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Identifying and Preventing Work Accidents in Production and Installation Video Wall and Signage Monitor Using JSA

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ABSTRACT

Work accidents are a serious problem for many companies. CV. JVS, a manufacturer of video walls and signage monitors, prioritizes worker safety. Their work processes involve lifting/rigging materials, cutting, assembly, and finishing. Observations indicate a fairly high risk of accidents, with an average of 5-10% occurring monthly. Accident types include physical hazards (being hit by heavy tools and materials, pinched materials, scratched hands) and welding-related hazards (sparks, light reflections). Therefore, this research aims to identify and analyze factors that cause work accidents and develop a preventive action plan. The methods used in this research are fault tree analysis and job safety analysis (JSA). Data collection involved direct observation, interviews with workers and management, and document review of previous workplace accident reports. The results showed that several critical tasks in CV. JVS's production and installation processes have a high potential for work accidents. Potential hazards include contact with moving machinery and handling heavy loads. Causes include a lack of worker training and safety awareness, lax supervision, and inadequate equipment maintenance. The JSA documents, as the research outcome, can serve as a reference for the CV. JVS and similar companies to improve work safety performance. CV JVS may reduce workplace accidents by under 5% per month.

Keywords: Accident prevention, fault tree analysis, job safety analysis, risk assessment, workplace safety

1. Introduction

The safety problem that occurs in the manufacturing industry is usually caused by the condition of the workplace, tools, and equipment, the absence of standard operating procedures, and the safety awareness of the employees or workers doing their work [1]. Work accidents are more triggered by discomfort while working, lack of lighting, noise, or air temperature in the work environment. Other factors are caused by human (workers) error or unsafe action [2]. CV. JVS is one of the growing manufacturing industries that is meeting market demand by producing and installing video walls and signage monitors. The 5-10% of work accidents that occurred in the period of January 2022 up to March 2023 the work that has the greatest potential for work accidents is work on installing frames, making foundation holes, and assembling screens. The potential for work accidents occurs because workers have to interact directly with machines and other work tools. This has an impact on CV. JVS in the form of increased production costs, non-achievement of production targets, and customer complaints. The company suffered losses due to those incidents.

The production and installation of video walls and signage monitors are the processes that involve the workers directly and heavy materials handling. Therefore, it is necessary to identify and analyze the critical work activities or processes in this research by using the Job Safety Analysis (JSA) method [3] [4]. The JSA can identify previously undetected hazards, minimize the rate of work accidents, and increase workers' knowledge and awareness of workplace hazards [5]. By identifying and analyzing the factors that are the potential causes of work accidents in the production and installation processes of video walls and signage monitors, can determine preventive actions for work accidents in the company [6]. Then CV. JVS can have JSA documents, which become the guide for the workers in doing their activities safely. Those are the aim of this research.

2. Material and Methods

In this research, preliminary studies were carried out, including field studies and literature reviews, and then data collection was done by observation and interviews with the persons in charge to specified activities. In general, the research consists 4 (four) stages, namely [3]:

1. Preliminary study
   This preliminary stage begins with preliminary studies related to research by conducting field studies and literature studies so that the object of research can be in the form of work accidents that can occur in the production and installation divisions so that known problems can be formulated and determine the objectives of research related to work accidents [7].
2. Data collection
   Data is obtained from two data collection methods, namely primary data and secondary data. The primary data itself consists of interviews and observations while secondary data is taken based on company's reports and journals (Table 1).

Table 1: Stages, Types and Data Collection and Analysis

No.	Stages	Types of Data Required	Data Sources and Data Collection Methods
1.	Work flow (work activities)	Process of production and installation of video walls and siganage monitors between processes and the parties involved	Observing the production and installation division
2.	Factors that give rise to potential danger	Factors that give rise to potential work accidents in the production and installation processes (4M + 1E)	Conduct interviews with the head of the production and installation division
3.	Hazard control	Work procedures based on JSA results	Conduct interviews with the head of the production and installation division
4.	Make Proposals/ Plans to prevent work accidents	Cause and effect analysis using FTA method and JSA results	Conduct interviews with the head of the production and installation division

3. Job safety analysis
   Determining the work to be analyzed so that they can make the sequences of production and installation processes. Then the potential factors for causing work accidents can be find out by using job safety analysis, fault tree analysis and cause effect analysis [8]. So that the data that has been processed and analyzed can produce proposals for preventing work accidents and develop work procedures based on job safety analysis [9]. Fault tree analysis method is used to identify the root causes of system failures (Table 1).
4. Concluding stages
   The final stage of this research results in identifying and analyzing the causal factors of the root problems that can cause accidents in the production and installation processes by making appropriate proposals or plans so as to prevent work accidents based on the factors that have been described in the job safety analysis documents [10].

3. Results and Discussions

The production and installation of video walls and signage monitors consist of material lifting or rigging, cutting, part assembly, and finishing processes. After *brainstorming* and field observation, the potential factors and causes of work accidents in the installation area on CV. JVS obtained (Table 2). The factors that are the cause of the potential work accident include humans, work machines and equipment, methods, materials, and work environments.

Table 2: Recapitulation of potential work accident factors

Factors	Potential factors of work accidents
Human	Workers do not use full PPE and do not comply with SOPs
	Lack of work experience
	Lack of training for workers
	Some workers do not use full PPE and do not comply with SOPs
	Some workers have not complied with the SOPs provided
	Workers have not fulfilled sufficient training in doing their jobs
Work machinery and equipment	Age of aging engines
	There are frequent errors in the machine during the work process (the number of machines that have been damaged

	Adequate work machines and equipment are available but lack of maintenance of work machines and equipment
	Inadequate PPE
Method	Some workers do not know the SOPs provided
	Availability of SOPs but lack of socialization among workers
	SOPs already cover work rules and steps, but need a detailed explanation of work accidents
Materials	The weight of the material used
	Lack of location for material goods placement
Working environment	Inadequate lighting
	The amount of materials, machines and work tools used in the work environment
	Lack of adequate material placement locations
	Cramped and inadequate work environment

Based on the Table 2, the results of the recapitulation of potential work accident factors include humans, work machines and equipment, methods, materials and work environments. The causes of potential work accidents are dominated by human factors. Even though SOPs are available, workers do not follow them. Similarly, workers rarely use PPE. However, the availability of PPE is still insufficient. The weight of the material, the condition of the machine and the work environment also have a large contribution to the occurrence of accidents in the workplace.

2.1. Fault tree analysis

Fault tree analysis (FTA) is a method used to identify the root causes of system failures. It's like a detective board for potential problems, visually showing how different events can lead to an undesired outcome. FTA can help to see the bigger picture and understand how seemingly unrelated events can combine to cause a system failure. By proactively identifying these potential problems, you can take steps to prevent them from happening in the first place [11]. The simple FTA is implemented in this research to get a better understanding of the causes of the potential work accidents.

The cause of potential work accidents is based on the highest percentage of work accident rates, namely the lack of detailed explanation of SOPs that causes work accidents. The FTA results obtained 9 (nine) basic events where the basic event is the most basic form of events (C symbols). The events that are above it are called intermediate events. They include 7 events that potentially cause work accidents (Table 3 and Figure 1).

Table 3: Fault Tree Analysis Event Elements

Event	Information
A	Potential causes of work accidents
B1	Lack of detailed explanation of SOPs
B2	Lack of SOPs training
B3	Lack of operating (technical) training
B4	Absence of a training plan for the improvement of workers' competence
B5	Cramped work environment
B6	The weight of the material weight
B7	Age of mechines
C1	Negligence in work
C2	Do not understand what you are doing
C3	Not complying with SOPs
C4	Not understanding the operation of a machine
C5	Lack of experience
C6	Minimal material placement
C7	Inadequate tools with appropriate weight
C8	Frequent errors on the machine
C9	Lack of maintenance on the machine periodically

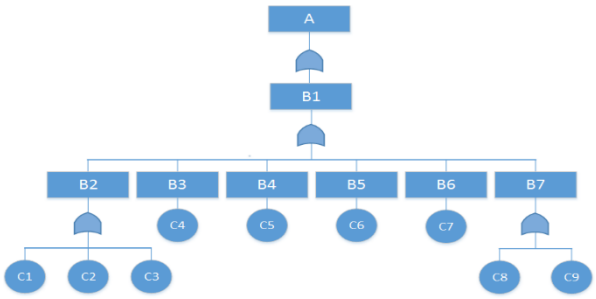

Figure 1: Fault Tree Analysis of Potential Causes of Work Accidents

2.2. Job safety analysis

Job safety analysis (JSA) is carried out based on the sequence of work in the production and installation process of video walls and signage monitors [5]. Job safety analysis is carried out by the results of identifying factors that have the potential to cause work accidents and their causes as depicted in the fishbone diagram[12]. The job safety analysis (JSA) document is useful for minimizing work accidents. The job safety analysis (JSA) document for the production and installation process of video walls and signage monitors consists of 4 parts which are presented in Table 4 to Table 7.

Table 4: Job Safety Analysis Document of Material Lifting/Rigging Process

Type of work	Material movement	Date of issue :	**JSA Number:**	Revision :
Project		Prepared By	Known By	Approved By
Executing Company	CV. JVS	Muhamad Rizky Devianto		
JSA Maker Department	Production operator			
Recommended Training Requirements		• Occupational Safety and Health training; • Socialization of understanding of SOP; • Material handling equipment operation training.		
Tools Used		Pulleys and mini cranes		
Materials Required		Hollow steel		
Personal protective equipment that must be worn: **Safety helmet, safety shoes and gloves**		**Work location:** **Customer location**		

	BASIC SEQUENCE OF WORK STEPS	**DANGER ASSOCIATED RISKS**	**CAUSES OF WORK ACCIDENTS**	**RECOMMENDED PREVENTIVE ACTIONS OR PROCEDURES**
1	Inspection of the material lifting process	Items fall	– Not using PPE and not complying with SOP – Insufficient tools	– Provide and use complete PPE – Understand the SOP for the material lifting process – Use tools appropriate to the weight of the material
2	Inspection of machines and work tools	Hit by work tools	– The machine is aging – Frequent errors occur on the machine during the work process – Lack of routine maintenance on the machine	– Check the suitability of the machines and work equipment used – Carry out machine maintenance periodicly
3	Material placement	Pinched material	– There is no special storage for materials and narrow work locations – Insufficient lighting	– Create special space for material storage – Expand production and installation areas – Added lights at certain points

In the JSA Table 4, the causes of work accidents in the process of moving materials are hazards that can occur such as falling goods, and being crushed by work tools and pinched by materials. Actions that can be recommended by using PPE, using material aids, carrying out periodic maintenance, and checking the feasibility of machines and tools make a special room for storing tools with good lighting.

Table 5: Job Safety Analysis Document of Cutting Process

Type of work	Cutting materials	Date of issue :	**JSA Number:**	Revision :
Project		Prepared By	Known By	Approved By
Executing Company	CV. JVS	Muhamad Rizky Devianto		
JSA Maker Department	Grinding Operator			
Recommended Training Requirements		• Occupational Safety and Health training; • Material handling equipment operation training.		
Tools Used		Bench Grinder		
Materials Required		Hollow steel		
Personal protective equipment that must be worn: safety glasses, gloves		**Work location:** Customer location		

	BASIC SEQUENCE OF WORK STEPS	**DANGER ASSOCIATED RISKS**	**CAUSES OF WORK ACCIDENTS**	**RECOMMENDED PREVENTIVE ACTIONS OR PROCEDURES**
1	Prepare materials and machines	Short-circuit the power cable when plugging it into the socket	Damage to the power cable of the bench grinding machine	Prepare a machine that is suitable for use
2	Material cutting	Hands scratched from cutting machines and materials	– Not wearing PPE – Lack of experience and no training in operating material handling equipment	– Workers must wear complete PPE – Workers are required to take training in operating material handling equipment (material handling) – Demo for operating the cutting machine

In the JSA Table 5, the causes of work accidents in the material cutting process cause work accidents that can occur such as electrical short circuits and hands scratched by cutting machines and materials. Precautions that can be recommended in the cutting process by checking the initial preparation of the machine are suitable for use, workers are required to use PPE, conduct operation training, and appropriate demonstrations on the machine.

Table 6: Job Safety Analysis Document of Part Assembly Process

Type of work	Assembly Part	Date of issue :	**JSA Number:**	Revision :
Project		Prepared By	Known By	Approved By
Executing Company	CV. JVS	Muhamad Rizky Devianto		
JSA Maker Department	Installation Operator			
Recommended Training Requirements		• Occupational Safety and Health training; • Socialization of understanding of SOP; • Material handling equipment operation training.		
Tools Used		Welding Machines, Pulleys, and Scafolding		
Materials Required		Hollow steel that has gone through the cutting process		
Personal protective equipment that must be worn: Body harness, safety shoes, safety helmet, welding mask and gloves		**Work location:** Customer location		

	BASIC SEQUENCE OF WORK STEPS	**DANGER ASSOCIATED RISKS**	**CAUSES OF WORK ACCIDENTS**	**RECOMMENDED PREVENTIVE ACTIONS OR PROCEDURES**
1	Determination of the midpoint	Falling from a height	– Security requirements are not respected – Workers do not use PPE	– Implementation of SOPs in the work process – Workers must use complete PPE

			– Negligence at work	– Require workers to train
2	Lifting of materials	The material fell when lifted from the previous process	– The weight of the material is heavy, the iron frame that has been formed	– Inspection of the process of lifting the iron frame with the implementation of applicable SOPs – Use tools appropriate to the weight of the material
3	Joining materials with a welding machine	Exposed to sparks and reflections of welding machine light	– Workers do not use complete PPE – Lack of training in operating material handling equipment	– Workers are required to use complete PPE – Material handling operations training for workers – Demo for operating the welding machine

In the JSA Table 6, the causes of work accidents in the part assembly process, and related hazards can be seen in the table above, hazards that can occur in this process, such as falling from a height, falling material, and being exposed to sparks and light when welding. Prevention actions that can be taken by the company such as the obligation to conduct training following SOPs, using tools that are by the material weight, and the use of complete PPE.

Table 7. Job Safety Analysis Document of Finishing Process

Type of work	Finishing	Date of issue :	**JSA Number:**	Revision :
Project		Prepared By	Known By	Approved By
Executing Company	CV. JVS	Muhamad Rizky Devianto		
JSA Maker Department	Production and Installation Operator			
Recommended Training Requirements		• Occupational Safety and Health training; • Material handling equipment operation training; • Electrical installation operation training.		
Tools Used		Scaffolding, pulleys and laptops		
Materials Required		Formed hollow steel frame and monitor		
Personal protective equipment that must be worn: Body harness, safety helmet, safety shoes, gloves		**Work location:** Customer location		

	BASIC SEQUENCE OF WORK STEPS	**DANGER ASSOCIATED RISKS**	**CAUSES OF WORK ACCIDENTS**	**RECOMMENDED PREVENTIVE ACTIONS OR PROCEDURES**
1	Ensure the strength of the frame	- Material fell - Fall from a height	– Hit by material – Workers do not use PPE	– Using supporting tools, namely scaffolding – Workers must use complete PPE
2	Monitor installation	- Hit by material - Falling from a height	Workers need to use complete PPE	Workers are required to use PPE, body harness, and tools, namely scaffolding

In Table 7 of JSA, the causes of work accidents in the finishing process, and hazards that can occur such as falling materials so that the need for PPE that is according to standards is the most prioritized thing by using supporting tools such as scaffolding is also one of the recommended preventive measures.

4. Conclusion

Based on the analysis, it was found that the factors that have the potential to cause work accidents at CV. JVS comes from workers, machines and equipment, methods, materials, and work environments where the human factor is that has the most potential to cause work accidents at CV. J.V.S. The workers do not follow the SOPs correctly and consistently because of a lack of socialization or training, safety awareness, and lax supervision. On the other hand, material handling equipment

refers to heavy materials, machines, conditions, and space availability that are not sufficient to support worker to perform their task with safe working conditions.

Preventive action plans are made in the form of JSA documents for material lifting or rigging, cutting, part assembly, and finishing processes which are useful for CV. JVS and similar companies to improve work safety performance. CV JVS hopefully can reduce workplace accidents by under 5% per month.

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