Recommendations of ergonomic checkpoints and total ergonomics intervention in the pempek kemplang palembang industry

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Abstract. This study evaluates the potential industrial working environment of the Pempek & Kemplang Palembang. Observation of the work environment found a lot of un-ergonomics impact that has not optimal productivity and exceeds the threshold value of aspects of human health. In order to optimize productivity, the production line is required to work quickly in an ECSHE (Effective, Comfortable, Safety, Healthy, Efficient) ergonomics for workers. Evaluate the work environment by implementing Ergonomics Checkpoints to see whether the working environment has been running well or not. Ergonomics Checkpoints used in this study include material handling aspects, safety, workstation design, lighting, development of human resources and sources of danger contribute to the value of most incompatibility which becomes the top priority in determining suggestions for improvement. While the Total Ergonomics intervention study includes; work posture, un-ergonomics design tools, un-physiological work, classification of subjectivity level of musculoskeletal system is 55-76 (high risk), classification of subjectivity level of fatigue is 66-79 (high category), physical workload at workload level is 125-150 bpm (weight category), and the %CVL category is 78-85% (rather heavy). To be more holistic the 5S method and participatory training in human resources are also used as a method of evaluating the work environment in this industry.

1. Background
Pempek & Kemplang as a typical Palembang food has become one of the 17 mainstay non-oil and gas export commodities in South Sumatera Province. Palembang is famous as a city of pempek & kemplang potentially developing a traditional food industry. It has been able to penetrate the markets of ASEAN countries such as Malaysia, Singapore and Thailand. They are very valuable because from the field data of production and sales centers in Palembang every day as many as 14 tons a day they are sent to domestic and foreign markets [1]. On the other hand, increasing industrial competitiveness is an important issue that needs attention from various parties. Competitiveness about standardization of quality and work systems in an ergonomic production process. Increasing civilization through civilizing the work system that is ECSHE (Effective, Comfort, Safety, Healthy, Efficient) and improving the welfare of the community through participatory empowerment of all workers involved in the industry. Work systems that are not ergonomically designed that can impact ECSHE, enable workplace accidents which actually cause industrial and physical losses.
Figure 1. shows how the working environment conditions. Seen in Figure 1, the working environment conditions that do not support the creation of an ergonomic work environment. The observation of the work environment that has not been ergonomic and ECSHE is therefore an evaluation that is useful to assess the extent and completeness of the work environment. The results of Ergonomic Checkpoints (EC) are synergized with the recommendations from the results of measurement of Total Ergonomics (TE) Intervention. To ensure the research can run well, it is necessary to conduct a literature study to study and answer theoretical questions around research problems where in this study will discuss EC, TE Intervention, and 5S methods.

![Figure 1. (a). The Process of Making Pempek; (b). The Kemplang Drying Process Figure 1. The Proses of Making Pempek and Kemplang](image)

2. Literature Review

2.1. Ergonomic Checkpoints

EC are methods used to assess the current work environment and apply a work environment that is in accordance with working conditions [2],[3],[4]. Easy implementation solutions in practice for improving security, health and working conditions. The stages of how to use EC, are; a) knowing the workplace, b) defining work area to be checked, c) walk-through initials, d) writing your check results, e) selecting priorities, and f) group discussion about the check results. The reviewed checkpoints incorporated in these checklists have common structures as indicated in Table 1. [5], [2], [3], [4].

| Table 1. Common Structure of the Checkpoints Incorporated in The Checklists of the Typical Participatory Programs [4] |
|-----------------------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|
| WISE checklist (44 items) | WIND checklist (42 items) | Construction site checklist (45 items) | ISO/TS 20646 checklist (25 items) |
| For small enterprise | For farmers | For small sites | For muscular load |
| Materials handling (8) | Materials handling (8) | Materials handling (7) | Handling work (6) |
| Machine safety (6) | Workstations (7) | Work at height (7) | Workstations (9) |
| Workstations (8) | Machine safety (5) | Work posture (5) | Work organization (2) |
| Lighting (5) | Work environment and control of Hazards (9) | Machine safety (5) | Heat and lighting (2) |
| Control of hazard sources (6) | Welfare facilities (8) | Physical environment (7) | Design process (1) |
| Premises (4) | Work organization (5) | Welfare facilities (5) | Resting facilities (1) |
| Welfare facilities (4) | | Emergency preparedness (3) | Work time (2) |
| Work organization (3) | | Work organization (3) | Safety organization (3) |

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3. Materials and Methods

This study uses the synergy of EC, TE Intervention and the 5R concept [5], [2], [3], [4], [9] to evaluate and provide recommendations on whether the working environment in the SMEs Pempek and Kemplang Palembang industries has meet the rules of ergonomics that are good or not based on ECSHE related to the conditions of the work environment in the production process area.

Evaluation of current working environment conditions uses a synergy method between EC with stages [3]; a) knowing the workplace, b) defining work area to be checked, c) walk-through initials, d) writing your check results, e) selecting priorities, and f) group discussion about the check results. Assessment aspects include; storage and handling materials, hand tools, machinery design, lighting, premises, hazardous substances and agents, welfare facilities, and work organizations. and TE Intervention with the identification of 8 ergonomic problems (nutrition & calories, posture, muscle power utilization, environmental conditions, time conditions, social conditions, information conditions, and human and machine interaction), simultaneously applying the SHIP approach and applying AT (technical, economical, ergonomic/ healthy, socio-cultural, energy efficient, and not damaging to the environment) [10], [11], [12]. Based on the results of EC, TE Intervention then identification of problems, priority scale of problem solving, implementation of 5R, design of tools, improvement of the environment and work organization, which are then evaluated accordingly or not. The Synergy EC and TE Intervention models applied in this study are presented in Figure 2.

4. Results and Discussion

Data collection on the condition and the old work environment were examined using EC as one of the tools to correct the standards that have been implemented in SMEs Pempek and Kemplang. EC detect at least 11 items, can be seen in Table 2.
Conditions and
SHIP Approach:
Environment Old Work

1. Systemic
2. Holistic
3. Interdisciplinary
4. Participatory

Identification of Problems

Priority Scale

Problem Solving

5R, Tool Design,
Environment Improvement, and Work Organizations

Evaluation?

No

Yes

Improvemen/Finals

Figure 2. Synergy Model of Ergonomic Checkpoints and Total Ergonomics Intervention

Table 2. Table of Ergonomic Checkpoints aspects

| Correction Aspects                  | Items |
|-------------------------------------|-------|
| Storage & materials handling        | 8 item|
| Machine safety                      | 6 item|
| Workstations                        | 9 item|
| Heat & lighting                     | 2 item|
| Work posture                        | 5 item|
| Physical environment                | 7 item|
| Resting facilities                  | 1 item|
| Work time                           | 2 item|
| Premises                            | 4 item|
| Welfare facilities                  | 4 item|
| Work organization                   | 5 item|

Table 3. Ergonomic Checkpoint Observation Results

| Aspect                        | Sub Aspects | Assignment No | Good | No |
|-------------------------------|-------------|---------------|------|----|
| Storage & materials handling  | 8           | 3             | 5    |    |
| Workstations                  | 9           | 2             |      | 7  |
| Heat & lighting               | 2           | 1             | 1    |    |
| Work posture                  | 5           | 1             | 4    |    |
| Physical environment          | 7           | 2             | 5    |    |
| Work time                     | 2           | 1             | 1    |    |
| Premises                      | 4           | 3             | 1    |    |
| Welfare facilities            | 4           | 2             | 2    |    |
| Work organization             | 5           | 1             | 4    |    |
| **Total**                     | 46          | 16            | 30   |    |
From 11 aspects of correction in EC in (Table 2), there were 9 aspects used in this study. These aspects are; storage & materials handling, workstations, heat & lighting, work posture, physical environment, work time, premises, welfare facilities, work organization. The results of filling in EC show in Table 3. The reason for choosing these 9 aspects is because this study only examined the problem of physical conditions and work environment in SMEs Pempek and Kemplang Palembang. While the 2 aspects that were not included in this study, such as the machine safety aspect, it is caused that in this work area workers only use simple machines without having to pay attention to machine safety. And the resting facilities aspect is also not included in the research because this aspect is not very urgent needed in SME, since resting facilities simply exist.

From the 46 items, 30 of them need repairs. While of the 30 items, there are priority scale problems, namely; storage and material handling (urgent), work posture (urgent), physical environment (essential), and work organization (important). Synergy of EC with TE Intervention harmonizes ILO 2010 rules with interventions to improve working conditions and environments based on TE. The application of the TE Intervention method, begins with observation and evaluation of old working conditions and environments with an approach to 8 ergonomics problems and AT to identify problems, determine priority scale of problem solving, then conduct design studies of tools, environmental improvement studies and work organization studies. One improvement in the un-ergonomic problem that is urgent related to storage & material handling and work posture is to design a saving rack trolley tool ergonomic that can minimize workload due to incorrect posture work.

4.1 Results of Application of the 5R Concept
While improving the conditions of the work environment by applying 5R, are as follows:

a) **RINGKAS** is the activity of sorting out items that are needed and not needed (to be disposed of) based on Figures 3 & 4, piles of wood and materials that cannot be used anymore are immediately cleaned because they will become a nest of disease and damage the work environment. The recommendation is to place the pile of wood and material into a more representative container or warehouse. b) **RAPIH** is how workers arrange a good layout so that the work environment is ECSHE. Warehouse area, production process, scrap, and room arrangement are still low, which disrupts transportation routes. The work environment area integrated with the owner's residence, is very narrow and is not available between human lines and workstations. The recommendation for this problem is to make road lines and road dividers so that the items are placed more in accordance with their purpose and look neat. c) **RESIK** is an activity to maintain the cleanliness of the work environment by removing garbage and foreign goods so that the workstation becomes cleaner. Scraping the kneading process and crumbs of the frying process will interfere with health. Not yet available representative bins. Recommendations for cleaning problems by cleaning regularly before and after the production process. d) **RAWAT** is an action to care for items in the work environment. Seiketsu will be effectively implemented if the 3 main aspects of 5R (Ringkas, Rapi, Resik) have been implemented properly. In SMEs Pempek and Kemplang do not have SOP’s to maintain simple machines used, safety procedures, etc. e) **RAJIN** is the advanced stage of care. Recommendations about PPE that are good, simple and relevant to the task, such as hair covers, masks, etc. are highly recommended.

4.2 Results of Application of EC
The results of the EC (Table 2 and Table 3) show that the problems of storage and materials handling, workstations, and physical environments have high complaints so that the physical work environment also impacts workstations and storage and material handling which are not optimal in the production process. The recommended work environment with the application of the 5R concept can be seen in section 3.1.

4.3 Results of the Implementation of Total Ergonomics Intervention
Ergonomics intervention studies at the SMEs Pempek and Kemplang Palembang, in terms of the aspects of Task, Work Organization, and Environment. This review of 3 aspects is synchronized with ECSHE.

Figure 3 shows the kneading process & pempek shape, pempek submarine egg shape process, pempek adaan shape process, pempek frying process, and pempek cutting process. **Task:** no physiological work attitude (sitting with a chair that is not anthropometric, bending, standing). Muscle energy use is large because it forms a manual pempek by bending, the NBM results show
Musculoskeletal pain/complaints 78-85% of the wrist, arm, shoulder, and back with a high risk 55-76, the classification of fatigue level is high 66-79, the category of physical workload weighs 125-150 bpm, and the % CVL category is 78-85% (rather heavy). **Work Organization:** work without regulating work breaks, without providing additional nutrition. ISHOMA Time (Rest, Prayer, Lunch), 12.00 - 13.00 a.m. **Environment:** hot workspace 38-40°C, dark, moist, lacking ventilation so that air circulation is less optimal. **Recommendation:** it is necessary to apply 5R, redesign of the ergonomic work system (cadaver, printer of pempek, boilers, drums, etc.) and increase productivity. Necessary increase in productivity in order to fulfill the demand for pempek which has not been optimal with the application of TE interventions. Identification of 8 ergonomic problems, to implement SHIP Approach, AT and 5R through workshops on conditions and working environment of SMEs so far, to determine the priority scale of problems and improve tool design, work organization and involving participatory of all SMEs workers and owners.

**Figure 3.** Work System and Work Environment in SMEs Pempek Palembang: Shaping

Figure 4 shows the kneading of material process, boiling, drying, roasting, frying, kemplang crackers. **Task:** the work attitude is not physiological (bending and pressing repeatedly). Muscle energy use is large because the cadre process is still manual, the NBM results show musculoskeletal pain/complaints 50-62% of the wrist, arm, back and shoulder with high risk 52-74, classification of fatigue level in the high category 65-72, the physical workload category weighs 125-150 bpm, and the %CVL category is 70-88% (rather heavy). **Work Organization:** work without regulating work breaks, without providing additional nutrition. ISHOMA Time (Rest, Prayer, Eat), 12.00 - 13.00 a.m. **Environment:** hot workspace 38-40°C, moist, lack of ventilation so that air circulation is not optimal. **Recommendation:** the application of 5R is required, working system redesign (cadaver, boilers, ergonomic trolley, drying, frying) and AT. The results of various types of kemplang and crackers, there are still many who have not met food standards. The environment and work system that have not been ergonomic have an impact on the rapid level of fatigue experienced by workers, heavy physical burden and finally the level of productivity is not optimal. It is necessary to increase productivity in order to fulfill the demand have not been optimal with the application of TE interventions. Figure 5, here is one of the drying tool designs and the storage of a rack saving trolley which is useful for drying and storing kemplang before the
cooking process or frying. The work system is more ergonomic than before it was designed. Proven total ergonomic interventions are indications of increasing the quality of life of workers and increasing productivity. Quality of life, aspects of workload, musculoskeletal complaints rate, fatigue rate, work stress rate, boredom numbers have decreased indications, while numbers of comfort and satisfaction indicate an increase. Ultimately it has an impact on increasing productivity [11], [12], [13].

Figure 4. Work System and Work Environment at SMEs Kemplang Palembang: Processing

Figure 5 and 6, here is one of the drying tool designs and the storage of a rack saving trolley which is useful for drying and storing Kemplang before the cooking process or frying. The work system is more ergonomic than before it was designed. Proven total ergonomic interventions are indications of increasing the quality of life of workers and increasing productivity. Quality of life, aspects of workload, musculoskeletal complaints rate, fatigue rate, work stress rate, boredom numbers have decreased indications, while numbers of comfort and satisfaction indicate an increase. Ultimately it has an impact on increasing productivity [11], [12], [13].

Figure 5. The Work System Un-Ergonomics

Figure 6. Working System Before and After the Design of Ergonomic Tools
5. Conclusion
Recommendations of EC and TE Interventions in The Pempek & Kemplang Palembang industry, can be summarized as follows:

1. Application of EC tools (9 aspects), the results show that 16 items are appropriate and 30 items are not in accordance with ILO 2010 standards. The aspects with the most incompatibility are less ergonomic or ECSHE, namely; storage & materials handling, workstations, and physical environment. Warehouses that are not available, routes that are not safe and there are no lines markings, poor workstations because there are still many stations that are integrated with the owner's residence and many posture work is not ergonomics at work. In the production process at SMEs Pempek has not been ergonomics in the process of kneading & pempek shape, egg submarine shape, pempek adaan shape, pempek frying pan, and pempek slicing. And in the production process in the SMEs Kemplang it is un-ergonomics in the kneading of material process, boiling, drying, roasting, frying, there are still many un-physiological working posture (sitting with chairs that are not anthropometric, bending, standing). Muscle energy use is large because it forms a manual pempek by bending, the NBM results show musculoskeletal pain on the wrist, arm, shoulder and back with high risk, high fatigue classification, heavy physical workload category, and category % CVL is rather heavy.

2. Implementation of TE Intervention and 5R concept in SMEs Pempek and Kemplang, has not been fully implemented because of constrained infrastructure investment costs. Where the selection of goods (RINGKAS) is still not well implemented by accumulating unused items and materials. Arrangement (RAPI) in the workstation area of the production process is also not good, because there are still many packages of scrap that accumulate in any place, and cleanliness (RESIK) work area that is not good, especially in the parts of a simple tool/ machine. Synergy model of TE intervention analysis and EC results of a nine aspects assessed; storage & material handling, workstation, heat & lighting, work posture, physical environment, work time, premises, welfare facilities, work organization contribute to the value of most incompatibility which becomes the top priority in determining suggestions for improvement. While the TE intervention study includes; work posture, un-ergonomics design tools, un-physiological work, classification of subjectivity level of musculoskeletal system is 55-76 (high risk), classification of subjective fatigue level is 66-79 (high category), physical workload at workload level is 125-150 bpm (weight category), and the % CVL category is 78-85% (rather heavy). To be more holistic the 5S method and participatory training in human resources are also used as a method of evaluating the work environment in this industry.

3. Recommendations on the conditions and working environment of SMEs Pempek and Kemplang Palembang are still found in work system inefficiencies, which have an impact on productivity not optimal and exceed the threshold value of human health aspects; limitations, ability and capability. The role of ergonomics interventions is still very much needed in designing work systems (task, work organization and environment), given the interrelationships between ideas, people, and the tools practiced in SMEs. The study of ergonomic interventions in the context of a suitable idea is to conduct ergonomics analysis (work posture, muscle usage, nutrition, conditions of information, time conditions, environment conditions, socio-cultural conditions and man-machine interface) and AT. The adjustment of suitable work equipment is a tool that must be user friendly and sustainable. It is necessary to apply 5R, redesign the work system (cadaver, pempek printer, frying pan, boilers, drying trolley, waster, etc.) which is ergonomics and appropriate technology.

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