

Macroergonomic Approach in Development of Lean Six Sigma

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Abstract - Lean Six Sigma has experienced significant development in recent years. This was due to many adjustments that have to use other approaches to resolve failure in the implementation of lean six sigma in previous studies. The previous study saw several aspects of failure based on organizational elements, operators and work environment. Elements that were failing to implement lean six sigma can be enhanced with macroergonomics. This study aims to see to what extent the methods available in macroeconomics can be integrated with lean six sigma. The results of this study were work steps of macroergonomics integration with lean six sigma methods.

Keywords - Lean, Six Sigma, Lean Six Sigma, Macroergonomics.

I. INTRODUCTION

The approach for using lean six sigma concept considered the most appropriate way to solve problems related to wasteful production processes, defective products and rework. Many studies have successfully implemented lean six sigma in manufacturing (Chikkara et al, 2017). Such scrap is eliminated by reducing idle time carried out by previous studies by reducing process variation simultaneously in the application of lean six sigma methodologies (Panat et al, 2014). But in SMEs, Lean Six Sigma still faces many obstacles, Belhadi et al (2017) found five barriers to lean implementation in SMEs that were found: (1) Lack of management involvement, (2) Lack of methodologies adjusted for lean implementation, (3) short term vision (4) fear and resistance to change and (5) lack of understanding of lean. These obstacles are part of macroergonomic elements. macroergonomics is a sociotechnic approach from the top to the bottom that is applied to the design of the work system as a whole with the aim of optimizing the design of the work system and ensuring the work system is running harmoniously (Hendrick and Kleiner, 2002; Agustin et al. 2013). Widodo et al. (2006) the work system has several sub-systems which consist of human systems, tool subsystems and the environment. Where each of these items affects each other

so that it can produce maximum results. A good work system is a work system that thinks of humans in it.

According to Widodo et al. (2006) the approach in the design of an industry is called Human Design, which utilizes all information about humans, where the advantages and disadvantages of humans are included, in an integrated manner these are used as the basis of system design. The objectives of the ergonomics approach to fulfill occupational health, safety and safety so that the effectiveness and efficiency of the work system can be achieved properly.

PT. XYZ is a company engaged in manufacturing experiences waste in the production process. This is because there is a repetition of the production process in each unit. So it needs a comprehensive approach to reduce process rework on the production floor. This study aims to eliminate waste in the production process by paying attention to human factors. Where this research will be carried out at manufacturing companies engaged in the manufacture of oil tank that undergo process rework.

II. LITERATURE

This study examines several journals to see the extent to which the development of lean six sigma and macroergonomy concepts. This was done to see the possibilities in the integration of methods to solve the waste

problem in the lean six sigma stage that had not been successful.

1. Lean Manufacture

The concept of lean process or lean comes from the concept of the Toyota management system that was developed and expanded. Toyota's management system initially eliminates waste and shortens production flow to achieve quality, cost, and delivery according to the plan (Muraliraj et al, 2017). "Lean is a continuous effort to eliminate waste and increase the value added of products (goods or services) in order to provide customer value. The aim of lean is to continually increase customer value through increasing the ratio between value-to-waste (Gasperzs, 2007).

2. Six Sigma

Six Sigma is a philosophy of quality management and methodology that focuses on reducing variation, measuring defects and improving the quality of products, processes and services (Ghaleeb et al, 2014).

3. Lean Six Sigma

Lean six sigma (LSS) is an approach aimed at improving quality, reducing variation and eliminating waste in the company. This supports the idea of combining two repair programs, six sigma and lean manufacturing, also called lean Enterprises (Ghaleeb et al, 2017).

III. DISCUSSION

The researcher examined several journals to see the extent to which the development of the lean six sigma and macroergonomics concepts. This was done to see the possibility of integration methods to solve the problem of waste in the lean six sigma stage that was unsuccessful. The process or lean concept comes from the concept of the Toyota management system that was developed and expanded. The Toyota management system initially eliminated waste and shortened the production flow to achieve quality, cost, delivery according to plan (Muraliraj et al, 2017). "Lean is a continuous effort to eliminate waste and increase the value added products (goods or services) in order to provide value to the customer.

Six Sigma is a quality management philosophy and methodology that focuses on reducing variation, measuring defects and improving the quality of products, processes and services (Ghaleeb et al, 2014). Lean Six Sigma (LSS) is an approach that is intended to improve quality, reduce variation and eliminate waste in the company. It supports

the idea of combining the two program improvement, six sigma and lean manufacturing, also called lean Enterprises (Ghaleeb et al, 2017).

1. Developments Lean Six Sigma

Lean Six Sigma in the last 10 years was improved significantly. Many lean six sigma integration methods for solving waste problems, such as previous studies from Belhaldi et al. (2017) that combine Fuzzy, AHP, TOPSIS into lean concept, Belhadi et al.(2018) integration between CSF and AHP, Salleh et al. (2011) integration of lean six sigma and CSF concepts. Sahoo et al. (2017) Integration of Lean, TQM and TPM concepts. Many developments in the concept of lean six sigma are still not able to solve problems that occur in implementation.

2. Development based Macroergonomics

Ergonomics is the macro perspective, the methodology and the sub-discipline of ergonomics or human factors that are supported by science in the research empirical from sociotechnic system becomes the basis for the development of modern laboratory and field investigation of the system elements sociotechnic (Hendrick et al, 2002). Sociotechnical elements are caused by the contribution of macro ergonomics and manufacturing systems to be taken as the basis for analysis and design or redesign of various system elements such as job descriptions, technology, and environment interact with human factors. It had been the goal of macro ergonomics to analyze and design elements of the system to detect potential factors of health, safety, and employee performance (Realyvasquez et al, 2018).

Widodo et al. (2006) describe process stage in the micro ergonomics approach identifies the problem, comparing work based on ability in humans. Further correct verification if there is a problem in question. followed by developing alternative solutions, selecting the best solutions, implementing solutions, and then following up.

Macroergonomics is a top-down sociotechnical approach that is applied to overall system design work at various levels of human interaction such as micro-work ergonomics, human-machine and human-software with the aim of optimizing system design work and ensuring the system runs in harmony (Mayang et al, 2013). Macroergonomics has a role in designing several sociotechnical systems that are related to "human organization" and "technology".

Macroergonomics is a system approach that is top-down sociotechnics in analyzing, designing, or improving work systems and work organizations and then harmonizing these design elements into a whole (Puryani et al, 2018).

One of the most commonly used methods in solving problems in macroergonomics is participatory ergonomics. Participatory Ergonomics is a concept that has always actively involving stakeholders through Focus Group Discussion (FGD) to settle the problem with the approach of ergonomics. Participatory ergonomics is a problem-solving process ergonomics in a working system by involving stakeholders from the process of planning and implementation by considering ergonomics (Agustin et al, 2013).

Agustin, et al (2013) defines ergonomics as a participatory planning process and also control of some of the activities which involve the operator with sufficient knowledge and ability to influence the process and outcomes to achieve certain goals. Agustin, et al (2013) states that participatory ergonomics is a concept by actively involving workers in order to be involved in implementing the knowledge and procedures in their workplace ergonomics.

Least of employee participation in designing a working system can cause workplace accidents, the implementation of participatory ergonomics able to lower the accident rate and the improvement of the working environment (Agustin, et al. (2013). Agustin, et al. (2013) describes the improvement of working conditions and systems using participatory ergonomics will create a good cooperation, working conditions will be created as the desire of stakeholders and continues improvement will be more easily realized because the system refers to the wishes and needs of stakeholders and all it will have an impact on increasing productivity.

3. Development of Lean Six Sigma with Macroergonomics

In the DMAIC, Six Sigma concepts can be developed by identification through macroergonomics. One method that can be developed is to use Macroergonomic Analysis of Structure (MAS). MAS was developed by Hendrick to evaluate the structure of work systems in terms of compatibility with the sociotechnical characteristics of engineering. Among these characteristics MAS include aspects of technology, people and environment of the company. MAS is designed to integrate the new system with existing systems. This model increases the complexity of optimal organization. Increased organizational complexity is measured by comparing the results of the new system from the Macroergonomic Analysis of Structure (MAS) method with the existing organizational structure. This is done to enable companies to identify deficiencies. This research will

reduce waste related to aspects in macroergonomics. In this research methodology, the future steps outlined are described in the future. The steps in this study are shown in Figure 1. Lean six sigma design develops a macroergonomics approach in solving waste problems comprehensively.

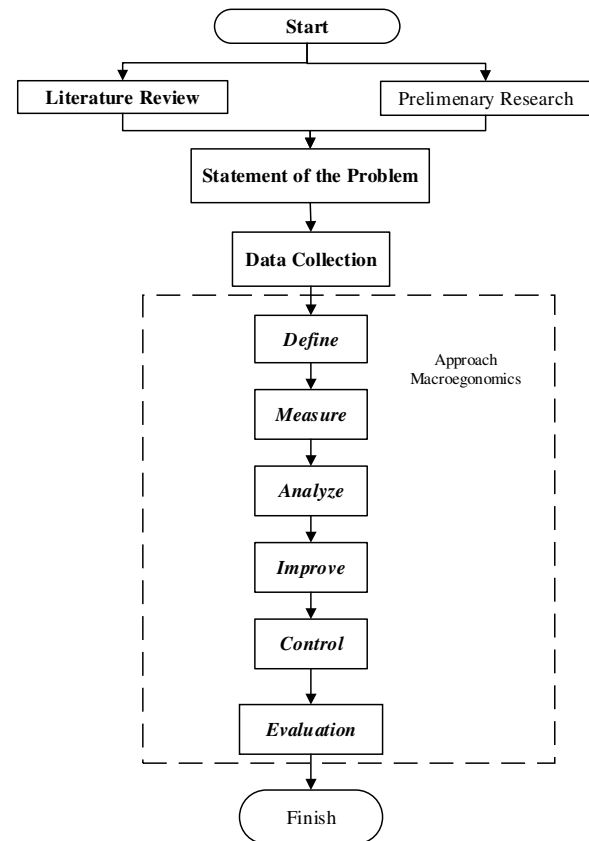


Figure 1. Flowchart of Methodology

The development scope of this research can be seen from Figure 1. where macroergonomics follow into each stage according to the needs of the DMAIC process and added to the evaluation process.

IV. CONCLUSION

Based on the results of the literature review it was found that the lean six sigma concept can be developed with various methods including macroergonomics, it causes macroergonomics to solve problems more comprehensively and comprehensively in a company. All developments are carried out as seen in Figure 1.

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