Behavior-Based Safety on Rattan Workers at Trangsan Rattan Industry, Sukoharjo Regency Indonesia

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Abstract. A preliminary study conducted on twenty-four rattan workers at the Trangsan Rattan Industry Center showed various types of occupational health and safety risks including respiratory disorder due to exposure of fine dust, hand tools usage, chemical hazards of using rattan coloring, and Musculoskeletal Disorders (MSDS) due to improper working positions. This condition encourages research to improve safety behavior for workers by identifying factors related to unsafe behavior and implementing Behavior-Based Safety (BBS) for workers. The BBS approach was carried out with four stages, namely Define, Observe, Intervene, and Test (DOIT), while the level of worker behavior was calculated using the Safety Performance Index (SPI). There were ten unsafe actions that were targeted for intervention for hundreds of workers. Through an intervention program which was based on a motivational intervention approach, the value of SPI in the Trangsan Rattan Industry Center increased by 36.21%.

1 Introduction

In the economic structure of many countries, both developed and developing countries, the Small and Medium Enterprises (SME) sector has been recognized as one of the pillars of a strong economy for the State [1]. In Indonesia, SMEs have become the biggest advocate for sustainable development and an important means of absorbing labor. In fact, more than 60% of the workforce work in SMEs [2]. In 2017, SMEs absorbed a workforce of 10.78 million people, where this employment was still concentrated on the island of Java (6.88 million or 63.82%).

However, in the midst of its development, SMEs are still facing various challenges, including how to increase productivity, while at the same time they have to improve occupational safety and health (OSH) and existing working conditions. OSH development in Indonesian SMEs is not only related to the welfare of society but also the global interest in sustainable development in which the social, economic and environmental dimensions are integrated [2]. Based on data [3], one worker in the world dies every 15 seconds due to work accidents and 160 workers experience work-related illnesses [4]. Occupational Health and Safety (OSH) is an important aspect of the production process, especially for SMEs that

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employ more than 95 percent of the world's working population. SMEs are also key to creating and developing decent work for all. For this reason, the effective and efficient implementation of OSH is very important in increasing the productivity and competitiveness of SMEs in Indonesia [3].

Indonesia is the largest rattan producing country in the world. An estimated 80% of rattan raw materials worldwide come from SMEs in Indonesia, and the rest is produced by other countries such as the Philippines, Vietnam and other Asian countries [5]. Based on data from the Indonesian Rattan Foundation, in 2010 in the report of the Commission for the Supervision of Business Competition (KPPU), several regions which have become centers of the downstream rattan industry in Indonesia include West Java (especially Cirebon), East Java (Surabaya, Sidoarjo and Gresik), Central Java (Jepara, Kudus, Semarang, and Sukoharjo), and Yogyakarta. Rattan industry in Central Java concentrated in two main centers, namely in Jepara and Sukoharjo. The general pattern of trade in Sukoharjo and Jepara is relatively similar Cirebon Regency. The perpetrators are also more concentrated in producing finished rattan products, and only a few are involved in processing raw rattan into semi-finished rattan [6]. Data sourced from [7] showed that there were 259 SMEs in Trangsan Village, of which 87-100 were businesses engaged in rattan processing from small to medium scale.

A survey conducted on 24 workers spread across five rattan product processing, namely raw material processing, framing, plaiting, finishing and coloring as well as packaging, found various types of work accidents and work-related illnesses that they had experienced while working. Preliminary survey results show that the potential hazards and risks that can occur in the finished rattan processing industry are respiratory problems due to the work environment being exposed to fine dust left over from rattan processing, the risk of using hand tools such as grinders, hammers, glue guns, staples and the use of cutting machines that are can injure workers' hands, chemical hazards from using rattan dye, and musculoskeletal disorders (MSDS) which cause aches and pains in the spine in workers due to improper working positions. Based on these facts, informal industrial workplaces such as rattan generally have risks of accidents and health problems due to the influence of the nature of work, worker characteristics, and work safety culture as well as the use of dangerous machines and poor spatial layout [8].

Safety behavior is a behavior that is implemented by person in everyday life that leads to safety actions to prevent or minimize the possibility of an accident [9]. The opposite of safe work behavior is unsafe behavior, which is an act of someone who deviates from predetermined rules and can result in danger to himself, others, and equipment around him [10]. Based on statistical data in Indonesia, 80% of accidents are caused by unsafe acts and 20% by unsafe conditions [11]. SMEs in the rattan industry center often have work accidents which result in disruption of the production process and even loss of working hours, as well as a lack of awareness of work safety such as not using Personnel Protective Equipment (PPE) at work, unfavorable working conditions, and so on. This behavior is certainly dangerous for both workers and the company. Therefore, there is a need for improvements that focus on behavior workers using the Behavior-Based Safety approach (BBS) as a way to improve the safety performance index which is a behavioral indicator workers so as to create a safe and comfortable atmosphere at work and can increase work productivity. BBS approach chosen because of the focus on reducing risky habits or behaviors then placing workers at a recorded risk for improvement [12]. Several studies related to BBS have been conducted by [13-31].

Based on the identification of these problems, the formulation of the problem in this study is how to improve safe work behavior through the implementation of the BBS method. An effort to improve safety behavior in workers at SME processing rattan products at the
Trangsan Rattan Industrial Center is targeted by reducing unsafe behavior so as by increasing the value of the Safety Performance Index.

2 Methods

This research was used an analytical descriptive research that aims to find out how unsafe behavior can occur and can lead to accidents. Based on the time dimension, this research was a cross-sectional study, because the data collected is only one period of time, namely when carrying out research practices in the field [32]. The data collection method was carried out by distributing questionnaires to 100 respondents from 14 rattan industries in Trangsan Village. The location of this research is Small and Medium Enterprises in the Rattan Industry Center in Trangsan Village, Sukoharjo. The participants used are workers who carry out types of work such as framing, weaving, finishing, and coloring or painting.

Data collection was carried out using the BBS approach [12] to increase the SPI value of rattan workers based on the critical behavior checklist. The initial stage is hazard and risk identification to determine the level of risk in each process using the AS/NZS 4360:2004 method which considers likelihood, exposure, and consequence. Factors related to unsafe work behavior are included in the intervention stage through the BBS approach. BBS is defined as a process consisting of four continuous stages. These four stages are Define, Observe, Intervene, and Test.

3 Results and Discussion

The define stage in BBS begins with the identification of hazard risks with the results as shown in Table 1, while the risk level can be seen in Table 2. Based on Table 2 it can be seen that the painting process is a process that has the highest level of risk with a score of 180. This value indicates that this process is included in the priority risk level category 1, where control is required as soon as possible to reduce the level of occupational health and safety risks. Workers in this process continuously inhale the dye that is sprayed on rattan products without wearing a mask. The work of this process is not equipped with gloves so that the workers' hands make direct contact with work tools that are connected to an electric current. The working floor in this process is damp and slippery due to scattered paint drops, but workers do not use safety shoes while working. According to [33], the level of risk can be lowered based on the risk control hierarchy. There are several stages, namely elimination, substitution, engineering control, administration, and PPE. Controls that can be applied to reduce the level of risk are through an administrative risk control hierarchy, namely by providing safe work procedures for the dyeing process, and the use of complete PPE such as masks, gloves, and safety shoes.

Then the process of making frames and weaving produces the same risk level (100). This value requires the system to make substantial improvements. The working environment conditions in the weaving process are generally contain a lot of scattered rattan materials and work tools, damp and dirty workplace, and slippery floor. For the process of making frames, the working environment conditions are more or less the same as in the weaving process, however, in the process of making frames, there is a danger of heat coming from the evaporation process. Workers in the framing and plaiting process have dangerous working postures, such as bending for a relatively long time. Based on the risk control hierarchy, administrative control can be selected by applying work environment structuring procedures with 5S (Sort, Set Shine, Standardize, and Sustain).
Table 1. Identification of hazards and risks

<table>
<thead>
<tr>
<th>Process</th>
<th>Hazard</th>
<th>Exposure</th>
<th>Deviation</th>
<th>Consequences</th>
<th>Caused</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacture of rattan product frames</td>
<td>Dirty and dusty work environment, slippery floor, messy work place, hot</td>
<td>continuously</td>
<td>Workers do not wear gloves and masks, work position is not correct, do not wear safety shoes</td>
<td>Hands injured by grinding, hands scratched by holes, hands bruised from hammers, feet stepping on nails, slipping, coughing and breathing problems, aches and pain in the lower back</td>
<td>Not enough PPE available, do not understand the importance of safe work behavior</td>
</tr>
<tr>
<td>Wicker rattan</td>
<td>Dirty and damp workplace, slippery floor, messy workplace</td>
<td>continuously</td>
<td>Workers do not wear gloves and masks, as well as safety shoes, and work positions are not correct</td>
<td>Fingers injured by staples, palms exposed to glue gun, fingers scratched by scissors, sore and lower back pain</td>
<td>Not enough PPE available, do not understand the importance of safe work behavior while working</td>
</tr>
<tr>
<td>finishing</td>
<td>Heat sources from work tools, slippery floors, hot and humid working environment, dust from the sanding process</td>
<td>frequently</td>
<td>Workers don't wear masks, don't always use gloves, don't use safety glasses, dangerous work positions</td>
<td>Exposure to inhaled fine dust, blistered hands exposed to heat radiation, aches and pains in the lower back and legs</td>
<td>Not enough PPE available, do not understand the importance of safe work behavior</td>
</tr>
<tr>
<td>Dyeing Process</td>
<td>Dyes, dirty and damp working environment, electric shock, slippery floor</td>
<td>frequently</td>
<td>Not using gloves, masks and safety shoes, incorrect working position</td>
<td>Exposure to furniture dyes can be inhaled, exposed to an electric current because they don't wear gloves, and slip on liquid dye</td>
<td>Not enough PPE available, do not understand the importance of safe work behavior</td>
</tr>
</tbody>
</table>
### Table 2. Risk level.

<table>
<thead>
<tr>
<th>Process</th>
<th>Likelihood (L)</th>
<th>Exposure (E)</th>
<th>Consequences (C)</th>
<th>Ratings (LxExC)</th>
<th>Risk Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frame Making</td>
<td>10</td>
<td>10</td>
<td>1</td>
<td>100</td>
<td>Substantial, requiring technical improvements</td>
</tr>
<tr>
<td>Weaving</td>
<td>10</td>
<td>10</td>
<td>1</td>
<td>100</td>
<td>Substantial, requiring technical improvements</td>
</tr>
<tr>
<td>finishing</td>
<td>10</td>
<td>6</td>
<td>1</td>
<td>60</td>
<td>Priority 3, It needs to be monitored and cared for on an ongoing basis</td>
</tr>
<tr>
<td>Painting</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>180</td>
<td>Priority 1, Need control as soon as possible</td>
</tr>
</tbody>
</table>

### Table 3. Types of unsafe actions.

<table>
<thead>
<tr>
<th>No</th>
<th>Unsafe Act</th>
<th>Number of unsafe behavior (person)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Not giving warnings, such as giving signs/symbols to hazardous work situations or equipment</td>
<td>31</td>
</tr>
<tr>
<td>2.</td>
<td>Not carrying out security, such as not turning off work equipment or machines that are not in use</td>
<td>24</td>
</tr>
<tr>
<td>3.</td>
<td>Using faulty work equipment</td>
<td>17</td>
</tr>
<tr>
<td>4.</td>
<td>Using work equipment that is not suitable for the job</td>
<td>11</td>
</tr>
<tr>
<td>5.</td>
<td>Carrying excessive loads (eg lifting rattan or rattan products excessively alone and without assistance)</td>
<td>37</td>
</tr>
<tr>
<td>6.</td>
<td>Do not use PPE at work (Do not wear masks, gloves and safety shoes)</td>
<td>54</td>
</tr>
<tr>
<td>7.</td>
<td>Improper placement, such as placing work equipment both at work and after work is not in the right place</td>
<td>45</td>
</tr>
<tr>
<td>8.</td>
<td>Lifting weights in awkward body positions, for example, with a bent position</td>
<td>33</td>
</tr>
<tr>
<td>9.</td>
<td>Wrong body position while working (bending, twisting the body)</td>
<td>44</td>
</tr>
<tr>
<td>10.</td>
<td>Repair or perform maintenance on work equipment that is being used or in live condition</td>
<td>38</td>
</tr>
<tr>
<td>11.</td>
<td>Excessive joking (Shocking coworkers, shouting, pranking or pranking coworkers, etc.)</td>
<td>40</td>
</tr>
<tr>
<td>12.</td>
<td>Smoking while at work</td>
<td>40</td>
</tr>
</tbody>
</table>
Management needs to provide education about the importance of correct work posture when working as well, while safe working procedures in the process related to emphasizing the importance of using PPE to improve occupational health and safety.

The last process is the finishing process. In this process there is a lot of dust resulting from the manual sanding process or with an electric tool. In addition, the work environment in this place is also humid. The results of the risk level in this process produce a value of 60 so that it is included in the priority 3 category and requires continuous monitoring and attention. Based on the risk control hierarchy, control can be carried out administratively, namely by implementing safe work behavior through making procedures that must be carried out by each worker. In this process management never tires of always reminding every worker about the importance of safe work procedures. In addition, adherence to the use of PPE such as masks, gloves and safety shoes must also be instilled in every worker.

Determination of behavioral targets is carried out based on the results of hazard and risk identification as well as interviews with several people representing each process of making finished rattan products. There are twelve unsafe behaviors that are often performed. These unsafe acts are then included in the distribution of questionnaires to calculate the SPI. The types of unsafe acts that occurred were obtained from the results of interviews with business owners and workers making frames, weaving, finishing and coloring (Table 3). The calculation of the SPI value in the Trangsan rattan industrial center was carried out for each business and obtained an average of 33.79%.

Observations were made of work behavior as seen from the distribution questionnaire and the relationship test of the factors that influence unsafe actions. Questionnaires were distributed randomly to rattan workers in Trangsan Village. The target behavior indicators to be observed are based on the results of hazard identification and risk evaluation at the define stage and group discussions conducted with several workers from each process. The factors studied were worker characteristics (age, gender, years of service, employee status, level of education, work process) knowledge, perceptions, and work fatigue. Factors that influence unsafe work behavior among workers at the Rattan Industrial Center in Trangsan Village are gender, perception, and work fatigue. Worker behavior is said to be safe if the percentage is safe > 80% [34].

This means that the maximum unsafe action taken is 20%. In observations made of 100 workers as shown in the results, there were 10 unsafe actions with a percentage above 20%, and only 2 actions were categorized as safe. Based on these considerations, there are 10 actions that will be targeted for intervention according to the stages of the BBS method. BBS method is the most appropriate approach for unsafe behaviors with the consideration of being able to improve safety management and prevent accidents [35]. Intervention targets are given for the 10 highest unsafe actions.

The intervention stage is the third stage in the BBS implementation process. At this stage an intervention program will be developed to reduce unsafe acts through a series of programs based on a safe work behavior approach. The intervention program is prepared by considering the factors that cause workers to behave unsafely and also management's commitment to behavior change. Interviews conducted with several rattan business owners revealed a lack of management commitment regarding occupational health and safety. This is indicated by the lack of provision of PPE such as masks, gloves and safety shoes, unorganized work environment, unavailability of safety procedures regarding safe work processes in the workplace, and minimal training or briefings regarding occupational health and safety. Furthermore, the factors that influence unsafe acts, namely gender, perceptions, and work fatigue will also be included in the preparation of the intervention program. According to [12] there are three types of intervention approaches in BBS including Instructional intervention, Supportive intervention, and Motivational intervention.
Based on the conditions of the workers at the Rattan Industrial Center in Trangsan Village, a motivational intervention approach was chosen. Motivational intervention approach selected when workers are in a situation where they know what they should do to avoid a hazard, but they deliberately do not do it. This is indicated by the good level of OSH knowledge and perception but inversely proportional to the percentage of safe work behavior. The purpose of motivational intervention is to show the consequences that will be received by workers if they carry out these unsafe actions, both in the form of positive and negative consequences, but more emphasis on positive aspects [12]. Based on these conditions, external motivation or encouragement is needed to change behavior from unsafe or risky to safe behavior. The implementation or intervention phase is carried out for one month where the last week is used for program evaluation. Some of the programs compiled at the intervention stage are as follows:

- **Making Safety Guidance** in the form of a guidebook for realizing safe work behavior.
  The purpose of preparing this guidebook is to provide an overview to rattan workers and business owners on how to embody safe work behavior to improve occupational health and safety.

- **Making OSH posters and safety signs** as displays to motivate workers about safe work behavior
  There are seven posters and two safety signs that will be installed in 14 rattan SME. Each image will be posted in a location that can be read by workers according to the process being carried out. The installation of posters and safety signs aims to increase the motivation of workers to behave in a safe way.

- **Implementation of Safety Briefing**
  Safety Briefing is an activity in the form of socialization and discussion regarding the importance of safe work behavior and ensuring that all workers understand the consequences of unsafe actions that they usually take while working. This activity was attended by all rattan workers and business owners who would later act as supervisors in the testing phase. In carrying out this safety briefing, apart from explaining the form of intervention, it will also explain the results of the research questionnaire which produces three factors related to unsafe work behavior, namely gender, perception, and work fatigue. The explanation is carried out at the same time as motivating workers on how to recognize symptoms of work fatigue and prevent fatigue from occurring, as well as how to build a good perception of occupational health and safety, in this case in particular, safe work behavior. With the implementation of this safety briefing, it is hoped that there will be changes in worker behavior in a better direction.

At the testing stage, an evaluation process was carried out on the intervention model carried out at the Rattan Industrial Center in Trangsan Village to find out changes in workers' SPI scores after the implementation process was carried out. The testing phase is carried out in the 4th week, which involves rattan business owners as appraisers to observe the success rate of the implementation process through observation. The rattan business owner who acts as an appraiser will observe work behavior two times on different days but in the same week, then record it on a critical behavior checklist sheet or safe work behavior implementation evaluation sheet. After implementation, the average SPI result in the Trangsan Village Rattan Industry Center was 70.00%. This result increased before implementation, with an average increase in SPI in 14 SMEs of 35.44%.

### 4 Conclusion and Further Study
Based on unsafe behavior that has been obtained through observation and interviews as well as discussion groups, the SPI value can be calculated before the BBS program intervention was 33.79%. The application of the BBS method resulted in 12 types of unsafe acts that were often carried out and there were 10 unsafe acts with an SPI value of <80%. The motivational intervention approach is carried out through a series of programs such as safety briefings, making safety signs and posters, as well as preparing safety guidance in the form of a guidebook for realizing safe work behavior as a form of intervention which is implemented for 1 month. The SPI value after the intervention was 70.00%.

Future research should better understand the characteristics of the finished rattan product business and the processes involved. This is important to do in order to develop the most effective intervention program that can be accepted by all small business units within it. In addition, future research is expected to be able to identify other factors that influence unsafe work behavior so that the value of the worker's safety performance index can be further increased.

References


35. S. Ramli, Practical Guidelines for Risk Management in the OHS Risk Management Perspective (Dian Agung, Jakarta, 2010)