A New Approach to the Assessment of the Safety Environment and Performance in the Footwear Industry

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Abstract - Safety climate refers to an individual’s perception of safety in the workplace, which is essential in the labor-intensive industries, one of which is the footwear industry. References about the implementation of safety climate measurements are still lacking. This study focuses on the safety climate amongst management and employees, the correlation between climates and safety performance, along with the employees’ perspective in safety management in a footwear company in Bandung. Indonesian translations of Nordic Occupational Safety Climate Questionnaire responses from 163 employees and ten supervisors (managers) were verified by observations of workplace conditions coupled with informal discussions with the supervisors. Findings show that safety perception of the managers is similar to the employees. From the observations of the workplace conditions and discussions with the members of the industry, the managers’ responses reflected the espoused policies. Meaning, there is an indication of misalignment between the espoused policies and enacted practices. Several managerial implications are suggested to develop a better safety climate.

Keywords - safety climate, safety system performance, safe behavior, footwear industry, nosacq-50

I. INTRODUCTION

Safety climate refers to the perceptions of work environment (1–3). The work environment corresponds to organizational policies, procedures and practices. Perceived safety climate represents individual perceptions of work environment (3). Individuals evaluate specific features of the environment based on their personal values for the overall well-being. Therefore, safety climate deals with the individual perceptions which involve individuals’ assessments towards workplace safety attributes, e.g., employee’s outlooks about management values for safety and personnel policies about safety.

Perception is defined as the ways in which an environment presents itself to the individual. Perception is a process of interpreting a stimulus, or a series of stimuli by the brain through one of the sensory mechanisms. The way an individual interprets incoming information will lead to the formation of perception. The perceptual processes begin with responses to incoming stimuli by an individual. Stimuli may be accepted, rejected, or ignored; which is strongly based on the beliefs, values, and attitudes of an individual. Finally, the selected stimuli are organized to produce meanings to a specific individual. These perceptual processes are associated with the knowledge, skills and experience of an individual, and there may be some correlation between these skills and the potential for accidents. Errors in perceptions are one of the contributing factors in many accidents (4).

Safety climate provides a framework to guide safety behavior of employees in the workplace (5). In this respect, employees develop perceptions and expectations regarding safety outcomes and behave accordingly (4, 5). Safety behavior, that is, the behavior that influences safety, describes the actual behavior that individuals perform at work. Individuals generally evaluate their environment in terms of their personal values for their overall well-being (6). Safety behavior is determined by the 3 determinants of individual performance: knowledge, skill and motivation. These determinants represent factors that are responsible for individual differences in safety performance, i.e. safety compliance and safety participation. Safety compliance reflects activities that have to be performed by individuals to maintain workplace safety. Safety participation depicts behavior that may not directly contribute workplace safety, but helps to develop an environment to support safety (7, 8).

The footwear industry in Indonesia is fundamentally labor-intensive. In the industrial system engineering point of view, where the human is the center of the system, safety climate measurement is critical. Labor-intensive work practices are still common in the fashion and footwear, cleaning, farming, some of the mining industries. However, references regarding implementation of standardized and valid questionnaires in labor-intensive industry are scarce. Therefore, a case study will be valuable for both practitioners and academics. In addition to describing the implementation of the methods, this study also aims to describe complex problems that common labor-intensive businesses face.

The current study aims to describe the improvement of safety system management (safety engineering) by focusing on the levels of safety climate management and employees, as well as safety management from the
employees’ perspective in a footwear company. The company being studied employs 2000 staff in Bandung, Indonesia. The study concentrates on the following aspects, i.e., (i) management commitment to safety and concern for employee well-being, and (ii) communication and employee involvement in the workplace health and safety.

II. LITERATURE REVIEW OF SAFETY IN THE FOOTWEAR INDUSTRY

Safety climate reflects the individual perception of the importance of safety in the workplace (1,7). Shared perceptions of individuals within a workgroup or organization are referred to as group climate or organizational climate (3). Individual safety behavior mediates the relationship between safety climate and system safety. Management values, supervision and organizational practices, communication and employee involvement in workplace health and safety are recognized as essential components of safety climate.

Safety climate is an antecedent of safety performance in the workplace, which represents factors that affect behavior through knowledge, skill and motivation (2,3,5,7). These factors, i.e., knowledge, skill and motivation, are determinants of safety performance and are responsible for individual differences in behavior. The relationship among antecedents, determinants and components of safety performance is illustrated in Fig. 1.

Safety performance characterizes the behaviors of individuals at their workplace. There are two types of safety behavior, i.e., (i) safety compliance to describe the activities that need to be carried out by individuals to maintain the workplace safety, and (ii) safety participation to describe behavior to develop an environment that supports safety. An individual is required to possess adequate knowledge, skill and motivation to comply with the safety regulations or to participate in safety activities (3,6). Safety behaviors of individuals at the workplace are also affected by a range of individual and environmental factors, e.g., ability, experience and personality. Ability and experience are antecedents of safety compliance. Personality constructs, such as conscientiousness, are antecedents of safety participation. In this respect, safety climate is one of the potential antecedents of safety behavior in the workplace (3).

An important factor of safety climate is a strong management commitment to safety (1). Espoused policy is determined by top management of an organization (8,9). In addition to the policy-making, top management also has a particular concern about the company’s strategic goals and resources. They are also responsible to establish the procedures in facilitating the policy implementation. Lower management levels, such as supervisors, are responsible for executing these procedures. In some cases, procedures rarely can cover every situation since human-machine-environment interaction contains innumerable contingencies (8). In the hierarchy, supervisors are more closely attached to employees than the top management. Due to the unpredicted events, supervisors may not always execute the espoused policy. Discrepancies between espoused and enacted policies, as well as procedures and practices, may affect safety climate perceptions of the employees. In this respect, safety climate may be used to measure the discrepancies between formal and informal policies.

Safety communication between management and employees are another form of management commitment to safety. Communication may enact safety climate or improve the existing safety climate in an organization (9). As an example, when safety procedure has to be compromised with competing for operational demands, e.g., production burdens or costs, information on how to face the challenge can be immediately distributed to employees. In this respect, the employees (the lower level of the organization) can easily transmit their response to management (the higher level of organization). Communication is an essential component of safety climate that provides an opportunity for employee’s involvement in workplace health and safety (7).
III. A NEW APPROACH TO SAFETY ASSESSMENT

Safety climate assessment was formulated by a Nordic Safety Climate Questionnaire (NOSACQ-50): A tool for diagnosing occupational safety climate and evaluating safety climate interventions. The questionnaire was developed by a Nordic working group of work environment specialists (10–12). NOSACQ-50 is organized in seven safety climate dimensions, comprising 50 items with 22 evaluating management level (dimensions 1-3) and 28 evaluating employee level conditions (dimensions 4-7):

1. Management safety priority and ability – 9 items
2. Management safety justice – 6 items
3. Management safety empowerment – 7 items
4. Workers’ safety commitment – 6 items
5. Workers’ safety priority and risk non-acceptance – 7 items
6. Peer safety communication, learning and trust in co-workers’ safety competence – 8 items
7. Workers’ trust in the efficacy of safety systems – 7 items

The items in NOSACQ-50 are divided into two groups – stated in both positive and negative stances. Scores for positive items were 1 (strongly disagree), 2 (disagree), 3 (agree) and 4 (strongly agree). That for reversed items were 4 (strongly disagree), 3 (disagree), 2 (agree) and 1 (strongly agree). Mean score of items in a dimension reflected safety climate level for an individual or a group of individuals or supervisors or employees for the respective dimension. T-test determined the similarity or dissimilarity of two means. The mean score was not similar if p-value < 0.05. The structure of NOSACQ-50 that is used in this study can be seen in Fig 2.

IV. RESULTS AND DISCUSSIONS

In the current study, management teams were represented by supervisors. Employees were the individuals on the front line (those who perform the task on production floor). The reliability test results for NOSACQ-50 Bahasa Indonesia are as per table 1. In table 1, we can conclude that the reliability of the questionnaire is good because the coefficient is > 0.7 (13).

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Supervisor</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.7</td>
<td>0.8</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
</tr>
<tr>
<td>2</td>
<td>7</td>
<td>1</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>0.7</td>
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<td>0.7</td>
<td>0.7</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

Based on the procedure of safety engineering, safety conditions for each workstation shall be assessed in the first instance. The results are as per shown in Table 2. Both the management’s and workers’ score for each dimension is above 3.00 (good).

TABLE 2: SUMMARY MEAN OF NOSACQ-50 RESULT FOR EACH DEPARTMENT

<table>
<thead>
<tr>
<th>Department</th>
<th>Dimensions</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Supervisor</td>
<td>3.22</td>
<td>3.29</td>
<td>3.12</td>
<td>3.37</td>
<td>3.34</td>
<td>3.20</td>
<td>3.07</td>
</tr>
<tr>
<td>Laminating</td>
<td>3.20</td>
<td>3.29</td>
<td>3.07</td>
<td>3.33</td>
<td>3.06</td>
<td>3.23</td>
<td>3.26</td>
</tr>
<tr>
<td>Cutting</td>
<td>3.10</td>
<td>3.14</td>
<td>3.11</td>
<td>3.24</td>
<td>3.03</td>
<td>3.17</td>
<td>3.14</td>
</tr>
<tr>
<td>Sewing</td>
<td>3.17</td>
<td>3.20</td>
<td>3.13</td>
<td>3.30</td>
<td>3.11</td>
<td>3.15</td>
<td>3.13</td>
</tr>
<tr>
<td>Rubber</td>
<td>3.09</td>
<td>3.20</td>
<td>3.06</td>
<td>3.18</td>
<td>3.09</td>
<td>3.09</td>
<td>3.07</td>
</tr>
<tr>
<td>Stock Fit</td>
<td>3.14</td>
<td>3.16</td>
<td>3.06</td>
<td>3.23</td>
<td>3.13</td>
<td>3.13</td>
<td>3.09</td>
</tr>
<tr>
<td>Assembly</td>
<td>3.15</td>
<td>3.19</td>
<td>3.10</td>
<td>3.21</td>
<td>3.10</td>
<td>3.17</td>
<td>3.06</td>
</tr>
</tbody>
</table>
The mean scores of the safety climate dimension for supervisors and for employees is presented in Table 3. The dimension mean score for ten supervisors is 3.07-3.37 and that for 163 employees is 3.09-3.24. For the respective dimension, with the exception of dimension 7, the mean scores for supervisors were slightly higher than those of employees. Other than dimension 5, no significant differences were observed between mean scores for supervisors and employees. The mean score of respective dimension for supervisors and employees showed that safety climate of the footwear company (between 3.00-3.30) is relatively acceptable with a slight need for improvement. A score of more than 3.30 indicates an adequate level of safety climate, allowing for maintained and continuous development.

After examining the mean score of statements in each dimension, the following observations can be made. Dimension 1 is evaluating management concerning management safety priority and ability. For the entire dimension, there was no distinction between the mean score of management and employees. However, there is a statement in dimension 1 that shows a distinctive mean score. The supporting statement is, “Management ensures that safety problems discovered during safety rounds/evaluations are corrected immediately”. The mean score of the statement reveals that most of the supervisors respond “strongly agree” (mean score of 3.60), while employees responded “agree” (mean score 3.09).

During the discussions on safety aspects in the workplace, supervisors stated that human errors mainly cause accidents in the workplace. Supervisors view safety management from a traditional (person-centered) approach which focuses on the unsafe acts/errors and procedural violations of people on the front line (14). The traditional approach, or person-centered analysis and prevention approach, is focused mainly on the individual responsibilities when causing an error (15). That is, when an accident occurs – and an employee had been held accountable – supervisors believe that the cause of the problem had been resolved. This behavior clearly does not attempt to seek the root cause of the problem. Supervisors fail to realize that human error is the starting point of an accident investigation, not the end. In addition, accidents rarely occur as the result of a single unsafe act. Some act involved in a previous accident will probably not have an adverse outcome in the absence of the other causal factors (16). Management commitment to safety is represented by promoting safety by guidance and counselling rather than enforcement and admonition (1). It seems that the supervisors’ knowledge on occupational safety has to be improved. The improvement is essential because the perception of safety climate is connected more to supervisory safety rather than company policies and procedure (17).

Detail results obtained from the questionnaire are described in three sub sections as follows: sub sections 4.1 discusses questionnaire result on management’s safety justice; sub section 4.2 describes analysis on management’s safety empowerment; sub section 4.3 describes the analysis on managerial implication on this research.

A. Management’s Safety Justice

Table 4 displays a mean score of respective statement in dimension 2 for supervisors and employees.

B. Management’s Safety Empowerment

Dimension 3 is the evaluation of management’s safety empowerment. The mean score of dimension 3 for supervisors was similar to that for employees and showed that the safety climate in the footwear industry was acceptable (between 3.00-3.30). One of the statements in
dimension 3 is: “Management always blames employees for accident”. The mean score reveals that all supervisors respond “disagree”. In this case, the responses of supervisors were inconsistent with their statements that human error mainly causes accidents in the workplace. In short, supervisors’ responses to the questionnaire are not consistent with the actual practices in the workplace.

TABLE 5: MEAN SCORE OF RESPECTIVE STATEMENT IN DIMENSION 5 FOR SUPERVISORS AND EMPLOYEES

<table>
<thead>
<tr>
<th>Statement No.</th>
<th>29</th>
<th>30</th>
<th>31</th>
<th>32</th>
<th>33</th>
<th>34</th>
<th>35</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supervisors</td>
<td>3.00</td>
<td>3.40</td>
<td>3.70</td>
<td>3.60</td>
<td>3.00</td>
<td>3.20</td>
<td>3.50</td>
</tr>
<tr>
<td>Employees</td>
<td>2.91</td>
<td>2.87</td>
<td>3.06</td>
<td>3.44</td>
<td>2.98</td>
<td>3.17</td>
<td>3.23</td>
</tr>
<tr>
<td>p-value</td>
<td>0.560</td>
<td>0.001</td>
<td>0.000</td>
<td>0.313</td>
<td>0.841</td>
<td>0.874</td>
<td>0.066</td>
</tr>
</tbody>
</table>

As represented in Table 3, the significant differences of safety climate dimension of supervisors and employees are observed only in dimension five, the evaluation of workers’ safety priority and risk non-acceptance. As can be seen in Table 5, this distinction appears from the statement: “We who work here, consider minor accidents to be a normal part of our daily work”, and: “We who work here accept dangerous behavior as long as there are no accidents”. These statements are reversed formulated items. From the mean score, most of supervisors responded “strongly disagree”; most of the employees responded “disagree”; and only a few of them responded, “agree”. It seems that the responses of supervisors reveal the espoused policies and that of employees reflected the enacted practice.

In the discussion, the employees noticed that in some cases, supervisors do not seem to be bothered if they break safety rules or safety condition. If there were any unsafe acts that caused accidents, the supervisor usually blamed the employees. The events were consistent with the supervisors’ awareness that the cause of the accidents, in accordance with the person-centred approach, were mainly human error. This phenomenon implied that inconsistencies between espoused policies and enacted practices happened frequently. These occasions signify that employees have to perform their tasks in an unsafe workplace. These cases are described in the analysis below.

In the Pouncing machine working system (button hole) the operator must hold the shoe strap pouncing device and step on the pedal to activate the machine as depicted in Figure 3. From investigation of of potential hazards in the Pouncing Machine it became apparent that the operator's hand can get caught and be pounced by the machine. The identification of latent hazards consists of two phenomena, namely Phenomenon A and B. Phenomenon A is a condition where the operator pulls back his hand too late when the Punching machine is active. Phenomenon B is a condition where the machine can be active when the operator's hand is still in the machine desk area. Accidents will not occur if the two phenomena do not occur simultaneously.

Efforts are required to avoid accidents that is caused by occurrence of those two events. First, the hole printer is attached to the puncher so that the operator does not need to hold the hole printer when working and the use of an upper clamp is proposed so that the upper part remains stable when the machine operates as illustrated in Figure 4. Secondly, for this machine a two-button system is proposed that functions as a machine activation button. The purpose of this two-button system is to ensure that the operator's hands are no longer under the machine table so that they can avoid the danger described in Figure 5.
Figure 5. The design of the upper clamping design proposal

In Figure 6. Overall Pouncing Machine Design.

Figure 6 shows that the Pouncing machine can only be active if both buttons are pressed, meaning that there are no hands on the table. The design results of this machine make the work system safer. However, the proposed work system has not been approved by management because the working time will be longer and requires more costs.

C. Managerial Implication

An additional severe hazard in shoemaking is due to organic solvent exposure. The organic solvents were used in glues, primers, degreasers, cleaners, and paints. The vapors of the organic solvents are spread throughout the workplace. Most of the exposure is generated through inhalation and absorption through the skin.

Footwear chemicals have serious health effects on the body, e.g., nervous system, skin, liver, kidneys, lungs. The effects may be manifested in years to come. The organic chemicals are flammable and represent serious fire hazards (18). Therefore, safety precautions are necessarily needed.

In this respect, supervisors pointed out that the company has provided masks for employees' protection against the organic vapors. On the contrary, employees responded that the masks did not comply with the intended usages. They considered that there was no significant difference with or without wearing the mask. That is the reason why employees refused to wear the mask.

The supervisors stated that the particular accidents were caused by employees' unsafe behavior (or human error). That is why the supervisors were convinced that human error essentially caused the accident. After watching the supervisors demonstrating the using of masks in the workplace, we can infer that this type of mask is not designed to protect an individual from organic vapor exposure. This event confirms that the employees show sufficient awareness in occupational safety.

Over several decades, the traditional approaches have reached the limit of their utility and shift from the traditional reductionist approach towards work systems and environments. The reductionist paradigms that seek to trace phenomena – such as workplace accidents to a single root cause have shifted attention from critical role played by organizational and other systems factors (19). The system-centered approach assumes that humans are fallible and systems must be designed so that humans are prevented from making errors (14,15). Within a sociotechnical perspective, safety represents the degree of protection against harm in a working system which characterizes the system level attribute of the work systems. Occupational safety is an emergent property of dynamic interaction between social and technical components. Assessment of systems dimensions, such as the adaptive role of employees, can be more readily and more apparently revealed (20,21).

Employees are mostly engaged in their work and are familiar with their workplace. In some cases, they may encounter situations in which there are unavoidable risks to achieve the organizational goals, e.g., using the mask to protect employees in handling organic chemicals. Systems approach, e.g. sociotechnical system and/or participatory ergonomics approach (22), will allow the employees in providing input directly to the top management and supervisors, and to get involved in solving the problems. Even more, employees' direct participation in problem solving is proven to have a positive influence on workplace safety even though the involvement is not directly related to safety (23).

The participatory ergonomics approach is the most effective and sustainable way to promote and practice ergonomics in developing countries (24). The approach is implemented in an open discussion between the management, employees (or representative of employees) and experts (if needed). Management that encourages open communication on safety can send a strong signal on how safety is valued in the organization. Communication is not merely an exchange of information, but a basis for learning and enabling innovative ideas to emerge (11). Communication should take place not only as interaction between management and employees but also between groups of employees.
V. CONCLUSIONS

The study has shown the implementation of NOSACQ-50 in a footwear manufacturing company. This study has also shown how NOSACQ-50 can give improvement on the safety of the manufacturing system. Based on the questionnaire responses, it seems that there is no distinction between the safety climate for supervisors and employees. However, the qualitative data has shown signs of inconsistencies between the questionnaire result and safety implementations in the workplace, even though those employees have shown sufficient awareness in occupational safety. For this reason, it is suggested that employees need to perform communications between all levels to allow the staff to provide input and get involved in solving the safety problems (e.g. conducting participative ergonomics). In the future, the company is also suggested to control the implementation as well as to measure the improvement of safety climates.

REFERENCES