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Research Article

Line Balancing Analysis with Ranked Positional Weight (RPW) and Region Approach (RA) Methods on the Production Line at PT. Vitapharm Surabaya

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ABSTRACT

Increasingly fierce industrial competition requires companies to improve the efficiency and productivity of their production processes. PT Vitapharm Surabaya faces the problem of workload imbalance in the Manual-A production line, especially in the facial serum packaging process which has an impact on low production efficiency and non-achievement of daily output targets. This study aims to analyze and improve line balancing using two approaches, namely the Ranked Positional Weight (RPW) and Region Approach (RA) methods. The data collected includes work cycle time, adjustment factors, and allowances for each work element. After the application of RPW and RA methods, there was an increase in line efficiency from 61.10% (actual condition) to 80.56% (RPW) and 84.72% (RA), a decrease in balance delay from 38.90% to 19.44% (RPW) and 15.28% (RA), and a significant reduction in idle time. The results showed that both methods were able to improve the balance of the production line, with the Region Approach method providing slightly more optimal results. This research can be used as a basis for continuous improvement in the cosmetics production line of PT Vitapharm.

Keywords: Idle Time; Line Balancing; Production Efficiency; Ranked Positional Weight; Region Approach

1. INTRODUCTION

Along with technological advances, the challenges faced by global industries and international competition are becoming increasingly complicated and constantly evolving. The efficiency, effectiveness and optimal productivity of industries around the world play an important role in determining their success. Various initiatives have been undertaken to find solutions to these problems, including the development of appropriate production system planning and design based on the principle of production line balance, which is influenced by factors such as operator performance, appropriate layout and the presence or absence of material queues. (Sinurat et al., 2023). Production process efficiency has a significant impact on an industry's ability to maximize profits and optimize time. This efficiency is largely determined by a company's production process system, which allows it to achieve the highest possible profit by avoiding bottlenecks. When a bottleneck occurs at a workstation, it can cause delays, especially during periods of increased demand that exceed capacity. Such blockages or bottlenecks on the production line can result in idle time and slowdowns, preventing the process from operating optimally in terms of both quantity and quality. The term often known as line balancing is a technique that involves distributing various tasks among work stations in a production line, which ensures that each station has the same completion time. This method optimizes the allocation of resources assigned to a team of individuals or machines engaged in successive tasks for product assembly, thereby achieving high efficiency at each workstation. Implementing the concept of line balancing offers advantages, including task balance across work stations, which helps to increase production speed, maximizing manpower while minimizing idle time. (Rangkuti et al., 2024).

PT. Vitapharm PT. Vitapharm is a company that works in the field of cosmetics since 1962 with Viva Cosmetics products. PT Vitapharm has produced many products such as Viva Cosmetics, Viva Queen Cosmetics, Red-A Cosmetics and Viva White Cosmetics, with hair, face, body and makeup care products. The production process at PT Vitapharm is divided into several production units including cream & lipstick production units, liquid production units, powder production units and pencil production units. Working hours at PT Vitapharm last for a total of 7.5 working hours including 0.5 hours of rest. If the demand for production increases, a shift work hour system is carried out which is divided into two shifts, namely the morning shift and the afternoon shift. However, for the research that I used, the normal work system which lasts from 07.30-15.00. For the production process that is raised as a topic this time, namely in the liquid production unit where there are several work stations used for the production of cosmetics according to their respective needs. In the production process of the liquid unit of PT Vitapharm, there are production processes that already use machines for production, one of which is a rotary machine and there are also production processes that still use human labor. In the production process at the liquid unit PT Vitapharm produces facial serum with several variants of its products on the Manual-A production line.

Based on data obtained from the company in January, the average amount of production obtained was 178 OB/day or 12,816 bottles / day with a target of 250 OB / day or 18,000 bottles / day.

In the problems faced by the company in the production process is the level of efficiency of labor and production machinery that is still low because the amount of production has not been able to meet the company's target and for the percentage of achievement of the Manual-A production line does not reach 80%. According to (Lestari & Darmala, 2022), the price that is generally taken in the standard percentage of work efficiency of workers / employees set by the price that is generally taken in the standard percentage of work efficiency of workers / employees set by the company in determining work productivity standards ranges from 80% to 90%, because labor productivity is unlikely to reach 100% due to fatigue and saturation factors. Therefore, based on the graph above, the amount of production in each day has not met the productivity standards as stated above that the minimum standard of productivity is 80% while the target of the Company is 250 OB, so the minimum productivity standard in each day is 200 OB but the Company has not reached the minimum target of labor and machine efficiency. As a result, the workload between work stations is not balanced. The unbalanced workload in the facial serum production process occurs in the packaging process 1 and packaging 2. The packaging process 1 and packaging 2 are done manually using labor. The process causes problems in the production of PT Vitapharm, namely at one of the work stations, causing high production time at the workstation, and affecting the output produced. For the production process at PT Vitapharm in the liquid unit precisely on the Manual-A line has several work stations including work station 1 which consists of assembling rings and rubber and glass pipettes, work station 2 which consists of the filling process and the bottle closing process, work station 3 which consists of printing the expired code, folding the folding box, and inserting the bottle in the folding box, work station 4 which consists of sticking the label, stamping the inner box and folding the inner box, and work station 5 which consists of inserting the folding box into the inner box and inserting the inner box into the outer box. After the outer boxes are arranged on a certain number of pallets, then the pallets will be moved to the storage warehouse to wait for the quality control process. The occurrence of the waiting time process is located at work station 3 where the production speed is 59 BPM compared to the speed of work station 2 which is longer at 25 BPM. The occurrence of bottlenecks around 15 minutes and occurs 4-6 times in each day causes the production of facial serum to be below the target and the unproductive waiting time process in the production process. Efforts that can be made to overcome this problem are to set Line Balancing using the Ranked Positional Weight (RPW) method and the Region Approach (RA) method, in order to make improvements, namely by finding the best results on the production trajectory which results in bottlenecks, which means there is a buildup of work.

Maka Therefore, in the production process at PT Vitapharm, it is necessary to analyze or calculate the balance of the production process so that it can run smoothly. It aims to be able to produce with the optimal amount and in accordance with the capacity of the company which is useful to get maximum profit. Efforts that can be made to overcome these problems are by organizing Line Balancing using the Ranked Positional Weight (RPW) method and the Region Approach (RA) method, in order to make improvements, namely by finding the best results on the production trajectory. In this method, tasks are ranked based on how important they are in completing all tasks that depend on them. The level of importance is measured based on the position of each task, which is the sum of processing time for all tasks that directly follow it in the priority diagram (Buyuksaatci et al., 2015). While the Region Approach method is a method that uses a work operation time sequencing technique based on a regional approach. The region in question is the naming for the division of work operations based on the precedence diagram.

2. RESEARCH METHOD

2.1. Line Balancing

Line Balancing is a line balancing that involves the allocation of task elements from assembly line to work station, which aims to reduce the total number of work stations and overall idle time at all stations for a given output level. In Line Balancing, assignments are made to several interconnected work stations on one track or production line. The work station has a time that does not exceed the cycle time and work station (Mujahidulloh & Bakhtiar, 2021). Industrial management must determine the daily production rate adjusted to the total demand level and then divide it into the available productive time per day. The result is the cycle time which is the time the product is available at each work station. The relationship between one job and another is displayed in the form of a diagram called a precedence diagram (Basalamah et al., 2021).

Some of the advantages that can be gained from good production line planning are as follows:

1. Minimal material movement distance is obtained by organizing the arrangement and workplace.
2. Workpiece (material) flow, including the movement of continuous workpieces. The flow is measured by production speed and not by specific quantities.
3. The division of tasks is divided evenly according to the expertise of each worker so that the utilization of labor is more efficient.
4. Simultaneous operation, i.e. each operation is done at the same time on the entire production line.
5. Unit operation. A track is intended to be a single unit producer, a series of operations or a group of workers assigned to a product. The entire trajectory constitutes one unit of production.
6. The workpiece movement is fixed according to the set-up of the track and is fixed.
7. The process takes minimal time.

To balance an assembly/production line, there are several limiting factors, namely:

1. Technology constraints

This constraint is also called precedence constraint, which is a constraint on certain work processes. The sequence of processes and their dependencies are described in dependency diagrams and Operation Process Chart (OPC).

2. Facility constraints
   This restriction is related to the existence of production facilities that cannot be moved.
3. Position Constraints
   A constraint relating to the orientation of the product towards a particular operator.
4. Zoning Contraint
   Zoning constraints consist of Positive Zoning Contraint (PZC) and Negative Zoning Contraint (NZC). PZC means that certain work elements must be placed close together in the same workstation, while NZC means that certain work elements must be placed far apart from each other. (Baroto, 2017).

According to (Pristi et al., 2020) the requirements for grouping work stations (line balancing) are as follows:

1. Relationship with the previous process.
2. The number of work stations should not exceed the number of work elements.
3. Cycle time is more than or equal to the maximum time of each time at the work station of each work element.

In a mass-producing company, production planning plays an important role in making production scheduling. For tasks that require the assembly of a large number of components, the placement of tasks and tasks to be performed can be helpful. When setting up and operating assembly lines have different production speeds. This results in unbalanced production rates between work stations, inefficient cross-assembly, and accumulation of materials and products. (Rachman & Santoso, 2019).

2.2. Ranked Positional Weight Method

The line balancing process is a key element that helps industries improve labor productivity by optimizing the number of work stations and minimizing cycle time. Ranked Positional Weight (RPW) is a line balancing method developed by Helgeson and Birnie where each job is ranked based on its importance in completing all tasks associated with that job. This method considers the priority and processing time of all tasks to optimally allocate work items to locations. The RPW value for each operation is determined and the operations are assigned to workstations using the RPW method to balance the assembly line which is useful for balancing the assembly line. This helps to improve line efficiency and minimize the number of workstations. Line balancing using RPW utilizes the parameters line efficiency, balance delay, smoothest index (Hapid & Supriyadi, 2021).

According to (Dharmayanti & Marliansyah, 2019) The steps of this method are:

1. Calculate the position weight of each task, which is the weight of a task plus the weight of the next task.
2. Sort the tasks based on the position weight, i.e. from the largest to the smallest.
3. Assign the task with the largest weight to a station that does not violate the precedence constraint and the time does not exceed the cycle time.
4. Make arrangements until all tasks are assigned to work stations.

2.3. Region Approach Method

The next heuristic method in determining workstations in production is killbridge's and western/region approach. This method begins by reorganizing the work network into regions from left to right by placing all work at the far end wherever possible. The redrawn work network adds regions of increasing precedence from left to right (Basuki et al., 2019). The Kilbridge Wester method was designed by M. Kilbridge and L. Wester. In this method, tasks are grouped into a number of groups that have the same level of connectedness. The steps used by the Kilbridge Wester method are as follows:

1. Group several tasks into one group. For example, the nth group is tasks that have no previous tasks, the n+1st group consists of tasks that have previous tasks in the nth group, the n+2nd group consists of tasks that have previous tasks in the n+1st group, and so on until all tasks are grouped.
2. Place tasks in a group. Start group 1, into the same workstation. The best combined result is that the total time of all tasks is close to or equal to the cycle time. If placing a task at a station causes the total time of all tasks to exceed the cycle time, then place the task at the next workstation. Remove the tasks that have been placed from their groups.
3. If there are tasks that have not been assigned to a workstation and their total time amounts to less than the cycle time, continue merging with the next task.
4. Re-do steps 2 and 3 until all tasks have been incorporated into a workstation.

The next step is utilization measurement which is a measurement of the results of an assembly line. Measurement is done by calculating production line efficiency, balance delay, and smoothness index.

2.4. Working Time Measurement

Work time measurement and work method analysis basically focus on how the work is done. Measurement of working time is the work of observing workers and recording their working time both per element and cycle. The purpose of measuring working time is to determine the average working time required by operators in doing a job. The goal is to get the standard time or what is commonly known in the company as Cycle Time, which is the time that is reasonable to complete a job carried out in the best work system that has considered the allowance required by a worker. Measurement of work time can be done directly, which is a form or method of measuring work carried out in the place where the work is carried out.(Putra & Jakaria, 2020). Working time measurement techniques are generally divided into two types of measurements, namely direct time measurement and indirect time measurement. Measurement can be said to be direct if the party taking the measurement is in the same location as the object being measured. While indirect time measurement is when the party taking the measurement is not directly at the location of the object of measurement.

2.5. Working Time Measurement with Stopwatch Time Study

Measurement of working time (time study) is basically an attempt to determine the length of working time required by an operator to complete a job. From the measurement results, the standard time to complete one work cycle will be obtained, which is used as a standard for completing work for all workers who will do the same job. In the context of work time measurement, direct stop watch time is a work measurement technique using a stop watch as a measuring device for the time shown in the completion of the observed activity (actual time). The measured and recorded time is then modified by considering the operator's work tempo and adding it with allowences. The work activities to be measured must first be divided into detailed work elements. By observing the activity to be measured, the time required to complete the work element is measured and recorded. This method of measuring work time with downtime is well applied in measuring short and repetitive work. In measuring work, there are requirements that must be met, namely that the work measured is work with a predetermined standard with a predetermined method in the process of completing the work. The stages in the implementation of work time measurement with stopping hours are determining measurement objectives, selecting operators, classifying operations into work elements, measuring work time, checking work measurement requirements, determining performance ratings, and calculating standard time. (Pradana & Pulansari, 2021).

2.6. Cycle Time Calculation

Cycle time is the time that workers complete their work when observed at that time. This time is the basic time a worker completes his/her work under the conditions he/she receives in the field and in a reasonable situation. This means that the worker is not motivated (so the time is accelerated) or demotivated (so the time is slowed down). Determination of good cycle time can be done several times so that it can be compared between the results of one measurement with another. cycle time is the time required to produce a product. And can be calculated with the following formula.

$$Ws = \frac{\sum Xi}{N}$$

2.7. Normal Time

Normal time is the working time that has considered the adjustment factor, which is the average cycle time multiplied by the adjustment factor. The normal time for an element of a work operation simply indicates that a well-qualified operator will be able to complete the work at a normal working speed. However, in practice we will see that it cannot be expected that the operator will be able to work continuously throughout the day without any interruptions. Here, in reality, the operator will often stop work and require special time for purposes such as personal needs, rest breaks, and other reasons beyond his control. Normal time is the working time with the adjustment factor taken into consideration. The process of transforming cycle time to normal time is as follows:

$$W_N = W_S \times P$$

2.8. Performance Rating Adjustment Factor

Adjustment factor is a factor that is taken into account if the measurer believes that the operator is working at an unreasonable speed so that the time calculation results need to be adjusted or normalized first. Performance Rating is a comparison of the operator's actual performance with a concept that has been defined in a normal performance state. Work performance measurement can be done in four ways, including:

1. Skill and Effort Rating

The work measurement procedure includes determining the rating of the skills and efforts shown by the operator at work by considering other time allowances.

2. Speed Rating

Rating based on a single factor, namely according to the speed or tempo of the operator's work. With this method, the process of determining the rating factor will be carried out by comparing the ability determined by the speed or tempo of the operator's work with the normal ability possessed by the observer.

3. Westing House System's

Rating A method used to measure a person's work performance with reference to four criteria, namely proficiency, effort, working conditions, and consistency of the operator in performing work.

4. Synthetic Rating

A method for evaluating an operator's work tempo based on a predetermined time value. The procedure is carried out by measuring work as usual and comparing this measured time with the completion time of the work element that has previously known time data.

2.9. Allowance Adjustment Factor

This allowance factor is added to the normal time that has been obtained. Allowance is given for three things, namely:

1. Allowance for personal needs

This allowance is given to operators to carry out their personal needs such as drinking, praying, going to the toilet or other personal needs. For fairly light work, where operators work for 8 hours per day without an official break, around 2 to 5% (10 to 24 minutes) is needed to complete their personal needs.

2. Allowance to eliminate fatigue

This allowance is given to operators to eliminate fatigue. Continuous fatigue without being balanced with sufficient rest will result in decreased production results, both in quality and quantity. The length of the break and the frequency of its holding will depend on the type of work available. In general, the rest period given ranges from 5 to 15 minutes

3. Allowance for obstacles

Unavoidable obstacles Allowance in the production process can be caused by delays that can be caused by several factors that are difficult to avoid, such as machine problems or damage, power outages or other things beyond control. These allowances are basically translated as values in a certain percentage of normal time that can affect handling time and machine time. If the three types of time allowances are practiced simultaneously, it can simplify the calculations that must be done for all work elements. Thus, standard time can be obtained using the following formula

$$WB = WN \times \frac{100\%}{100\% - \%Allowance}$$

3. RESULTS AND DISCUSSION

3.1. Facial Serum Production Operation Time Data Collection

In conducting this research activity, some data are needed to support the resolution of problems in line balancing. The data obtained is based on interviews with supervisors and field workers. The data required are work element data, time data for each work element, cycle time for each work element and precedence diagram data. In implementing line balancing, standard time for each work operation is needed. For this purpose, observations and measurements of work time are carried out. Data collection was carried out by observing the work time 30 times from the Manual-A production line work elements in the following table:

Table 1. Operating Time of All Working Elements of Manual Production Line-A

Work Station	No	Work Elements	Number of Observation Time / second
Station 1	1	Rubber Pipette Assembly	49,13
	2	Pipette Assembly	58,13
Station 2	3	Liquid Filling Process	67,29
	4	Bottle Closing Process	70,85
Station 3	5	Print Expired Code	30,31
	6	Folding Box Formation Process	107,02
	7	Insert Bottle Into Folding Box	136,63
Station 4	8	Attach Label	63,15
	9	Stamping Inner Box	1,65
	10	Fold Inner Box	19,91
Station 5	11	Insert Folding Box Into Inner Box	23,21
	12	Insert Inner Box Into Outer Box	7,50

To find out the normal time, the adjustment factor value (p) must first be determined. For this study, the average adjustment factor of 12 work elements was used.

Table 2. Average Westinghouse Adjustment Factor Provisions

Factors	Class	Symbol	Adjusment
Skill	*Good*	B2	+0,08
Effort	*Excellent*	B1	+0,10
Working Condition	*Good*	C	+0,02
Consistency	*Excellent*	B	+0,03
Total			+0,23
Working Under Normal Conditions			+1,00
Factor Adjustment			+1,23

Based on the **Table2**, it is known that the P value with the Westinghouse method is 1.23 with details of 0.08 + 0.10 + 0.02 + 0.03 = 1.23. In calculating standard time or standard time, the allowance value must first be calculated. Allowance is the time for workers to interrupt the ongoing process due to unavoidable things. The time can be calculated by considering several aspects including the calculation of fatigue. Some allowances that are classified as fatigue are: energy expended, work attitude, work movements, eye fatigue, temperature conditions, atmospheric conditions and work environment conditions.

Table 3. Allowance Provisions

No	Factors	Values
1	Energy Expended: Working at a Desk, Sitting	3%
2	Work Posture: Working sitting, Light	0%
3	Work Movement: Normal	0%
4	Eye Fatigue: Continuous viewing with changing focus	8%
5	Temperature Condition: Normal (22-28)	0%
6	Atmospheric Condition: Good	0%
7	Work Environment Condition: Repeated work cycle between 0-5 seconds	1%
8	Personal Needs	2%
	Total	**14%**

Based on the **Table 3**, the average allowance value of the 12 work elements used for the study is 14% to find the standard time. After knowing the value of the allowance factor (P) and allowance, the next step is to calculate the normal time from the cycle time multiplied by the adjustment factor.

Table 4, Cycle Time, Normal Time dan Standard Time

Work Station	No	Work Elements	Cycle Time	Normal Time	Standard Time	Total Standard Time
Station1	1	Rubber Pipette Assembly	1,64	2,01	2,34	5,11
	2	Pipette Assembly	1,94	2,38	2,77	
Station 2	3	Liquid Filling Process	2,24	2,76	3,21	6,59
	4	Bottle Closing Process	2,36	2,90	3,38	
Station 3	5	Print Expired Code	1,01	1,24	1,44	13,06
	6	Folding Box Formation Process	3,57	4,39	5,10	
	7	Insert Bottle Into Folding Box	4,55	5,60	6,51	
Station 4	8	Attach Label	2,11	2,59	3,01	4,04
	9	Stamping Inner Box	0,05	0,07	0,08	
	10	Fold Inner Box	0,66	0,82	0,95	
Staion 5	11	Insert Folding Box Into Inner Box	0,77	0,95	1,11	1,46
	12	Insert Inner Box Into Outer Box	0,25	0,31	0,36	
TOTAL			21,16	26,03	30,26	30,26

LE = $\frac{30,26}{5x13,06} x\ 100\% = 46,34\%$

BD = 100% - 46,34% = 53,66%

IT = $n.Tc - Twc$

IT = 5 x 13,06 – 30,26

IT = 35,04 detik

From the calculations above, it can be seen that the line efficiency in the current facial serum production process is 46.34%, Balance Delay is 53.66%, and idle time is 35.04 seconds.

3.2. Analysis Line Balancing

3.2.1. Line Efficiency Ranked Positional Weight Method

The first step of this method is to create a precedence diagram according to the conditions in the field, then determine the position weight for each work element of an operational process, then sort it from the highest position weight value to the lowest position weight value.

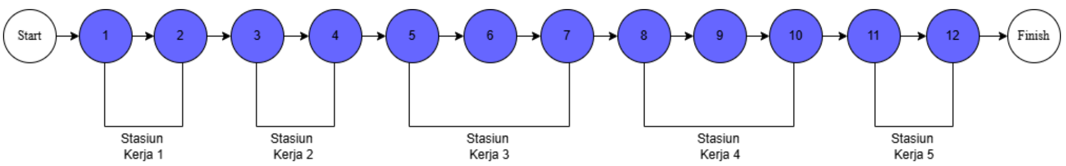

Fig 1. Early *Precedence* Diagram

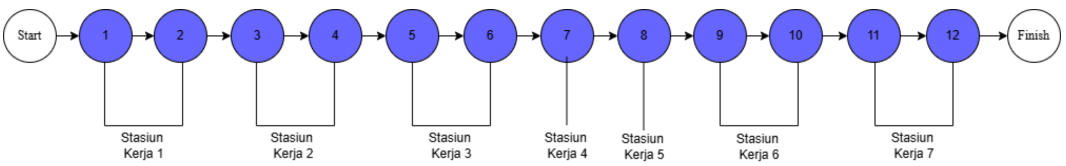

Figure 2. Precedence Diagram RPW Method

The following are details of the grouping of work elements using the RPW method:

Table 5. Grouping of Work Elements Using the RPW Method

Work Station	No	Work Elements	Standard Time	Weight	Ranking	Total Standard Time
Station 1	1	Rubber Pipette Assembly	2,34	30,26	1	5,11
	2	Pipette Assembly	2,77	27,49	2	
Station 2	3	Liquid Filling Process	3,21	24,28	3	6,59
	4	Bottle Closing Process	3,38	20,91	4	
Station 3	5	Print Expired Code	1,44	19,46	5	6,55
	6	Folding Box Formation Process	5,10	14,36	6	
Station 4	7	Insert Bottle Into Folding Box	6,51	7,85	7	6,51
Station 5	8	Attach Label	3,01	4,83	8	3,01
Station 6	9	Stamping Inner Box	0,08	4,76	9	1,03
	10	Fold Inner Box	0,95	3,81	10	
Station 7	11	Insert Folding Box Into Inner Box	1,11	2,70	11	1,46
	12	Insert Inner Box Into Outer Box	0,36	2,34	12	
		Total	30,26			

LE = $\frac{30,26}{7x6,55} x$ 100% = 65,99%
BD = 100% - 65,99% = 34,01%
IT = $n.Tc - Twc$
IT = 7 x 6,55 – 30,26
IT = 15,59 detik

From the calculations above, it can be seen that the line efficiency in the facial serum production process using the RPW method has increased by 65.99%, while the balance delay is 34.01% and the idle time is 15.59 seconds.

3.2.2. Line Efficiency Balance Delay Method

In this method, it is done by having a regional approach by dividing the work elements into the same region or area for each work element that works in parallel. However, we must first make a precedence diagram, namely by dividing the work elements into regional groups vertically.

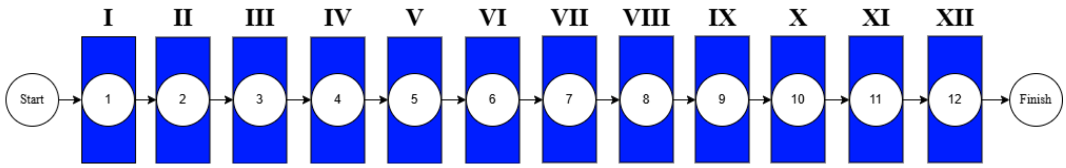

Figure 3. Division of Work Elements into Regions

Table 6. Grouping of work elements using the Region Approach method

Work Station	No	Work Elements	Standard Time	Weight	Total Standard Time
Station 1	1	Rubber Pipette Assembly	2,34	30,26	11,70
	2	Pipette Assembly	2,77	27,49	
	3	Liquid Filling Process	3,21	24,28	
	4	Bottle Closing Process	3,38	20,91	
Station 2	5	Print Expired Code	1,44	19,46	13,06
	6	Folding Box Formation Process	5,10	14,36	
	7	Insert Bottle Into Folding Box	6,51	7,85	
Station 3	8	Attach Label	3,01	4,83	5,50
	9	Stamping Inner Box	0,08	4,76	
	10	Fold Inner Box	0,95	3,81	
	11	Insert Folding Box Into Inner Box	1,11	2,70	
	12	Insert Inner Box Into Outer Box	0,36	2,34	
		Total	30,26		

LE = $\frac{30,26}{3x13,06} x$ 100% = 77,23%
BD = 100% - 77.23% = 22,77%
IT = $n.Tc - Twc$
IT = 3 x 13,06 – 30,26
IT = 8,92 detik

From the calculations above, it can be seen that the line efficiency in the facial serum production process using the RA method has increased by 77.23%, while the balance delay is 22.77% and the idle time is 8.92 seconds.

4. CONCLUSION

Based on data processing using two line balancing methods, namely ranked positional weight and region approach, it can be seen from the difference in the results of the facial serum production process before and after the application of the method used. For the results of line efficiency and balance delay of the facial serum production process before data processing using the ranked positional weight and region approach methods, the line efficiency was 46.34%, then the balance delay was 53.66% and the idle time was 35.04 seconds. After data processing using the ranked positional weight method for the line efficiency of the facial serum production process, the results were 65.99%, then for the balance delay of facial serum production 34.01% and idle time 15.59 seconds. Furthermore, after data processing using the region approach method for the line efficiency of the facial serum production process, the results were 77.23%, then for the balance delay of facial serum production 22.77% and idle time 8.92 seconds. Based on the results of data processing using two line balancing methods, namely ranked positional weight and region approach, it can be seen from the comparison of the results of the two line balancing methods for the facial serum production process, it can be concluded that the region approach method is the best method that can be chosen for line balancing because it has the highest line efficiency value and the lowest balance delay and the lowest idle time value.

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