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Kinesics of engine assembly line using lean management

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ABSTRACT

This paper explains the use of kinesics and visual management to improve line productivity in engine assembly. We use principles of visual management and lean production together to reduce losses and reduce the time taken to produce one complete engine. Since the assembly is done by hand, humane factors such as vagueness, error, speed and many more affect the productivity. These can be reduced by using signs and symbols which help workers to make the right decision in the shortest time. We will explain in detail how this can be done, and how effective results can be, along with the better organization of the factory floor and better communication without any verbal intervention. This will help increase productivity and reduce losses hereby helping the line to maintain its lean standards.

Keywords— *Kinesics, Assembly line, Lean management*

1. INTRODUCTION

Visual communications have been in existence ever since the beginning of civilization. It has been the best mode of communication than verbal or even written, saving time and making communication short and precise. The primitive forms of visual communication were fires, rock markings, tree marking, and even small scale landscaping could make a place communicate for itself. As time passed by, we began choosing colors and symbols, and visual communication grew with civilization. In this growth, man gained from visual communication and adopted it in every field of his work and lifestyle. And now, we have visual communication spread across every piece of this planet, from space to the kitchen shelf. We use them in our daily lives, in our homes, and even on the roads of our city. We need not to think much about how traffic lights started, but we simply know that we need to stop for RED and move for GREEN. In the field of production, we still have human effort in play, especially in assembly, visual inspection, material movement and so on. Overworking causes fatigue, which results in a human error. Even inadvertent work may cause problems in the line. Working patterns if not taken proper care during planning can cause disasters on the personal lives of the employees as well as take a toll on the company's productivity. We cannot completely avoid error. It is not very easy to do so. So we prepare remedies for every situation imaginable and keep them on standby, just in case one of those problems may show up, and we always expect our remedies to give the maximum outcome. For example, we have a fire extinguisher even though we don't wish to see a fire. We even have a first aid box even though we don't want to get hurt. We don't need to tell people to use the extinguisher in-case of a fire or use the first aid box if they get hurt. Such talk may raise negativity and may not make people feel very comfortable, especially in our homes. The point of visual management is to make the fire extinguisher and first aid box be seen when needed and ready for use. Every extinguisher communicates for itself for the type of fires it can be used for, and how to be used by images and symbols printed over it. And in the same way, every element of the first aid box shows a visual description of how it has to be used. Such inanimate things can communicate with precision with the help of visual management. So, this example gives us a picture of the use of visual management. This type of communication is even used in industries to communicate task, condition, direction and cause.

Visual management helps enhance the following other forms of management:

- Personal
- Process
- Performance
- Knowledge
- Inventory
- Workplace maintenance
- Quality
- Safety
- Production

2. PRINCIPLES OF LEAN MANUFACTURING

The concept of lean manufacturing was a revolution of the fabrication and assembling process in the industries from the late 1960s. This concept is an ideology of reducing wastage of the materials and time in the production level and the entire organization. The operational wastage of any manufacturing plant can be described in these ten points:

- Production of excess materials.
- Waiting time of the component for the next step to be done.
- Unwanted and excess movement of the materials and the employees.
- Processing time.
- Defective materials.
- Time is taken for inspection.
- Too high or too low of materials for inventory.
- Time is taken for transportation of the materials and products of the company.
- Rework Time of any defective component or product.
- Waste material disposal.

Principles of kinesis and visual management are used to reduce the wastage that affects the overall efficiency of the production company that can be eliminated easily. The measurement and simulation of Waiting time, Excess movement, Defective materials, Inspection time, Inventory level, Transportation time, Rework time, Waste material disposal is quite easy to be done. The table below shows the type of waste, Measurement type and the unit of the measurement.

Table 1: Type of waste, measurement type

Waste	Measurement Type	Unit of the measurement type
Waiting	Time	Seconds
Motion	Time or Distance	Seconds or Meters
Defects	Defect Numbers	Numbers
Inspection Time	Existing or Non-Existing	Numbers
Inventory	Number of Items	Number of parts
Time for transportation	Time or Distance or Cost	Seconds or Meters or Rupees
Rework Time	Time	Seconds

3. FACTORS USED FOR LEAN PRODUCTION EFFICIENCY

Time Factors are used to reduce the Production timing and reduce the time wastage in the industries for quantifying and qualifying the improvement. The choice of factors used should be able to reduce the time consumed for each process that is to be completed in the industry to increase the overall efficiency. To do this six lean efficiency time factors are being used for measuring the inputs, outputs and the improvements that are mentioned below:

3.1 Internal Movement Time Factor

The motion of the materials, parts, components and employees inside the industry takes a particular time to reach their places. Right from the receiving of the material to the quality check of the product the time is to be measured and improvement has to be planned to reduce the timing of them.

$$A_t = T_i/T$$

Where,
A_t = Average Time taken for the internal movement
T_i = Actual time taken for the internal movement
T = Time Set by the industry to finish the product.

3.2 Outside movement time factor

The motion of the materials, parts and components outside the industry takes a particular time to reach their places. Right from the ordering of the material till receiving of the industry time is to be measured and improvement has to be planned to reduce the timing of them.

$$A_o = T_o/T$$

Where,
A_o is the Average Time taken for the external movement
T_o is the Actual time taken for the internal movement
T is the Time Set by the industry.

3.3 Rework Time Factor

The Time taken for there work of each product that has been identified with any defect has to be either replaced or rework on that product has to be done in the industry to avoid overall losses as when the number of defective products increases the overall loss is also increased for that particular industry. So the rework time for each defective product has to be reduced in order to reduce the losses.

$$T_R = A_R/T$$

Where,
A_R is Average Rework time of each product or component
T_R is the Actual Rework time taken
T is the Time set by the company.

3.4 Incoming Order Fulfillments Factor

The order for the materials and the components that are needed by the industry has to be made after checking in with the inventory level. The inventory level of the materials and components has to be checked regularly and when the level of inventory gets below a particular level then the industry has to order the raw materials from their dealers. For this the timing is an important factor as the time for ordering and receiving the components has to be done.

$$A_r = T_r / T$$

Where,
A_r is the average time for the industry to receive the raw materials
T_r is the Actual time taken for the industry to receive the materials
T is the Time set by the company.

3.5 Material Processing Waiting Time Factor

The Components that are being manufactured inside the industry has to be done in a certain time and has to be processed through differently advanced types of machinery. These machines take a certain amount of time to process the components when this timing of the process is reduced by maintain or upgrading the tools and machinery the overall production timing of that particular component can be reduced and also the number of components can also be increased.

$$A_{WP} = T_{WP} / T$$

Where,
A_{WP} is the Average time taken for the processing of each component
T_{WP} is the Actual time take for the processing of the component
T is the Time fixed by the industry for processing of each component.

3.6 Inventory Raw Material Pull Time

The Time taken for the raw materials from the inventory to reach the staff members in the production line or the assembly line is the Inventory Raw Material Pull Time. When the time taken for this process increases the production has to be on hold till the raw materials arrive at their respective station.

$$A_{RP} = T_{RP} / T$$

Where,
A_{RP} is the Average time taken for the material to reach the production line from the inventory
T_{RP} is the Actual time taken for the material to reach the production area
T is the Time set by the company for the time of transportation.

4. CONCLUSION

The above theory can be applied to an assembly line, factory or industry floor. This can help improve productivity and enhance Lean methods of manufacturing. The results can be quantified, and the difference can be observed clearly. Visual management can be one of the most sought after non-technical methods to support lean production which can be used to point out the problems and solving them on a quantifiable scale. The investigation of the timing and other factors that reduce the overall efficiency of the production of any industry can be resolved and rectified. Thus Lean methodology plays a major role in the industrial business.

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