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Optimizing denim jacket assembly: Comparative analysis of line balancing techniques for efficiency improvement

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Abstract

Bangladesh is one of the world's leading garment producers, with the apparel sector contributing over 80% of the country's total export earnings and around 11% to its GDP. Therefore, guaranteeing competitiveness in the apparel manufacturing sector depends critically on the efficiency of garment production lines. One of Bangladesh's biggest garment companies, XYZ Group, has a denim jacket assembly line whose production efficiency is under improvement. In this company, 27 workstations on the current production line, efficiency is just 51.05%, suggesting unequal allocation of the workload. The objective of this research is to increase the line efficiency through three-line balancing approaches: ranked positional weight (RPW), largest candidate rule (LCR), and computer method of sequencing operations for assembly line (COMSOAL) which were used to redistribute work while preserving precedent requirements in order to solve these inefficiencies. With a balancing delay of 8.4% and a smoothness index of 72.11, COMSOAL achieved the highest efficiency at 91.6%, reducing the number of workstations to 15. Meanwhile, LCR and RPW also improved efficiency to 81.1% and 72.5%, respectively. This study offers a structure for raising denim jacket manufacturing production efficiency and can be modified to various clothing production lines to best use available resources and operational effectiveness.

Keywords: Process Efficiency Improvement; Line Balancing; RPW; Yamazumi Chart; LCR; COMSOAL

1. Introduction

The garment industry plays a significant role in the economy of many countries, especially in Bangladesh, which is one of the largest apparel producers in the world [1]. The demand for high-quality garments, including denim jackets, is increasing due to shifting consumer preferences and the expansion of global fashion markets [2]. To meet these growing demands, manufacturers must ensure that their production lines operate at peak efficiency while maintaining product quality and minimizing waste [3].

Denim jackets, being a highly demanded apparel item, require a structured and efficient production process. However, many garment production lines face inefficiencies due to imbalanced workloads, suboptimal workstation distributions, and excessive cycle times [4]. These inefficiencies lead to increased production costs, higher lead times, and reduced productivity. As industrial engineering has evolved, several systematic methods have been developed to address these challenges through line balancing techniques. Line balancing technique is a systematic approach to allocate the total workload into each workstation as effectively as possible to get the optimum production and it is widely used to increase the efficiency of an assembly line [5] [6]. The efficiency of an assembly line can be improved either by assigning tasks into workstations such that the number of workstations is minimized for a given cycle time (SALBP type-1) or by minimizing the cycle time and maximizing the production rate for a given number of workstations (SALBP type-2) [7]

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[8]. Proper line balancing ensures that tasks are assigned efficiently across workstations, reducing idle time, improving workflow, and ultimately increasing production efficiency [5].

Line balancing is the most important topic in terms of production in factories and industries. Many works have been done focusing line balancing. Line efficiency depends on many factors such as line type (Straight, u-shape), number of line (single, multiple), number of workstations, manpower, machines etc. [9] [10]. A study has been done to improve the existing sewing line efficiency of a product Hoodie using existing resources like machines, personnel and other facilities [11]. Another work in a t-shirts manufacturing industry investigates and demonstrates the application of computer simulation for design and manufacturing. They have been able to increase the efficiency by 9% and labor productivity by 6% [11] [12]. In another research RPW method was used to increase the line efficiency as well as minimize the number of workstations without violating the constraints: precedence relations, cycle time, and resource type in a trouser assembly line [13].

This study focuses on evaluating and optimizing the production line efficiency of denim jacket manufacturing at XYZ Group, Kashimpur, Gazipur, one of Bangladesh’s leading garment manufacturers. The research investigates the current state of the production line, identifying bottlenecks and inefficiencies. In line balancing, while allocating tasks into the workstations some requirements are needed to be followed like, 1) the precedence must be followed strictly; 2) a same task cannot be assigned into more than one workstation; and 3) the workstation time must be equal or less than the talk time [14]. Maintaining this condition, three-line balancing techniques: RPW, LCR, and COMSOAL are applied to improve the line's efficiency. Different parts of denim jacket is shown in figure 1.

Figure 1 Various parts of Denim jacket

The objective of the research is to distribute the total workload as effectively as possible to the workstations for a targeted production rate and to increase the line efficiency. This research is critical as line balancing is an essential aspect of industrial engineering that directly influences productivity, cost-effectiveness, and resource utilization. The findings of this study aim to contribute valuable insights into garment manufacturing optimization, offering practical implications for apparel manufacturers seeking to enhance efficiency in a competitive market. Additionally, as sustainability becomes an increasing concern in the textile industry, improved efficiency can contribute to lower resource consumption and reduced production waste, aligning with global sustainability goals [15].

2. Material and Methods

Methodologies provides a systematic overview entire research method, focusing on the calculation of Standard Minute Value (SMV), cycle time, and line balancing using three different techniques: RPW, LCR, and COMSOAL. The discussion also covers the key performance indicators such as efficiency, balance delay, and smoothness index (SI) with their respective equations and interpretations.

2.1. Research Methodology

- Data collection and preparation of time study sheet for SMV calculations and process times.
- Construction of the precedence diagram to represent the workflow sequence.
- Computation of the existing line's workstations, manpower, cycle time, efficiency, balance delay, and smoothness index.
- Implementation of COMSOAL, RPW, and LCR methods to balance the production line.
- Feasibility analysis of the revised workstation distribution while maintaining precedence constraints.
- Comparison of newly balanced line efficiency with the initial setup.
- Presentation of results, recommendations, and future research prospects for optimizing garment production lines.

2.2. Theoretical Model

2.2.1. SMV

SMV is defined as the time required to complete a specific task under standard working conditions [16]. It is widely used in industrial engineering to evaluate labor productivity and optimize resource allocation. The SMV is calculated based on motion study techniques such as time study, predetermined motion time systems (PMTS), and work sampling.

The basic formula for SMV is:

$$SMV = (ObservedTime \times RatingFactor) + Allowanc \text{.................. (1)}$$

where:

- Observed Time is the actual time taken for the task.
- Rating Factor accounts for worker efficiency.
- Allowances include fatigue, rest, and machine delay time.

2.2.2. Cycle Time

Cycle time is the total time taken to complete a unit of production from start to finish. It defines the required workstation distribution in the production line.

$$CT = \frac{Production\ Volume\ per\ Shift}{Total\ Available\ Time\ per\ Shift} \text{................................ (2)}$$

where:

- Total Available Time per Shift is the net working time excluding breaks.
- Production Volume per Shift is the expected output per shift.

2.2.3. Efficiency

Efficiency measures how well the production line is balanced.

$$Efficiency = \frac{(Total\ Work\ Content\ (SMV))}{Cycle\ Time \times No.of\ Workstations} \times 100 \text{.................(3) [17]}$$

where:

- ∑ Task Times is the total operational time.
- Total Workstations × Cycle Time is the ideal total available time.

2.2.4. Balance Delay

It quantifies the inefficiency caused by uneven workload distribution among workstations. Balance delay indicates the idle time in the production line. The formula for balance delay is [18]:

$$Balance\ Delay\ (BD) = (1 - \frac{Efficiency}{100} \times 100) \text{.................................... (4)}$$

A lower balance delay signifies better workload distribution. Whereas a higher balance delay suggests poor line balancing and inefficiency.

2.2.5. Smoothness Index (SI)

Smoothness Index evaluates the uniformity of workload distribution in various workstation [19].

$$Smootness\ Index\ (SI) = \sqrt{\sum_{i=1}^{N} (CTmax - Ti)^2} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(5)$$

Where:

- SI = Smoothness Index
- $CTmax$ = Maximum cycle time allowed (115 sec)
- Ti = Cycle time in each workstation
- N = Number of workstations

2.3. Line Balancing Techniques

Line balancing technique is a systematic approach to allocating the total workload into each workstation as effectively as possible to get the optimum production and it is widely used to increase the efficiency of an assembly line. Three heuristics line balancing techniques are used to improve the efficiency of the production line.

2.3.1. RPW Method

RPW is a heuristic line balancing technique that assigns tasks based on their total positional weight, calculated by summing the task time and all subsequent dependent task times [20]. The model is developed by Helgeson and Brinie. It helps in achieving a well-balanced production line with minimum idle time.

Procedure

- Compute the Positional Weight for each task.
- Rank tasks in descending order based on their weights.
- Assign tasks sequentially to workstations without exceeding cycle time.
- Maintain precedence constraints while balancing the workload.

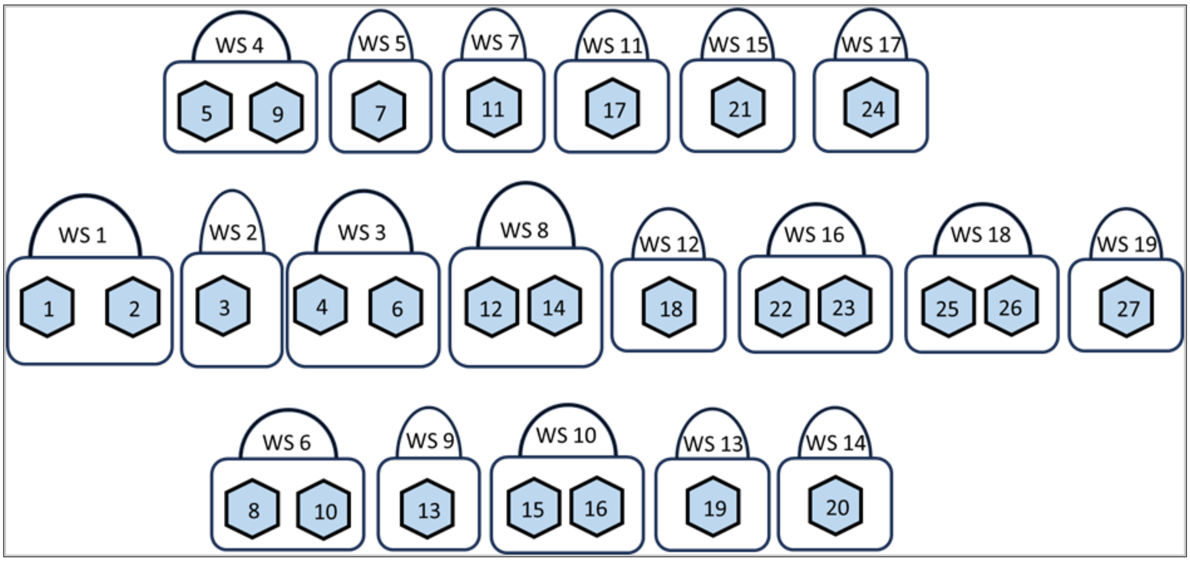

Figure 2 Modified workstation after applying RPW method

The full procedure of the application of RPW method is described in table 1 in the appendix section and the precedence diagram is shown in figure 2. RPW method reduces the total number of workstations from 27 to 19 hence the manpower is reduced. According to the RPW method, two operations are performed consecutively in the same workstation (workstation 1, 3, 4, 6, 8, 10, 16 and 18) where the minimum manpower is removed and only the maximum manpower of these two is allocated into these new workstations. The machine type does not conflict in this merging workstation as both of them are the same machine or one of them is performed by man only or one of the machines is unique and only used in this workstation.

2.3.2. LCR Method

LCR prioritizes tasks based on their individual task time, rather than positional weight. LCR is one of the heuristics methods in which the work elements are assigned to the workstations according to their work processing time [21]. To apply this method, first rearrange the data table in descending order according to their task completion time i.e., the work element with the highest task time at the top of the table. The rearranged table is shown in table 4. First select from the rearranged table an operation that has no precedence and has the maximum task time. Then put it into the workstation 1. If the task time is greater than the cycle time, then no other operation is added to workstation 1 and moved to workstation 2. Select another operation according to the precedence. Add another workstation if its task time is less or equal to the unassigned cycle time. Continue the process according to the precedence diagram. The modified workstations are shown in figure 3. By applying the LCR method the workstations are reduced to 17 from 27 and at the same time the manpower is reduced. The workstation processing time is less than the cycle time. In this method the workstations which combine multiple operations are 1, 3, 4, 6, 7, 8, 10, 15, 16 and 17. The workload is more balanced in this case.

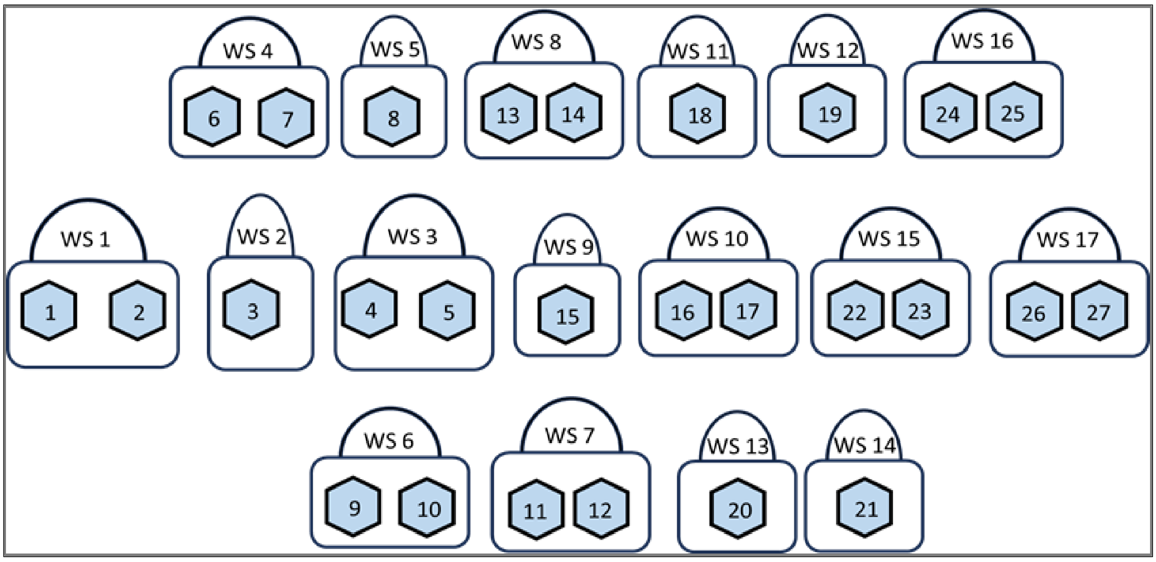

Figure 3 Modified workstation after applying LCR method

2.3.3. Computerized COMSOAL Method

COMSOAL is a probabilistic line balancing method that generates multiple feasible solutions and selects the best fit based on efficiency. COMSOAL is an iterative method developed by Arcus which generates a large number of feasible solutions using a simulation method [22]. To assign the work elements into a workstation, first list the work elements according to precedence and then choose that work element whose processing time is less than or equal to the unassigned cycle time (UACT) and repeat this until the UACT can effort another workstation's processing time according to precedence. If several workstations have the chance to be chosen equally for the same position, then another iteration appears [23]. The modified workstations using COMSOAL are shown in figure 4. The COMSOAL method reduces the total number of workstations from 27 to 15. In this method, UACT is less than the other two methods. Hence, the efficiency is maximum here.

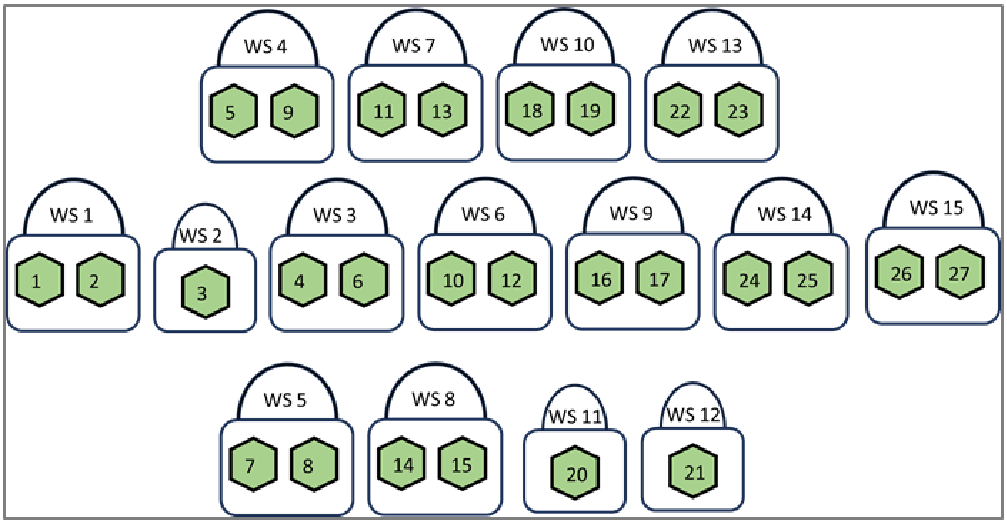

Figure 4 Modified workstation after applying COMSOAL method

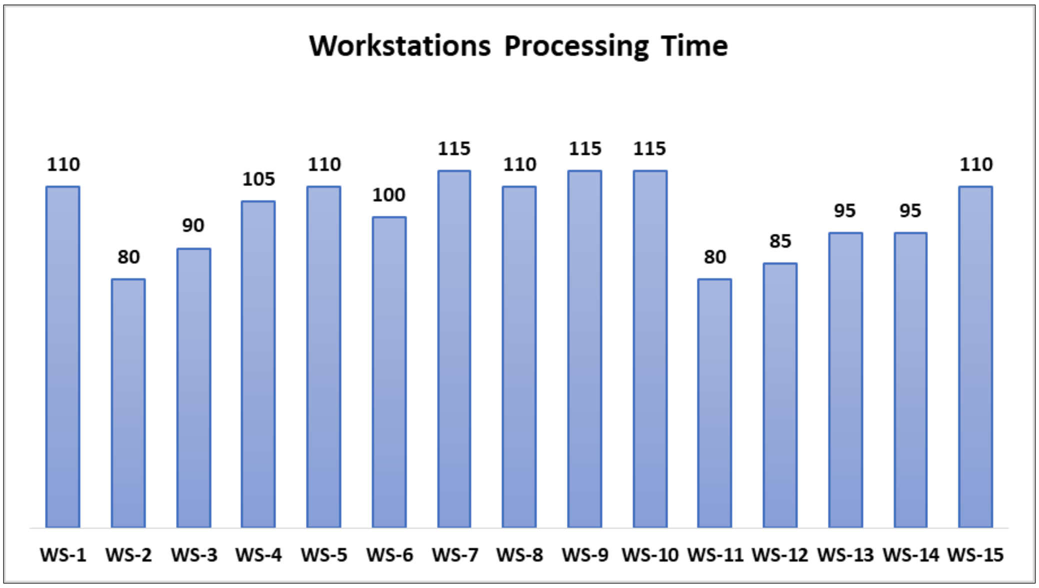

Figure 5 Workstation processing time after applying COMSOAL method

Figure 5 shows the processing time for different workstations which reflects better distribution of workload among workstations.

3. Calculation and Data Analysis

3.1. Existing Line Analysis

The existing production line for denim jacket manufacturing at XYZ Group, one of the largest garment manufacturers in Bangladesh, consists of 27 processes. The processing time for each process is given in figure 6. The figures show that the operation time and workload are unbalanced with the cycle time. The precedence diagram for the existing line is given in figure 7. That is why the efficiency is very low; on the other hand, the smoothness factor is very high for the process.

Upon examining the production line, we observed the process times for each workstation and calculated the SMV. There is a total of three shifts of 8 hours long and the demand of denim jacket per shift is 250 pieces. Each process requires one operator, resulting in a total of 27 workstations. Subsequently, we determined the cycle time based on production demand and shift duration. Finally, the efficiency of the existing line was computed to establish a baseline for comparison with optimized methods.

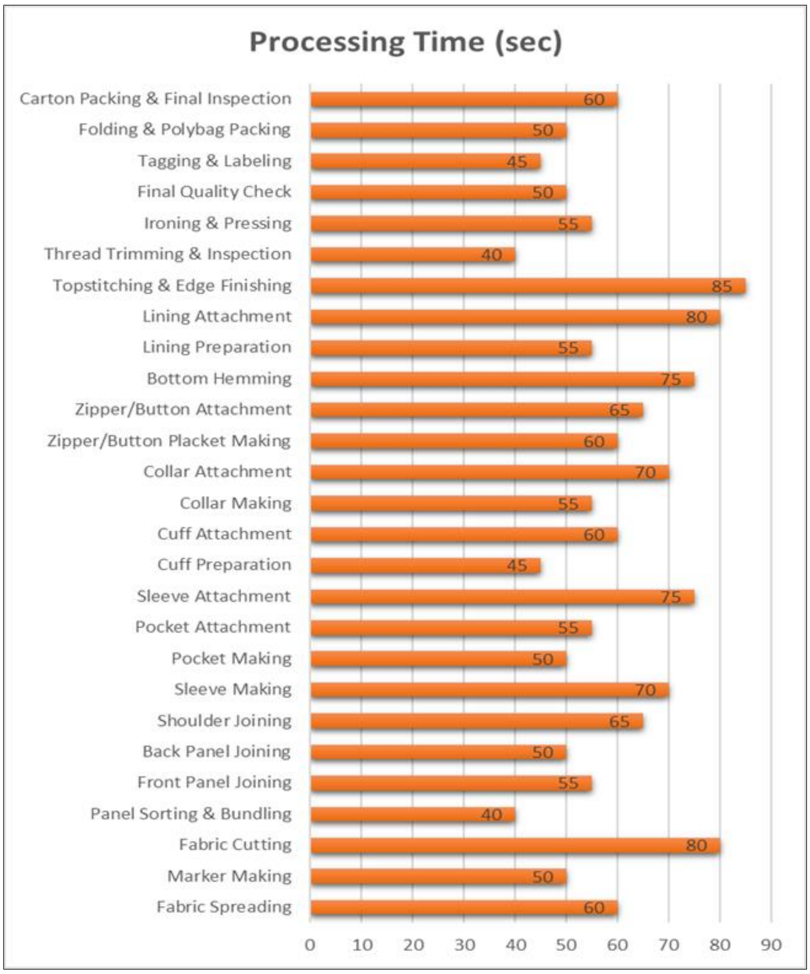

Figure 6 Processing time of operations

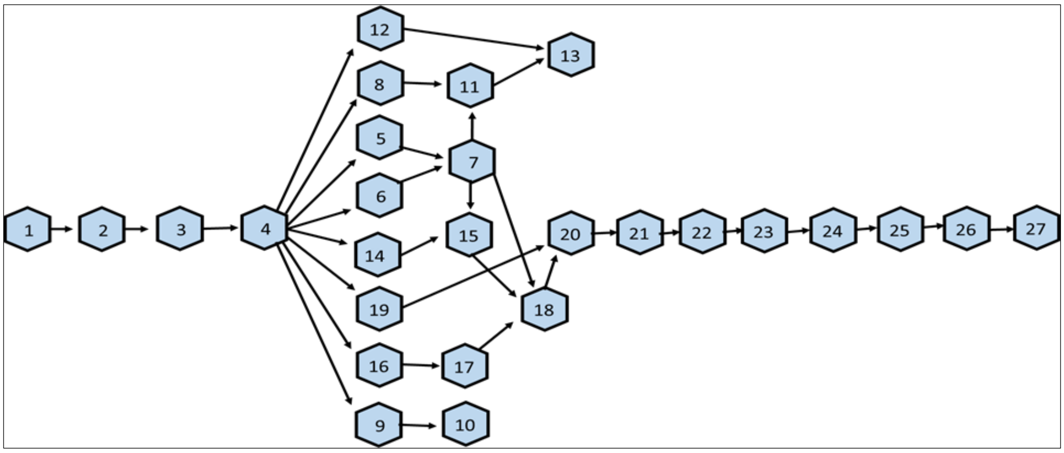

Figure 7 Precedence diagram for the existing production line

3.1.1. Operations Details with CT

Precedence table 1 for denim jacket production with cycle times (in seconds):

Table 1 Operations with their cycle time

Operation No.	Workstation/Task	Preceding Operation(s)	Cycle Time (sec)
1	Fabric Spreading	-	60
2	Marker Making	1	50
3	Fabric Cutting	2	80
4	Panel Sorting & Bundling	3	40
5	Front Panel Joining	4	55
6	Back Panel Joining	4	50
7	Shoulder Joining	5, 6	65
8	Sleeve Making	4	70
9	Pocket Making	4	50
10	Pocket Attachment	9	55
11	Sleeve Attachment	7, 8	75
12	Cuff Preparation	4	45
13	Cuff Attachment	11, 12	60
14	Collar Making	4	55
15	Collar Attachment	7, 14	70
16	Zipper/Button Placket Making	4	60
17	Zipper/Button Attachment	16	65
18	Bottom Hemming	7, 15, 17	75
19	Lining Preparation	4	55
20	Lining Attachment	18, 19	80
21	Topstitching & Edge Finishing	20	85
22	Thread Trimming & Inspection	21	40
23	Ironing & pressing	22	55
24	Final Quality Check	23	50
25	Tagging & Labeling	24	45
26	Folding & Polybag Packing	25	50
27	Carton Packing & Final Inspection	26	60

3.1.2. CT

Shift: 8 hours

Production Volume per Shift: 250 pcs

By using equation 2,

$$CT = \frac{Production\ Volume\ per\ Shift}{Total\ Available\ Time\ per\ Shift}$$

$$= \frac{8 * 60 * 60}{250} = 115.2\ sec\ \approx 115\ sec$$

3.1.3. SMV

SMV is the sum of all cycle times:

SMV=60+50+80+40+55+50+65+70+50+55+75+45+60+55+70+60+65+75+55+80+85+40+55+50+45+50+60=1585 s econds=26.42 minutes

3.1.4. Efficiency Calculation for the existing line:

$$Efficiency = \frac{(Total\ Work\ Content\ (SMV))}{Cycle\ Time \times No.of\ Workstations} \times 100$$

$$= \frac{(1585)}{(115 \times 27)} \times 100$$

$$= 51.05\%$$

3.1.5. RPW Method

Each task's RPW is calculated as:

$$RPWi = ti + \sum(processing\ times\ of\ all\ successors)$$

RPW Value:

Table 2 Positional weight value of RPW method

Operation	Predecessors	Cycle Time (sec)	RPW (Total time of successors)
21	20	85	85
20	18, 19	80	165
19	4	55	220
18	7, 15, 17	75	240
17	16	65	305
16	4	60	365
15	7, 14	70	275
14	4	55	330
13	11, 12	60	390
12	4	45	435
11	7, 8	75	480
10	9	55	535
9	4	50	585
8	4	70	655
7	5, 6	65	720
6	4	50	770
5	4	55	825
4	3	40	865
3	2	80	905
2	1	50	955
1	-	60	1015

Workstation Assignment according to the **RPW** Following Precedence Table.

Table 3 Workstation according to RPW method

Workstation	Operations Assigned	Total Time (≤115 sec)
WS-1	1, 2	110
WS-2	3	80
WS-3	4, 6	90
WS-4	5, 9	105
WS-5	7	65
WS-6	8, 10	110
WS-7	11	75
WS-8	12, 14	100
WS-9	13	60
WS-10	15, 16	115
WS-11	17	65
WS-12	18	75
WS-13	19	55
WS-14	20	80
WS-15	21	85
WS-16	22, 23	95
WS-17	24	50
WS-18	25, 26	95
WS-19	27	60

3.1.6. RPW Efficiency Calculation

$$Efficiency = \frac{(Total\ Work\ Content\ (SMV))}{Cycle\ Time \times No.of\ Workstations} \times 100$$

$$= \frac{(1585)}{(115 \times 19)} \times 100$$

$$= 72.5\%$$

3.1.7. LCR Method

Organizing Tasks in Descending Order of Cycle Time

The given tasks are sorted based on their cycle times from highest to lowest:

Table 4 Organizing tasks in descending order of cycle time

Operation No.	Task Name	Cycle Time (sec)	Preceding Task(s)
21	Topstitching & Edge Finishing	85	20
20	Lining Attachment	80	18, 19

3	Fabric Cutting	80	2
11	Sleeve Attachment	75	7, 8
18	Bottom Hemming	75	7, 15, 17
14	Collar Attachment	70	7, 14
8	Sleeve Making	70	4
13	Cuff Attachment	60	11, 12
27	Carton Packing & Final Inspection	60	26
1	Fabric Spreading	60	-
16	Zipper/Button Placket Making	60	4
26	Folding & Polybag Packing	50	25
24	Final Quality Check	50	23
9	Pocket Making	50	4
6	Back Panel Joining	50	4
2	Marker Making	50	1
7	Shoulder Joining	65	5, 6
17	Zipper/Button Attachment	65	16
5	Front Panel Joining	55	4
10	Pocket Attachment	55	9
19	Lining Preparation	55	4
23	Ironing & Pressing	55	22
15	Collar Making	55	4
25	Tagging & Labeling	45	24
12	Cuff Preparation	45	4
22	Thread Trimming & Inspection	40	21
4	Panel Sorting & Bundling	40	3

Workstation Assignment according to the LCR Following Precedence Table

Table 5 Workstation according to LCR method

Workstation	**Assigned Tasks**	**Preceding Operations**	**Total Time (sec)**
WS1	Fabric Spreading (60s), Marker Making (50s)	-	110
WS2	Fabric Cutting (80s)	2	80
WS3	Panel Sorting & Bundling (40s), Front Panel Joining (55s)	3, 4	95
WS4	Back Panel Joining (50s), Shoulder Joining (65s)	4, 5, 6	115
WS5	Sleeve Making (70s)	4	70
WS6	Pocket Making (50s), Pocket Attachment (55s)	4, 9	105
WS7	Sleeve Attachment (75s), Cuff Preparation (45s)	4, 7, 8	115
WS8	Cuff Attachment (60s), Collar Making (55s)	4, 11, 12	115

WS9	Collar Attachment (70s)	7,14	70
WS10	Zipper/Button Placket Making (60s), Zipper/Button Attachment (65s)	4,16	115
WS11	Bottom Hemming (75s)	7, 15, 17	75
WS12	Lining Preparation (55s)	4	55
WS13	Lining Attachment (80s)	18, 19	80
WS14	Topstitching & Edge Finishing (85s)	20	85
WS15	Thread Trimming & Inspection (40s), Ironing & Pressing (55s)	21, 22	95
WS16	Final Quality Check (50s), Tagging & Labeling (45s)	23, 24	95
WS17	Folding & Polybag Packing (50s), Carton Packing & Final Inspection (60s)	25, 26	110

3.1.8. LCR Efficiency Calculation

$$Efficiency = \frac{(Total\ Work\ Content\ (SMV))}{Cycle\ Time \times No.of\ Workstations} \times 100$$

$$= \frac{(1585)}{(115 \times 17)} \times 100$$

$$= 81.1\%$$

3.1.9. COMSOAL Method

COMSOAL uses randomized assignments to create multiple solutions, selecting the best one that minimizes the number of workstations while maintaining precedence constraints.

3.1.10. COMSOAL Workstation Distribution (Balanced)

Table 6 Workstation according to COMSOAL method

Workstation	Operations Assigned	Total Time (≤115 sec)
WS-1	1, 2	110
WS-2	3	80
WS-3	4, 6	90
WS-4	5, 9	105
WS-5	7, 8	110
WS-6	10, 12	100
WS-7	11, 13	115
WS-8	14, 15	110
WS-9	16, 17	115
WS-10	18, 19	115
WS-11	20	80
WS-12	21	85
WS-13	22, 23	95
WS-14	24, 25	95
WS-15	26, 27	110

3.1.11. COMSOAL Method Efficiency Calculation:

$$Efficiency = \frac{(Total\ Work\ Content\ (SMV))}{Cycle\ Time \times No.of\ Workstations} \times 100$$

$$= \frac{(1585)}{(115 \times 15)} \times 100$$

$$= 91.6\%$$

3.1.12. Balance Delay (BD) Calculation

Balance Delay (BD) measures the percentage of idle time in the production line. It is given by:

$$Balance\ Delay\ (BD) = (1 - \frac{Efficiency}{100} \times 100)$$

Balance Delay (BD) measures for RPW:

$$Balance\ Delay\ (BD) = (1 - \frac{72.5}{100} \times 100)$$

$$= 27.5\%$$

Balance Delay (BD) measures for LCR:

$$Balance\ Delay\ (BD) = (1 - \frac{81.1}{100} \times 100)$$

$$= 18.9\%$$

Balance Delay (BD) measures for COMSOAL:

$$Balance\ Delay\ (BD) = (1 - \frac{91.6}{100} \times 100)$$

$$= 8.4\%$$

3.1.13. Smoothness Index (SI) Calculation

Smoothness Index (SI) helps measure workload variations across workstations. It is given by:

$$Smootness\ Index\ (SI) = \sqrt{\sum_{i=1}^{N} (CTmax - Ti)^2}$$

Where:

- SI = Smoothness Index
- $CTmax$ = Maximum cycle time allowed (115 sec)
- Ti = Cycle time in each workstation
- N = Number of workstations

Smoothness Index (SI) calculation for RPW:

$$(\text{SI}) = \sqrt{87875} = 296.44$$

Smoothness Index (SI) calculation for RPW:

$$(SI) = \sqrt{27225} = 165$$

Smoothness Index (SI) calculation for LCR:

$$(SI) = \sqrt{13950} = 118.11$$

Smoothness Index (SI) calculation for COMSOAL:

$$(SI) = \sqrt{5200} = 72.11$$

4. Results and Discussion

The efficiency analysis of the denim jacket production line at XYZ Group was conducted using three different line balancing methods: RPW, LCR, and COMSOAL. The results of this analysis are summarized in figure 8, which presents the total number of workstations, efficiency percentage, balance delay percentage, and smoothness index for each method compared to the existing production line.

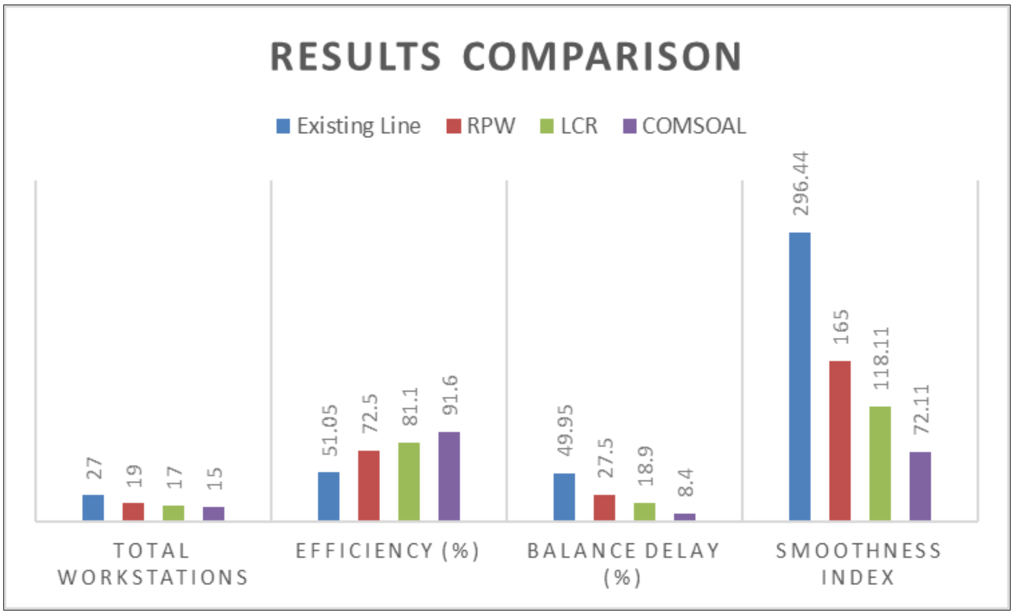

Figure 8 Modified workstation after applying LCR method

The existing line comprises 27 workstations with an efficiency of 51.05% and a high balance delay of 49.95%, indicating significant inefficiencies in workload distribution. In contrast, The COMSOAL method demonstrated the highest efficiency improvement at 91.6%, with only 15 workstations, minimizing balance delay to 8.4% and attaining the best smoothness index of 72.11.

5. Discussion

The findings indicate that the existing line at XYZ Group suffers from significant inefficiencies due to poor workload distribution. The high balance delay (49.95%) and smoothness index (296.44) suggest that certain workstations experience bottlenecks while others remain underutilized, leading to low overall efficiency.

Among the three methods applied, COMSOAL provided the most significant improvements in all key performance indicators. With only 15 workstations, it achieved the highest efficiency (91.6%) and the lowest balance delay (8.4%). This demonstrates the effectiveness of computerized simulation in optimizing production flow by minimizing idle time and ensuring better task distribution.

Overall, these results highlight the importance of adopting systematic line balancing techniques in garment production. The COMSOAL method, in particular, stands out as the most effective approach, suggesting its suitability for large-scale implementation in similar manufacturing environments.

Nomenclature

SALBP	: Single Assembly Line Balancing Problem
RPW	: Rank Positional Weight
LCR	: Largest Candidate Rule
COMSOAL	: Computer Method of Sequencing Operations for Assembly Line
SMV	: Standard Minute Value
UACT	: Unassigned Cycle Time
SNLS	: Single Needle Lock Stitch
SI	: Smoothness Index

6. Conclusion

This research successfully analyzed and improved the efficiency of the denim jacket production line at XYZ Group through the application of three-line balancing methods: RPW, LCR, and COMSOAL. The study found that the existing line was highly inefficient, with an efficiency of only 51.05% and a balance delay of 49.95%.

By implementing line balancing methods, significant improvements were achieved. The COMSOAL method demonstrated the highest efficiency (91.6%), the lowest balance delay (8.4%), and the best smoothness index (72.11), making it the most effective solution. LCR also performed well, improving efficiency to 81.1% with a balance delay of 18.9%. RPW provided moderate improvements but was still superior to the existing set-up.

These findings emphasize the necessity of applying structured line balancing techniques in garment production to enhance productivity and reduce inefficiencies. The study provides valuable insights for industrial engineers and garment manufacturers seeking to optimize production lines, ultimately contributing to increased competitiveness in the global apparel market.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Author Contributions

Conceptualization, AH., ARI. and MSA.; methodology, AH.; software, AH.; validation, AH., ARI.; formal analysis, AH., ARI. and MSA.; investigation, AH., ARI. and MSA.; resources, ARI.; data curation, AH.; writing—original draft preparation, AH., ARI.; writing—review and editing, AH., ARI. and MSA.; visualization, AH.; supervision, MSA., and ARI. All authors have read and agreed to the published version of the manuscript.

Data Availability Statement

Data was provided upon request.

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