



JURNAL IPTEK

MEDIA KOMUNIKASI TEKNOLOGI

homepage URL : ejurnal.itats.ac.id/index.php/ipitek



Analysis of Occupational Safety and Health in the Production Process Section Using the Failure Mode And Effect Analysis (FMEA) Method at PT Mitra Mandiri Perkasa

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ARTICLE INFORMATION

Jurnal IPTEK – Volume 25
No.1, May 2021

Page:
27 – 34
Published Date:
31 Mei 2021

DOI:
[10.31284/j.ipitek.2021.v25i1.1178](https://doi.org/10.31284/j.ipitek.2021.v25i1.1178)

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PUBLISHER

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Alamat:
Jl. Arief Rachman Hakim
No.100, Surabaya 60117,
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ABSTRACT

Based on the results of the analysis carried out, it was found that there were 29 work accidents in the turning wood production process for a period of 3 years, then after the classification was carried out based on the company's working environment conditions obtained 5 categories of work accidents. The results of the calculation of the risk priority number (RPN) show that the potential failure with the highest RPN level is that the hand is exposed to wood on the rip saw machine with an RPN value of 140. Proposed improvement is that machine operators must use PPE when doing work, provide a grace period when moving raw materials to rip saw machines to provide space for workers, routine inspections and always moving materials after being processed in the rip saw machines and giving danger signs in the production process area, improving standard operational procedures and periodic supervision in accordance with the applied K3 procedures.

Keywords: FMEA, K3, Risk, RPN

ABSTRAK

Keselamatan dan kesehatan kerja adalah hal yang sangat penting dalam proses produksi di industri manufaktur. PT Mitra mandiri Perkasa merupakan industri manufaktur yang memproduksi kayu bubutan (Turning). Penggunaan bahan baku kayu ukuran balok dan mesin produksi yang mempunyai berpotensi tinggi terhadap kecelakaan kerja sangat dibutuhkan pengawasan yang maksimal terhadap pekerja untuk menerapkan K3. Identifikasi terhadap potensial failure mode terhadap proses produksi bertujuan untuk mengurangi terjadinya kecelakaan kerja. Tujuan penelitian ini untuk mengidentifikasi risiko penyebab terjadinya kecelakaan kerja pada departemen produksi kayu turning dan menyusun tindakan preventif yang bisa dilakukan oleh perusahaan untuk mengurangi tingkat terjadinya risiko kecelakaan kerja. Hasil penelitian diperoleh terdapat 29 kejadian kecelakaan kerja dengan 5 kategori kecelakaan kerja berdasarkan kondisi lingkungan perusahaan. Nilai RPN tertinggi sebesar 140 pada kecelakaan tangan terkena kayu di mesin rip saw. Usulan perbaikan yaitu operator mesin wajib menggunakan APD pada saat melakukan pekerjaan, Memberikan waktu tenggang saat pemindahan bahan baku ke mesin rip saw, memberikan tanda bahaya pada area proses produksi, perbaikan standart operasional prosedur dan pengawasan secara berkala sesuai dengan prosedur K3.

Kata kunci: FMEA, K3, Risiko, RPN

INTRODUCTION

PT. Mitra Mandiri Perkasa is a manufacturing company engaged in wood processing which is processed into turning wood products. As an active company, of course, there are problems, both internal and external, which include problems regarding occupational safety and health risks. Companies must have a good system in managing risks so that they can minimize the occurrence of risks in every production activity[1]. Risk is the chance of something happening that has an impact

on the objectives measured in terms of consequences and probabilities[2]. A risk is an event that arises as a result of an error or negligence while working which results in consequences and uncertainty[3].o reduce or minimize risk, it takes time from an effective and efficient strategy, so that the minimum risk that occurs can be avoided[4]. If there is a level of consequence, it is necessary to have research to analyze the occurrence of occupational risks. The Failure Mode and Effects Analysis (FMEA) method is used to identify potential hazards of work accidents and to measure the level of risk that may occur as a result of these accidents[5].Lack of awareness in maintaining safety while working in the production department greatly affects productivity and the high number of work accidents. Machine operators who do not use personal protective equipment (PPE) and do not comply with standard production work operation regulations are the dominant factors in the occurrence of work accidents in the production division.

To reduce the occurrence of work accidents, good control is needed on all activities of the production process, matters related to risks must be avoided and minimized. The results of the analysis using the FMEA method are to determine the potential risks that could potentially occur during the turning wood production process at PT. Mitra Mandiri Perkasa. The purpose of this study is to identify the risk of causing work accidents in the turning wood production department, to carry out a risk assessment of work accidents using the FMEA, and to formulate preventive actions that can be taken by companies to reduce the level of risk of accidents at work.

LITERATURE STUDY

A work accident is an incident caused by an error committed by a worker, damage to tools and machines that can result in injuries to workers[6]. To minimize damage due to work accidents, hazard risk mapping can be carried out to anticipate work accidents[7]. FMEA is a method that identifies and measures in a structured manner to prevent potential failure of a process [8]. FMEA is used to determine and identify activities of an operational nature as well as to mitigate risks which are measured using the Risk Priority Number (RPN)[9].

The stages and steps of the FMEA method used are (a) Identifying categories of work accidents that occur during the production process in a section (b) Determining the value of the seriousness or severity due to work accidents (c) Determining the Occurance value or the level of the frequency the occurrence of an accident (d) Determine the value of the detection or the possibility of an error occurring or the impact of an error. (e) Calculation of RPN to determine priority actions that must be taken. The Risk Priority Number is a multiplication of severity, occurrence, and detection. ($RPN = \text{severity} \times \text{occurrence} \times \text{detection}$), (f) Determining recommendations for potential failures from the highest RPN value, (g) Doing solutions to the RPN value in the form of suggestions and improvements.

The severity rating is a rating related to the severity of the effect caused by the failure mode. The directing effect can be rated on a scale of one to ten, with ten being the most severe.

Tabel 1.Severity Rating [10]

Level	Impact	Effect
10	Losing a life or changing an individual's life	Death of several individuals (mass)
9		Individual (person's) death
8		Need serious treatment and cause permanent disability
7	Has a big impact on the individual so that they no longer participate in activities	Was treated for more than 12 hours, with broken blood vessels, severe memory loss, major losses, etc.
6		Being treated for more than 12 hours, fractures, shifting bones, frostbite, burns, difficulty breathing and temporary memory loss, falls / slips
5	The impact received was moderate (individuals only 1 to 2 days did not participate in	Sprains/sprains, minor cracks/fractures, cramps, or spasms.
4		Minor burns, lacerations / cuts, frosnips (frostbite /

Level	Impact	Effect
	the activity	heat).
3	Small impact accepted (individuals can still participate in activities)	Blisters, heatstroke, minor sprains, light slips or slips
2		Sunburned, bruised, light cut, scratched
1	No impact (the individual does not have a felt impact)	Exposed to splinters, stung by insects, bitten by insects

Occurrence rating is a rating that corresponds to the estimated number of cumulative failures that occur due to a particular cause on a specified number of elements produced by the currently used control method.

Tabel 2.Occurrence Rating[10]

Probability of Event	Incidence rate	Value
Very high and unavoidable	>1 in 2	10
	1 in 3	9
High and frequent	1 in 8	8
	1 in 20	7
Is and sometimes happens	1 in 80	6
	1 in 400	5
Low and relatively rare	1 in 2.000	4
	1 in 15.000	3
Very low and almost unheard of	1 in 150.000	2
	1 in 1.500.000	1

The detection rating depends on the control method currently used by the company.

Tabel 3.Detection Rating[10]

Detection	Possible Detected	Rangking
Almost impossible	There is no controller capable of detecting	10
Very rarely	Today's control devices are very difficult to detect the form and cause of failure	9
Rare	Controllers today are very difficult to detect the shape and cause of failure	8
Very Low	The ability of the control device to detect forms and causes is very low	7
Low	The ability of the controller to detect forms and causes is low	6
Moderate	The ability of the control device to detect moderate forms and causes	5
It's a little tall	The ability of the controller to detect moderate to high forms and causes	4
High	The ability of the control device to detect shapes and causes is high	3
Very high	The ability of the control device to detect shapes and causes is very high	2
Almost certain	The ability of the controller to detect shape and cause is almost certain	1

After the severity value, occurrence and detection is obtained. Then calculate the value of the risk priority number by multiplying the values of the severity (S), occurrence (O), detection (D). This RPN value will be used as material for analysis and corrective actions to reduce and improve standard work procedures in the turning wood production process.

RESEARCH METHODS

This research was conducted at PT Mitra Mandiri Perkasa, a company engaged in the manufacturing industry that produces processed wood in the form of Turning. Where in the production process, PT Mitra Mandiri Perkasa still often finds problems in the form of work accidents that occur in every environment in the production site. This research begins with the first step to identify work accident data in the turning wood production process. The work accident data used is from 2018 to 2020. From the work accident data, it can be seen the causes of work accidents, types of accidents, their impact, and the frequency of accidents that occur. The second step is to classify the types of work accidents into several categories, namely due to negligence of workers, damage to equipment, and damage to machines, as well as due to environmental conditions in the workplace. After the classification of work, accidents are carried out, the third step is to compile a questionnaire to obtain severity, occurrence, and detection values, the questionnaire is given and filled in by the company's K3 team which is responsible for the identification and analysis of work accidents in the production department. After obtaining the Severity, Occurrence, and Detection values, the fourth step is to calculate the Risk Priority Number value. The results of this calculation are then used as a ranking or ranking to obtain the highest RPN value as a proposed improvement step that will be carried out to reduce the occurrence of work accidents.

RESULT AND DISCUSSION

Based on the results of collecting data on work accidents in the turning wood production process in 2018 to 2020, data on the causes of accidents, types and impacts of the occurrence of work accidents can be obtained. Work accident data is presented in table 4 below.

Tabel 4. Work Accident Data for 2018 to 2020

No	Causes of Accidents	Accident type	The impact	Incident
1	The process of moving material using a forklift is not careful enough so that the wood falls on the workers	The wood falls off the stack / pallet	Torn hands and scuffed feet	3 Incident
2	The pile load of material on the pallet is irregular so that the wood falls when it is lifted using a forklift	The wood fell when lifted	Scuffed feet	3 Incident
3	The process of moving material using a forklift is not careful enough so that the wood falls on the workers	The wood falls when it is moved to the molding machine	Bruised and torn head	1 Incident
4	The operator is not careful and careless when handling the material that is transferred to the woodpile	The head hits the wood when the wood is moved by a forklift	Bruised and torn head	3 Incident
5	Operators are unfocused and careless when doing work in the machine area	The hand hit the wood in the rip saw	Bloody hands and torn skin	2 Incident
6	Lack of maintenance and inspection at machine facilities so that the machine does not work optimally when used	The wood fell from the molding machine	The skin on the feet is torn/blistered, bruised	1 Incident
7	Lack of maintenance and inspection at machine facilities so that the machine does not work optimally when used	The remaining wood of the rip saw hit the arm	Scuffed arm	2 Incident

No	Causes of Accidents	Accident type	The impact	Incident
8	Workers are not focused and careless when handling material to be processed in the machine	The wood falls when it is lifted to enter the machine	Bruised leg	2 Incident
9	Workers are less careful and negligent when doing work on the Sanding machine	Worker's feet scratched by the sanding box	Scuffed feet	4 Incident
10	Workers are not focused and lazy when doing work	Hands pinched when putting the wood to stack	Hand bruised and abrasions	2 Incident
11	Workers are not concentrated and careless when handling work	Hammering hands when making pallets	Hand bruised and abrasions	2 Incident
12	Workers are unfocused and negligent when spraying the environment	Pesticide spray on feet	Itchy and hot skin on the feet	1 Incident
13	Operators are less careful when doing work so that their fingers hit the knife	The hand hit the knife in the crush cut machine	Hand wound bleeding	1 Incident
14	Workers do not see their surroundings when lifting logs so they collide with other workers while walking	Dropped while lifting wood to move it	Scuffed feet	1 Incident
Sum of incidents				28 Incident

From the table above it is known that there were 28 work accidents. Furthermore, these types of work accidents entirely occurred in the production department at PT Mitra Mandiri Perkasa. From these results, work accident categories will be identified and carried out according to the real conditions of the company. The results of the work accident category adjusted to the company's work environment are shown in the table below.

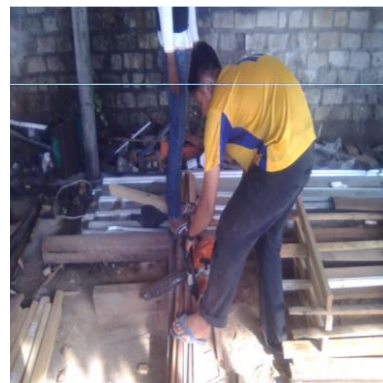
Tabel 5. Occupational Accident Category Based on Company Work Environment Conditions

No	Work Accident Category	Explanation
1	Contact with a moving machine or material in the machine	This category is a work accident that occurs due to contact or interaction with production machines while working or contacts with material (in the machine) when the machine is operating.
2	Hit by a moving vehicle	This category is a work accident that occurs due to being hit by a vehicle in a factory such as a forklift.
3	Being hit by a moving, flying, or falling object	This category is a work accident that occurs due to a collision between the victim and an object that is in an unstable/flat position so that the object falls and hits the victim.
4	Slip, trip, and fall at the same height	This category is a category of work accidents that occur because the victim slips, trips, falls. because the floor conditions are uneven, wet, slippery or perforated.
5	Getting hurt while handling work, lifting things, or carrying them	This category is a general category of work accidents that often occur in companies. Especially when the victim is handling the work at hand.

Based on the table above, it can be seen that there are 10 categories of work accidents in PT Mitra Mandiri Perkasa, whereof these types of work accidents generally often occur due to errors and negligence of workers. The following are pictures of some examples of workers' activities while doing Turning wood production work.



(a)



(b)

Figure 1.a) the distance between workers close together without using PPE, b) Workers cut wood with a jigsaw with their feet on the wood

Source: PT MitraMandiri Perkasa Turning wood production process

From the picture above, it can be seen that workers do not wear PPE in the form of shoes and head protection helmets when doing work on molding and wood cutting machines where can have the potential for work accidents to these employees. After obtaining the occupational accident categorization, then measuring the scale of severity, Occurrence, Detection as shown in the following table. The respondent who gave the assessment was the supervisor of the production department who is a member of the company's K3 group who has received training and understands the potential hazards that occur in the production department.

Tabel 6. Rating Scale of Severity, Occurrence, and Detection as well as the value of RPN

No	Failure Mode	Mode Potential Failure	Failure Mode	S	O	D	RPN
1	Contact with a moving machine/material in the machine	His hand hit wood on the Rip saw machine	Bloody hands and torn skin	4	67	35	140
		The wood from the Molding machine fell off	The skin on the feet is torn/blistered & bruised	4	2	4	32
		The remaining wood of the rip saw hits the arm	Scuffed arm	2	3	4	24
		Her feet are leaning against the box	Scuffed feet	4	6	3	72
		Hand hit by a knife in crosscut machine	Hand-wound bleeding	6	2	4	48
2	Collided with moving, flying, / falling objects	The wood fell from the pallets	Ripped hands and scuffed feet	5	5	3	75
		Hit the head of the wood while being moved by a forklift	Bruised and torn head	5	3	4	60
3	Wounded while handling work, lifting goods / bring it	The wood fell when lifted	Scuffed feet	3	5	4	60
		The wood falls when it is moved to the Molding machine	Bruised and torn head	6	3	3	54
		The wood falls when it is lifted to enter the	Bruised leg	2	3	2	12

No	Failure Mode	Mode Potential Failure	Failure Mode	S	O	D	RPN
		machine					
		Hammering hands when making pallets	Hand bruised and abrasions	2	3	3	18
		Fall while lifting wood to move it	Scuffed feet	2	3	2	12
4	Dropped/crushed the material	Hands pinched when putting wood for arranged	Hand bruised and abrasions	2	3	2	12
5	Contacted/boxed with hazardous materials/substances	Pesticide spray on feet	Itchy and hot skin on the feet	3	3	2	18

Based on the results of the RPN calculation above, it can be seen that the one with the highest RPN value is from the Potential Failure Mode, namely, the hand is exposed to wood on the rip saw machine with a branch value of 140. From the results of the above calculations, then priority actions will be taken to prevent this type of accident. The causes of this type of work accident when workers' hands are exposed to wood on the rip saw machine is not wearing PPE, unfocused and negligent, narrow space or, no danger signs on machines, no periodic cleaning after completion of work and equipment and work processes are not conformity and lack of oversight.

Suggestions for improvement that can be proposed are that the head of the production sector gives a warning to workers on the importance of using PPE when doing work, Provides delay time, and turns when moving raw materials to the rip saw machine so as to provide space for workers, routine inspections and always moving materials after processing in the rip saw machine and giving a danger signal to the machining facility, carry out tighter supervision in accordance with the applied PPE procedure.

CONCLUSION

Based on the results of the analysis carried out, it was found that there were 29 work accidents in the turning wood production process for a period of 3 years, then after the classification was carried out based on the company's working environment conditions, there were 5 categories of work accidents. The results of the calculation of the risk priority number (RPN) show that the potential failure with the highest RPN level is that the workers' hands are exposed to wood on the rip saw machine with an RPN value of 140. The proposed improvement is that machine operators must use PPE when doing work, provide a grace period when moving raw materials to the rip saw machine in order to provide space for workers, routine inspections, and always moving materials after processing on the rip saw machine as well as giving a danger sign in the production process area, improving standard operational procedures and periodic supervision in accordance with PPE procedures.

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