Evaluation of Safety Behavior and Work Environment of Operators in the SME Producing Shuttlecocks

Issa Dyah Utami, Ika Deefi Anna, Trisita Novianti, Richo Dwi Cahyo
Department of Industrial Engineering, Universitas Trunojoyo, Madura, Bangkalan, Indonesia

Keywords: Safety behavior, work environment, small and medium enterprises.

Abstract: The role Small and Medium Enterprises in increasing the incomes and employment can certainly be rated for Indonesia. The implementation of behavioral-based safety in SMEs in Indonesia is still very minimal, one of which is the implementation at MM SME that produces shuttlecocks. The shuttlecock production processes have not implemented a culture of work safety. Moreover, the working environment is still poor and work standards are not applied. The application of Behavior-Based Safety (BBS) method in the research at MM SME resulted in the values of safety behavior of 44% and unsafety behavior of 56%. The calculation of rating indicates that the feather perforation process was unsafe. Unsafe production processes are recommended to be improved by using the 5S method.

1 INTRODUCTION

Behavior-Based Safety (BBS) is a program to activate employees in Occupational Health and Safety efforts. Behavior-Based Safety strives to help management to control unsafe work cultures in work areas that involve operators or employees (Williams and Geller, 2000). The main cause of unsafety behavior and unsafety conditions at work are the weaknesses in management control that cannot be corrected only by interfering unsafety behavior. The main purpose of Behavior-Based Safety is to build the enthusiasm of workers to observe if unsafety behavior occurs directly in the workplace (Geller, 2005).

In Indonesia, the Behavior-Based Safety (BBS) evaluation application as an effort to improve the occupational safety and health system of employees in small and medium enterprises (SMEs) has not received much attention from the government and researchers (Unnikrishnan *et al.*, 2015; Ansori, Sutalaksana and Widyanti, 2018)(Wang *et al.*, 2018)(Subramaniam *et al.*, 2016; Subramaniam, Mohd. Shamsudin and Lazim, 2016)(Abdullah *et al.*, 2016; Osman, Dhabi University Khalizani Khalid and Mohsen AlFqeeh, 2019). This is not in line with the conditions in which SMEs contribute more than 50% to the economy in Indonesia. Therefore, this study aims to evaluate the behavioral safety of one of the SMEs in Indonesia that produces shuttlecocks. The results of this study are expected to be an example and increase the motivation of other SMEs in Indonesia in implementing and improving their OHS system.

The MM SME is a SME engaged in the manufacturing industry producing shuttlecocks established in 2005. This SME produces 10 packs of shuttlecock per day, in which one pack contains 50 boxes and one box contains 12 units of shuttlecocks, meaning that MM SME can produce 6,000 units of shuttlecocks each day. The production processes of shuttlecocks have not implemented a culture of work safety. The working environment is still poor and the standards for work are not well-applied. The operator of each machine at the MM SME still deals with potential hazards that can cause accidents at the workplace. The facilities and equipment to support the tidiness of equipment and the cleanliness of the workplace are not available. However, the types of equipment available are brooms, trash bins, garbage bins and shoe bins that are no longer suitable for use. This causes ineffective and inefficient work procedures and is risky for accidents in the workplace because the products are various and high-quality. Based on these problems, the research on the prevention of occupational accidents by applying health and safety culture, which covers Sort, Set in Order, Shine, Standardize, and Sustain (5S) (Ghodrati and Zulkifli, 2012; Agrahari, Dangle and Chandratre, 2015; Filip and Marascu-Klein, 2015; Sánchez *et al.*, 2015; Ankomah, Ayarkwa and Agyekum, 2017; Adzrie *et al.*, 2019) and minimizing risky behaviors

Utami, I., Anna, I., Novianti, T. and Cahyo, R.
Evaluation of Safety Behavior and Work Environment of Operators in the SME Producing Shuttlecocks.
DOI: 10.5220/0010305500003051
In *Proceedings of the International Conference on Culture Heritage, Education, Sustainable Tourism, and Innovation Technologies (CESIT 2020)*, pages 158-164
ISBN: 978-989-758-501-2

by analyzing Behavior-Based Safety (BBS) approach (Geller, 2005; Ismail, 2012; Persekutuan, 2015; Skowron-Grabowska and Sobociński, 2018) needs to be carried out.

2 RESEARCH METHOD

This research was conducted at the MM SME that produces shuttlecocks. This study uses qualitative methods through the CBC (Critical Behavior Checklist) questionnaires, interviews and direct observations. The questionnaires were distributed to 70 operators in the production area. The supporting data of this research were obtained by collecting information on work accidents and documentation in the production area. The first step was identifying unsafe behaviors. The identification table contains the types of the production processes, the hazards, the consequences of the potential hazards, the description of the operators when working and the causes of hazards. The stages in the CBC questionnaire include assessing the aspects of the work environment, namely floors, spatial planning, leakage prevention, state of the facilities, and temperature. The equipment and facilities include barriers and protectors, lifting equipment, correct use, and the state of the equipment. The personal protective equipment comprises hand, face, eye, feet, fall, respiratory, hearing and body protection equipment. The body use and position include the eye safety at work and the dangerous path. The aspects of the procedures consist of work preparation, lock-out and tag-out.

The formula for calculating the safe score stated by (Williams and Geller, 2000) is as follows:

$$\%Safety\ score = \frac{TSO}{(TSO + TRO)} 100\% \quad (1)$$

Note: TSO (Total Safety Observation) and TRO (Total Risk Observation).

According to (Salem *et al.*, 2007), the scoring and calculation of unsafety behaviour rating numbers indicate the range of values from 0 to 1, where the security level is still in a safe condition, and vice versa if it shows a range from 0 to (-1), and then classified as unsafe condition. The formula (2) was used for the rating calculation.

$$\text{Rating} = \frac{[\sum(safe\ work) - \sum(unsafe\ work)]}{[\sum(safe\ work) + \sum(unsafe\ work)]} \quad (2)$$

Behavioral observation card was used to assess the safety and danger of the operator's behavior in carrying out the work and maintaining the work environment. This research used Likert scale 1 to 5 as shown in Table 1.

Table 1: The assessment of safety and risk levels.

Safety		**Risk**	
Score	Description	Score	Description
5	Very high safety	5	Very high hazard
4	High safety	4	High hazard
3	Medium safety	3	Medium hazard
2	Low safety	2	Low hazard
1	Very low safety	1	Very low hazard

The efforts to achieve an attitude become tangible necessary supporting factors, and among others are facilities. Facilities are resources to support safety behaviors. It was found that the workplace in the MM SME was not well structured. However, workers had the desire to implement a good workplace arrangement. These were proven in the results of interview with an informant that he sorted goods, returned goods to the workplace, cleaned the workplace, and often had difficulty finding equipment. The attitude of workers were still poor in implementing a good workplace, and this was evidenced by messy and disorganized condition of workplace. Therefore, the efforts to improve the workers' behaviors can be conducted by structuring the work environment using the following 5S principles (Sort, Set in Order, Shine, Standardize, and Sustain).

1. A brief design includes the method of selecting materials and equipment that are used and not. Critical Behavior Checklist is used to classify equipment, materials, and objects that are in a good condition, deformed, or damaged. Equipment and objects that are not used are also labelled with particular symbols.
2. Neat design involves the storing of equipment, materials, and objects by disposing or placing them in a storing place when they are no longer used. They are stored based on the frequency of use. The stored equipment and layout are given labels.
3. The design of dress comprises several cleaning phases involving workers' participation.

Partial cleaning involves the operators at the production stations. It can be done by making schedules, steps for cleaning, and procurement of Personal Protective Equipment (PPE).

4. The design of care includes the stages of maintaining and implementing the initial 3S and making SOP (Standard Operating Procedure) by taking into account the safety.
5. The design of diligent behavior includes the 5S and SOP processing steps. Reward is granted for those implementing the 5S principles and SOPs, while punishment is given for the violators of those regulations. Information on OHS implementation is also continuously provided.

3 RESULT AND DISCUSSION

This section describes the results of identification of the unsafety behaviors applied by the MM SME producing shuttlecocks, safety behavior index calculation, rating and evaluation of the 5S (Sort, Set in Order, Shine, Standardize, and Sustain) design. The number of employees at MM is 100 people, with 71 production employees. Table 2 presents the number of employees at each work station. All employees in the production section became the respondents in this study to provide information about their behaviors at workplace by filling out the critical behavior checklists. Table 3 demonstrates the activities that cause unsafety behaviors in the shop floor.

Table 2: The number of daily production operators.

No	Work Station	Operators
1	Feather selection and oven	10
2	Feather perforation	10
3	Duck perforation	2
4	assembling	8
5	Stitching	8
6	Controlling	6
7	Gluing and drying	8
8	Testing	7
9	Packaging	12

Table 3: The identification of unsafety behaviors.

Process	Shuttlecocks production process
Hazard	Unprotected machinery and equipment, slippery floors, scattered items, dust, chemicals, dirt, and liquids
Exposure	Infrequently
Deviation	Operators do not wear personal protective equipment such as gloves, masks, goggles, safety shoes, and do not apply cleaning procedures, etc.
Consequence	Wounds, sliced fingers, shortness of breath, eye pain, itching, eye irritation, blisters, skin irritation, fainting, bruising, blisters
Cause	Operators dot use PPE and implement 5S

Analysis on the information obtained from CBC questionnaires on the behaviors of 10 operators in feather selection station shows the following scores of safety and risk levels, as presented in Table 4.

Table 4: The summary of responses to CBC questionnaires on the behaviors of 10 operators in feather selection station.

Critical Behavior Checklists in Feather Selection Station			
Behavior	**REF.**	**Safe**	**At Risk**
Work Environment	0	0	0
Spatial layout	1.1	25	37
Floor	1.2	23	31
Lighting	1.3	24	30
The condition of goods and facilities	1.4	23	36
Temperature	1.5	25	30
Personal Protective Equipment (PPE)	2	0	0
Eye protective equipment	2.1	25	29
Hand protective equipment	2.2	27	29
Respiratory protective equipment	2.3	25	33
Hearing protective equipment	2.4	30	30

Foot protective equipment	2.5	30	30
Body protective equipment	2.6	29	31
Fall protective equipment	2.7	30	30
Equipment and Facilities	3	0	0
Barrier equipment and protective equipment	3.1	30	32
Lifting equipment	3.2	29	30
The proper use of equipment	3.3	29	30
The condition of equipment	3.4	28	31
Body Use and Position	4	0	0
Eye safety at work	4.1	30	30
Hazardous path	4.2	25	31
Procedures	5	0	0
Work preparation	5.1	30	31
Lock-out/Tag-out	5.2	30	30
Total		547	621

The calculation shows the safety score in the feather selection station of 46%. This result implies 54% unsafety or potential of occupational accidents.

In terms of the measurement of unsafety behavior, if the score ranges from 0 to 1, the condition is considered safe, while if the score ranges from 0 to -1, the condition is perceived unsafe.

Tables 5 and 6 demonstrate the identification results of critical behaviors in feather perforation and duck perforation.

Table 5: The summary of responses to CBC questionnaires on the behaviors of operators in feather perforation station.

Critical Behavior Checklist in Feather Perforation Station			
Behavior	**REF.**	**Safe**	**At Risk**
Work Environment	0	0	0
Spatial layout	1.1	23	37
Floor	1.2	22	30
Lighting	1.3	22	30
The condition of goods and facilities	1.4	19	38
Temperature	1.5	23	30
Personal Protective Equipment (PPE)	2	0	0
Eye protective equipment	2.1	20	30
Hand protective equipment	2.2	14	40
Respiratory protective equipment	2.3	30	33
Hearing protective equipment	2.4	30	30
Foot protective equipment	2.5	32	31
Body protective equipment	2.6	30	32
Fall protective equipment	2.7	33	28
Equipment and Facilities	3	0	0
Barrier equipment and protective equipment	3.1	19	32
Lifting equipment	3.2	29	30
The proper use of equipment	3.3	29	30
The condition of equipment	3.4	26	33
Body Use and Position	4	0	0
Eye safety at work	4.1	30	30
Hazardous path	4.2	21	37
Procedures	5	0	0
Work preparation	5.1	30	31
Lock-out/Tag-out	5.2	30	31
Total		512	643

Table 6: The summary of responses to CBC questionnaires on the behaviors of operators in duck perforation station.

Critical Behavior Checklist in Duck Perforation Station			
Behavior	**REF.**	**Safe**	**At Risk**
Work Environment	0	0	0
Spatial layout	1.1	6	6
Floor	1.2	6	6
Lighting	1.3	6	6
The condition of goods and facilities	1.4	4	7
Temperature	1.5	8	6
Personal Protective Equipment (PPE)	2	0	0
Eye protective equipment	2.1	4	8
Hand protective equipment	2.2	4	6
Respiratory protective equipment	2.3	4	7
Hearing protective equipment	2.4	6	7
Foot protective equipment	2.5	6	6
Body protective equipment	2.6	6	6
Fall protective equipment	2.7	6	6
Equipment and Facilities	3	0	0
Barrier equipment and protective equipment	3.1	6	7
Lifting equipment	3.2	6	6
The proper use of equipment	3.3	6	6
The condition of equipment	3.4	6	7
Body Use and Position	4	0	0
Eye safety at work	4.1	4	6
Hazardous path	4.2	6	6
Procedures	5	0	0
Work preparation	5.1	6	7
Lock-out/Tag-out	5.2	6	6
Total		112	128

The summary of safety score calculation of the results of observation on the nine processes in producing shuttlecocks is presented in Table 7. The safety score in the feather selection process was 46%, denoting 54% potential of risky working condition and behavior.

Table 7: Safety scores of nine processes.

No.	Processes	Safety Score
1	Selection and feather oven	0.468322
2	Feather perforation	0.443290
3	Duck perforation	0.466667
4	Assembling	0.568432
5	Stitching	0.530271
6	Controlling	0.603974
7	Gluing and drying	0.491886
8	Testing	0.553687
9	Packaging	0.452684

The summary of scoring calculation on safety and unsafety behaviors of workers in each process of production is demonstrated in Table 8.

Table 8. The summary of rating scores.

No.	**Shuttlecock Production Processes**	**Rating**
1	Feather selection and oven	-0.1191
2	Feather perforation	-0.2036
3	Duck perforation	-0.1245
4	Assembling	0.31671
5	Stitching	0.12874
6	Controlling	0.52403
7	Gluing and drying	-0.0319
8	Testing	0.24019
9	Packaging	-0.1728

The ratings of behaviors in feather selection, feather perforation, duck punching, gluing and packaging processes ranged from 0 to -1; and thus, the conditions were classified unsafe. The unsafe production processes were then further evaluated for improvement using the 5S principles of health and safety culture (Sort, Set in Order, Shine, Standardize, and Sustain).

The results of 5S evaluation were yielded after the calculation of safety and unsafety rating scores at each production process. The processes include father selection, feather perforation, duck perforation, gluing and packaging. The activities of operators in applying 5S and SOP procedures were observed by the person in charge in each station.

Work safety procedures set in the MM SME Guidance regulate that operators must use Personal Protective Equipment (PPE), comply with OHS (Safety, Health and Work), apply 5S, report and document unsafety conditions to superiors, be honest and attend OHS briefings. The briefing is held every Monday before the production process starts. The activity aims to provide various information to operators, including OHS, compliance with SOP and 5S, potential hazards and how to overcome them, the latest OHS issues, etc. It is usually conducted in five to 15 minutes and all operators are required to attend.

The Personal Protective Equipment used in the MM SME includes:

a. Clothes protective equipment
   This equipment protects the body from liquid, dust, and dirt. Some of the equipment are apron clothes from fabric or leather and waterproof clothes from parachute that can be used in humid work place.
b. Hearing protective equipment
   It functions to prevent noise resulted from machines. The equipment is commonly made of rubber, hard plastic, soft plastic, wax, and cotton.
c. Eye and face protective equipment
   It is commonly made of plastic and functions to shields eye and face from small materials, heat, light, and radiation.
d. Respiratory protective equipment
   This equipment protects nose and mouth, as well as respiratory system from pollution at work place.
e. Hand protective equipment
   It protects fingers of exposure to fire, heat, chemicals, radiation, scratches, and collisions. This equipment to shield hands from heat and fire is made of asbestos, cotton, and wool. Equipment to protect wound and scratches is made of leather. Synthetic materials are used for chemical hazards.
f. Foot protective equipment
   The equipment protects toes and soles of feet from being hit by hard objects, liquid spills, tripping, and slips, being punctured by objects, the hazards of hot water, dirt, and cold. Shoes are made of plastic or synthetic rubber, and leather with a rough surface.

Socialization and information are provided in the forms of pictures or posters so that operators and others will notice and understand them more easily.

4 CONCLUSION

Identification of potential hazards was done at each shuttlecock production station by examining the data of accidents. In the process of feather selection, the danger was from hot objects and equipment used in the feather curing. Direct contact with hot equipment could cause the palm to bend if operator did not implement the 5S principles. The feather perforation process with sharp knives could endanger the operators. The 5S principles were not applied so that the operators were vulnerable to finger-cuts. The results of identifying unsafety behavior were evaluated using the SBI (Safety Behavior Index) (Mohammad, Zuraida and Esmail, 2018) calculation. SBI values in the feather selection process, the feather perforation process, the duck perforation process, and tide process were 0.468, 0.443, 0.466, and 0.568, respectively. Meanwhile, the SBI values in the sewing process, the service process, the gluing and drying process, the test process and the packaging process were 0.53, 0.603, 0.491, 0.533, and 0.452, respectively. The SBI results that were more than 50% or 0.50 indicated the implementation of safety behaviors. The rating calculation showed the unsafe production processes, where the values in the feather selection, feather perforation, duck perforation, gluing, and packaging processes were -0.119, -0.203, -0.124, -0.031, and -0.172, respectively, denoting negative values as represented by 0 to -1 scores.

The evaluation of improvements was carried out with the 5S principles by examining the production processes and the result showed that the processes were considered fairly unsafe. Therefore, a short design was made by selecting equipment and items needed. The equipment and items that were not required in the processes were given red labels. Neat design was created by organizing and storing items according to the frequency of use. Name labels and storage areas, such as toolboxes, cabinets, and small shelves, were provided. Dresses were designed by making cleaning schedules and rules, including time, cleaning tools used, and responsibilities. The procurement of PPE (Personal Protective Equipment) was performed by considering the needs of operators. The design of care was made by setting SOP (Standard Operating Procedure) of 5S and PPE so that

the 5S principles could be applied earlier. Salary was designed by customizing the SOPs, giving punishment to SOP violators, and granting rewards to SOP implementers. The information was announced by using pictures, posters, and weekly briefing to discuss about OHS.

ACKNOWLEDGMENT

This research publication was funded by the Faculty of Engineering, Universitas Trunojoyo Madura.

REFERENCES

Abdullah, M. S. *et al.*, 2016. 'Safety Culture Behaviour in Electronics Manufacturing Sector (EMS) in Malaysia: The Case of Flextronics', *Procedia Economics and Finance*. Elsevier B.V., 35(October 2015), pp. 454–461. doi: 10.1016/s2212-5671(16)00056-3.

Adzrie, M. *et al.*, 2019. 'Implementation of 5s in Small and Medium Enterprises (SME)', 1(1), pp. 1–18.

Agrahari, R. S., Dangle, P. A. and Chandratre, K. V., 2015. 'Implementation Of 5S Methodology In The Small Scale Industry A Case Study', *International Journal of Scientific & Technology Research*, 4(4), pp. 180–187.

Ankomah, E. N., Ayarkwa, J. and Agyekum, K., 2017. 'A theoretical review of Lean implementation within construction SMEs', *6th International Conference on infrastructure development in Africa*, (April), pp. 71–83..

Ansori, N., Sutalaksana, I. Z. and Widyanti, A.., 2018. 'Comparison Between Key Success Factors in Safety Behavior in Small- and Medium-Sized Enterprises (SMEs) and Large Industries, and Development of a Hypothetic Model for Safety Behavior in Indonesian SMEs', *KnE Life Sciences*, 4(5), p. 582. doi: 10.18502/kls.v4i5.2587.

Filip, F. C. and Marascu-Klein, V., 2015. 'The 5S lean method as a tool of industrial management performances', *IOP Conference Series: Materials Science and Engineering*, 95(1). doi: 10.1088/1757-899X/95/1/012127.

Geller, E. S., 2005. 'Behavior-based safety and occupational risk management', *Behavior Modification*, 29(3), pp. 539–561. doi: 10.1177/0145445504273287.

Ghodrati, A. and Zulkifli, N., 2012. 'A Review on 5S Implementation in Industrial and Business Organizations', *IOSR Journal of Business and Management (IOSR-JBM)*, 5(3), pp. 11–13.

Ismail, F., 2012. 'Steps for the Behavioural Based Safety: A Case Study Approach', *International Journal of Engineering and Technology*, 4(5), pp. 594–596. doi: 10.7763/ijet.2012.v4.440.

Mohammad, A., Zuraida, A. and Esmail, J. M.., 2018. 'A Conceptual Framework for Upgrading Safety Performance by Influence Safety Training, Management Commitment to Safety and Work Environment: Jordanian Hospitals', *International Journal of Business and Social Research*, 8(7), pp. 25–35. doi: 10.18533/ijbsr.v8i7.1117.

Osman, A., Dhabi University Khalizani Khalid, A. and Mohsen AlFqeeh, F., 2019. 'Exploring the Role of Safety Culture Factors Towards Safety Behaviour in Small-Medium Enterprise', *International Journal of Entrepreneurship*, 23(3), pp. 1939–4675.

Persekutuan, W., 2015. 'Level of Awareness on Behaviour-Based Safety (Bbs) in Manufacturing Industry Towards Reducing Workplace Incidents', 3(1), pp. 77–88.

Salem, O. *et al.*, 2007. 'A behaviour-based safety approach for construction projects', *Lean Construction: A New Paradigm for Managing Capital Projects - 15th IGLC Conference*, (July), pp. 261–270.

Sánchez, P. M. *et al.*, 2015. 'Impact of 5S on quality , productivity and organizational climate - Two Analysis Cases', *Proceedings of the 2015 International Conference on Operations Excellence and Service Engineering*, (Cura 2003), pp. 748–755.

Skowron-Grabowska, B. and Sobociński, M. D., 2018. 'Behaviour Based Safety (BBS) - Advantages and Criticism', *Production Engineering Archives*, 20(20), pp. 12–15. doi: 10.30657/pea.2018.20.03.

Subramaniam, C. *et al.*, 2016. 'The influence of safety management practices on safety behavior: A study among manufacturing smes in Malaysia', *International Journal of Supply Chain Management*, 5(4), pp. 148–160.

Subramaniam, C., Mohd. Shamsudin, F. and Lazim, M., 2016. 'Safety Management Practices and Safety Compliance: A Model for SMEs in Malaysia', in *The European Proceedings of Social & Behavioural Sciences*, pp. 856–862. doi: 10.15405/epsbs.2016.08.120.

Unnikrishnan, S. *et al.*, 2015. 'Safety management practices in small and medium enterprises in India', *Safety and Health at Work*. Elsevier Ltd, 6(1), pp. 46–55. doi: 10.1016/j.shaw.2014.10.006.

Wang, Q. *et al.*, 2018. 'Analysis of Managing Safety in Small Enterprises: Dual-Effects of Employee Prosocial Safety Behavior and Government Inspection', *BioMed Research International*. Hindawi, 2018. doi: 10.1155/2018/6482507.

Williams, J. H. and Geller, E. S., 2000. 'Behavior-Based Intervention for Occupational Safety: Critical Impact of Social Comparison Feedback', *Journal of Safety Research*, 31(3), pp. 135–142. doi: 10.1016/S0022-4375(00)00030-X.