DETERMINATION OF STANDARD TIME FOR BISCUIT PACKAGING PROCESSING

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ABSTRACT

A firm named PT. XYZ specializes in the production of biscuits, wafers, and chocolate chips. The biscuit production process encompasses several stages, beginning with the collection of raw materials in the warehouse, followed by weighing them according to the recipe, and culminating in packaging and storage in the finished product warehouse. A problem arose during the packaging stage in the first work shift, where production fell short of the target only 200 cartons of biscuits were produced compared to the goal of 250 cartons per shift. To address this issue, standard time calculations will be conducted. The research process involves observing cycle times in the packaging process, testing data adequacy, ensuring data uniformity, identifying rating factors, calculating normal time, identifying allowances, determining standard time, and calculating labor requirements, utilizing a stopwatch to measure the necessary work time accurately. The calculated standard time for secondary packaging is 75.683 seconds, while for tertiary packaging it is 53.409 seconds. Based on these results, it is determined that an additional eighteen workers are needed for secondary packaging, and two more workers are required for tertiary packaging.

Keywords: *Standard Time, Rating Factor, Allowance, Number of Labor*

1.0 INTRODUCTION

Production and operation activities are very essential elements in the company. The sustainability of the company is influenced by the production activities of a company. Production activities can be said to be an activity of creating goods or services offered by a company to consumers. All companies require action in the measurement of time. This is done for all production activities contained in the company. The measurement results will then be used to provide information about work performance.

Measurement of working time in the company in order to determine the time standard then used a tool in the form of a stowatch. This method is suitable for use on jobs that are short in duration and repetitive. The measured data will provide a standard time for completing the work cycle, which all workers performing the same activity will use as a benchmark for their tasks [3].

Chocolate chips, wafers, and biscuits are produced by PT. XYZ's enterprise. The biscuit production process consists of several stages starting from collecting raw materials in the warehouse and then weighing them according to the recipe until they are packed and stored in the finished product warehouse. In the product packaging process, the company packs using machine assistance and also manual human assistance. The biscuit packaging process comprises a primary packaging

stage, where an automatic machine uses polycello plastic packaging. Subsequently, the products are manually placed into PP plastic for secondary packaging. Six products encased in polycello are transferred into PP plastic. Following this, the products in PP plastic are manually placed into cartons, with each carton containing six products. The cartons are then sealed using transparent duct tape with a tape machine sealer and subsequently stacked onto pallets.

In companies, packaging activities still require human assistance in packing, in the primary packaging section the company already uses automatic machines, while in secondary and tertiary packaging it still uses manual methods. The company has a biscuit production target of 250 cartons per shift and per day. The company has 3 shifts, three shifts begin at different times: 00:00 to 08:00 for the first shift, 16:00 to 00:00 for the second, and 00:00 to 08:00 for the third. In the first work shift, production did not meet the target, where only 200 cartons of biscuit products were produced. Consequently, 50 target cartons remain unprocessed in both secondary and tertiary packaging. As a result, the unfinished polycello-packaged products are placed into container baskets and transferred to shift 2 workers for completion in PP plastic and carton packaging. The corporation currently lacks the ability to accurately estimate the time required for employees with average capabilities to complete the packaging, as there is no established standard time for its manufacturing process. Therefore, it is imperative to measure the standard time for both secondary and tertiary packaging processes to establish a reliable standard time for future operations [8].

Apart from that, with the standard time set at the workstation, this will help the operator in completing the work given, where the standard time is used for the maximum reference in completing one unit of product so that workers cannot work casually or exceed the predetermined standard time. The method used in solving efficiency and effectiveness problems in biscuit products is by calculating the standard time in the biscuit packaging process to find out how much time it takes to pack the biscuits into plastic and then into cardboard by taking into account the rating factor and allowance needed by workers. This standard time calculation is assisted by filling in and assessing the packing operator on the form rating factor and allowance. Additionally, a worker count computation is also performed.

2.0 METHODOLOGY

The method employed in this research is descriptive research [7]. Descriptive research seeks to methodically, objectively, and precisely characterize the features and attributes of a particular item or group. This type of study seeks to accurately describe the characteristics and facts of the subject without speculating or attempting to solve any potential issues [6].
The activities to be conducted are outlined in the following stages.

a. Observe the cycle time in the packaging process and determine the selected cycle time.
b. Perform data adequacy test and data uniformity at the observed cycle time.
c. Identify the value of the rating factor on the packaging operator.
d. Calculate the normal time in the packaging process.
e. Identifying allowance values for packaging operators.
f. Calculate the standard time in the packaging process.

$$W_s = \frac{T_t \times W_t \times R_f}{T_p} \times \frac{100}{100 - A\mu} \quad (1)$$

The total time spent on observation (Tt), working time (Wt) (average work %), rating factor (Rf), total product produced (Tp), and job allowance (All) are all indicated [14].

g. Calculating the number of workers needed so as to know the shortage of labor [11].

$$= \frac{JP}{\frac{Standard\ Time\ x\ Demand}{Available\ Time}} \quad (2)$$

3.0 RESULTS AND DISCUSSION

3.1 Measuring Cycle Time

Data was collected on the cycle time for each step of the process. In solving this problem, the process steps taken are the secondary packaging process stages in PP plastic and the tertiary packaging process stages in cardboard packaging [2].

a. Cycle time in the primary packaging process in polycello plastic.
b. Cycle time in the secondary packaging process in PP plastic.
c. Cycle time in the tertiary packaging process in carton packaging.

Observations were made to 10 operators for the secondary packaging section and 2 operators for the tertiary packaging section.

3.2. Test for Adequacy and Uniformity of Data

When more observational data than necessary is obtained via the data sufficiency test, proceeding to the next stage is possible; if insufficient observational data is found, further observations must be taken. Following the data adequacy test, the average cycle time (centre line) was computed to perform the data uniformity test, which involved calculating the standard deviation. Finally, using the control chart to record the data that has been seen, the values for the upper control limit (UCL), lower control limit (LCL) may be found [1].

a. Secondary packaging process (PP plastic)
   1) Adequacy test of the data
      The following formula used to determine the operator 1 tertiary packaging data adequacy test [4].

$$N' = \left[\frac{k}{\frac{s\sqrt{N\,(\sum X^2) - (\sum \mathrm{X})^2}}{\sum \mathrm{X}}}\right]^2$$

$$N' = \left[\frac{40\sqrt{30\,(86.258) - (1.597)^2}}{1.597}\right]^2$$

$$N' = 23.4$$

      According to the computation's findings, the value of N' < N is 23.4 < 30, so the observed data is sufficient.
   2) Data uniformity test
      This formula used to calculate the secondary packaging data uniformity test on operator 1 [5].
      a) Standard Deviation

$$\text{sd} = \frac{1}{N}\sqrt{N\,(\sum X^2) - (\sum \mathrm{X})^2}$$

$$sd = \frac{1}{30}\sqrt{30\,(86.257) - (1.597)^2}$$

$$sd = 6.548$$

      b) Central Line

$$\underline{X} = \frac{\sum X_t}{N} = \frac{1.597}{30} = 53.233\ seconds$$

      c) Control Limits

$$\text{UCL} = \underline{X} + 2sd$$

      UCL = 53.23 + 2 (6.548)
      UCL = 66.329

$$\text{LCL} = \underline{X} - 2sd$$

      LCL = 53 .23 - 2 (6.548)
      LCL = 40.138

A control chart, shown in Figure 1, may be used to represent the control boundaries based on the analysis results.

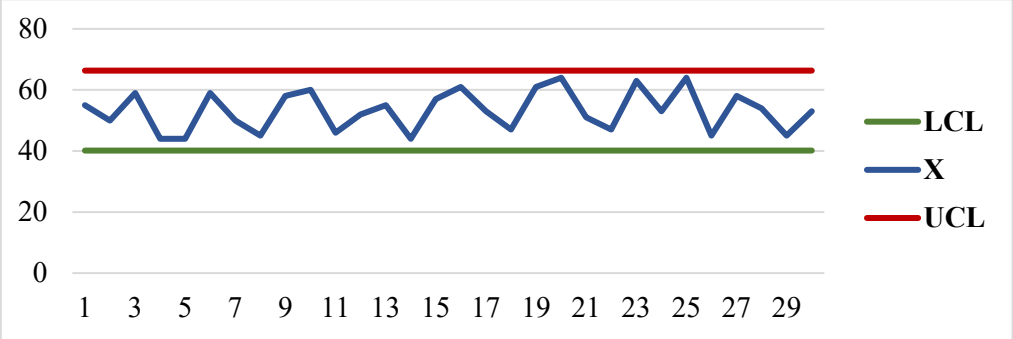

Figure 1: Secondary Packaging Control Map

Figure 1 shows that all of the data remain within the control limits. The 10 operators' data uniformity test, is shown in Table 1.

Table 1: Summary of the Uniformity Test for Secondary Packaging

Operator	∑X	∑X ²	N	Standard Deviation	LCL	UCL	Description
1	1597	86257	30	6.548	40.138	66.329	Uniform
2	1572	83382	30	5.899	40.602	64.198	Uniform
3	1616	88322	30	6.627	40.613	67.120	Uniform
4	1627	89547	30	6.719	40.794	67.672	Uniform
5	1604	86974	30	6.469	40.529	66.604	Uniform
6	1597	86257	30	5.995	41.710	65.690	Uniform
7	1595	85925	30	6.226	40.714	65.619	Uniform
8	1649	91475	30	5.366	44.235	65.698	Uniform
9	1638	90644	30	6.457	41.685	67.515	Uniform
10	1609	87563	30	6.610	40.414	66.853	Uniform

Table 1 indicates that all data remain within the control limits. Table 2 presents the cycle time for secondary packaging activities.

Table 2: Cycle Time in Secondary Packaging

Operator	Cycle Time	Operator	Cycle Time
1	53.230	6	53.230
2	52.400	7	53.167
3	53.867	8	54.967
4	54.230	9	54.600
5	53.467	10	53.630

b. Tertiary packaging process (carton packaging)
   1) Data adequacy test
      The adequacy test for tertiary packaging data on operator 1 can be calculated in the way described beneath it [12].

$$N' = \left[\frac{\frac{k}{s\sqrt{N\,(\sum X^2) - (\sum X)^2}}}{\sum X}\right]^2$$

$$N' = \left[\frac{40\sqrt{30\,(41.309) - (1.105)^2}}{1.105}\right]^2$$

$$N' = 23.91$$

According to the computation's findings, the value of N' < N is 23.91 < 30, so the observed data is sufficient.

2) Data uniformity test

This formula used to calculate the tertiary packaging data uniformity test on operator 1 [13].

a) Standard Deviation

$\text{sd} = \frac{1}{N}\sqrt{N\,(\sum X^2) - (\sum X)^2}$

$$sd = \frac{1}{30}\sqrt{30\,(41.309) - (1.105)^2}$$

$$sd = 4.579$$

b) Central Line

$$\underline{X} = \frac{\sum X_t}{N} = \frac{1.105}{30} = 36{,}833\ seconds$$

c) Control Limits

$\text{UCL} = \underline{X} + 2sd$

UCL = 36.833 + 2(4.579)

UCL = 45.992

$\text{LCL} = \underline{X} - 2sd$

LCL = 36.833 - 2(4.579)

LCL = 27.674

Figure 2 displays a control chart that describes the control limits based on the calculation results.

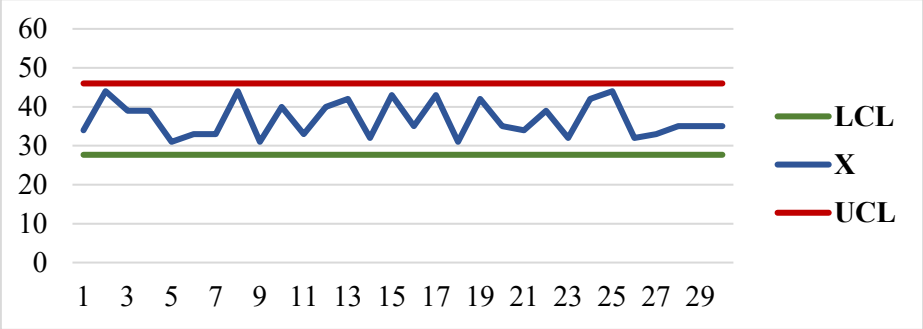

Figure 2: Tertiary Packaging Control Map

From Figure 2 shows that all of the data remain within the control limits. The 2 operators' data uniformity test, that is shown in Table 3.

Table 3: The Tertiary Packaging Data Uniformity Test Summary

Op.	∑X	∑X ²	N	Standard Deviation	LCL	UCL	Description
1	1105	41309	30	4.579	27.674	45.992	Uniform
2	1126	42774	30	4.200	29.134	45.933	Uniform

From Table 3 shows that all of the data remain within the control limits. Next, the tertiary packaging operations' cycle time is displayed in Table 4.

Table 4: Recapitulation of Cycle Time in Tertiary Packaging

Operator	Cycle Time
1	36.83
2	37.53

3.3 The Method for Determining Standard Time

The secondary and tertiary packing methods, which will be explained below, use the normal packaging time calculation.

a. PP plastic secondary packaging process

Standard time calculation requires calculation of cycle time and normal time. In addition, an assessment was also carried out on the rating factor and also the allowance [15]. The rating factor of ten operators is displayed in Table 5.

Table 5: Rating Factor of Secondary Packaging

Factor	Op. 1	Op. 2	Op. 3	Op. 4	Op. 5	Op. 6	Op. 7	Op. 8	Op. 9	Op. 10
Skills	+0.06	+0.11	+0.00	+0.11	+0.06	+0.06	+0.11	+0.06	+0.15	+0.11
Effort	+0.10	+0.05	+0.02	+0.05	+0.05	+0.05	+0.05	+0.05	+0.08	+0.05
Working Conditions	+0.02	+0.02	+0.02	+0.02	+0.02	+0.02	+0.02	+0.02	+0.02	+0.02
Consistency	+0.03	+0.03	+0.01	+0.01	+0.03	+0.01	+0.03	+0.01	+0.03	+0.03
Amount	**+0.21**	**+0.21**	**+0.05**	**+0.19**	**+0.16**	**+0.14**	**+0.21**	**+0.14**	**+0.28**	**+0.21**

The following formula used on operator 1 to determine normal time after the number of rating factors is known [16].

Normal Time = Cycle Time x (1+ Rating Factor)
= 53.230 x (1+ 0.21)
= 64.408 seconds

The normal time for the ten operators is displayed in Table 6.

Table 6: Normal Time Recapitulation in Secondary Packaging

Operator	Cycle Time	Rating Factor	Normal Time
1	53.23	0.21	64.408
2	52.4	0.21	63.404
3	53.867	0.05	56.560
4	54.23	0.19	64.534
5	53.467	0.16	62.022
6	53.23	0.14	60.682
7	53.167	0.21	64.332
8	54.967	0.14	62.662
9	54.6	0.28	69.888
10	53.63	0.21	64.892

Standard time can be calculated if we have determined the allowance value in secondary packaging [15].

Table 7: Allowance of Secondary Packaging

Factor	Op. 1	Op. 2	Op. 3	Op. 4	Op. 5	Op. 6	Op. 7	Op. 8	Op. 9	Op. 10
Labor released	3%	4.20%	3.60%	2.50%	5%	4.80%	3%	1%	4.50%	6%
Work attitude	1%	0.40%	0.20%	0.30%	0.60%	0.50%	0.40%	0.20%	0.50%	1%
Work movement	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Eyestrain	6.50%	6.20%	6.80%	6.40%	7.20%	6.80%	6.40%	7%	6.80%	7.50%
Workplace temperature conditions	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Atmospheric state	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Good environmental conditions	3%	1.70%	2.10%	1%	2.40%	1.80%	2%	1.50%	1.50%	3%
Personal needs	4%	3.40%	4%	2.80%	3.80%	4.20%	2.70%	2.30%	2.50%	5%
Amount	**20.50 %**	**18.90 %**	**19.70 %**	**16.00 %**	**22.00 %**	**21.10 %**	**17.50 %**	**15.00 %**	**18.80 %**	**25.50 %**

After knowing the number of allowances for the ten operators, this formula may be used to figure out the standard time [17].

Standard Time = Normal Time × (1 + Allowance)
= 64.408 × (1 + 0.205)
= 64.408 × 1.205
= 77.612 seconds

Standard Time for each of the ten operators is shown in Table 8.

Table 8: Standard Time of Secondary Packaging

Operator	Normal Time	Allowance	Standard Time
1	64.408	0.205	77.612
2	63.404	0.189	75.387
3	56.56	0.197	67.702
4	64.534	0.16	74.859
5	62.022	0.22	75.667
6	60.682	0.211	73.486
7	64.332	0.175	75.590
8	62.662	0.15	72.061
9	69.888	0.188	83.027
10	64.892	0.255	81.439
	Average		**75.683**

Based on the standard time in Table 8 above, the average standard time is 75.683 seconds. The amount of labor required for secondary packaging is as follows.

Demand = 250 cartons × 6 PP plastic packs × 6 polycello packs
= 9.000 units

Available time = 7 hours × 3600 seconds
= 25.200 seconds

$$JP = \frac{Standard\ Time\ x\ Demand}{Available\ Time}$$

$$JP = \frac{75.683\ x\ 9.000}{25.200} = 27.03\ \approx 28\ persons$$

According to the previous calculation's results, in order to achieve the production objective, up to 18 operators must be added, as there are now only 10 available.

b. Packaging process tertiary carton packaging

Standard time calculation requires calculation of cycle time and normal time. In addition, an assessment of the rating factor and allowance is also carried out [9].

Table. 9: Rating Factor of Tertiary Packaging

Factor	Op. 1	Op. 2
Skills	+0.06	+0.11
Effort	+0.10	+0.05
Working Conditions	+0.02	+0.02
Consistency	+0.03	+0.03
Amount	**+0.21**	**+0.21**

The following formula used on operator 1 to determine normal time after the number of rating factors is known.

Normal Time = Cycle Time × (1 + Rating Factor)
= 36 .83 × (1 + 0.21)
= 44.564 seconds

The normal time for both operators is displayed in Table 10.

Table 10: Normal Time for Tertiary Packaging

Operator	Cycle Time	Rating Factor	Normal Time
1	36.83	0.21	44.564
2	37.53	0.21	45.411

Standard time can be calculated if we have determined the allowance value in tertiary packaging.

Table 11: Tertiary Packaging Allowance

Factor	Operators 1	Operators 2
Released power	7%	6.80%
Work attitude	2%	2.20%
Work Movement	0%	0%
Eyestrain	6%	6%
Workplace temperature conditions	3%	3%
Atmospheric state	0%	0%
Good environment	1%	0.20%
Personal needs	3%	2.40%
Amount	**22.0%**	**20.6%**

After knowing the number of allowances for the two operators, this formula may be used to figure out the standard time [10].

Standard Time = Normal Time x (1 + Allowance)
= 44.564 x (1+0 .22)
= 44.564 x 1.22 = 54.368 seconds

Standard Time for both operators is displayed in Table 12 below.

Table 12: Standard Time Recapitulation in Tertiary Packaging

Operator	Normal Time	Allowances	Standard Time
1	44.5643	0.22	54.368
2	45.4113	0.206	54.766
	Average		**54.567**

Based on the standard time in Table 12 above, the average standard time is 54.567 seconds. The number of workers required for tertiary packaging is as follows.

Demand = 250 cartons × 6 PP plastic packages
= 1,500 units

Available time = 7 hours x 3600 seconds
= 25,200 seconds

$$JP = \frac{Standard\ Time\ x\ Demand}{Available\ Time}$$

$$JP = \frac{54.567\ x\ 1.500}{25.200} = 3{,}248 \approx 4\ persons$$

According to the above computation's results, in order to achieve the production objective, up to two operators must be added, as there are now only two operators available.
Recapitulation of the energy requirements for secondary and tertiary packaging is tabulated in Table 13 below.

Table 13. Recapitulation of Labor Needs in Secondary and Tertiary Packaging

No	Station	Labor		
		Available	Needed	Deficiency
1	Secondary Packaging	10	28	18
2	Tertiary Packaging	2	4	2

4.0 CONCLUSION

From the detailed description and thorough observations of the packaging processes at PT. XYZ, coupled with the comprehensive results of the standard time calculations, it can be determined that the secondary packaging process has a standard time of 75.683 seconds, necessitating addition of 18 operators. Conversely, the tertiary packaging process has an average duration of 54.567 seconds, requiring the inclusion of 2 additional personnel.

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