Eliminating waste using lean tools and delmia quest simulation

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Abstract. Manufacturing industries and servicing providers have successfully implemented lean tools during managing and controlling the activities. This study was carried out at pickle manufacturer one of Small Medium-sized Enterprise (SME) in Malaysia to reduce non-value added activities using some tools from time and motion study and Delmia Quest software. Solutions were suggested to reduce non-value added activities which yielded improvement of 24% and 36% in labor utilization and 25% in daily output.

1. Introduction
Lean manufacturing (LM) is one of traditional approach to identify and eliminating wastes. An increasing number of literature studies have found that LM has significantly contributed to the success of companies by reducing costs [1], maximizing the productivity [1][2], reducing production time [3] and reducing work in process (WIP) [4].

There are approximately 25 Lean Tools [5] but this study is only focusing on layout management and time and motion study. Proper layout management will reduce the material handlings, thus reducing unnecessary movement of labors. Time and motion study is used to analyze human motions and eliminate non-productive process, which can reduce the number of tasks, maximize the space utilization and reduce production time.

Anything in the manufacturing process that does not adds value during transformation of inputs into outputs is known as waste [6]. There are seven wastes that exist in manufacturing or servicing companies which are overproduction, queues, transportation, inventory, motion, underutilized people and defective product [7].

This study is performed to identify and eliminate wastes in pickle manufacturer. The selected company is one of Malaysian SMEs. Lack of expertise, limited resources, and lack of method and procedure are among SMEs weaknesses [8]. Hence, Lean Tools are proposed to eliminate wastes and the solutions are validated through Delmia Quest Simulation. Delmia Quest Software is powerful tools that can create a virtual manufacturing environment that allow the simulation of actual processes[9].

2. Methodology
Time and motion observations were performed in the company using stopwatch. The qualified worker was selected to be studied. Data collected including process flow, handling time and distance from
area to other area were simulated in Delmia Quest Simulation. The simulation was simulated for eight working hours.

Non-value added activities were listed by referring the motion study principles which are eliminate all necessary work, combine operations or elements, change the sequence of operations, and simplify the necessary operations [10]. Possible solutions and alternatives were searched and evaluated using Delmia Quest.

Total distance, labour utilization and daily output are measured to evaluate the effectiveness of the solutions.

3. Result and Discussion
This company uses traditional method where majority of the processes involving human. After observation and investigation, it was found the cutting section consumed highest completion time compared to other sections. The procedure for cutting section is shown in Figure 1.

![Figure 1 Procedure in cutting section.](image)

In cutting section, there are two main activities; collecting raw fruits from receiving bay and cutting fruits into desire shape. The receiving bay is located 70.1m from cutting area. The worker is requested to return the trolley to trolley area after unloading the fruits. This is because the trolley will be used in salting area as well. The detail of the workflow of current layout is illustrated in Figure 2. From the observation there is no standard time for each cutting activity. The worker spends more time in collecting fruits rather than cutting activity.
Table 1 shows the distance and travelling time from cutting area to receiving bay. Taking trolley and returning trolley to trolley area were identified as non-value added activities.

3.1. Alternative 1: Relocate trolley area

The improved layout where the trolley area is relocated next to cutting area is shown in Figure 3. The receiving bay is remained in current position. It is expected to save approximately 35% time (64s out of 180s). Returning trolley to trolley area is eliminated by this solution.
Figure 3 Proposed layout for Alternative 1.

3.2 Alternative 2: Relocate receiving bay and trolley area
Figure 4 represents the new locations for receiving bay and trolley area. Receiving bay is located next to cutting area. The distance travel is reduced from 249.2m to 59.6m. The workers However, this suggestion will need the company to modify the main entrance.
3.3 Evaluation of the alternatives

Table 2 represents the simulation result from Delmia Quest and it shows total distances, labour utilization and daily output for current layout and two proposed layouts. The simulation result shows the current layout is not efficient where the total distance travel is 1128m and the company is not fully utilize the workers.

Table 2 Total distances, labour utilization and daily output for current layout and two proposed layouts.

|                     | Current | Alternative 1 | Alternative 2 |
|---------------------|---------|---------------|---------------|
| Total distance (m)  | 1128    | 744           | 293           |
| Busy loaded (%)     | 51.8    | 64.43         | 70.48         |
| Output (kg)         | 200     | 200           | 250           |

Effective layout will minimise production time and maximise the output. It was found the worker utilization increase by 24% for Alternative 1 and 36% for Alternative 2. It is proved that there are
wastes generated in the workers motion for current production. The daily output is expected to be increased by 25% for Alternative 2 if the proposed changes are implemented.

4. Conclusion
This study identified the use of Delmia Quest simulation integrating with Lean Tools are able to improve cutting section efficiency. It is proven by eliminating the wastes will contribute to high output and high labor utilization. By making simple changes to the process, the company able to compete and improve profitability.

Acknowledgement
The authors acknowledge the financial supports provided by Universiti Teknologi MARA Cawangan Pulau Pinang.

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