

# Productivity improvement in Diesel Powered Screw Air Compressors by Work Study

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**Abstract:** As per today's need, any company has to fulfill its customer needs to survive in the market. Productivity improvement plays a vital role in improving the customer demands. When several processes involves in producing a product, the standard operating procedure must be set accordingly. This project aims to analyze the micro and macro level cycle time for the Material Feeding and Main Assembly work in Diesel Powered Screw Air Compressors (DPSAC) using lean manufacturing principles. Time study helps to define the standard stage cycle time for each assembly Stages and also helps to define a process sequence. Line balancing technique has been implemented to distribute the work in between stages to meet the TAKT time target. In addition to detailed time study for Material feeding and Main Assembly work, some scope of improvements have been identified and future work can be taken up based on this. This process helps in analyzing the list of processes and for the developing the line Balance to improve productivity.

**Keywords:** Lean manufacturing, TAKT time, Time study, Line balancing, Total Operating Cycle Time (TOCT)

## 1. Introduction

In this paper, the progress was conducted in an industry that manufactures air-compressors. The industry manufactures many varieties of compressors. The industry requires to increase the production based on the customers demand. To increase the production, the process is carried out through the reduction of the cycle time in the material feeding and main assembly. The cycle time reduction is carried out through the time study by video capturing. By the time study on the main assembly, line balancing is done. Line balancing is done on based on the average time of Total Operating Cycle Time (TOCT). In material feeding the work content is standardized and provide the Scope of improvement can also increase productivity. Line balancing is carried on the work spilt up between the operators and maintaining the TAKT time in the main assembly. By the line balancing and identification of scope will improve the production.

## 2. Literature review

The focus of the literature survey is to gather information about the usage and importance of simulation in an assembly line, the ways in which to determine the standard work time and

to understand the techniques to improve the productivity [1]. Has studied that Productivity measure output to input. To increase productivity in industrial and business area, Work measurement is a best tool. In order to improve the productivity of assembly workstation, Work measurement is conducted. Time study is working measurement technique consisting time measurement of worker that doing jobs in normal pace [2] has suggested at the Work and time study techniques is raising the efficiency of utilization of the factors of production have been used for all manufacturing and service sectors as a scientific approach. Actual time and standardized time is compared and as a result it is aimed that measuring inevitable times and take necessary precautions against them. [3] Studied that Motion and time study technique is one of the productivity improvement techniques used in many manufacturing companies. Assembly line balancing contributes positively towards achieving productivity. [4] Suggest that Time study is an important tool which needs to be worked out on. The method is applied to the manufacturing processes which have been divided into parts with an objective to establish time standards for carrying out specific operations and setting up a production schedule in the factory.

## 3. Methodology

As mentioned earlier, the productivity can be increase by taking the time study and line balancing. The process is carried out through the steps in the methodology as shown in fig 1.

## 4. Data analysis and discussion

### A. Time study on material feeding

Time study was done for the material feeding using the timer pro software with two operators is done is shown.

OPERATOR A

MODEL 1= 50 MINUTES

MODEL 2 = 50.7 MINUTES

MODEL 3 = 49.7 MINUTES

MODEL 4 = 32.4 MINUTES

MODEL 5 = 32.4 MINUTES

MODEL 6 = 39.7 MINUTES

**OPERATOR B**

- MODEL 1 = 29 MINUTES
- MODEL 2 = 27 MINUTES
- MODEL 3 = 35 MINUTES
- MODEL 4 = 30 MINUTES
- MODEL 5 = 26 MINUTES

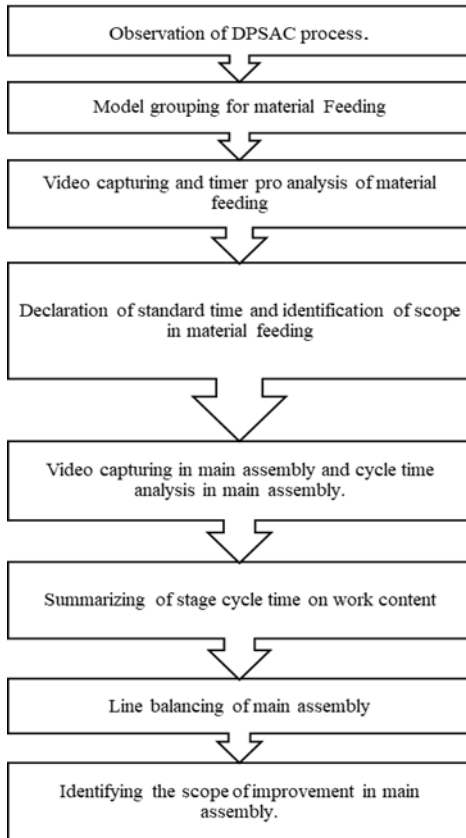


Fig. 1. Methodology

**5. Time study on main assembly**

Time study on the main assembly is taken place by the 3 different models, the cycle time is carried out by the video capturing and TOCT is noted. Time study on main assembly for 3 models are taken as TOCT

MODEL 1

Table 2  
Scope of improvement in material feeding operator B

Scope of Improvement	Benefits	Time Reduction (Minutes)
Material Feeding material feeding trolley standardization	Searching of Material Bin is Avoided	2-5 Minutes
Material flow rack can be installed in Diesel Tank Sub Assembly	Movement Can be Reduced	1-3 Minutes
Fasteners List Must Be Standardised For Main Assembly Kitting	Human error & wrong fasteners kitting can be avoided	5-8 Minutes
Fasteners Kitting can be Moved to Store & should be in preset form.	Work Can be Reduced and work from Operator A can be balanced with Operator B.	20-25 Minutes

TOCT = 500 MINUTES  
AVERAGE TIME = 36 MINUTES

MODEL 2  
TOCT = 526 MINUTES  
AVERAGE TIME = 38 MINUTES

MODEL 3  
TOCT = 576 MINUTES  
AVERAGE TIME = 41 MINUTES

**A. Line balancing on main assembly**

Line balancing is done for improve productivity. Line balancing is based on the principle of lean manufacturing technique. By the line balancing, the TOCT is reduced and work content is shared up for the operators. Line balancing is done based on the time study on main assembly for 3 different models. In line balancing, the work content is divided up on the average time of the TOCT. In Line balancing, work content is equalized for 9 stages to avoid the bottle neck time.

MODEL 1  
TOCT = 467.82 MINUTES  
AVERAGE TIME = 26 MINUTES

MODEL 2  
TOCT = 492 MINUTES  
AVERAGE TIME = 27 MINUTES

MODEL 3

Table 1  
Scope of improvement in material feeding operator A

Scope of Improvement	Benefits	Time Reduction (Minutes)
Engine Packing Cover Should be Changed to a different material	Difficulty in Bending and Folding the cover will be eliminated	4-6 Minutes
Keeping the Waste Bin near to the Engine Sub Assembly.	Movement Can be Reduced	2-3 Minutes
Material Feeding material feeding trolley standardization	"Giving the Engine parts to main assembly and Sub Assembly and placing engine manual and Certificate in the rack", this work allocated to operator B. Movement Can be Reduced for Operator A, since two activities will be covered by Operator B during his movement. Currently both operators move separately to all stages.	7-10 Minutes
Hose covers removal work to be eliminated by provision of standardized material transfer/feeding method	No Need of Removing the Cover	9-12 Minutes (based on Model)
Keeping of Hoses in the material Trolley With standard Material Trolley	Movement Can be Reduced and the hose trolley layout space can be freed	2-4 Minutes

TOCT = 560 MINUTES

AVERAGE TIME = 31 MINUTES

**B. Improvement by line balancing**

Line balancing helps to improve the productivity. By the line balancing, the Total Operating Cycle Time (TOCT) is reduced and work is completed within the TAKT time. By the line balancing, improvement is carried out by graph.

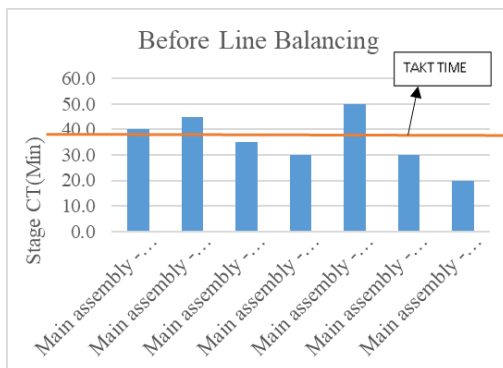


Fig. 2. Before line balancing

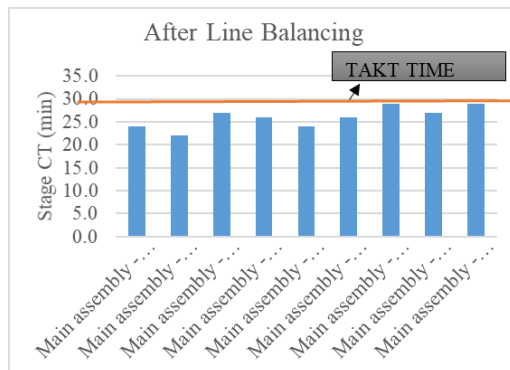


Fig. 3. After line balancing

**C. Scope of improvement in main assembly**

Table 3  
Scope of improvement in main assembly

Scope of Improvement	Benefits	Time Reduction (Minutes)
Fasteners Kitting bin in Main assembly Can be Given in Pre Set for Each Stages	Cycle time will be Reduced by taking Corresponding Bolt and Nut	3-5 Minutes For Each Stages
Fasteners Taking in Canopy Can be Moved to Material Feeding (By Future to Stores)	Cycle time will be Reduced by taking Corresponding Bolt and Nut	2-3 Minutes
Material Trolley must be Standardized For Main Assembly	No need of Searching Parts	3-5 Minutes For Each Stages
Fixture To be Designed For Air end And Engine Coupling	Easily Assembled in the Base	7-10 Minutes For Stage 1
Separate Tools is Provided For the Each Operator Team	Movement Can be Reduced	5-7 Minutes
Mudguard Cover Removing Can be Moved To store	Cycle time will be Reduced	1.6-2 Minutes

**D. Scope for future development in main assembly**

Table 4  
Scope for future development in main assembly

Scope of Improvement	Benefits
Automatic Guided Vehicle(AGV) Is Implemented On Behalf of Assembly Trolley	No Need of Pushing the Trolley and Remote Control is easy to Move the Line
Separate Assembly Line is need for Large Model	No Need of waiting the Line to Move And Work Can be Achieved By Takt Time
On base of IOT(Internet On Things),Tablet Can be Provided For Each Operator team	Build up Card And Check List Can Be Taken Placed in Tablet and Waste Capturing Can be Easily Monitored
Fasteners Kitting Can be Taken by Pick & Place Robot	Reduce Time For Kitting the Fasteners in Material Feeding
Bar Code Should be Taken for Each Components And Each unit	Easily Scan And Enter in the Build Up card By Using Tablet

**6. Conclusion**

Thus, the productivity improvement is carried out through the time study in main assembly and material feeding. From the Video Study, the Cycle time is calculated stage wise and the process sequence is determined for Material feeding and Main assembly activity. Scope of Improvement has been identified for cycle time reduction in Material feeding activity and this can be the basis for future work. The stage wise time study of Main assembly is analyzed to identify the bottle neck operation & thereafter line balancing technique is implemented to balance the work as per TAKT time.

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