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# Assessment of the new 8-piece pallet welding process

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**Abstract**

A certain manufacturing plant is in the business of manufacturing plastic products majority of which are crates and pallets. After molding, pallet parts are welded together using welding machines. Recently, to increase productivity and reduce costs, the pallet welding process has omitted the cutting step. A previous study was done to determine the optimal number of pallets welded per shift with the cutting process. This study compares the old process and the new process using simulation software, Arena. The result of the simulation shows a 25% improvement in terms of the number of pallets produced per shift from 180 to 226. Based on the worker utilization of the process, there are some workers who are underutilized; therefore one option is to do line balancing. Based on the results of the line balancing, one worker can be removed by combining the job of two workers. The combination of the job of the two results to an increase in the worker utilization without compromising the amount of pallets produced.



*Keywords:* Time and motion study; Simulation; Arena; Line balancing; Pallet welding

## 1. Introduction

A certain plastics manufacturing plant uses an injection molding process to produce different types of rigid plastic packaging materials. The injection molding process is a process wherein plastic resins are melted in a machine and they are "injected" into a mold. The plastic is then cooled so that it will solidify to create the final product. The main products of the plant in this study are plastic crates and plastic pallets both of which are considered as transport packaging materials. In the production of plastic pallets, as compared with the production of plastic crates, there is an additional step after molding the product, this is called the welding process. The welding process is mostly common to pallets made of separate parts.


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In the welding process, different parts of the pallet are attached to each other by heating and cooling. The number of machines involved in the welding process differs based on the number of parts of the pallet. Generally, the number of machines that will be used is the number of parts divided by two. Once parts are welded together, workers need to trim the parts to remove sharp edges and so that it would be more aesthetically appealing. The last part of the welding process is the attachment of rubber inserts. The use of rubber inserts is done to increase the friction between the pallet and the goods. The number of rubber inserts in the pallet depends on the design of the pallet. There are some pallets on the other hand, which do not require the use of rubber inserts.

Recently, the process of the welding in the plastic manufacturing plant was changed in order to reduce the number of people that would be needed and thus reducing the cost of labor. The practice of cutting was omitted and instead the parts are just matched in terms of size. In effect, the cutting machine operator is not needed anymore. This study will be done in order to compare the current process with the previous process in terms of number of pallets produced per shift. The comparison between the current process with the previous process will be able to verify if there is significant savings (in terms of number of workers) attained because of the new system. This study will also pin point areas in which bottlenecking occurs and make recommendations based on the results. This study will demonstrate the use of simulation software in determining the standard times of the current and proposed systems.

## 2. Background

The pallet is considered as a tertiary packaging product. Pallets are essential when warehousing as they are used to keep the goods in order and with pallets, racking is possible. One advantage of using pallets is that they help unitize the products which mean that the products will be easier to count. Ideally, plastic pallets or pallets in general are used together with forklifts of jack lifts. There are different kinds of pallets including paper, wood, plastic and metal. All have their advantages and disadvantages but this study will focus on the plastic pallet. There are different types of plastic pallets and in the plastics plant considered in this study; they are classified by the number of parts used to make a pallet. The 8 piece plastic pallet has four main parts, the top grill, bottom grill, long short side frame and the long side frame. There are two of each part needed to produce one pallet. Other parts that can be put in plastic pallets are metal reinforcements, to increase the load capacity and rubber inserts to reduce slipping.

To put the parts together and create one pallet, pallet welding is done. In the welding of plastic pallets, the main processes that occur are the heating and cooling of the plastic in the welding machine and the trimming done by the worker. The amount of time the pallet parts are welded together in each welding machine is held constant while the amount of time trimming would depend on the worker. In the eight piece pallet welding, there are four welding machines. In the first machine two grills are welded together side by side. In this process, there are two layers of grills that are welded together. This process will produce the parts that are needed in the second welding machine. Once finished, the trimmers will remove the excess plastic produced during the welding process. After trimming, the four grills are attached to each other using the second welding machine. Then, the welded parts will be trimmed and sent to the third welding machine. In the third welding machine, the short side frames are attached to the grills. After trimming, cutting can be done to remove any uneven parts and so that the parts would be straight and easier to weld. Then, the long side frames are attached using fourth welding machine. In this step, the sizes of the parts are critical. There should not be any excess because after this step, it cannot be resized anymore.

A previous study was done to determine the optimum number pallets produced. The number of pallets produced in a 12 hour shift was noted along with the worker utilization. In the study, the process was divided into different elements. These elements can be seen in Table 1. The model was then simulated using Arena to determine the optimum number of pallets produced and the worker utilization. The worker utilization obtained from this model can be found on Table 2 and Figure 1(a).

Recommendations in the number of workers were then made based on the worker utilization. Simulations varying the number of workers per station were done. After completing the simulations, the recommendation of the study based on the optimum number of pallets and the number of workers was to keep the “current” set-up of eleven workers. This study was not only able to determine the optimal set-up for the welding section, but it was also able to determine the standard time for the said system and it was also able to determine the average number of pallets that can be made in a 12 hour period and thus creating a standard in the process. The previous set-up as observed by the