

Improving Employees' Safety Behaviour On The Production Process By Designing Occupational Health And Safety System

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Abstract. *Occupational Health and Safety (OHS) of a company is of paramount importance, but employees' lack of awareness lead to cases of workplace accidents. This research looks into the production process of a casting company to assess its safety system. The company produces cast iron products, such as wheel pans and fan blowers. This research aims to identify the risks of workplace accidents using Job Hazard Analysis (JHA) method, which is a systematic identification of potential hazards in the workplace. Utilizing JHA method, this research identified, analyzed, and recorded the risks of workplace accidents. In this study, researchers also created Standard Operating Procedure (SOP) to prevent occupational accidents and diseases .* **Keywords:** (OHS) Occupational Health and Safety, JHA (Job Hazard Analysis), SOP (Standard Operating Procedure)

1. Introduction

Occupational health and safety system impacts the production cost, time, and quality of products. It directly affects all workers, both on those who work on the raw materials and those who work on the finishing process. Workers are one of the companies' assets that should be protected and ensured they are able to work efficiently and productively. Risk management is needed to reduce the risk of occupational hazards, and therefore accidents will not hinder workers' performance at work. Understanding the risk of occupational accidents, a company needs to employ effective safety culture to prevent accidents and diseases at the workplace. It can be manifested through proper safety behaviour among workers. Thus, occupational health and safety should be generated and implemented by the company to improve employees' safety at work. This research identified the problems in order to determine the best occupational health and safety procedures to be implemented on the production line. The most suitable occupational health and safety system will also be designed. This research aims to provide knowledge and solution to the company in the matter of occupational health and safety.

2. Literature Review

Job Hazard Analysis (JHA) is a technique that mainly focuses on the working phases as a way to identify hazards before it happens. This technique prioritizes interaction among workers, tasks, working equipment, and working environment. After identifying the potential hazard in a working phase, this technique will also attempt to eliminate or minimize the risks up to the point where it can be considered as an "acceptable risk".

Risk management directly manages the activities and control the organization by paying attention to its risks. Its main aim is to prevent serious issues in a company that is closely related to unpredictable loss. Risk management involves identification and analysis of the causes of loss, evaluation of measurement, and implementation of the solution. Lawrence Green stated that human behavior is constructed by three factors, namely predisposing, enabling, and reinforcing.

3. Research Methodology

This research will firstly explain the production process of metal casting. Furthermore, it will identify the potential danger and risks in each working process. By using JHA method, consequence number, exposure, and likelihood will be determined. The risk value will be derived from the multiplication of those three in numbers, both on basic risk and existing risk. This measurement will result in a percentage of risk reduction to understand the working process with the highest risk. After knowing the highest risk working process, this research will also analyze views with main informant and triangulated informant using Lawrence Green's behaviour theory. Based on the analysis, this research will result in a design recommendation of occupational health and safety system to be implemented as part of the company's regulation.

4. Results and Discussion

Using JHA method, this research aims to identify and the working hazard and working risks. The analysis will cover the working process, working stages, hazard, sources, risks, impacts, and existing management. After elaborating each factor, assessment of occupational health and safety will be done as shown on Table 1. It considers all aspects, such as the process, risks, and impacts which will determine the consequences, exposure, and likelihood and it will be multiplied by the risk value and risk level. The calculation will be based on basic risk and existing risk. The percentage of risk reduction will be calculated by reducing the value of basic risk and existing risk then multiply it by 100%. This method establishes which process has the highest risk, as shown on Table 2.

Table 1. Analysis using *Job Hazard Analysis* (JHA)

No	Process	Risks	Impacts	Analysis of Basic Risk			Risk value	Risk level	Analysis of Existing Risk			Risk value	Risk level	Risk Reduction
				C	E	L			C	E	L			
1.	Melting metal	Odd body postures	-Lower back pain - Musculoskeletal disorder -Fatigue	5	1	3	15	Acceptable	5	1	3	15	Acceptable	0%
		-Fatigue -Decreasing ability to concentrate	-Work stress -Reducing productivity	5	3	3	45	Priority 3	5	3	3	45	Priority 3	0%

No	Process	Risks	Impacts	Analysis of Basic Risk			Risk value	Risk level	Analysis of Existing Risk			Risk value	Risk level	Risk Reduction
				C	E	L			C	E	L			
		-Slipped -Fatigue -Decreasing ability to concentrate	-Wounds -Injury -Heat cramp -Heat exhaustion -Heat stress	15	10	3	450	Very high	15	10	3	450	Very high	0%
		-Struck down by raw materials -Hurt by fire flames -Hurt by induction stove	-Injury -Burns -Blisters -Burns caused by infrared	1	10	3	30	Priority 3	1	6	3	18	Acceptable	40%
		-Fire	-Fatality -Property loss -Environment loss -Material and equipment loss -Merusak citra perusahaan	15	10	3	450	Very high	50	1	3	150	Substantial	50%
		Lack of concentration	-Decreased productivity -Lost time injury	1	6	10	60	Priority 3	1	6	10	60	Priority 3	0%
		-Burnt by hot metal -Inhaling carbon monoxide (CO)	-Burns -Blisters -Affected by carbon monoxide (CO)	50	1	6	300	Priority 1	50	1	6	300	Priority 1	0%
2.	Finishing	-Fatigue -Decreasing ability to concentrate	-Work stress -Reducing productivity	5	3	3	45	Priority 3	5	3	3	45	Priority 3	0%
		-Fatigue -Decreasing ability to concentrate	-Work stress -Reducing productivity	5	3	3	45	Priority 3	5	3	3	45	Priority 3	0%

No	Process	Risks	Impacts	Analysis of Basic Risk			Risk value	Risk level	Analysis of Existing Risk			Risk value	Risk level	Risk Reduction
				C	E	L			C	E	L			
		-Slipped -Fatigue -Decreasing ability to concentrate	--Wounds -Injury -Heat cramp -Heat exhaustion -Heat stress	15	10	3	450	Very high	15	10	3	450	Very high	0%
		-Hurt by grinding machine -Hurt by fire flames -Hurt by lathe tool -Struck down by hand truck -Noisiness of the working equipment	-Wounds -Injury -Blisters -Hearing impairment	5	10	3	150	Substantial	5	6	3	90	Acceptable	40%
		-Hurt by drill bit -Exposed to vibration around arms and hands	-Wounds -Injury -Bleeding -White finger - Musculoskeletal disorder -Hand and arm vibration	15	3	6	270	Priority 1	50	3	6	270	Priority 1	0%
		-Hit by gantry crane -Struck down by casting products	-Wounds -Injury -Bleeding -Permanent disability -Death	50	1	6	300	Priority 1	50	1	3	150	Substantial	50%
		-Fire	-Fatality -Property loss -Environment loss -Material and equipment loss -Damaging company's image	50	1	6	300	Priority 1	50	1	3	150	Substantial	50%
		Lack of concentration	-Decreased productivity -Lost time injury	1	6	10	60	Priority 3	1	6	10	60	Priority 3	0%

Table 2. Calculation of Risk Reduction

No.	Process	Risks in total	Risk reduction in total	The average of risk reduction
1.	Foam designing	6	130%	21.67%
2.	Mold making	9	190%	21.11%
3.	Melting iron metal	7	90%	12,86%
4.	Pouring the molten iron metal	7	140%	20%
5.	Mold opening	7	140%	20%
6.	Cast cleaning	7	140%	20%
7.	Finishing	8	140%	17.5%
Total		51	970%	19.02%

On the table, we can see that the average of risk reduction on the metal casting process is at 19.02% with the highest value at 21.67% and the lowest at 12.86%. Based on the numbers, we conclude that the risk reduction on the casting process is low. The working stage with the highest risk is the finishing process. In other words, prevention attempt is needed to reduce the impacts of risks during the production process.

After knowing that the two production processes with the highest risk are melting the iron metal and the finishing process, researchers also interviewed workers on both lines of work. There are four main informants in total, all males. The youngest informant is 22 years old and the oldest is 34 years old. The average age of all informants is 27 years old. All informants are vocational school (SMK) graduates.

Other than that, researchers also interviewed two triangulated informants to compare the information gathered from main informants, namely the Head of Human Resources Development and the Head of Production.

Below is the analysis results based on the interview with research subjects, which is examined using Lawrence Green's theory:

1. Predisposing factor

a. Knowledge

Based on the interview with the four main informants, Personal Protective Equipment (PPE) is understood as simply a tool to protect the body. The answer shows how workers have limited knowledge about PPE, and the knowledge is not being implemented as it should because there is no clear sanctions on those who do not wear PPE. If we look into Manpower Ministerial Regulation (Permenaker) No. 8/2011 on Personal Protective Equipment, it is explained that PPE has the ability to isolate a part or the whole part of workers' body to protect the body from hazards in the workplace.

During the interview, workers can explain the types of PPE during the process of metal casting, especially on the melting process and finishing process. However, they do not implement their knowledge on a daily basis. Workers understood the types of PPE and the potential hazard that might happen when they

do not use PPE, but they did not have an awareness of how important occupational safety is, and thus they did not implement it.

Lawrence Green said that knowledge is one of the predisposing factors that can affect behaviour. Therefore, in order to improve the situation, the company should have a supervisor to supervise the implementation of PPE and remind workers on how important PPE is for their own safety. The company may also create a regulation to enforce the rules regarding PPE with clear sanctions so that workers would take PPE more seriously.

b. Attitude

Attitude is the result of one's behaviour which is affected by knowledge. Based on the interview, workers behaviour are mainly good as the main informants have positive attitudes towards PPE although almost all of them do not wear it.

Management's ignorance is also part of the problem as they fail to create firm regulation regarding PPE. Employers should be able to lead by example on the usage of PPE. They also need to provide proper training and education to the workers on how to properly wear and maintain PPE. Proper training would help changing workers' behavior.

c. Comfort

The interview result also shows that all informants are not comfortable in wearing the PPE. They mention that the equipment makes them feel hot, especially when it comes to face masks and safety shoes. Because the working environment is hot, the workers prefer not to wear the PPE.

According to Lawrence Green, the one thing that is part of a person as a predisposing factor, in this case the discomfort of wearing PPE, can affect a person's behaviour.

2. Predisposing factor

a. Regulation

The line of production did not have written rules on the obligation to wear PPE in the working environment during work. Workers mention that the management never remind them to wear PPE, and those who do not wear it never received any sanctions.

b. Availability of PPE

Company has provided PPE but not as a complete set that covers all parts of the body from head to toe. The face masks' quality provided by the company is still below the standard. It failed to meet the needs of the workers, considering the working environment that is highly polluted by metal dust and may affect workers' respiratory health. Company also provided safety shoes, safety body, glasses, and helmets, but in limited amount. The company also did not provide enough number of PPE for all their workers knowing that the workers are not comfortable wearing it.

Green also mentioned that enough resources are needed in order to affect behaviour as it can be the enabling factor. By providing PPE for all workers, the company can start advocating the importance for all workers to wear it during work.

c. Training

Training is an attempt to provide guidance, it can be provided by companies or non companies, formally to the workers in accordance to each line of work. For new workers and workers who are about to be moved, training is required to be given by the Head of Production. Training can affect one's behaviour because training can change one's behavioral pattern.

3. Reinforcing factor

a. Monitoring

Monitoring has been done in the factory simply to monitor whether all workers have worked according to the procedure without considering the occupational health and safety aspects and without reinforcing the use of PPE among workers.

Based on the main informants' statement, there is no sanction from the supervisors if the workers do not wear PPE. Triangulated informants also saying the same thing. Green also stated in his theory that in order to affect a person's behaviour there should be a strong external enforcing factor, which is in this case, can be done by implementing a proper monitoring system.

b. Peer pressure

The interview results also show that all workers are not aware of the importance of wearing PPE. The main informants mentioned that wearing PPE is not important at work. Therefore, workers did not remind each other to wear PPE. Meanwhile, Lawrence Green believe that peer pressure can be the external reinforcing factors that can affect one's behaviour.

The design of Standard Operating Procedure (SOP) for the production line can be seen on Table 3.

Table 3. Design of Standard Operating Procedure (SOP)

No.	Working process	SOP activities	PPE to be worn
1.	Foam designing	Drawing patterns on foam using pencils and marking it with needles Cutting the finished patterns	Masks Safety shoes
2.	Mold making	Creating a mold based on the patterns Pounding the sand using a pounder Taking the sand using hand truck Mixing the materials using the grinding machine Burning the mold	Glasses Masks Gloves Safety body Safety shoes
	Melting iron metal	1. Lit up the induction stove 2. Adjusting the stove's temperature 3. Putting in the iron metal 4. Preparing a ladle 5. Mixing using the ladle 6. Collecting molten metal on the ladle	1. Glasses 2. Masks 3. Gloves 4. Safety body 5. Safety shoes

No.	Working process	SOP activities	PPE to be worn
	Pouring the molten iron metal	1. Preparing a ladle 2. Pouring the molten metal using the ladle	1. Helmet 2. Glasses 3. Masks 4. Gloves 5. Safety body 6. Safety shoes
	Mold opening	1. Preparing hitting tool 2. Opening the mold using the tool	1. Glasses 2. Masks 3. Gloves 4. Safety body 5. Safety shoes
	Cast cleaning	1. Preparing hitting tool 2. Cleaning casting results using the tool	1. Glasses 2. Masks 3. Gloves 4. Safety body 5. Safety shoes
	Finishing	1. Preparing the required machine/tool (grinding machine, drill tool, welding tool, lathe, gantry crane) 2. Turning on and operating the machine based on instruction	1. Helmet 2. Glasses 3. Masks 4. Gloves 5. Safety body 6. Safety shoes

Regulation that should be implemented by the companies are the following:

1. Explaining to all workers, whether directly or indirectly, about the importance of occupational health and safety in the company, such as by doing safety talk, putting on banners, creating written rules and safety posters, including prohibition to smoke as well as implementation of 5R movement (*ringkas* (orderly), *resik* (clean), *rapi* (neat), *rawat* (care) and *rajin* (diligent)). Those are the necessary steps to increase productivity and comfort, while at the same time, reducing hazards in the workplace by improving the environment quality.
2. Head of Production should monitor workers intensively and diligently regarding the use of PPE who are at the workplace. This is important because PPE procedure is part of implementing occupational safety.
3. Company should provide specific training on the principles of PPE and implementation of SOP to protect workers from potential hazards in the workplace and make them more aware of the risks of work accidents.
4. The company should implement a regulation that enforce all workers to wear PPE, not to smoke in the workplace, and not to use mobile phones during work time.
5. Company should give persuasive sanctions to encourage workers to wear PPE. Later on, firmer sanctions can be implemented as well, such as imposing fines to those who violate the regulations.

5. Conclusion

1. Based on the calculation of basic risk and existing risk, it is concluded that the working process with the highest risk (the smallest risk reduction) is the process of pouring molten metal at 14.44%.
2. Workers in the production lines had not have safety behaviour, such as the habit to wear Personal Protection Equipment (PPE) properly when they are at work.
3. Predisposing factor involves knowledge, attitudes, and comforts. Workers had limited knowledge on PPE. Their attitude towards PPE are also not good enough. They are also reluctant to wear PPE because they feel hot when they wear it.
4. The enabling factors include the availability of PPE, regulation, and training. Company has not provided the complete set of PPE. There is also no regulation to encourage workers to wear PPE. They also have not conducted any training about occupational health and safety for the workers.
5. The reinforcing factors involves monitoring and peer pressure. Monitoring has only been done to supervise the working procedure, but not on whether all aspects of working safety are managed. At the workplace, peer pressure failed to become the reinforcing factor to encourage workers to wear PPE as almost all workers ignored the importance of occupational safety.

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