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Workload Analysis Using the Full Time Equivalent Method to Determine the Optimal Workforce in the Sewing Section of CV Bebetrend Sukoharjo

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A B S T R A C T

The manufacturing sector, particularly the textile and textile products (TPT) industry, is one of the main pillars of national economic growth. The garment industry plays a strategic role in Indonesia's economy, particularly the labor-intensive sewing process. This study aims to analyze the workload of sewing operators at CV Bebetrend Sukoharjo and determine the optimal number of workers using the Full Time Equivalent (FTE) method. Primary data were collected through stopwatch time study measurements of 10 operators selected via total sampling, supported by observation and interviews during the 2026 research period. The results show that four workstations fall into the normal category, while six workstations experience overload (FTE above 1.28). Adding six operators is recommended to balance workload, reduce dependence on overtime, and save the company's operational costs.

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INTRODUCTION

The manufacturing sector, particularly the textile and textile products (TPT) industry, is one of the main pillars of national economic growth. Indonesia's Central Bureau of Statistics reports that the processing industry contributes around 18-19 percent of the national Gross Domestic Product (GDP), and the TPT industry absorbs approximately 3.75 million workers, or 19.16% of total manufacturing labor (Coordinating Ministry for Economic Affairs). A mismatch between workload and workforce size can reduce a company's operational efficiency (Tridoyo & Sriyanto, 2019).

In the garment industry, the production process consists of cutting, sewing, and finishing stages, with sewing being the most dominant stage because it requires a relatively large workforce and demands high skill, speed, and precision from each operator (Rahman et al., 2023). Workload imbalance can affect productivity, occupational safety, and employee satisfaction (Wijaya et al., 2024), while overload and underload conditions frequently occur in production systems and affect operator performance (Rifka Alkhilyatul Ma'rifat & I Made Suraharta, 2024).

Initial observation of the sewing section at CV Bebetrend Sukoharjo found that the daily production target of 400 pieces per line had not been consistently achieved over the last three months (January-March 2026), with actual output of 370 pieces (92.5%), 350 pieces (87.5%), and 320 pieces (80%) respectively. The gap between target and actual output ranged from 30 to 80 pieces per day, which, if accumulated over one working month (25 days), could result in a production loss of 750 to 2,000 pieces per month. This condition indicates a workload imbalance among operators and suboptimal work distribution.

An objective and systematic workload measurement method is needed to address this issue. The Full Time Equivalent (FTE) method was chosen because it compares the total working time required with the available effective working time, allowing determination of the optimal workforce based on actual workload (Studi et al., 2025). This study analyzes the workload level of sewing operators at CV Bebetrend Sukoharjo and determines the optimal workforce requirement using the FTE method to improve company productivity.

LITERATURE REVIEW

Workload refers to a set of tasks that a worker must complete within a certain period, influenced by job complexity, completion time, and individual capability. Unbalanced workload, whether overload or underload, can reduce productivity (Setyawan et al., 2023). Full Time Equivalent (FTE) is a workload analysis method that compares the total time required to complete a job with the available effective working time (Gerri et al., 2024). This method was chosen because it objectively measures workload and suits a line-production system in which each operator's task is interrelated with others. The FTE value is formulated as:

$$\mathbf{FTE = (Total\ Activity\ Time + Allowance) / Total\ Available\ Time}$$

FTE results are categorized as underload (0-0.99), normal (1-1.28), and overload (above 1.28). Before obtaining the standard time, data sufficiency and data uniformity tests are performed on the time measurement results (Wignjosoebroto, 2008), after which the normal time is adjusted using a rating factor via the Westinghouse System Rating, along with allowances for personal needs, fatigue relief, and unavoidable delays (Sutalaksana, 2006).

Several previous studies demonstrate the effectiveness of the FTE method across industrial contexts. Naufal & Frederika (2026) confirmed a mismatch between staff numbers and workload volume in a data-analysis unit and recommended workforce addition. Suwanto (2025) found workload imbalance in a production section and recommended merging several tasks to achieve an optimal workforce. Hardiansyah & Sibuea (2022) applied FTE in a study-desk manufacturing process to identify the causes of production delays. These studies form the basis for applying the FTE method to the sewing section of CV Bebetrend Sukoharjo, with the main distinction lying in the research object and the characteristics of the production process studied.

Two supporting parameters determine the accuracy of the standard time used to calculate FTE. The Westinghouse rating factor system adjusts the observed cycle time by evaluating four aspects of operator performance - skill, effort, working conditions, and consistency - so that the resulting normal time reflects a reasonably skilled worker rather than the specific individual observed (Sutalaksana, 2006). Allowance, meanwhile, compensates for personal needs, fatigue, and unavoidable delay using the International Labour Organization (ILO) framework, which accounts for energy expenditure, work posture, visual fatigue, temperature, atmosphere, noise, and personal needs (Wignjosoebroto, 2008). Both adjustments are applied before the standard time is converted into annual workload and compared against the total available effective working time to obtain the FTE index.

METHODOLOGY

This research was conducted at CV Bebetrend Sukoharjo, a garment company located in Sukoharjo Regency, Central Java. The study population consisted of all 10 workers in the sewing section, with the sample determined using total sampling.

Primary data included work-activity data, per-activity working time obtained from stopwatch time study, work frequency, production output, actual workforce size, effective working hours, allowances, and interview results with operators and the operations manager. Secondary data included the company profile, employee data, production data, standard operating procedures, and the company's official working hours. Data were collected through literature study, direct observation, and interviews.

Data analysis was carried out in four stages: (1) identifying work activities at each sewing workstation; (2) measuring working time using stopwatch time study, followed by a data sufficiency test, data uniformity test, rating factor determination, and standard time calculation; (3) calculating annual workload using the formula Total Activity Time = Standard Time x Daily Frequency x Working Days, then converting it into an FTE value by comparing it with the total available effective working time; and (4) evaluating the FTE results to formulate workforce-addition recommendations for overloaded workstations.

The sewing section operates 8 hours per day under the working schedule summarized in Table 1.

Table 1. Company Working Schedule

Day	Time	Activity
Monday-Thursday, Saturday	07.30-12.00	Working
	12.00-13.00	Break
	13.00-16.30	Working
Friday	07.30-11.30	Working
	11.30-13.00	Break
	13.00-16.30	Working

The total available effective working time used as the FTE denominator was derived from the annual working calendar. Of the 365 calendar days in the reference year, 52 fall on the weekly day off, 16 are national holidays, and 5 are allocated to leave and other permitted absences, leaving 292 effective working days, equivalent to 2,336 effective working hours or 140,160 minutes per year at 8 working hours per day (Table 2).

Table 2. Calculation of Effective Working Time per Year

Description	Value	Unit
Working hours per day	8	Hours
Working days per week	6	Days
Days per year	365	Days
Weekly day off	52	Days
National holidays	16	Days
Leave / permitted absence	5	Days
Effective working days per year	292	Days
Effective working hours per year	2,336	Hours
Effective working minutes per year	140,160	Minutes

Working time for each element was recorded directly at the workstation using a stopwatch time study, following the sequence of tasks each operator actually performs, such as taking and positioning the material, sewing the component, and inspecting and tidying the result. The repeated cycle-time observations for every element were tested for data sufficiency and uniformity before being averaged into the observed cycle time (Ws). This cycle time was then adjusted twice: first by the rating factor, to obtain the normal time (Wn = Ws x (1+RF)), and second by the allowance percentage, to obtain the standard time (Wb = Wn x 100/(100-allowance)). The rating factor for each workstation, assessed using the Westinghouse system across skill, effort, working condition, and consistency, is presented in Table 3.

Table 3. Rating Factor per Workstation (Westinghouse Method)

Workstation	Skill	Effort	Condition	Consistency	RF	1+RF
Placket Sewing	0.03	0.02	0.01	0.02	0.08	1.08
Pocket Sewing	0.03	0.02	0.01	0.02	0.08	1.08
Pocket Attaching	0.04	0.02	0.01	0.02	0.09	1.09
Shoulder Stitching	0.04	0.03	0.01	0.02	0.10	1.10
Shoulder Sewing	0.04	0.03	0.01	0.03	0.11	1.11
Collar Sewing	0.05	0.03	0.02	0.03	0.13	1.13
Collar Attaching+Closing	0.05	0.04	0.02	0.03	0.14	1.14
Side Overlock+Sleeve Attach	0.05	0.04	0.02	0.04	0.15	1.15
Sleeve/Hem Hemming	0.06	0.04	0.02	0.04	0.16	1.16
Button Attach+Buttonhole	0.06	0.05	0.02	0.04	0.17	1.17

The rating factor values in Table 4 show a clear upward pattern from the front-process stations (placket and pocket sewing, 1.08-1.09) toward the closing-process stations (hemming and button attaching, 1.16-1.17), reflecting the greater dexterity, precision, and attention required as the garment nears completion. Adjustment for allowance used the ILO framework in Table 4, giving a uniform allowance of 15% for all sewing operators based on the shared nature of the work (light physical effort, seated posture, repetitive motion, sustained visual focus, and a moderately noisy environment).

Table 4. Allowance Factors (ILO Framework)

Factor	Category	Allowance
Energy expended	Light	6%
Working posture	Sitting	1%
Work motion	Normal and repetitive	1%
Eye fatigue	Continuous focus on the work object	2%
Temperature	Normal	1%
Atmosphere	Good	0%
Work environment	Somewhat noisy	2%

Factor	Category	Allowance
Personal needs	Male operator	2%
Total allowance		15%

RESEARCH RESULTS

Before workload was measured, initial observation compared each workstation's average daily output against the company's production target of 400 pieces per line, as summarized in Table 5.

Table 5. Production Target and Average Actual Output per Workstation

Workstation	Workers	Avg. Output/Day	Target/Day
Placket Sewing	1	430	400
Pocket Sewing	1	430	400
Pocket Attaching	1	428	400
Shoulder Stitching	1	425	400
Shoulder Sewing	1	405	400
Collar Sewing	1	380	400
Collar Attaching+Closing	1	365	400
Side Overlock+Sleeve Attach	1	360	400
Sleeve/Hem Hemming	1	350	400
Button Attach+Buttonhole	1	320	400

Table 5 shows that the four workstations later classified as normal (placket sewing through shoulder stitching) already met or exceeded the daily target, whereas the six workstations later classified as overload (shoulder sewing through button attaching and buttonholing) were already falling short of the 400-piece target, with shortfalls ranging from 20 pieces at shoulder sewing to 80 pieces at button attaching and buttonholing. This early output gap is consistent with, and is subsequently explained by, the FTE results below.

Standard-time calculations were performed for all work elements at 10 sewing workstations, namely Placket Sewing, Pocket Sewing, Pocket Attaching, Shoulder Stitching, Shoulder Sewing, Collar Sewing, Collar Attaching and Closing, Side Overlocking and Sleeve Attaching, Sleeve and Hem Hemming, and Button Attaching and Buttonholing. The annual FTE value for each workstation was obtained by comparing total activity minutes against the total available effective working time of 140,160 minutes per year. The FTE recapitulation results are presented in Table 6.

Table 6. Recapitulation of FTE Values and Operator-Number Recommendations per Workstation

Workstation	Total FTE	Category	Recommendation
Placket Sewing	1.18	Normal	Remain 1 person
Pocket Sewing	1.23	Normal	Remain 1 person
Pocket Attaching	1.25	Normal	Remain 1 person
Shoulder Stitching	1.28	Normal	Remain 1 person
Shoulder Sewing	1.32	Overload	+1 person (to 2)
Collar Sewing	1.34	Overload	+1 person (to 2)
Collar Attaching+Closing	1.39	Overload	+1 person (to 2)
Side Overlock+Sleeve Attach	1.37	Overload	+1 person (to 2)
Sleeve/Hem Hemming	1.40	Overload	+1 person (to 2)
Button Attach+Buttonhole	1.39	Overload	+1 person (to 2)

Table 6 summarizes the annual FTE index obtained after each workstation's standard time - already adjusted using the rating factors in Table 3 and the allowance in Table 4 - was multiplied by its daily task frequency and the number of working days, then divided by the 140,160-minute annual effective working time from Table 2. The four normal-category workstations correspond to the earlier process stages (placket, pocket, and shoulder stitching), which also carry the lowest rating-factor adjustments, while the six overload workstations correspond to the later, more intricate closing and finishing stages, which carry the highest rating-factor adjustments and the FTE values furthest above the 1.28 upper threshold of the normal category.

To determine how many additional operators would be required to relieve the six overloaded workstations, the total FTE of each was redistributed across a proposed operator count until the resulting average FTE fell within the normal range. The comparison between the initial and proposed conditions is summarized in Table 7.

Table 7. FTE Before and After the Proposed Workforce Addition

Workstation	Initial FTE	Current Workers	Proposed Workers	Proposed Avg. FTE	Category
Placket Sewing	1.18	1	1	1.18	Normal
Pocket Sewing	1.23	1	1	1.23	Normal
Pocket Attaching	1.25	1	1	1.25	Normal
Shoulder Stitching	1.28	1	1	1.28	Normal
Shoulder Sewing	1.32	1	2	0.66	Overload -> Normal
Collar Sewing	1.34	1	2	0.67	Overload -> Normal

Workstation	Initial FTE	Current Workers	Proposed Workers	Proposed Avg. FTE	Category
Collar Attaching+Closing	1.39	1	2	0.70	Overload -> Normal
Side Overlock+Sleeve Attach	1.37	1	2	0.69	Overload -> Normal
Sleeve/Hem Hemming	1.40	1	2	0.70	Overload -> Normal
Button Attach+Buttonhole	1.39	1	2	0.70	Overload -> Normal

Table 7 shows that doubling the operator count at each of the six overloaded workstations brings the proposed average FTE down to a range of 0.66-0.70, which falls under the underload category on a per-operator basis but reflects a deliberate, evenly split allocation of workload between two operators rather than genuine idle time; in practice, the two operators share the station's full-day task cycle. As an alternative to this addition, the company had been relying on overtime at the six overloaded workstations. Table 8 details the estimated monthly overtime incentive at each station under that alternative.

Table 8. Estimated Monthly Overtime Incentive at Overloaded Workstations

Workstation	Overtime/Day (hrs)	Incentive/Day	Incentive/Month
Shoulder Sewing	4.06	Rp110,115	Rp2,870,456
Collar Sewing	4.22	Rp115,026	Rp2,990,681
Collar Attaching+Closing	4.62	Rp126,587	Rp3,291,306
Side Overlock+Sleeve Attach	4.46	Rp121,963	Rp3,171,080
Sleeve/Hem Hemming	4.70	Rp128,899	Rp3,351,417
Button Attach+Buttonhole	4.62	Rp126,587	Rp3,291,306
Total			Rp18,966,246

As shown in Table 8, sustaining current staffing while covering the shortfall through daily overtime of roughly 4.1 to 4.7 hours per operator at the six overloaded workstations would cost the company approximately Rp18,966,246 per month in total, compared with the approximately Rp15,000,000 per month estimated for adding six new operators - a difference that underlies the cost-efficiency argument developed further in the Discussion.

DISCUSSION

The calculations show that every workstation has an FTE value above 1.0, indicating that operators have made optimal use of the available effective working time. Four workstations - Placket Sewing, Pocket Sewing, Pocket Attaching, and Shoulder Stitching - fall into the normal category with FTE values of 1.18 to 1.28, meaning the current number of operators is still adequate. In contrast, the remaining six workstations fall into the overload category with FTE values of 1.32 to 1.40, indicating excessive workload that risks operator fatigue and declining productivity if maintained over the long term.

Adding one operator to each of the six overloaded workstations reduces the proposed average FTE to a range of 0.66 to 0.70, resulting in a more balanced workload distribution. Under this recommendation, the total number of sewing operators increases from 10 to 16. Cost analysis shows that maintaining current conditions and relying on overtime at the overloaded workstations would result in an estimated total overtime incentive of approximately IDR 18,966,246 per month, whereas adding 6 new operators is estimated to cost approximately IDR 15,000,000 per month. Adding workforce is therefore more cost-efficient, with potential savings of around IDR 3,966,246 per month, while also reducing the company's dependence on overtime and lowering operator fatigue risk.

The pattern also indicates that workload imbalance in this line is systematic rather than incidental: it tracks the increasing skill and consistency demands captured by the Westinghouse rating factor as garments move toward completion. This suggests that, beyond simply adding operators, the company can further stabilize workload by cross-training operators from the normal-category stations to assist at closing and finishing stations during peak periods, and by periodically re-evaluating the rating factor and allowance assumptions - which in this study follow a uniform ILO baseline - as production methods or working conditions change.

CONCLUSION AND RECOMMENDATIONS

1. Of the 10 sewing operators at CV Bebetrend Sukoharjo, 4 operators (Placket Sewing, Pocket Sewing, Pocket Attaching, Shoulder Stitching) fall into the normal workload category with FTE indices of 1.18 to 1.28, while the remaining 6 operators (Shoulder Sewing, Collar Sewing, Collar Attaching and Closing, Side Overlocking and Sleeve Attaching, Sleeve and Hem Hemming, Button Attaching and Buttonholing) fall into the overload category with FTE indices of 1.32 to 1.40.
2. To balance the workload according to the FTE standard, adding 6 operators to the overloaded workstations is recommended, bringing the total number of sewing operators to 16.
3. Cost analysis shows that adding workforce (approximately IDR 15,000,000/month) is more efficient than maintaining the overtime system (approximately IDR 18,966,246/month), with potential savings of around IDR 3,966,246 per month while also reducing operator workload.

4. The company is advised to add operators at the overloaded workstations, conduct periodic workload evaluations using the FTE method, reduce dependence on the overtime system, and provide multi-skill training to operators at normal-category workstations so they can assist other stations during work-accumulation periods.

ADVANCED RESEARCH

This study is limited to the sewing section of CV Bebetrend Sukoharjo, using production and work-activity data from the last three months, and does not comprehensively address cost factors or external company factors. Future research is recommended to combine the Full Time Equivalent method with other approaches such as Work Sampling, Line Balancing, Workload Analysis, or production-process simulation, to obtain more comprehensive recommendations regarding production line balance, productivity, and workforce efficiency.

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