CHAPTER VII

QUALITY IMPROVEMENT

Recognizing the benefits of quality cost system, both high failure and hidden cost were discovered, as a result the quality improvement program was set up to reduce that cost of product for achieving a company's target, 15% total cost. In additional benefits, quality cost system showed how to using quality cost information to meet that improvement, including how long that the quality investment would be worthwhile.

However, the establishment of quality cost system only did not mean the quality would be better than the previous. But, to be superior on quality the quality improvement program was an essential step. By controlling the prevention, appraisal and failure cost, the quality should be higher standard and met the desired cost.

To find out improvement areas, quality cost information, which was collected, would be explored through several quality indexes or element such as rework, repair, and scrap as well as hidden. They helped to identify the problem areas such as cutting, bending and so on and then comparing to the standard cost, a deviation of costs, which were such as DM, DL and FOH, was explored.

In this chapter, the quality improvement steps would be discussed including found out the investment, which was used to reduce a major problem.

7.1 QUALITY ELEMENTS AND COST RELATIONS

By theory, the quality investments were grouped into 2 categories: Appraisal and Prevention. Both of them were invested by purposing to reduce the failure cost that was Rework, Repair and Scrap and so on. Reducing the failure cost, the prevention and Appraisal cost would be higher. Besides, the categories were segregated into several elements.

In manufacturing process, the quality elements had several items (see table 7.1) that had involved directly measuring the cost, were grouped into 3 quality cost model, so called PAF model. Each element was similar as an indicator to measure problem areas were happen clearly. The following table showed a group of quality cost indexes.

Table 7.1: Quality cost indexes

Cost elements	Cost catagories
1. **Rework**	Failure
2. **Repair**	Failure
3. **Scrap**	Failure
4. **Hidden**	Failure
5. **Inspection and testing**	Appraisal
6. **Education and training cost**	Prevention
7. **Maintenance cost**	Prevention
8. **Quality improvement cost**	Prevention

These cost and quality relation also helped to calculate the total cost of quality grounded on the quality cost model as mention in Chapter VI.

Total COQ = Prevention cost + Appraisal Cost + Other Failure cost + Hidden cost

The total cost of quality actual cost is the actual cost adds all quality cost elements such as rework, repair and etc. and then minus standard cost. On the other hand, the actual cost minus the standard cost is so called Hidden cost, which the company miss a keeping of both quality and cost record. Besides, the cumulative of prevention, appraisal and failure cost is so called PAF model.

Consequently, the model could be grouped as follow:

Total COQ = Hidden cost + PAF cost

In January, the data of these cost elements was significantly shown that the hidden cost became extraordinary, while the repair, rework and scrap were rather high, respectively.

This result, the total COQ was very high at 352,284.8 Baht. (0+4734.6+96309.2+251241) that was around 26.45% of total cost.

Even though the cost of quality is so high, the PAF model showed that appraisal cost was only 1 % of the total quality cost.

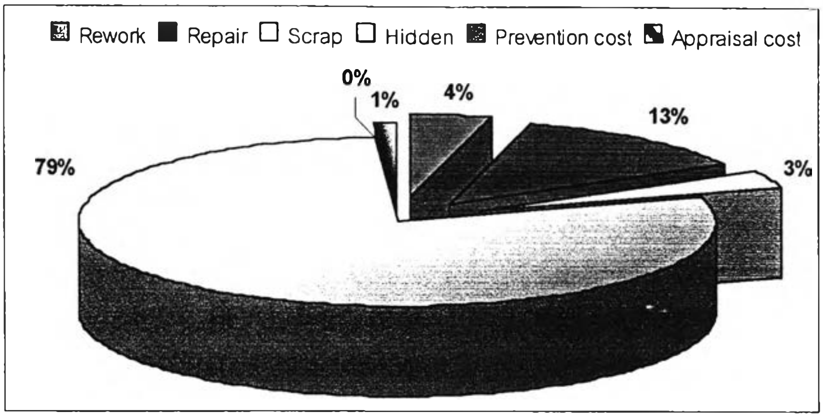

Figure 7.1: The cost of PAF model

In figure 7.1, the failure cost was raised up to 99% of total COQ model that composed of 79% of hidden cost, 13% of repair, 4% of rework and 3% of repair. Whereas, the prevention cost was zero and appraisal cost was 1%. This also means that the cost of non-conformance was 99%, while the conformance cost was only 1%.

This showed that the company invested in quality 1% of total PAF model to detect the problem, which occurred around 99%, but there was no correction and prevention. To analyze the problem area and the cause of problems for prevention, the problem analyzes would be discussed in 7.1.1.

7.1.1 Cost analysis

As mention earlier, the problems were the deviation from standard, which includes DM, DL and FOH as well as other costs. And, the total manufacturing cost of a French-fries product was 25,121.40 Baht/unit, this result the total standard cost during the months was 628,035 Baht that could identify by elements as following.

7.1.1.1 Direct materials

1. Stainless steel	9420 Baht x 39 = 367380
2. Drawer rails	388.5 Baht x 39 = 15151.5
3. Switch and holder	1432 Baht x 39 = 55848
4. Ceramic heater	3340 Baht x 39 = 130260
5. Lamp and holder	438 Baht x 39 = 17082
6. Pilot lamp	250 Baht x 39 = 9750
7. Footings	330 Baht x 39 = 12870

7.1.1.2 Direct labors

1. Cutting section 150 Baht x 39 = 5850
2. Layout/CNC 300 Baht x 39 = 11700
3. Bending section 400 Baht x 39 = 15600
4. Assembly section 864 Baht x 39 = 33696
5. Polishing section 205 Baht x 39 = 7995
6. Technical assembly 540 Baht x 39 = 21060

7.1.1.3 Factory Overheads: Manufacturing focus

1. Cutting section 345 Baht x 39 = 13455
2. Layout/CNC 536 Baht x 39 = 20904
3. Bending section 544 Baht x 39 = 21216
4. Assembly section 3729 Baht x 39 = 145431
5. Polishing section 487.5 Baht x 39 = 1901.25
6. Technical assembly 1300 Baht x 39 = 50700

7.1.1.4 Other costs: Prevention, Appraisal

The other costs were counted around 121.40 Baht/unit, which was about 4734.6 Baht by total. Consequently, the total standard cost in January was 979734.6 Baht. This cost would be compared to actual cost as shown in quality cost report in Chapter VI.

7.1.2 Cost comparisons

In this session, the actual cost was compared with standard cost as shown following.

Table 7.2: Cost element in Hidden details

	DM		DL		FOH	
Section	Act.	Std.	Act.	Std.	Act.	Std.
Cutting	405430	367380	7985	5850	16895	13455
Layout/CNC	0	0	16700	11700	29904	20904
Bending	0	0	20840	15600	36740	21216
Assembly	133410	28021.5	42350	33696	153600	145431
Polishing	0	0	9600	7995	25032	19012.5
Technical assembly	251400	212940	24850	21060	56240	50700

In table 7.2, the actual cost of manufacturing was compared with the standard cost though common cost (DM, DL and FOH). The data showed that there were many several deviations through out the process. For example: the cutting area was deviated from the target around 11.3% and Assembly area was 59%.

Table 7.3: Cost deviation

Account. No.	Section	Total Act.	Total Act.	Diff.	Percents
61250	Cutting	430310	386685	-43625	-11.3
61251	Layout/CNC	46604	32604	-14000	-42.9
61252	Bending	57580	36816	-20764	-56.4
61253	Assembly	329360	207148.5	-122211.5	-59.0
61254	Polishing	34632	27007.5	-7624.5	-28.2
61255	Technical assembly	332490	284700	-47790	-16.8
		1230976	***975000***	***-255976***	***-26.3***

Also, in table 7.3, the comparison showed that Assembly, Bending and Layout/CNC were founded that the cost variation was so high respectively.

Focusing on these elements, the most problem areas was rather high in the cost of DL and FOH, while the cost of direct material was highest in assembly areas. The following table was explained the problems in details.

Table 7.4: The cost of problems in details

	DM			DL			FOH		
Section	**Act.**	**Std.**	Diff	**Act.**	**Std.**	Diff	**Act.**	**Std.**	Diff
Cutting	405430	367380	-10.36	7985	5850	-36.50	16895	13455	-25.57
Layout/CNC	0	0	0	16700	11700	-42.74	29904	20904	-43.05
Bending	0	0	0	20840	15600	-33.59	36740	21216	-73.17
Assembly	133410	28021.5	-376.10	42350	33696	-25.68	153600	145431	-5.62
Polishing	0	0	0	9600	7995	-20.08	25032	19012.5	-31.66
Technical assembly	251400	212940	-18.06	24850	21060	-18.00	56240	50700	-10.93

In table 7.4, it shows that the detail of deviation in term of common cost concepts: DM, DL and FOH. Analyzing the cost deviation, most of them come form DL and FOH, which was around 40% of total manufacturing cost.

7.1.3 Problem analysis

From the above information, the problem costs were contributed through all manufacturing areas. The cause and effect diagram was settled up as shown below.

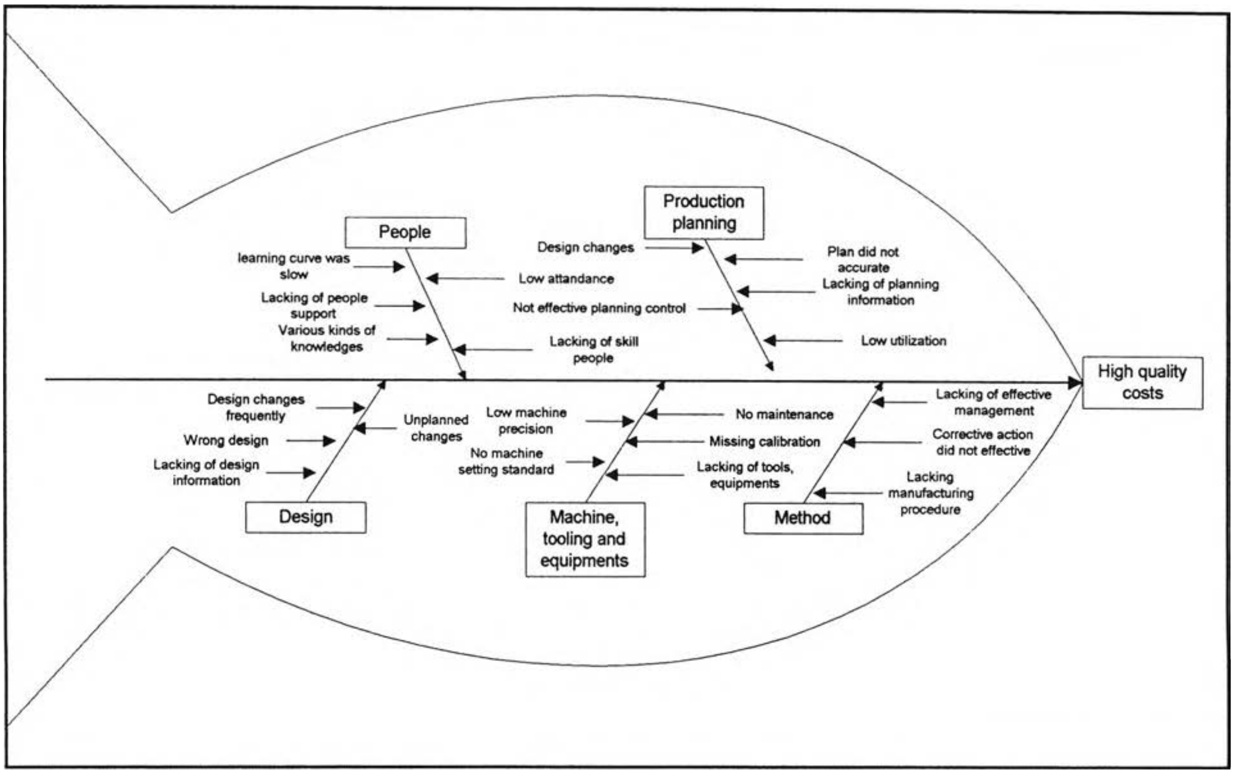

Figure 7.2: Cause and effect diagram of high quality cost

For additional study, the each probability of quality problems were analyzed by using various methods such as collecting information from different departments, meeting and manufacturing's operator survey.

The results showed that the majority of problem came from design changes and wrong design, since the every change affects the time that was using in the manufacturing process such as time for readjust the part whenever the part location changed.

7.2 QUALITY IMPROVEMENTS: INVESTMENTS AND RESULTS

7.2.1 Investments

In this session, the quality investment to reduce that change of design were identified as follows:

7.2.1.1 Skill operators

One of the problems of wrong design is lacking of skill operators. Currently, the skill operators were only 2 people, which control the other operators. However, the 2 people did not enough to control all of operators, because of many jobs.

Consequently, the 2 skill operators would be requested, which cost was around 2,5000 Baht per month.

7.2.1.2 Trainings

According to, one of major problem was low learning curve, lacking of working knowledge. These results 2 courses were provided that were manufacturing process efficiency as well as production trick and techniques. The cost was occurred around 50,000 Baht.

One important thing, these investments would be assigned to the products: French-fries station with 23% of manufacturing hour. Resulting the cost of hiring skill operators and training were 5,750 Baht and 11,500 Baht, respectively.

7.2.2 Results

In figure 7.3, the results of the implementation were significantly shown that the quality cost could be reduced around 12%, from 26.45% to 14.46% within a month, as a result the French fries cost would be counted the cost saving around 42,274 Baht a month and 507,288 Baht a year.

In addition, this implementation benefits to other products would be cut cost as well. The company expects that the cost saving is minimum around 2.5 Million a month.

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This report provides detailed cost of quality information

COQ detail report - By cost catagories, all cost catagories

From Febuary 2000 *to* March 2000

As of 3/27/2000

Product name *French-fries station*

Cost catagories	Cost elements	Cost	% of total costs
Manufacturing	Cutting	359395	35.12
	Layout/CNC	29950	2.93
	Bending	36850	3.60
	Assembly	208000	20.32
	Polishing	27500	2.69
	Technical assembly	286000	27.94
	Total	**947695**	**92.60**
Appraisal cost	Inspection and testing	4120.5	0.40
	Total	**4120.5**	**0.40**
Failure cost	Rework	10065	0.98
	Repair	30700	3.00
	Scrap	9500	0.93
	Total	**58506**	**5.72**
Prevention cost	Education and trainning	11500	
	Maintenance	0	
	Quality improvement	5750	
	Total	**17250**	
Total actual cost		**1023451**	100.00
Standard cost		**854128**	
Failure cost	Hidden cost	**-89447**	**-8.74**

Figure 7.3: Quality cost report.

7.3 FINANCIAL ANALYSIS

Referring to the financial analysis theory, the financial analysis emphasized to study the efficiency of the project and to appraisal the capital expenditure of that project by using several techniques such as Pay Back Period, and Internal rate of return.

In case of quality cost, the economic cost of quality is formulated by:

Prevention cost + Appraisal cost = (Other Failure + Hidden) cost

Consequently, the investment of quality came from the summation of Prevention and Appraisal cost that would be discussed further through Pay Back Period and IRR analysis.

7.3.1 Pay Back Period

This techniques is one of the measures to be tested a general indication of risk and identify the possibility of re-investment. The following shows the pay back period of this improvement.

Table 7.5: Pay Back Period analysis

	Month 1	Month 2	Month 3	Month 4
Project investment	21,370	9,870.5	9,870.5	9,870.5
Net cash income: Cost reduction	42,274	42,274	42,274	42,274

The analysis shows that the pay back period of the quality investment is less than 1 month, around 13 days.

7.3.2 Internal Rate of Return, IRR

Generally, the management thinks that the rate of interest of the bank might be higher than the project. Especially, If the rate of interest of project is lower than the bank, the company should deposit in the bank instead of invest in the project because of the risks.

The IRR of this cost of quality investment could be calculated as follows.

Table 7.6: Internal Rate of Return

Month	Cash Flow
1/2/00	-21370
1/3/00	32403.5
1/4/00	32403.5
1/5/00	32403.5
1/6/00	32403.5
1/7/00	32403.5
1/8/00	32403.5
1/9/00	32403.5
1/10/00	32403.5
1/11/00	32403.5
1/12/00	32403.5
IRR	142.95 %

From the table 7.6, the IRR is around 142.95 % per year higher than the actual current interest rate, 3.5%.