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Analysis of Mental Workload in Plastic Packaging Production Operators' Activities Using the Modified Cooper Harper Method

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ABSTRACT

UD Restu Jaya is a manufacturing enterprise producing plastic packaging products from polypropylene (PP) and polyethylene (PE) materials. The variation in task allocation across production lines leads to differing levels of mental workload experienced by operators. Excessive mental workload has the potential to decrease operator focus, accuracy, and overall operational efficiency. Therefore, this study aims to measure and analyze the mental workload of production operators using the Modified Cooper Harper (MCH) method. Primary data were collected through direct workplace observations, in-depth interviews, and questionnaire distribution to the operators. The analysis results indicate that blowing machine setup (7.63), blowing machine troubleshooting (7.94), and cutting machine setup (7.72) fall into the overload category. Meanwhile, most other production activities are categorized as optimal load, whereas machine startup, product weighing, and packing activities are classified as underload. Based on these findings, proposed improvement recommendations focus on high-workload tasks, particularly machine setup and troubleshooting, to minimize cognitive stress, optimize operator performance, and maintain continuous production quality at UD Restu Jaya.

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1. Introduction

Fundamentally, production is an activity aimed at increasing the utility of goods or services to satisfy daily human needs. Within this process, the role of labor is essential. In plastic manufacturing, the production sequence involves several key phases, notably blowing and mixing. The blowing phase processes raw materials into plastic pellets, whereas mixing involves blending and stirring these pellets together (Raja et al., 2023). One manufacturer operating in this sector is UD Restu Jaya, a firm specializing in PP and PE plastic packaging established in 1998. The company manufactures various sizes of plastic bags for crackers, snacks, sugar, and other daily necessities, while also offering custom screen-printing services based on client requests. During operations, management sets specific production targets for each operator. These performance targets directly affect the workload carried by workers on the shop floor. Therefore, evaluating mental workload is essential so the company can understand the level of cognitive pressure operators experience, allowing management to design appropriate interventions to prevent negative impacts caused by excessive workload (Sulistiyo & Vitasari, 2024). Assessing workplace psychological pressure serves as a critical tool for management to map staff cognitive stress levels, enabling the organization to implement preventive measures to minimize the adverse consequences of workload overload (Nurcahyo & Prasetyo, 2023).

In running this plastic packaging production, the plant sets daily output targets of 3 quintals for small packaging and 5 quintals for large packaging. These targets must be met by 34 operators divided into two shifts, with each shift lasting 8 hours. Throughout their shifts, operators must continuously monitor machines that run non-stop, meaning rest breaks must be taken in turns. At the same time, workers carry the responsibility of maintaining output quality. However, production data indicates that the defect rate remains at 5%, equivalent to roughly 15 kg for small packaging and 25 kg for large packaging. These operational circumstances demand ongoing precision and concentration from workers over extended shifts to meet output targets while keeping defect rates low. Such rigorous job requirements are expected to escalate operator cognitive stress during manufacturing routines (Prambahan & Putra, 2023). Compelling staff to preserve constant mindfulness across their working hours to guarantee seamless operations, sustain high output, and satisfy daily quota expectations (Yoggi Aldi Trisnanto et al., 2024).

To evaluate these operational pressures, the Modified Cooper Harper (MCH) method is employed in this research due to its procedural simplicity, rapid execution, and flexibility across diverse operational functions. The MCH framework fits well in task settings centered on human-machine interfaces, including system monitoring, fast operational choices, workplace communication, and total production oversight. Additionally, its 1-to-10 evaluation scale allows operators to report their perceived psychological strain in an intuitive manner. Manufacturing personnel remain highly susceptible to occupational fatigue given their demanding duties and continuous focus requirements (Handika et al., 2021). Evaluating cognitive strain therefore offers an essential reference regarding task burdens, laying the groundwork for designing better workplace ergonomics (Lubis & Mu'minah, 2022).

The Modified Cooper-Harper (MCH) scale has been widely utilized across various sectors to assess mental workload. High workload targets combined with overtime hours significantly increased psychological strain among collection personnel at PT Bank X when evaluated using MCH(Destrada & Pramestari, 2021). Furthermore, excessive mental demands elevate occupational fatigue risks, highlighting the necessity of workload assessments to safeguard employee performance and workplace safety (Okisa Putri Fathonah et al., 2023). However, the critical research gap lies in the heavy focus of prior studies on the service sector or isolated job activities. Research evaluating mental workload across an integrated production line in the plastic packaging industry remains scarce. Consequently, direct data regarding operator mental workload in a continuous manufacturing process is still limited.

The novelty of this study lies in the application of the Modified Cooper-Harper (MCH) method to analyze operators' mental workload across interconnected activities in the plastic packaging production process at UD Restu Jaya. The analysis considers the cognitive demands associated with each production activity, including blowing, mixing, machine monitoring, and quality control. Based on this approach, this study aims to analyze the mental workload of production operators using the Modified Cooper-Harper (MCH) method, identify the activities with the highest mental workload, and propose work system improvement recommendations to support productivity while reducing operators' mental workload.

2. Literature Review

Ergonomi

Ergonomics is a comprehensive approach used to adapt work tasks, equipment, methods, and the overall workplace environment to fit the physical and mental capabilities as well as the limitations of workers, ensuring the creation of a safe, comfortable, healthy, and highly productive atmosphere. The main goal of implementing ergonomic principles is to establish a well-balanced harmony between job demands and the actual capacity of the workforce, which directly contributes to improving their safety, health, overall work performance, and holistic physical and psychological well-being(Adam et al., 2023). Within industrial settings, these principles help identify risk factors across routine operational activities, offering a clear baseline for refining work systems, reducing injury risks, and streamlining operations (Iswahyudi & Putra, 2025). Beyond physical factors, ergonomics also accounts for cognitive dimensions, where mental strain such as sustained concentration, information processing, and real-time decision-making plays a direct role in worker performance. Consequently, analyzing mental workload becomes essential for developing work systems that respect human cognitive boundaries (Dewi & Rahayu, 2026)

Mental Workload

Mental workload is the level of cognitive demand experienced by an individual when performing tasks that involve thinking, information processing, concentration, and decision-making. Mental workload can arise from high job demands, task complexity, time pressure, and the need for workers to maintain focus throughout their activities. Because every job possesses distinct characteristics and difficulty levels, the mental load experienced by workers varies accordingly. Therefore, measuring mental workload is essential to determine the psychological demands placed on workers and to evaluate the alignment between job requirements and individual capabilities (Yasmin et al., 2023). A mismatch between job demands and an operator's mental capacity can increase cognitive load, subsequently impairing the ability to maintain concentration, make decisions, and complete tasks optimally. Analyzing mental workload in industrial environments is crucial for identifying job factors that elevate mental stress and assessing the load felt by workers during operational activities (Pratama & Haq, 2022). Furthermore, mental workload evaluation serves as a fundamental basis for optimizing work systems, such as adjusting task loads and balancing staffing requirements to better align with worker capabilities. This approach is essential for enhancing worker comfort, safety, and operational productivity in industrial environments (Alfonso et al., 2022).

Modified Cooper Harper (MCH)

The Modified Cooper-Harper (MCH) scale is a subjective assessment tool used to measure mental workload based on workers' perceptions of task difficulty. Designed to evaluate the mental strain experienced during work activities, this method uses a decision tree approach that enables a systematic evaluation process, yielding a numerical score that reflects cognitive load. This structured decision tree helps respondents evaluate their working conditions more easily, producing results that accurately reflect their perceived mental demands (Riza Fauzy et al., 2019). The MCH method has been applied across various fields to identify tasks with the highest cognitive demands. Findings from these assessments provide a baseline for evaluating workplace conditions and prioritizing system improvements based on the mental load experienced by personnel. In industrial environments, MCH effectively highlights critical operational tasks that require closer attention, allowing organizations to develop targeted interventions grounded in empirical workload data (Asyari et al., 2025).

Research Gap Analysis

he Modified Cooper-Harper (MCH) method is widely recognized for assessing mental workload across diverse occupational settings. Prior studies show that this approach effectively pinpoints tasks with heavy cognitive demands, offering valuable insights for work system optimization. Nevertheless, the implementation of MCH adapts to specific workplace dynamics and study objectives. Examining previous literature is therefore essential to understand how the MCH method has evolved and been applied across different industrial contexts.

Table 1. Summary of Previous Studies Using the Modified Cooper-Harper (MCH) Method

Author (Year)	Research Object	Method	Main Findings	Research Gap
Destrada & Pramestari (2021)	Collection Department, PT Bank X	Method	High workload targets and overtime increased employees' mental workload.	Focused on the service sector and did not compare production activities.
Handika et al. (2021)	Manufacturing Workers	Mothod	Continuous monitoring activities produced higher mental workload.	Only evaluated a specific work unit.
Firmansyah & Putra (2024)	Production Operators	Method	100% Machine-related activities showed higher mental workload than routine operational tasks.	Did not evaluate an integrated plastic packaging production process.
This Study	Plastic Packaging Production Operators (UD Restu Jaya)	Method	Evaluates mental workload across production activities and identifies activities with the highest mental workload	Provides ergonomic recommendations for workload management in plastic packaging manufacturing

Source:(Destrada & Pramestari, 2021),(Handika et al., 2021),(Prayoga Dwi Firmansyah & Boy Isma Putra, 2024)

As presented in Table 1, the Modified Cooper-Harper (MCH) method has been effectively utilized to assess mental workload across diverse work environments. However, most prior research primarily evaluates overall workload levels or focuses solely on isolated workstations. In contrast, this study applies the MCH framework to examine mental workload across interconnected production tasks within a plastic packaging plant, offering actionable insights for ergonomic interventions and workload management.

3. Methodology

This quantitative descriptive study evaluated operator mental workload in plastic packaging manufacturing at UD Restu Jaya using an ergonomic approach. Workload data were systematically collected across production activities using questionnaires structured according to the standard Modified Cooper-Harper (MCH) rating procedure. The study was conducted at UD Restu Jaya, a plastic packaging manufacturing company located in Pandelegan, Sumberejo Village, Pandaan District, Pasuruan Regency, East Java 67156, Indonesia.

This study employed a quantitative descriptive research design with an ergonomic approach to evaluate the mental workload of production operators involved in the plastic packaging manufacturing process at UD Restu Jaya. This approach was adopted to provide a comprehensive description of the mental workload experienced by operators based on data collected during the study. Mental workload was assessed using the Modified Cooper Harper (MCH) method, which evaluates perceived mental

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workload through operators' subjective assessments of their work activities. The assessment was conducted using a questionnaire developed according to the Modified Cooper Harper (MCH) rating procedure, allowing the mental workload associated with each production activity to be identified systematicallyPrimary data were gathered directly through field observations, interviews, and the administration of Modified Cooper Harper (MCH) questionnaires. Applying a total sampling technique, this study engaged the entire population of 34 production operators and the management of UD Restu Jaya. Theat UD Restu Jaya as survey respondents, comprising 16 workers in the blowing process and 18 workers in the cutting section. Furthermore, in-depth interviews were conducted with the owner of UD Restu Jaya to extract comprehensive details concerning operational conditions, task distribution, job complexity, workplace pressures, and daily routines in plastic packaging production. These interview findings served to reinforce and contextualize the interpretation of the mental workload evaluation results.

This study utilized an adapted version of the Modified Cooper Harper (MCH) questionnaire based on the evaluation protocol outlined by Pramestari et al. (2022) The adaptation involved modifying task descriptions to reflect the specific operational workflows of operators at UD Restu Jaya, while fully preserving the fundamental MCH decision tree structure and its 1 to 10 scale. Because the research relied on a standardized subjective measurement tool and only adjusted contextual descriptions, further statistical validity and reliability tests were omitted.

As for the secondary data in the form of company reports needed for this research, they include:

- Data on the number of production operators.
- Data on the distribution of production operator activities.
- Data on the stages of the plastic packaging manufacturing process.

The overall research procedure is illustrated in the flowchart shown in Figure 1.

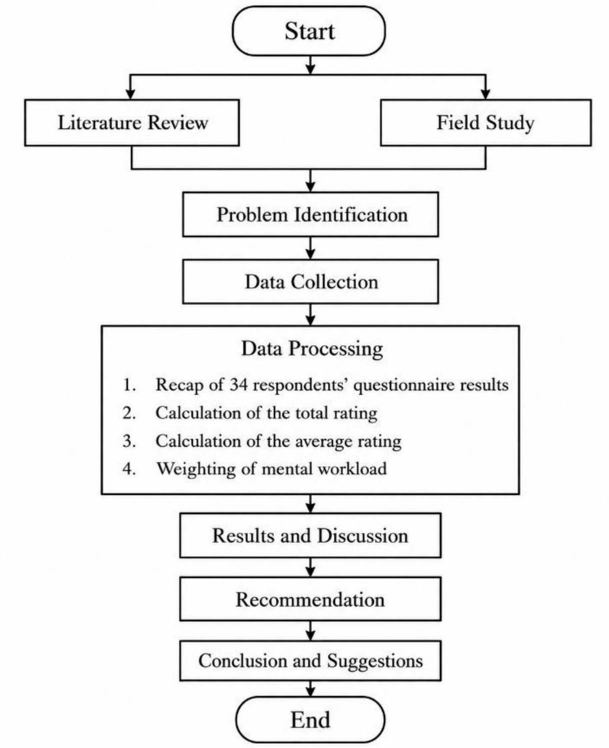

Figure 1. Research Flowchart
Source: Data processing result

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As shown in Figure 1, the research began with a field study and a literature review. The field study was conducted through direct observations and interviews at UD Restu Jaya to obtain an understanding of the working conditions of production operators involved in the plastic packaging manufacturing process. The literature review involved examining theories, previous studies, and other relevant references related to mental workload and the Modified Cooper Harper (MCH) method. Based on the information obtained from these activities, the research problem was identified and formulated to establish the main focus of the study, followed by the determination of the research objectives.

The next stage involved data collection, which consisted of primary and secondary data. Primary data were obtained through direct observations, interviews, and the administration of Modified Cooper Harper (MCH) questionnaires to production operators to assess their perceived mental workload. Secondary data included the number of production operators, working hours, the distribution of work activities, and the stages of the plastic packaging manufacturing process. The collected data were subsequently analyzed through questionnaire data compilation, rating calculation, average rating calculation, and workload weighting to determine the level of mental workload experienced by production operators. A systematic data collection and analysis process is essential to ensure that the findings accurately represent actual working conditions and provide a reliable basis for evaluating and improving the production work system (Andhini Ayu Widyasti et al., 2021).

Following the data analysis stage, the results were interpreted to classify the mental workload of production operators into the appropriate workload categories. The findings were then used to identify work activities associated with the highest levels of mental workload and to formulate improvement recommendations based on the actual working conditions. The processed data were compiled and analyzed to provide appropriate solutions for addressing the identified problems. Finally, conclusions were drawn and recommendations were proposed to support the company in evaluating and improving working conditions, enhancing product quality and productivity, and reducing the mental workload experienced by production operators (Daffa & Pitoyo, 2023).

Modified Cooper Harper (MCH) Measurement Procedure

Mental workload was measured using the Modified Cooper Harper (MCH) method through a series of systematic stages, including the identification of work activities, direct observation, questionnaire distribution, and data analysis to obtain the average mental workload score for each production activity (Prayoga Dwi Firmansyah & Boy Isma Putra, 2024).

$$\mathit{Average}\ \text{Mental Workload Score} = \frac{\text{Rating Score}}{\text{number of respondents}} \quad \ldots\ldots (1)$$

Source. (Prayoga Dwi Firmansyah & Boy Isma Putra, 2024)

The average mental workload score for each work activity was calculated using Equation (1). Subsequently, the workload percentage was calculated based on the percentage formula proposed by Wakil & Ernawaty (2026), where the average mental workload score was used as the numerator because it had been calculated in the previous analysis step.

$$\text{Mental Workload Weight (\%)} = \frac{\text{everage Mental Worload Score}}{\text{Maksimum Score}} \text{X } 100 \quad \ldots\ldots (2)$$

Source. (Wakil & Ernawati, 2026)

Classification of Mental Workload Levels

The Modified Cooper Harper (MCH) approach utilizes a subjective evaluation continuum spanned from 1 to 10 to measure the cognitive pressure felt by workers during task execution. A score of 1 represents minimal mental strain, whereas a score of 10 signifies extreme cognitive demands. In accordance with the MCH evaluation steps outlined by Prayoga Dwi Firmansyah and Boy Isma Putra (2024), the mean MCH rating gathered from operators was transformed into a percentage-based workload index via Equation (2), treating a value of 10 as the upper limit.

To simplify the data analysis, the resulting mental workload scores were grouped into four categories: Underload (10%–40%), Optimal Load (41%–60%), Overload (61%–80%), and High Overload (81%–100%). Tasks labeled as Underload usually involve simple, routine work that requires very little focus or decision-making, while Optimal Load shows a balanced condition where work demands still fit the operator's mental capacity, allowing tasks to be done well without causing excessive stress. On the other hand, Overload covers activities that need constant attention, fast decisions, and high concentration, whereas High Overload represents critical tasks that demand immediate responses and complex problem-solving to keep production running smoothly and avoid product defects. The complete breakdown connecting the MCH scores, workload percentages, and these categories is presented in Table X.

Table 1. Relationship Between MCH Rating Scale, Workload Percentage, and Mental Workload Classification

Average MCH Score	Workload Perencentage	Classification
1.0 – 4.0	10% - 40%	Underload
4.1 – 6.0	41% - 60%	Optimal Load
6.1 – 8.0	61% - 80%	Overload
8.1 – 10.0	81% - 100%	High Overload

Source: Developed by the authors based on the Modified Cooper Harper (MCH) assessment procedure adapted from (Prayoga Dwi Firmansyah & Boy Isma Putra, 2024)

4. Results and Discussion

Respondent Characteristics Based on Production Section

The population of this study consisted of all 34 production operators involved in the plastic packaging manufacturing process at UD Restu Jaya. These operators were directly engaged in all production activities, ranging from machine operation to the final packaging process. The respondents were distributed across several production workstations, as presented below:

Table 2. Distribution of Production Operators at UD Restu Jaya

Production Section	Number of people	Presentase
Blowing Machine Operator	16	47,06%
Cutting and Packing Operator	18	52,94%
Total	34	100%

Source: Primary Data Processed, 2026.

Referring to Table 1, this study involved 34 production operators, consisting of 16 blowing machine operators (47.06%) and 18 cutting and packing operators (52.94%). Differences in sample size across divisions were aligned with staffing requirements at each production stage. All selected respondents directly participate in plastic packaging manufacturing, ensuring their ratings accurately reflect actual mental workload conditions across all work activities.

Questionnaire Score Recapitulation Using the Modified Cooper Harper (MCH) Method

The recapitulation of Modified Cooper Harper (MCH) questionnaire scores was based on the assessments provided by all respondents for each work activity. This recapitulation served as the basis for calculating the rating scores and determining the mental workload category associated with each activity. The data recap for the Modified Cooper Harper (MCH) questionnaire was compiled from ratings submitted by all respondents for each task activity. This recap serves as the baseline for calculating rating values and assigning mental workload categories to each respective activity.

Table 3. MCH Questionnaire Score Recapitulation for Blowing Machine Operators

Responden	A1	A2	A3	A4	A5	A6
Rian	3	4	5	9	5	8
M yunus	2	5	6	7	6	9
Tanto	2	4	5	8	5	8
Masykur	3	6	6	6	6	7
M Tholip	3	5	5	8	5	8
Khayat	3	5	5	9	5	7
Arda	2	4	4	7	4	8
Andi sulis	2	6	6	8	6	9
Yanuar	2	5	5	7	5	8
Dimas Saputra	2	6	6	8	6	8
Gunawan	3	5	5	7	5	7
Kiki Ramadan	3	6	6	9	6	8
Yoga pratama	2	4	4	6	5	8
Candra Wijaya	3	6	6	8	6	7
Hendra	2	5	5	7	5	9
Lukman	3	6	6	8	6	8
Total	42	82	86	122	88	127

Source: Data processing results

Referring to Table 3, questionnaire results from 16 blowing machine operators indicate varying scores across work tasks. Machine startup recorded a total score of 42, raw material preparation scored 82, machine operation reached 86, machine setup totaled 122, cutting and thickness measurement scored 88, and troubleshooting machine faults recorded the highest score at 127. These variations show that each task carries different mental demands. This score data was subsequently used to calculate average values and assign mental workload categories using the Modified Cooper Harper (MCH) framework.

Table 4. MCH Questionnaire Score Recapitulation for Cutting and Packing Operators

Responden	A1	A2	A3	A4	A5	A6	A7
Julia	5	6	8	6	5	3	2
Slatin	5	4	7	5	4	2	2
Annisa	6	5	8	5	5	3	2
Lulut Anasari	6	6	9	6	6	3	3
Khusnul chotima	5	5	8	5	5	2	2
Windah	4	4	7	4	4	2	2
Sugiyati	6	5	8	5	5	3	2
Yuliati	6	6	9	6	5	3	3
Lina	5	4	8	5	5	2	2
Diana	5	4	7	4	4	2	2
Dewi Lestari	6	5	7	6	5	3	2
Erna	5	6	9	6	5	3	3

Sulastri	5	4	7	5	5	2	2
Sri wahyuni	4	5	7	4	4	2	2
Nur aina	6	5	8	5	5	3	2
Yuni Asturi	6	6	9	6	6	3	3
Ernawati	5	5	7	5	4	5	2
Yuliana	4	4	7	4	3	4	2
Total	101	81	139	91	87	45	40

Source: Data processing results

In Table 4, questionnaire feedback from 18 cutting and packing operators also demonstrated score variations across task activities. Mounting rolls onto cutting machines scored 101, measuring product dimensions per orders scored 81, setting up cutting machines reached 139, operating machines scored 91, quality inspection scored 87, weighing products scored 45, and packing recorded the lowest score at 40. These differences highlight that perceived operator mental workload fluctuates depending on the specific task performed. All collected scores were then processed to compute average values for determining workload categories.

Work Activity Rating Assessment of Production Operators

Task rating values were derived from processing questionnaire responses gathered via the Modified Cooper Harper (MCH) method. Calculations strictly followed the analytical procedures outlined in the methodology section.

Table 5. Work Activity Rating Scores of Blowing Machine Operators

No	Activities	Total Ratings	Average Rating
1	Starting the Machine	42	2,63
2	Preparing Raw Materials	82	5,13
3	Operating the Machine	86	5,38
4	Machine Setup	122	7,63
5	Cutting and Measuring Thickness	88	5,50
6	Handling Machine Disturbances	127	7,94

Table 6. Work Activity Rating Scores of Cutting and Packing Operators

No	Activities	Total Ratings	Average Rating
1	Installing Rolls on the Cutting Machine	101	5,61
2	Measuring Products According to Orders	84	4,67
3	Setting Up the Cutting Machine	139	7,72
4	Operating the Machine	91	5,06
5	Quality Inspection	87	4,83
6	Weighing	46	2,56
7	Packaging	40	2,22

Source: Data processing results

Based on data in Table 5 and Table 6, operator task ratings reveal clear differences in mental workload levels. For blowing machine operators, the highest rating occurred during machine troubleshooting 7,94, whereas the lowest occurred during machine startup 7,63. Conversely, for cutting and packing operators, machine setup yielded the highest rating 7,72, while packing recorded the lowest 2.22. These contrasting ratings confirm that work activities carry distinct mental workload burdens depending on task characteristics.Average Rating Calculation for Starting the Machine.

$$\text{Average weight} = \frac{42}{16} = 2{,}63$$

After determining task rating values, score conversion was executed using the standard Modified Cooper Harper (MCH) conversion scale. Converted values served as the baseline to classify task mental workload into underload, optimal load, or overload.

Mental Workload Classification of Production Operators

After the rating scores for each work activity were obtained, they were converted using the Modified Cooper Harper (MCH) method. The converted scores served as the basis for classifying the mental workload of each activity into one of three categories: underload, optimal load, or overload.

Table 7. Mental Workload Classification of Production Work Activities

No	Work Activities	Average Rating	Weight (%)	Classification
1	Starting the Machine	2,63	26,3 %	Underload
2	Preparing Raw Materials	5,13	51,3%	Optimal load
3	Operating the Machine	5,38	53,8%	Optimal Load
4	Machine Setup	7,63	76,3%	Overload
5	Cutting and Measuring Thickness	5,50	55,0%	Optimal load
6	during machine troubleshooting	7,94	79,4%	Overload

Source: Data processing results

As shown in Table 6, weighting results confirm that mental workload levels for blowing machine operators vary across tasks. Machine startup fell under the underload category. Raw material preparation, machine operation, and cutting and thickness measurement were categorized under optimal load. On the other hand, machine setup and troubleshooting were categorized as overload. These findings indicate that most blowing operator tasks remain within ideal cognitive strain boundaries, though setup and troubleshooting involve higher mental strain requiring careful management during execution.

Table 8. Mental Workload Classification of Production Work Activities

No	Work Activities	Average Rating	Weight (%)	Classification
1	Installing Rolls on the Cutting Machine	5,61	56,1%	Optimal load
2	Measuring Products According to Orders	4,67	46,7%	Optimal load
3	Setting Up the Cutting Machine	7,72	77,2%	Overload
4	Operating the Machine	5,06	50,6%	Opimal load
5	Quality Inspection	4,83	48,3%	Optimal load
6	Weighing	2,56	25,6%	Underload
7	Packaging	2,22	22,2%	Underload

Source: Data processing results

Date summarized in Table 7 reveals that mental workload classifications for cutting and packing personnel vary across daily operations, with product weighing and packaging categorized as underload. Conversely, loading roll materials onto cutting equipment, verifying dimensional specifications against customer orders, supervising active machinery, and executing quality control steps belong to the optimal load group. Meanwhile, cutting machine setup is classified under the overload category. These findings confirm that the majority of duties within the cutting and packing line remain within manageable cognitive limits. Even so, machine calibration demands noticeably higher mental effort, marking it as a critical priority for shop-floor interventions.

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Discussion

The results show that blowing machine setup, blowing unit troubleshooting, and cutting machine setup have the highest mental workload levels compared with other production activities at UD Restu Jaya. These activities require operators to adjust machine parameters accurately, monitor production processes continuously, identify machine problems, and make appropriate decisions within a short time to maintain production continuity and product quality. Performing several cognitive activities simultaneously increases the operator's concentration and decision-making demands, resulting in a higher mental workload. In contrast, raw material preparation, blowing machine operation, product inspection, cutting machine operation, and finished product measurement are categorized as optimal workload activities because they follow clearer and more standardized procedures with fewer complex decisions. Meanwhile, machine startup and final packaging are classified as underload activities because they involve simpler, repetitive tasks with lower cognitive demands.

These findings are consistent with the study by Destrada and Pramestari (2021), which explained that high work targets and activities requiring continuous attention can increase workers' mental workload based on the Modified Cooper-Harper (MCH) method. Although their study was conducted in a different field, the results indicate that mental workload is not only affected by the type of industry but also by task difficulty, concentration requirements, and work responsibilities. Furthermore, Abryandoko et al. (2024), found that machine operation and troubleshooting activities require operators to respond quickly to equipment problems while maintaining production continuity. These conditions increase the mental demands experienced by operators. This finding also supports the theory proposed by Jimmy et al. (2022), which states that mental workload increases when task complexity, vigilance requirements, and work responsibilities become higher. oting require greater attention from the company because they create higher mental demands for operators. Identifying activities with the highest mental workload allows the company to determine appropriate improvement strategies based on actual working conditions. The MCH assessment results can be used as a reference for evaluating work systems, managing workload distribut

Based on these results, activities related to machine setup and troublesho ion, and developing strategies to improve production performance at UD Restu Jaya.

Improvement Recommendations

Based on the mental workload assessment using the Modified Cooper-Harper (MCH) framework, initial blowing machine setup, blowing machine troubleshooting, and cutting machine setup. To reduce cognitive fatigue and keep product defect rates under 5%, management should implement the following targeted actions:

1. Conduct Task Specific Training for Setup Operations: Run practical training modules focused directly on initial blowing machine setup and cutting machine setup.
   Expected Impact: Fewer mechanical breakdowns mean operators spend less time handling unplanned blowing machine troubleshooting, preventing sudden spikes in cognitive pressure.
2. Establish Preventive Maintenance for Blowing Machines: Shift from reactive repairs to scheduled inspections targeting high-failure components on blowing units.
   Expected Impact: Fewer mechanical breakdowns mean operators spend less time handling unplanned blowing machine troubleshooting, preventing sudden spikes in cognitive pressure.
3. Schedule Focused Micro-Breaks for Complex Setups: Mandate brief 5 minute rest breaks right before starting cutting machine setup and initial blowing setup.
   Expected Impact: Restoring mental sharpness before fine-tuning machine parameters prevents calibration mistakes and maintains dimensional precision

4. Standardize Setup Protocols for Both Machines: Create simplified, step-by-step checklists for both blowing and cutting machine setups.
   Expected Impact: Standard procedures remove guesswork during initial parameter adjustments, shortening setup duration and reducing overall defect rates.
5. Assign Dynamic Support During Peak Demand: Station secondary operators to assist lead technicians specifically during blowing machine setup and active troubleshooting when production output scales up.
   Expected Impact: Sharing diagnostic and physical tasks prevents single-operator overload, keeping individual mental workload within sustainable limits.

Practical Implication

The results of this study have practical implications for UD Restu Jaya, especially in managing the mental workload experienced by operators during production activities. The MCH assessment shows that several activities, such as blowing machine setup, blowing unit troubleshooting, and cutting machine setup, have higher mental workload levels compared with other activities. These findings can be used by the company as a reference to determine which work activities need improvement first based on actual conditions in the production process. The company can improve the work system by providing additional training for operators, preparing clearer work instructions, and adjusting task distribution, especially for activities that require high concentration and quick decision-making. These improvements are expected to help operators deal with production problems more effectively, reduce excessive mental workload, minimize work errors, and support better production performance.

5. Conclusion

This study successfully evaluated operator mental workload using the Modified Cooper-Harper (MCH) framework at UD Restu Jaya, establishing a direct link between specific task characteristics and cognitive strain. The empirical results reveal that while routine production activities remain within the optimal load zone and minor steps fall into underload, three critical tasks induce severe mental overload: initial blowing machine setup, blowing machine troubleshooting, and cutting machine setup. High cognitive pressure during these specific tasks stems from continuous operator vigilance, complex parameter adjustments, and rapid decision-making required under tight operational limits.

Practically, these findings demonstrate that targeted operational changes rather than generic supervision are essential to sustain factory performance and worker well-being. Management must directly address high-strain tasks by implementing specialized setup training programs, executing preventive maintenance on blowing units, scheduling brief cognitive rest breaks, and balancing technical task assignments during peak demand. Executing these focused interventions will alleviate operator mental fatigue, minimize calibration errors, optimize overall shop-floor workflow, and effectively keep product defect rates below the targeted 5% threshold. Ultimately, this study provides a practical framework for small-to-medium manufacturing enterprises to balance cognitive demands with operational quality.

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