THE INFLUENCE OF IMPROVING THE ASSEMBLY PROCESS ON THE ORGANIZATION AND OPERATION OF A PRODUCTION LINE

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ABSTRACT: In this study, I described a first step in the process of improving a manufacturing line. In order to be able to improve an assembly process, it is necessary to analyze it from the point of view of layout, location, but also from the point of view of line times. The main goal is to synchronize jobs to increase productivity

***KEY WORDS**: technological system, assembly line, line indicators,evaporator,layout.*

1. Introduction

Usualy, for an Automotive Company, policy is conducted mainly along the following lines: increase the quality of staff, steady decrease in non-quality costs, react better to meet customers requirements and to solve problems, regulatory compliance for the environment, optimizing natural resource consumption, better waste management, prevent any type of pollution, chronic or accidental.

The theme aims to improve the production process of evaporators, by applying specific improvement methods in order to synchronize jobs and increase productivity.

During the study, i have followed:

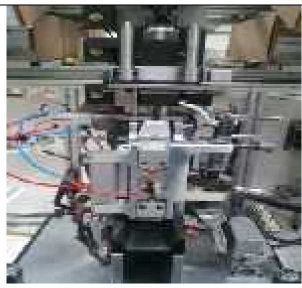
- description of the technological process of assembling the vaporizer;
- presentation of the initial situation of the assembly line;
- presenting the problems identified on the assembly line;

In order to be able to improve the process, it was necessary that the entire assembly line of the evaporator be analyzed. I performed the analysis of the activities and especially their durations in order to highlight the blocking positions.[1]

2. The actual stage

The production process in the case of the evaporator is a technological assembly process that consists of a series of operations that refer to the placement and fixing of component by component in order to obtain evaporators.). The detailed representation of the production process will refer to its structural elements, thus the operations, the time on each operation, the assembled components and the technological system will be specified. This detailing will be done in the form of a centralizing table 1 .[2]

Tabelul 1. Detailing the assembly process

Nr. Operation	*Name of operations / duration [sec]*	*Detailing operations / components to be assembled*	*Photo technological system*
Operation 1	Grease the body inlet-outlet holes 13''	- automatic grease of holes made with the help of the 'Glue Depozit' technological system,	
Operation 2	Crimping inlet-outlet pipes 13''	- manual assembly of rings, pipes on the lubricated body, - automatic crimping of pipes on the body by pushing using the 'Pusher' technological system, - subassembly 1 is obtained	
Operation 3	Assembling the grommet on pipes 14''	- manual assembly of the grommet on the pipes of subassembly 1 performed with the help of the technological system 'Grommet Station' - subassembly 2 is obtained	
Operation 4	Flange, gasket and TXV assembly 17''	- manual assembly of components: clamp, gaskets and TXV on subassembly 2 made with the help of the technological system 'TXV Station' - subassembly 3 is obtained	
Operation 5	Helium test 12''	- automatic testing of possible liquid leaks from the evaporator performed using the 'Helium machine' technological system	

The form of production organization in this case is the organization in flow, on the assembly line, having specialized jobs in order to perform certain assembly operations, the final goal being to obtain evaporators.[3]

1.Evaporator assembly line

The characteristics of this assembly line are:

- the division of the assembly process into 6 approximately equal operations in terms of time, respectively the volume of work;
- the operations are carried out on 6 workstations;
- the grouping of operations on workstations was carried out according to the rhythm of the line;
- job specialization;
- performing two operations on each workplace;
- placement of workplaces in the order imposed by the execution of assembly operations, ensuring one-way movement for the evaporator: greasing, crimping, grommet mounting, clamp, gaskets, TXV, helium testing, final control;
- performing operations continuously, with a free rhythm;
- moving the object of work from one workplace to another is done manually, by the operator.

These types of lines are made up of workplaces where several operators work, performing several operations at several workstations (machines) on a single type of product.

The 'U' shape of the line gives operators the possibility to simultaneously service several machines that represent distinct operations, but this system requires the operator to support the part, space being limited.

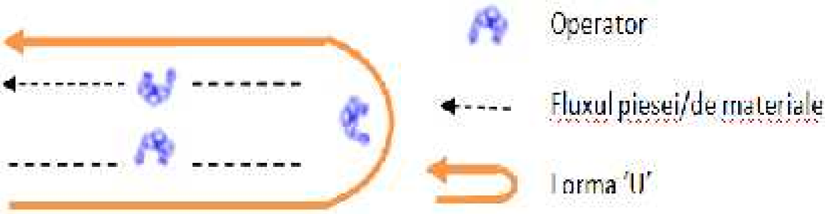


Fig. 2 The shape of the evaporator assembly line

One of the big disadvantages of this type of line is the impossibility of maintaining the continuity of the production process, when certain machines break down or certain materials are missing.

The number of machines on the evaporator assembly line is 6, these being served by only 3 operators in a cycle time of 1.55 min. The basic element of the line is the workstation. The line is delimited by 6 workstations. The correlation between all these elements of the evaporative assembly line is according to the table 2.

Tabelul 2. Work stations

Nr. Operation	***Workstation***	***Job***	***Nr. operators***	***Description of the activities of the work stations***

Operation 1	PL1	LM1		- Grease the body inlet-outlet holes - Crimping inlet-outlet pipes
Operation 2	PL2			
Operation 3	PL3	LM2		- Assembling the grommet on pipes - Flange, gasket and TXV assembly
Operation 4	PL4			
Operation 5	PL5	LM3		- Helium test - Final control
Operation 6	PL6			

The spatial arrangement of the evaporative assembly line is carried out according to figure 5.6, having a total area of 7m*7m, being surrounded by access ways and storage places of the line.

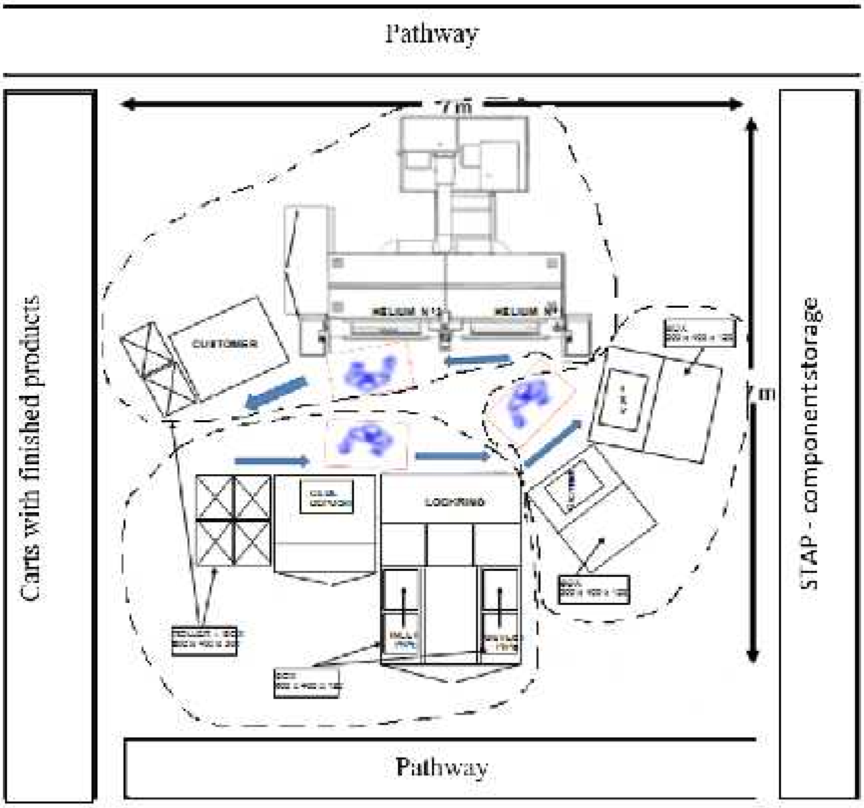


Fig.3 Evaporative assembly line layout

On this assembly line, 4 different types of evaporators can be produced (the difference being given by the way the pipes and TXV are assembled) but the process remains the same.[4]
As can be seen from the layout, the line has 2 storage areas:
- the supply area - represents the area where the necessary components for the supply of the line are stored, figure 5.7 a);

- the finished products storage area - represents the area where the finished products are stored in plastic boxes, figure 5.7 b);


Fig.4 Supply area


Fig 5. Finished products storage area

The supply on the line is done by one of the operators on the line, having its own supply unlike the other lines in the factory where the supply is done by an employee specialized for this activity.

The initial indicators of the evaporative assembly line

The general characterization of the line can be expressed most easily by determining its indicators. These indicators create an overview of the line from a functional point of view, as well as from the point of view of its performance, according to table 3.[5]

Tabelul 3. Line indicators

Functional line indicators										
Nr. of operators	***Td***	***Reg. stops***	***Q***	***T***	***R***	***KOSU***	***CP***	***L***	G_{il}	N_{lml}
[pers.]	***[min/sch]***	***[min]***	***[piece/sch]***	***[min/piece]***	***[piece/min]***	***[min/piece]***	***[piece/an]***	***[m]***	***%***	***[piece/line]***
3	**450**	**30**	**868**	**0.52**	**1.93**	**1.55**	**347400**	**10,5**	**85**	**3**

The determination of these indicators was carried out by applying calculation formulas, taking into account the following aspects:

- number of operators: 3

- available time/sch: 450 min (7.5 h)

- quantity produced/sch: 868

- line rate (Ci) or production rate

$$T = \frac{Tf}{Q} \quad (1)$$

$$T = \frac{450}{868} = 0{,}52 \; [min/piece]$$

- the rhythm of the line

$$R = \frac{1}{T} \quad (2)$$

$$R = \frac{1}{0.52} = 1.93 \; [buc/piece]$$

-the number of total jobs on the line

$$N_{lml} = \sum N_{lmi} = 3 \quad (3)$$

- line capacity

$$CP = Td*Q = 347400 \; |piece/year| \quad (4)$$

$$Td = 200 \; working\ days \; (\frac{5days}{week} * 2 \; work\ shitfs * 4 \; weeks * 10 \; months)$$

- the length of the line

$$L = (N_{lml} \times d)/2 \quad (5)$$

$$L = (N_{lml} \times d)/2 = 3*7/2 = 10{,}5 \; [m]$$

-KOSU

$$KOSU = (Nr_{op}*td)/Q \quad (6)$$

$$KOSU = (3*450)/868 = 1{,}55 \; [min/piece]$$

As a general conclusion, a maximum of 868 evaporators are assembled per shift, in an effective working time of 450 minutes (7.5 hours). The 6 operations are performed at 3 workstations, each operated by one operator (3 operators in total). The time interval at which a piece/initial cycle of the line is completed is 31 seconds (0.52 minutes).
The annual capacity has been calculated taking into account the time reserved for maintenance and the factory's annual shutdowns (holidays, etc.).

Problems identified on the assembly line

The time on each job can be represented with the help of the diagram:

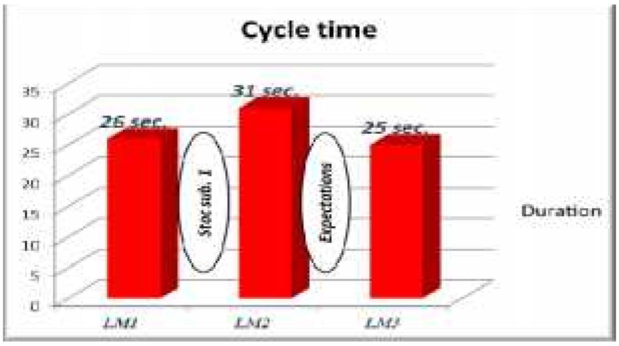


Fig.6 Job-time representation

The following problems were identified with the help of the diagram:
-a storage space needs to be created between workstation 1 and workstation 2, as the cycle time of LM1 (the greasing and crimping operation - 26 seconds) is smaller than that of LM2 (the grommet and TXV installation operation - 31 seconds).
-there is an intermediate storage space created between the two workstations with a maximum capacity of 200 products, as shown in figure 5.9. The maximum stock of pieces that can appear between the two workstations is 170 pieces, which is calculated as the difference between the total number of sub-assemblies that can be produced at LM2 (1038 sub-assemblies) and the total number of pieces that can be assembled at LM1 (868 sub-assemblies).

Fig.7 Intermediate subassembly storage space

-this intermediate storage space is considered an obstacle for operators when they need to move within the assembly line;
-as indicated in the diagram, there is a waiting period between workstations 2 and 3 during which the operator supplies components to the other stations, completes logistics forms, etc.;
-there are periods when the daily capacity of the evaporator assembly line is not sufficient compared to the firm order given by the customer, considering the maximum number of pieces per day (868 pieces).

3. Conclusion

As a general conclusion, following the analysis of the diagram, it was observed that an improvement of the assembly line is necessary from the point of view of the time lost between the workstations and the operations performed. In order to be able to improve an assembly process, it is necessary to analyze it from the point of view of layout, location, but also from the point of view of line times. The main goal is to synchronize jobs to increase productivity. Automated processes are expected to increase productivity and reduce error rates within the production line. Workers in such production lines have to adapt quickly to rapidly changing working conditions and at the same time, training and learning time should be minimized[2].

4.Bibliography

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