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Participatory Ergonomics in Industrially Developing Countries: A Literature Review

Participatory ergonomics (PE), the origins of which can be traced back to the western ergonomics approach, is an approach that focuses on involving workers to improve safety and health at their workplace. This paper has presented a literature review of studies concerning PE, the methodological approaches used to study PE and PE in industrial developing countries (IDCs). The paper has also explained factors which would seem to pose an extra challenge in applying PE in IDCs and Indonesia. The purpose of this was to provide the reader with a view of how the development of participatory ergonomics today possibly can help solve the problem of occupational safety in small-medium size enterprises (SMEs) in Indonesia.

Keywords: Participatory Ergonomics, SMEs, Indonesia.

1. INTRODUCTION

One of the approaches to improving occupational safety and health (OSH) performance and reducing or eliminating fatalities is the application of ergonomics. Ergonomics is the study of work and everyday activities, including industrial workplaces, from design processes, production facilities, workers' productivity and health and safety. According to the ergonomics definition put forth by the International Ergonomics Association[1]: 'Ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance.' Ergonomics intervention has been found to improve quality of life for both people and organizations. One of the approaches used to support ergonomics intervention is participatory ergonomics (PE). Kuorinka[2] defined participatory ergonomics as 'practical ergonomics with necessary actors in problem solving' (p.268). Meanwhile, the definition of participation in ergonomics, according to Wilson [3], is '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'[4].

Ergonomics cannot be ignored by industries. In fact, industries need ergonomics to improve productivity, safety, and health. OSH-related problems which emerge, including work accidents, are mostly due to ergonomics deficiency (Wignjosoebroto, 2007). In order to establish the condition of Indonesian industries, Wignjosoebroto [5] stated in his paper that: 'In Indonesian factories, most of the workers are lowly educated, with only a basic six to nine years of school education. In addition, most of the factory workers are from the poor. Although ergonomics may be taught to these workers, they are too timid to question the authorities when they are faced with poor OHS conditions, fearing that they may lose their jobs and that it may mean to lose their future life.' [5, p. 96]. Instead of enforcing occupational safety and health regulations, which is not easy, ergonomists have a wide-open opportunity to change the management and or workers' paradigm to use ergonomics tools to improve work performance [5]. Ergonomists in IDCs, and especially in Indonesia, should be agents of change in implementing ergonomics in SMEs to help workers find solutions to ergonomic problems in a simple manner [6].

After reviewing ergonomics applications in IDCs, Hermawati et al. [7] posited that a participatory approach is needed as a bottom-up approach in implementing ergonomics within the workplace. They also suggested that 'having an appropriate adaptation and modification of ergonomics tools will definitely be beneficial in the future' (p.1777). Hermawati et al. [7] also found that there are few studies which have addressed the health and safety domain in Indonesia. Therefore, this literature review could enrich research in the ergonomics intervention area, developing methods of ergonomics intervention in Indonesia, and implementing and investigating the effectiveness of the chosen method of ergonomics intervention.

2. RESEARCH METHODOLOGY

This paper presents an overview of the literature pertaining to participatory ergonomics and occupational safety and health (OSH) in small and medium-sized enterprises (SMEs). The source material reviewed came mainly from scientific journals and conference papers. For this narrative, review data were sought from two main databases: Science Direct and Web of Science provided by the University of Nottingham website (NUsearch). The following groupings emerged and consequently formed the basis of the structure for this paper:

- Participatory Ergonomics
- Methodology and Approaches to studying Participatory Ergonomics
- Participatory Ergonomics in Industrial Developing Countries (IDCs)

The literature review contains information on the development of participatory ergonomics and OSH status in SMEs in IDC. The purpose of this was to provide the reader with a view of how the development of participatory ergonomics today possibly can help solve the problem of occupational safety in SMEs in Indonesia.

3. RESULTS

3.1 Participatory Ergonomics

Participatory Ergonomics (PE) is a scientific approach used to improve safety and health performance, productivity and comfort during work carried out by humans; the approach focuses on involving workers in the development of their workplace, and this will enhance productivity. During the implementation, PE should consider technical and social aspects, including organizational culture, management system, communication pattern, rewards, and other variables that support ergonomics that provides one perspective of macro ergonomics[2], [8]. According to the definition of macro ergonomics, the term refers to system issues which are socio-cultural and organizational in nature; conversely, micro ergonomics comprises system issues related to individuals, physiology and psychology [9]. In addition, the implementation of PE requires a factual and practical approach [3]. PE in the US and Europe has been implemented for 40-50 years [10]. In the US, PE is leaning towards macro ergonomics, while in Europe it applies to all levels of ergonomics interventions [4].

Hignet et al. [4] illustrated PE implementation in health care, the military, manufacturing, production and processing plants, service industries, construction, and transport in Canada and Japan. Additional authors also explained PE implementation case studies such as [8], [11]–[17] and other areas in health, library, home care work, scaffolding, crane, organisational change [3], [18]–[25]. Those PE programs were intended to produce appropriate ergonomic solutions that would modify the work demands to match the worker's capacity better. The plan seemed to alter their job tasks successfully.

There are advantages in implementing PE, such as improving safety and health initiatives, and enhancing the design of products, which leads to a better learning experience for designers[26], [27]. Wilson [10] confirmed that involvement in a development or implementation process can result in faster and deeper learning of a new system and can also decrease training cost. In addition to this, Noro and Imada[8] asserted that PE would improve communication among those involved in the inter-industry sharing of information in ergonomics such as designers, managers, and workers. For example, designer can receive feedback on what the user thinks about the product. Meanwhile, Imada and Nagamachi[28] explained that the outcomes of the participatory approach process would result in approximately the same outcomes as those of consultant intervention. The difference is the effect on those who participate. While a consultant intervention could propose changes, the implementation of those changes would require the participation and commitment of employers and workers [29].

Although a participatory approach has advantages in terms of implementation, participatory intervention has factors which affect the success of participatory intervention. Wilson [30] reported some problems which may occur during the implementation of PE, such as minimum support from top level management, reluctance of management and workers because of suspicious occurrences, feeling that there is a lack of knowledge, insufficient motivations, time and energy, such as because of different focus of workers[26]. Wilson [10] expounded the view that some people will simply not want to participate, that the management see the participatory approach as a threat to their rights to manage rather than as an aid, and that some people may perceive said approach as an attempt to weaken trade unions. However, these should be seen as opportunities to design and conduct better PE projects in the future.

3.1 Methodology and approaches to studying Participatory Ergonomics

The methodology used in PE relies on the social, organizational and industrial context [2], [4]. Kuorinka [2] stated that problem solving is the aim of PE, and it represents a way of finding solutions to current problems. To solve such problems, Hignett et al. [4] mentioned that a unification of quantitative and qualitative data is suitable, and that such data can be collected using different methods. The methods should take into consideration participants or workers, since they may come from different education backgrounds. This process could begin with easy exercises and a collection of simple techniques and approaches [2], [4].

Hignett et al. [4] developed the Participatory Ergonomics Framework (PEF), which is a dimension of PE. This contains nine dimensions that can be used as a basis to produce practical guidance on participatory ergonomics programs, namely: Decision-making, Mix of participants, Remit, Role of ergonomics specialist, Involvement, Focus, Level of influence, Requirement, and Permanence [26]. As can be seen in Table 2.1, which illustrates the participatory ergonomics framework, one example of PEF is the Requirement dimension, which concerns the requirement of participation, and specifically whether it is voluntary or compulsory.

Table 1: Participatory ergonomics framework (PEF).

Dimension	Extent of dimension
Decision-making	Group delegation—group consultation—individual consultation
Mix of participants	Operators—supervisors—middle management—union personnel—specialist/technical staff—senior management
Remit	Process development—problem identification—solution generation—solution evaluation—solution implementation—process maintenance
Role of ergonomics specialist	Initiates and guides process—acts as team member—trains participants—available for consultation
Involvement	Full direct—partial direct—representative
Focus	Designing equipment or tasks—designing jobs, teams or work organisation—formulating policies or strategies
Level of influence	Entire organisation—department/work group
Requirement	Compulsory—voluntary
Permanence	On-going—temporary

Haines and Wilson [26] split the methods and techniques used in PE into five categories, namely Problem analysis (e.g. link analysis, Pareto analysis, activity analysis, Creativity stimulation and idea generation (e.g. round robin questionnaire word map, Idea generation and concept development (e.g. scenario-driven discussion, design decision group, focuses groups, Concept evaluation (e.g. layout modelling and mock-ups, intervention ideas, checklists, and Preparation and support (e.g. team formation and building. Kuorinka [2] argued that the creation of the solutions is rarely straightforward and is ‘usually non-linear, iterative and aims to recruit the innovative capacities of the participants’ (p.269). He also stated that learning is the foundation of a participatory ergonomics process.

3.2 Participatory ergonomics in Industrial Developing Countries (IDCs)

The development of the participatory approach in implementing ergonomics has been successful in industrial countries (ICs) and/or in western countries [31], [32]. However, a number of authors questioned how the implementation would perform in industrial developing countries (IDCs) ([33], [26], [11] and [9]). They questioned this kind of approach, considering the gaps between ICs and IDCs, types of workplace improvements achieved, and the acceptance of the western norms in IDCs [5], [7], [9], [11], [26], [33].

For example, McNeill et al. [9], Hermawati et al. [7] and Legg [34] agreed that small and medium-sized enterprises (SMEs) in IDCs have more dangerous and unsafe workplace environments than those in industrial countries (ICs). McNeill et al. [9] also identified several factors as the cause of a detrimental effect on the safety, comfort and performance of workers, i.e. economic, socio-culture, and inappropriate technology transfer, the latter of which is defined as ‘the process of introducing an existing technological knowledge where it has not previously been conceived or implemented’ (p.3). They suggested that the holistic system-based ergonomics approach is required to solve technology transfer problems. Moreover, they also stated that there

are two aspects which should be considered when it comes to implementing ergonomics in IDCs, i.e. macro-ergonomics and micro-ergonomics. In macro-ergonomics, the issues relate to culture, organization, infrastructure, climate, and environment. Conversely, in micro-ergonomics the issues are anthropometrics, nutrition, heat, posture, language and literacy, and stereotypes [9]. As an example of the culture issue, McNeill et al. [9] stated that ‘culture is reflected through beliefs and attitudes towards work organization, motivation, working habits, group dynamics, religion and custom’ (p.4). In addition, Scott [33] and O’Neill [9] stated that in order to assist IDCs in implementing the participatory approach, it is important to understand the culture, needs problems, strengths and limitations of the indigenous work force within their own micro and macro environment. O’Neill [32] also added that, in order to introduce ergonomics in IDCs, consideration must be given to employing low-cost and bottom-up rather than top-down technology development.

Ergonomics has attracted a great deal of attention in Indonesia since 1987 through the Indonesian Ergonomics Society (Perhimpunan Ergonomi Indonesia); indeed, this is due to the fact that the development of industrialization started in the 1970s, with help also coming from academics and technology transfers from large industrial companies. In terms of occupational safety and health, most multinational process industries implement good occupational safety and health programs with a top-down approach [5]. Wignjosoebroto [5] reflected that, due to limited transfer knowledge, there is a lack of awareness from industrial organizations when it comes to ergonomics and occupational safety and health.

In their critical review, Hermawati et al. [7] suggested three ways in which ergonomists in IDCs could take part in improving working conditions within Indonesian SMEs. The first of these approaches focuses on implementing the participatory approach, as said approach allows workers to become involved in the process of improving their workplace through education working together with the owners of SMEs. The second and third approaches focus on providing ‘more initiatives to encourage the creation of local technology and tools for SMEs’, as well as the ‘appropriate adaptation and modification of ergonomics tools’ (p.1777). Local technology defined as a regional development of essential tools. These authors advanced the view that there are two most urgent issues, namely the need to implement the participatory approach in Indonesian SMEs i.e. to resolve ergonomics issues in the workplace, and reduce the commonly-implemented top-bottom approach.

4. DISCUSSION

Implementing PE brings about benefits for the industry, as it encourages workers to improve their workplace since they experience the work first-hand and have an understanding which allows them to support improvement; indeed, this also means that they will be more dedicated to their own workplace [4]. Some studies have explained why it is important to involve people in the development of ergonomics technology, i.e. people involvement for disseminating ergonomic information, participatory approach could result in improved ideas, and effectively contribute to work-related risk reduction particularly in small medium-sized enterprises [8], [26], [35].

In Indonesia, there is evidence of PE application. However, it is limited, and PE is not the most common approach used to solve safety and health issues; indeed, the implementation of ergonomics is still focused on the physical ergonomics domain [7]. The authors stated that all of the reviewed studies were intended for resolving existing and specific problems in SMEs. For example, the issues i.e. work layout and tool design, and manual handling and work postures. Therefore, the studies did not contribute to the broader knowledge of ergonomics. Legg [34] opined that policies and legislation regarding OSH are still based on larger enterprises (usually defined as companies with more than 250 employees). He observed that some characteristics of SMEs make it more difficult for them to create and maintain a safe and healthy work environment and to manage safety; low level of management and training skills, lack of resources, burden of compliance with regulations, difficulties in implementing and understanding safety practices.

Indonesian government has paid attention to OSH in larger enterprises, especially in high-risk areas such as mining and construction, but has not addressed SMEs [7]. However, the Panitia Pembina Keselamatan dan Kesehatan Kerja (P2K3), or the Advisory Team on Occupational Health and Safety has been formed to help SMEs with more than 50 employees to strengthen safety and health in the workplace. P2K3 is a work assistant body; it provides a forum of cooperation between employers and workers in order to develop cooperation, mutual understanding, and effective participation in OSH implementation. The task of P2K3 is to provide the employer with advice on OSH issues, regardless of whether or not such advice is requested. Since its establishment in 1987, it seems that this initiative has not been running well. This initiative was rarely followed, and even if it was, it was a mere formality [36].

The review shows that there is an indication that PE is acceptable as a relevant approach for SMEs. However, there needs to be more detailed information, such as which methodology or approaches to be used

and more suitable, on implementation of PE in SMEs in Indonesia or other industrial developing. Furthermore, additional studies to see if a PE approach is sufficient enough to overcome the problem of the work accidents are also needed. Although PE appeared to be accepted within the SME environment, there were significant constraints on communication, culture and knowledge. As with the ergonomic approach, the barriers of implementing PE in other SMEs in Indonesia or other countries need to be seen to improve the effectiveness of PE in SMEs. Some authors have suggested that to achieve better safety and health in SMEs, the methods should be tailored, action-oriented, low-cost approaches, based on trust, participation and dialogue [11], [34]. However, in conjunction with research by the author in Indonesia which is included in industrial developing countries, the methodology and approach of PE may require modifications.

Although it remains doubtful as to whether the implementation results in better productivity, there is an argument that PE implementation could be successful if workers in the team are committed and it is carried out in an effective and efficient way [10]. Participation, motivation and methods are all very important aspects to be considered when implementing PE, regardless of the potentially different circumstances [2], [10], [11], [26]. Moreover, a successful participatory ergonomics programs requires initial and continuing resources and support from top management in the organization. The resources required include time for development of the programs, time for the development and implementation of the solutions, financial resources, and support offered by management to individuals in the ergonomics team [10].

5. CONCLUSION

In summary, the implementation of PE in IDCs is not too different than in ICs, although the application would seem to require an extra challenge and require a more applied, simple, and reachable approach through a participatory process [9], [11], [33]. PE is a well-established ergonomics approach that has been successfully implemented in western countries, where the implementation of PE can be applied by understanding the values and standards of local communities.

To successfully implement PE in Indonesia, the involvement of workers and management commitment are the two most important factors to consider. Management commitment is needed to help ergonomists and OSH staff effectively implement ergonomics in the workplace. To support this, communication between management and workers is essential during the implementation of the participatory approach, as it keeps them motivated. Wignjosubroto [5] reflected that this can be done by ‘assigning ergonomic and OHS staff to the program and providing time during the workday to deal with ergonomic concerns, by establishing clear goals for the program and evaluating the result, by communicating to all stakeholders the importance of the program and finally, by making resources available for the program itself, such as training and tools for implementing improvements’ (p.97) Training and appropriate tools used to implement improvements are also important when it comes to solving these problems accurately and efficiently [5]. Hermawati et al. [7] summarised that, with regard to the implementation of ergonomics in Indonesia, there are still aspects which require attention, the most urgent of which is the demand for participatory approach adoption in solving workplace problems.

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