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Optimization of times in the machining area of the production lines U1, U2, U3, U4, and U5

Optimización de tiempos en el área de maquinado de las líneas de producción U1, U2, U3, U4, y U5

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Abstract

This document shows the optimization of time in the area of machined production lines U1, U2, U3, U4 and U5. The study was done because the company is newly created and has no standardization of times, that will be the basis for a balance of lines and oblivious to meet compact load the customer's requirement. The results exhibit the adequacy of the study and seeks to publicize the benefits of line balancing methodology in combination with other tools, aimed at ensuring a continuous and uniform flow of the products, assigning operations so as to balance the times.

Takt time, Cycle time, Machine cycle time, Time manual operation

Resumen

El presente documento muestra la Optimización de tiempos en el área de maquinado de las líneas de producción U1, U2, U3, U4, y U5. El estudio se realiza debido a que la empresa es de nueva creación y no cuenta con la estandarización de tiempos, que será la base para un balanceo de líneas y el establecimiento de cargas para el cumplimiento del requerimiento del cliente. Los resultados exhiben la conveniencia del estudio y busca dar a conocer las bondades de la metodología de balanceo de líneas en combinación con otras herramientas, cuya finalidad es asegurar un flujo continuo y uniforme de los productos, asignando las operaciones de tal forma que se equilibren los tiempos.

Tiempo takt, Tiempo ciclo, Tiempo ciclo de la máquina, Tiempo de operación manual

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Introduction

This project was developed in an automotive manufacturing company, in the Machining area; It consisted of taking the times of each of the production lines (U1, U2, U3, U4, and U5), specifically the machine cycle times, the manual operation times and the tool change times. The times were graphically analyzed to propose improvements, which contribute to making the lines more productive, also based on the times taken, its standard time was determined for each operation, in order to help plan production and establish workloads.

The project for taking times in the production lines was developed to study and analyze in depth the behavior of the operations and the variability that exists in the times of both the operator and the machine and compare it with the takt time of model A that it is 94.2 seconds, model B 50 seconds, and model C 131 seconds. It seeks to standardize the times of the machines and operations with the help of the study, to achieve the standardization of manual operations and the machining times of the lines. With the study, proposals for improvement will arise, both for the machines and for the operations that will contribute to having better productivity.

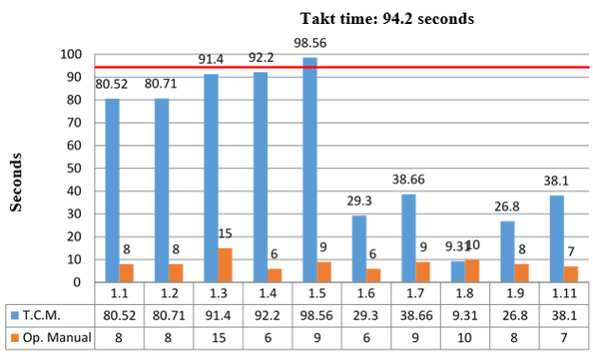
Methodology to be developed

This project will use the line balancing methodology, supported by the operations diagram and takt time (E. Meyers, 2000).

The procedure is as follows: a) Selection of the machining line; b) Time the machine cycle time. (10 events); c) Record the time in the format; d) Determination of the average cycle time; e) Time the manual operation time (10 events); f) Record the time in the format; h) Determine the cycle time; i) Determination of the standard time; j) Determine the number of units required per shift; k) Compare the estimated standard time with the takt time used by the company.

Results

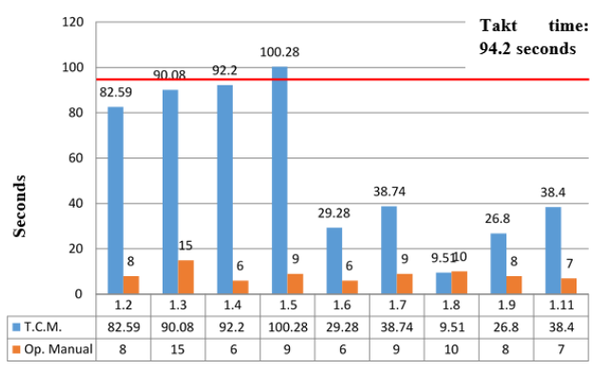
The models were analyzed by means of graphs (The cycle time of the machine and the operator). In model A U1, it has an operator to supply operation 1.1 and 1.2 (three machines), in 1.3 and 1.4 there is an operator (of 1.3 are two machines and 1.4 three machines), in 1.5 there is an operator (with three machines), operation 1.6, 1.7 and 1.8 is operated by one person (one machine). The average cycle time of each machine and the manual operation was determined and represented graphically, obtaining the following results: The takt time or target time for U1 is 1.57 minutes, operation 1.5 exceeds the time of 98.56 sec. (See Graphic 1), this operation is the bottleneck of the line; In addition, based on the capacity of 1.5, production must be planned, since it is the operation that sets the pace of work, having the pieces per hour (JPH) equal to 36 pieces, so it will be an area of opportunity to improve the line.



	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	1.11
T.C.M.	80.52	80.71	91.4	92.2	98.56	29.3	38.66	9.31	26.8	38.1
Op. Manual	8	8	15	6	9	6	9	10	8	7

Graphic 1 Time of Model A U1 Takt Time: 94.2 seconds

On lines U2, operations 1.2, 1.3 and 1.4 exceed the Takt time and operation 1.5 is at the limit, which are respectively: operations 1.2 of 82.59 seconds, 1.3 of 90.08 seconds, 1.4 of 92.2 seconds and 1.5 with 100.28 seconds with respect to takt time (See Graphic 2) and its JPH is equal to 36 pieces.



	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	1.11
T.C.M.	82.59	90.08	92.2	100.28	29.28	38.74	9.51	26.8	38.4
Op. Manual	8	15	6	9	6	9	10	8	7

Graphic 2 Time of Model A U2

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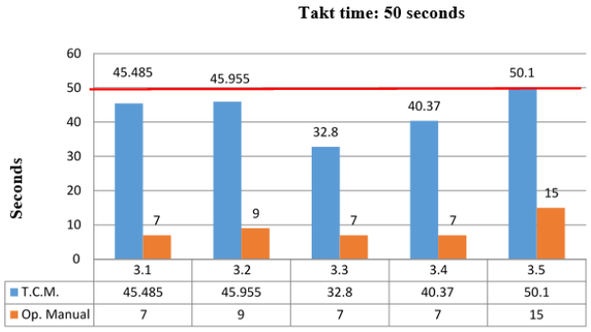
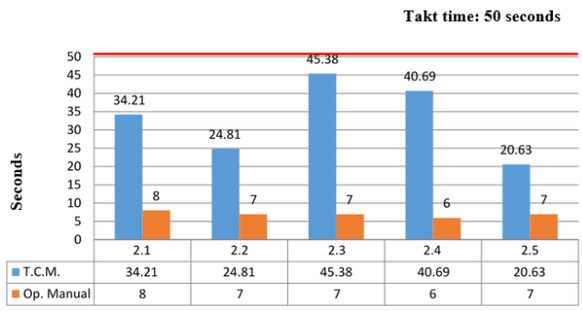
Model B U3

Model B, of line 3, its operation 3.5, the cycle time of the machine is 50.1 seconds; which is within the takt time limits (See Graphic 3), operation 3.1 and 3.2.



Graphic 3 Model B, Times Line U3 of process 3

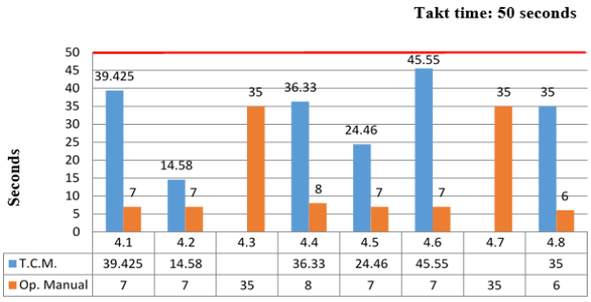
Model B is made by lines U3 and U4. This model emphasizes bottleneck operations, which are approaching the takt time limit. In line U3 of process 2, its operation 2.1, the cycle time of the machine is 34.21 seconds; Two pieces are washed per machine cycle, in order to supply operation 2.2, (See Graphic 4), the real time is 68.42 seconds. The JPH, of these two lines maximum is 72 pieces and the minimum is 62 pieces.



Graphic 4 Model B, Line Time U3 Process 2

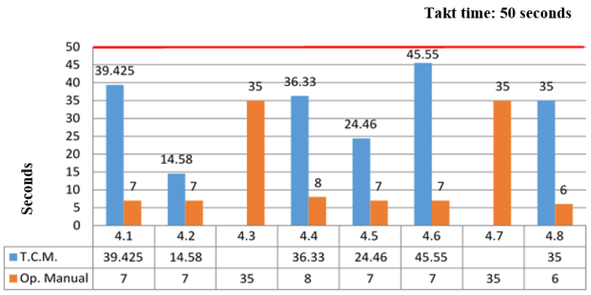
In line U3 of process 4, all the cycle times of the machines are below the takt time, only operation 4.6 is close to the takt time.

In operations that do not show the time of the machines: 4.3 and 4.7, only visual inspection and validation of the grooves is done with the gauges (See Graphic 5).



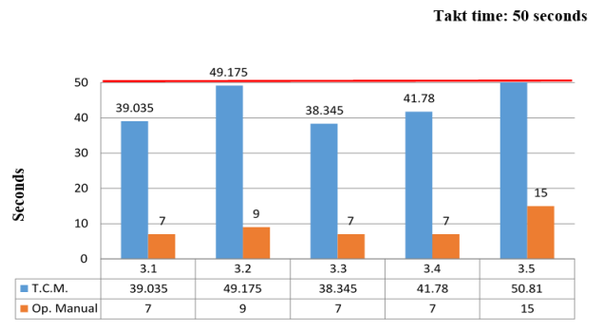
Graphic 5 Model B, Times Line U3, from process 4

In line U3 of process 5; the operation that approaches the takt time is 5.3 with 49.8 seconds, therefore this operation is the bottleneck (See Graphic 6).

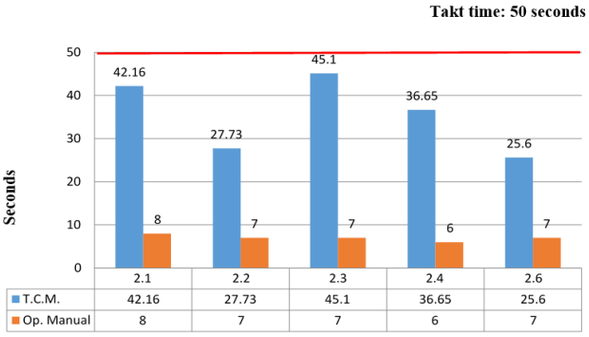


Graphic 6 Times for line U3, process 5

In line U4 of process 3, the operation that is closest to the takt time is 3.5 with a time of 50.81, which exceeds its takt time (See Graphic 7). In Process 2, the operations that are closest to the takt time are 2.1 with 42.16 seconds and 2.3 of 45.1 seconds (See Graphic 8).



Graphic 7 Model B, from line U4 of Process 3



Graphic 8 Model B, Line Time U4 Process 2

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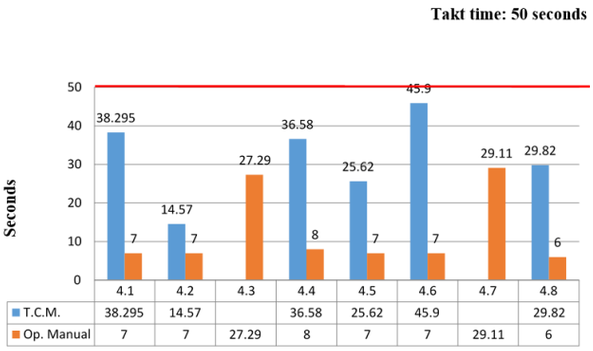
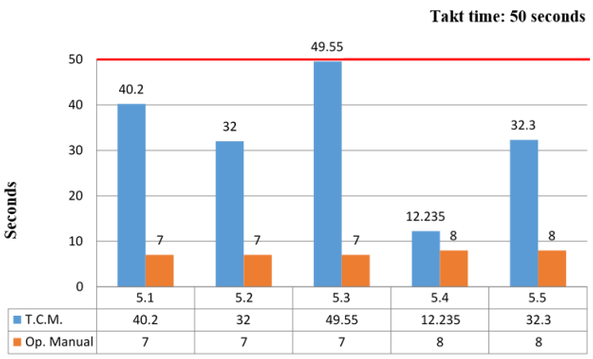
In line U4 of process 4.9, the time of the operation (Packing) was not considered, since it is done within the cycle time of the impregnator of operation 4.8 of 29.82 seconds respectively, so it is below the takt time.

In operation 4.6, the takt time is approached with 45.9 seconds (See Graphic 9) and if the machinery undergoes changes / adjustments in the program, it will be impossible to meet the customer's requirements.



Graphic 9 Times Line U4 Process 4

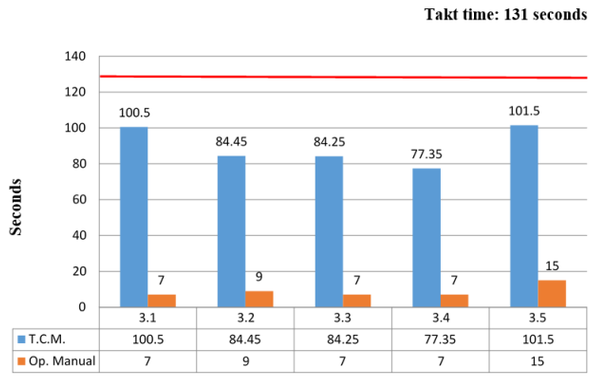
In process 5, operation 5.3, the machine cycle time is 49.55 seconds, close to the takt time, therefore this is the operation in which attention must be paid to changes and improvements in order to reduce the cycle time of the machine. machine (See Graphic 10).



Graphic 10 Times Line U4 Process 5

Model C U5

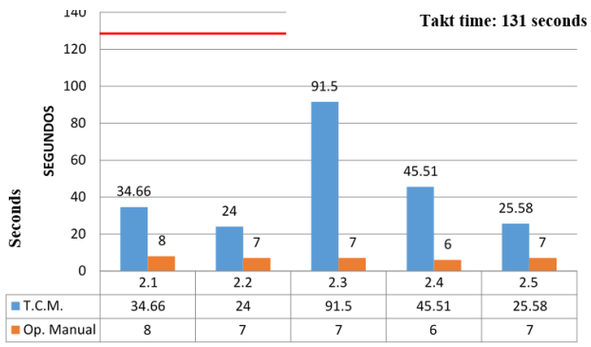
In line U5 of process 3, it can be seen in the graph that no operation is close to the takt time, it is mentioned that in operation 3.5 the machining times vary between cycle and cycle (See Graphic 11), and also the doors open faster than others.



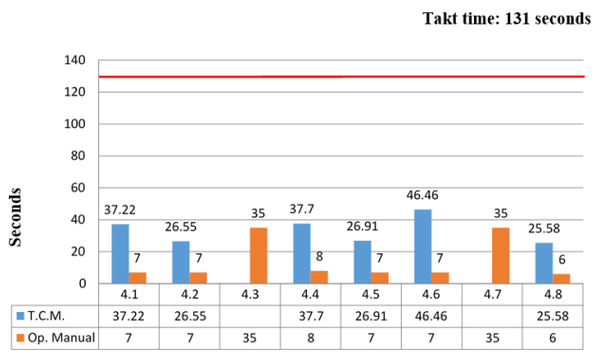
Graphic 11 Model C, Times of Line U5, U5 C of Process 3

In processes 2.1 and 4.1, you work with two parts per machine cycle, which is reduced to half the time, and there is no risk of exceeding the takt time (See Graphic 12 and Graphic 13).

In processes 3, 2 and 4 it can be seen that there is no bottleneck, on the contrary, the machining and visual inspection times are well below what is required (See Graphic 11, Graphic 12 and Graphic13).



Graphic 12 Model C, Process 2 U5 line times



Graphic 13 Times line U5 C Process 4

In process 5, the operation that sets the work rate is 5.3 with 131.4 seconds, therefore, based on its capacity, production must be planned (See Graphic 14).

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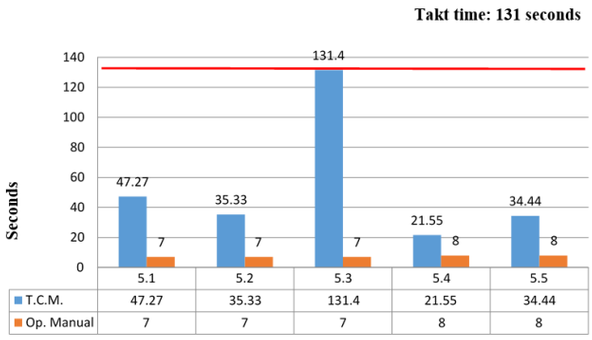

Graphic 14 Model C, Times Line U5 of Processes 5

Conclusions and recommendations

There are areas of opportunity in the machining lines of this company, these range from very simple things that can save time to other more complicated types of kaizen that require investments such as: new tool, machinery, among others.

Based on the results obtained in the cycle times of each process, the improvement proposals that will contribute to the increase in productivity are mentioned below:

1. Redefine the customer takt times of the A lines, to re-establish the production objectives.

Redefine the standard time on the lines, as well as the capacity per shift and per hour (See Table 2), and it can be concluded that it meets the customer's requirement.

Aspects	Procedure	Results
Bottleneck	1.5 98.56 + 9 sec Upload / Download	107.56 seconds
Capacity pershift		368 pcs. (11 hours day shift) 334 pcs (10 hours night shift
Capacity per hour	3600 sec / hour /107.56 Bottleneck	33.46 pcs / hour
Weather Takt	39600 seconds of the day / 368 pcs	107.60 seconds

Table 2 Proposal of capacities and time of model A of lines U1 and U2

2. Update HOEs. (Manual operations and operation times), to change the cycle times of manual operation.

3. Regulate the times of the machinery start-ups. (Open and close).

4. Eliminate unnecessary movements for CNC programs.

5. Place the tools in the carousel (magazine). Consider the cycle times mentioned in the results obtained.

6. Place a drawer under the conveyors to avoid dirt on the floor, this will help minimize cleaning time at the end of the day.

7. With the times previously taken, balance the workloads on lines A

8. Establish a new process flow in U5.

9. Determine the operator's cycle giving priority to the fastest machines to comply with the planned takt time.

It is worth mentioning that the proposals contained in this document are already in the implementation process, so it is necessary to evaluate the process to validate the viability and compliance of the established programs.

We appreciate the willingness and opening of the company, for the realization of this project.

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