Ann PUBLISHER
Journal Engineering Sciences (Improsci)
e-ISSN 3031-7088
p-ISSN 3032-3452

Work System Improvement in the Production Process Station Area PT SMS Using Macro Ergonomics and Design (MEAD) to Increase Productivity

Heri Setiawan[1], Sani Susanto[2*], Micheline Rinamurti[3], Achmad Alfian[4], Yohanes Dicka Pratama[5] , Dominikus Budiarto[6]
[1]Industrial Engineering Study Program, Musi Charitas Catholic University, Palembang, Indonesia
[2]Industrial Engineering Study Program, Parhyangan University, Bandung, Indonesia
[3]Management Study Program, Musi Charitas Catholic University, Palembang, Indonesia
[4,5,6] Industrial Engineering Study Program, Musi Charitas Catholic University, Palembang, Indonesia
***Corresponding Author : ssusanto@unpar.ac.id**

Abstract:

Background. PT SMS produces bottled drinking water (amdk) in gallons and cups with Vit and Forme brands for gallon packaging and Airnes, Forma, and OK Oce brands in cup packaging. In identifying the problem at PT SMS, it was found that the work system is not well-designed and lacks ergonomics at several workstations, which has an impact on achieving less than optimal daily productivity. The output per work shift set by the company is 2,100 gallons and 3,150 boxes for cup packaging, but in fact, it can only produce approximately 2,050 gallons and 3,000 boxes.
Aim. Analyze the factors that cause the work system to be less effective and less ergonomic. The formulation of work system factors encompasses physical work environment factors, equipment, infrastructure, machinery, workload factors, and organisational factors.
Methods. The Macro Ergonomic Analysis and Design (MEAD) method is used to identify factors that affect the work system and then implement improvements and design changes based on the identified factors.
Results. Physical work environment factors and organisational factors are problems within the work system at PT SMS, as the workspace designated for the production workflow lacks ergonomic support for employees' postures while working, and task management is inadequate. The machinery has not been crafted based on the anthropometric measurements of the workers. Oversight is absent for the work being done, and the standard time required for the production process has yet to be established. So that it increases productivity per work shift at PT. SMS is not optimal and experiences over time.
Conclusions. Redesign of physical work environment facilities, scheduling of rest periods, and organisational factors through supervision from PT SMS resulted in output per shift meeting the standards set by the company..
Implication. The application of MEAD can identify factors that cause suboptimal productivity. Redesigning ergonomic physical work environment facilities, scheduling rest periods, and supervisory organisational factors within the company have an impact on optimising productivity, as measured by the output per shift set by the company.

Keywords: bottled water, work system improvement, MEAD, and productivity.

INTRODUCTION

The demand for healthy and hygienic drinking water in the community tends to increase with the growing population, but the amount of clean water available does not keep pace. Sources of this include groundwater pollution, and this has led to the use of water that is no longer healthy or safe to use as drinking water. (Setiawan et al., 2024b).

One of the bottled drinking water companies (AMDK) is PT SMS, which was built since 2011 and could only start operating at the end of 2015 due to problems and obstacles in the bottled mineral water business permit. Based on the persistence of the owner, who wanted to produce high-quality mineral water for the surrounding community, the business permit was finally obtained at the end of 2015, and production began under his brand, Forme. In early 2016, PT SMS gained the trust of PT Tirta Investama, the pioneer of bottled mineral water in Indonesia, with the AQUA brand, to collaborate in producing bottled mineral water under the Vit brand. The cooperation that has been in place for over eight years continues to encourage the factory to produce high-quality mineral water for the community consistently. SMS factory has an area of 6,493 m2, with building 2,500 m2, including: Production floor, raw material warehouse, finished product warehouse, and office (Aziz & Tarya, 2024).

Water treatment at PT SMS is divided into eight stages, namely: 1) groundwater intake, 2) addition of chlorine and sodium bicarbonate, 3) initial storage tank, 4) manganese filter, 5) carbon filter, 6) catriedge filter, 7) final storage tank, and 8) UV lamp. The production carried out by PT SMS is no longer classified as either unconventional or traditional, so the bottled water production process should meet the desired output target. However, the production process takes a long time and has not achieved the production targets, resulting in decreased work productivity. Based on observations made, four factors can affect production results at PT SMS, namely: (1) physical environment factors, noise in the production process station area is 96 dB with lighting of 2,050-2,780 lux which comes from sunlight during the day and outdoor temperature in the production process station area is 33-35oC, (2) equipment/machine factors, there is work infrastructure equipment that has not been adjusted to the anthropometric size of workers.

LITERATURE REVIEW

The success of the work system can be seen in its high efficiency and productivity, but realizing it is not an easy task because it requires skills to improve the work system. Creating an ergonomic work system necessitates the inclusion of components that ensure the system is ENASE (efficient, secure, pleasant, healthy, and practical) (Setiawan et al., 2024a; El Ahmady et al., 2020).

Ergonomics is a field of study that applies knowledge regarding human characteristics, strengths, and weaknesses to design work environments that support comfort and efficiency. A comfortable working system is deemed suitable within specific boundaries and poses no threat to human health or safety. (Setiawan et al., 2023). A scenario in which employees can agree to job conditions that come with growing technological and organizational constraints. Ergonomics is generally divided into macro and micro. Micro ergonomics is a top-down sociotechnical systems approach to analysing, designing or improving work systems and work organisation, then harmonising the design into the elements as a whole. (Setiawan et al., 2025a; Danial et al., 2024). The field of macro ergonomics research is quite intricate, encompassing various elements such as the organizational framework, policies, work process management, systems of communication, team collaboration, participatory design, evaluation methods, and insights from technology specialists. (Versloot et al., 2024). Macro ergonomics aims to harmonize elements within the work system and organizational structure, focusing on enhancing the design of the work system in relation to the sociotechnical environment. This process involves translating the design features into the micro level to establish a cohesive work system. (Rodríguez et al., 2022; Cahyadi & Setiawan, 2021).

In the context of macro ergonomics, the Macroergonomic Analysis and Design (MEAD) approach is recognized as one of the methods used during the implementation phase of macro ergonomics, aimed at creating a comprehensive system that effectively supports the attainment of organizational objectives. There are 10 stages in implementing MEAD, namely: a) recognizing the organization's surroundings and subsystems (examining the vision, mission, and fundamental principles, assessing environmental factors, and initial aspects of organizational structure), b) specifying the nature of the production system and anticipated performance, c) establishing operational units and workflows, d) determining varying data, e) creating variant matrices, f) developing variant control tables and role networks, g) assigning responsibilities and integrating designs, h) analysing roles and responsibilities, i) redesigning support sub-systems, j) implementation, iteration, and improvement. Other tools used in the research are questionnaires, determination of break time with the equation: $E=1.80411-0.0229083X+4.71733x10^{-4}$ X2, where: E=Energy (Kcal/min), X=heart rate/pulse (beats/min), energy consumption equation K= Et-Ei, where:

K=energy consumption (Kcal/min), Et=energy expenditure at work (Kal/min), Ei=energy expenditure before work (Kcal/min) and then the need for rest time in the equation R=T [(W-S)/(W-1.5)] where: R=rest required (minutes), T=total working time (minutes/shift), W=average energy expenditure at work (Kcal/minute), S=recommended average energy expenditure (S for women=4 Kcal/minute, S for men=5 Kcal/minute), the value of 1.5 is the basal metabolic value (Kcal/minute).

METHOD

This research was conducted at the production process station area of PT SMS, located at Jl Palembang-Betung, KM 17, No. 503, Kel. Sukajadi, Kec. Talang Kelapa, Banyuasin South Sumatra 30961. The research to be conducted will encompass physical environment factors, equipment and machinery factors, work factors, and organisational factors, with the primary objective of identifying the root cause of not maximising productivity. This will be followed by an evaluation of the identified factors using the MEAD approach to implement work system improvements that enhance work productivity. (Silvianita et al., 2024; H Setiawan & M Rinamurti, 2020). The necessary information includes the following: 1) recorded observations, interviews, and pulse readings of employees engaged in tasks at the production work area. (Ma & Zuhair, 2024), 2) using survey data to identify elements within the work system to gather varied information on four different factors (Esmaeili et al., 2023), 3) environmental data concerning the workplace, which includes metrics on temperature, noise levels, and lighting conditions in the production area gathered through direct measurements using tools such as a thermometer, sound meter, and light meter (Davey et al., 2024), and 5) comprehensive company information including details on organizational structure, vision, mission, goals, location, workforce size, and other relevant data pertinent to the study being conducted.

DISCUSSION

Data processing utilizes the MEAD method, which comprises 10 stages that must be fulfilled to address existing problems. (Carlos & Hugues, 2024; Analysis et al., 2024; Jamali et al., 2024). The stages are as follows:

Identification of the physical environment of the production workstation area and organisational subsystems at PT SMS.

The plant occupies an area of 6,493 m² with a building area of 2,500 m². The SMS factory also holds an official license and is certified by BPOM RI MD 265228042054 as Halal, as per MUI. PT SMS has a vision ‘To be the best food product company that is inseparable from the healthy living of Indonesian people by providing the best service’. Mission: Producing and distributing food products that nourish Indonesian people. Company Purpose ‘PT SMS is committed to produce quality products, halal and safe for consumption through efforts to improve quality, halal products and food safety and prevention of pollution on an ongoing basis, under the company's goal of becoming the best producer of food products that are inseparable from the healthy life of the Indonesian people by always providing the best service’.

Define the type of manufacturing system and performance goals.

The manufacturing tasks performed resemble those of a job shop, indicating that the items produced can be tailored according to customer preferences, utilizing various methods and quantities of products within a set timeframe (Rinamurti, M., & Setiawan, H., 2023). Generally, the production of AMDK at PT SMS involves a sequence of production processes in the water treatment section. However, when ordering different products according to consumer desires, actions need to be undertaken as well, rather than focusing solely on the overall order of the manufacturing procedures that must be executed. Performance determination at PT SMS is conducted subjectively by the leader, adjusted according to standard checkpoints or critical points. (Lee et al., 2024; Hasanain, 2024). The provisions to be used are the standard checkpoints in the work system. The performance expectations are presented in Tables 1 and 2.

Define the operating units and work processes at PT SMS.

The operating unit in water treatment at PT SMS is divided into eight stages, namely: 1) groundwater intake, 2) addition of chlorine and sodium bicarbonate, 3) initial storage tank, 4) manganese filter, 5) carbon filter, 6) catriedge filter, 7) final storage tank, and 8) UV lamp. The types of equipment/machinery and infrastructure facilities and their quantities are as follows: a) 12 Water treatment machines, b) 2 Packaging machines (filling and packaging), c) 2 Bottle washer machines, d) 2 Bottle dryers, e) 2 Carton packaging machines, f) 2 Counting and packaging machines, g) 1 Water quality testing machine, h) 3 Water pumps and chemical pumps, i) 5 Water and chemical storage tanks, and j) 2 Pipe and valva systems. The production process at PT SMS is relatively straightforward but requires a relatively long product processing time, especially in the packaging and finished goods section, before being packaged and placed in the box. For other processes, it is brief because the production process of mineral water in gallon and cup packaging is almost entirely automated. The production process station area that is less ergonomic occurs during the process of transporting gallons from the conveyor belt, which is still done manually. The existing production process is carried out at a single production site, which facilitates collaboration on the product and allows tasks to be completed in conjunction with the assigned tasks, while also offering flexibility in the work done (Hughes et al., 2024).

Identifying variant data.

The identification of variant data aims to identify problems that occur at PT SMS, facilitating the analysis. To obtain more detailed variant data, a questionnaire was distributed to all workers at the production stage, allowing for an understanding of the problems faced by workers in the AMDK production section at PT SMS. After calculating the percentage of all respondents' answers from the questionnaires distributed, variant data can be identified, as shown in Table 3.

Building a variant matrix.

At this stage, the variant data obtained is analyzed to determine the relationship between variants and whether one variant can affect other variants. The factor whose variant has the most linkage relationship will become the key variant. The selected key factors are presented in Table 4.

Creating key Variant management tables and responsibility networks.

The objective of this phase is to determine the current variant management practices and the functions of the staff responsible for accountability at PT SMS. The results of determining the key variant control and role network are presented in Table 5.

Table 1. Quality and Flexibility

Check points	Number of Checkpoints	Quality	Number of checkpoints	Flexibility
Supplier	1	The supplier's ability to provide raw materials for bottled mineral water when needed, and also pay attention to the quality of the raw materials.	6	Supplier flexibility is seen when it can provide raw materials for bottled mineral water whenever needed.
Input	2	Input quality is reflected in the variants of raw materials used for bottled mineral water and in worker performance during product production.	7	Flexibility depends on the standard specifications of mineral water in product packaging, which can be adjusted to meet the customer's specific needs.
Process	3	The quality of the production process can be seen in the accuracy and success of adjusting to the product orderer's wishes.	8	The flexibility of the production process is evident in the stages that can be adjusted to meet the product desired by the purchasing vendor.
Output	4	The quality of the output can be assessed by examining product quality standards and product performance.	9	Output flexibility depends on the standard of AMDK products that have been produced.
Outcome	5	The quality of the outcome depends on the level of consumer satisfaction with the product results and the product's quality standards.	10	The flexibility of the outcome is evident in the level of satisfaction with the product that the purchasing vendor has experienced.

Table 2. Performance Expectations

Check points	Number of Checkpoint	Performance Expectations
Input Utilization	11	The use of raw materials for bottled water products depends on consumer demand standards as well as the brand and type of gallon or cup packaging.
Capacity	12	Determining the capacity of mineral water products in gallon and cup packaging depends on the wishes of the purchasing vendor.
Innovation	13	Innovation is carried out based on the quality specifications of the packaged mineral water products that are made and the creativity of workers in carrying out finishing such as packaging that is in accordance with the requests of the purchasing vendor.
Output Production	14	The production output obtained is the mineral water product in gallon and cup packaging that is in accordance with the wishes of the consumer, vendor, buyer and the time agreed upon at the time of the vendor contract.
Productivity	15	Productivity is carried out when there is an order from the consumer because it uses the Make to Stock (MTS) and Make to Order (MTO) methods.
Process Value	16	Process value is based on all costs required in the production of mineral water in gallon and cup packaging ordered according to the specifications of the purchasing vendor and also the profits to be obtained from the sale. Process value is also seen in terms of the quality of the product that has been produced whether it is in accordance with the specifications of the request.
Management	17	Management is applied directly to the work system at PT SMS based on provisions by the company owner.

Table 3. Variant Data

Variant Factor	Variant
Physical Environment	The temperature in the production process station area is hot.
	Noise in the production process station area exceeds the NAB.
Equipment/Machinery and Infrastructure	Machine work/infrastructure slowed down due to bottlenecks in the conveyor belt when handling gallons of material.
	Maintenance of machinery/infrastructure is done irregularly.
	The design of facilities and infrastructure still fails to take into account the anthropometry of workers.
Working Conditions	Workers easily experience fatigue while working.
	Workers often experience work stress.
	There is no Personal Protective Equipment (PPE) provided for all workers, especially those involved in manual material handling (MMH).
Organisation	The social security provided is not yet appropriate.
	Leaders pay little attention to the workplace.
	Leaders do not reward workers.

Preparation of function allocation and joint design.

This stage aims to make function allocation and alternative design improvements from the variant control table and existing key variants in the form of an objective tree. The alternative design is illustrated in Figure 1. Evaluation of roles and perceptions of responsibility. At this stage, it is used to assign weight to each alternative improvement obtained, so that the weighting carried out will produce the best alternative that can later be used to improve the work system at PT SMS.

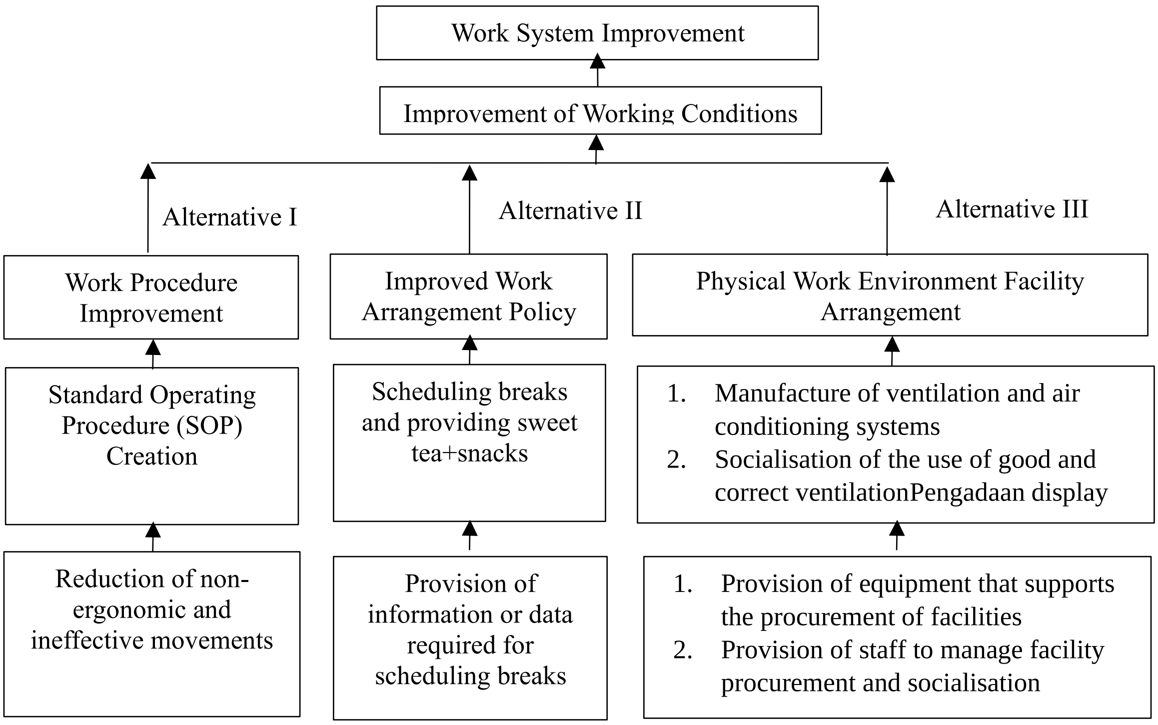

Figure 1. Objective Tree (Alternative Problem Solving)

Table 4. Variant Matrix

Variant Factor	Variant	Process station temperature Production	Noise in the sasiun area production process	Machine work/ infrastructure	Unorganised carer	Means not yet anthropometric workers	Workers get tired easily	Workers are easily stressed	No noise PPE yet	Social security is not yet appropriate	Lack of attention to the workplace	No awards yet	Total
Physical Environment	The temperature in the production process station area is hot					X	X	X	X				4
	Noise in the production process station area exceeds the NAB								X				1
Equipment/ Machinery and Infrastructure	Engine work slows down						X	X					2
	Irregular maintenance	X					X	X					3
	Not yet anthropometric						X	X					2
Working Conditions	Workers are tired	X	X	X	X	X		X	X				7
	Stressed out worker	X	X	X		X	X			X			6
	Belum pakai APD bisning Not yet wearing PPE bisning		X								X		1
Organisation	Social security does not yet exist							X				X	2
	Lack of attention						X	X	X				3
	No awards									X			1

The weighting of the alternatives that have been made is (Rodríguez et al., 2022; Mahfirah'eni & Suhardi, 2021); improvement of work procedures with a total weight of 0, improvement of work arrangement policies with a weight of 5, and provision of physical work environment facilities with a weight of 5.

Table 5. Key Variant Control and Role Network

No.	Key Variant	Key Variant	Handling Party	Directly Involved Parties	Existing Support Activities
1.	Workers easily experience fatigue while working	Production process station area	Leader	Production process station area workers	Resting area near at production floor
2.	Workers often experience work stress	Production process station area	Leader	Production process station area workers	-

Improving the supporting sub-system.

This phase focuses on creating enhancements for subsystems that will subsequently be implemented to upgrade the current work system, thereby enhancing the productivity of employees within the production department at PT SMS. In this design, the assessment of workers' heart rates, the evaluation of cardiovascular strain (%CVL), and the determination of energy usage are conducted to ascertain the necessary duration of rest for production personnel at PT SMS.

Workload calculation

The 17 PT SMS worker respondents studied consisted of 12 male workers and 5 female workers, aged between 26 and 34 years. The average resting pulse rate (DNI) was 77.08 minutes, the average working pulse rate (DNK) was 117.49 minutes and the maximum pulse rate (DNmax) was 182.94 minutes.

Calculation of % HR Reverse:

$$\text{\% HR Reserve} = \frac{DNK-DNI}{DNmax-DNI} x\ 100 = \frac{117{,}49-77{,}08}{182{,}94-77{,}08}\ x\ 100 = 38{,}17\%$$

Calculation of Cardiovascular load (%CVL):

$$\text{\% CVL} = \frac{100\ x\ (DNK-DNI)}{DNmax-DNI} = \frac{100\ x\ (117{,}49-77{,}08)}{182{,}94-77{,}08} = 38{,}17\%$$

Energy consumption calculation:

Known: X = 117,49 (Working pulse rate (beats/minute)), so that:

$Et = 1{,}80411 - 0{,}0229083X + 4{,}71733 \text{ x } 10^{-4} X^2$

$= 1{,}80411 - 0{,}0229083\ (117{,}49) + 4{,}71733 \text{ x } 10^{-4}\ (117{,}49)^2 = 5{,}62$ Kkal/menit

Known: X = 77,08 (Working pulse rate (beats/minute)), so that:

$Ei = 1{,}80411 - 0{,}0229083X + 4{,}71733 \text{ x } 10^{-4} X^2$

$= 1{,}80411 - 0{,}0229083\ (77{,}08) + 4{,}71733 \text{ x } 10^{-4}\ (77{,}08)^2 = 2{,}84$ Kkal/menit

Energy consumption calculation as follows: K = Et-Ei. K= 5,62 – 2,84 = 2,78 Kkal/menit

Calculation of the length of break time:

W=5,62 Kkal/minute; T=480 minute/ working days; S for female=4 Kkal/minute; S for male=5 Kkal/minute; Basal Metabolism=1,5 Kkal/minute

$$R = T\frac{(W-S)}{W-1{,}5} = 480\frac{(5{,}62-5)}{(5{,}62-1{,}5)} = 72{,}23\ menit\ \approx 72\ minute \text{ (for male)}$$

$$R = T\frac{(W-S)}{W-1{,}5} = 480\frac{(5{,}62-4)}{(5{,}62-1{,}5)} = 188{,}74\ minute\ \approx 189\ minute \text{ (for female)}$$

From the assessment of the duration of downtime for employees in the manufacturing area of the operational process, the results are 72 minutes for male workers and 189 minutes for female workers, so that the rest time which is only 60 minutes/working day needs to be increased by 12 minutes / working day for male workers and 129 minutes/working day for female workers.

Implementation, iteration, and refinement.

In the last stage of the MEAD method, namely the implementation of the results obtained from the previous stage, based on the alternatives that have been selected and the results of the design of supporting sub-systems. Implementation is carried out as a form of improvement, namely by assessing the heart rate of employees through the 10 pulse technique, which helps determine break times based on the tasks assigned to them in the production area. We aim to lessen the fatigue experienced by workers throughout their duties (Hadasa et al., 2024).

Following the receipt of the outcomes from the computation regarding the increment of employees' break periods, it is then applied to workers with the permission of the company owner by simulating the results of alternative improvements that have been selected, then interviews are conducted with workers in the production section of PT SMS to find out the differences in conditions felt before and after the addition of rest hours (Setiawan, Susanto, Rinamurti, et al., 2025b). Based on the results of the improvement of the work arrangement policy, it is found that the calculation of the %CVL results is better the workload obtained is 38.17%, so the workload in the production section is categorised as having a moderate workload and needs to be improved (Setiawan, H., et al., 2025) (Okunade et al., 2023; Selamat et al., 2021). Extra break periods for employees in the manufacturing area amounting to 12 minutes per workday for male employees and 129 minutes per workday for female employees (Setiawan et al., 2025c; Nurmianto et al., 2024).

The energy expended before the addition of rest time was 5.62 Kcal/minute while the energy expended after the addition of rest time was 2.84 Kcal/minute. The additional rest time of 12 minutes is scheduled for production workers outside the normal rest time, namely at 10.00-10.12 WIB while the normal 60-minute break is carried out at 12.00 - 13. 00 WIB, for female workers is equal to male workers, with this can reduce fatigue from the workload received by workers who are routine or monotonous and also influenced by air temperature conditions that reach 35ºC in the production section (Swann et al., 2024), workers have the appropriate time to restore stamina so they can continue their work properly, and scheduling additional time makes workers have more time to make good social contact with fellow workers in the production section (Fadhilah et al., 2024).

CONCLUSION

The goal of enhancing the work system revolves around the chosen essential elements aimed at refining the work organization approach by introducing more breaks for employees in the production department of PT SMS. Enhancements implemented based on feedback from employees due to the fatigue experienced by workers during production tasks. Modifications to the work process aim to decrease the fatigue experienced by employees, with the %CVL computation yielding a result of 38.17%, categorizing it within the moderate workload range that requires attention. Improvements made are by adding rest time for 16 minutes / working day outside the normal rest time of workers at 10.00-10.12 WIB, with a total rest time obtained by male and female workers of 72 minutes / working day. According to the extra break periods, there was a boost in work efficiency observed in the manufacturing line aimed at meeting the AMDK goal, achieving a total of 2,100 gallons and 3,150 boxes, compared to earlier figures of 2,050 gallons and 3,000 boxes.

.

IMPLICATION

The application of MEAD is able to identify factors that cause suboptimal productivity. Ergonomic redesign of work facilities, scheduling of breaks, and organisational factors of supervision from the company have an impact on optimising productivity in accordance with the output per shift set by the company.

Acknowledgement:
The authors would like to thank Prof. Dr. Ir. Sani Susanto, M.T., Ph.D., CRMP, IPU, AER, Prof. Drh. drh. Retno Widyani, M.S., M.H., the academic community of Industrial Engineering Study Programme, Faculty of Science and Technology, Catholic University of Musi Charitas, and the entire PT SMS community for allowing this paper to be published.

BIBLIOGRAPHY

Aziz, D., & Tarya, A. (2024). Saltwater Intrusion at Kapuas Besar Estuary Using 1-Dimensional Analytical Method. *IOP Conference Series: Earth and Environmental Science*, *1298*(1). https://doi.org/10.1088/1755-1315/1298/1/012003

Cahyadi, A., & Setiawan, H. (2021). Rancangan Perbaikan Postur Kerja Dan Temperatur Lingkungan Kerja Yang Ergonomi Untuk Meningkatkan Produktivitas Tiang Kotak Sampah. *SAINTEK : Jurnal Ilmiah Sains Dan Teknologi Industri*, *4*(1), 33–41. https://doi.org/10.32524/saintek.v4i1.148

Carlos, J., & Hugues, O. (2024). *Organizational and Human Factors in Dentistry : A Macroergonomic Approach to Maximize Dental Practice Performance and Minimize Burnout and Psychophysical Stress*. 47–51.

Danial, M. M., Purnaini, R., Hadary, F., Lestari, A. D., Prasetya, H., Yhavez, D. D., Putri, E. M., & Apriyantine. (2024). Small Scale Plant of Desalination Using Multiple Tray Aerator and Two Different Membranes of Reverse Osmosis Using Low-Pressure Pump. *IOP Conference Series: Earth and Environmental Science*, *1298*(1). https://doi.org/10.1088/1755-1315/1298/1/012008

Davey, S. L., Lee, B. J., Robbins, T., & Thake, C. D. (2024). Prevalence of occupational heat stress across the seasons and its management amongst healthcare professionals in the UK. *Applied Ergonomics*, *118*(April), 104281. https://doi.org/10.1016/j.apergo.2024.104281

El Ahmady, F. R., Martini, S., & Kusnayat, A. (2020). Penerapan Metode Ergonomic Function Deployment Dalam Perancangan Alat Bantu Untuk Menurunkan Balok Kayu. *JISI: Jurnal Integrasi Sistem Industri*, *7*(1), 21. https://doi.org/10.24853/jisi.7.1.21-30

Esmaeili, R., Shakerian, M., Esmaeili, S. V., Jalali, M., Pouya, A. B., & Karimi, A. (2023). A multicomponent quasi-experimental ergonomic interventional study: long-term parallel four-groups interventions. *BMC Musculoskeletal Disorders*, *24*(1), 1–15. https://doi.org/10.1186/s12891-023-06220-4

Fadhilah, N., Abdul Rahim Matondang, & Anizar Anizar. (2024). Assessing Work System Processes Using Macroergonomic Analysis and Design Approach: A Literature Review. *Jurnal Sistem Teknik Industri*, *26*(1), 47–56. https://doi.org/10.32734/jsti.v26i1.12878

H Setiawan & M Rinamurti Series, I. O. P. C. (n.d.). *Recommendations of ergonomic checkpoints and total ergonomics intervention in the pempek kemplang palembang industry Recommendations of e rgonomic c heckpoints and t otal e rgonomics i ntervention in t he p empek k emplang p alembang i ndustry*. https://doi.org/10.1088/1757-899X/885/1/012057

Hadasa, Y. B., Murdjito, Prastianto, R. W., Djatmiko, E. B., Wahyudi, & Faiz, M. (2024). Study on the effects of lifting loads on the longitudinal strength of a crane barge during heavy lifting operations due to various angle of crane rotation. *IOP Conference Series: Earth and Environmental Science*, *1298*(1). https://doi.org/10.1088/1755-1315/1298/1/012021

Hasanain, B. (2024). The Role of Ergonomic and Human Factors in Sustainable Manufacturing: A Review. *Machines*, *12*(3). https://doi.org/10.3390/machines12030159

Hughes, N., Jia, Y., Sujan, M., Lawton, T., Habli, I., & McDermid, J. (2024). Contextual design requirements for decision-support tools involved in weaning patients from mechanical ventilation in intensive care units. *Applied Ergonomics*, *118*(April), 104275. https://doi.org/10.1016/j.apergo.2024.104275

Jamali, N., Gharib, M. R., Moayyedian, M., & Hedayati-Dezfooli, M. (2024). Machine Learning for Optimizing Macro-ergonomics in Pharmaceutical Supply Chain. *International Journal of Computational Intelligence Systems*, *17*(1). https://doi.org/10.1007/s44196-024-00513-9

Lee, C., Shin, M. J., Eniyandunmo, D., Anwar, A., Kim, E., Kim, K., Yoo, J. K., & Lee, C. (2024). Predicting Driver's mental workload using physiological signals: A functional data analysis approach. *Applied Ergonomics*, *118*(March), 104274. https://doi.org/10.1016/j.apergo.2024.104274

Ma, F., & Zuhair, M. H. (2024). *Examination of the Impact of Work System Variables on Job Satisfaction Utilizing the MOQS Methodology*. *7*(2), 134–147.

Mahfirah'eni, R., & Suhardi, B. (2021). Implementation of Macroergonomics in Human Safety. *Asian Journal of Social Science and Management Technology*, *3*(6), 2313–

7410. www.ajssmt.com

Mead, D., Hidayat, T., Triaananda, Z., Hendrick, W., & Kleiner, B. M. (2024). *Analysis Global Usulan Perancangan Sistem Kerja dengan Metode*. *Jurnal Inovasi*. *2*(2), 238–248.

Nurmianto, E., Kusuma, S. H., Soehardjoepri, S., Nadhiroh, S. R., Rahmaningsih, S., Fauziah, F. N., & Trikurniawan, G. S. (2024). Processed Seafood Determination for Fishermen Prosperity Using Macro Ergonomic and Analytical Hierarchy Process. *IOP Conference Series: Earth and Environmental Science*, *1298*(1). https://doi.org/10.1088/1755-1315/1298/1/012009

Okunade, O. S., Oladokun, V. O., Iwu-Jaja, C. J., Jaca, A., & Wiysonge, C. S. (2023). Protocol for a scoping review of work system design in health care. *F1000Research*, *12*, 1–13. https://doi.org/10.12688/f1000research.128913.2

Rodríguez, Y., Pérez, E., & Robertson, M. M. (2022). Ergonomic Maturity Model: A tool for integrating ergonomics/human factors into organizations. *Work*, *73*(s1), S279–S292. https://doi.org/10.3233/WOR-211142

Selamat, M. N., Mohd, R. H., Mukapit, M., Abdul Aziz, S. F., & Omar, N. H. (2021). A Review on Participatory Ergonomic Approaches: What ‘Participants’ mean to the Organization? *International Journal of Academic Research in Business and Social Sciences*, *11*(8), 612–627. https://doi.org/10.6007/ijarbss/v11-i8/10068

Setiawan, H., Rinamurti, M., Kusmindari, C. D., & Alfian, A. (2023). *Ergonomic Hazard Measurement , Evaluation and Controlling in the Pempek Palembang Home Industry Based on SNI 9011 : 2021*. *8*(6).

Setiawan, H., Susanto, S., Budiarto, D., & Alfian, A. (2025c). *Recommendations for Sustainable Waste Management Technology in Palembang City*. *2*(4), 254–266. https://doi.org/10.62885/agrosci.v2i4.641

Setiawan, H., Susanto, S., Rinamurti, M., & Alfian, A. (2025a). *Design and Implementation of Green Human Resource Management (Green HRM) in SMEs Palembang City*. *2*(3), 188–198. https://doi.org/10.62885/ekuisci.v2i3.597

Setiawan, H., Susanto, S., Rinamurti, M., & Alfian, A. (2025b). *Design of a Round Tofu Printer Using the Ergo-Product Design Method (Case Study : Mr . Andi ’ s Tofu Factory Palembang)*. *2*(4), 234–245. https://doi.org/10.62885/improsci.v2i4.614

Setiawan, H., Susanto, S., Rinamurti, M., & Alfian, A. (2025c). *Ergo-Technopreneurship Training to Improve Knowledge and Attitude of Technology Entrepreneurs Palembang Local Culinary Traders*. *2*(4), 226–236. https://doi.org/10.62885/ekuisci.v2i4.633

Setiawan, H., Susanto, S., Rinamurti, M., & Pratama, Y. D. (2024a). *Implementation of A Total Ergonomics Approach To Improve the Quality of Life of Freight Workers In 16 Ilir Market , Palembang City , South Sumatera Province*. *2*(3), 172–182. https://doi.org/10.62885/medisci.v2i3.596

Setiawan, H., Susanto, S., Rinamurti, M., & Pratama, Y. D. (2024b). *Implementation of Ergo-Tourism and Local Wisdom to Design Tourism Village Governance Based on Balinese Cultur in Darma Buana , Belitang II South Sumatera Province*. *2*(3), 237–247. https://doi.org/10.62885/toursci.v2i3.618

Silvianita, Harahap, A. A., & Khamidi, M. F. (2024). Operation failure of risk analysis on floating storage and offloading. *IOP Conference Series: Earth and Environmental Science*, *1298*(1). https://doi.org/10.1088/1755-1315/1298/1/012031

Swann, L., Popovic, V., & Wiredja, D. (2024). Visual inspection problem-solving strategies at different experience levels. *Applied Ergonomics*, *118*(March), 104273. https://doi.org/10.1016/j.apergo.2024.104273

Versloot, A. H. C., Jackson, J. A., van Rijn, R. M., Elbers, R. G., Søgaard, K., Macri, E. M., Koes, B., Burdorf, A., Chiarotto, A., & Gerger, H. (2024). Physical and psychosocial work-related exposures and the occurrence of disorders of the shoulder: A systematic review update. *Applied Ergonomics*, *118*(January). https://doi.org/10.1016/j.apergo.2024.104277