Identification of Ergonomics Implementation Challenges Faced by Engineers in Malaysian Manufacturing Industries

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ABSTRACT

The implementation of effective ergonomics programs worldwide has proven to enhance both work performance and worker well-being. However, in Malaysia, there is limited documentation on ergonomics practices in workplaces, with existing publications being relatively outdated and lacking recent updates from researchers. This study aims to identify and analyze the challenges faced by engineers in the Malaysian manufacturing industry when implementing ergonomics programs. The research involved a systematic literature review and interviews with twenty engineers experienced in ergonomics improvement initiatives. The thematic analysis of the literature highlighted four major challenges: 1) limited awareness, knowledge, education, and practical experience in operational ergonomics, 2) insufficient resources and management support, 3) inadequate technical support, and 4) the absence of specific standards or regulations within the legal framework. Additionally, the thematic analysis of interviews with engineers revealed four key challenges: 1) limited documentation and references for ergonomics, 2) restricted exposure and practical experience in ergonomics, 3) workers' resistant behaviors and attitudes towards ergonomics, and 4) delayed consideration of ergonomics during the design process. These findings provide valuable insights for engineers in the Malaysian manufacturing sector, offering guidance to address common challenges in implementing workplace ergonomics.

Keywords: Ergonomics Implementation, Ergonomics Program, Engineers, Challenges, Manufacturing Industries

INTRODUCTION

Worldwide, researchers have agreed that implementation of well-conducted ergonomics intervention programs at the workplace can improve productivity and human performance as well as reduce the likelihood of work-related musculoskeletal disorders (MSD) injuries (Leber et al., 2018; Sweeney et al., 2021; García et al., 2021; Susana, 2018; Zare et al., 2020)

Implementation and integration of ergonomics in the workplace, particularly in the manufacturing sectors, has been discussed by many researchers (Brito et al., 2018; Cimen et al., 2022; Hadidi et al., 2019; Shin & Park, 2019; Iranzo et al., 2020). However, there has been limited information related to the topic of ergonomics implementation in Malaysian manufacturing sector. Ali et al. (2001) in one of the earliest studies involving Malaysian small and medium sized industries reported low ergonomics awareness and knowledge among Malaysian engineers. Similarly, Yeow and Sen (2002) claimed that ergonomics implementation in Malaysia is still in its infancy stage. After close to a decade, the issue seems to be prevailing as low level of ergonomics

knowledge among Malaysian engineers was still mentioned by several researchers (Loo & Richardson, 2012; Ahasan, 2014; Yusuff et al., 2016). Review of recent literatures indicate the publication on the topic of ergonomics implementation in Malaysia is relatively outdated and has not been revisited by researchers in years.

Engineers are one of the most important stakeholders in the ergonomics implementation program at workplace (Guastello, 2023; Sun et al., 2019; Village et al., 2014). Engineers are generally involved in overall workplace design and layout in the early stage of manufacturing setups, as well as responsible for optimization and improvement processes when facilities are in operation. The way in which engineering design process is carried out has a significant impact on the ergonomics of the workplace (Broberg, 2007). However, there has been limited documentation and recent knowledge in investigating specific challenges to implement ergonomics from engineers' point of view. The aim of this manuscript is to identify and analyze ergonomic implementation challenges, particularly faced by engineers in Malaysian manufacturing industries. The outcomes would provide knowledge, reference, and guidance on common challenges faced by manufacturing engineers to implement ergonomics in the workplace.

METHODOLOGY

The study employed qualitative methods to analyze the data. Interviews, observations, and document reviews are three well-established types of qualitative data sources (Dingwall, 1997; Huberman & Miles, 2002; Mason, 2013; Wolcott, 2002). The study involved three major activities: Step 1) conducting a literature review from online databases, Step 2) interviewing engineers, and Step 3) analyzing data through thematic analysis.

In Step 1, existing publications were systematically searched in online databases, including Google Scholar, Elsevier's Scopus, Taylor & Francis, Springer, Mendeley, and others. The keywords used included "ergonomics," "implementation challenges," "implementation issues," "awareness," "knowledge," "engineers," "technical team," "manufacturing industry," and "Malaysia." Boolean operators "AND" and "OR" were applied to refine the literature search. Relevant findings from the literature were documented, organized, and compiled before being screened for redundancy and alignment with the specific scope of the research. The literature review selection process is summarized in Figure 1.

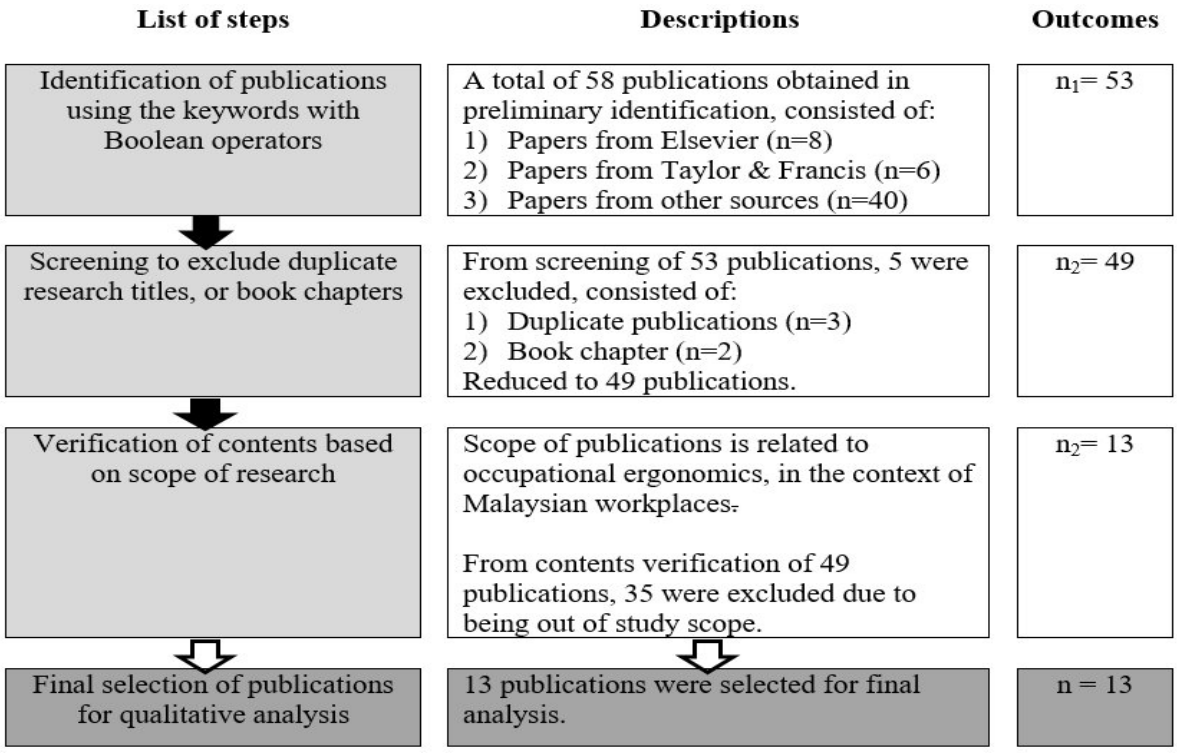

Figure 1: A flow chart of literature review selection process

In Step 2, the method employed to investigate ergonomics implementation challenges was through semi-structured interviews. Twenty engineers (mean years of experience = 4.05 years, SD = 2.8 years, range of experience = 1–12 years) directly involved in ergonomics implementation in the manufacturing industry were recruited through convenience sampling. The engineers came from various manufacturing sectors, including automotive, semiconductor, electrical, solar, plastic, rubber, aircraft, and metal fabrication industries. As part of the selection criteria, participants were required to have at least one year of work experience in the manufacturing sector and direct involvement in workplace ergonomics programs. The sample was considered heterogeneous due to potential variances in the manufacturing sectors and differences in years of professional experience. The sample size used aligns with other qualitative studies involving heterogeneous participants (Creswell & Poth, 2016; Dworkin, 2012; Kvale & Brinkmann, 2009; Marshall et al., 2013).

The interview sessions began with a brief introduction to the study and the collection of participants' consent. Demographic information and sensitizing questions about participants' roles and involvement in previous ergonomics programs were asked to prepare them mentally for the primary questions. Primary questions focused on the challenges faced during ergonomics implementation as manufacturing engineers, followed by concluding discussions. The audio recordings were transcribed in preparation for analysis.

In Step 3, data from the literature review, audio recordings, and research notes were extracted and analyzed using the thematic analysis method. Thematic analysis is a technique used to identify themes and significant patterns within a dataset related to the research question (Clarke & Braun, 2021). Key actions and concepts from the data were identified through coding and indexing, which involved recognizing theories, concepts, repeated words, and similar findings. The coding process was adapted from the method described by Saldana (2021).

RESULTS AND DISCUSSION

Thematic analysis from Literature Review

Analysis from 13 reviewed publications revealed a limited focus on the specific implementation challenges faced by engineers; instead, most publications emphasized the general challenges of implementing ergonomics in the workplace. In total, four themes and 21 codes were generated regarding general ergonomic implementation challenges. The themes were, 1) Limited operational ergonomics awareness, knowledge, education, and practical experiences, 2) Lack of resources & support from management, 3) Limited technical support such as ergonomics specialist or trained personnel for guidance and direction, and 4) Absence of any clearly stated standard or regulation within legal framework.

The first theme, extracted from 10 publications, highlights the issue of limited operational ergonomics awareness, knowledge, education, and practical experience. Ali et al. (2001) in an older study reported that among Malaysian engineers, none had taken ergonomics or human factors engineering courses during their tertiary education. Some engineers believed ergonomics was only relevant to product design, and many struggled to connect ergonomics with industrial health. Despite the passage of more than a decade, low ergonomics knowledge among engineers remains a persistent issue, as reported by several researchers (Loo & Richardson, 2012; Ahasan, 2014; Yusuff et al., 2016).

Beyond engineers, studies also reported a general lack of awareness and knowledge among workers, managers, and safety practitioners, posing challenges to effective ergonomics implementation (Tamrin et al., 2017; Sirat et al., 2018, Yeow & Sen, 2002; Yusuff et al., 2016). Mustafa et al. (2009) concluded that the most significant challenge in implementing ergonomics programs among managers, human resource officers, engineers, and safety practitioners was the lack of information, education, or training. Another study found a positive correlation between the number of ergonomics training hours and the level of ergonomics awareness and practices (Sirat et al., 2018). A lack of training may lead to misunderstandings about the importance of ergonomics. Loo and Richardson (2012) noted that most Malaysian managers associate ergonomics with safety

and health issues, viewing it as a costly investment rather than a performance-enhancing measure. Some researchers attributed this to the lack of demand for universities and colleges to develop comprehensive ergonomics programs or modules (Loo & Richardson, 2012; Tamrin et al., 2017).

The second theme centers on the lack of resources and management support, identified in seven publications. Ahasan (2014) reported that managers of Malaysian small-medium industries (SMIs) typically do not associate ergonomics with productivity or profit, prioritizing it less than larger companies do. Yeow and Sen (2002) similarly found that many managers perceived ergonomics as expensive rather than worthwhile investment. Loo and Richardson (2012) explained that SMIs, which usually operate with limited capital, focus primarily on production and allocate minimal budgets for ergonomics. The limited in-house knowledge and awareness force companies to rely on third-party professionals, but tight budgets often prevent SMIs from hiring experts. Abdul Aziz et al. (2016) identified tight production schedules and heavy workloads as additional challenges that hinder flexibility in adopting ergonomics practices. Even when consultants are hired, the need for follow-up studies to evaluate the impact of ergonomics interventions is often overlooked, as management fears that experimental processes may reduce production output or affect product quality (Yeow & Sen, 2006).

Yeow and Sen (2002) emphasized that management support and teamwork are essential for the success of ergonomics programs. In one case study at an electronic manufacturing plant, ergonomics initiatives succeeded because management provided necessary resources, hired safety practitioners, and encouraged worker feedback. In contrast, another case study in a similar manufacturing production setting found that despite promising results from preliminary interventions, management's reluctance to allocate funds prevented larger-scale improvements (Yeow & Sen, 2004). Poor understanding of ergonomics among management was cited as a key reason for this resistance. Deros et al. (2015) highlighted that management plays a crucial role in creating awareness and fostering a culture of ergonomics to mitigate risks in the workplace. Mustafa et al. (2009) noted that 40% of industrial practitioners in their study attributed the lack of pressure from management as a significant barrier to implementing ergonomics programs, with 18% identifying financial constraints as a major issue.

The third theme, extracted from three publications, focuses on the limited availability of knowledgeable technical personnel, such as ergonomics specialists or trained practitioners, to guide workplace ergonomics programs. Loo and Richardson (2012) reported a scarcity of ergonomists and human factors specialists in Malaysia. Ahasan (2014) added that many ergonomics practitioners in Malaysia are not certified professionals. Tamrin et al. (2017) pointed out the absence of established competency standards and professional certifications for ergonomics practitioners in Malaysia. The unclear recognition process for ergonomics qualifications creates challenges for aspiring practitioners, hindering career growth and limiting the supply of experts. Additionally, ergonomics is not widely included in the curricula of higher education institutions, and collaboration between academia and industry remains limited. Without sufficient awareness and demand at the corporate level, universities have struggled to promote ergonomics education effectively (Loo & Richardson, 2012; Tamrin et al., 2017). As a result, the ecosystem needed to develop future ergonomists and specialists is underdeveloped, further constraining the availability of technical expertise for implementing ergonomics programs.

The final theme relates to the absence of standards or regulations within the legal framework for ergonomics implementation in workplaces. Currently, there is no clear legislative mandate requiring ergonomics programs, with only general provisions loosely defined in the Occupational Safety and Health Act (1994) and the Factories and Machinery Act (1967) (Tamrin et al., 2017). This situation is compounded by lax government enforcement, particularly concerning labor, safety, and health issues (Loo & Richardson, 2012). The abundance of cheap labor, along with the presence of foreign and contract workers who are hesitant to report problems due to fear of job loss, further exacerbates the issue (Yeow & Sen, 2002). Although the Department of Occupational Safety and Health published an ergonomics risk assessment guideline in 2017 (DOSH, 2017), the guideline is not legally binding. Moving forward, formal recognition of ergonomics through professional

certifications and upgrading ergonomics programs to 'industrial codes of practice' or 'regulations' within the legal framework could enhance the infrastructure for effective ergonomics implementation.

Thematic analysis from Interview Session

The analysis of interview content generated a total of four themes and nine codes related to the ergonomics implementation challenges faced by engineers in manufacturing industries. The four themes representing the main challenges are: 1) limited ergonomics documentation and references for engineers, 2) limitations of ergonomics exposure and practical experience 3) worker's unconstructive behaviors and attitude towards ergonomics, and 4) late considerations of ergonomics in the design process.

The first theme addresses the scarcity of documentation, references, and knowledge specifically tailored for engineers' internal use. Among 15 participants (75% of the sample), it was revealed that ergonomics programs were predominantly driven or overseen by occupational safety and health (OSH) teams rather than engineering or production teams. In Malaysia, ergonomics generally falls under the OSH team's purview due to provisions in the OSH Act of 1994, which mandates that employers create a work environment aligned with employees' physical and psychological needs. However, the participants noted that engineering teams are engaged throughout ergonomics identification, assessment, and improvement efforts. Engineers rely on the OSH team for ergonomics documentation, but these materials are often written from a safety perspective, focusing on risk factors and incident-based investigations. As a result, the content primarily addresses compliance with legal requirements, offering limited insights into productivity and efficiency. Four engineers expressed frustration over the absence of clear documentation outlining specific roles and responsibilities in past ergonomics programs, leading to disagreements among engineering team members about whether ergonomics implementation fell within their job scope. They emphasized that the lack of defined roles, coupled with limited ergonomics guidance and references from an engineering perspective, hindered their ability to contribute effectively to ergonomics implementation.

The second theme concerns the limited exposure to ergonomics and practical experience among engineers. Ten engineers (50% of the sample) reported that they had never attended formal ergonomics training or short courses, despite expectations from the OSH team for their involvement in ergonomics programs. Those who did receive training indicated that the contents covered were largely theory-based, safety-oriented, and not specific to their industry. A further challenge arose from the limited experience of some ergonomics program participants, who struggled to offer practical solutions that did not negatively impact production rates. Three engineers reported that some safety and health officers (SHOs) overseeing ergonomics programs lacked engineering or technical-related postsecondary education and experience. As a result, the ergonomics interventions proposed by these SHOs were often impractical, costly, and failed to consider engineering constraints. Since engineers are accountable for production outputs, they were frequently left to manage the implementation of these impractical solutions, adding to their frustration.

The third theme relates to unconstructive behaviors and attitudes among workers toward ergonomics. Eight engineers (40% of the sample) noted that their ergonomics interventions were often undermined by workers who preferred to take shortcuts. Some workers resisted changes, having grown accustomed to work methods that had become ingrained habits, despite the fact that the new ergonomics methods were both safer and more efficient.

The final theme involves the late consideration of ergonomics in the design process, identified by seven engineers (35% of the sample). One issue raised was the tendency to overlook space requirements and clearances during the design stage, particularly for non-routine maintenance tasks. Limited accessibility for maintenance teams to repair, replace, or install components led to poor work postures and forceful manual exertions, as tight spaces made it difficult to use assistive load-handling devices. Additionally, engineers highlighted challenges with imported equipment and machinery. Ergonomics requirements specific to the local population were often not included in the tender specifications, and the Factory Acceptance Test (FAT)

process did not account for ergonomics considerations. This oversight resulted in anthropometric mismatches that were only discovered during the operational stage, by which time corrections were expensive and difficult to implement.

DISCUSSION

There are several similarities and differences between the thematic data on ergonomics implementation challenges identified from the literature review and the interviews. For starters, limited ergonomics knowledge was highlighted in both sources. The interviews with engineers associated this challenge with a lack of documentation and references tailored specifically for engineers. Engineers also linked limited ergonomics knowledge to workers' unconstructive behaviors and attitudes toward ergonomics. A study among Nigerian engineers identified the absence of ergonomics content in engineering curricula as a major barrier to promoting human-centered design in Nigeria (Ismaila & Samuel, 2014). Similarly, Soares (2016) reported that in Latin American countries, including Argentina, Brazil, Chile, Colombia, Mexico, and Peru, the lack of postgraduate programs at the master's and doctoral levels, except in Brazil, contributed to slow progress in ergonomics practices. In Indonesia, Wignjosoebroto (2007) found that a low education level among factory workers negatively impacted ergonomics implementation in the workplace. Workers also displayed poor attitudes toward ergonomics programs and feared raising issues with management out of concern for job security. Many studies cited a lack of training as a significant challenge to effective ergonomics implementation (Falck & Rosenqvist, 2012; Shikdar & Al-Araimi, 2001; Sealetsa & Thatcher, 2011).

Another similarity between the literature and the interview findings is the critical role of management in the ergonomics implementation process. Wignjosoebroto (2007) reported that poor management attitudes were a primary challenge to successful ergonomics implementation in Indonesian workplaces, as management tended to underinvest in safety and health due to the availability of cheap labor. Similar challenges were highlighted in other studies, where poor management and worker attitudes hampered ergonomics efforts. Yazdani and Wells (2018), in a review of 88 papers across various sectors, summarized 11 common barriers to implementing ergonomics interventions for preventing musculoskeletal disorders (MSDs). These barriers included a lack of time, resources, communication, and management support; resistance to change; changing work environments; fear of job loss or loss of authority; and process deficiencies. Another recurring issue was the timing of ergonomics activities. When ergonomics is introduced late in the design phase, workers often experience safety and health difficulties (Radin Umar et al., 2022). Early incorporation of ergonomics can facilitate the early identification of human interaction problems, enabling design modifications before the facility is commissioned (Aromaa & Vaananen, 2016; Dul et al., 2012).

One notable difference between literature and the interview findings relates to the role of education in ergonomics practice. Sirat et al. (2018) found that formal education levels (e.g., PMR, SPM, degrees, or postgraduate qualifications) had no significant impact on the adoption of safety culture or ergonomics. This may be because occupational ergonomics programs in Malaysia are predominantly driven by Safety and Health Officers (SHOs), and becoming an SHO does not require tertiary-level academic qualifications (Tamrin et al., 2017). However, the interviewed engineers provided a different perspective, emphasizing that ergonomics, as an interdisciplinary field, requires high-level critical thinking to address challenges effectively. Several engineers noted that while SHOs may be capable of identifying and assessing ergonomics concerns, most lack the knowledge and skills to contribute meaningfully to problem mitigation and control. This aligns with other studies suggesting that education plays an important role in ergonomics practices in workplaces (Bahari, 2011; Beardwell & Holden, 1997).

Another noteworthy point related to implementation challenges is the role of authority to promote ergonomics programs at workplaces. The Department of Occupational Safety and Health (DOSH), from Malaysian's Ministry of Human Resources have already embarked in program to educate industries and enforce ergonomics program in Malaysia. Several guidelines on manual material handling, as well as ergonomics risk assessment process have been introduced to encourage ergonomics program implementation in workplaces

(DOSH, 2017, 2018). This agrees with a publication by Dul et al (2012), which specifically identify authorities and regulators as 'system influencers' in effective ergonomics implementation. Wignjosoebroto (2007) in another publication also pointed out the need of regulation and enforcement by authorities to foster ergonomics program, although the authors cautioned that there is a risk to economic growth, especially in developing countries as foreign investors may opt to relocate to other countries with a more relaxed legal requirement.

CONCLUSION

There has been limited documentation summarizing the challenges of implementing ergonomics programs in workplaces, particularly in the Malaysian manufacturing sector. A total of eight themes related to ergonomics implementation challenges were identified through literature review and interviews with engineers. The themes identified from the literature review are: 1) limited operational ergonomics awareness, knowledge, education, and practical experiences, 2) lack of resources & support from management, 3) limited technical support such as ergonomics specialist or trained personnel for guidance and direction of ergonomics program, and 4) absence of standard or regulation within legal framework with regards to ergonomics implementation in the workplace. In contrast, the themes identified from interviews with engineers include: 1) limited ergonomics documentations, references, and knowledge, especially for internal use by engineers, 2) limitation of ergonomics exposure and practical experience, 3) unconstructive behaviors and attitude towards ergonomics, and 4) late considerations of ergonomics in the design process. The outcomes of this study are intended to provide engineers information, a point of reference, and directions on typical difficulties with implementing ergonomics in the workplace, especially in Malaysian manufacturing sector.

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