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ABSTRACT

In this project, assembly lines of electrical panels of SIEMENS are investigated to make developments in the current process and to increase the overall efficiency of the line. In order to optimize the current process, we proposed and developed new layouts which aim to reduce the cycle time. The project is separated into two main parts. Firstly, we collected necessary data from the company by observing the ongoing systems and gathering appropriate past data about the assembly line to have a full understanding of the current processes. Secondly, improvements in the current processes are suggested and developed and also; their simulations are performed before implementation of the proposed system. In regard to the results of these simulations, favorable revisions are implied to the developed system.

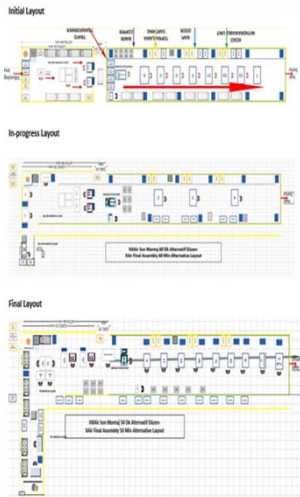


OBJECTIVES

- Reducing the cycle time
- Decreasing the load of rework
- Increasing the worker safety and improving the working conditions
- Minimizing the walk distance of workers
- Organizing the work environment, applying 5S to reduce untidiness

The main focus of the project is to optimize the cycle time of the mixed assembly line of SIEMENS in which switchgears are manufactured. In order to do that, we designed a new layout for the line and, we prepared a line-balancing study.

PROJECT DETAILS



At the beginning of our project, the layout was like in the initial form on the right side. There were mainly 8 stations. Towards the end of the line, there were optional stations where mostly rework is done. In addition to the long cycle time, there were several problems like disorderly environment, long walking distances, and transportation of the heavy switchgears.

After examining tasks of each station, we offered a new layout which decreases the cycle time. At the step, the prominent change was distinguishing pre-assembly and assembly tasks and separating pre-assembly tasks from current stations to a dedicated pre-assembly station in order to decrease the maximum cycle time in the assembly line. By this way, these tasks together, we obtained a cycle time around 60 min. The factory also started to use a small area near the line, we used this area for preparation.

As another tool, we aim to develop an application which gives the optimal sequence of production. The type of the product and the demand information are given by user. KZ06 and KZ09 are the hard products to manufacture. KZ01, KZ02, KZ04, KZ5 are the easier products which requires less time in line. To keep the workforce need constant on average, we thought of a logic which orders one hard one easy product consecutively comparing their demands.

Sipariş Sırası Belirleyici

Tipik	Talep miktarı
<input type="checkbox"/> kZ01	20
<input checked="" type="checkbox"/> kZ02	5
<input checked="" type="checkbox"/> kZ04	400
<input type="checkbox"/> kZ05	3
<input type="checkbox"/> kZ06	0
<input type="checkbox"/> kZ09	4

Devam İptal

Initial State of the Line	KZ01	KZ02	KZ04	KZ05	KZ06	KZ09
Number of Stations	12	13	12	12	13	13
Number of Tasks	59	65	60	59	68	65
Total Task Time	895	1217	905	907	1407	1217

II. State	KZ01	KZ02	KZ04	KZ05	KZ06	KZ09
Number of Stations	17	19	16	15	19	21
Number of Tasks	69	78	69	68	81	81
Total Task Time	843	1116	843	824	1206	1206

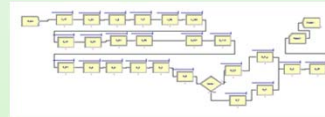
III. State (in progress)	
Total Number of Stations	19
Total Number of Tasks	114
Total Task Time	1183

As it can be seen above, since the assembly line is changed with some radical implementations and technical improvements, even total station times and some task times are changed. For instance; a crane is placed above the line which carries the panels and parts throughout the line, thus, causes a decrease in some task times and total task times for every panel.

Furthermore, total number of tasks are increased since they are separated into smaller tasks to balance the total task times of stations. Total task times are reduced as a result of the successful model application.

WHY ARENA?

As we deal with a dynamic mixed assembly line, we needed a model on which we can implement and visualize the changes we design for improvement. Therefore we started modeling the assembly line on Arena, as our company supervisors also found helpful in terms of the quick report solution of this software.



Initial Model

We first modeled the initial layout and the time study of the assembly line and observed the maximum waiting time on the bottleneck station, as well as a utilization difference between the bottleneck and the other stations.

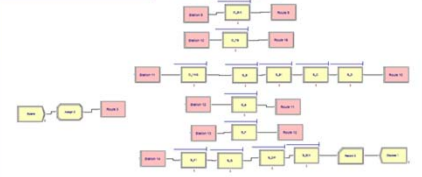
Simulation Model

As the improvement on the assembly line goes on; we updated the model for 22 stations and better design by using advanced Arena modules.

Simulation Objectives

As we discussed with our company supervisor, we inherited two new objectives on the current model:

- Having stable workforce (20 as decided by the company) with optimized capacity
- Studying the different production sequences to minimize the waiting time for a 22 station - 20 worker assembly line.



We have 6 different products which are varying by the stations they are processed in; which we can categorize as simple and complex products. By having a simple and a complex product on the assembly line in consecutive order; we are going to use some stations only in one round of assembly between those two. In that case, we can allocate workers on those stations that differ between consecutive stations and minimize the waiting time.

CONCLUSION

- Since the assembly line is changed with some radical implementations, total station times, total number of stations and even some task times are changed due to new technical developments.
- Cycle time of 67 minutes is achieved in the final state of the line with 22 workstations for the most complex panels and 18 workstations for the simplest types.
- For the future of the project, company wants to fix the total number of workers to 20. In order to do this, we are conducting an easy to use "production order system" which will hold the deviation from cycle time in a certain level.

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