No change.
4. Technological awareness for minimum maintenance 10% improved.

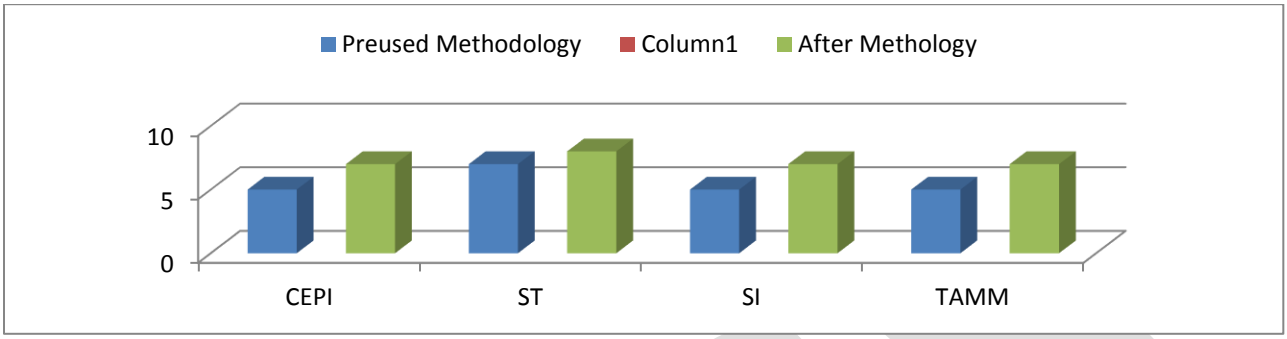

FIGURE: LACK OF FUNDAMENTAL PRODUCTION CONCEPT, TRICK & TECHNIQUES

IV). Improving work efficiency by implementing 5S methodology:

1. Enthusiasm at working area among the staff 20% better.
2. Working speed 10% improved.
3. Control on waste of time and work force 20% better.
4. Control over variation of work due to variant level of skills of different operators 30% improved.

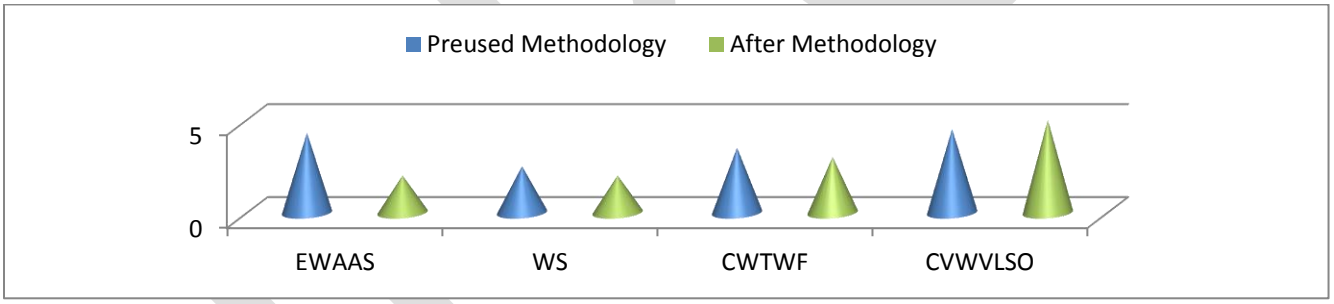

FIGURE: IMPROVING WORK EFFICIENCY BY IMPLEMENTING 5S METHODOLOGY

V). Comparative chart for Awareness & implementation of TPM

1. Top management support 50 % better.
2. TPM awareness 30 % better.
3. Autonomy to operators 10 % better.
4. Impact of TPM on employees 40 % better.

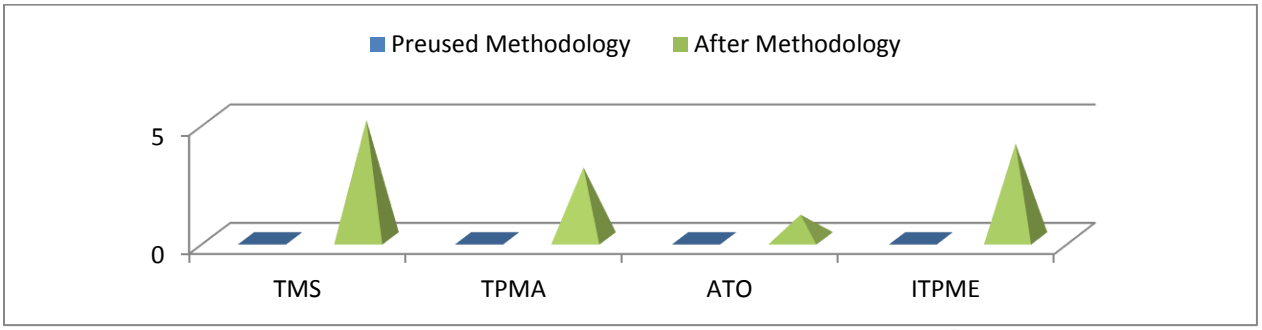

FIGURE: COMPARATIVE CHART FOR AWARENESS & IMPLEMENTATION OF TPM

VI). Comparative chart for Counter of Unnecessary loads before and after Ergonomics concepts:

1. Feel of Unnecessary loads 30 % decreased.
2. Physical fatigue 20% decreased.
3. Possibility of errors and mistakes 10 % decreased.
4. Injuries probability 40 % decreased.

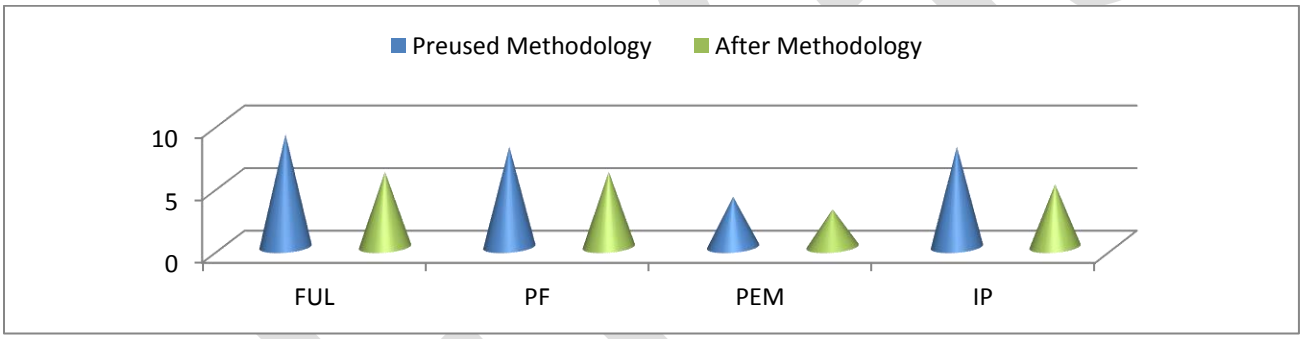

FIGURE: COMPARATIVE CHART FOR COUNTER OF UNNECESSARY LOADS BEFORE AND AFTER ERGONOMICS CONCEPTS

VII). Comparative chart for Uncontrolled Waste formation before and after JIT:

1. Over manufacture of parts and products 10 % decreased.
2. Unnecessary Inventory 20 % decreased.
3. Control over Faulty Products 0 % no change.
4. Unnecessary Transport 30 % decreased.
5. Waiting Time 30 % decreased.

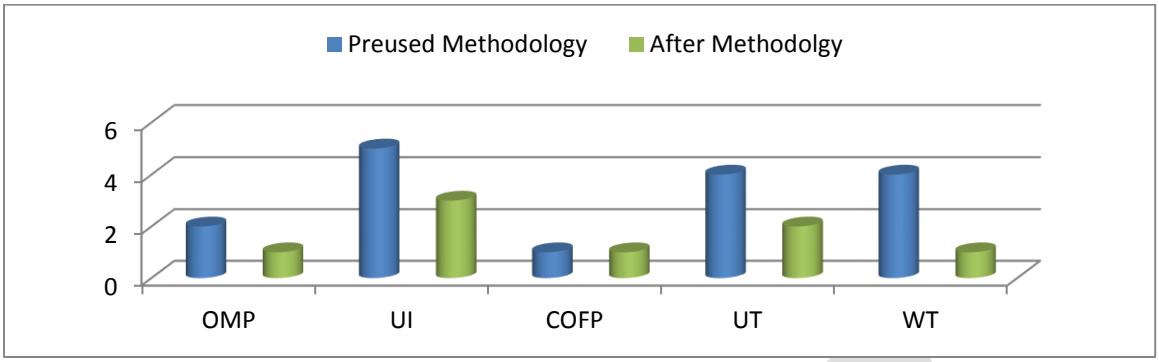

FIGURE: COMPARATIVE CHART FOR UNCONTROLLED WASTE FORMATION BEFORE AND AFTER JIT

VIII). Comparative chart for Process Waste:

1. Setup time 0 % No change.
2. Waiting time for inventory 10 % decreased.
3. Waiting time of machinery 10 % decreased.
4. Waiting time of man force 10 % decreased.

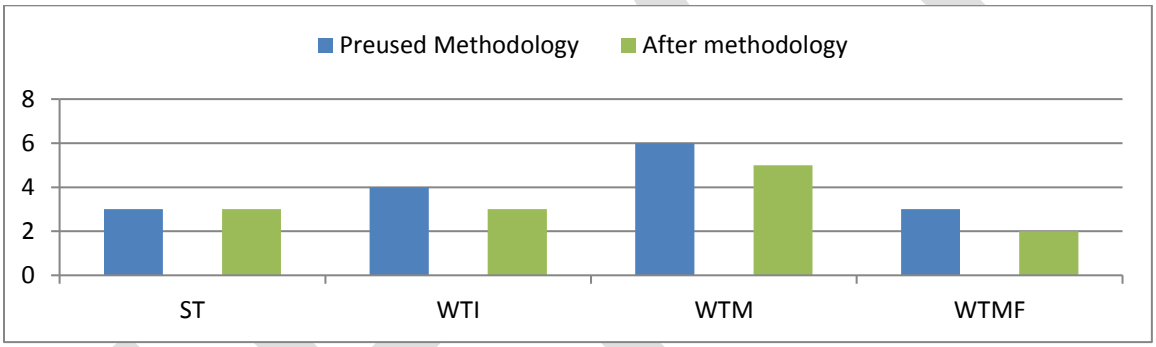

FIGURE: COMPARATIVE CHART FOR PROCESS WASTE

IX). Standardize target, Performance records and Re-configurability:

1. Clearly of targets 20% improved.
2. Ease of performance monitoring 20% improved.
3. Real time performance recodes 20% improved.
4. Continues effort 30% improved.

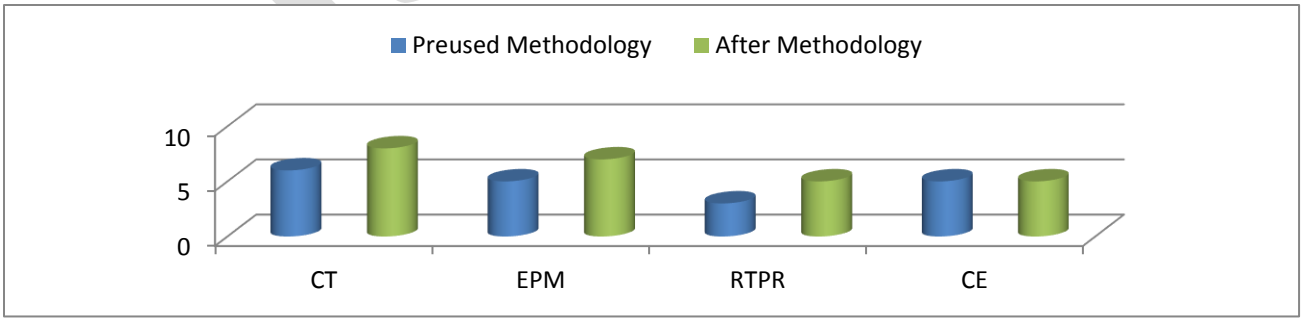

FIGURE: STANDARDIZE TARGET, PERFORMANCE RECORDS AND RE-CONFIGURABILITY

X). Comparative chart for Miss Assumption:

1. Unplanned maintenance 30% improved.
2. Disturbance due to maintenance of the mechanic 20% improved.
3. Disturbance to the mechanic 20% improved.
4. Sequencing of machine for maintenance 20% improved.

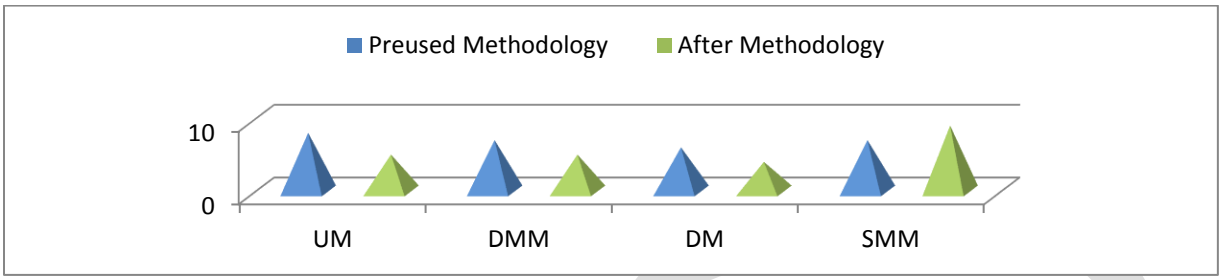

FIGURE: COMPARATIVE CHART FOR MISS ASSUMPTION

CONCLUSION:

This research study mainly focuses on Lean Productive Maintenance and its impact on organization performance. It is an empirical investigation. The study is confined to the automobile Industry.

This research guides to: reduce frequency of machine breakdown, reduces maintenance cost. reduced production cost, enhance quality with control on rejection, leads to high productivity, produce quality product, in less efforts, less time, in least cost and develop the environment in which everyone want to excel for quality products, improve productivity.

This research methodology summaries following points.

• If proper training will be provided it will reduce implementation tenure. • Major barriers in found implementing Lean are lack of experience and awareness, resistance to change. • Observed improvement in employees' behavior such as morale and attitude, creativity, initiative, belongingness and commitment, problem solving nature, co-ordination and cooperation. • Noticed that there is improvement in productivity and quality and reduced machine breakdown production cost and rejection. • Lean system is helpful for reducing man-hours of production and maintenance department.

FUTURE CONCEPT:

Majority of small scale Indian automobile industries are hesitant to adopt Lean maintenance practices, there is further scope to explore to do comparative analysis among Lean maintenance system implemented and non-implemented small scale industries. There is also scope for research in service sector industries where heavy use of machineries in operation. For examples Transportation and Hospital etc.

During the Lean maintenance practices, It has been found that on life of machine no much concern. Hence there is need to evaluate machine's life on various parameters and if required that machine should be discarded. Operator's performance also needs to be evaluated properly not only on the basis of production but also on the basis of reduction in breakdowns and maintenance cost. It will be helpful to give due regards, awards, recognition and monetary benefits to operator as per the performance of machine.

We surveyed the models integrating maintenance reasoning into production problems, optimizing the performance of the production system in the long term. First, we provided a brief background on the common maintenance concepts and solution approaches. We

then divided the production problems in to production planning and maintenance situations into no control and partial control over machine conditions.

Implement the Integrated maintenance and production planning with partial control over machine conditions in the context of a periodic review production system. The goal should be to determine the optimal amount of investment in maintenance for a given production quantity considering the inventory on hand.

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