Development on Meso Ergonomics in Manufacturing Based on Research Trends in The Last Twenty Years

Nismah Panjaitan¹, Amir Yazid Bin Ali², Hasnida Ab Samat²

¹Department of Industrial Engineering, Faculty of Engineering, Universitas Sumatera Utara, Jl. Almamater Kampus USU Medan 20155, Indonesia
²School of Mechanical Engineering, Engineering Campus, Universiti Sains Malaysia Seri Ampangan, 14300Nibong Tebal, Seberang Perai Selatan, Pulau Pinang, Malaysia

E-mail: ¹nismahpj@gmail.com, ²meamir@usm.my, ³hasnida@usm.my

Abstract. Meso ergonomics continues to develop, research journals on meso ergonomics continue to increase in number, meso ergonomic discussions are carried out ranging from the scope of studies to the application of meso ergonomics in various fields. Macro, meso and micro ergonomics do not yet have clear scope limits, this makes the researchers continue to conduct studies on the limits of meso ergonomic studies. The application of ergonomic science continues to be developed by researchers, during the span of 1997 to 2017 a total of 51 studies on ergonomic meso were carried out, the main focus of the research was carried out in the fields of health, services, manufacturing and other fields. Meso ergonomic research in the field of health as many as 20 studies, 6 services and 12 fields of manufacturing and 13 other fields of research. Most research occurred in the health sector with the most research in 2005 as many as 5 studies, research in the field of health, especially in hospitals consisting of, managerial design and improvement, improvement of hospital services and the impact of managerial policies on nurses. In the field of services, the focus of his research is the managerial system and improvement of the customer's perspective on services. In manufacturing the focus of the research is to maximize output by taking into account worker fatigue. All fields of ergonomic meso studies will be evaluated because they still have shortcomings and are not credible

Keywords: Health, Services, Manufacturing, Mesoergonomy.

1. Introduction
This paper aims to summarize studies that have existed in the last ten years. This paper deals with the development of research in the field of Meso Ergonomics. This paper will examine the boundaries of a development perspective or the boundaries between Macro Ergonomics, Meso Ergonomics and Micro Ergonomics. As material for study and comparison which can later be used as a reference for conducting research. This paper was made to see how meso ergonomics tendencies in manufacturing. Meso ergonomics research is not widely known, research has also been conducted in very few in recent years. Ergonomics is a science with very extensive studies ranging from the state of the operator to the policy applied in an organization. Macro ergonomics and micro ergonomics have been known by many circles, the boundaries between macro ergonomics and micro ergonomics are also unclear, so this study seeks to determine the boundaries with the presence of meso ergonomics. The tendency of ergonomics studies...
will make it easier to determine the criteria of ergonomics as a reference to macro ergonomics, meso ergonomics and micro ergonomics.

The study of ergonomics can be applied in services and manufacturing, because ergonomics always has human aspects, work environment and equipment. In the case of ergonomics services are usually used to assess the service performed by the company to its customers and in the manufacturing sector to measure the workload of operators the company gives workers. Humans must be treated like humans so it is important that measurements are made to see the capabilities of each operator. If there is no measurement, fatigue will occur to the operator which can cause muscle damage. Declining operator performance will affect company productivity because the results for each operator will decrease. Ergonomics is very positive in terms of workers and the company as a whole, meso ergonomics is a study that determines the ease of application of ergonomics in the service sector, especially in the health sector.

2. Literature Review
In various literatures we have obtained various definitions of Ergonomics. Ergonomics definition according to experts can be found in various existing text books. Ergonomics is one scientific discipline that deals with understanding of interactions between humans and other elements of the system, and professions that apply theories, principles, data and methods to design, optimize human well-being and overall system performance. The basic principle of ergonomics is that the demands of work must not exceed work capabilities and limitations to ensure that they will not be exposed to work stresses that can affect the company's safety and health and productivity [1].

Macroergonomics, which is related to sociotechnical system theory (Karsh et al., 2014), and security climate are strong areas in safety and ergonomics research, each of which has unique strengths and constancy when sharing some conceptual overlaps. Macroergonomics has a more holistic-approach to safety through the theory of a good sociotechnical communication system needed but not sufficient in creating a safe and secure work environment. Macroergonomic constraints are the lack of prescribed mechanisms through which the system spreads safety responsibilities across different subsystems. Given the conceptual overlap between macro climate ergonomics and safety, the reluctance that strengths in one area can be exploited while compensating for weaknesses in other areas. Ergonomics are compatible with organizational / machine interface technology and also to research, develop, and apply ergonomic and organizational design principles to macro-level system design [2].

By using construction and many others, macroergonomics seeks to design work systems that fit the characteristics of the organization’s sociotechnology system and “then ensure that micro ergonomics is designed to be aligned with the overall structure and process of work systems” [3]. Complex systems, such as an organization, consist of interrelated components, and the nature of those components will change if the system itself changes [4]. The mesoergonomic framework is based on the meso paradigm, the concept of organizational behavior in which two or more levels are examined simultaneously. Karsh et al. (2014) identified safety climate as a good example of mesoergonomic research, which explains that variables are specifically measured at the organizational, unit, and individual levels to determine cross-level relationships.

3. Method
Literature study is often also called a literature survey is a documentation of a comprehensive review of the results on the work contained in the literature either published or not published. The intended forms of literature vary, among others, science books, scientific journals, scientific magazines, conference proceedings, doctoral dissertations, master’s theses, government publications, financial reports, marketing and others. Literature surveys can be carried out simultaneously with interviews or before / after the interview.

Literature studies of topics relating to the problem areas to be clarified through initial data collection are very helpful because the data and information obtained together with interviews shorten the time collected in the initial data collection. The reason for the importance of conducting a literature
survey is to ensure that no important variables related to research problems will be left behind. That is, if the interview does not reveal the existence of certain variables but found in the literature survey, the researcher can consider it.

The selection of scientific journals is done by adjusting the keywords of the journals relating to ergonomics in manufacturing and services, so that the journals collected have similarities in terms of their scientific studies, making it easier to draw conclusions for each of the journals collected. Journals that have similar studies will be put together to be a reference journal based on previous journals. There are 26 journals related to the journal and the rest only explain in general the study of ergonomics in services and manufacturing, but all journals collected were made as comparison material in the study of ergonomics, judging by the criteria, stages and methods used.

4. Discussion

Table 1. Number of studies per sector in 1997-2017

| Year | Health | Service | Manufacture | etc |
|------|--------|---------|-------------|-----|
| 1997 | 0      | 0       | 1           | 0   |
| 1998 | 0      | 0       | 0           | 0   |
| 1999 | 0      | 0       | 0           | 0   |
| 2000 | 1      | 0       | 0           | 0   |
| 2001 | 0      | 0       | 0           | 0   |
| 2002 | 0      | 0       | 0           | 0   |
| 2003 | 0      | 1       | 1           | 0   |
| 2004 | 1      | 0       | 0           | 2   |
| 2005 | 0      | 0       | 0           | 1   |
| 2006 | 0      | 0       | 1           | 0   |
| 2007 | 0      | 0       | 1           | 0   |
| 2008 | 0      | 1       | 0           | 2   |
| 2009 | 2      | 0       | 0           | 0   |
| 2010 | 2      | 1       | 2           | 2   |
| 2011 | 1      | 1       | 1           | 0   |
| 2012 | 0      | 0       | 1           | 2   |
| 2013 | 2      | 0       | 2           | 0   |
| 2014 | 0      | 1       | 1           | 1   |
| 2015 | 5      | 1       | 0           | 0   |
| 2016 | 2      | 0       | 1           | 2   |
| 2017 | 4      | 0       | 0           | 1   |

Table 1. Above shows the research that has been done that shows in which areas the ergonomic meso was conducted or designed with the development of the amount of research in each year. Starting from 1997 until 2017 researchers get the number of journals that research about meso ergonomics with a total of 51 journals that have been obtained by researchers.

With the division in the field of health 20 studies, in the field of services 6 research, in the field of manufacturing 12 fields and in other fields with a total of 13 studies which cumulatively obtained a total of 51 studies.
Figure 1. Graph of Development of Meso Ergonomics Research in 1997-2017 in the Health Sector

In Figure 1. It is seen that the development of Meso Ergonomics research in the largest health sector is located in 2015 with a total of 5 studies. Although in previous years there was still a vacuum of ergonomic meso research. For example, in 2014 and others.

Figure 2. Graph of Development of Meso Ergonomics Research in 1997-2017 in Services

In Figure 2. It is seen that the development of Meso Ergonomics research in the field of service on average only 1 journal is obtained which discusses the Meso Ergonomics in services

Figure 3. Graph of Development of Meso Ergonomics Research in 1997-2017 in Manufacturing

In Figure 3. It is seen that the development of Meso Ergonomics research in the manufacturing sector was mostly found in 2010 and 2013, namely 2 studies. But it can be seen that research on Meso Ergonomics began in the field of manufacturing because there was 1 journal that discussed Meso Ergonomics in 1997.
Figure 4. Graph of Development of Meso Ergonomics Research in 1997-2017 in Other Areas

In Figure 4. It is seen that the development of other Meso Ergonomics research which includes examples in the field of telecommunications, consultants and others that are seen also have a stagnant amount each year starting in 2004 to 2017.

5. Conclusion

The objective of this research is to evaluate, through the surveyed literature even though research on Meso Ergonomics in each of these field trends still has shortcomings in its accuracy and reability. After reviewing 51 journals about Meso Ergonomics it can be seen that research on health has the most number, 20 research journals in which have application in the design of improvement or improvement councils from hospitals or from the nursing department itself. And many studies that combine the 3 elements of ergonomics in it to get the best results from these studies. The most research on Meso Ergonomics was found in 2015 in the health sector, which is 5 journals that discuss it.

In the field of research services on meso ergonomics, it is stagnant in 1 journal in several years, whereas in other years there are no journals that discuss the research. The application of this journal much lies in how the managerial system and shareholders in order to maximize the service and customer perception of the services they run.

In the field of manufacturing it can be seen that as a start of research in the field of Meso Ergonomics but in its development the journals obtained were only the 2 highest journals in a few years. With the application of this journal in the field of manufacturing as a way to optimize production and minimize fatigue from workers.

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