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Application of the Lean Six Sigma Method to Improve the Packaging System

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A B S T R A C T

At present, the tissue and toilet papers are used very popular in over the world. However, this product has much change about the quality in the domain and abroad. Therefore, in order to solve the problems of quality and productivity, this research adropted the lean six sigma method to analyse and improve the current state of the packaging systems which purposes to increase quanlity and productivity of product. Moreover, the simulation result also shows that the lean six sigma method helps to increase the productivity of 2740 products per day and decreases the watse time about 1 minutes and 45 seconds.

Keywords: *Tissue and toilet paper, packaging system, lean six sigma method, quanlity and productivity of product.*

1. Introduction

Currently, the tissue packaging system is often designed and operated autmatically. To ensure the packaging process is carried out efficiently, the product meets the high quality standards. The parameter control of the packaging process is really nescessery. This article research the strengths and weaknesses of the system as well as the missing parts of the packaging system and the need to do and improve. Improving the packaging system includes the productivity and quality of the packaged products, thereby helping the factory to achieve its production and quality targets [1-2]

There were many researches on Lean Lean Six Sigma method in packaging operations. However, there is no topic on applying lean Six Sigma method to solve bottleneck problems in the packaging operation. Especially the application to overcome the waste of time and increase the productivity for the system to operate efficiently [3-4].

2. Research diagram and method

2.1 Research diagram

The manufacturing process is a very important stage which dicides the productity and quanlity, which also supports the standard way in the manufaturing operation as shown in Figure 1 [5].

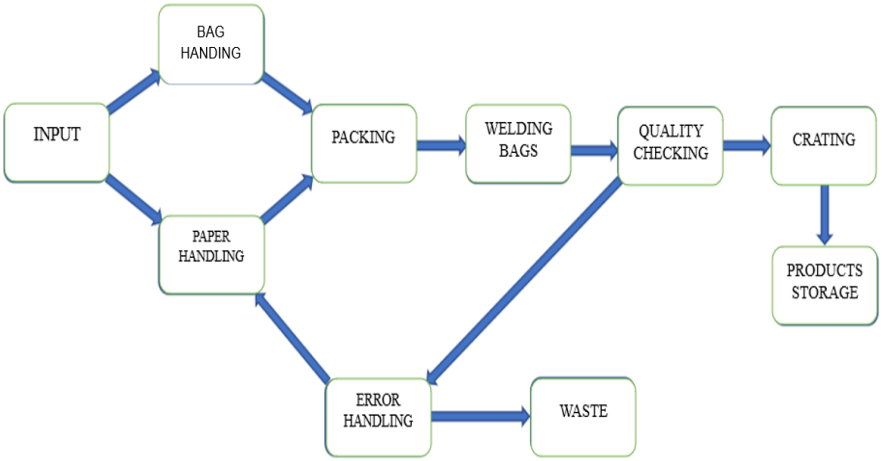

Figure 1: Tissue packaging process

Figure 1 shows a tisuese packaging process which includes 10 steps as input tisues, paper and bag handing, packing, welding bag, quality checking, crating, error hading, prodcut storage and waste. Currently, the system has many suitable working processe as shown above diagram.

2.2 Research method

The simulation method was used to establish the model, simulate and estimate the tissue packaging system in this research. The lean six sigma was also adropted to improve about productivity and quality of product. The calculation parameter are as follows [7-9]:

- Packing system capacity: From 30 to 40 products per minute

The produced amount per day for 8 hours of working is:

$$P = S * 8 * 60 \text{ (products per day)} \quad (1)$$

The average output quantity per 1 month is:

$$Q = P * N \text{ (products per month)} \quad (2)$$

Where: P is the total packed products in 1 day

S is the packed products in 1 minute

Q is the average total packed products in 1 month

N is the actual packed products of working days in a month

- Product cost:

The cost of a product box is:

$$T = P / n \text{ (US dollar)} \quad (3)$$

The cost of 1 product bag is:

$$H = T / p \text{ (US dollar)} \quad (4)$$

Where: P is the total packed products in 1 day

T is the cost of 1 product box

H is the cost of 1 product bag

n is the number of product boxes

p is the number of bags in a product box

3. Results and discussion

3.1 Input parameter and packaging results

Classification process of packaging time for a product was shown in Table 1. Through individual time observation to measure the time of a work component, the steps that create the value can be identified. Non-value-added activities are the cause of production prolongation, so eliminating or reducing these activities not only reduces packaging costs, but also reduces packaging time, packaging operations. Factory packages will be more flexible to accommodate changes in orders.

Table 1. Classification of packaging time

Process	Classification of activities		
	Standard time (seconds)	Actual time of operation (seconds)	Delay time (seconds)
Paper handling	2.5	3	3
Packaging handling	2.5	4	3
Pack	2	3	5
Weld the mouth of the bag	2	2	6
Error checking	4	5	7
Error handling	2	6	9
Crating	12	12	8
Total time to complete	27	35	51

Through the flowchart as shown in Figure 2, it can be seen that the time spent on non-value-added activities is very large compared to the time spent on value-added activities. In which the activity that takes up the longest time is the activity that waits for the next stage to pick up the semi-finished products for the operation leading to the inventory of semi-finished products, whereas the relatively short time to check the quality of the semi-finished products leads to defects. product.

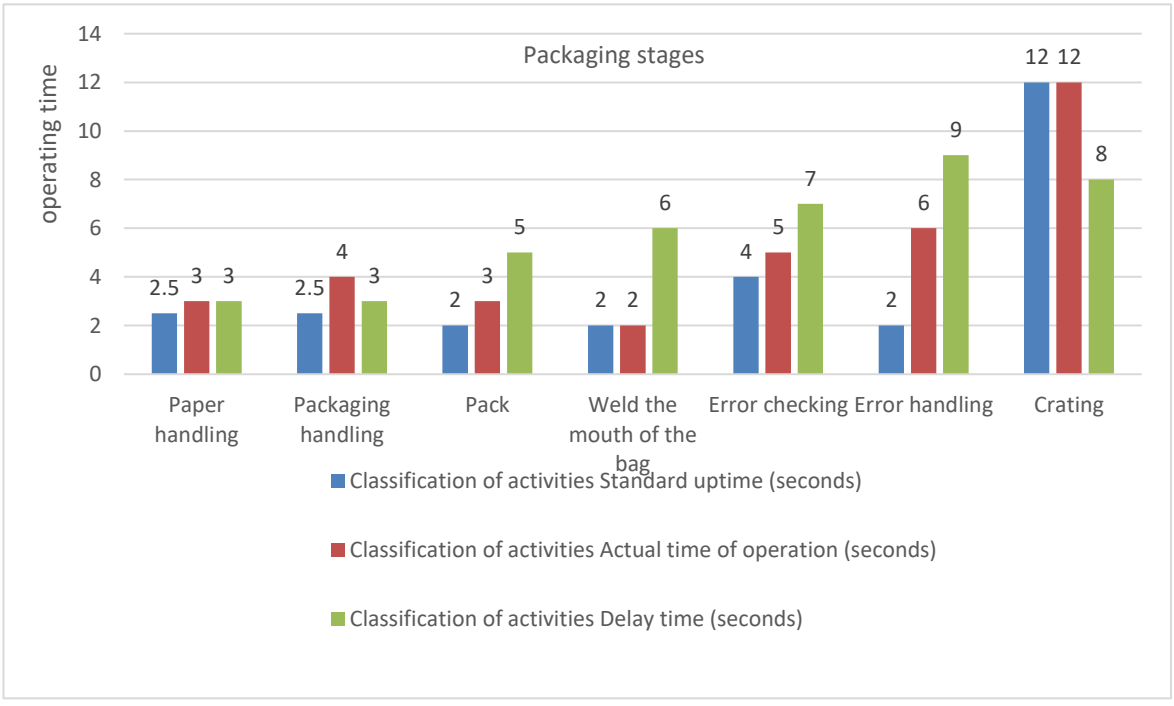

Figure 2: Time chart of tissue packaging stages

The working status for each station in the system is shown in Figure 3. The result shows that the packaging, paper processing, welding, packaging stage is blocked as shown in the yellow column. It is quite obvious and quite much blocked in column 3 of packed stage.

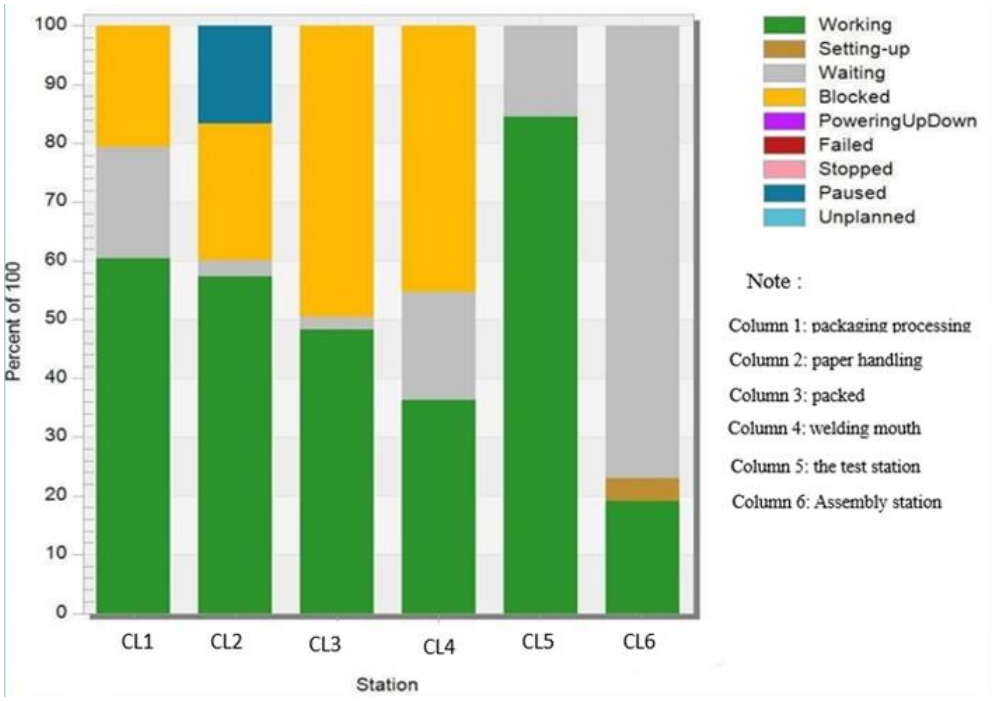

Figure 3: System's working status

Looking at the columns in Figure 3, the working index of the system is explained as follows:

Column 1 (CL1): Packaging process with a yellow index means the blocked index is shown in the column with a ratio of 20%

Column 2 (CL2): Paper handling with yellow index means that the congestion index is shown in the column with a ratio of 15% and has a paused index of 12%

Column 3 (CL3): Packed station with yellow index means the congestion index shown in the column with the ratio of 50%

Column 4 (CL4): Sealing station the mouth of the bag with the yellow index means the blocked index is shown in the column with the ratio of 42%

Column 5 (CL5): The column of the test station with a green index, we see that the index in the column is 85%, showing that the stations are working normally

Column 6 (CL6): Assembly station with the brown indicator occupies 5% of the parameter setting and 20% is in normal operation.

3.2 Using lean six sigma method to solve the blocked problem (bottleneck)

For the material transportation department, two distribution stations will be established at the warehouse, based on the packing plan of the planning department, an employee of the warehouse will move to the distribution station to supply materials. data according to the order progress before and after. For individual orders will supply each order, then receive the notification of streamlining the requirements for the next order. For the packing department, based on the plan given by the planning department, it will carry out the packing activities according to the planned schedule and fulfill the requirements as set forth.

For bottlenecks in the initial result that are resolved quickly, the productivity as well as the time to improve is more efficient. Lean six sigma is a suitable method which is adropted for resolving this problem. The new result is shown in Table 3.

Table 0. Runtime in Lean Six Sigma

Process	Classification of activities		
	Standard uptime (seconds)	Actual time of operation (seconds)	Delay time (seconds)
Paper handling	2.5	3	2
Packaging handling	2.5	2	2.5
Pack	2	3	4
Weld the mouth of the bag	2	2	2

Error checking	4	5	5
Error handling	2	4	6.5
Crating	12	10	8
Total time to complete	27	29	35

The performance indicators are as follows: Standard operating time of 27 second, actual operating time of 29 second and delay time of 35 second.

As a result of this we can draw that on average 1 carton can be produced in 5 minutes that makes both the operation time as well as the process waiting time is reduced as well as the cost of lost time as well as the process waiting time will be more beneficial for packaging. The result got after using lean six sigma as shown in Figure 4.

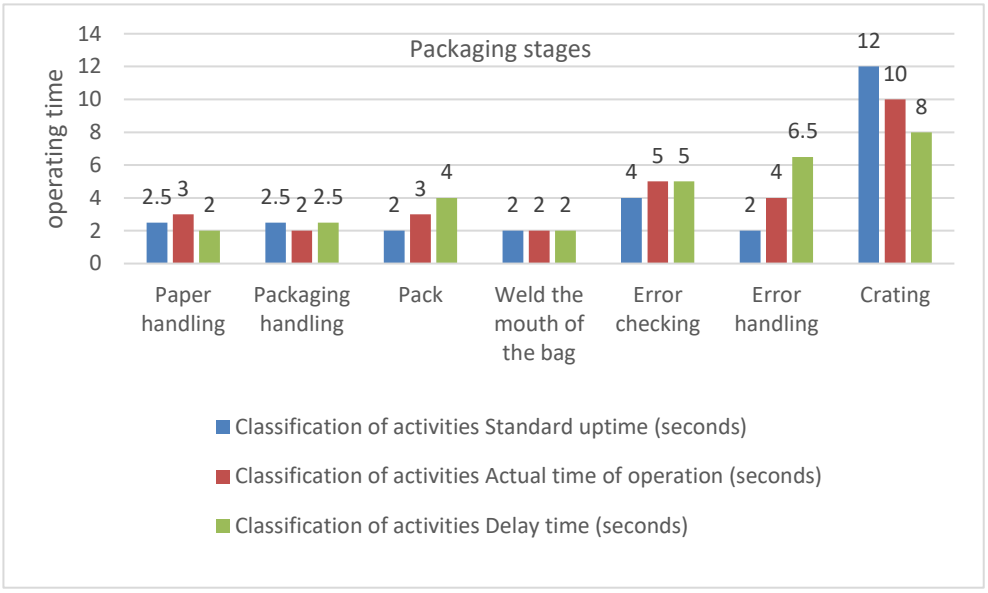

Figure 4: Time chart after using lean Six Sigma

Based on the time chart of the stages, we can see that the waiting time is also when the delay time of the stages is greatly reduced, making the productivity of the transmission line higher to achieve the target. In terms of productivity, the time of the stages is significantly reduced compared to before using the bottleneck method.

This paper used simulation software and lean six sigma method to determine and improve the uptime parameters of tissue packaging system. The results after improvement is shown in Figure 5.

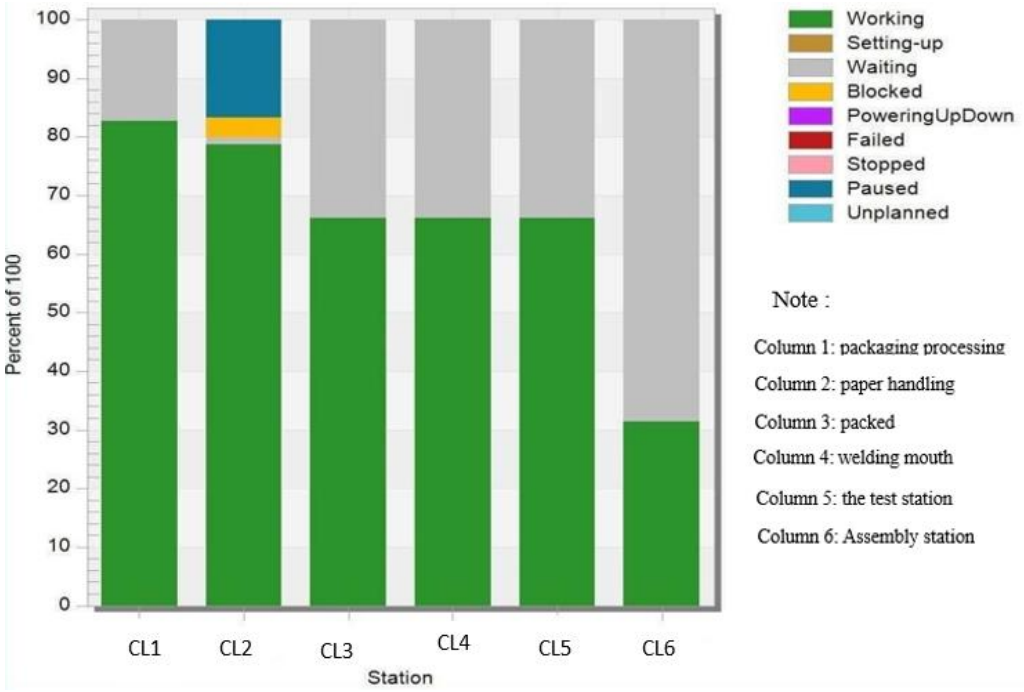

Figure 5: System's working status after improvement

Figure 5 shows the working status after improvement which the blocked phenomana were resolved quite well. Therefore, the packaging process at stations operate more smoothly.

The output of the packaging system has also been improved and increased very well from 620 cartons per day and equal to 7440 products to 849 ropes per day equal to 10,188 products per day.

Looking at the columns in Figure 5, the working index of the system as follows:

Column 1 (CL1): Packaging processing with yellow index means that the congestion index (blocked) is almost zero.

Column 2 (CL2): Paper handling with a yellow index means that the congestion index is shown in the column with a ratio of 5% and has a pause index of 15%

Column 3 (CL3): Packed with yellow index means that the congestion index is shown in the column with an almost absolute ratio.

Column 4 (CL4): Welding mouth with a yellow index means that the blocked index is shown in the column with an almost absolute ratio of effective operation.

Column 5 (CL5): The test station with the blue index, we see that the index in the column is 68%, showing that the stations are working normally

Column 6 (CL6): Assembly station column with brown indicator 0% is setting parameters and 30% is operating normally.

The results have much change before and after impvement which are shown in Table 5 and Figure 6.

Table 5: Chain improvement comparison

	Output per one day (barrel)	Product per one day (piece)	Total congestion of workstations (%)	Normal working stations (%)
Before the improvement	1. 620	2. 7440	3. 127	4. 105
After improvement	5. 849	6. 10188	7. 5	8. 388

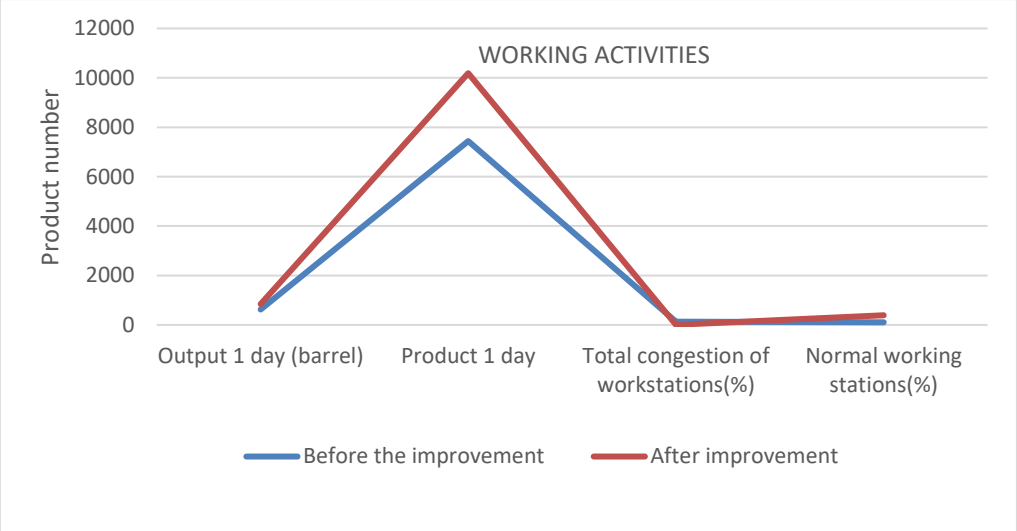

Figure 6: The diagram before and after improvement

Looking at the table as well as the graph, the result shows clear change to see that the application of the improved method to the line is very effective and leads to increased productivity and greater output than before. using improved methods.

4. Conclusion

It has much blocked phenomena at the initial working stations which causes the waste of the tissue line due to delay time for packaging process.

After applying the lean six sigma method into the tissue packaging line clearly for solving the blocked problem in the sysrem which shows that the waiting time as well as the delay time of the packaging system are significantly improved.

Therefore, the system not only reduce the wasted time but also increase the significantly productivity. Otherwise, lean Six Sigma approach also solves the system's bottleneck problem and wastes in transportation and waiting time with the expectation that it will be deployed so that the system with the required resources necessary for implementation and workers really understand the effectiveness of the measure. It is important for resolving the problems in the company to always be ready to absorb and apply new techniques and technologies in packaging.

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