Ergonomic Assessment in Small and Medium Enterprises (SMEs)

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Abstract. Small and Medium Enterprises (SMEs) industry plays important role in economic growth in Malaysia especially food production industries. Ergonomics in SMEs food industries are one of the most common issues being neglected among people. In this study, the objective is to identify the possibility of an adverse health effect, to conduct hazard and risk assessment and lastly to evaluate the ergonomics problem at SMEs. Hazards identification was done through interview sessions and Industrial Accidental Prevention Association (IAPA) checklist. Checklist based on direct observation on working activities is being evaluated in SMEs. Hazards recorded down are mainly focus on potential ergonomics problems. Then, Hazard Identification, Risk Analysis and Risk Control method (HIRARC) is used to further analyse the hazards. Results show that majority of the employees are unfamiliar with the concept of ergonomics which easily expose themselves to ergonomic injuries hence, it is indeed important to increase awareness among the employees and employer of the company to emphasize on the safety of the instruments and machines used. Lastly, recommendations on each hazard of working activity are given to improve the overall condition and production of the company. This study would serve as a guidance and reference related to this field to eliminate the potential ergonomics issues.

1. Introduction

Small and Medium Enterprises (SMEs) plays an increasingly crucial role in economic growth in Malaysia. SMEs are one of the significant industries in Malaysia besides running as an important source in developing a rural area and maximising the resources allocation by processing the raw part into products. SMEs in Malaysia, for instance in machinery industries, food supplies industries, and heavy workload industries are facing several problems such as they are still performing traditional technology [1]. Mikami and Tanaka (2008) shown that the food processing industry is one of the most important industry in developing economic growth[2].

Small and Medium Enterprises (SMEs) are playing huge and significant contribution to the economic development that can includes business activities in our country regardless of urban or rural area. The economy of our country is changing to a more knowledge-based economy rather than the industrial based economy to achieve the vision of 2020 [3].

Normally built in a rural area, people in those areas get their job to make their monthly wages for their living. Beck (2013) stated that SMEs were defined as an engine of innovation and growth and they help decrease poverty[4]. Ergonomics related problems are one of the most common issues being
neglected or ignored often among the industries. Ergonomics issues are mostly addressed by working posture and design of workstations or tools. Punnett L and Wegman (2004) also stated that risk factors for MSDs are rapid work pace and repetitive motion patterns, insufficient recovery time, heavy lifting and forceful manual exertions, non-neutral body postures, mechanical pressure concentrations, and body vibration [5].

In this rapidly globalizing world, safety performance is a key issue for the industries to become a world-class competitor. Occupational accidents may lead to permanent disabilities or deaths and/or economic losses or both [6]. In order to develop a good safety culture, the attitude of the workers needs to be changed by adopting best practices, good housekeeping, and changes in work culture and work practices.

The major contributing factors include physical factors, environmental factors, individual factors and work organization factors. Ilman et al., (2012) has implied the need for employers and employees to take more active roles in addressing issues related to work postures [7]. When employees are exposed to a combination of these contributing factors, the chances of having work-related injuries increase. Thus, identifying all contributing factors is crucial in reducing potential ergonomics issues.

The objectives of this study are to identify the possibility of an adverse health effect, to conduct hazard and risk assessment and to evaluate the ergonomics problem at the small and medium enterprises (SMEs). The research study has a scope that only limited to focus on the potential ergonomics problem among the workers at the SMEs and observation on working activities of the workers in small and medium food enterprises (SMEs) industry in Parit Raja, Johor.

2. Methodology
Methodology for this study is divided into 3 main components which are direct observations, ergonomics checklist, interview session and Hazard Identification, Risk Analysis and Risk Control (HIRARC) method.

The HIRARC method is to ensure that any potential risk to 3 three safety, health, environment and business aspects of any operation is minimized. To identify actual injury hazards, it is proposed that greater attention is given to exposure assessment by systematically analyzing injury cases and case series [8]. As for risk control, hazard should be controlled at their source. In order to reduce the accident or incident level, it is important to ensure that safe working practice is being observed and controlled [9]. The checklist is used in this study of assessing the potential ergonomic problems at the SMEs to evaluate the effectiveness in reducing ergonomic injuries and disorders in small and medium food enterprise industry. A form is very vital because observations have shown that most of managers or supervisors do not carry safety form or checklist when supervising their workers in the factory [10].

Firstly, interview questions are being prepared and applied during industries visit to further understand the condition of the company. Ergonomics questions are being asked during the interview. Then, Industrial Accidental Prevention Association Checklist also known as IAPA checklist is used to assess or evaluate the instruments the employees used at workstation and machines they operate. Ergonomics assessment is made based each category and comments were given as well.

Photos on each workstation are taken to further observe the condition of the working environment. After that, Hazard Identification, Risk Analysis and Risk Control method is used to provide a more systematic and objective approach ways to control risks where risk is calculated based severity and likelihood of hazard occurrence. Recommendations are given based on each working process.

Two crisps production industries were chosen and visited in this study which named as Company A and Company B. The crisps are mainly made from cassava roots or ‘Ubi Kayu’ in Malay language. Cassava root is also named scientifically as Manihot Esculenta. From the interview sessions, Company A and Company B have the same number of employees which is twenty persons. Company A has nine foreigners and eleven local workers whereas company B has four foreigners and sixteen locals.
3. Data Collection

According to the interview session, Company A has an industry accident record of five injuries over the past three years. Company B has only one injury case happened in three years. Majority of the employees in Company A and B have no knowledge of the concept of ergonomics. The process of making chips or crisps includes peeling, washing, slicing, deep-frying, colouring, and flavouring, weighing and packaging and lastly marketing.

Industrial Accidental Prevention Association checklist or IAPA checklist is used to identify hazard of each working process. The criteria of the checklist include records of injuries, employee comments, physical demands of work tasks, layout and condition of the workplace or workstation, characteristics of objects handled, environmental conditions, work clothing and PPE or personal protective equipment and characteristics of the organization of the work. A Yes or No answer is ticked based on the criteria through direct observation. Table 1 shows the results of the checklist in company A and company B.

After identified hazards of each working process, HIRARC method is used to deliver a more systematic approach to assess hazards and their respective risks based on each identified hazard as well as provide a method to control the risk. Hazard identified of work activities are divided into five which are cassava roots skin peeling, slice cassava roots with cutting machine, transfer buckets of cassava roots from places to places, stirring cassava roots in frying oils, deep-frying and packaging.

Table 2 illustrates the hazard identification of company A and B. Risk Analysis is also being calculated and ranked from the highest risk to the lowest risk. Table 3 shows the risk analysis of Company A and Company B. From the results of risk analysis acquired from company A acquired, stirring and deep-frying have the highest risk, 20. Cassava roots slicing with cutting machine has the second highest risk in rank, 12 followed by buckets of cassava roots transferring from places to places which rank the third, 10. As for the fourth in ranking, cassava roots skin peeling has a risk of 8 whereas the least risk out of all work activities is 3, packaging.

| No. | Work Activity | Hazard | Effect |
|-----|---------------|--------|--------|
| 1   | Cassava roots skin peeling | Non-ergonomic seats | Backpain |
| 2   | Slice cassava roots with cutting machine | Cutting blades | Amputation, fingers get caught into the machine |
| 3   | Transfer buckets of cassava roots from places to places | Heavy loads | Fatigue and back injuries |
| 4   | Stirring cassava roots in the frying oil, Deep-frying | Extremely high temperature of frying oil, splatter of oil | Heat exhaustion, fatigue, Upper limb injuries and legs injuries |
| 5   | Packaging | Heavy loads | Muscular strain and backpain |
| Table 2. Risk Identification |
|-------------------------------|
| **HAZARD IDENTIFICATION**     | A  | B  |
| **Records of Injuries**       | Y  | Y  |
| Are there records of injuries or accidents to indicate a risk of adverse health effects due to ergonomic factors in the task evaluated? |
| **Employee Comments**         | Y  | Y  |
| Are there employee comments to indicate a risk of adverse health effects due to ergonomic factors in the job or task being evaluated? |
| **Physical Demands**          | Y  | Y  |
| Is forceful physical handling such as carrying, lifting, lowering, pushing, pulling a part of the job? |
| Are there contact forces exerted on to the body? |
| Does the employee have difficulty gripping on object or tool, which has a smooth, slippery surface? |
| Are object handled with a pinch grip? |
| Does the work involve repetitive motions or many similar movements? |
| Is the work fast-paced or controlled by a machine or process? |
| Are employees required to sit or stand continuously for more than two hours or in total for more than three hours in the shift? |
| Does the task require that any part of the body be maintained in a static posture? |
| Does the task require the employee to work with any body part in an awkward position instead of a neutral one? |
| **Layout and Condition of the Workplace or Workstation** | N  | N  |
| Do working heights or reaches cause employees to bend or reach beyond a comfortable range? |
| Does the workplace layout require awkward or extreme movements? |
| Does the layout of the workstation restrict movements of the body, for example, by limiting leg room? |
| Do observations indicate problems with the design of seating? |
| Are employees unsure of how to adjust their workstations? |
| Do floors or sloped surfaces such as ramps pose a risk of slipping, cause problems for employees who stand on them for long periods, or cause problems for employees who stand on them for long periods, or cause problems for pushing or pulling objects? |
| **Characteristics of Objects Handled** | N  | N  |
| Are there problems handling an object due to its size, shape or weight? |
| Are there problems handling an object due to its condition? For example, is the object fragile, unbalanced, or non-rigid? |
| Are handles on containers an inappropriate size or shape, or not strong enough for the weight and size of the object? |
| Are the handles for tools or equipment in size, shape or height? |
| Is vibration from the tool or equipment transmitted to the operator’s hand/arm? |
| Is the palm or base of the hand used like a hammer for striking? |
| Do objects, tools or parts of the station with hard, sharp or uneven surfaces put pressures on any body part? |
Table 2. Risk Identification (con’t)

| Environmental Conditions | Is the employee exposed to extreme temperatures? | Y | Y |
|---------------------------|-------------------------------------------------|----|----|
|                           | Are any parts of the body exposed to cold from exhaust air, cold liquids or other objects? | N | N |
|                           | Do employees assume awkward postures to overcome problems associated with glare, in adequate lighting or poor visibility? | N | N |
|                           | Is the employee’s whole body exposed to vibration for significant portions of the work shift? | Y | Y |

| Work Clothing and PPE     | If the employee wears gloves, do the gloves hinder gripping or restrict movement? | N | N |
|----------------------------|-----------------------------------------------------------------------------|----|----|
|                            | Do records, employee comments or observations indicate fatigue or postural problems from the use of personal protective equipment? | N | N |

| Characteristics of the Organization of the Work | Are there indication of excessive fatigue or pain, or symptoms of adverse health effects due to extended work days or overtime? | Y | Y |
|------------------------------------------------|-----------------------------------------------------------------------------|----|----|
|                                                | Are there indications of excessive fatigue or adverse health effects due to shift work or piecework? | Y | N |
|                                                | Is there build-of fatigue or a risk of adverse or a risk of adverse health effects due to insufficient rest periods or task variety? | Y | Y |
|                                                | Are tasks in a job rotation program similar to one another, and therefore not providing a variation in movements? | N | N |
|                                                | Do peak workloads or sudden increases in pace occur with the task? | Y | Y |

However, in Company B, deep-frying and stirring has also the highest risk, 16. Cassava roots slicing with cutting machine is the second risky activity. Next, transfer buckets of cassava roots from places to places and cassava roots skin peeling has the third and the fourth rank in risk, 8, followed by the least risk in rank, packaging. Company B has a lower risk in average compared to company A. Lastly, control measures are suggested to improve the condition of each work station.

Comparisons between companies are shown in Table 4. Layout design of company A and company B are sketched but they are not the exact dimension and scale. It clearly shows that Company B has a better layout design than company A. Suggestion and modification is also given to have a better layout design which is shown in Figure 1.

![Figure 1. Figure Suggested and modified layout design.](image-url)
### Table 3. Risk Analysis

| Work Activity                              | Existing Risk Control (if any) | Company A | Company B |
|-------------------------------------------|-------------------------------|-----------|-----------|
|                                           | Likelihood | Severity | Risk     | Likelihood | Severity | Risk     |
| Cassava roots skin peeling                | Nil         | 4        | 2        | 8 (Medium) | 4        | 2        | 8 (Medium) |
| Slice cassava roots with cutting machine  | Safe work practice            | 4        | 3        | 12 (Medium)| 3        | 3        | 9 (Medium) |
| Transfer buckets of cassava roots from    | Usage of trolley              | 5        | 2        | 10 (Medium)| 4        | 2        | 8 (Medium) |
| places to places                           |                                             |           |           |            |           |           |            |
| Stirring cassava roots in the frying oil,| Safe work practice, safety boots | 5        | 4        | 20 (High)  | 4        | 4        | 16 (High)  |
| Deep-frying                                |                                             |           |           |            |           |           |            |
| Packaging                                 | Manual lifting procedure          | 3        | 1        | 3 (Low)   | 1        | 1        | 1 (Low)   |

### Table 4. Comparison between companies

| Differences                          | Company A | Company B |
|--------------------------------------|-----------|-----------|
| Design of the industry               | Opened space industry | Closed space industry |
| Floor condition                      | Slippery floor | Dry and safe floor |
| Layout Design                        | Disorganised layout of the stations | Systematic arrangement of the stations |
| Comfortability of the working condition | Cool working condition | Hot working condition |

Similarieties between company A & B
Organizational practice - No job rotation work practice

### 4. Conclusion

Based on this study that had been done, it can be conclude that it is indeed important to increase awareness among the employees and employer of the company to emphasize on the safety of the instruments and machines used. Level of ergonomics problem should also be highlighted to reduce all type of potential injuries.

Recommendation is given based on each work station. However, employee involvement is also the key to the working environment. Open communication between management or employer and the workers throughout the ergonomic improvement process allows for a flow of information critical to identify contributing factors and solving problems. Once the communication channel is in place, the next step is to form an ergonomics team whose job is to look for task that may lead to potential ergonomics injuries. Having a team who administers ergonomics can benefits the company because they can always come out with suggestions that can be easily implemented with minimal cost and mechanical intervention.

This research serves to identify possibility of adverse health effect as well as to evaluate the ergonomics problem of small and medium enterprises (SMEs). This could ensure the safety of the employees and the management of the company as well as to provide a more systematic layout design in order to increase the effectiveness and efficiency of the production. This study is also essential in recommending suitable approach at workplace so as to assist and provide employees a better working surrounding. Through this ergonomics assessment, risk measures and several recommendations were given to ease the employees at work and to avoid any unnecessary potential ergonomics issues.
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References
[1] Senik, G. 2010 Small-scale food processing enterprises in Malaysia.
[2] Mikami, K., & Tanaka, S. 2008 Food processing business and agriculture cooperatives in Japan: Market Power and Asymmetric Information. Asian Economics Journal, 22(1), 83–107.
[3] Ong, J. W., Yeap, P. F., & H. 2010 Malaysian small and medium enterprises: the fundamental problems and recommendations for improvement. Journal of Asia Entrepreneurship and Sustainability, 6(1)
[4] Beck, T. 2013 Bank financing for SMEs - Lessons from the Literature. National Institute Economic Review, 16.
[5] Wegman DH., & Punnett L. 2004 Work-related musculoskeletal disorders: The epidemiologic evidence and the debate. Journal of Electromyography and Kinesiology, 14(1), 13-23
[6] Dağdeviren M., & Yüksel İ. 2008 Developing a fuzzy analytic hierarchy process (AHP) model for behaviour-based safety management. 178, 1717-1733.
[7] Ilman, A. Y., & Y. Helianty. 2012 Rancangan perbaikan sistem kerja dengan metode Quick Exposure Check (QEC) di bengkel sepatu X di Cibaduyut. Jurnal Online Institut Teknologi Nasional, 2(1), 121-129.
[8] Robert M.Park. 2002 Hazard identification in occupational injury;Reflections on standard epidemiological methods. International Journal of Occupational.
[9] Radlinah Kunju Ahmad 2000 Developing a proactive safety performance Measurement Tool(SPMT) For Construction Sites .Loughborough University. Degree of Doctor of Philosophy.
[10] Nedumaran, B. 2004 Industrial safety and risk management. Sri Venkateswara College of Engineering. India.