Establishing Consensus on Participatory Ergonomics Implementation in Indonesian Tin Mining: Delphi Technique

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ABSTRACT

This article presents the process of establishing a consensus on proposed practical measures to implement Participatory Ergonomics (PE) in Indonesian tin mining small medium sized enterprises (SMEs). The practical measures are essentially proposed solutions designed to overcome the identified barriers standing in the way of PE implementation. A Delphi technique [1], consisting of a two-round questionnaire was conducted. A total of 57 proposed solutions were identified in the first questionnaire. These were then further refined in the second-round questionnaire, which resulted in a total of 35 proposed solutions.

INTRODUCTION

Thousands of employees in small and medium-sized enterprises (SMEs) in Indonesia’s tin mining industry are working in dangerous environments without an adequate safety and health protection programme. Such incidents can lead to serious injuries and fatalities, particularly given that mining involves dangerous and high-risk activities. This research was based on the outcome of study of Soejadi, et.al [2]. They investigate the identified factors, possible solutions and problems with PE in Indonesian tin mining companies. The results of the study revealed that participants suggested the dissemination of occupational safety and health through a kinship approach and specific safety training to break down communication, culture and knowledge barriers. Furthermore, clear definitions of job roles/tasks, as well as the appropriate allocation of time and resources, were suggested as ways to empower workers and managers. The research question addressed in this research was: What are practicable solutions to problems identified by stakeholders (owner, manager, and worker) who could improve safety in Indonesian tin mining companies? This research aimed to reach a consensus on proposed practical measures to implement PE in Indonesian tin mining companies.

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METHODS

The Delphi technique [1] was used, a two-round Delphi technique applied to the participants that were from a tin company, SMEs, local representative government and academia. The first-round questionnaire included problem statements which explained barriers affecting PE implementation, proposed solutions to the identified barriers and questions to gather participants’ point of view on the proposed solutions. The results of the first questionnaire were used to create the second-round questionnaire which was used to achieve a consensus. Participants were asked to complete using a rating on a 5-point Likert scales, ranging from strongly disagree to strongly agree. A consensus is defined as an accumulation of 4 or 5 Likert ratings from at least 90% of participants.

RESULTS

The first-round questionnaire results

Participants’ responses were analysed by compiling and identifying similar statements. The researcher translated each response. This was followed by reviewing and grouping responses which contained 57 proposed solutions (statements) to support PE implementation in Indonesian tin mining. A total of 15 statements relate to the communication issue, while 27 address the culture issue, and 15 pertain to the knowledge issue. The results from the first-round questionnaire were then used in the second-stage questionnaire of the Delphi process.

The second-round questionnaire result

Proposed solutions that were considered important (i.e. a Likert rating of 4 or 5) by 90% or more of participants are shown in Table 1; in addition, proposed solutions that were considered important by less than 90% of participants are shown in Table 2. It was found that 35 proposed solutions reached a 90% or greater consensus, 14 proposed solutions had an 80-89% consensus, 5 proposed solutions had a 60-79% consensus, and only 3 proposed solutions had a consensus below 50%.

Upon reviewing the proposed solutions that reached at least a 90% consensus, the following were identified as key themes:

Communication issues:
- Conducting a safety talk regularly and performing alternately among roles.
- Allowing workers to convey ideas or participate during safety talks.
- Involve workers in determining occupational safety (OS) policies.

Cultural issues:
- Owners, managers, and supervisors should actively request feedback from workers in order to formulate solutions to safety problems in the field.
- Ensure supervisors have adequate competence.
- Hold regular meetings between SMEs supervisors, owners and managers in order to discuss OS development and OS reporting.
- Improve a better remuneration and bonus system.
- Deliver safety training that is practical, simple and understandable for workers.
Knowledge issues:
- Ensure continuous monitoring of tin mining field by supervisors.
- Provide teamwork training.
- Provide dissemination of ergonomics to the workers.

Table 1. Details of proposed solutions considered important by 90% or more of participants (n=11).

| Issue | No | Details of proposed solutions                                      | Median score | % agreement for scores 4 & 5 |
|-------|----|---------------------------------------------------------------------|--------------|-----------------------------|
|       | 1  | Safety talk should be performed interchangeably between roles because it triggers stakeholders’ motivation. | 4            | 100%                        |
|       | 3  | Safety talk should regularly be conducted on the shift turn, as it takes 5-10 minutes.       | 4            | 100%                        |
|       | 5  | Safety talk should be followed by inspection of the use of personal protective equipment (PPE) by supervisors. | 4            | 91%                         |
|       | 6  | There should be a reward and punishment mechanism written as a rule. | 4            | 90%                         |
|       | 8  | Supervisors should provide the widest opportunity to workers to convey ideas, problems and solutions on safety talk. | 4            | 100%                        |
|       | 11 | In addition to choosing the right time, approaches such as simplifying the use of language in the conversation should also be implemented. | 4            | 100%                        |
|       | 12 | Discussion materials can be obtained from everyday cases in the tin mining industry and can be presented in the form of posters, jargon, etc. | 4            | 100%                        |
|       | 13 | Workers, managers, supervisors and owners of the company must position themselves as co-workers during the discussion with the kinship approach. | 4            | 100%                        |
|       | 1  | The owner, manager, and supervisor must go directly to the workplace's field to see, provide direction, and occasionally ask for feedback from workers for necessary solutions to possible problems. | 4            | 100%                        |
|       | 3  | Standard Operating Procedures should be formulated to guide the implementation of Participatory Ergonomics (PE). | 4            | 100%                        |
|       | 4  | Comfortable conditions (caring for and respecting each other as well a harmonious workplace) must be put in place to improve the work environment. | 4            | 100%                        |
|       | 7  | Supervisors must have a POP competence (first operating supervisor) as a sign of legality. | 4            | 100%                        |
|       | 9  | Supervisors should meet regularly to discuss the development of occupational safety and health in their workplaces. | 4            | 100%                        |
|       | 10 | Supervision of existing remuneration system must be considered and should be consistent. | 4            | 91%                         |
|       | 11 | The remuneration system should reward compliance with occupational safety & health (OSH), e.g. the use of PPE. | 4            | 100%                        |
|       | 12 | Workers prefer to receive a bonus for having no accidents in a certain period. | 4            | 100%                        |
|       | 15 | An adjustment of rest periods and adequate nutrition for workers must be made, since they are factors in improving performance. | 4            | 100%                        |
|   | Statement                                                                 | Value | Percentage |
|---|---------------------------------------------------------------------------|-------|------------|
| 21| Workers should be provided with more practical safety training.            | 5     | 100%       |
| 22| Training should be conducted by way of audio and visual techniques to develop a better understanding, especially for those with a lower educational background. | 4     | 100%       |
| 23| Allocation of work and function must be carried out based on worker’s educational background. | 4     | 100%       |
| 24| Management (owners and managers) should become an example in OSH culture continuously and consistently. | 4     | 100%       |
| 25| Employees need to be rewarded for their achievement of OHS compliance.    | 4     | 100%       |
| 26| There needs to be a brief OSH training session during the early hiring process. | 4     | 100%       |
| 27| Management should be a mediator among the diversity of workers’ cultural background. | 4     | 100%       |
| 1 | Continuous monitoring by supervisors of the field and direct guidance must be carried out in addition to notices on the several forms of notifications. | 4     | 100%       |
| 2 | The Advisory Team on Occupational Health and Safety (Panitia Pembina Keselamatan dan Kesehatan Kerja – P2K3) should help to improve the enforcement of health and safety at work for SMEs. | 4     | 91%        |
| 3 | OSH Training or OSH simulation is conducted on a regular basis, especially for the SMEs’ workers. | 4     | 100%       |
| 4 | OSH reporting to management and P2K3 must occur consistently on a regular basis. | 4     | 100%       |
| 5 | To introduce PE to SMEs, the issues of PE and cost-benefit must be explained. | 4     | 100%       |
| 9 | To support workers’ teamwork skills, training known as ‘capacity building’ is essential. | 4     | 100%       |
| 11| Training materials should be obtained from tin mining experience.         | 4     | 100%       |
| 12| The OSH train-the-trainer training programme in SMEs should be conducted by labour inspectors and can work with local government, i.e. the Regional Office of Manpower. | 4     | 100%       |
| 13| SMEs’ managers and supervisors should be participants in the OSH train-the-trainer programme. | 4.5   | 100%       |
| 14| The new employee selection process should involve knowledge of OHS issues.  | 4     | 100%       |
| 15| Psychological factors of workers should be considered in giving OSH knowledge. **Psychological factors** refer to thoughts, feelings and other cognitive characteristics that affect the attitudes, behaviours and functions of the human mind. These factors can influence how a person thinks and can later affect his/her decisions and the relations in his/her daily life. ([https://www.reference.com/world-view/psychological-factors](https://www.reference.com/world-view/psychological-factors)) | 4.5   | 100%       |
Table 2. Details of proposed solutions considered important by less than 90% of participants (n=11).

| Issue | No | Details of proposed solutions | Median score | % agreement for scores 4 & 5 |
|-------|----|--------------------------------|--------------|-----------------------------|
| Communication | 2 | Safety talk materials should come from everyday safety experience to build learning activity. | 4 | 75% |
| 4 | The safety talk should have variations so as not to bore the workers and to remain unique, e.g. with posters, etc. | 4 | 75% |
| 7 | In order to have a good discussion during the safety talks, supervisors should take specific training. | 4 | 87% |
| 9 | The kinship approach should be carried out sincerely, naturally and casually. | 4 | 87% |
| 10 | The kinship approach should also involve regular family gatherings among stakeholders' families. | 3.5 | 50% |
| 14 | Communication forums are needed to bridge the workers and management if kinship communications do not meet expectations. | 4 | 82% |
| 15 | Workers should be involved in determining OSH policy. | 4 | 87% |
| Cultural | 2 | A suggestion box should be provided to accommodate ideas, suggestions and solutions if one does not want to be known personally. | 4 | 87% |
| 5 | Supervisors should undergo specific supervisor training in class-based teaching/training. | 4 | 62% |
| 6 | Supervisors must have an occupational safety and health (OSH) expert’s certification, as this means they can assist labour inspectors in completing their tasks. | 4 | 87% |
| 8 | Supervisors should be rewarded for good work with financial bonuses. | 3.5 | 50% |
| 13 | Wages for supervisors, managers and workers will be reduced if there is a work accident during a certain period. | 2 | 37% |
| 14 | Punishing negligent workers is a great way to enforce rules which were agreed and proposed by workers themselves. | 4 | 87% |
| 16 | Safety in the workplace is the responsibility of individuals and teams. The team must take responsibility for individual mistakes. | 4 | 87% |
| 17 | The needs of employees should be recognised and fulfilled so that employees are more motivated to work. | 4 | 87% |
| 18 | Every personal mistake must be analysed in terms of whether there is any involvement of the team. | 4 | 87% |
| 19 | Workers must have intensive supervision from supervisors. | 4 | 62% |
| 20 | Evaluation or testing is required in order to develop better OSH knowledge for stakeholders. | 4 | 82% |
| Knowledge | 6 | Cooperation with local government for a dissemination of PE to SMEs in the form of ergonomics or OSH training must be made. | 4 | 87% |
| 7 | OSH reporting activity must include the implementation of PE. | 4 | 80% |
| 8 | The training programme should be conducted in the form of classical formal training. | 4 | 75% |
| 10 | Teamwork skills training is needed in order to change the top-down paradigm to a teamwork approach. | 4 | 82% |
DISCUSSION

At the end of the first-round questionnaire, there were 57 proposed solutions to the PE implementation problems. These were then refined in the second-round questionnaire by asking participants to rate them using a 5-point Likert scale. The responses from participants were then used to identify proposed solutions that were agreed on by the majority of participants, i.e. reaching a consensus. A consensus was defined as having been achieved if 90% or more of the participants rated a statement a ‘4’ or ‘5’ [3].

Communication issues

With regard to communication issues, a regular reminder of work safety using safety talks was proposed. Suggestions from participants indicated that variation in conducting safety talks was needed. This could take the form of involving different SME stakeholders (i.e. a manager, supervisor, or worker) during the safety talk, using different ways/methods to conduct the safety talk (e.g. daily work safety experience) or performing additional activities as part of the safety talk (e.g. PPE inspection). Adopting this variation is one of the important characteristics of PE techniques, and could allow employees to understand and apply ergonomics to the workplace [4]. Other proposed solutions to communication issues (i.e. giving a wider opportunity to workers to be actively involved in safety discussion during safety talk, kinship approach during communication among roles) are more difficult to implement in the early stage. However, it is important that efforts are made in these aspects. This includes encouraging employees to become involved, and offer their ideas so that they can see that their ideas are acted on and taken seriously; in this way, employees will be more productive and more motivated to become involved in the safety process [5].

Culture issues

With regards to culture issues, besides a kinship approach, there are three significant areas that are interesting and certainly merit discussion: 1) empowerment of supervisors, 2) remuneration system, and 3) training system. The role and existence of supervisors are relatively new in tin mining SMEs. There are, as yet, no clear roles/tasks definitions or competency requirements for them. To achieve this, supervisors could be requested to undertake a training and evaluation process so that they can be certified mining supervisors; they may also be asked to incorporate safety supervision (and not only productivity) on their workers as part of their roles. Supervisors are the direct link between management and the workers who carry out the work. As such, it is important they directly ensure that safe working conditions are maintained in their working area. The existing remuneration system, which gears towards rewarding workers who find more tin ores, could lead workers to work dangerously. Obtaining more tin in a dangerous manner could lead to a dangerous workplace situation and work-related accidents. Therefore, supervisors, together with the managers and the owner, should pay more attention to this matter. In this vein, it is suggested that the wages of the supervisors, managers and workers be reduced if there is a work accident within a certain period. However, this research showed that workers prefer to receive a bonus for having no accident within a certain period. Nonetheless, there is a disadvantage to this bonus system. While it could encourage
workers to work safely, they may not report work accidents in order to avoid the risk of receiving a bonus. Thus, if this approach is chosen, supervision on safety and production should be based on honesty/integrity and applied to all roles in the SMEs. Essentially, whichever approach to remuneration is adopted, an evaluation of the remuneration system and bonus programme must be conducted regularly to ensure that the main goals of creating work safety in the workplace are achieved. Local government can play an active role in producing new or enforcing existing legislation that supports honesty/integrity production and safety supervision; in addition, education institutions could provide recommendations or suggestions on best practices.

**Work safety**

Work safety and the participatory approach need to be supported by effective and comprehensive training. Through training, participants will receive an education on safety and other relevant subjects which may then help to create a more effective participatory approach. Many training subjects can be offered, such as tin mining safety, introduction to ergonomics, effective teamwork, effective supervision, etc. The impact of the training could be improved by delivering a structured evaluation. A structured evaluation allows management to establish the degree to which the training meets and achieves its objective. A link between training objectives and desired safety expectations in the tin mining field could also be made.

**Knowledge issues**

With regard to knowledge issues, participants in this study alluded to the importance of delivering safety knowledge to the workers. In addition, some of the participants also suggested a better safety reporting system, empowerment of *Panitia Pembina Keselamatan dan Kesehatan Kerja*—P2K3 (The Advisory Team on Occupational Health and Safety), and safety training on a regular basis. It is important to improve the mechanisms which are used to report and investigate work incidents. In Study 1, it was found that the OS reporting system was prepared by P2K3 in every SME and submitted to the Regional Office of Manpower (ROM) on a monthly basis. Due to the lack of staff at the ROM, no further action was taken upon receiving the report, and it seemed that the reporting was viewed simply as administrative work, i.e. box ticking. However, the whole process of reporting essentially refers to ‘the way in which people identify and respond to incidents or events in the workplace’ [6, p. 825]. If the reporting system is not well presented and acted on, the ROM cannot identify safety events or accidents and will have difficulties in analysing and preparing safety programmes. A good reporting system could strengthen the safety management system in the organisation. Typical information that could be included in the OS reporting system may encompass types of events or accidents, number of accidents, incentive programme, and organisation processes [6]. There is also a need for enhanced commitment of SMEs through P2K3 and the ROM as representatives of local government in supervising OS in industry.

**Ergonomics training**

Furthermore, it is also worth introducing safety and ergonomics through training,
and continuous safety monitoring by tin companies, local government and education institutions. The train-the-trainer programme, which was also suggested, could have a positive impact on the long-term safety system in the SMEs, as many more supervisors and managers will have the skills to train workers. Recent times have seen an increasing amount of attention being paid to the action-oriented training method in order to improve OSH in SMEs. In India in 2001, Kogi et al. [7] described a positive impact of ergonomics implementation in small-scale workplaces in IDCs through the train-the-trainer programme, which was referred to as participatory action-oriented training (PAOT). The training programme involved 28 employees from 14 SMEs. The effectiveness of the training was confirmed by examining the utility of training tools and the trainers’ understanding of basic ergonomics principles [7]. They evaluated the training effectiveness, and especially the training process used to teach good local practices and enhance participants’ capabilities in using training tools for ergonomics improvement planning. With regards the training effectiveness, participants exhibited better scores for the questions provided during the PAOT. The questions pertained to the usefulness of the methods employed and their willingness to apply them. Conversely, in the training results, it was found that 78 improvements were implemented in 13 SMEs, as the participants organised one-day workshops at their enterprises during the PAOT programme.

CONCLUSION

This research aimed to reach a consensus on practical solutions or measures to address PE implementation problems at Indonesian tin mining companies. The first-round questionnaire resulted in 57 proposed solutions for PE implementation, which covered 3 issues, i.e. 15 related to the communication issue, 27 pertaining to the culture issue, and 15 which addressed the knowledge issue. The second-round questionnaire resulted in 35 proposed solutions on which the participants had reached a consensus; these were deemed to be practical solutions to the PE implementation problems in Indonesian tin mining. Evaluation of the remuneration and bonus system, employing the train-the-trainer programme, and the OSH reporting system were among the other suggestions proposed as practical solutions to PE implementation problems in Indonesian tin mining.

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