

Minimization of Setup Times for Production Lines in Garment Manufacturing for Sustainability

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Abstract

While the ready-made clothing manufacturers continue their production for their customers, they are also working on how to make these processes more efficient. Each clothing order consists of a process starting from the design stage to the delivery of the completed products to the logistics company. In order for companies to survive in the competitive conditions in the global world, they need to produce according to less costly methods in their production processes. Starting from the order intake stage, it is necessary to make appropriate planning for the business and arrange all inputs to comply with this planning. For this, all processes during the workflow should be examined and improvements should be determined. For this study, the work processes in the garment stage were examined and the methods related to the minimization of the setup times (model changing processes) in the sewing department were examined.

Keywords: Setup time, garment production, scheduling, production, sustainability

1.Introduction

Organizations have to produce goods and services in a certain process time to meet the needs and expectations of their customers (İlleez, 2007). There are many processes involved in producing a product. A ready to wear production process is shown briefly in figure 1.

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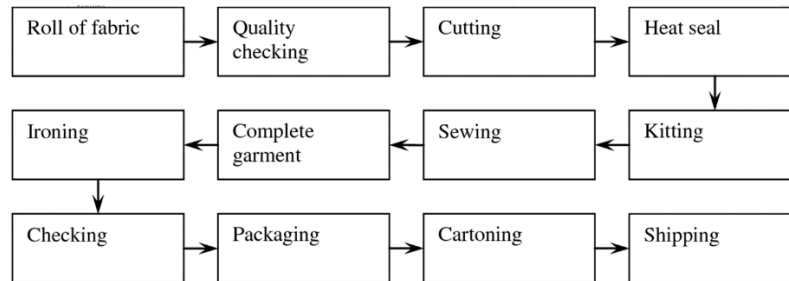


Figure 1. Process flow of a ready to wear company

Garment production, one of the sub-branches of the textile industry, is a production line where processes are most affected by the human factor. Sewing, as the longest and most complicated section in garment production process, is crucial to the efficiency improvement in garment industry (Xu et al., 2017). Efficiency can be defined in general terms as the measurement of the economic efficiency of the means of production as a whole (Güner & Yücel, 2014). Therefore, any improvement to be made in the production process will contribute positively to productivity (Güner, 2005).

In recent years, when we have begun to experience the effects of climate change more clearly, the importance of efficient use of scarce resources has once again emerged (Tatman et al. 2021) Sustainability studies initiated for this purpose in the textile and ready to wear clothing industry are becoming more and more important. Waste management and efficiency-enhancing methods as well as recycling are among the topics that are emphasized. Increasing productivity means using resources effectively. This is to make a positive contribution to sustainability studies.

Work required to change over a machine or process from one item or operation to the next item or operation. This time called as setup time (Yame, 2021). Setup times are among those that do not add any value to production. For this reason, the setup times in enterprises cause loss of productivity. When the current orders are examined; variety of models increased, but the numbers decreased. In addition, it is seen that the order times given for production are shortened. In this study, minimizing the setup times of production lines in ready to wear production for sustainability has been examined. The processes affecting the installation times were analyzed and suggestions were made about some of them.

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Furthermore, setup times among products have high varieties, and these product varieties are significantly high in the textile industry. Anderson (1995) mentions this complexity and investigates the impact of product mix heterogeneity (PMH) on manufacturing overhead cost in three different fabric production companies. She highlights variations in sequence dependent setup times that are causes of product varieties in the textile industry (Önem, 2018).

2. Materials and Methods

For this study, the work processes in garment sewing were examined. The existing orders of a company were examined and 11 of them were thought to be produced one after the other and the preparation times were analyzed. In this way, it has been found out at what points the improvement can be made in the production processes and how the company's processes will contribute to sustainability.

In garment production, production lines (assembly lines) are flow-oriented production systems that are still typical in the industrial production of high-quantity standardized commodities and even gain importance in low volume production of customized products. It has been shown in the figure below a sample t-shirt and its production line (figure 2) (İlleez, 2007).

Material

In this study, the processes in the sewing department of a company operating in Izmir were examined. In this company, products in the knit t-shirt group are produced. This company produces t-shirts in different production quantities and different models demanded by its customers.

The total processing time (tpt) was analyzed by dividing it into two; processing time (pt) and setup time (st). Processing time is a significant factor that increases the added value of the product since the other times have no effect on the value, and increase the cost of product. The improvement of processes will positively affect the energy use and sustainability of companies. In most factories, however, the processing time takes just 10% of the total production time (İlleez, 2007).

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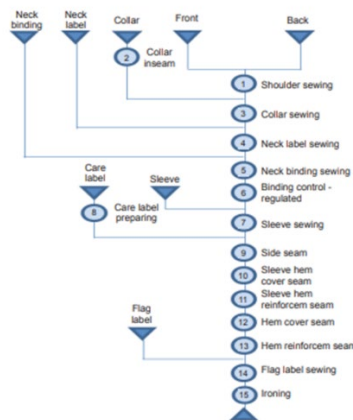


Figure 2. A Sample T-Shirt And Its Production Line

Therefore, reducing or rescinding completely the times, except for processing, has to be aimed at decreasing the total cost of the product. These setup times include some of the following preparation processes;

- Changing the places of the machines,
- Changing the threads on the machines,
- Changing the apparatus on the machines.

These arrangements are known as the setup process.

The Aim of The Study

If models with similar characteristics (working order, thread color, used machine characteristics...etc.) in an order group enter the sewing cell one after the other, the total preparation time is minimized. For this study, the work processes in the sewing phase were examined and analyzes were made about minimizing the preparation times (model changing processes).

Methods

The setup times analyzed in this study were recorded with video camera. From the recorded video recordings, the setup times were examined and their measurements were made with a stopwatch. The time study method is used to determine these processes.

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The basic principles of time study are the observation of the work flow by the time measuring. While making this observation, the work-student uses a time measuring instrument (stopwatch) and a time measuring form. Detected times are in minutes and seconds.

The models discussed in the study are women's upper clothing group. Each of them consists of at least 8 and at most 16 process steps. For this study, setup times during the preparation of the production lines of 10 different models, which started to be produced after the final model on the production line was completed, were analyzed.

By averaging these measurement results, unit times were found for each replacement operation (For example, thread replacement time on a lockstitch machine or 1 m displacement time on a sewing machine.....) (İlleez, 2007).

3.Results

When the preparation times observed in the production line, the following details have emerged.

1. Changing The Places of Machines in Production Lines

The displacement time was determined required for the sewing machine with the help of the wheeled feet. It has been shown in the figure below two samples of U shaped production lines. The second layout is obtained from the first layout by moving the sewing machines. (figure 3).

2. Changing The Threads on Machines in Production Lines

The replacement time of threads on the machines was determined for all types of sewing machines.

3. Changing The Apparatus on Machines in Production Lines

The replacement time of apparatus on the machines was determined for all types of sewing machines.

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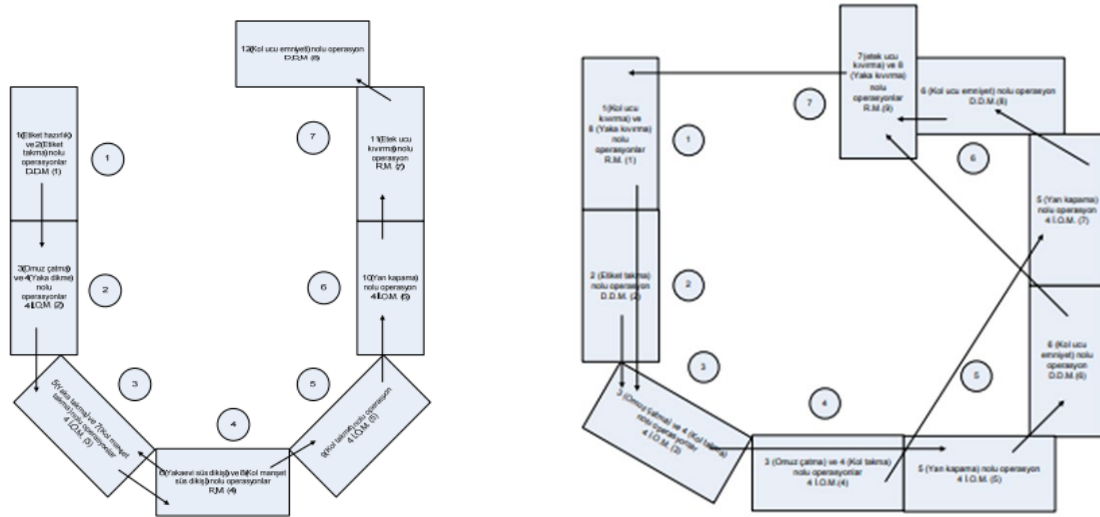


Figure 3. 2 Different U Shaped Production Lines

4. Conclusion

The precaution that can be taken to minimize the preparation times in the sewing process in the ready-made clothing industry are as follows (İlleez, 2007):

1. Scheduling of sewing cell
2. Layout of assembly line planning
3. Line balancing for every model that will be produced

Scheduling of Sewing Cell

It has been observed that the longest time required to start the production of a new model in the sewing department is the yarn changing period on the machine. With this in mind, it's important to find the model sequencing that minimizes downtime for the setup process.

Layout of assembly line planning

Layout of hardware and workstations is an important factor affecting production. The location of the line and the characteristics of the product to be produced determine the shape of the line. physical assembly lines; It can be designed in different shapes such as flat, circular, random,

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different angle, U-shaped and zig-zag. In order to minimize the free time, the belt placement should be selected in accordance with the product plan to be produced.

Line balancing for every model that will be produced

The main purpose of line balancing is to distribute the total workload in the assembly line equally to the stations in order to reduce the time redundancy at the stations.

All of these studies will enable garment production systems to work more efficiently. Thus, environmentally friendly production will be made in terms of consumed material, labor and energy. Their dissemination will be positive developments in terms of sustainability.

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