Hazard identification, risk assessment and risk control in a woodworking company

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Abstract. An industrial activity is never separated from potential hazards and risks that can lead to workplace accidents. A small accident could bring a major impact on a company. Woodworking industry is the type of industry with the highest accident rate in manufacturing sector. This research is focused on a company which take roles in selling furniture and building components made of high quality wood. In its practical history, the company has never conducted risk assessment within the company, which makes the company is probably at high risk and can be easily exposed to various potential hazards. Risk assessment is a necessary step to create a safe working environment for the company and for the people involved in it. By conducting risk assessment, the workplace accidents which possibly occur within the company can be reduced or even eliminated. This research is conducted by identifying hazards as the initial stage. And then risk analysis is performed using risk matrix to determine risk ranking of the identified hazards and risks. Once the risk ranking of each risk is determined, the risk is prioritized based on its urgency to be managed. According to risk ranking, production machines are mainly the source of risk within the company with the highest severity rate. In order to mitigate the risk, Job Safety Analysis for company’s production machines is organized so it can provide the most relevant output in the end. This research conduces recommendations for the company to reduce the potential hazards which possibly arise within the company.

1. Introduction
Risks are unavoidable in any complex program. Over the years, risk management has gradually become an important part of project management in each organization [1]. Companies need occupational health and safety management systems in order to enable them to prevent and mitigate accidents by identifying and prioritising the most essential hazards as well as to manage the hazards and to adopt preventive measures [2]. Thus, there is a clear need for companies to place emphasis on establishing risk assessment methods that are clearly linked to the implementation of practical risk reduction measures [3].

Risk assessment provides the foundation for successful health and safety management and is key to reduce work-related accidents and occupational diseases, which not only helps improve workplace health and safety but also business performance [4]. Risk assessment includes both hazard identification and an estimation of the probability and expected consequences of the identified hazard [5]. Risk assessments have traditionally been based on the identification of hazards in the workplace [6]. However, Booty (2006) stated that risk assessment is not merely a tool to calculate the probability and expected consequences of a hazard; it is also the phase in which the appropriate actions to minimise the probability
of risk occurrence is determined and the cost of resource allocation to manage the impact of the harm, in the event of its occurrence, is established [7].

Woodworking industry has the highest accident rate in manufacturing sector where this industry runs with highly mechanized and labour-intensive operating in high-volume production [8]. Workplace accidents in woodworking industry are mostly caused by contacts with moving production machinery that have sharp parts such as cutters and blades. This could cause serious injury to the exposed subjects. Subjects can be injured by the moving machine itself, by materials thrown from the machine, or subject’s body part can also be caught on the roller belt or pulley. The manufacturing sector also needs attention in handling accidents problem. This has prompted further research of risk assessment in manufacturing sector.

The company is one of a manufacturing company in Jakarta which produces furniture and building components. The company has more than 30 modern machines used to support the company’s productivity. The company is still in a growing phase, attempting to gain more customers and expanding its products to a wider distribution scope. However, in practice, the company has never conducted risk assessment throughout years since establishment. This becomes an important matter because the hazards and risks that possibly occur within the company is potentially high.

2. Methods
This study resorted to the case-study method in order to research safety risk assessment in woodworking industry, which was conducted in a private woodworking company, Indonesia. Descriptive research was also used as a method which describes a number of data to be analysed and compared based on the ongoing reality, furthermore the existing problems are solved to gain better results or to give recommendations later on. This study focuses on the physical risks that potentially occur in the production division of the company by using risk assessment method referring to OHSAS 18001 as follows:

1. Hazard Identification
2. Risk Analysis
3. Risk Evaluation

Field survey is conducted as the first stage, gathering initial information of the company such as organizational structure, plant layout, machinery, raw materials and business process. The primary data collection was mainly based on interviews. Interviews were carried out with the company’s Chief Executive Officer, Head of Factory, Head of Production and other entities experienced in this field. Semi-structured interviews with 20 workers at production division were also used to gather perceptions regarding the situation of safety at their workplace. After acquiring data from semi-structured interviews, scenario analysis was used in this study to capture important concepts for effective interpretation. Archival records supplemented data-gathering was the secondary method. For overall process, consequence/probability matrix is given to determine the acceptable level of impact caused by the potential hazards and risks.

3. Result
3.1. Hazard Identification
Hazard identification is an attempt to discover, recognize, and estimate the danger in a system such as equipment, workplace, procedures, rules, etc.
| No. | Location          | Description of Potential Hazards                                                                 | Picture | Source of Hazards   |
|-----|-------------------|-------------------------------------------------------------------------------------------------|---------|---------------------|
| 1   | Raw Materials Warehouse | • Tripped by scattered raw materials  
• Bumping against triplex boards  
• Got cut by scattered raw materials  
• Got hit by falling heavy equipment in the warehouse | ![Picture](image1.jpg) | Work Environment   |
| 2   | Production Area    | • Excessive dust exposure  
• Bumping against machine’s part  
• Stumbled upon machine’s cables | ![Picture](image2.jpg) | Work Environment   |
| 3   | Production Area    | • Short circuit  
• Stumbled upon disorganized power tools’ cables  
• Stepping on power tools (drill, saw, etc.) | ![Picture](image3.jpg) | Work Environment   |
| No. | Location        | Description of Potential Hazards                                                                 | Picture | Source of Hazards         |
|-----|----------------|-------------------------------------------------------------------------------------------------|---------|--------------------------|
| 4   | Production Area | • Worker’s hand gets clamped  
       • Got cut by machine’s sharp cutting part  
       • Got hit by falling production object  
       • Tripped over machine’s lower part | ![Picture](image) | Work Environment         |
| 5   | Production Area | • Got cut by machine’s moving part  
       • No protective device is used  
       • Dust exposure  
       • Hindrance around machine | ![Picture](image) | Work Environment         |
| 6   | Finishing Area  | • Exposure to dust  
       • Not using Personal Protective Equipment (PPE) during work process  
       • Stumbled upon production supporting objects (varnish can, glue, etc.) | ![Picture](image) | Work Environment and Worker’s Attitude |

3.2. Risk Analysis

Risk analysis is performed to identify the vulnerability that the identified risks can cause, and then get analyzed to determine the appropriate handling or mitigation for the risks by using a risk matrix. Literature studies and group discussions with safety experts were conducted to gain 7 variables risk matrix as given in Table 2 along with the description in Table 3. For this case, adding more variables can increase accuracy in valuation and more precise measures of vulnerabilities in the operation.
3.3. Risk Ranking
Risk ranking is conducted to ascertain which ones have the highest likelihood of occurrence and which ones have the greatest consequence of occurrence so as to rank the identified risks in overall order of importance.

| Location               | Hazard                   | Ranking                                |
|------------------------|--------------------------|----------------------------------------|
| Raw Materials Warehouse| Work environment         | 8-14 (Light Green), 15-21 (Blue), 22-28 (Light Blue) |
| Production Area        | Work environment         | 15-21 (Blue), 22-28 (Light Blue), 29-35 (Yellow) |
|                        | Machinery                | 29-35 (Yellow), 36-42 (Orange)         |
|                        | Worker attitude          | 22-28 (Light Blue)                     |
4. Discussion
The results of this study emphasized that the potential hazards and risks are attributed to the little attention of safety climate in the production area, which mostly related to the company’s machinery management. This can be seen from Table 4 where production area reached the “Yellow” and “Orange” rank level. The implementation and enforcement of machine safety in this company was also rather poor, making it more solicitous. In this matter, risk reduction is necessary to diminish the frequency of severity or loss. Risk reduction implementation is done based on hierarchy of controls with descriptions as follow:

1. Elimination – Substation
Replacing raw materials used with non-hazardous materials, modifying the physical features of the machines used, or reducing potentially dangerous events is not applicable for the company because the machines used are modern machines where each part of the machine is permanent or cannot be replaced. And the raw materials used for production process (triplex board and high-pressure laminate) are non-hazardous materials.

2. Engineering Controls
Procurement of mechanical aids or barriers is also not applicable to the company. This is due to the narrow space in the production division of the company with approximately one-meter length between one machine with another.

3. Administrative Controls
This method can be applied to the company by constructing and setting policies on a work area, establishing procedures and training for workers, or designing work practices that can reduce the level of risk to workers.

4. Personal Protective Equipment
For the company, personal protective equipment is considered the most applicable seeing the current condition of the company with the existing machinery. This is done by providing a variety of personal protective equipment that support the safety of workers such as safety shoes, safety gloves, eye googles, ear plug, and so forth. These personal protective devices can be relied upon as a short-term control measure until there is a proposed change or proposed improvement from the company's stakeholders.

In pursuance of the hierarchy of controls as defined, a Job Safety Analysis (JSA) was conducted on each main production machine. The purpose of Job Safety Analysis is to identify each job step and reduce it to a minimum level to protect workers' safety. Table 5 shows one of the company production machine’s Job Safety Analysis.

| Picture | Job Steps | Potential Hazards | Recommended Safe Job Procedures |
|---------|-----------|-------------------|--------------------------------|
| Putting objects on machine’s cutting space. | Worker may get injured or clamped while putting the object. | Wearing safety gloves. |

Table 5. Job Safety Analysis of Vertical Saw Machine
| Job Steps | Potential Hazards | Recommended Safe Job Procedures |
|-----------|-------------------|---------------------------------|
| Set and adjust object’s position on the machine. | Worker may get injured by the falling object while setting machine. | Wearing safety hard toe shoes. |
| Set machine’s cutting size. | Worker may get injured by machine’s cutting part. | Wearing safety gloves. |
| Turn on machine by pressing switch button. | Short circuit. | Always follow SOP dan warning tags before turning on machine and use footwear. |
| Machine will automatically do the cutting process. After finished, turn it off by pressing switch button. | Dust exposure to worker during cutting process. | Wearing mask and safety eye googles. |
| Take objects from machine’s cutting space. | Worker might get injured if accidentally contacts with machine’s cutting part. | Wearing safety gloves. |
| | Worker might get hit or injured while taking objects from the machine. | Wearing safety hard toe shoes. |

5. Conclusion
In this paper, potential risks at the company were investigated based on hazard identification, risk assessment and risk control process. The risk ranking of the potential hazards were evaluated in a 7 variables risk rating matrix, resulting that the highest severity rate is in the production area where most of the hazards potentially occur during machinery operation. Risk reduction was initiated in accordance with hierarchical steps of control. For this case, administrative control and employee training should be
incorporated to properly implement safe working procedures in the company, while the use of personal protective equipment should be implemented only after all other reduction measures are fully pursued. Human resource practices that ensure a workforce that can meet goals for safety and productivity is valuable for increasing safety performance. Hazard identification, risk assessment and risk control are on-going processes, thus regular review of the assessment is needed.

6. References

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