Hazard Identification and Risk Assessment (HIRA) at the Home Batik Sarong Screen Printing Industry in Pekalongan

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ABSTRACT

Home Industry Batik sarong screen printing is one of the economic pillars of the local community with many people involved in business and working in the field of batik. One of them is the Batik Sarong Screen Printing Home Industry in Pekalongan. The screen printing process poses dangers to workers. So it is necessary to evaluate the work environment and identify the risks of the screen printing process. This research aims to determine the conditions of the work environment by applying the Hazard Identification Risk and Assessment (HIRA) method in the process of making screen-printed sarongs. The method used in this research is qualitative and quantitative research. The results of identifying the hazards contained in all work activities found 7 types of activities that could pose 10 risks. The results of the assessment based on HIRA show the risk value of all potential hazards, namely, extreme risk (Extreme Risk) is 1, high risk is 3, moderate risk is 4, and low risk is 2 types. Suggestions from researchers are to make improvements using PPE, improve workplace design, and ergonomics training, stretch regularly, take regular breaks, substitute chemicals, and apply screen printing techniques correctly.
INTRODUCTION

The development of the Home Industry in Indonesia is now increasing, especially the Batik Industry. Based on data from the Ministry of Industry's Center for Crafts and Batik (BBKB), there are around 3,159 batik business units registered throughout Indonesia. Batik is considered to have many roles in the lives of Indonesian people. Not only as everyday clothing but also as clothing for important events and rituals. One of them is the sarong that Muslims usually wear for worship. (Databoks, 2022)

Pekalongan City is known as the Batik City of the World, which currently supplies 70% of batik in various regions in Indonesia. It cannot be denied that the batik sector is a supporter of the local community's economy with many people involved in business and working in the batik sector (Public Communication Team, 2022). So residents in this area have various small and medium businesses, one of which is the Batik Sarong Screen Printing Home Industry in Pekalongan City.

Screen printing is a printing technique using the basic tool of a screen, which is effective, efficient, easy, cheap, and simple and is widely applied in various industries (Zulyus & Hendrawan, 2021). Screen printing is usually used to print designs, images, and text onto the surface of various objects or media, such as fabric, plastic, ceramics, and glass en masse (Ridlo et al., 2023). In this printing process, a fine mesh screen made of silk, nylon, or stainless steel is tightly mounted on a rigid frame. With the non-image areas of the screen blocked, the printing ink is forced through the mesh and transferred to the substrate surface by scraping with a squeegee (Health Workforce, 2018).

Occupational safety and health are things that must be implemented in every workplace. Occupational safety and health are not only carried out by workers but are also carried out by everyone in the workplace (Muhammad Irzha Rizky Mahmuda, n.d.). Occupational safety is the protection of workers from injuries resulting from work-related accidents (Jaya Maulana et al., 2023). Including in the home industry such as manual batik sarong screen printing. The implementation of Occupational Safety and Health (K3) aims to provide protection for workers and other people in the workplace, protect company assets, and protect the community and the environment as mandated in Law No. 1 of 1970 (Adiratna et al., 2022). Based on the 2022 Annual Report of the Directorate General of Manpower and K3-Ministry of Manpower, work-related accidents reported to the Ministry of Manpower through the Provincial Manpower Service were 15,486 in 2019, 6,037 in 2020, and experienced another increase of 7,298 in 2021.

Every work environment and job in general has its dangers, the same is true in the screen printing home industry (Santoso et al., 2021). The higher the productivity, the greater the work hazards or risks that will arise (Magdalena et al., 2022). Work-related accidents are work-related accidents in companies, which means that accidents occur due to work, in general accidents can be caused by human actions that do not meet safety (unsafe human action) and unsafe environmental conditions (unsafe conditions) (Nugroho, 2020). Therefore, efforts to control work accidents and occupational diseases require efforts to identify
factors or sources of danger in the workplace evaluate risks, and carry out adequate control efforts. The hazard identification, risk assessment, and risk control methods are used to identify risks, assess risks, and be able to control risks by K3 norms to create safe working conditions to prevent incidents, accidents, and occupational diseases. (Supriyadi & Ramdan, 2017)

This research aims to determine the working environment conditions that apply the Hazard Identification Risk and Assessment (HIRA) method to the batik sarong screen printing process and provide recommendations for adequate control efforts.

LITERATURE REVIEW

Many studies have been carried out to identify and assess potential hazards and risks in the work environment, especially in the context of small and medium industries such as the batik industry. One relevant research is a study conducted by Sri Mayasari et al., 2020 which shows the importance of knowing the sources of danger and evaluating and implementing K3 in the Anugrah Batik industry. This research highlights that before implementing K3, many dangerous incidents were found for workers using the HIRA method and provided risk control recommendations to minimize potential dangers.

Based on research from Ashokkumar et al., 2021, shows that the implementation of the HIRA method in the textile industry found various dangers in the production process. Especially in dyeing and printing units which have a very high level of risk and require immediate control measures.

Even though these studies are in different contexts, it can be seen that these studies discuss aspects related to HIRA which can be applied effectively to identify and reduce risks in both small, medium, and large industries. The suggestions recommended by previous research can also be implemented effectively to improve work safety in the Batik Sarong Screen Printing Home Industry in Pekalongan.

Referring to the results of previous research which have been stated above the research carried out by researchers has never been carried out by previous researchers. In comparison, the main focus of research that will be carried out by researchers is on the screen printing industry. This home industry has unique characteristics, such as a smaller business scale, the use of traditional technology, and limited resources.

METHODOLOGY

This research was conducted at the Sarung Batik Home Industry in Pekalongan. The method used in this research is qualitative and quantitative research. Qualitative research uses the Hazard Identification Risk And Assessment (HIRA) method, while quantitative research uses the HIRA Risk Assessment method. The primary data obtained was by making observations at the Sarong Screen Printing Home Industry in Pekalongan.

Rare – The steps in collecting and processing data are as follows:
1. Carry out identification at the workplace, namely by determining the place or location to carry out observations first. In this research, observations were made
at the sarong screen printing process at the Batik Screen Printing Home Industry in Pekalongan.

2. Risk assessment

The assessment is carried out based on the identification table. Risk assessment was used to determine potential hazards in the sarong screen printing process in Pekalongan. The following is a risk matrix formula and table to determine potential hazards.

Risk Level = Likelihood x consequences

Table 1. Risk Matrix

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Insignia</th>
<th>Minor</th>
<th>Moderate</th>
<th>Major</th>
<th>Catastrophic</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 (Almost Certain)</td>
<td>H</td>
<td>H</td>
<td>E</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>4 (Likely)</td>
<td>M</td>
<td>H</td>
<td>H</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>3 (Possible)</td>
<td>L</td>
<td>M</td>
<td>H</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>2 (Unlikely)</td>
<td>L</td>
<td>L</td>
<td>M</td>
<td>H</td>
<td>E</td>
</tr>
<tr>
<td>1 (Rare)</td>
<td>L</td>
<td>L</td>
<td>M</td>
<td>H</td>
<td>H</td>
</tr>
</tbody>
</table>

Source: (UNSW Sydney Health and Safety, 2022)

The information on risk determination is shown in Table 2.

Table 2. Description

<table>
<thead>
<tr>
<th>Risk Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>E Extreme Risk</td>
<td>Very risky and requires immediate action</td>
</tr>
<tr>
<td>H High Risk</td>
<td>High risk, requires attention from top management</td>
</tr>
<tr>
<td>M Moderate risk</td>
<td>Medium risk, management responsibilities must be specific</td>
</tr>
<tr>
<td>L Low Risk</td>
<td>Low risk, treated with routine procedures</td>
</tr>
</tbody>
</table>

Source: (UNSW Sydney Health and Safety, 2022)

1. HIRA Worksheet

The HIRA Worksheet, which is used as a process for describing hazard sources in detail, includes activities, hazards, risks, impact and probability figures, risk level scores, bands, risk rankings, and control measures that will be recommended for improvement (action) to minimize potential hazards.
RESULTS

In research at the Batik Sarong Screen Printing Home Industry in Pekalongan, data was obtained from the results of risk identification and assessment through direct field observation to obtain potential hazards using the HIRA method.

Table 3. Hazard Identification and Risk Assessment Results for Batik Sarong Screen Printing Workers in Pekalongan

<table>
<thead>
<tr>
<th>Workplace Activities / Conditions</th>
<th>Hazard</th>
<th>Risk</th>
<th>Impact</th>
<th>Probability</th>
<th>Score (DxP)</th>
<th>Rank</th>
<th>Control Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepare work materials to be processed</td>
<td>Physical: Hit by sharp objects, hit by heavy objects when moving</td>
<td>Injuries to the hands and feet</td>
<td>2</td>
<td>2</td>
<td>4 M</td>
<td>8</td>
<td>Using PPE, Safe preparation and storage of equipment, Safe work procedures, K3 training</td>
</tr>
<tr>
<td>Mixing screen printing dyes</td>
<td>Chemical: Hands exposed to, splashed with, or inhaled dyes</td>
<td>Skin, eye irritation, respiratory infections and poisoning</td>
<td>4</td>
<td>2</td>
<td>8 H</td>
<td>4</td>
<td>Studying SOPs, using PPE (masks, face shields, using respirators, gloves), and setting up the air conditioning system in the room</td>
</tr>
<tr>
<td>The process of mixing the dye using a machine</td>
<td>Electrical: Electric shock</td>
<td>Burns</td>
<td>2</td>
<td>1</td>
<td>2 L</td>
<td>9</td>
<td>Inspect the machine, make sure the power source is protected from water, use PPE (gloves, footwear)</td>
</tr>
<tr>
<td>The screen printing process, namely applying dye to the sarong on which the screen has been placed, by pulling the</td>
<td>Physical: Pinched by screen printing equipment</td>
<td>Cedera pada tangan pekerja</td>
<td>2</td>
<td>3</td>
<td>6 M</td>
<td>5</td>
<td>SOP for screen printing, provide sufficient rest time, use PPE</td>
</tr>
<tr>
<td></td>
<td>Ergonomics: Repetitive motion of</td>
<td>Excessive fatigue and</td>
<td>4</td>
<td>4</td>
<td>16 E</td>
<td>2</td>
<td>Periodic breaks, Stretching before work, while working, and after work, Work desk design, Applying correct screen</td>
</tr>
</tbody>
</table>
The research results show that the potential dangers that exist in the screen printing workplace have different levels of risk, so a control plan is needed to minimize the dangers. From the results of the low-risk category analysis, there are 2 types of danger, which means low risk, and moderate risk, there are 4 types of danger, which means moderate risk. Furthermore, in the high-risk category, there are 3 types of danger which means high risk, while extreme risk has 1 type of danger which means extreme risk. Therefore, it is necessary to take control measures to minimize the occurrence of accidents or work-related illnesses in workers.

**DISCUSSION**

To minimize work accidents, identification of potential hazards is carried out in the work environment and then control recommendations are given for improvement so as not to harm workers and the industry. Potential dangers that have the highest risk value come from the screen printing and color mixing processes. Accidents can occur due to the behavioral factors of workers. Risk assessment is calculated from the probability/likelihood or possibility of whether the risk will occur frequently and the consequences or severity of the consequences caused by the risk. (Jaya Maulana et al., 2023)
In Table 3, the results show that there are 4 different types of hazards, namely physical, chemical, ergonomic, and electrical hazards from 7 activities and environmental conditions that cause 10 risks. Of course, the many types of dangers that have been discovered produce different recommendations. From these results, there is 1 danger that has extreme risk and 3 high risks.

Extreme risk means very risky, and immediate action is needed, while high risk means big risk, and requires attention from top management (Ruskartina et al., 2023). The process that found the extreme or highest level of risk in the identification results was the screen printing process, namely applying dye to a sarong that had been placed on a screen by pulling a squeegee along the sarong, with a score of 16 in the ergonomic hazard category. The manual screen printing process that is carried out repeatedly can cause excessive fatigue in workers, and unergonomic work postures can cause injury or musculoskeletal system disorders, this is by research conducted by (Siswanto et al., 2020).

Musculoskeletal Disorders (MSDs) Musculoskeletal disorders (MSDs) are injuries to the muscles, nerves, tendons, ligaments, joints, cartilage, or spinal discs. MSDs usually result from a momentary or acute event (slip, trip, or fall), otherwise, they reflect a more gradual or chronic development (Cici Aprilliani, 2022). Based on research from (Aji Samudra, 2017) the parts most at risk of experiencing soreness are the neck, body, upper arms, and wrists.

Furthermore, for hazards with a high risk level which has a score of 12 is the screen printing process, while a score of 8 is the color mixing process, with a chemical hazard category. Chemicals can enter the human body in 4 different ways, such as: (1) inhalation (breathing vapor); (2) ingestion (ingesting chemicals); (3) injection (by mechanical means, under the skin); or (4) absorption (skin contact) (Starovoytova, 2018). The color mixing process has a lower value because usually the process is not carried out continuously by workers so the level of risk of exposure to the material is lower. However, there is still a risk of exposure to chemicals because workers who mix these materials do not use PPE such as masks and gloves.

When screen printing, the dye used will be inhaled by the worker, even though the dye does not come into direct contact with the worker's skin. However, inhaling chemicals continuously has the potential to cause bad effects on health (can be acute (short term) or chronic (long term) according to research (Starovoytova, 2018). The screen printing dye used in this home industry is a combination of pigment and binder. The binder is used as a color adhesive on fabric (Salam, 2021). This can cause respiratory problems, dizziness, and even eye irritation in workers. throat and skin. Meanwhile, the pigments in paint are useful for coloring and increasing the durability of paint. Many types of pigments are dangerous ingredients, namely: Lead chromate: used to give green, yellow, and red colors; yellow and orange; can cause lung cancer and skin, nose, and upper respiratory tract irritation. Cadmium: gives green, yellow, orange, and red colors; can cause lung cancer (Hilman et al., 2023). During the screen printing process, workers did not use personal protective equipment such as masks and face shields.
The next process with a score of 9 which indicates a high level of risk is standing too long in the ergonomic danger category. In this industry, the screen printing process is carried out standing up to facilitate activities in all processes. Staying in one posture for a long time causes muscle contractions which causes the risk factor of Static Load (Lewaherilla et al., 2022). Working postures of standing for too long and frequently can increase muscle contractions and compartmental pressure on the legs, resulting in pressure in the veins increasing to 100 mmHg and pressure on the lower back, and causing fatigue (Arianti & Novendy, 2022).

CONCLUSIONS
This research concludes that the hazards identified in the screen printing workplace are 4 different types of hazards, namely physical, chemical, ergonomic, and electrical hazards from 7 activities and environmental conditions that cause 10 risks. The results of the assessment based on HIRA show the risk value of all potential hazards, namely, extreme risk (Extreme Risk) is 1, high risk is 3, moderate risk is 4, and low risk is 2 types.

Based on HIRA results, the 2 most risky activities are the screen printing process, namely in the Extreme risk category with 1 type of ergonomic hazard with a score of 16, and high risk with 2 types of hazards, namely chemical with a score of 12 and ergonomic with a score of 9, while the color mixing process is in the high category. risk there is 1 type of chemical hazard with a score of 8.

RECOMMENDATIONS
Some suggestions that can be taken into consideration to increase work effectiveness in the Batik Sarong Screen Printing Home Industry in Pekalongan are:

Musculoskeletal Complaints
1. Take regular breaks by arranging a break schedule so that workers can sit and stretch.
2. Stretch before work, while working, and after work
3. Design the work table by adjusting the table height to the worker
4. Apply correct screen printing techniques so that the worker's body posture does not change.

Exposure to Chemical Dyes
1. Workers are advised to use PPE in the form of masks and preferably double-wear to be more protective against chemical odors (Sartika et al., 2024). And use gloves or glasses.
2. Study SOPs by implementing safe work practices
3. Arrange the air conditioning system in the room to ensure good air circulation.
4. Substitution of materials, if possible other alternative materials that are safer or more environmentally friendly, for example using highly natural dyes (Zulyus & Hendrawan, 2021).
Complaints Due to Standing for Too Long
1. Stretch before work, while working, and after work
2. Take regular breaks by arranging a break schedule so that workers can sit and stretch.
3. Provide cushioning to reduce existing pressure (Lewaherilla et al., 2022)
4. Varying work positions, namely by rotating jobs alternately with other workers.
5. Ergonomics training to reduce the risk of injury.

FURTHER STUDY
Each research has its limitations: this research still has limitations, so further research needs to be carried out related to the topic of Hazard Identification and Risk Assessment (HIRA) in the Batik Sarong Screen Printing Home Industry in Pekalongan to perfect this research and increase insight for readers.

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