

# Productivity Optimization of Furniture Company in Inspection Station by using Motion and Time Study Techniques

<sup>1</sup>abdul Talib Bon, <sup>2</sup>hani Nadia Abd Karim, <sup>3</sup>y. Ngadiman, <sup>4</sup>ahmad Nur Aizat Ahmad, <sup>5</sup>hadilah Abdul Hamid

<sup>1,2</sup>Faculty of Technology Management and Business  
Universiti Tun Hussein Onn Malaysia

\*Corresponding Author Email: talib@uthm.edu.my

## Abstract

In the context of in industry, the productivity rate of the company plays an important role in order to maintain the company's production. In this study, an approach has been proposed with the aim to improve and optimize the work process on production time, number of processes and production layout using Motion and Time Study technique and some possible solution will be proposed in the end of study. Commonly, many of inspection process has operated manually by workers and caused some of waste in work process such as overproduction, motion and processing. Using Motion and Time Study Technique, the unnecessary motion and time processing will be detected by identify the standard time of each process and ARENA simulation will be applied in order to stimulate and predict the changes in inspection process. Overall, the suggested solution will helps in productivity improvement of the company and cost of production will reduce as well.

**Keywords:** productivity, optimize, Motion and Time Study, ARENA simulation

## 1. Introduction

The increases of productivity is a main driver of competiveness in the market. There are various management tools in helping the increases of productivity. Basically, the productivity performance is highly affected by the unnecessary motion and time processing in each work processes. When the company does not have the specific time processing or known as standard time, the production will be slow and take too long to complete the work process. To identify the standard time of the work process, Motion and Time Study techniques will be applied in order to improve the productivity of the company. However, a simulation software also will be used in this research to get the accurate data with animation and simulation. Every product will be having an inspection process whereby the product will be evaluated by inspectors. Inspection is a process to locate faulty items by certain defects. It is important process in manufacturing to maintain process control and ensure that faulty product will not reach to customers. Normally, inspection process will be done manually by their workers. So that it will take extra time and there is no standard time in each of inspection process. When inspection consumes more time than time estimated, there will shrinkage happened in the productivity of the company. This study will be conducted at AX Furniture Company at Johor by using observation and interview to collect the data. 4 samples of finished furniture with 4 work cycles will be observed. Then, the collected data will be analysed by Motion and Time Study technique in order to get the standard time of each inspection process and using the ARENA simulation software as another tool to get the accurate data with animation and simulation. After that, the possible solution will be proposed to the AX Furniture Company in order helps to improve the production rate. This study will focus more

on the work process in term of production time, number of process and production layout of the company.

## 2. Literature Review

Time study has been introduced since 1881 by Frederick W. Taylor which is generally used to measure work flow and cycle time in certain process. According to the [8], time study is one of the method that has been used to reduce the processes time and to determine the time required to accomplish the specific task by using a stop watch. While, [10] mentioned that, time study has been used in measures the time necessary for a specific task this is because time study is one of the analysis of a specific job in order to get the most efficient method in terms of time and effort also using stopwatch to analyse the specific process in order to find the efficient ways in terms of time. Stopwatch is one of the equipment that easy and faster in data recording which is suitable for this research to develop the accurate data. According to [4] time study has been used to measure work process. The time standard for the operation were based on the time of a worker in accordance with a job and fully trained to use specific methods. According to Bon et al motion study has been developed by Frank and Lillian M. Gilbreth which is has begun the investigation to identify the best way in performing the given task. Motion study helps to eliminate all the unnecessary motions and reduce the remaining motions which is has been known as work simplification. Work simplification can be defined as the most effective method in reducing cost, either eliminate the process or combining the process into one process. By [8], the motion study method is important in helps to make processes more efficient by reducing the motions. According to [9] motion and time study is one of the business efficiency techniques which are combining the Motion Study by Frank and Gilbreth with Time Study by

Frederick Winslow Taylor. In this techniques, the combination of these two methods help to reduce the extra work by measure the standard time in operation. Generally, motion studies focus on improving the work method while time studies establish the standard times. These two techniques has been widely accepted in improving and upgrading the work system and also known as method in engineering. Basically, the main objective of motion and time study techniques is to eliminate the unnecessary of work and the procedures that involved in process which is this technique is the most effective and suitable to use [2]. However, motion and time study required the continuous observation and need more precise method than work sampling which is collects data at intervals of time, [6].

### 3. Research Methodology

In this study, there will be two phase of analyzing data which are using Motion and Time Study Techniques and using an ARENA simulation software. After data collection completed by using standard time sheet and stopwatch, the next step is calculate the normal time of each inspection activity by using formula whereby,

$$Normal\ Time = Average\ of\ Observed\ Time \times Performance\ Rating \tag{3.1}$$

Normal time is needed in order to complete the operation efficiently without having no delays. Based on the formula, observe time was taken based on the data obtained, and the performance rating was based on the how efficient the worker in inspecting the product while the value of performance rating is based on the worker's performance shows in doing the inspection activity. The good performance is higher the value of performance rating.

Hence, the most needed data is standard time for each inspection activity. Standard time is the time whereby the operations need to complete with 100% efficiency with unavoidable delays. So that, the formula for standard time is,

$$Standard\ Time = Normal\ Time (1 - Allowance) \tag{4.2}$$

From the formula above, the normal time will be taken from the data that has been calculated and allowance is the adjustment to the normal time to get the standard time in order to recover the lost time due to the fatigue, personal needs, and others. So that, the allowance will be able to cover lost time and complete the work assigned to the worker. Next is second phase of analyzing data which is using ARENA simulation software. The result that obtained from simulation will helps this study to identify the production rate and suggest the possible alternative to increase the performance and production rate of the industry.

### 4. Data Analysis

In this study there will be one qualified workers that have been evaluated in order to get the standard time for all the inspection activity. There are 4 samples finished product that have been observed. Therefore, the inspection activity has been conducted by one qualified worker in 4 cycles of the activity process. Within the time, all the activity have been observed in order to identify which activity consume more time and effect the productivity rate of the production. Based on the result, the normal time and standard time of each activity has been evaluated, this shown in Table 3. The normal time for each activity was calculated by using stopwatch to calculate the standard time for each element of activity. The normal time was calculated by using formula as stated in methodology (3.1). The formula required the value of performance rating which is has been taken from the inspection process. So that, the value of the performance rating has been determined which are 90%. This is because, there is no sufficient worker that need to handle all the inspection process within 8 hours all the day

and it has gave impact to the worker worked slower than normal. Besides, the efficiency and performance of the worker become decrease because of the tiredness and restless work process.

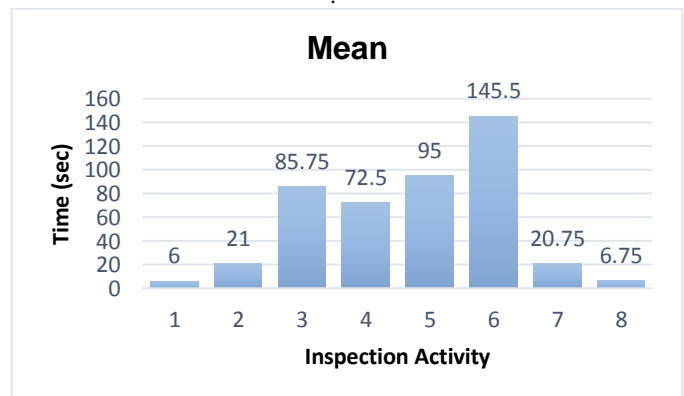
Hence, the standard time of the inspection activity was calculated by using formula that has been stated in methodology (3.2). The standard time is the time whereby the operations need to complete with 100% efficiency with unavoidable delays. In this study, the operation does not have any allowance. However, when a qualified worker worked in normal tempo, it is only need a time to perform the job. The worker may take time out for rest, personal need, and others reason. According to the [2], the worker who works 8 hours/day in light work without organized rest period earn 2% to 5% of allowance whereby, ( 10-24min)/day is approximately all the average worker will use for personal time. Therefore, this study was found that the allowance is 4% which is it used in the inspection station of finishing department. The result of the data collected will be shown in Table 1.

The graph of mean time of inspection activity, normal time and standard time will be shown in Figure 1, Figure 2 and Figure 3.

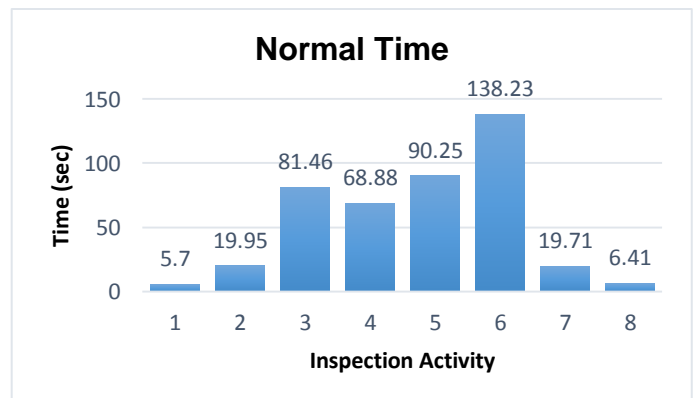
**Table 1:** The result of meantime, normal time and standard time

| Act. | Cycle (sec) |     |     |     | Time (sec) |        |        |
|------|-------------|-----|-----|-----|------------|--------|--------|
|      | 1           | 2   | 3   | 4   | MT         | NT     | ST     |
| A1   | 5           | 8   | 4   | 7   | 6          | 5.40   | 5.18   |
| A2   | 23          | 22  | 17  | 22  | 21         | 18.90  | 18.14  |
| A3   | 77          | 89  | 69  | 108 | 85.75      | 77.18  | 74.09  |
| A4   | 74          | 74  | 76  | 66  | 72.50      | 63.25  | 62.64  |
| A5   | 107         | 105 | 86  | 82  | 95         | 85.50  | 82.08  |
| A6   | 142         | 133 | 167 | 140 | 145.5      | 130.95 | 125.71 |
| A7   | 13          | 29  | 14  | 27  | 20.75      | 18.67  | 18.48  |
| A8   | 5           | 7   | 8   | 7   | 6.75       | 6.08   | 5.84   |

\*MT= Meantime, NI=Normal Time, ST=Standard Time



**Figure 1:** Mean inspection time for every inspection activity



**Figure 2:** Normal time for every inspection activity

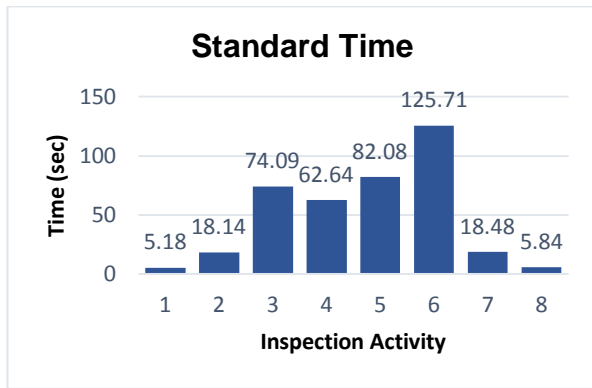


Figure 3: Standard time for every inspection activity

4.1 Results and Discussions

4.1.2 Number of Workers in Inspection Station

As discussed in data analysis, there is only one qualified worker who worked in inspection station for finishing department. The additional of worker in this station will bring changes to the production rate of the company. As the number of worker increase, the number of product inspected will be increased in a day. In this study, ARENA software will be used in order to estimate the output per day. ARENA software will helps to analyzing the manufacturing process and brings the improvement

to the business process. This study suggested that the number of worker will be added to the 3 to 4 qualified workers. So that, along the operation, the will be continuous activity and the number of product inspected will increased as well. To predict and stimulate the production rate per day (assume working in 8 hours), ARENA software will be used.

Table 2: The suggestion of time consumption in new work process for inspection activities

| Activity     | MT(s) | NT(s) | ST(s)         |
|--------------|-------|-------|---------------|
| A1           | 6     | 5.4   | 5.18          |
| A2           | 80    | 72    | 69.12         |
| A3           | 85    | 76.5  | 73.44         |
| A4           | 90    | 81    | 77.76         |
| A5           | 95    | 85.5  | 82.08         |
| A6           | 6     | 5.4   | 5.18          |
| <b>Total</b> |       |       | <b>312.76</b> |

\*MT= Meantime, NI=Normal Time, ST=Standard Time

4.2 Simulation Model

The simulation model for this study is based on the movement of the inspection activity. The process will start from the Activity 1 to Activity 8 with the time that has been recorded

4.2.1 Initial Model

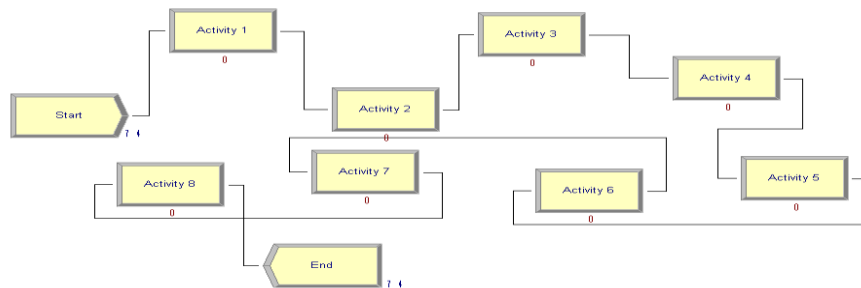


Figure 4: The simulation model of the inspection activity using ARENA

| Other      |         |                |               |               |
|------------|---------|----------------|---------------|---------------|
| Number In  | Value   |                |               |               |
| Product A  | 74.0000 |                |               |               |
| Number Out | Value   |                |               |               |
| Product A  | 74.0000 |                |               |               |
| WIP        | Average | Half Width     | Minimum Value | Maximum Value |
| Product A  | 0.00    | (Insufficient) | 0.00          | 1.0000        |

Figure 5: The result of output of initial situation

To predict and stimulate the production rate per day (assume working in 8 hours), ARENA software will be used. Based on the result shown in Figure 5, with 392.16s of standard time it was found that the output per day in the initial situation is 74 products.

4.2.2 Model Assumption

- There are three suggestion been discussed which are,
1. Combining element of work process which are Activity 2 and Activity 4.
  2. Change the white tape to the color sticker with the label of defects
  3. Increase the qualified workers from 1 to 3 persons.

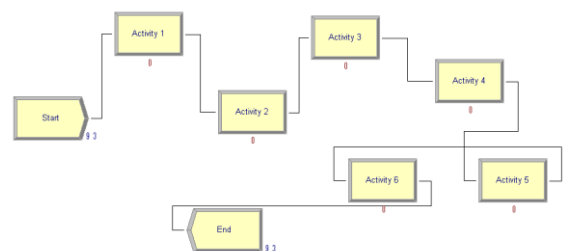


Figure 6: The new layout of work process for inspection activity.

| Other      |  |         |                |               |               |
|------------|--|---------|----------------|---------------|---------------|
| Number In  |  | Value   |                |               |               |
| Product A  |  | 93.0000 |                |               |               |
| Number Out |  | Value   |                |               |               |
| Product A  |  | 93.0000 |                |               |               |
| WIP        |  | Average | Half Width     | Minimum Value | Maximum Value |
| Product A  |  | 0.00    | (Insufficient) | 0.00          | 1.0000        |

Figure 7: The result obtained after apply the new possible solutions.

Based on the result, the production rate in 8 working hours has increased from 74 products to 93 products. There are 25.67% increases of the production rate.

## 5. Conclusion

The motion of each activity process consumed a lot of time which mean the motion can be eliminated or combined in order to reduce time consumption. In focusing the time consumed in each activity which is effect the productivity rate of the company, the possible solution has been determined in order to improve the performance and increase the production rate of the day. In this study, all the objectives has been achieved when the data obtained from the observation helps to analyse the time and motion consumed in this inspection activity. From the result, the time and motions has affected the production rate of this industry. The activity that consumed more time has been recognised and evaluated in order to get the improvement in performance of the industry. As conclusion, this study has proved that time and motions are really give big impact to the industry's performance and production rate optimization of the day. This study is recommended to any industry have similar problem with this company. Industry can use this study as their guideline to increase their performance and rate of production. For the future study, it is recommended for those who are using the same methodology in particular topic. In addition, it may help the future research in handling the problem happened.

## References

- [1] .Adams, T. N. (n.d.). Simulation in Arena to Determine Potential Bottlenecks for Dermatology Clinic Redesign, (Figure 1), 1–6.
- [2] Al-Saleh, K. S. (2011). Productivity improvement of a motor vehicle inspection station using motion and time study techniques. *Journal of King Saud University - Engineering Sciences*, 23(1), 33–41. <http://doi.org/10.1016/j.jksues.2010.01.001>
- [3] Bon, A., & Ariffin, A. (n.d.). an Impact Time Motion Study on Small Medium Enterprise Organization. *Internationalconference.Com.My*, 1–11. Retrieved from [http://internationalconference.com.my/proceeding/icber2010\\_proceeding/PAPER\\_107\\_ImpactTime.pdf](http://internationalconference.com.my/proceeding/icber2010_proceeding/PAPER_107_ImpactTime.pdf)
- [4] Bon, A. T., & Daim, D. (2010). Time Motion Study in Determination of Time Standard in Manpower Process. *3rd Engineering Conference on Advanced in Mechanical and Manufacturing for Sustainable Environment*.
- [5] Dawood, N., & Al-bazi, A. (n.d.). Improving the Performance and Reliability of Construction Supply Chain Using Simulation : a Case Study for Doorsets Manufacturing.
- [6] De Coster, I., Fournie, X., Faure, C., Ziani, E., Nicolas, L., Soubeyrand, B., & Van Damme, P. (2015). Assessment of preparation time with fully-liquid versus non-fully liquid paediatric hexavalent vaccines. A time and motion study. *Vaccine*, 33(32), 3976–3982. <http://doi.org/10.1016/j.vaccine.2015.06.030>
- [7] Khalili, M. H., & Zahedi, F. (2013). Modeling and simulation of a mattress production line using ProModel. *Proceedings of the 2013 Winter Simulation Conference - Simulation: Making Decisions in a Complex World, WSC 2013*, 2598–2609. <http://doi.org/10.1109/WSC.2013.6721632>
- [8] Lopetegui, M., Yen, P. Y., Lai, A., Jeffries, J., Embi, P., & Payne, P. (2014). Time motion studies in healthcare: What are we talking about? *Journal of Biomedical Informatics*, 49, 292–299. <http://doi.org/10.1016/j.jbi.2014.02.017>
- [9] Nejati, O., Rafei, M., Gandomkari, A. S., & Amirabadi, A. A. (2013). Determining the Optimum Number of Locomotives in the Steel Industry Using Motion and Time Study Techniques, 3(3), 939–943.
- [10] Patel, M. B., Thakkar, P. H. R., & Santosh, R. (2015). Reducing Manufacturing Cycle Time of Milk Tanks by Work Study Technique in Small Scale Fabrication Industry, 12532–12541. <http://doi.org/10.15680/IJIRSET.2015.0412163>
- [11] Yao, L. (2015). Productivity improvement based line balancing : a case study of pasteurized milk manufacturer, 22(6), 2313–2317.