Hybrid Methods of MOST and 5S for Reducing Time Processing and Waste Motion in Milk SMEs Industry: A Case Study

A D Sari, R Gumilar*, N Setiawan, M R Salleh, M R Suryoputro and N Zhafira

1Faculty of Industrial Technology Department of Industrial Engineering Islamic University of Indonesia
2Faculty of Manufacturing Engineering Universiti Teknikal Malaysia Melaka

Corresponding author *: retnegumilar90@gmail.com

Abstract. Motion is one type of waste and it is a great challenge for the Small and Medium Enterprises (SMEs) to enhance the efficiency and productivity of all processes. The integration between lean and ergonomics in waste reduction has been identified as a tool to boost up the performance of SMEs. The aim of this study is to reduce the processing time by eliminating the motion using the hybrid of MOST and 5S practices at CV. Sahabat Ternak. The data has been collected to determine and analyse the inefficient movements of operators at their work stations by comparing before and after MOST-5S implementation. The results had shown a significant reduction of processing standard time in each four division as follows: Receiving Div. is 5.7%, Processing Div. is 1.3%, Milling Div. is 5.8%, and Packaging Div. is 19.5%.

Keywords: 5S, MOST, Motion, Lean, Ergonomics

1. Introduction
CV. Sahabat Ternak is one of the food and beverage manufacturing industry in Yogyakarta, Indonesia which transforms the Etawa goats milk into powder milk as the instant products. This industry has a great opportunity to provide milk products for sufficient community nutrition. Based on data from Yogyakarta Government, the current population of Etawa goats is approximately 5,994. Each of female goat is able to produce 0.85 litres of milk per day [1]. The current amount is classified as ideal for daily needs [1]. The rapid development of livestock Etawa goats is one promising business potential if it can be processed and managed effectively and efficiently.

In global environment, Small and Medium Enterprises (SMEs) has become a key driver for economic growth through innovation process and commonly using manual or semi-automatic technology. However, many of them lack of the capability for developing continuous improvement process [2]. In this case study, the primary goal of company is to increase profit by reducing cost, increasing process efficiency and improving the productivity using the traditional process. It could be achieved by eliminating the waste in the production process with the integration of lean and ergonomics [3] and those wastes are including over processing, excessive motion, and transportation.
Motion is the most severe type of waste, because the extra movement will greatly affect the working time [4]. Several studies related to motion had been carried out, including [4] the motion analysis using work posture analysis with Ovako Working Assessment System (OWAS). The analysis of excessive motion using Rapid Entire Body Assessment (REBA) method also had been done by [5]. Then research conducted by [6] had shown that redesigning work stations, as well as the application of ergonomic aspects, especially Method Time Measurement (MTM) can reduce the number of lead times affected by work motion. According to [7] the indirect time measurement method with Maynard Operation Sequence Technique (MOST) can be done five times faster than MTM. Subsequent research was conducted by [8] which compared the time measurement method between Stopwatch method as well as MOST method. Measurement using MOST method had given a better result (i.e. 15% saving time) compared to Stopwatch method. Furthermore, research conducted by [9] suggested that identification of waste and making improvements with 5S can make the work more organized. The purpose of 5S is to reduce non value added activities, such as searching for something and reducing the distance to shorten work time [10].

This paper is presenting a case study about the difference before and after implementation of 5S in the production system at milk SMEs in Yogyakarta, Indonesia. The scope of this research will mainly focus on identifying the inefficient motion in the production process of milk powder.

2. Literature Review

Increasing business competition and high demands from consumers require companies to be able to manage the production process more efficiently and effectively [11]. Lean ergonomic is used to reduce activities and systems that are not in accordance with the principles of ergonomics [5]. Ergonomics is a key parameter of the assembly process, as well as parameters of lean manufacturing such as takt time, cycle time, and work in progress [12]. The linkage of lean production system with ergonomics is in human effort, worker autonomy, the risk of Work-related Musculoskeletal Disorder (WMSD), and participation or involvement of workers [13]. Employees assume that the ergonomic role of human factor and working conditions in lean manufacturing is very important for improvement in work stations, and its application can be more beneficial to the relationship between employees and the company [14].

Classification of waste is classified as transportation, over processing, waiting, motion due to movement, and waste of motion due to posture [5]. To be able to increase productivity and eliminate waste of motion, the proposed improvements including changing work positions, changing work layouts and eliminating work movements are necessary [5]. Motion can be eliminated by identifying and minimizing non value added activities (NVA), unnecessary movements, and identifying bottlenecks in the activity of taking and placing parts in Computer Numerical Control (CNC) machines using MOST [15]. MOST can determine activities that are not value added for some elements of work [16], and are able to minimize production costs [17]. This shows that MOST can reduce work movements in order to increase process productivity [18]. MOST can also be used for the implementation of standard time and setting the work station layout [19]. Positive changing in behavioural and environmental workplace can be provided through 5S practices. While, Radar chart is a tool in organizing tools and equipment, easy to find something based on function and place, better in control wastage, supporting for continuously improvement and have better mind set and awareness for important healthy and safety on working [9]. The combination of MOST and 5S aims to measure the standard time needed by the operator to work and save the processing time by applying the 5S method.

3. Methodology

In the process of data collection, sample selection was conducted in each related division. In the milk receiving division, there is only 1 operator involved. In the processing division, there are 9 operators, which then selected one operator using a rating factor as a sample. In the milling and packaging division there is only 1 operator for both divisions. Operators who are used as research samples are
the operators who have an average ability with a minimum of 1 year work experience. The object of research in this problem is the production process in SMEs processing milk powder. This study will identify the activities that cause ineffective motions happened in the milk production process using MOST and 5S. Data collection was done as follows:

1. Activity Identification
   Observe the overall activities that take place in production activities.
2. Motion Classification
   Identify all movements performed by the operator using an ergonomics approach.
3. Movement Identification
   Find out which ineffective movements are classified as non-value-added activities and calculate the processing time by MOST method.
4. Proposed improvements
   Propose the improvements. Re-layout the work station and apply 5S at the working area.

4. Result and Analysis
The unnecessary motion is particularly related to ergonomics. Excessive motion consists of bending, twisting, lifting, reaching, and walking. These should be dealt with as soon as they are recognized [20]. Accordingly [21], ineffective and inefficient movements can be arising in activities such as finding and selecting to object, putting on right position, etc. Based on the observations, the following are the analysis of ineffective motion elements that has been carried out by the operator during performing their tasks.

| Division          | Ineffective Motion                                                                                                                                 |
|-------------------|-------------------------------------------------------------------------------------------|
| Milk Receiving    | Searching for the filters that match the size of the milk tank.                           |
|                   | Selecting the marker which was used to write the name of the milk depositor in the plastic packaging. |
| Milk processing   | Searching for equipment when starts to cook.                                              |
| Milling           | There is no ineffective movement by the operator. This is because the operator had worked in accordance with the economic principles of the movement such as working with both hands, both hands are started and ended simultaneously, and there is no process of finding and choosing. |
| Packaging         | Repeating the inspection procedure when the operator wants to pack milk into plastic.     |

After identifying the ineffective movement carried out by the operator, then the standard time has been calculated. From the standard time obtained, the analysis had been done to identify the potential movements to be minimized. The efforts to improve work methods are carried out by applying 5S to each operator's work area. The proposed changes that have been made are shown in Table 2:

| No  | 5S Method | Treatment                                                                                                                                 |
|-----|-----------|------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | Seiri (Sort) | The first step is to do a large cleaning that serves to remove dust and dirt on the equipment.                                          |
|     |           | The second stage discards equipment that is unnecessary.                                                                                 |
|     |           | The third stage is to separate the defective equipment and placed in temporary storage.                                                   |
|     |           | Set aside the damaged milk filter so that it is not mixed with a good milk filter. Therefore, the operator does not necessary to select and inspect the filter to be used. |
No | 5S Method          | Treatment                                                                 |
---|--------------------|---------------------------------------------------------------------------|
 2 | Seiton (Set-in Order) | The first stage is grouping the equipment, so that only the necessary equipment will be available in the work area.  
The second stage prepares the equipment storage.  
The third stage is to provide a boundary mark on the storage area that serves as a limit of goods.  
The last stage is labelling the storage place and equipment and it will facilitate the operator in storing and returning equipment. |
 3 | Seiso (Shine)     | The first stage is to carry out the micro level cleaning activities at the entire work area environment.  
The second stage is the cleansing at the individual level, cleaning carried out in the specific work area of the operators.  
The last stage is micro phase cleaning where the cleaning is done on equipment used by each operator such as milk mixers, knives, pans and machines used. |
 4 | Seiketsu (Standardize) | Form a standard operating procedure e.g. sequence task, job description, person scheduling task per day for processing operators.  
Receipt, milling and packaging operators must mop and sweep the workspace before returning home.  
The awareness of employees to maintain Seiri, Seiton and Seiso is constantly being formed because it has begun to get used to new methods and ways of working. |
 5 | Seitsuke (Sustain) | Counselling to operators about the importance of cleanliness and neatness of equipment and workplaces. |

5S activities such as cleaning, sorting items, giving labels and restrictions had been adopted and implemented.

![Figure 1. Before and after labelling freezer in 5S](image_url)
Figure 1-3 shows the improvement ideas that had been adopted at CV. Sahabat Ternak Industry. As shown in Figure 1, the position among the freezers are more fixed after separated with restriction sign, while Figure 2, shows better organizing on the freezer contents, and Figure 3, shows the equipment are easier to identify and closer to reach. Several improvement conditions can lead to some positive impacts such as easier to calculate and identify the liquid milk packs based on date or suppliers so that it could be easy for tracing the quality of material related some defects, speed up the retrieval process and simplify the work flow with yellow line guidance.

After improving the work method with 5S, the new standard time measurement was done. Standard time is the time required by an operator who has an average level of ability to complete a job normally in the best study system by considering allowance [21]. Standard time measurement with MOST is carried out in four stages. The initial stage was done before implementing 5S (before). After implementing 5S, data collection was done with MOST 16 days after 5S implementation (after 1). Subsequent data collection was carried out 40 days after the 5S implementation (after 2). Data is taken 2 months after the implementation of 5S (after 3). Standard time measurement with MOST is done by the following formula:

\[
Standard \ Time = Normal \ time \times \frac{100}{100-\% \ Allowance}
\]  

(1)

Based on the results of the standard time calculation with MOST performed on the work process, the results of standard time between before and after 5S are shown as in Table 3.
The results of the standard time calculation using MOST indicate that the standard time value has decreased from after 5S application. The decrease in standard time was caused by the successful application of 5S to reduce ineffective motions and speed up the standard time of a job. Although the decline in standard time experienced is not significant but can affect the amount of output per day produced.

In this stage, statistical processing uses Friedman's non-parametric test, it is because the comparison test consists of more than 2 groups and the data used. Friedman test aims to find out whether there are differences in effects between treatments. The treatment here is the application of 5S in different time periods. An average comparison is made on the data group so that it can be seen whether there is a difference between the standard time before, after 1, after 2 and after 3.

Hypothesis:

H0: There is no significant difference between the standard time before and after the 5S application
H1: There is a significant difference between the standard time before and after the 5S application

Significance level: \( \alpha = 5\% \) or 0.05
If the p-value is <0.05 then H0 is rejected and H1 is accepted. Following are the results of Friedman's testing using SPSS software on four different treatments.

### Table 3. The difference standard time

|                     | Before | After 1 | After 2 | After 3 |
|---------------------|--------|---------|---------|---------|
| Milk receiving      | 0,87   | 0,83    | 0,8     | 0,82    |
| Milk processing     | 23,56  | 23,51   | 23,49   | 23,25   |
| Milling             | 4,78   | 4,63    | 4,5     | 4,5     |
| Packaging           | 2,82   | 2,54    | 2,34    | 2,27    |

### Figure 4. Standard time comparison chart

The standard time comparison chart shows the difference in standard time before and after 5S application for each process. The chart indicates that the standard time has decreased after the implementation of 5S, which is consistent with the results of the Friedman test.
Table 4. Standard time difference test

| Test Statistics<sup>a</sup> |
|-----------------------------|
| N                          | 4  |
| Chi-Square                 | 11.154 |
| df                         | 3  |
| Asymp. Sig.                | .011 |

Friedman test results show a significance value of p-value is 0.011. The p-value 0.011 is smaller than 0.05, so the conclusion is H0 rejected and H1 is accepted. It means that there are significant differences in the comparison of the measurement results at the standard time, in the conditions before and after the 5S implementation.

5. Conclusion and Future Research
The ineffective motion identification had been carried out at milk receiving, processing, milling, and packaging division. The percentage of decreasing in standard time using the hybrid of MOST and 5S practices are 5.7% at the receiving division, 1.3% at the processing division, 5.8% at the milling division and 19.5% at the packaging division. Based on statistical calculation using Friedman's testing, the result (p-value = 0.11<0.05) and it shows that there are significant differences between standard time and standard output before and after the application of 5S.

For further research, it is recommended to carry out data collection in a gradual and relatively long period of time, so that the changes that can be seen significantly. Subsequent research is expected not only to measure the standard time produced, but also to calculate the value of productivity resulting from the changes that occur.

Acknowledgments
This study was supported by Directorate of Student Development Universitas Islam Indonesia, Yogyakarta; Industrial Engineering Department, Faculty of Industrial Technology, Universitas Islam Indonesia; Faculty of Manufacturing Engineering, Universiti Teknikal Malaysia Melaka; Government of Industrial, Trading and Cooperative of Sleman Yogyakarta District; and CV. Sahabat Ternak (Etawa Goat Milk SMEs).

Reference

[1] D Agus 2017 “Radar Jogja,” [Online]. Available: https://www.radarjogja.co.id/2017/03/30/susu-kambing-pe-potensi-baru-di-sleman/. [Accessed 11 September 2017].

[2] I L Nunes 2015 Integration of Ergonomics and Lean Six Sigma A Model Proposal Procedia Manuf Vol 3 No Ahfe pp 890-897

[3] J P E Souza and J M Alves 2017 Lean Integrated Management System : A Model For Sustainability Improvement International Converence on Production Research (ICPR) No Icpr pp 678-648

[4] G Mulyati, Suharno and M Muharom 2015 An Implementation of Lean-ergonomic Approach to Reduce Ergonomic Parameter Waste in the Manufacture of Crackers ICoA Conference Proceedings ISSN 2413-0877 Vol 3 pp 21-24
[5] Sumiyanto and N. Rizani 2017 Analisis Ergowaste pada Proses Produksi Yoke dengan Pendekatan Lean Ergonomics Di PT.X Prosiding SNTI dan SATELIT Malang: Jurusan Teknik Industri pp B272-277

[6] P Kuhlang, T Edtmayr and W Sihn 2011 Methodical approach to increase productivity and reduce lead time in assembly and production-logistic processes CIRP Journal of Manufacturing Science and Technology p 24–32

[7] B Niebel and A Freivalds 2009 Niebel's Methods, Standards, and Work Design 12th ed New York: McGraw-Hill

[8] J Senthil and G Haripriya 2016 Time Analysis With MOST Technique Int. J. Chem. Sci 14(S2) ISSN 0972-768X pp 519-526

[9] L Huda 2016 Lean Ergonomic with 5S Concept : A Case Study in Small Scale Industry 4th SEANES International conference on human factors and ergonomics in South-East Asia

[10] A Sigh and I Ahuja 2015 Review of 5S methodology and its contributions towards manufacturing performance towards manufacturing performance Vol 5 No 4

[11] I N Pujawan 2009 Ekonomi Teknik, Edisi Kedua Jilid Pertama ed., Surabaya: Guna Widya

[12] L Botti, C Mora and A Regattieri 2017 Integrating ergonomics and lean manufacturing principles in a hybrid assembly line Computers & Industrial Engineering 111 p 481–491

[13] P Arezes, J Carvalho and A Alves 2014 Workplace ergonomics in lean production environments: A literature review p 57–70

[14] Z Santos, L Vieira and G Balbinotti 2015 Lean Manufacturing and ergonomic working conditions in the Automotive Industry 6th International Conference on Applied Human Factors and Ergonomics (AHFE) p 5947 – 5954

[15] S Gunjar and A Pandey 2016 Application of Maynard Operation Sequence Technique (MOST)- A case study International Journal of Innovations in Engineering and Technology (IJIET) ISSN: 2319-1058 Vol 6 No 3

[16] Belokar R M, Y Dhull, S Nain and S Nain 2012 Optimization of Time by Elimination of Unproductive Activities Through MOST "International Journal of Innovative Technology and Exploring Engineering" ISSN: 2278-3076 Vol 1 No 1

[17] P K Gupta and S S Chandrawat 2012 To Improve Work Force Productivity in a Medium Size Manufacturing Enterprise by MOST Technique IOSR Journal of Engineering (IOSRJEN) e-ISSN: 2250-3021, p-ISSN: 2278-8719 Vol 2 No 10 pp 8-15

[18] Deshpande V A 2007 M.O.S.T-The Most Advanced Work Measurement Technique Journal of Engineering & Technology S. P. University Vol 20 pp 109-113

[19] T Yadav 2013 Measurement Time Method for Engine Assembly Line with Help of Maynard Operating Sequencing Technique (MOST) International Journal of Innovations in Engineering and Technology (IJIET) ISSN: 2319-1058 Vol 2 No 2

[20] J Walder and C Kerk 2007 Integrated Lean Thinking & Ergonomics : Utilizing Material Handling Assist Device Solutions for a Productive Workplace, South Dakota School of Mines

[21] R Barnes 1980 Motion and Time Study: Design and Measurement of Work, New York: John Wiley and Sons