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Ergonomics and Human Factors; Contemporary Enhancement and Sustainability for Work Environment

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Abstract- The purpose of this paper is to review the importance and significance of ergonomics and human factors on various aspect of human lives. Ergonomics can be looked at as the study of people in their working environment, and to be exact, an ergonomist creates or adapt the work to fit the employees, not the other way around. The goal is to discard discomfort and threat of injury due to work environment. In this paper human factors and ergonomics are defined, ergonomics and health care are discussed, types of ergonomics are introduced and result and discussion are provided.

Keywords- *Ergonomics, Human Factors, People, Work Environment*

I. METHODS OF THE PAPER

Descriptive method and literature review is adopted to reach the goal of the paper which is to discussed the importance and significance of ergonomics and review the previous research on this issue.

II. INTRODUCTION

Ergonomics 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." International Ergonomics Association (chartered institute of ergonomics and human factor)

Systems ergonomics methods provide a highly useful means to analyse complex systems; systems which exhibit a number of key aspects. Systems ergonomics methods can model many aspects of complexity such as interdependence, non-linearity, and the hierarchical nature of system and sub-system organization (Read, et al, 2020).

The terms 'ergonomics' and 'human factors' can be used interchangeably, although 'ergonomics' is often used in relation to the physical aspects of the environment, such as workstations and control panels, while 'human factors' is often used in relation to wider system in which people work. On this site we generally use the term that fits most closely with the research or the industry that we are discussing (chartered institute of ergonomics and human factor).

III. HUMAN FACTORS AND ERGONOMICS

human factors and ergonomics (HFE), defined as a unique and independent discipline that focuses on the nature of human-artefact interactions, viewed from the unified perspective of the science, engineering, design, technology and management of human-compatible systems. Such systems include a variety of natural and artificial products, processes and living environments (Karwowski,2005). Ergonomics is a science-based discipline that brings together knowledge from other subjects such as anatomy and physiology, psychology, engineering and statistics to ensure that designs complement the strengths and abilities of people and minimize the effects of their limitations. Rather than expecting people to adapt to a design that forces them to work in an uncomfortable, stressful or dangerous way, ergonomists and human factors specialists seek to understand how a product, workplace or system can be designed to suit the people who need to use it (chartered institute of ergonomics and human factor) Dul et al, 2012, propose four groups for HFE interventions:

1. Systems actors: healthcare staff, patients (service users), careers, etc. For IPE, this is often the only group involved but may be the least able to effect change.
2. Systems experts: including HFE professionals
3. Systems decision makers, such as senior executives and managers, with immediate power to effect change.
4. Systems influencers; political bodies, policymakers, regulators (in vosper et al,2018).

IV. ERGONOMICS AND HEALTH CARE

According to the national institute for occupational safety and health, NIOSH, the goal of ergonomics, i.e., the scientific study of people at work, is to prevent soft tissue injuries and musculoskeletal disorders caused by sudden or sustained exposure to force, vibration, repetitive motion, and awkward posture. To create an ergonomically sound work environment, NIOSH ergonomists and industrial hygienists recommend designing tasks, work spaces, controls, displays, tools, lighting, and equipment to fit employee's physical capabilities and limitations (the national institute for occupational safety and health, NIOSH).

Healthcare practitioners, patient safety leaders, educators and researchers increasingly recognize the value of human factors/ergonomics and make use of the discipline's person-centred models of sociotechnical systems (Holden et al,2013). The past decade has seen an increase in the application of human factors and ergonomics (HFE) techniques to healthcare delivery in a broad range of contexts, domains, locations and environments (Hignett,2013).

Dul and Hildebrandit,1987 discussed the usefulness of common ergonomie guidelines for preventing low back pain at the workplace. Sixteen ergonomie, biomechanical and epidemiological books were reviewed to obtain common ergonomie guidelines for both static and dynamic work and to obtain an overview of commonly observed individual and work-related risk factors of low back pain. Dul and Hildebrandit,1987, found out that the aspects of work for which ergonomie guidelines are presented generally correspond to work related risk factors as shown by epidemiological studies. They said in quantitative terms the guidelines show a great variety, possibly due to differences in criteria. In certain cases, it is not clear whether or not the guidelines are based on back load or back pain data, due to lack of references. It appears that many guidelines are based upon a combination of back load criteria and other criteria, although it is unknown how these criteria are combined. Hence, many guidelines do not apply specifically to low back pain (Dul and Hildebrandit,1987).

With certain exceptions, most guidelines do not take into account individual factors, although epidemiological studies indicate that several factors such as age, strength, fitness, psychosocial factors, and history of back pain should be considered. However, because of the qualitative character of most current epidemiological studies, results cannot be readily implemented into quantitative ergonomie guidelines (Dul and Hildebrandit,1987).

V. TYPES OF ERGONOMICS

Mat middlesworth of Ergo plus provided different types of ergonomics among them:

A. Physical ergonomics

Physical ergonomics is concerned with human anatomical, anthropometric, physiological and biomechanical characteristics as they relate to physical activity. This is the ergonomics domain we are most concerned with in the workplace, and most of the content on this site is very much focused on work place.

B. Cognitive ergonomics

Cognitive ergonomics is concerned with mental processes, such as perception, memory, reasoning, and motor response, as they affect interactions among humans and other elements of a system.

C. Organizational ergonomics

Organizational ergonomics is concerned with the optimization of sociotechnical systems, including their organizational structures, policies, and processes (https://ergo-plus.com/ergonomics-definition-domains-applications/#introduction).

In addition, Thatcher, 2013, stated that the goals of ergonomics (i.e., effectiveness, efficiency, health, safety and usability) are closely aligned with the goals of design for environmental sustainability (Thatcher,2013). The significance of sustainability has developed and spread during the past two decades, permeating widely through political, industrial, commercial, scientific and other channels (Haslam and Waterson,2013).

VI. RESULT AND DISCUSSION

Schalkwyk and Steenkamp,2017, provided a holistic review of ergonomic history shows that science remains important for general occupational health and safety (OSH), the broad society, culture, politics and the design of everyday things. Science provides an unconventional and multifaceted viewpoint exploring ergonomics from a social, corporate and OSH perspective. Ergonomic solutions from this mindset may redefine the science, and it will change with companies that change within this socially hyper-connected world. Authentic corporate social responsibility will counter ‘misleadership’ by not approaching ergonomics with an afterthought. The review concludes that ergonomics will be stronger with social respect and ergonomic thinking based on the optimisation of anthropometric data, digital human models, computer-aided tools, self-empowerment, job enrichment, work enlargement, physiology, industrial psychology, cybernetic ergonomics, operations design, ergonomic-friendly process technologies, ergonomic empowerment, behaviour-based safety, outcome-based employee wellness and fatigue risk management solutions (Schalkwyk and Steenkamp,2017).

Hulm, et al 2017, conducted a study on sport and physical activities and ergonomics they said the popularity of running as a form of exercise continues to increase dramatically worldwide. Alongside this participation growth is the burden of running-related injury (RRI). Over the past four decades, traditional scientific research applications have primarily attempted to isolate discrete risk factors for RRI using observational study designs as commonly used in public health epidemiology. Unfortunately, only very few randomised controlled trials have evaluated the efficacy associated with a well-specified RRI prevention intervention. Even though the knowledge about risk factors as generated in observational studies is valuable for better understanding why RRI develops, it nonetheless means that there remains a major knowledge gap about how best to prevent it, especially in a way that fully addresses all causal factors. Alongside the continuing use of traditional scientific approaches, a particular systems ergonomics methodology should also be considered in light of its potential to visualise the complete distance running system. This article adapts the Systems Theoretic Accident Mapping and Processes (STAMP) model to the RRI research prevention context. The direct application of STAMP might offer new knowledge about how to prevent RRI, such as exposing questions around the feasibility of adopting novel injury prevention interventions that do not directly target runners themselves(Hulm, et al 2017). Furthermore according to the

American center for disease control and prevention CDC, The goal of ergonomics, the scientific study of people at work, is to prevent soft tissue injuries and musculoskeletal disorders, MSDs, caused by sudden or sustained exposure to force, vibration, repetitive motion, and awkward posture. To create an ergonomically sound work environment, the national institute of occupational safety and health, NIOSH, ergonomists and industrial hygienists recommend designing tasks, work spaces, controls, displays, tools, lighting, and equipment to fit employee's physical capabilities and limitations (the national institute of occupational safety and health, 2018).

Tatcher et al, 2018, said in their article that in his 1993 IEA keynote address, Neville Moray urged the ergonomics discipline to face up to the global problems facing humanity and consider how ergonomics might help find some of the solutions. In this State of Science article, we critically evaluate what the ergonomics discipline has achieved in the last two and a half decades to help create a secure future for humanity. Moray's challenges for ergonomics included deriving a value structure that moves us beyond a Westernised view of worker-organisation-technology fit, taking a multidisciplinary approach which engages with other social and biological sciences, considering the gross cross-cultural factors that determine how different societies function, paying more attention to mindful consumption, and embracing the complexity of our interconnected world (Tatcher et al, 2018).

Holman, et al, 2020, suggested that We are teetering on the precipice of the imminent Fourth Industrial Revolution. In this new age, systems are set to become more densely intraconnected and interconnected, and massive sociotechnical systems exhibiting unprecedented levels of complexity will increasingly take hold. At the dawning of this new age, the Ergonomics discipline must reflect on its preparedness for tackling problems in these novel systems. This paper engages in this reflection by putting forth a critical commentary on the implication of these changes on the discipline and discusses the utility of our current methods in this new paradigm. A resulting Radical Systems Thinking in Ergonomics Manifesto is put forward – a set of mandates to guide practitioners and researchers in the development of new methods capable of coping with these imminent challenges. From the manifesto are derived a series of capability requirements for future computational modelling approaches in Ergonomic (Holman, et al, 2020).

Also, Davis, et al, 2020 believed that Contemporary ergonomics problems are increasing in scale, ambition, and complexity. Understanding and creating solutions for these multi-faceted, dynamic, and systemic problems challenges traditional methods. Computational modelling approaches can help address this methodological shortfall. We illustrate this potential by describing applications of computational modelling to: (1) teamworking within a multi-team engineering environment; (2) crowd behaviour in different transport terminals; and (3) performance of engineering supply chains. Our examples highlight the benefits and challenges for multi-disciplinary approaches to computational modelling, demonstrating the need for socio-technical design principles. Our experience highlights opportunities for ergonomists as designers and users of computational models, and the instrumental role that ergonomics can play in developing and enhancing complex socio-technical systems. Recognising the challenges inherent in designing computational models, we reflect on practical issues and lessons learned so that computational modelling and simulation can become a standard and valuable technique in the ergonomists' toolkit (Davis, et al, 2020).

In a broad perspective Broday,2021, saw that Participatory Ergonomics Programmes are generally considered to be Macroergonomics interventions in order to contribute to the continuous improvement of the work. However, over the past few decades, the industrial operation has been changing until reaching a new form of industrialisation. Now, the Fourth Industrial Revolution, Industry 4.0, begins to be part of the routine of organisations and people. In this sense, this article aimed to perform a literature review about the existing studies on the relationship of Industry 4.0 and Participatory Ergonomics. Through the combination of keywords, 112 articles were found. After eliminating the repeated articles, an analysis was performed with the remaining articles, showing the sources and period of publication, countries and most frequent keywords. Finally, a more detailed analysis was performed with the 10 most recent articles published in Journals. The "Operator 4.0" is a valuable resource in order to integrate Ergonomics and the Industry 4.0, being that researches are scarce and much remains to be investigated (Broday, 2021).

Research showed according to Dul et al 2012, that Human factors ergonomics has great potential to contribute to the design of all kinds of systems with people, work systems, product service systems, but faces challenges in the readiness of its market and in the supply of high-quality applications. Human factors ergonomics has a unique combination of three fundamental characteristics it takes a systems approach, it is design driven and it focuses on two closely related outcomes performance and well-being. In order to contribute to future system design. Human factors ergonomics must demonstrate its value more successfully to the main stakeholders of system design. It has a strong value proposition mainly well being and interactivity with the stakeholder group of 'system actors' employees and product/service users. However, the value proposition mainly performance and relationships with the stakeholder groups of 'system experts' experts from technical and social sciences involved in system design, and system decision makers, managers and other decision makers involved in system design, purchase, implementation and use, who have a strong power to influence system design, need to be developed (Dul, et al, 2012).

VII. Conclusion

The complexity and scale of problems being tackled by ergonomists is growing. Work and societal systems are becoming increasingly reliant on technology, and the technologies themselves are becoming progressively sophisticate. On top of this, we are seeing a significant broadening of scope in terms of application areas, with

ergonomics being proposed as a viable solution to large-scale societal and global scale issues (Read, et al, 2020). In line with this increasing interest, a core set of systems ergonomics methods are being applied in a diverse set of domains. Methods such as Cognitive Work Analysis, the Event Analysis of Systemic Teamwork, Systems Theoretic Accident Model and Processes and the Functional Resonance Analysis Method are increasingly being applied to describe, evaluate, design and re-design sociotechnical systems to support human wellbeing and overall system performance (Read, et al, 2020). It is concluded that there is a great need for ergonomie guidelines that apply specifically to low back pain, and for quantitative epidemiological data on which these guidelines may be based (Dul and Hildebrandit, 1987) and the main focus of the HFE discipline in the 21st century will be the design and management of systems that satisfy human compatibility requirements (Karwowski, 2005).

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