Work time measurement analysis with indirectly working measurement method on cement bagging station

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Abstract: Work measurement is one method that can be used to determine the standard time of a job. PT. Yoga Wibawa Mandiri is a company engaged in cement bagging business, this company in cooperation with PT. Semen Padang. In cement bagging companies it is known that so far there are production targets and unfulfilled customer demand due to the absence of standard time that can be used as a reference in conducting production activities. The purpose of this research is to improve the working system in order to get the standard time at the cement bagging station to reach the production target. Therefore, in this research the draft of proposed working method using Method Time Measurement (MTM) to conform to the economic principles of movement and work time measurement. Based on the result of the measurement of the improvement of working method on 3 operators of cement-bagging stations resulted in decreasing cycle time by 6.28 seconds and the increase of cement production amounted to 155.2 tons / operator. This timing can be used as a reference to meet company targets and customer demand.

Keywords: MTM, Elements of Movement, Principles of Movement Economy, Standard Time.

1. Introduction

The cement industry in Indonesia is one of the main needs in the field of infrastructure development, the demand for cement continues to increase from year to year as the rapidly growing infrastructure development by the government. PT. Yoga Wibawa Mandiri is a company engaged in cement bagging business. Observing the development of cement bagging production in PT Yoga Wibawa Mandiri, until now the company always set the target of cement production that must be processed that is equal to 45 ton per hour. Within one working day employees are divided into two shifts, each shift is eight hours of work, and for two shifts there are 16 hours for production, so the production target is 700 tons / day. Based on the observation, the operator performs repetitive movements so that the work time becomes longer and causes the unfulfilled production target set at PT. Yoga Wibawa Mandiri.

2. Methods

2.1. Measurement of Work Time

Time measurement is the work of observing and recording the working times of either each element or cycle by using the tools that have been prepared. To calculate the standard time of completion of work, then it takes principles and techniques of work measurement. Measurement of working time will relate to efforts to establish the standard time required to complete a job. Briefly the work measurement is a method of determining the balance between the human activities contributed by the output units.
2.2. Motion Study
The motion study is a study of the movements that workers do to complete their work (Wignjosoebroto, 2003). This study will produce standard movements for the completion of work that is a series of movements that are effective and efficient. The main purpose of motion studies is to minimize and reduce ineffective movements. So the work will be done easier and the production rate can be improved.

2.3. Principles of Movement Economics
Improved work system is done by analyzing the elements of the work without forgetting the principles of economic movement. Because to get an efficient process, the work system must be designed by combining the right movements and energy efficient (economical). The principle of movement is called the movement’s economy (Sutalaksana et al, 1979), which outline consists of three groups related to:

1. The principles of economic movement are connected with the human body and its movements.
   a. Both hands should start and end the movement at the same time.
   b. Both hands should not be idle at the same time except at rest.
   c. Movement of both hands will be easier if one against the other is symmetrical and counterclockwise.
   d. Hand or body movements should be thrifty, ie only move the hands or the body needed to do the job as well as possible.

2. The principles of economic movement are related to the arrangement of the workplace layout.
   a. It should be endeavored that the body and equipment have the right place.
   b. Place materials and equipment in an easy, fast and easy to reach place.
   c. The storage of materials to be worked out should utilize the principle of gravity so that the body to be used is always available in the near future to be taken.
   d. Materials and equipment should be placed in such a way that movements can be performed in the best possible sequence.
   e. Height of workplace and chair should be such a way, so the alternative of standing or sitting is a enjoyable thing to do.
   f. The height of the chair should be such a way, so that the occupant has a good posture.
   g. The layout of equipment and lighting should be arranged in such a way that it can form a good condition for vision.

3. The principles of the movement’s economy are related to the design of the equipment.
   a. Hands should be freed from all work when the use of auxiliary tools or movable tools with the feet can be increased.
   b. Equipment designed to have more than one use.
   c. Equipment should be designed to make it easier to hold and hold.
   d. When each finger moves individually, such as typing work, the loads distributed on the fingers must match the strength of each finger.
   e. Handrails, bars and similar equipment should be arranged so that the load is well distributed and with minimum power.

3. Result and Discussion
Data obtained from the company can be seen graph of demand and cement production for one year. From the below graph can be seen demand and cement production in 2017 fluctuated.
3.1. Work Element Data
The operator's movement at the cement-bagging station is broken down into job elements based on the MTM method. The time-measuring system with MTM divides the work of basic motion elements including reaching, holding, engaging, rotating, positioning, removing, loose rafts, eye movements, and other limbs. The timing for each element of the basic movement is determined based on several conditions called "motion classes."

| No | Work  | Work Elements                     | MTM Motion |
|----|-------|-----------------------------------|------------|
| 1  | 1     | Turn the machine on               | RD         |
| 2  | 2     | Spin                              | TBC2       |
| 3  | 3     | Walking back                      | WP         |
| 4  | 4     | Picked up a cement bag            | G1A        |
| 5  | 5     | Spin                              | TBC2       |
| 6  | 6     | Walking carrying a cement bag     | WPO        |
| 7  | 7     | Put a cement bag in the machine   | RL1        |
| 8  | 8     | waiting until the bag of cement is fully loaded | AB |

3.2. Work Time Data
Calculation of working time data using Methods Time Measurement (MTM).
Operator 1

Table 2. MTM analysis chart for operator 1

| Left Hand Information | No | Left Hand | TMU | Right Hand | No | Right Hand Information                                      |
|-----------------------|----|-----------|-----|------------|----|-------------------------------------------------------------|
|                       |    |           | 26,7| R30D       |    | Turn on the packer machine                                  |
|                       |    |           | 7,3 | EF         |    |                                                             |
|                       |    |           | 10,6| APA        |    |                                                             |
|                       |    |           | 37,2| TBC2       |    | Spin 180°                                                   |
|                       |    |           | 9,4 |            |    |                                                             |
|                       |    |           | 15  | W2P        |    | Walking back                                                |
|                       |    |           | 2   | G1A        |    | Picked up a cement bag                                      |
|                       |    |           | 7,3 | EF         |    |                                                             |
|                       |    |           | 37,2| TBC2       |    | Spin 180°                                                   |
|                       |    |           | 9,4 |            |    |                                                             |
|                       |    |           | 17  | W2Po       |    | Walking carrying a cement bag                               |
|                       |    |           | 2   | RL1        |    | Put a cement bag in the packer machine                      |
|                       |    |           | 7,3 | EF         |    |                                                             |
|                       |    |           | 10,4| NS         |    |                                                             |
|                       |    |           | 31,9| AB         |    | waiting until the bag is fully loaded                       |
|                       |    |           |     |            |    |                                                             |
|                       |    |           |     |            |    | Total 230,7                                                 |

Operator 2

Table 3. MTM analysis chart for operator 2

| Left Hand Information | No | Left Hand | TMU | Right Hand | No | Right Hand Information                                      |
|-----------------------|----|-----------|-----|------------|----|-------------------------------------------------------------|
| Hold the machine      |    | R10       | 21,2| R22D       |    | Turn on the packer machine                                  |
|                       |    |           | 7,3 | EF         |    |                                                             |
| No | Left Hand Information          | TMU | Right Hand Information | No | Right Hand Information |
|----|--------------------------------|-----|------------------------|----|------------------------|
|    | Hold the machine              |     |                        |    |                        |
|    | Hold the machine              | R10 | R26D                   | 23,9|                        |
|    |                               |     | EF                     | 7,3 |                        |
|    |                               |     | APA                    | 10,6|                        |
|    |                               |     | TBC2                   | 37,2|                        |
|    |                               |     | Spin 180°              | 9,4 |                        |
|    |                               |     |                        | 15  | Walking back 1-2       |
|    |                               |     |                        | 2   | Picked up a cement bag |
|    |                               |     | EF                     | 7,3 |                        |
|    |                               |     | TBC2                   | 37,2|                        |
|    |                               |     | Spin 180°              | 9,4 |                        |
|    |                               |     | W2Po                   | 17  | Walking carrying a cement bag |
|    |                               |     |                        | 2   | Put a cement bag in the packer machine |
|    |                               |     | EF                     | 7,3 |                        |
|    |                               |     | NS                     | 10,4|                        |
|    |                               |     | AB                     | 31,9| waiting until the bag is fully loaded |
| Total |                                     |     |                        |    | 225,2                   |

**Operator 3**

Table 4. MTM analysis chart for operator 3
3.3. *Proposed Design*

Based on the results of observation, identification, formulation and measurement, the researcher proposes a solution to reduce the timing of the product by replicating the method of working precisely on the movement of work that is not in accordance with the principle of economic movement. The operator’s movement which is not in accordance with the economic principle of movement will be reduced or eliminated.

3.4. *Time Calculation with Proposed Movement Elements*

Can be seen from the actual MTM analysis chart, a work movement that is not in accordance with the principle of economic movement is a rotating motion and walked to pick up a bag of cement. Furthermore, the unsuitable work movements are eliminated, then recalculated time of processing using MTM method.

**Operator 1**

| Table 5. MTM analysis chart based on proposed design for operator 1 |
| --- | --- | --- |
| **MTM ANALYSIS CHART** |  |  |
| **Section** : Cement bagging | **Date** : Oct, 27th 2018 | **Sheet Number**: 1 |
| **Operator** : 1 | **Analyst** : Wan Dermawan |  |
| **Left Hand Information** | **No** | **Left Hand** | **TMU** | **Right Hand** | **No** | **Right Hand Information** |
|  |  |  | 26,7 | R30D |  |  |
|  |  |  | 7,3 | EF |  |  |
|  |  |  | 10,6 | APA |  |  |
|  |  |  | 2 | G1A |  |  |
|  |  |  | 7,3 | EF |  |  |
|  |  |  | 2 | RL1 |  |  |
|  |  |  | 7,3 | EF |  |  |
|  |  |  | 10,4 | NS |  |  |
|  |  |  | 31,9 | AB |  |  |
| **Total** |  |  | 227,9 |  |  |  |

Walking carrying a cement bag

Put a cement bag in the packer machine

waiting until the bag is fully loaded

Turn on the packer machine

Picked up a cement bag

Put a cement bag in the packer machine

waiting until the bag is fully loaded
Based on the analysis of movement economic principles, the proposed method of work is to eliminate the spinning movement and walking movement and also move the table, the cement bag, to be easily accessible. This proves that the proposed work method provides a shorter standard time than the actual work method with a time difference of 6.28 seconds.

4. Conclusion
After calculating and analyzing the result of working time measurement by Methods Time Measurement (MTM) method at cement bagging station at PT Yoga Wirawan Mandiri, it can be concluded as follows:
1. The cause of non-achievement of production targets at PT. Yoga Wirawan Mandiri is caused by work methods that are inconsistent with the economic principles of the movement.
2. Proposed improvement of work methods in accordance with the economic principles of movement that eliminates the movement of work spins and walks, and move the tool of the table is how to close to the reach of hand.
3. The proposed working method can reduce the working time from 11.4 seconds to 5.12 seconds per one sack of cement.
4. Comparison of the amount of cement production is equal to 155.2 tons greater using the proposed work method.

5. References
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