Chapter V

Result, conclusion and suggestion

The result of the implementation in chapter 4 can reduce the rejection in process from about 6-7 percent in January'99 to March'99 to about 3-4 percent in January'00 to Febuary'00 in table 5.1 and 5.2. In both months, they produce the crankshaft were produced about 30,000 pieces and had the rejection rate at 3.58% and 3.49% consequently. The high percentage of defect still come from the continuous defects but they are reduced as shown in the result of February'00. There is a new defect, the miss position of drilling in process 3, that has never been occurred. This defect increases the percentage of defect in process 3 but it is accidentally occurred because it happened only one lot and does not occur again after solving this problem. And the trend of increasing of defect from other process, the out of specification of diameter 13.8 mm. in process 4, makes the increasing of the total defect of this line.

The Pareto diagrams in fig.5.1 and 5.2 show the type and amount of defects in January'00 and February'00. The result in the Pareto diagrams in fig.5.1 and 5.2 show that the amount and percentage of four defects in process 3 is reduced but in still in top five ranks. In fig 5.2 the Pareto diagram shows the change of position of the four defects in process 3; the highest percentage comes from defects in process 4. Although, the defects in process 3 is reduced but they still in top ten defects. Especially, in the distance of eccentric defect was not found in February'00 because of the inspection, both sampling and in process, that can eliminate the continuous defect effectively.

Table. 5.1 The in house defect of crankshaft in January' 00

Crank Shaft Hitachi Sep.	Total	%	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Eccentric 9.0	61	5.68%					3			4		9	30	8	2						3			2									
Diameter 14 mm. out of spec.	85	7.91%											13	8	12	2	6			4	4	8	4			7		8		3	6		
Diameter 13.8 mm. out of spec.	196	18.25%										15		12	4	3			20	3			2			12		27	47		32	19	
Diameter 18 mm. out of spec.	27	2.51%								4			1		1				1		3			3		2					12		
Diameter 17.6 mm. out of spec.	0	0.00%																															
Diameter 8 mm. out off spec.	14	1.30%												2									10						2				
Distance 7.45 under spec.	229	21.32%										16		2	3	3	9		1	2	142	4		5		26			4		12		
Clamp and bump at part	399	37.15%							43	22			25		9	2	17		4	16	12	31	22	19		63		15	14	5	42	38	
Distance 5.60 under spec.	13	1.21%											4	1		4			2	1	1												
Distance 1.00 under spec.	0	0.00%																															
Diameter 3 mm. out of spec.	33	3.07%												2	3		5					3		6				11		3			
Other	17	1.58%								3					5	4										5							
Total	1074	1074	0	0	0	0	3	0	43	33	0	40	73	35	39	18	37	0	28	26	165	46	38	35	0	115	0	61	67	11	104	57	0

Production	30,000
Percentage of rejection	3.580%

Continuous Defects

Table. 5.2 The in house defect of crankshaft in February' 00

Crank Shaft Hitachi Oct.	Total		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Eccentric 9.0	0	0.00%																															
Diameter 14 mm. out of spec.	103	9.84%		7	6		57	7						9				9						2						6			
Diameter 13.8 mm. out of spec.	311	29.70%	5	19	35			1		5	13		14	40		26	6	6		4	32		28	5	10	3	10	41		8			
Diameter 18 mm. out of spec.	67	6.40%	5				6	4		6	14	3	2	10			2	3		2			8				2						
Diameter 17.6 mm. out of spec.	0	0.00%																															
Diameter 8 mm. out off spec.	216	20.63%					7				7		22	153				3		6					2			16					
Distance 7.45 under spec.	81	7.74%		3	9		2	3		2	1	3	2				11	3		5			6	3	2	3	7	14		2			
Clamp and bump at part	126	12.03%	5	3	8		15	4		6	11	3	5	8		4	4	10		1	4			26	2	3				4			
Distance 5.60 under spec.	12	1.15%					11			1																							
Distance 1.00 under spec.	0	0.00%																															
Diameter 3 mm. out of spec.	67	6.40%	2				8			2			3	2		4	2				6		5	9	3	3	1	3		14			
Other	64	6.11%		9	6			2		4	4	8						7		2	7					15							
Total	1047	1047	17	41	64	0	106	21	0	26	50	17	48	222	0	34	25	41	0	20	49	0	47	45	19	27	20	74	0	34	0	0	0

Production 30,000

Percentage of rejection 3.490%

Continuous Defects

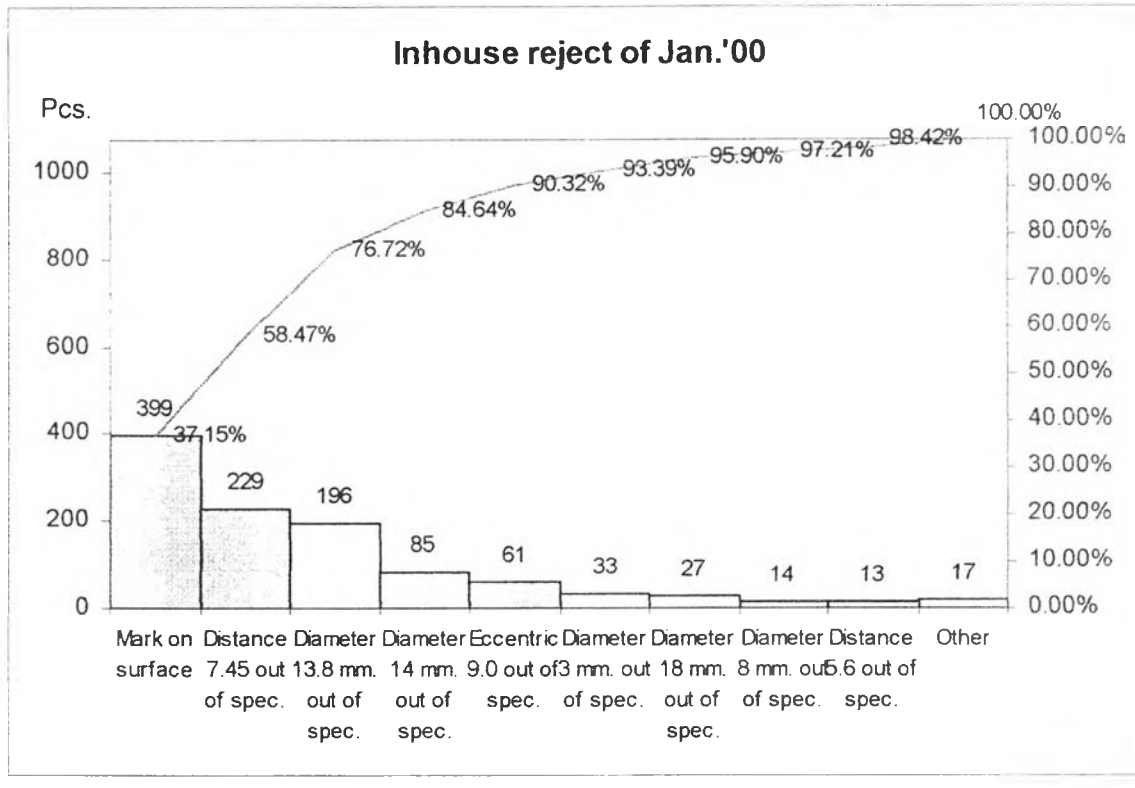


Fig.5.1 The Pareto diagram of the type of defects in January'00

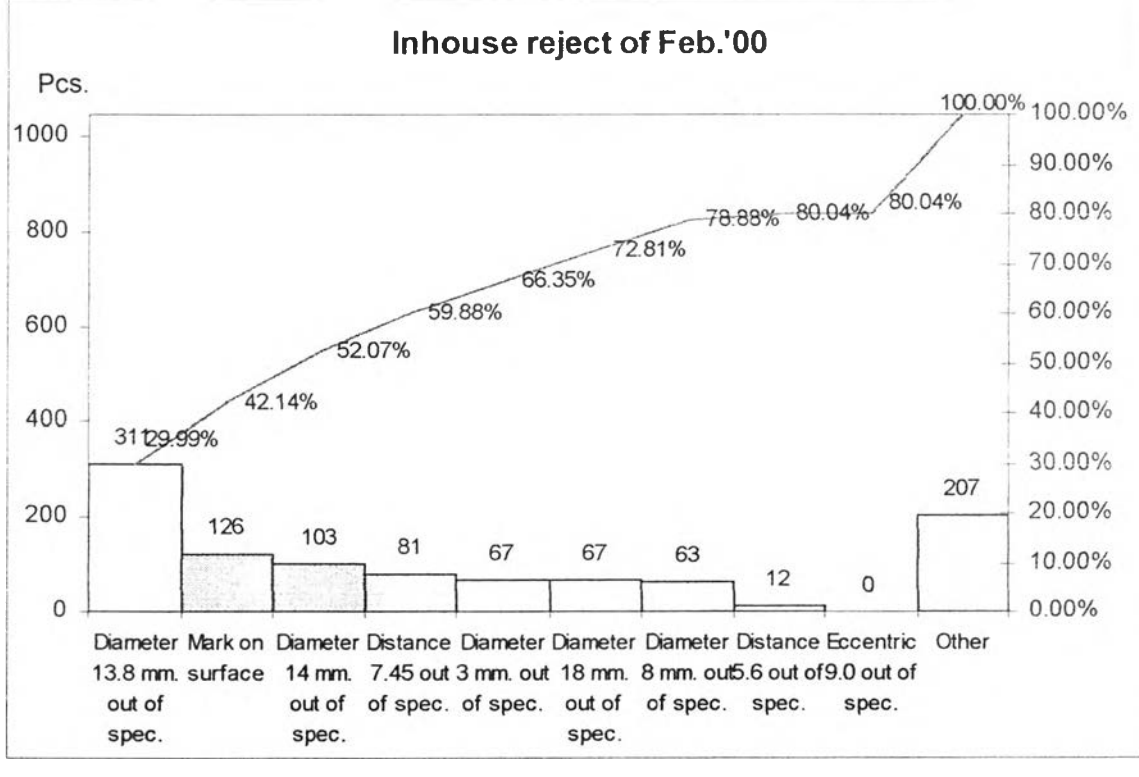


Fig.5.2 The Pareto diagram of the type of defects in February'00

When the type of defects is defined into manufacturing process, it finds that process 4 change to the highest percentage of defect but the percentage of defect was nearly process 3 in the second rank as shown in fig. 5.3. The rejection in process 4 is increased from the miss position of drilling that does not relate to process 3. The miss position of drilling came from the change in drilling machine.

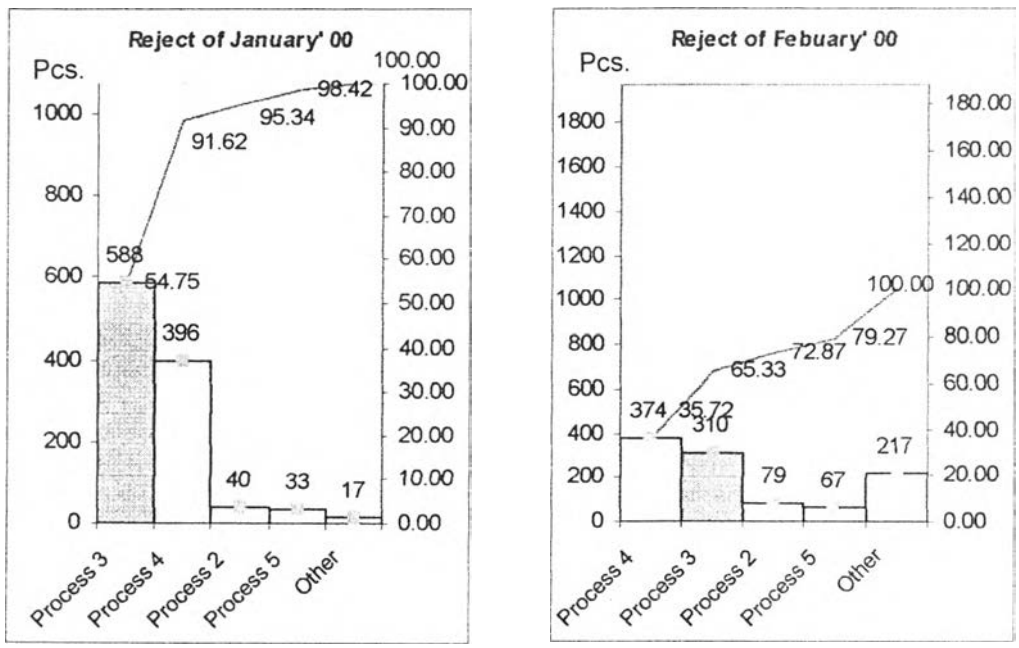


Fig. 5.3 Pareto diagrams show amount and percentage by process

The result of implementation

The reduction of rejection rate could define into two areas, which are

1. The reduction of amount of rejected lot
2. The reduction of the size of rejected lot

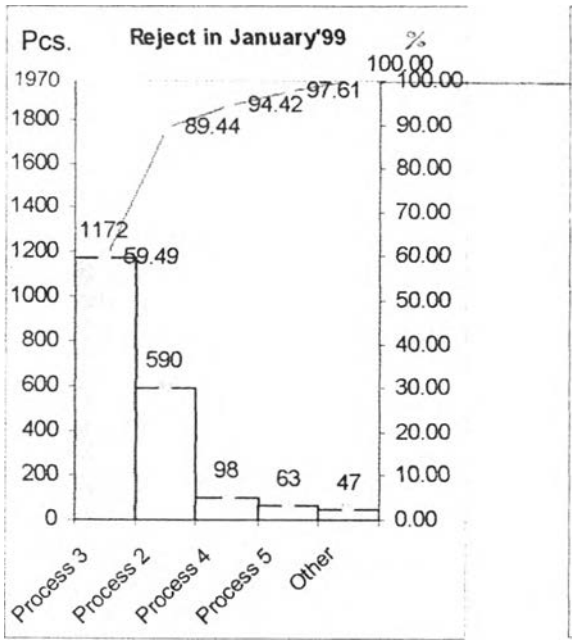
Reduction of two major causes is the fastest method to reduce the rejection because these amounts of rejection about one-third or half of all rejection in the month.

The reduction of amount of rejected lot: before implementing the program, the frequency of rejected lot is high as the continuous defect. This problem runs in a period of time (e.g. an hour, a shift or a day) that has to separate and rescreen by

inspection. The cause of this problem is the ineffectiveness of controlling process such as the cleaning and maintenance program and inspection method.

The reduction of the size of rejected lot: the size of rejected lot relates to the controlling process. The control of tools' life and machines' program is used in controlling process. These two methods can also reduce the variation of data (e.g. diameter of crankshaft and distance of eccentric).

Before improvement



After improvement

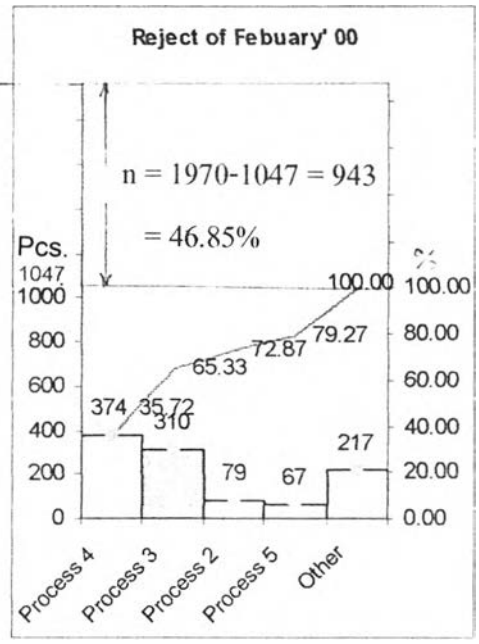


Fig. 5.4 The Pareto diagrams compare the result of improvement

The comparison of the amount of rejection before and after implementing the improvement program is shown in fig. 5.4. The result in fig 5.4 shows that the total rejection of this production line in January'99 at 1970 pieces is reduced to 1047 pieces in February'00, about 46.85 percent. The total rejection in process 3 is reduced from 59.49 percent to 29.61 percent. The result of the reject in process 4 is increased because of the new kind of defect, the miss position of drilling, that causes of the change in machine and type of insert.

The comparison of result in improvement by using the 4 major defects is shown in fig. 5.5. In fig. 5.5 the percentage of defects in process 3 is reduced especially in the out of specification of eccentric distance. But other defects have a trend to reduce from the data of January'00 and February'00. The continuous defects is the major cause that make it still has high percentage of defects in process 3.

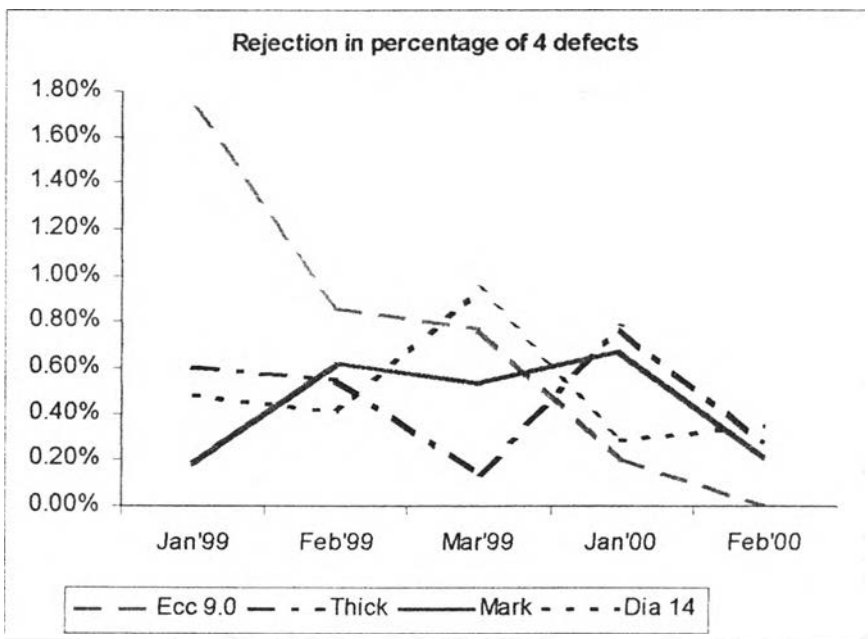


Fig 5.5 The comparison in percentage of four major defects in process 3

In case of the distance of eccentric defect, when we increase the frequency of inspection in production line and modify the clamping system as explained in chapter 4, we find that the stability of process is improved. Because the adjustment of operators is reduced and the cycle of adjustment is expanded as shown in fig. 5.6.

In fig. 5.6, the control chart shows that the spread of data is reduced both maximum and minimum value. As this reason, the process capability of this process is increased.

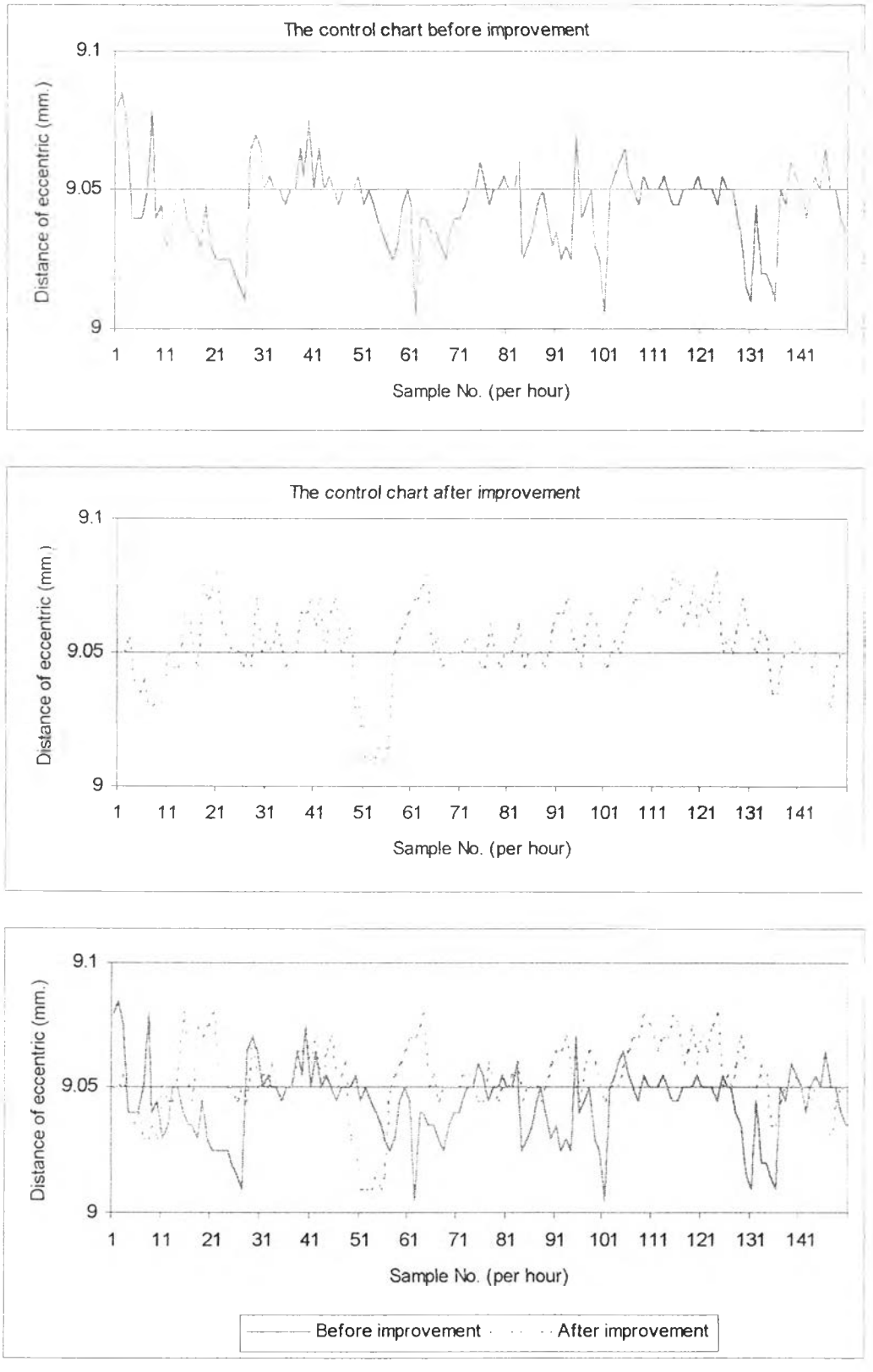
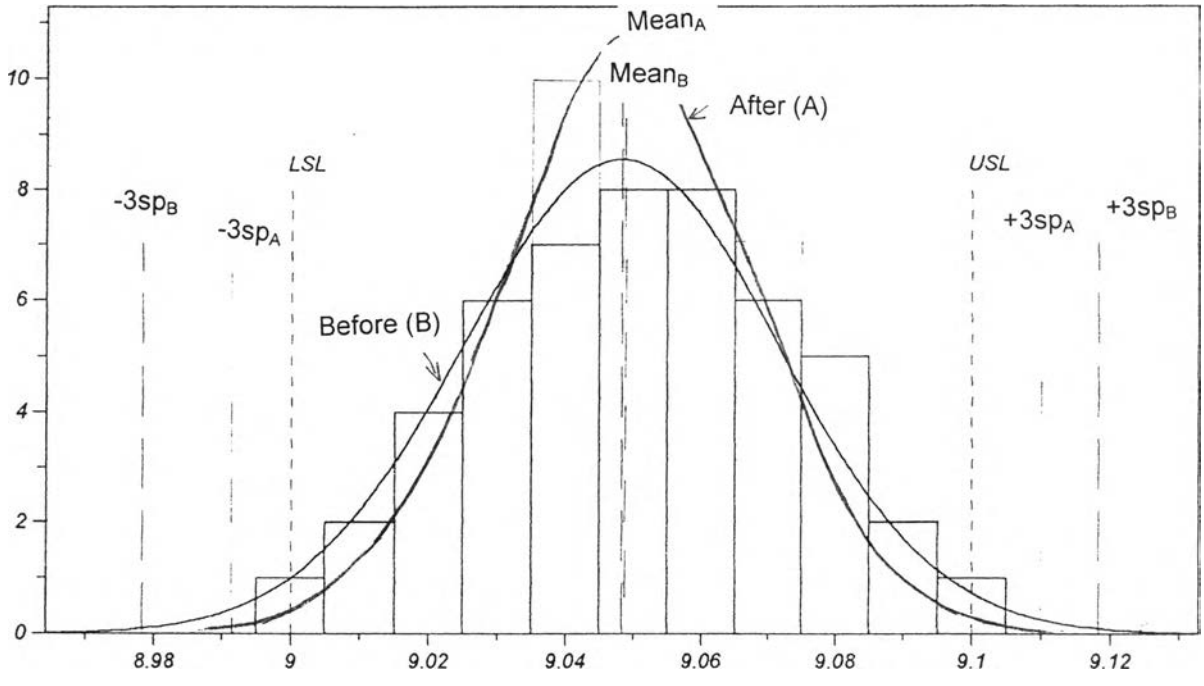


Fig. 5.6 The control chart of eccentric distance and comparison before and after improvement

The improvement program in the previous chapter can reduce the percentage of the defects in process 3 and increase the process capability of process 3 but it is still lower than 1.00. The cleaning and maintenance program and the monitoring system can increase the value of process capability a little bit as shown in fig. 5.7



Distance of eccentric before improvement

Samples:	50	Cpm:	.7123	3sp Lim:	(8.9783, 9.1183)
Mean:	9.0483	CPU:	.7385		
Std Dev:	.023335	Cpk:	.69	Spec Lim:	(9, 9.1)
Skewness:	-.088898			Min, Max:	(9, 9.095)
				Est % out:	(1.9232, 1.3359)

Distance of eccentric after improvement

Samples:	50	Cpm:	.8813	3sp Lim:	(8.9919, 9.1051)
Mean:	9.0485	CPU:	.9107		
Std Dev:	.018851	Cpk:	.8576	Spec Lim:	(9, 9.1)
Skewness:	.062921			Min, Max:	(9.015, 9.085)
				Est % out:	(.50449, .31477)

Fig. 5.7 The comparison in result of Cp. and Cpk. before and after improvement

In fig. 5.7, the value of standard deviation after improvement is smaller than before improvement. The range of the out of specification data is narrow and the probability in out of specification is reduced.

The problems in improvement

There are 3 major problems that cause the ineffective implementation, the project team, the skill and experience of operators and budget and time for improvement.

The project team: the problems that found in the project team were

1. The inexperience of working team and their responsibilities: the team is consisted of the member from each department but all of them have their own responsibilities. As this reason, the effectiveness of this project team is lower than expectation.
2. The ineffective communication: some problems need to correct constantly. Sometimes, the incorrect method was implement in production line because of an inappropriate method to transfer the data from project team to operators
3. Unclear-cut to do decision making of team: the decision making for corrective action did not clear because of the financial problem made the delay to do corrective action and large amount of reject.
4. Inadequate knowledge and experience to solve problems: lack of persons who have specific knowledge and experience to solve the problems effectively.

The skill and experience of operators: the operators had to training about the measurement tools and instruction before work in production line. But this line still has problems about the skill of operator.

1. High turnover rate of operators: this line run in 3 shift at 24 hours a day and sometimes 7 days a week that make the fatigue of operators. As this reason, the turnover rate in this line is high that make the insufficient of training.
2. Bad culture in organization: operators do not operate as instruction consistency because the pattern from older operators and the leaders pay attention less than it should be.

3. Using of unskilled operators: when lack of operators for run machine, new operators from other line has to operate that lack of skill and knowledge to inspection and correct regular problems.

The budgeting and time for improvement: because of the economic crisis the budgeting for improvement is decreased, it is used for do the corrective action and maintenance for production only. The time also the factor that obstruct the improvement because the capacity of this line is full so the improvement program is postponed until the stock and delivery plan was covered.

Conclusion

The scope and objective of this project is emphasized on the process 3 because the amount of defect in this process were more than 50 percent of total reject. But after implementation this project, we find that the rejection change to process 4 and some low percentage defect change to significant defect. It means that the preventive plan cannot cover all possibility of defect in process 3 (e.g. the out of specification in drilling process). This project is the guideline for improving and reducing the defect in process but it just only one circle of improvement if this project runs continuously like the Deming circle, it will be improved and help reducing the defect in higher level.

The problem in previous section is the significant problems in this project that needs effective method to eliminate them. The knowledge and experience to do corrective action and improvement is necessary for organization. The difference of the knowledge in any level in organization from the operator level to the management level obstructed the development and improvement of organization. This difference makes misunderstand of the right method to operate because the policy and target of management level too difficult to understand and implement for operator level. So it needs interpreting system to change the policy and target to be easier to understand and implementation. On the other hand, the right method to do corrective action needs the experience person to reduce the time to develop and improvement because some cases is the trial and error that takes a lot of time to solving.

The expansion of the scope of this project to other process of this line or other line by using this project for the basis of improvement will increase the effectiveness and quality of product.

Suggestion

The process capability of process 3 is lower than 1.00 but it is increased when compared with before improvement. The increasing of the index is caused from the elimination of the variation of the relative factors such as the machines, tools and measurement errors. Another factors that waiting for doing corrective action is the equipment, the clamping system, because the clamping system needs the high budget to invest so the change is postponed.

The clamping system relates to all defects in process 3 especially the mark on surface and the distance of eccentric. The reduction of defect in process 3 in February' 00 causes of the increasing of frequency of inspection in process. But this method is not suitable for the high capacity in the future. This method increases the cost and time for inspection. As this reason the change of clamping system is the suggestion for this process. When compare the application of clamping system between local supplier and standard clamping there is the difference as shown in table 5.3

Table 5.3 The comparison of clamping system between standard and local supplier

	Standard clamping system	Local supplier
Quality and accuracy	Higher	Lower
Tool's life of clamping system	~1 year	~3 years
Price of clamping system	~130,000 Baht	40,000 Baht

This table is the guidance for decision making of the management because other factor is done as explained in previous chapters.

The human resource is another problems that make an ineffective improvement as expectation. It includes the team working, experience and knowledge because the improvement needs both trial and error and knowledge and experience to increase effectiveness of corrective action and improvement.

In case of another defects in other process of this line, we can solve them by using the same method. But they have to improve continuously and maintain the effective system of corrective action method to prevent the previous problems.