

Prijoko P. SOEJADI<sup>\*,\*\*</sup>, Glyn LAWSON<sup>\*</sup>, Brendan RYAN<sup>\*</sup>,  
Setia HERMAWATI<sup>\*</sup>

## PARTICIPATORY ERGONOMICS IN INDONESIAN TIN MINING

DOI: 10.21008/j.0239-9415.2017.075.20

Thousands of small and medium enterprises' (SMEs) employees in Indonesian tin mining companies work in dangerous environments without sufficient safety and health protections. This study's aim was to investigate the identified factors, such as difficulty in communication among stakeholders (owner, manager, and worker), and workers' negative attitudes towards and lack of knowledge in the use of personal protective equipment that inhibit the implementation of Participatory Ergonomics in Indonesian tin mining companies. Eighteen participants from five SMEs, encompassing three different roles, i.e. worker, owner and manager, participated in the interview study. The study revealed that the dissemination of occupational safety through a kinship approach and specific safety training were preferred to resolve communication, cultural and knowledge problems. The provision of clear definitions of roles and tasks and the allocation of time and resources were suggested as ways to empower workers and supervisors.

**Keywords:** participatory ergonomics, small and medium enterprises, industrially developing countries, occupational safety

### 1. INTRODUCTION

#### 1.1. Indonesian tin mining

Tin mining in Indonesia is mostly located in Bangka Belitung islands and produces 90% of Indonesia's tin. This industry is the world's second-largest exporter of

---

<sup>\*</sup> Human Factors Research Group, Faculty of Engineering, The University of Nottingham, United Kingdom.

<sup>\*\*</sup> Teknik Mesin, Fakultas Teknik, Universitas Bangka Belitung, Indonesia.

the metal and also fulfils 30% of the world's tin requirements (Hodal, 2012; PT.Timah (Persero) Tbk, 2013). The only state-owned tin mining company, PT Timah (Persero) Tbk, referred to from here as PT. Timah, is the world's largest tin mining company. PT. Timah, has been operating for more than 50 years and has a considerable experience in running tin mining operations, including occupational safety and health (OSH) issues in its company. However, since a decade ago, as the government introduced a policy to legalise illegal tin mining, they had to hand over some of their tin mining activities to 16 private onshore small and medium enterprises (SMEs) in approximately 400 tin mining locations under the PT. Timah co-operation scheme. In the scheme, the company must provide assistance to SMEs that housed the illegal mining worker groups to mine in the mine sites owned by the company. Unfortunately, OSH issues were not fully included in the scheme. Thousands of SMEs' employees are therefore working in dangerous environments without an adequate safety and health protection program. Since then, many accidents were recorded by PT. Timah and the number of fatalities had its peak in 2004 where 21 workers died in onshore operations (PT.Timah (Persero) Tbk, 2014). Even though there is no significant difference in the number of fatalities (3 to 5 workers) over the following 10 years, there are still a number of accidents with fatalities.

## **1.2. Participatory Ergonomics**

One approach to improving OSH performance and solving workplace problems is applying participatory ergonomics (PE) (Wilson, Haines, Morris, 2005). Wilson (1995) defined participatory ergonomics as 'the involvement of people in planning and controlling a significant amount of their own work activities, with sufficient knowledge and power to influence both processes and outcomes in order to achieve desirable goals'. There are suggestions regarding successful implementation of PE in industrially developing countries (IDCs), which is argued as an appropriate approach because of the necessity of low-cost solutions, and consideration of cultural factors (Apud, 2012; Haines, Wilson, 1998; Hermawati, Lawson, Sutarto, 2014; Hignett, Wilson, Morris, 2005; O'Neill, 2000, 2005; Scott, Charteris, 2004; Thatcher, 2005; Wisner, 1985). Furthermore, improved organisational support, team processes, team building, role clarity, communication, management commitment and a supportive culture through innovation in the form of training are the other considerations (Apud, 2012; Imada, Nagamachi, 1995; Wignjosebroto, 2007). Specifically in IDCs, 'participation and ergonomics solutions should be built on local practice, and the method should be adapted to local customs, cultures, norms, and values' (Imada, Robertson, 1987).

In a study investigating the suitability of participatory approaches for improving ergonomics and OSH in Indonesian tin mining SMEs conducted by the author, it

was found that participatory ergonomics is a useful approach for SMEs. The study used scenario based design (SBD) to gather data on the specific ergonomics issues and three issues were found that could inhibit the implementation of PE: communication; culture; and knowledge. Communication problems included difficulty to discuss specific problems, difficulty understanding roles (owner, manager, and worker) and problems with facing 'stubborn' people. Culture was defined based on Roughton and Crutchfield (2014) as 'holding basic assumptions on how things work, the perceived values of the organisation, what employees believe about how they should act and behave, and work practices'. Cultural problems include less participation from workers, difficulty receiving new knowledge, workers are less committed to safety, and the top down approach (it is unclear to define it as an appropriate approach for SMEs). In knowledge issues, the concepts of ergonomics and/or participatory ergonomics are not familiar within Indonesian tin mining SMEs.

This paper aimed to address the research question: What are the specific problems in communication, culture, and knowledge of stakeholders (owner, manager, and worker) which could affect the implementation of PE in Indonesian tin mining companies? By answering the research question above, this study hopes to elaborate on the barriers to a participatory ergonomics approach and to identify possible solutions to the identified problems in Indonesian tin mining companies.

## 2. METHOD

### 2.1. Participants

Eighteen participants within five SMEs participated in this research consisting of three owners, five managers, and ten workers. They were all male, ranging in age from 27 to 69 years ( $M = 38$  years;  $SD = 10.8$  years) and had an average of 7.1 years' experience in their roles ( $SD = 4.9$ ).

### 2.2. Procedure

PT. Timah was visited and meetings with the Head of Human Resources Planning and Development Department were arranged to describe the intent and purpose of the study. The author requested permission to conduct in-depth interviews with five tin onshore exploitation SMEs under PT. Timah's cooperation scheme who had agreed to participate. The study was conducted in two of PT. Timah's offices at Sungailiat and Pangkalpinang. At the start of the interview, information regarding the aim, objectives, and procedures was provided and the participants

were asked to sign the consent form. Each interview, which was performed in Bahasa, lasted 30-60 minutes and involved up to three participants at a time. The research methodology was approved by the Faculty of Engineering Ethics Committee, the University of Nottingham, UK.

### **2.3. Materials**

Three in-depth interview plans were prepared for an owner, manager, and worker. The main questions for them were on communication, cultural and knowledge issues that were found in the SBD study. The expected information gathered from interviewees were specific communication, cultural and knowledge problems and possible solutions to those problems.

### **2.4. Data analysis**

The interview responses were translated into English and analysed using thematic analysis to find patterns of meaning within the qualitative data (Braun, Clarke, 2006). The procedure involved five phases, familiarising with the data; initial generation of codes; searching for themes; evaluation of themes and final definition of themes. In this study, themes within data were identified deductively, driven by the researcher's analytic interest from the specific research question i.e. communication, culture, and knowledge.

## **3. RESULTS AND DISCUSSION**

This section reports the results of the in-depth interviews with stakeholders which were conducted to obtain specific problems and possible solutions in communication, culture, and knowledge of stakeholders (owner, manager, and worker) provided by interviewees.

### **3.1. Communication**

Within the communication theme, three problems were identified from the interviews and two possible solutions were addressed to the identified problems (see Table 1). In this theme, the owners, managers, and worker had replied to the given interview questions in 80%, 65%, and 46%, respectively.

Table 1. Problems and possible solutions in communication

| Problems                                                                                                                                                                                                                                                            | Possible solutions                                                                                                                                                                                                                                             |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Ignorance of safety talk messages that result in workers working without safety rules.</p> <p>Workers have difficulty understanding safety information because they are poorly educated.</p> <p>Managers have difficulty understanding owners' expectations.</p> | <p>Dissemination of safety – involving stakeholders in regular and active dissemination of information about work safety.</p> <p>Kinship discussion – discussion of safety problem solutions with a kinship approach, i.e. familial, open, clear and firm.</p> |

#### *Dissemination of safety*

Dissemination of safety is one of PT. Timah's programmes to improve safety in the area of mining operations and involves activities such as inspections, safety patrols, safety meetings and safety talks (PT.Timah (Persero) Tbk, 2015). This company applies a contract-based safety management system to SMEs as a company partner while one of the SME's obligations is appointing the person in charge of the operational field, including working safety (called Supervisor) in every group of workers at one site. During the study, there was no clear information about the Supervisor's role in the working groups. The supervisor is usually an owner and leader of his group. In circumstances where workers are ignoring or negligent of working safety, disseminating of the importance of work safety, i.e. by safety talks on a regular basis, is very important. Thus, an absence of a supervisor in these circumstances would be detrimental.

#### *Kinship discussion*

Involving workers to develop a safety management system could be the best way and effective since they know exactly what the hazards and risks in their workplace are (Roughton, Crutchfield, 2014). In the interviews, stakeholders believed that solving safety problems by discussing them in a relaxed, familial and amicable atmosphere will help management improve working safety. Imada and Robertson (1987) suggested that if participation is based on local practice and culture, workers could provide real suggestions for safety improvements.

### **3.2. Culture**

For culture, five problems were identified and three possible solutions were addressed to the identified problems (see Table 2). 90% of the interview questions were answered by the owners, 80% by the managers, and 84% by the workers.

Table 2. Problems and possible solutions in culture

| Problems                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Possible solutions                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>In understanding safety, most of the workers are not comfortable to openly discuss issues with their boss and tend to not actively report workplace conditions.</p> <p>The top down approach is still unclear to define as an appropriate approach for SMEs.</p> <p>The remuneration system impacts workers' behaviours and results in tendencies to take a dangerous and fastest and shortest way to get tin.</p> <p>Workers are negligent and show less commitment, contribution and participation in solving safety problems.</p> <p>Workers have difficulty receiving new knowledge because of their low level of understanding.</p> | <p>Kinship approach – the kinship approach in disseminating safety issues to all workers to increase their commitment.</p> <p>Focus on workers – workers are key to a company's success and should get the appropriate attention and aid in order to increase their ability to understand and implement safety practices in the field.</p> <p>Supervisor empowerment – supervisors must be empowered and be responsible with workers' safety during work.</p> |

#### *Kinship approach*

Indonesia is a developing country that has a low individualism index (IDV) on 1970 national wealth (per capita GNP) for 50 countries (Hofstede, 1983). Hofstede (1983) explains that according to a power distance versus individualism-collectivism plot for 50 countries and 3 regions, Indonesia is in the 'large power distance – low individualism' part of the scale. In the organisational context, Indonesia includes a high degree of centralisation of authority and autocratic leadership, and has societies in which the ties between individuals are very strong. Even though there is no direct family relationship between workers and managers, kinship is a primordial loyalty throughout them. Kinship, probably as an appropriate form to resolve work problems where opinions and votes are predetermined by in-group, relationship prevails over task (Hofstede, 2011). This approach allows workers to take care of each other during work or even during break time since most of them are living in camps. The supervisor, manager or even owner can disseminate safety issues and hear workers' complaints face to face at any time and in any circumstances.

#### *Focus on workers*

Workers are an important part of SMEs that could improve safety in the workplace since they are much closer to the real problems in the field and have unique knowledge and experience in the work (Haines & Wilson, 1998). Involving workers in participating in solving safety and ergonomics problems has some positive impacts, i.e. to create ownership, better commitment, better understanding of ergo-

onomic design changes (Haines, Wilson, 1998; Imada, Robertson, 1987). In order to participate effectively in the development of safety in the workplace, two key elements that can guide SMEs to achieve workers' involvement in Indonesian tin mining need to be applied, i.e. communicating regularly on safety issues with all stakeholders and providing safety/ergonomics training for old and new workers on site-specific safety issues.

Apud (2012) believed that training could encourage participation. In addition to this, as training participation will likely be group-based, training may provide an opportunity to resolve problems as a team. Besides focusing on worker improvement, management commitment, organisational support and role clarity are among those aspects that must be improved for the successful implementation of participatory ergonomics (Imada, Nagamachi, 1995).

#### *Supervisor empowerment*

The role of a tin mining supervisor in SMEs was established to improve the performance of PT Timah in implementing operational standards, according to the rules of OSH (PT.Timah (Persero) Tbk, 2015). Since supervisors are relatively new in small scale tin mining, they need to be empowered by giving them clear roles and tasks in their position. The supervisor's tasks include looking after workers during their work in terms of technical mining and work safety. Specific training for supervisors should be given in order to strengthen their knowledge and capabilities in supervising the operational field, including working safety and communication skills.

### **3.3. Knowledge**

Table 3 shows two problems that were identified within this theme and two possible solutions were proposed to overcome the problems. In this theme, the interview questions had been responded to in as much as 90%, 68%, and 74% by the owners, managers, and workers, respectively.

Table 3. Problems and possible solutions in knowledge

| Problems                                                                                                                                   | Possible solutions                                                                                                                                                   |
|--------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Safety training is very limited by restrictions related to time and participants' availability.                                            | Continuous safety talks – providing safety information or knowledge to the workers.                                                                                  |
| Stakeholders do not recognise 'ergonomics' and 'participatory ergonomics' and there is no ergonomics or participatory ergonomics training. | Safety training improvement – improving safety training by conducting it more frequently with more participants, and showing real case studies in tin mining fields. |

### *Continuous safety talks*

In order to remind workers about safety risks in the workplace, SMEs have to make sure that workers are kept informed of safety objectives through safety talks, safety meetings, notices on the boards. Informing about safety issues in several forms is recommended, i.e. safety announcements before working, bulletin boards, and a suggestion box as a formal way and 'heart to heart' talks conducted by supervisors, managers or owners with the workers as an informal way (kinship).

### *Safety training improvement*

None of the interviewed workers participated in the safety training done by PT Timah and/or the local government. According to managers, the safety training by PT Timah and the local government was of good quality and needed to be conducted more often and with more participants. However, too much training is costly and takes up much time, so a programme of train-the-trainer would be the best step in order to encourage trainers' availability from middle level management.

## **4. CONCLUSION**

The findings of this study offered new information on specific barriers to the implementation of participatory ergonomics that were identified in the SBD study. Furthermore, this study found possible solutions to those specific barriers in communication, culture, and knowledge themes. The study suggested that regular working safety dissemination through a kinship approach and specific safety training can be useful to resolve communication, cultural and knowledge problems. Moreover, this study also suggests that empowering workers and supervisors by giving clear roles and tasks, as well as time and resources, allows workers and supervisors to generate concrete ideas for safety improvements.

One limitation of this study was the lack of the necessary number of participants to investigate specific problems in implementing PE. The challenges of getting more participants from Indonesian tin mines were significant. However, the three roles of participants i.e. owner, manager and worker, were gathered. Eighteen participants from five companies successfully participated.

## **ACKNOWLEDGEMENTS**

This research was funded by the Directorate General of Higher Education, Ministry of Research and Higher Education, the Republic of Indonesia through the Overseas Post-graduate Scholarship Program. The authors would like to thank PT.Timah for their assistance and to all participants in Indonesian tin mining for their participation in the study.



## REFERENCES

- Apud, E. (2012). Ergonomics in Mining: The Chilean Experience. *Human Factors: The Journal of the Human Factors and Ergonomics Society*. <http://doi.org/10.1177/0018720812456701>.
- Braun, V., Clarke, V. (2006). *Using thematic analysis in psychology* (September 2015). <http://doi.org/10.1191/1478088706qp063oa>.
- Haines, H., Wilson, J.R. (1998). *Development of a framework for participatory ergonomics*. Health and Safety Executive.
- Hernawati, S., Lawson, G., Sutarto, A.P. (2014). *Mapping ergonomics application to improve SMEs working condition in industrially developing countries: a critical review*. <http://doi.org/10.1080/00140139.2014.953213>.
- Hignett, S., Wilson, J.R., Morris, W. (2005). Finding ergonomic solutions – Participatory approaches. *Occupational Medicine*, 55, 200-207. <http://doi.org/10.1093/occmed/kqi084>.
- Hodal, K. (2012). Death metal: tin mining in Indonesia. *The Guardian*. Retrieved from <http://www.guardian.co.uk/environment/2012/nov/23/tin-mining-indonesia-bangka>.
- Hofstede, G. (1983). *The Cultural Relativity of Organizational Practices and Theories*, 75-89.
- Hofstede, G. (2011). Dimensionalizing Cultures: The Hofstede Model in Context. *Online Readings in Psychology and Culture*, 2(1), 1-26. <http://doi.org/http://dx.doi.org/10.9707/2307-0919.1014>.
- Imada, A.S., Nagamachi, M. (1995). Introduction to participatory ergonomics. *International Journal of Industrial Ergonomics*, 15(5), 309-310. [http://doi.org/10.1016/0169-8141\(94\)00078-H](http://doi.org/10.1016/0169-8141(94)00078-H).
- Imada, A.S., Robertson, M. (1987). Cultural perspective in participatory ergonomics. *Proceedings of The Human Factors and Ergonomics Society Annual Meeting*, 1019-1022.
- O'Neill, D. (2000). Ergonomics in industrially developing countries: does its application differ from that in industrially advanced countries? *Applied Ergonomics*, 31(6), 631-640. [http://doi.org/10.1016/S0003-6870\(00\)00033-8](http://doi.org/10.1016/S0003-6870(00)00033-8).
- O'Neill, D. H. (2005). The promotion of ergonomics in industrially developing countries. *International Journal of Industrial Ergonomics*, 35(2005), 163-168. <http://doi.org/10.1016/j.ergon.2004.04.016>.
- PT.Timah (Persero) Tbk. (2013). *PT.Timah (Persero) Tbk. Annual Report 2013*.
- PT.Timah (Persero) Tbk. (2014). *PT.Timah (Persero) Tbk. Annual Report 2014*.
- PT.Timah (Persero) Tbk. (2015). *PT.Timah (Persero) Tbk. Annual Report 2015*.
- Roughton, J., Crutchfield, N. (2014). *Safety culture: An innovative leadership approach*. Oxford: Butterworth-Heinemann.
- Scott, P.A., Charteris, J. (2004). Ergonomics in industrially developing countries (IDCs): socio-cultural perspectives. *Advances in Human Performance and Cognitive Engineering Research*.
- Thatcher, A. (2005). Excerpts from the CybErg 2002 discussion on industrially developing countries (IDCs). *International Journal of Industrial Ergonomics*, 35(2), 169-173. <http://doi.org/10.1016/j.ergon.2004.08.002>.

- Wignjosoebroto, S. (2007). Indonesia ergonomics roadmap: where we are going? *Journal of Human Ergology*, 36(2), 91-8. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/18572801>.
- Wilson, J.R. (1995). Solution ownership in participative work redesign: The case of a crane control room. *International Journal of Industrial Ergonomics*, 15(5), 329-344. [http://doi.org/10.1016/0169-8141\(94\)00080-M](http://doi.org/10.1016/0169-8141(94)00080-M).
- Wilson, J.R., Haines, H., Morris, W. (2005). Participatory Ergonomics. In: J.R. Wilson, C. Nigel (Eds.), *Evaluation of Human Work*, 933-949. Taylor & Francis.
- Wisner, A. (1985). Ergonomics in industrially developing countries. *Ergonomics*, 28, 1213-1224. <http://doi.org/10.1080/00140138508963244>.

## ERGONOMIA PARTYCYPACYJNA W INDONEZYJSKIM GÓRNICTWIE WYDOBYWCZYM

### Streszczenie

Tysiące pracowników MŚP w indonezyjskich przedsiębiorstwach wydobywczych cyny pracuje w niebezpiecznym środowisku bez wystarczającej ochrony bezpieczeństwa i zdrowia. Celem tego badania było zbadanie zidentyfikowanych czynników, takich jak trudności w komunikacji między zainteresowanymi stronami (właścicielem, menedżerem i pracownikiem), a także negatywne nastawienie pracowników i brak wiedzy na temat korzystania z osobistego wyposażenia ochronnego, które utrudnia wdrożenie ergonomii partycypacyjnej w indonezyjskich przedsiębiorstwach wydobywczych cyny. W badaniu wywiadu uczestniczyło 18 uczestników z pięciu MŚP, obejmujących trzy różne role, tj. pracownik, właściciel i menedżer. Badanie wykazało, że było preferowane upowszechnianie bezpieczeństwa pracy poprzez podejście więzi i konkretne szkolenia z zakresu bezpieczeństwa w celu rozwiązania problemów związanych z komunikacją, kulturą i wiedzą. Zapewniono jasne definicje ról i zadań oraz alokacji czasów i zasobów jako sposoby wzmocnienia pozycji pracowników i przełożonych.

**Słowa kluczowe:** ergonomia partycypacyjna, małe średnie przedsiębiorstwa, kraje uprzemysłowione, bezpieczeństwo pracy