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Order Scheduling System for Garment Industry

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Abstract: *Scheduling plays an important role in any manufacturing system. Scheduling is a communications tool that helps balance customer demands with your ability to fulfill that demand. Here are many factors such as lag time, order specification, inventory level, customers waiting time, number of staff active, etc. That needs to be considered before scheduling an order and also the entry of the order depends on many factors. This system computerizes garments order scheduling system and helps the manager to choose the optimal set of orders that provide the most profit to the organization. This system uses Weighted Modified Due Date (WMDD) and Weighted Shortest Processing Time First (WSPT) scheduling algorithms. This system compares the two algorithms and allows the manager to choose the best result.*

Keywords: *Garments, Scheduling, WMDD, WSPT.*

1. INTRODUCTION:

Scheduling is the process of planning, controlling and expediting job and to the management to achieve the objectives. Scheduling deals with the management of resources to takes over given time and due date. It plays an important role in most factory and manufacturing industry. Therefore the scheduling system requires how to meet the customer demand in better way.

Scheduling is the most important decision making process in production. Scheduling calls for through understanding of all aspects of the production process and is an outcome of the integration of the efforts of planners in the planning group and the people in the shop-floor. Scheduling integrated the people, machine, materials, customer demands, and quality requirements in finalizing the priorities. Company use backward and forward scheduling. Forward scheduling is selecting a planned order release date to determine the due date. Backward scheduling is planning the tasks from the due date or required-by date to determine the start date or any changes in capacity required.

The benefits of production scheduling are increasing production efficiency, labor load reducing, and real-time information. The objective can take many different forms. These are to save the paper work for scheduling orders, to save the time of the manager in selecting the orders, to save the paper work for scheduling orders, to help the manger choose the optimal set of order, to allow the manager to get an up-to-date schedule.

In this research, Weighted Modified Due Date (WMDD) Scheduling will be applied to support the margents production companies to reduce the money that must be paid as the penalty fees for late completion of the customer's orders. And then Weighted Shortest Processing Time First (WSPT) algorithm is used to schedule the orders in non-decreasing order of 'processing time per unit of importance'. This system compares the result between the two algorithms and allows the manager to choose between the two resulting sequences.

1.1 Overview of the System

In this system, Weighted Modified Due Date (WMDD) Scheduling will be applied to support the garment industry to reduce the money that must be paid as the penalty fees for late completion of the customer's orders. And then Weighted Shortest Processing Time First (WSPT) algorithm is used to schedule the orders in non-decreasing order of 'processing time per unit of importance'. This system compares the result between the two algorithms and allows the manager to choose between the two resulting sequences. The customer will put orders with due date, price and quantity. Then the orders will be regarded as the Waiting Orders which are not decided to accept the order or not. If the manager does not accept orders within 24 hours, then the orders will be automatically regarded as Rejected Orders. If the manager accepts the order, then the order will be regarded as Accepted Orders which are waiting to process and the complete date is specified.

There are four types of order that the organization accepts, (1) Short-arms T-shirt, (2) Long-arms T-shirt, (3) Short-arms Shirt, and (4) Long-arms Shirt. Also, there are three types of machines to process the orders, (1) Cutting Machine, (2) Machine Set for T-shirt, and (3) Machine Set for Shirt. Each order type needs to process on different machines. Short-arms Shirt and Long-arms Shirt need to pass Cutting Machine and Machine Set for Shirt. Short-arms T-shirt and Long-arms T-shirt need to pass Cutting Machine and Machine Set for T-shirt. And each machine takes

different processing time for specific order type. Cutting Machine can cut 250 pieces in 1 hour for all types of orders. Machine Set for T-shirt can produce 15 Short-arms T-shirts or 13 Long-arms T-shirts per hour. Machine Set for Shirt can produce 10 Short-arms Shirts or 8 Long-arms Shirts per hour.
The system schedules orders on machines regarding as five working days a week, eight working hours a day from 8a.m to 12p.m and 1p.m to 5p.m. Although the system shows orders schedule without resting hours, the resting hours are excluded.

2. METHOD:

The scheduling problems are evaluated for increasing production efficiency of the machines and to obtain the optimal set of data for the same. Single machine method has been taken into consideration for this research.

2.1 Classification of Scheduling

The scheduling problems can be classified into three types:

1. Single Machine Scheduling
2. Flow Shop Scheduling
3. Job Shop Scheduling

2.1.1Single Machine Scheduling

Single machine scheduling is the process of assigning a group of tasks to a single machine or resource. In this type of scheduling are arranged in a particular order in a classification of scheduling. Our Objective may be fulfilled when the delivering order completed before due dates and bring the maximum profit to the industry. The results that can be obtained for single machine models not only provide insights into the single machine environment, they also provide a basis for heuristic that are applicable to more complicated machine environments. In practice, scheduling problems is more complicated with a single machine. There are many single machine scheduling algorithms to solve problems. Some of them are Shortest Processing Time (SPT), Weighted Shortest Processing Time First (WSPT), Earliest Due Date (EDD), Modified Due Date (MDD), and Weighted Modified Due Date (WMDD).

2.1.2 Weighted Shortest Processing Time First (WSPT)

The weighted shortest processing time first rule is a variation of the Shortest Processing Time (SPT) scheduling. In this case, the objective is to consider the total weighted completion time, wjCj. The weight wj of job j may be regarded as an importance factor; it may represent either a holding cost per unit time or the value already added to job j. This problem gives rise to one of the better known rules in scheduling theory, the so-called Weighted Shortest Processing Time first (WSPT) rule. According to this rule the jobs are ordered in decreasing order of wj/pj. The computation time needed to order the jobs according to WSPT is the time required to sort the jobs according to the ratio of the two parameters. A simple sort can be done in O (n log (n)) time.

Implementation of Weighted Shortest Processing Time First (WSPT) in pseudo-code:

```
Input: Unsorted list of tasks, tasks (0… n)
Output: Sorted list by increasing modified due date, sortedTasks (0,…,n)
Function wspt (task)
    Return (task.processTime / task.weight)
Function wsptSort (tasks)
    unsortedTasks = copy (tasks)
    sortedTasks = list
    processed = 0
    while unsortedTasks isn't empty
        bestTask = unsortedTasks.getFirst ()
        bestWspt = wspt (processed, bestTask)
        for task in unsortedTasks
            wspt = wspt(processed, task)
            if wspt < bestWspt then
                bestWspt = wspt
                bestTask = task
        sortedTasks.pushBack (bestTask)
        unsortedTasks.remove (bestTask)
    return sortedTasks
```

2.1.3 Weighted Modified Due Date (WMDD)

Weighted Modified Due Date (WMDD) is a version of Modified Due Date (MDD) [2]. WMDD takes into account the weights. Implementation of the MDD algorithm in pseudo-code:

```
Input: Unsorted list of tasks, tasks (0,…,n)
Output: Sorted list by increasing modified due date, sortedTasks (0,…,n)
Function wmdd (processed, task)
        Return (1 / task.weight) * max (processed + task.processTime, task.dueDate)
Function wmddSort (tasks)
        unsortedTasks = copy (tasks)
        sortedTasks = list
        processed = 0
        while unsortedTasks isn't empty
                bestTask = unsortedTasks.getFirst ()
                bestMdd = mdd (processed, bestTask)
                for task in unsortedTasks
                        mdd = mdd (processed, task)
                        if mdd < bestMdd then
                                bestMdd = mdd
                                bestTask = task
                sortedTasks.pushBack (bestTask)
                unsortedTasks.remove (bestTask)
                processed += bestTask.processTime
        return sortedTasks
```

3. RESULTS AND DISSCUSSIONS:

3.1 Weekly Schedule Form

The following figure 3.1 shows the admin/manager weekly schedule of orders on machines together with date. Each order is specified in color. When the cursor moves onto the specific order, start processing time and end processing time of the order are shown in red color box. Also the name of the order with the specified color is shown below the grant chart. When the order is completed, it will be automatically removed from the schedule.

Figure 3.1 Weekly Schedule Form

3.2 Processing Time

Processing times are calculated by dividing order quantity with total processing unit produced by machine in one hour as shown in Figure3.2. If the machines are not idle at the calculation moment, the system will regard their last processing time as the starting free time of the machine. Otherwise, when the calculation moment is during working hour, the moment is regarded as the start free time of the machine. If the calculation moment is during off-work hour, the system will regard tomorrow's start working hour as the start free time of the machine. Due date is calculated by subtracting due date of the order and start free time of the machine. Due date calculation excludes weekends and shows in hourly format.

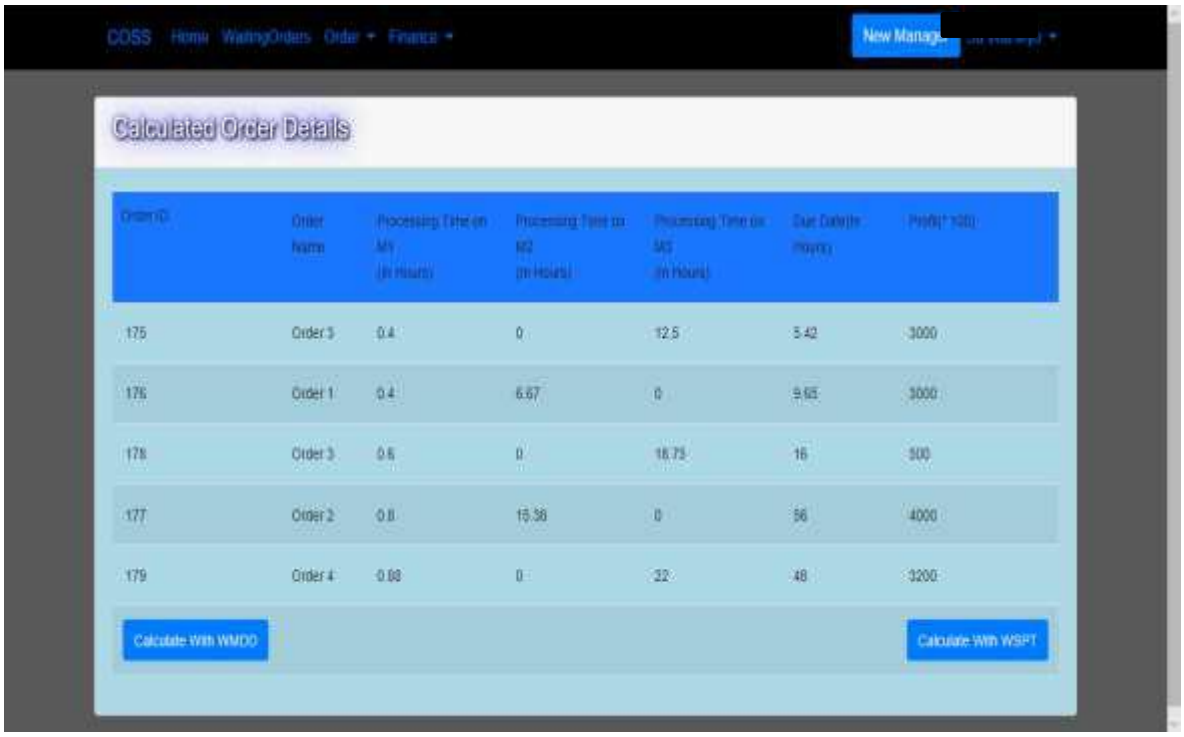

Figure 3.2 Calculation showing processing time of each order on each machine, due date, and profit with minimization

3.3 Compare Two Algorithms

The comparison between the two algorithms is shown in Figure 3.3 and Figure 3.4 together with profit, 'No Late' order list and list of rejected order. In this example, the resulting profit of the two algorithms is exactly the same. Sometimes, the order of the 'No Late' list is different. Sometimes, 'WMDD' algorithm results more profit than 'WSPT' algorithm. And sometimes, the opposite occurs.

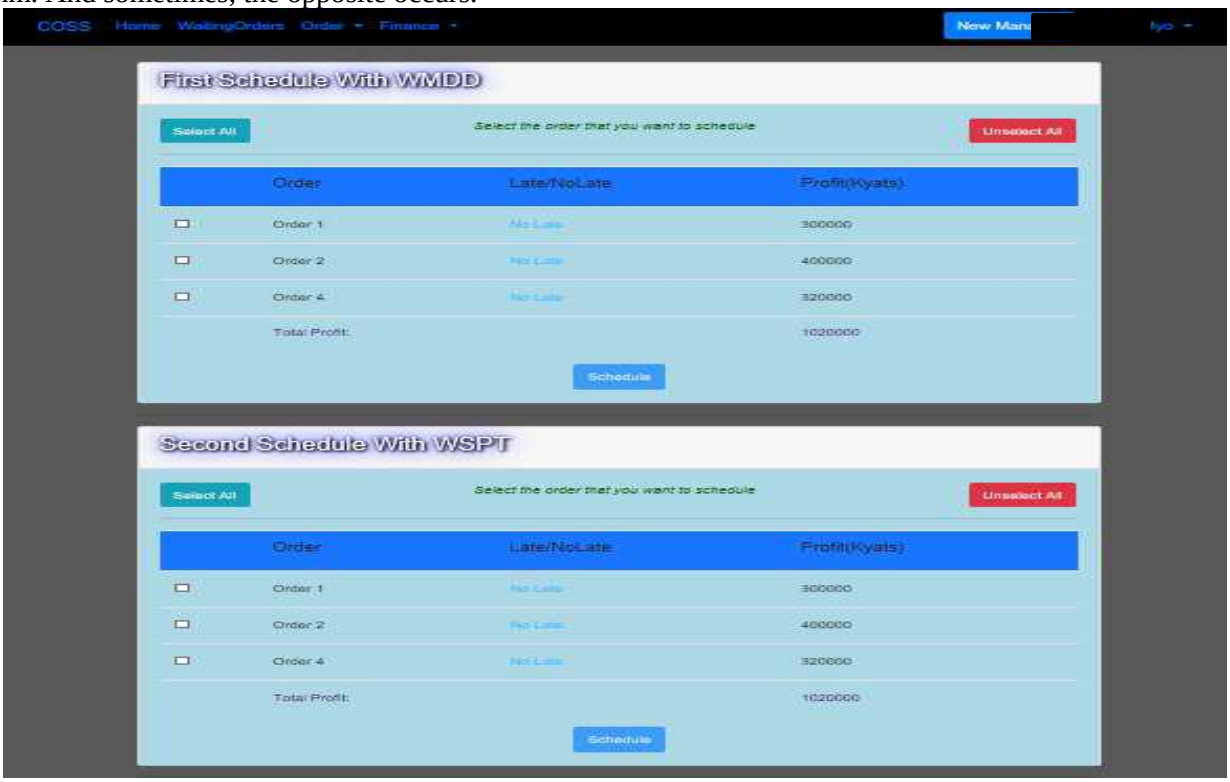

Figure 3.3 Comparison of 'No Late' Order List

Figure 3.4 Comparison of Rejected Order List

3.4 Output of the System

The system is developed to find the optimal set of orders that brings the maximum profit and that doesn't need to pay the penalty fees. The system compares between Weighted Modified Due Date (WMDD) Scheduling Algorithm and Weighted Shortest Processing Time First (WSPT) Scheduling Algorithm. The system informs admin/manager the weekly schedule of orders on the machines. Also, the system shows profit and sold unit.

4. CONCLUSION:

This system is developed to reduce workload of a manager in scheduling orders on machines and to fulfill the objectives of delivering orders before due dates and bring the maximum profit to the organization. This system uses Weighted Modified Due Date (WMDD) and Weighted Shortest Processing Time First (WSPT) Scheduling Algorithms to compare the two algorithms based on this system**.** This system is able to reduce paperwork and workload of manager in scheduling orders on machines. Since the system includes the off work hours and weekends in calculation, the manager will be more comfortable. Since the system automatically updates weekly schedule on machines, the manager will be more comfortable.

5. RECOMMENDATIONS:

Since the system mainly focuses on scheduling, it excludes the accounting category such as returning some orders items from the customers, purchasing resources and others. It also excludes the category of considering human resources.

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