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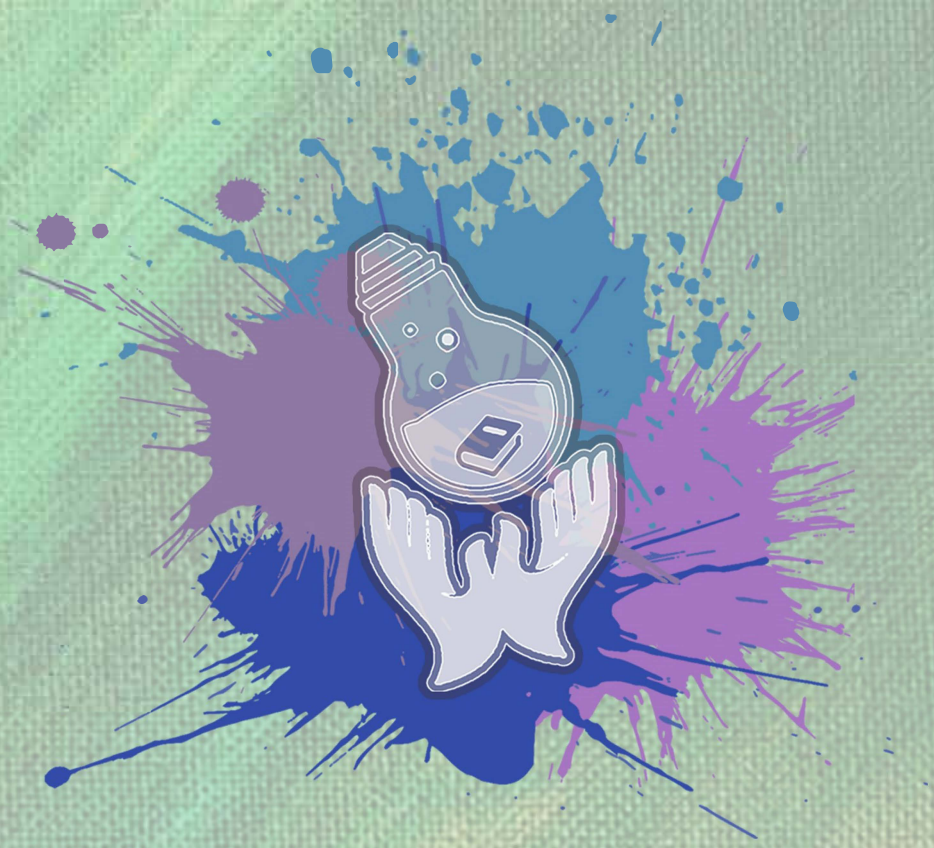

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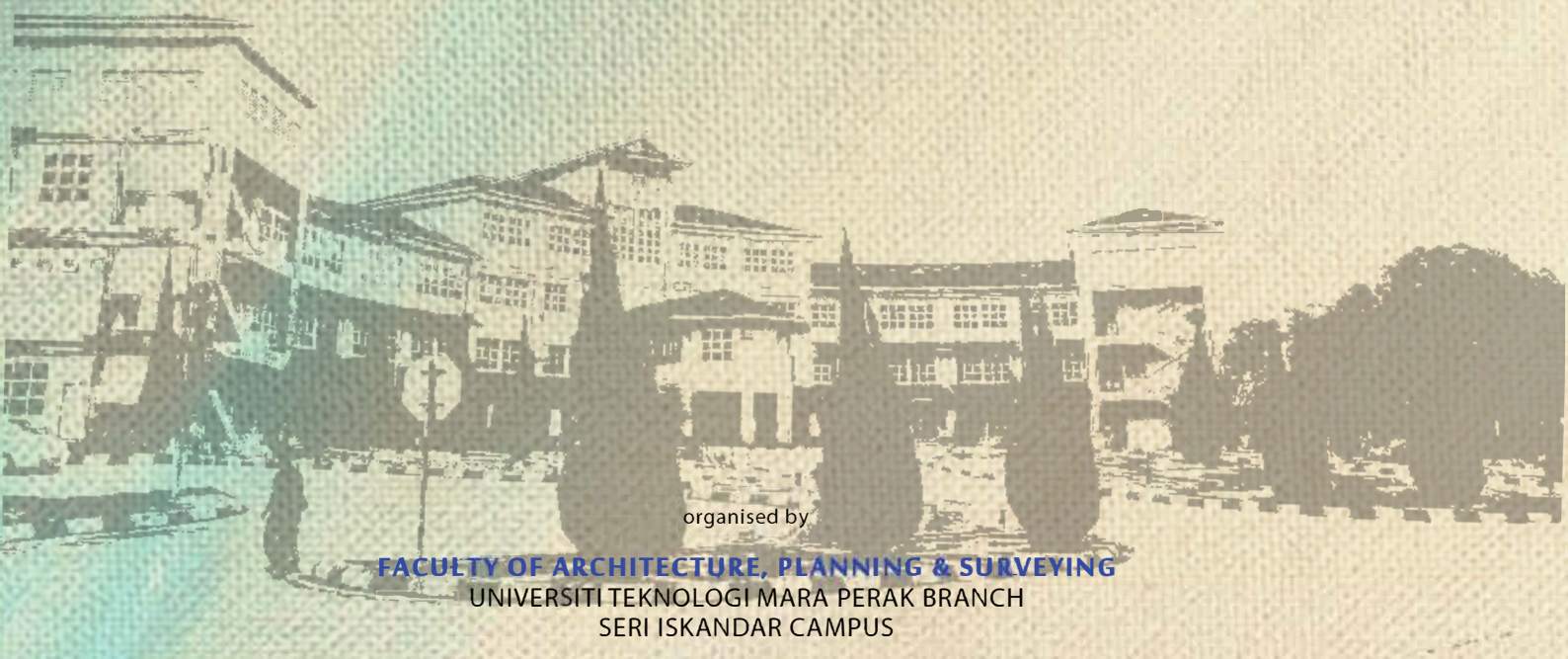

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THE CONCEPT OF SKELETAL SAFETY JACKET

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Abstract
The subject matter of innovation in safety wear for construction has been discussed over a considerable period. Current research and statistical data show that safety wear innovations in construction especially in Malaysia are lagging behind other areas in the aspects of productivity, efficiency, and health, for which lack of innovation is to be blamed. This paper intends to illustrate the present status of construction innovation on safety and health wearables and the present statistics on Musculoskeletal Disorder diseases based on a review of current literature and research. This paper also aims to raise awareness on the Musculoskeletal Disease (MSD) among manufacturing and construction workers in Malaysia and tackle the problems by doing immediate innovation to prevent cases of MSD from increasing year by year. This paper also aims to elaborate on the innovation concept of a skeletal safety jacket. A methodology has been developed to make sure that the objectives of this innovation are achieved. Literature review and desk studies have been done to collect the data.

Keywords:
Musculoskeletal Disease; skeletal safety jacket; wearables; innovation; safety; health

1.0 INTRODUCTION

The construction industry is constantly challenged to innovate to satisfy the aspirations of the government towards the Fourth Industrial Revolution (IR 4.0). In Malaysia, IR 4.0 related policies were launched since 2018 to intensify the adoption of IR 4.0 related technologies. Human influence in heavy works is still high despite all these new high-tech innovations for the manufacturing and installation of precast components. In Malaysia, some areas of work are still human-dependant to ensure the quality of the products is being taken care of. The degree of automation or robotics in the process of manufacturing the Industrialized Building System (IBS) components is still low in Malaysia compared to other countries. The installation of precast components and the tying of the reinforcement bars still need human input to make sure that the works are executed correctly. Due to this heavy and repetitive works, some physical health issues have emerged. In the past 30 years, work-related musculoskeletal disorders (WMSDs) have become a growing concern in industrialized countries.

The recent record of cases that were reported to the Social Security Organization (SOCSO) shows a tremendous increase of Musculoskeletal Disease (MSD) cases from 10 in 2005 to 675 in 2014. A demographic analysis carried out shows that the occurrence of MSDs is highest (51.72%) among industrial manufacturing workers here in Malaysia compared to the other industries. Despite all these hazards and accident record, the degree of safety awareness and workers' emotional health is still low among the industry players. Until today, there are yet to be any innovations that can cater to these health problems. The objective of this paper is to illustrate the present status of construction innovation on safety and health wearables. This paper also aims to raise awareness of MSDs among manufacturing and construction workers in Malaysia. The next step is to propose an innovation that will help in reducing MSDs among industrial workers from increasing year by year. This is followed by elaborating the innovation concept of a skeletal safety jacket.

2.0 LITERATURE REVIEW

From a study done on 33 male industrial workers, it was discovered that 27 main activities contribute to the MSDs. 94% of the workers were experiencing neck discomfort and 56% were experiencing back

discomfort. Discomforts at the workers' neck, back, shoulder and arm, and knee and legs amount to 42%, 74%, 89% and 29% of them respectively, as shown in Figure 1. (Shamsudin *et al.* 2017).

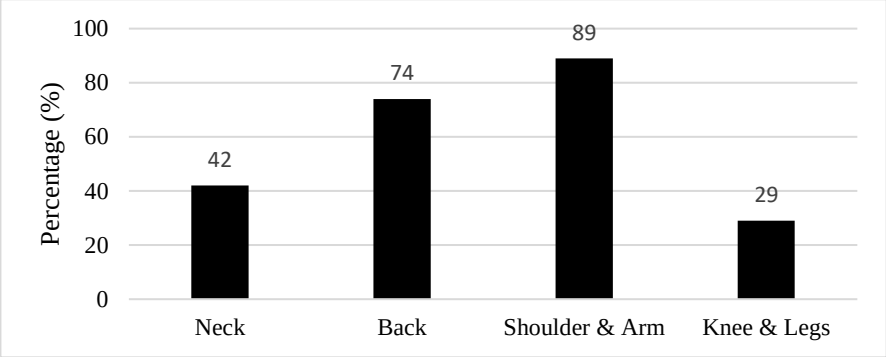

Figure 1 Discomfort survey by body regions
Source: (Shamsudin, Vijayakumar, & Md Daud, 2017)

Back discomfort was second highest after shoulder and arms. The use of the back side of the body region for pulling, pushing, and lifting have developed symptoms of discomfort. Back twisting and lateral bending increased the spine muscles and disc injury according to the biomechanical characteristics (Shamsudin *et al.* 2017). There is an increase in cases of MSDs even though the employer response rate is still low. On a survey conducted to 30 respondents, 87.2% of them know that MSDs is a disorder that affects body movements. Unfortunately, 51.3% of the respondents did not know MSDs will occur if the workload is higher than physical ability and 46.2% were not aware of any law in Malaysia that protects workers from MSDs. Depending on the severity level, the condition might be irreversible. Having this wrong information may lead them to ignore the seriousness caused by MSDs on their health and working capability (N. N *et al*. 2015). In 2010, a questionnaire conducted to the retired workers of construction workers shows that the respondents reported regular or long-lasting complaints of the lower back (43%), knees (31%), and shoulders (31%) more often. At the follow-up questionnaire, 69% of the respondents with MSDs reported that their complaints resulted partially or completely from their works as a construction worker. About half of the respondents indicated that their complaints worsened because of their work and they experienced limitations in their works due to their MSDs (Boschman *et al.* 2015).

3.0 METHODOLOGY

The collection of data will be done through literature review and desk study. Articles on MSDs among the manufacturing and construction workers in Malaysia were reviewed. Problem statements were developed during the process of the literature review. The articles reviewed were on the challenges faced with the implementation of robotics and technology in the construction industry. The article on works that been contributing to a higher case of Musculoskeletal Disorder also been reviewed to identify the nature of the disease and how the disease can happen. This method is done to get a better and clearer understanding of the aims, objectives, and problems for better improvements to the innovation that will be done. Desk study has also been done to collect data on a more detailed definition of MSDs and the activity that have the highest contribution to the MSDs. Desk study is done to identify the latest innovation of the safety jacket and skeletal mechanism. It is to identify the strength and weaknesses of the product that been developed. The desktop study provides an initial understanding of the situations and enable identification of potential risks and inform the details of subsequent investigations. The desk studies will be done on the statistics on the MSDs in Malaysia 5 years back to give a clearer understanding of the degree of seriousness of the diseases in Malaysia.

4.0 ANALYSIS AND FINDINGS

Products that have been developed that have the same function of the skeletal safety jacket include exoskeleton. The exoskeleton design unsuitable to be adopted in Malaysia due to the hot humid weather. The person wearing the exoskeleton suit can feel hot and uncomfortable causing faster energy depletion. The weight of the exoskeleton suit is also very heavy - up to 5kg. There are two versions of this

exoskeleton which comprises of legs and arms support system. The first version can lift to 77 pounds of goods and the second version can lift to 200 pounds of goods in weight. The exoskeleton is powered up by a battery lasting 8 hours of use. The current statistics that were published thru SOCSO online journal recorded an increasing amount of MSDs cases throughout the year of 2014 until 2017. A total of 675 cases of MSDs were reported in 2017. In the year of 2015, a total of 708 cases were reported and recorded by the SOCSO. A total of 1,006 cases of MSDs were recorded in the year of 2016. A significant increase of 298 cases between 2015 and 2016 is very worrisome. In the year 2017, the MSDs cases recorded are at 1,354 cases. Average of 170 cases were reported each year and the trend seems to be increasing. MSDs cause harm to and suffering to the workers and have an enormous negative impact on society as well. At the workplace level, the disorder results in increased production costs due to reduced human capacity and disturbance to production. Skeletal safety jacket is proposed to reduce the uncomfortableness of the disorder among manufacturing and construction workers. Thus, the safety jackets innovated will comprise of some technologies such as sensors to detect falls or trips and a skeletal system or design that will give relief to back pains and thus cater for the musculoskeletal disorder diseases.

5.0 CONCLUSION

In conclusion, despite the cases of MSDs among the manufacturing and construction workers increasing year by year, no innovation can cater to these individuals. From a study that was conducted by previous researchers and statistics from the SOCSO indicates that individuals who experienced MSDs are not given proper aid and thus resulting in body disorder for a long period. The skeletal safety jacket is innovated so that the degree of body discomfort among the workers can be reduced while working. It is anticipated that the number of cases of MSDs can be reduced among manufacturing and construction workers.

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