CHAPTER 5

IMPLEMENTATION OF KEY PERFORMANCE INDICATORS

This chapter will test the performance value of each KPIs in order to verify each value which the working team established by using statistical technique.

5.1 Performance Value Verification

To verify each performance value that the working team set in Chapter 4, the method to verify them must be performed. According to the statistical theory in Chapter 2, there are many kinds of tests depending on the character of data. The characters of collected data are normal distribution, small sample and independent, then, test for equal variances (F- test) is selected to validate the performance values. The purpose of the test is to compare the difference between each performance value before implementing KPIs and after implementing KPIs. If both data are not different, the performance value that the team set is appropriate for this factory.

5.2 Data Analysis

Firstly, data after implementing KPIs will be collected in order to calculate the value of each KPIs. These data are presented in Table 5.1. In addition, the value of each KPIs after implementing KPIs are presented in Table 5.2.

Table 5.1 Collecting data in period 7 – 12

Data	Unit	Period					
		7	8	9	10	11	12
Raw material cost	Baht	1,944,000	1,956,000	1,944,000	1,944,000	1,968,000	1,968,000
Total raw material used	Kg.	16,200	16,300	16,200	16,200	16,400	16,400
Unit production	Kg.	14,840.88	14,958.40	14,799.23	14,865.79	14,972.92	15,064.51
Unit production	Pieces	494,696	498,613	493,308	495,526	499,097	502,150
Quantity of defect that occur when using out of specification of raw material	Kg.	328.99	331.36	332.28	325.14	330.50	333.28
Product cost	Baht	2,378,689	2,496,432	2,420,706	2,361,397	2,431,086	2,417,417
Cost of good sold	Baht	2585635	2711125	2645832	2571561	2671764	2683526
Quantity of product uncompleted on time	Kg.	129.08	135.96	62.55	100.49	81.17	116.44
Quantity of non-conform raw material	Kg.	325.54	325.12	324.57	324.47	324.75	323.47
Unit defect	Kg.	311.44	294.58	307.39	319.28	306.64	299.01
Defect rate found from in-line production	Kg.	306.56	307.92	320.18	309.17	319.30	315.67
Working time (at roaster machine)	Minutes	6,644	6,658	6,690	6,676	6,631	6,680
Available time (at roaster machine)	Minutes	7,200	7,200	7,200	7,200	7,200	7,200
Loading time (at roaster machine)	Minutes	7,086	7,093	7,159	7,125	7,024	7,153

Data	Unit	Period					
		7	8	9	10	11	12
Break down time (at roaster machine)	Minutes	333	340	306	326	382	302
Accumulate idle time	Hours	692	614	664	765	517	773
Number of delayed lot	Lots	6	9	1	8	5	7
Power cost	Baht	39174.6	39878.0	40563.1	40645.9	39945.6	40879.3
Labor cost	Baht	190,000	190,000	190,000	190,000	190,000	190,000
Depreciation	Baht	210,000	210,000	210,000	210,000	210,000	210,000
Number of customer complain	Pieces	596	661	341	647	281	331
Number of good sold	Pieces	490000	481000	485000	479000	500000	485000
Total machine down time	Hours	20	13	19	28	21	15
Maintenance cost	Baht	23,760.80	26,052.80	22,600.20	28,232.40	27,080.80	22,249.50

Table 5.2 Performance value of KPIs in period 7 – 12

KPIs	Period					
	7	8	9	10	11	12
Raw material cost per unit production (Bath/piece)	3.93	3.92	3.94	3.92	3.94	3.92
Defect ratio that occur when using out of specification of raw material	2.03	2.03	2.05	2.01	2.02	2.03
Raw material cost to product cost ratio	81.73	78.35	80.31	82.32	80.95	81.41
Performance ratio	92.28	92.47	92.92	92.72	92.10	92.78
Value of product uncompleted on time (Baht)	729,080	835,960	162,550	900,490	481,170	516,440
Machine Idle Time Ratio (%)	4.70	4.79	4.27	4.57	5.44	4.23
Non-conform raw material per total raw material used	2.01	1.99	2.00	2.00	1.98	1.97
Quantity of defect per quantity of production	2.10	1.97	2.08	2.15	2.05	1.98
Number of delayed lot (lots/period)	6	9	1	8	5	7
Accumulate idle time (hours/period)	692	614	664	765	517	773
Unit production per machine (pieces/minute)	68.71	69.25	68.51	68.82	69.32	69.74
Product cost per unit (Bath/piece)	4.81	5.01	4.91	4.77	4.87	4.81
Power cost to product cost ratio	1.65	1.60	1.68	1.72	1.64	1.69
Depreciation to product cost ratio	8.83	8.41	8.68	8.89	8.64	8.69
Number of customer complain per number of good sold	0.12	0.14	0.07	0.14	0.06	0.07

KPIs	Period					
	7	8	9	10	11	12
Defect rate found from in-line production	2.07	2.06	2.16	2.08	2.13	2.10
Total machine down time (hours/period)	20	13	19	28	21	15
Maintenance cost to product cost ratio	1.00	1.04	0.93	1.20	1.11	0.92

5.3 Confirmation Test

The method of test for equal variances (F- test) is performed to confirm the performance values that set by the working team are appropriate for the factory. The method of test for equal variances (F- test) is used to test the difference between two variances of performance value of each KPIs before and after implementing KPIs. This was done by using the MINITAB computer program. There are 18 KPIs to perform test for equal variances.

Initially the normal probability plot of performance value of each KPIs before and after implementing KPIs are tested and illustrated in Appendix A.

Refer to Appendix A, the plot data of all tests show that the points fall reasonably close to the reference line, indicating that all data are normal distribution. Furthermore, the p-value of all tests is more than 0.05, it can be interpreted that all data are considerably normal.

Since all tests are normal distribution, test for equal variances (F- test) are performed. The hypotheses are presented below.

$$H_0 \text{ (The null hypothesis): } \sigma_1^2 = \sigma_2^2$$
$$H_1 \text{ (The alternative hypothesis): } \sigma_1^2 \neq \sigma_2^2$$

By using the MINITAB computer program perform test for equal variances of performance value of each KPIs before and after implementing KPIs, the results are illustrated in Appendix B.

According to Appendix B, the p-value of all tests is more than level of significance, 0.05. Therefore, the null hypothesis can be accepted which means that no difference between the two variances. As a result, the performance value of all KPIs that the team set is stable. Except Value of product uncompleted on time and Number of

delayed lot that the p-value of both tests is less than 0.05 thus, the null hypothesis can not be accepted. As a result, the performance value of both KPIs is unstable.

5.4 Results of Verifying Performance Value

According to the previous information, it can be separated KPIs into 2 groups as stable and unstable.

5.4.1 Stable KPIs

The result 16 KPIs are stable. There are:

1. Raw material cost per unit production (Bath/piece)
2. Defect ratio that occur when using out of specification of raw material
3. Raw material cost to product cost ratio
4. Performance ratio
5. Machine idle time ratio (%)
6. Non-conform raw material per total raw material used
7. Quantity of defect per quantity of production
8. Accumulate idle time (hours/period)
9. Unit production per machine (pieces/minute)
10. Product cost per unit (Bath/piece)
11. Power cost to product cost ratio
12. Depreciation to product cost ratio
13. Number of customer complain per number of good sold
14. Defect rate found from in-line production
15. Total machine down time (hours/period)
16. Maintenance cost to product cost ratio

Once stable KPIs are identified, the working team finds the target value of each KPIs from performance value in period 1 - 12. These target values are used as the standard for measuring and controlling performance in further. The target value of each KPIs are presented in Table 5.3.

Table 5.3 Target value of stable KPIs

KPIs	Target Value
Raw material cost per unit production	3.92 Bath/piece
Defect ratio that occur when using out of specification of raw material	2.03 %
Raw material cost to product cost ratio	80.72 %
Performance ratio	92.64 %
Machine Idle Time Ratio	4.74 %
Non-conform raw material per total raw material used	1.99 %
Quantity of defect per quantity of production	2.03 %
Accumulate idle time	653 hours/period
Unit production per machine	69.31 pieces/minute
Product cost per unit	4.86 Bath/piece
Power cost to product cost ratio	1.65 %
Depreciation to product cost ratio	8.66 %
Number of customer complain per number of good sold	0.10 %
Defect rate found from in-line production	2.10 %
Total machine down time	19 hours/period
Maintenance cost to product cost ratio	1.03 %

According to Table 5.3, in the further study that does not be analyzed in this stage, the factory should benchmark the target value with other similar factory in order to know its performance. The suggestions can identify as below.

1. The target value that appropriate, the factory should find the method to maintain this value.

2. The target value that inappropriate, the factory should find the method to improve the performance.

5.4.2 Unstable KPIs

The result 2 KPIs are unstable. There are:

1. Value of product uncompleted on time (Baht)
2. Number of delayed lot (lots/period)

According to team brainstorming, the causes that make KPIs unstable are the weakness in inventory management. The team has tracked further down into detail and finally found that the root cause of unstable KPIs is the inventory supply has never been planned. Therefore, the factory should set the quality standard to control inventory supply in order to keep these KPIs stable.