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Identification of Occupational Safety and Health Hazards with Job Safety Analysis (JSA) Method for Paper Core Factory Workers

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ABSTRACT

This study aims to analyze occupational hazards and health risks among Paper Core factory workers, with a particular focus on occupational diseases, especially hypertension. The research is grounded in Government Regulation No. 88 of 2019 concerning occupational health and the relevance of work-related diseases to worker safety and productivity. The study employed the Hazard Identification and Risk Assessment (HIRA) and Job Safety Analysis (JSA) approaches, with risk analysis based on the AS/NZS 4360:2004 standard. Data were collected through observation, interviews, blood pressure measurement, and source triangulation. The findings indicate that workers are exposed to multiple risk factors, including workplace temperatures exceeding 30°C, noise levels up to 103.7 dB, dust exposure, adhesive chemicals, and heavy physical workloads. Among the 74 workers examined, 20 were diagnosed with hypertension. The analysis suggests that prolonged exposure to heat and noise significantly contributes to hypertension risk, although lifestyle factors and individual health history also play a role. Furthermore, suboptimal production facility layout was found to increase ergonomic and occupational safety risks. The study concludes that hypertension can be classified as an occupational disease among Paper Core factory workers. Implementation of risk management, improvement of facility layout, consistent use of personal protective equipment (PPE), and routine application of JSA are recommended to reduce occupational hazards and enhance both worker safety and productivity.

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1. INTRODUCTION

According to Government Regulation No. 88/2019 Article 1, occupational health is an effort to protect individuals in the workplace to stay healthy and avoid health problems and negative impacts due to work (Pemerintah Republik Indonesia, 2019a). One of the main issues in occupational health is occupational diseases, which are diseases caused by work or the work environment. Workers themselves are defined as everyone who works by receiving salaries, wages, or other forms of compensation (Pemerintah Republik Indonesia, 2019b) Occupational diseases are an important concern in the occupational safety and health (OSH) system due to their significant impact on the health of the workforce and the productivity of the company. These diseases can arise from exposure to certain risk factors that are directly related to work activities or environments. One such risk factor is physical exposure, such as hot air, which is often found in certain workplaces (PEMERINTAH REPUBLIK INDONESIA, 2012).

Paper core mills convert raw materials into paper core tubes utilized throughout diverse industries, including textiles, paper, and plastic films. The procedure entails high-velocity machinery, adhesive substances, and cutting and winding operations, which provide potential risks to employees. Risks frequently encountered in this work setting encompass injuries from rotating machinery, such being squeezed or struck by a cutting blade. Exposure to paper dust may lead to respiratory issues. Exposure to adhesive compounds, which may result in skin irritation or other health issues. Ergonomic deficiencies, including suboptimal working postures, which may result in musculoskeletal problems. (Paulina Tambunan, 2025).

Implementing safety management practices can mitigate the risks and dangers associated with workplace accidents, ensuring safe and efficient work procedures. A job safety analysis (JSA) is employed to evaluate procedures, identify hazardous work practices, and implement requisite measures to mitigate them. (Satrio & Wibowo, 2023). Job Safety Analysis (JSA) is a systematic approach employed to identify, assess, and mitigate hazards related to a specific task. This strategy enables workers to comprehend prospective threats and execute suitable safety protocols, including the utilization of personal protection equipment (PPE), standard operating procedures, and ergonomic design alterations to enhance job comfort and efficiency. Through the regular implementation of Job Safety Analysis (JSA), the paper core plant may diminish work-related accidents, enhance production efficiency, and foster a safer workplace for all employees (Evi, 2020; Kartika et al., 2022).

2. METHODS

Data analysis methods commence with risk assessment to ascertain the risk level derived from the computation of consequences and probabilities through semiquantitative analysis. Standards Australia/Standards New Zealand 4360:2004(Australian/New Zealand Standart, 2004; Kartika et al.,

2022) Subsequently, evaluate the risk level against the established criteria. Subsequent to that, the risk assessment and risk mitigation will be conducted. The data analysis process commenced concurrently with the initial research involving data collection, followed by data processing until the conclusion of the field activity. If the data is deemed insufficient, additional data collection will be undertaken. Subsequently, a flowchart can be presented. The approach for ensuring data authenticity is achieved through source triangulation, method triangulation, and triangulation with the source.

3. FINDINGS AND DISCUSSION

The Paper Core plant provides high-quality packaging to many well-known companies worldwide. Paper packing and cores are the main focus. The factory employs 193 people, including drivers and security, with 25 in the office and 168 on the production line. All women in this factory work in the office, while some men work in the production department. Employees range in age from twenty to fifty-four, with the oldest being fifty-four. While producing, the plant offers paper cores and carton boxes. The production room's main product is paper core. A paper roll's core is a cylindrical product made of adhesive-bonded paper layers. Paper cores are used in tape rolls, thread rolls, and aluminum

foil. The paper core facility makes general core and seamless core to client specifications. The production process for each paper core product is different.

1. Stages of General Core Production Process

Figure 1. Flow of the General Core Production Process Stages

1.1. Slitting/Cutting Process

Figure 2. Storage of paper core raw materials

The production process of the General Core type Paper Core begins with the transportation of raw materials in the form of jumbo paper from storage to the slitter machine.Jumbo Paper is a roll of paper that has a very large size, with a diameter of 110 – 115 cm and a thickness of 110 cm, weighing 750 – 900 kg.Jumbo Paper has a very large size, making it unsuitable for direct processing into the winding process.Therefore, jumbo paper needs to be cut into rolls with a smaller thickness, around 4 – 10 cm, which are called paper coils.Cutting jumbo paper into paper coils is called the slitting process and is done on a slitter machine. Cutting jumbo paper into paper coils is called the slitting process and is done on a slitter machine.

Figure 3. Slitting/Cutting Process

The slitting process can produce 5 – 11 paper coils. Some suppliers provide jumbo paper that has already undergone the slitting process (pre-slitted jumbo paper), so it does not need to go through the slitting process, but can go directly to the winding process. Jumbo The paper used for the General Core variant is called Jumbo Kraft, which is then processed into paper coils known as kraft coils. In this process, there are 2 workers responsible for moving the base material of the paper core from the previous stage to the cutting stage.

1.2. Winding Process

After going through the slitting process, the kraft coil is then placed into the winder machine for the winding process.Winding is the process of rolling and bonding several paper coils into a paper core that has a high thickness. Winding is the process of winding and bonding several paper coils into a paper core with high thickness.

Figure 4. Winding Process with small diameter raw materials

Paper core is a semi-finished product (WIP) that has a very long size, which will later be cut through the trimming process into General Core products with lengths according to customer requests. The paper cores resulting from the winding process are then stacked in several rows on wooden pallets.Paper cores resulting from the winding process tend to have a high moisture content.If the customer requests a product with a specific moisture level, or what is called moisture content (MC), the paper core will be placed in the drying room to undergo the drying process. In this process, there are two people on duty.The highest noise level during the processing stage reached 70.2 decibels.The room temperature during the processing stage is 31.1 °C.

1.3. Drying Process (Optional)

The drying process is carried out to reduce the moisture content (MC) in the paper core to meet customer requirements.This stage is carried out before the trimming process.There are no workers assigned to this area.This section becomes the hottest area in the production room, with the highest temperature reaching 36 °C during the dry season.

1.4. Trimming Process

After the paper core reaches the MC that meets the customer's requirements, the paper core is removed from the drying room and transported to the trimmer machine for the trimming process.Trimming is the process of cutting the paper core into several units of paper core, each with a length according to customer specifications.After the trimming process is completed, the general cores are stacked on wooden pallets in several tiers and then transported to the FG (Finished Goods) Area

Figure 5 Trimming Process

At this stage, the personal protective equipment (PPE) used consists only of masks and safety shoes.The noise level peaks at 103.7 decibels and drops to 33.5 decibels.At this stage, there are two machines, with each machine operated by two workers.

1.5. Finishing Process

After being transported to the FG Area, wooden pallets containing general core products will be wrapped with several layers of plastic wrap and other protective layers, then transported to the loading area for shipment to customers.

Figure 6. Location of Storage from production that is ready

2. Stages of Seamless Core Manufacturing Process

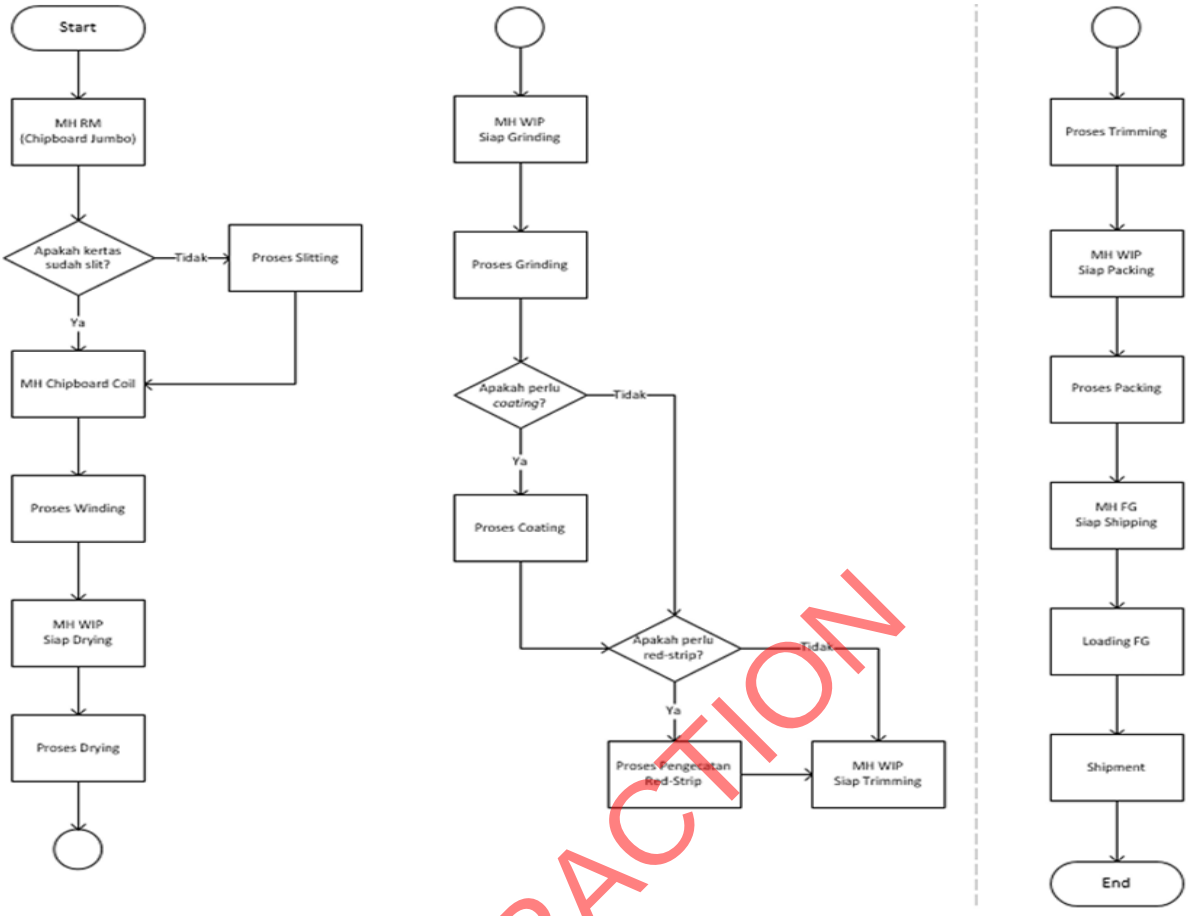

Figure 7 Flow of the Seamless Core Manufacturing Process Steps

2.1. Slitting/Cutting Process

The production process of Seamless Core type Paper Core is almost similar to the production process of General Core type products, which begins with the transportation of raw materials in the form of jumbo paper from storage to the slitter machine.After the transportation of raw materials, the jumbo paper is cut through the slitting process to become 5–11 units of paper coil.For the Seamless Core product type, the raw material used is jumbo paper made from chipboard. In this process, there are 2 workers responsible for moving the paper core raw material from the previous stage to the cutting stage.

2.2. Winding Process

After going through the slitting process, the resulting paper coil is then transported to the winder machine for the winding process, producing a seamless paper core.

Figure 8 Winding Process with Large Diameter Raw Materials

Seamless paper core from the winding process is then transported to the drying room for the drying process.One of the differences between Seamless Core products and General Core products is in the drying process.

Figure 9. Winding process with raw materials of large diameter 2

In this processing section, there are 5 workers.At this processing stage, the highest noise level reaches 77.9 decibels, while the room temperature is at 33.4 °C.

2.3. Drying Process

In General Core products, the drying process is optional and not mandatory.Whereas in the Seamless Core product, the drying process is mandatory to reduce the MC of the paper core.There are no workers assigned to this area.This section becomes the hottest area in the production room, with the highest temperature reaching 36 °C during the dry season.

Figure 10. Drying Room

2.4. Grinding Process

After the drying process is complete, the paper core is then transported to the grinding machine to undergo the grinding process. In the grinding process, the partitions or joints resulting from the winding process are removed so that the paper core becomes seamless. At this stage, there are 2 workers.

Figure 11 Tension device machine in the grinding process

2.5. Seamless/Coating Process (Optional)

The grinder machine additionally eliminates the partitions on the paper core but also undergoes a coating and red-stripping procedure. Upon the customer's request for the Seamless Coating product version, the coating process must be executed. Coating is the procedure of applying a liquid layer to the paper core produced by the seamless process, resulting in a glossy appearance. Alongside the coating process, there exists the red-stripping process, which involves the application of a red line motif on the paper core, a consequence of the seamless process or the coating process, if required. Currently, 4-5 workers are utilizing full personal protective equipment (PPE). The noise level at this period attains a peak of 91.2 dB and a nadir of 33.8 decibels.

2.6. Trimming Process

After undergoing the grinding process, the paper core is then transported to the trimmer machine for the trimming process.In this process, the seamless paper core is cut into shorter units of seamless core, according to customer requests.After the trimming process is completed, the seamless cores are stacked on wooden pallets in several tiers and then transported to the FG (Finished Goods) Area.

At this stage, the personal protective equipment (PPE) used consists only of masks and safety shoes.The noise level peaks at 103.7 decibels and drops to 33.5 decibels.At this stage, there are two machines, with each machine operated by two workers.

2.7. Finishing Process

After being transported to the FG Area, the wooden pallets containing seamless core products will be wrapped with several layers of plastic wrap and other protective layers, then transported to the loading area for shipment to customers.

Discussion

2.8. Risk Hazard Analysis: Identification of Potential Hazards, Likelihood of Work Accidents, and Work-Related Health Disorders

Table 1. Identification of Potential Work Hazards

Basic Step	Potential Hazard					Risk of workplace accidents
	Physics	Chemical	Biology	Ergonomics	Psychological	
Slitting/Cutting	Exposure to hot air 1 C (N: 23-26 C)	Dust	Bacteria Virus Fungi Parasit	Lifting and moving movements	Long working hours→ Lack of Rest Beban kerja yang berat dengan SDM produksi sedikit	Vulnus laceratum Muscle strain
Winding	Exposure to hot air 33,4 C (N: 23-26 C)	Dust White Glue Dextrin Glue	Bacteria Virus Fungi Parasit	Lifting and moving movements	Long working hours→ Lack of Rest Beban kerja yang berat dengan SDM produksi sedikit	Crush injury Muscle strain
Grinding	Hot Air 29,2 C (N: 23-26 C) Noise Exposure 87,3 dB (N:<85 dB)	Dust	Bacteria Virus Fungi Parasit	Lifting and moving movements	Long working hours→ Lack of Rest Heavy workload with little production manpower	Crush injury Muscle strain
Seamless/Coating	Exposure to hot air 33,8 C (N: 23-26 C) Noise Exposure 91,2 dB (N:<85 dB) Less exposure to light (91 lux)	Dust Coating	Bacteria Virus Fungi Parasit	Lifting and moving movements	Long working hours→ Lack of Rest Heavy workload with little production manpower	Corpus alienum dari pecahan kaca Muscle strain
Trimming	Exposure to hot air 33,5 C (N: 23-26 C) Noise Exposure 103,7 dB (N: < 85dB Less exposure to light (175 lux)	Dust	Bacteria Virus Fungi Parasit	Lifting and moving movements	Long working hours→ Lack of Rest Heavy workload with little production manpower	Vulnus laceratum Muscle strain
Finishing	None	Dust	Bacteria Virus Fungi Parasit	Lifting and moving movements	Long working hours→ Lack of Rest Heavy workload with little production manpower	Muscle strain

2.9. Risk Assessment

Work Flow	Risk Hazard	C	L	R	Efforts to minimise risk
Slitting/Cutting Process	Hot air, long working hours, heavy workload → Dehydration	1	B	L	Provide gallons of water for workers and there is a large enough fan
	Hot air, long working hours, heavy workload, long working hours→ Decreased concentration	2	B	M	Provide gallons of water for workers and there is a large enough fan
	Hot Air, long working hours, heavy workload → Heat Stress	2	B	M	Provide gallons of water for workers and there is a large enough fan
	Hot Air, Heavy workload, Exposure to noise, Long working hours → Hypertension	3	B	H	Provide gallons of water for workers and there is a large enough fan
	Exposed to Dust, exposed to biological factors in the form of Bacteria/viruses → ARI	1	A	L	The company recommends the use of PPE in the form of Masks
	Lifting and moving movements → Spasme otot	1	C	M	The company has provided goods trolleys for the transfer of goods
	Long working hours, heavy workload → Cephalgia	1	C	M	None
	Long working hours, heavy workload → Job stress	1	C	M	None
Winding Process	Hot water, long working hours, heavy workload → Dehydration	1	B	L	Provide gallons of water for workers and there is a large enough fan
	Hot Air, Heavy workload, Long working hours→ Penurunan konsentrasi	2	B	M	Provide gallons of water for workers and there is a large enough fan
	Hot Air, long working time, heavy workload → Heat Stress	2	B	M	Provide gallons of water for workers and there is a large enough fan
	Hot water, long working hours, heavy workload → Hypertension	3	B	H	Provide gallons of water for workers and there is a large enough fan
	Exposed to Dust, exposed to biological factors in the form of Bacteria/viruses → ARI	1	A	L	The company recommends the use of PPE in the form of Masks
	Exposure to chemicals such as glue and biological agents → DKI	1	B	L	None
	Gerakan mengangkat dan memindahkan → Spasme otot	1	C	M	The company has provided goods trolleys for the transfer of goods
	Long working hours, heavy workload → Cephalgia	1	C	M	None
	Long working hours, heavy workload → Job stress	1	C	M	None
Grinding Process	Hot Air Long working hours, heavy workload → Dehydration	1	B	L	Provide gallons of water for workers and there is a large enough fan
	Hot air, heavy workload, Long working hours→ Decreased concentration	2	B	M	Provide gallons of water for workers and there is a large enough fan
	Hot Air, long working hours, heavy workload → Heat Stress	2	B	M	Provide gallons of water for workers and there is a large enough fan
	Hot Air, Heavy workload, Exposure to noise, Long working hours → Hypertension	3	B	H	Provide gallons of water for workers and there is a large enough fan
	Exposure to continuous noise for 7 hours → NIHL	2	A	L	None
	Exposed to Dust, exposed to biological factors in the form of Bacteria/viruses → ARI	1	A	L	The company recommends the use of PPE in the form of Masks
	Lifting and moving movements → Spasme otot	1	C	M	The company has provided goods trolleys for the transfer of goods
	Long working hours, heavy workload → Cephalgia	1	C	M	None
	Long working hours, heavy workload → Job stress	1	C	M	None

Seamless/Coating Process	Hot water, long working hours, heavy workload → Dehydration	1	B	L	Provide gallons of water for workers and there is a large enough fan
	Hot air, heavy workload, long working hours→ Decreased concentration	2	B	M	Provide gallons of water for workers and there is a large enough fan
	Hot Air, long working hours, heavy workload → Heat Stress	2	B	M	Provide gallons of water for workers and there is a large enough fan
	Hot Air, Heavy workload, Exposure to noise, Long working hours → Hypertension	3	B	H	Provide gallons of water for workers and there is a large enough fan serta earplug
	Exposure to continuous noise for 7 hours → NIHL	2	A	L	Perusahaan menyarankan penggunaan APD berupa earplug
	Less exposure to light → Astenopia	1	A	L	None
	Exposed to Dust, exposed to biological factors in the form of Bacteria/viruses → ARI	1	A	L	The company recommends the use of PPE in the form of Masks
	Exposure to chemicals in the form of coatings and biological agents → DKI	1	B	L	None
	Lifting and moving movements → Spasme otot	1	C	M	The company has provided goods trolleys for the transfer of goods
	Long working hours, heavy workload → Cephalgia	1	C	M	None
	Long working hours, heavy workload → Job stress	1	C	M	None
Trimming Process	Hot Air, long working time, heavy workload → Dehidrasi	1	B	L	Provide gallons of water for workers and there is a large enough fan
	Hot Air, Heavy workload, Long working hours→ Penurunan konsentrasi	2	B	M	Provide gallons of water for workers and there is a large enough fan
	Hot Air, long working time, heavy workload → Heat Stress	2	B	M	Provide gallons of water for workers and there is a large enough fan
	Hot Air, Beban kerja yang berat, Terpapar suara bising, waktu bekerja yang lama → Hipertensi	3	B	H	Provide gallons of water for workers and there is a large enough fan
	Exposure to continuous noise for 7 hours → NIHL	2	A	L	None
	Less exposure to light → Astenopia	1	A	L	None
	Exposed to Dust, exposed to biological factors in the form of Bacteria/viruses → ARI	1	A	L	The company recommends the use of PPE in the form of Masks
	Lifting and moving movements → Spasme otot	1	C	M	The company has provided goods trolleys for the transfer of goods
	Long working hours, heavy workload → Cephalgia	1	C	M	None
	Long working hours, heavy workload → Job stress	1	C	M	None
Finishing Process	Exposed to Dust, exposed to biological factors in the form of Bacteria/viruses → ARI	1	A	L	The company recommends the use of PPE in the form of Masks
	Lifting and moving movements → Spasme otot	1	C	M	The company has provided goods trolleys for the transfer of goods
	Long working hours, heavy workload → Cephalgia	1	C	M	None
	Long working hours, heavy workload → Job stress	1	C	M	None

The assertion that hypertension is one of the occupational diseases can be supported by research linking work environment conditions with high blood pressure. Factors such as exposure to high temperatures (>30°C) and continuous noise have been shown to contribute to an increased risk of hypertension. The study by (Liu et al., 2022) showed that exposure to hot temperatures in the work environment can lead to increased physiological stress, including increased blood pressure. In addition, a study by (Wang et al., 2018) found an association between industrial noise exposure and increased blood pressure and hypertension risk in workers. However, it is important to consider other variables that may contribute to hypertension among workers, such as diet, lifestyle, and individual medical history. The 20 out of 74 workers who developed hypertension did show a trend of health risks, but further analysis is needed to ascertain whether work environment factors are the main cause, or there are other influencing factors.

4. CONCLUSION

Paper Core Factory workers are health risk workers where one of the health risks that can arise is cardiovascular health risks in the form of hypertension. Hypertension, or high blood pressure, is a chronic condition characterised by increased blood pressure on the artery walls. A person is considered to have hypertension if their blood pressure measurement shows 140/90 mmHg. Hypertension is one of the diseases that can arise due to work. Based on the results of the hazard identification analysis, information was obtained that workers do their work for 8 hours a day and workers work in rooms with temperatures > 30'C and are exposed to noise continuously. Based on observations and initial data collection through blood pressure checks on workers, it was found that 20 out of 74 workers had hypertension. Facility layout takes an important role in factory operations, because with the right facility layout will produce many benefits such as: First, Optimisation of space and resources. Facility layout can reduce the amount of waste and minimise the creation of several wastes such as motion, transportation, and waiting. Second, Simplification of material flow. By implementing a good facility layout, it can simplify the flow of materials from raw materials to the end of the finished product, in its application it will also reduce the risk of material loss and minimise production cycle time. Third, increased labour productivity. Structured placement of facilities and workflows can increase labour productivity by reducing travel time and labour movement, so that time can be maximised for productive things for the company. Fourth, occupational safety and health. The risk of accidents and injuries during work can be suppressed with the right facility layout, so that it will create a safe working environment and support the welfare of workers. In general, an effective and efficient facility layout will bring many benefits to the company and workers, creating a smooth production flow, a safe and prosperous work environment, and more optimal production results. Paper Core Factory, also known as WberPack, is a company established in 2017 that specialises in paper packaging and plays a role in providing premium packaging solutions to users, ranging from local industries to multinational companies. As a company that provides paper packaging solutions, WberPack offers 2 main product types, namely Paper Core and Carton Box products. Production activities at WberPack take place with a duration of about 8 working hours per shift, with 3 shifts per day. In the production process, Paper Core products require raw materials with a relatively heavy mass, reaching a weight of 850-900 kg per unit of raw material. In addition to the transportation of raw materials, there is also the transportation of semi-finished goods between processes, where these semi-finished goods are counted in pallets, with each pallet capable of having almost the same mass as raw materials. However, after observation, there is a problem in the production area of Paper Core products, which is related to the layout of facilities. In the production area of Paper Core products, the arrangement of facilities is still not good. Researchers found that the arrangement of production machinery is still fairly irregular, the aisle boundaries are not clear, and the empty space (including the aisle) tends to be used for storage of semi-finished goods. This irregular arrangement of facilities is also supported by the opinions of operators when researchers conducted interviews with several operators, where most complained that there were difficulties in the material handling process between production processes, especially for material transportation that required special material handling equipment.

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