CHAPTER VI

QUALITY COST SYSTEM ESTABLISHMENT

6.1 INTRODUCTION

Bringing the quality into the finance, the quality control system as mention in previous chapter, is very important for identifying the good products from defects. As a result, the manufacturing process problems are occurred and can be calculated into money term.

In the studied company, the defects had not been recorded and separated from the product costs because they included into the total cost. This resulted the quality cost was not explored and usually found that the cost of product was higher than competitors. Especially, the employees worked by themselves without top-down and bottom-up feed back, since they did not have any indicator measurement. To reduce the over product costs, the company had been cutting many cost in different company's area.

To improve the quality in term of quality cost, a cost model would be discussed as follows.

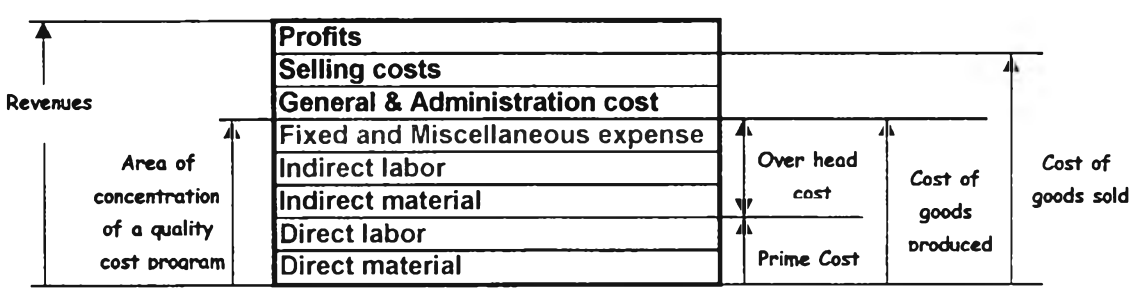

Figure 6.1: Cost model

Source: ASQ quality cost committee, Principles of quality costs, 1999 page 180

In figure 6.1, the area of quality cost contributes through the overhead cost and prime cost, which both of them are normally traditional cost system using in the company. This model helped to establish quality cost, however the cost of good produced had a lot of concerns to all departments in the company such as customer service, store, purchasing, personal and R&D and etc. These departments concerned

inevitably the cost of quality though their inefficient works. The mention on all departments to the quality cost was so called macro quality cost.

Due to the limited time to study, the area of quality cost was directly to manufacturing because it contains around 45% of employees and 80% of capital investments in the company. Besides, the manufacturing was a real making profit department. This focusing was also called micro quality cost. Referring to the structure of quality cost model as recommended on chapter II, it would be used for this analysis.

6.2 QUALITY COST ESTABLISHMENT STEPS

The steps of quality cost establishment were grouped into 4 groups, which each stage would be discussed in details.

1) Stage 1: Poor costing system of manufacturing activities: Activity Analysis
2) Stage 2: Cost of quality model and Activity based cost setting up
3) Stage 3: Standard cost system
4) Stage 4: Implementation

6.2.1 Stage 1: Poor costing system of manufacturing activities: Activity analysis

This stage was introduced the first stage of studying the quality cost system, composing of 4 steps; each step discussed how to develop the traditional cost to be Activity based costing leaning on the activity analysis.

According to, the current costing system in the manufacturing did not mention on the defects and cost information in details. This results the problem in manufacturing process was not shown to top management and operators clearly and resulting to the problems normally are disregarded.

The following was the problem that has been occurring.

1) Employee thought that the problems are not the problems.
2) The action usually assigned from top-down management not bottom-up.
3) Solving the problems mostly was corrective action.
4) The planning for preventive action was just planning not has any control and the results were not clear.

Causing of the existing cost system did not provide sufficient information to explore the quality problems clearly and lacking of quality problem management as generally recommended on various engineering books such as scrap, rework, repair and delay and etc. As a result, the quality cost system would be settled up.

To settle the quality cost system, the activity-based analysis was selected because this technique is enable the company can track all money which was spent on the manufacturing process and control it as budget availability.

6.2.1.1 Activity-based analysis

Activity-based analysis is an improvement tool to help the employees understand excellently about what they did and how the cost was contributed into their jobs. It helps to clarify manufacturing process in each activity, which has its input, add value to the materials and produce an output.

By theory, the activities are subset of the process, which each of them can be further divided into tasks. And, definition of task is an individual element that is also a subset of an activity. It shows how individual performs the specific assignment.

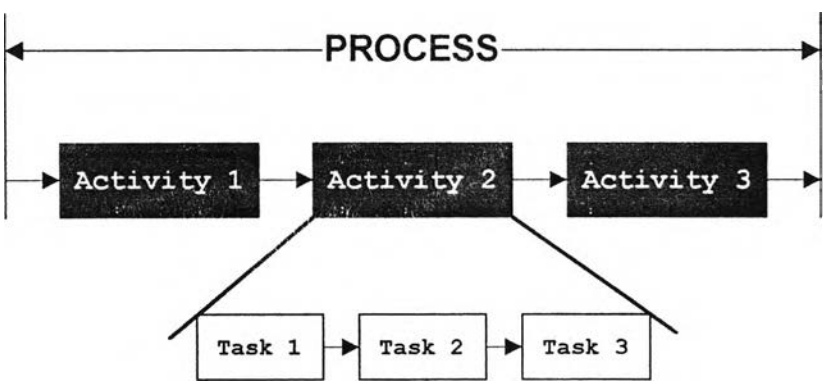

Figure 6.2: Process breakdown

Source: Warwick Manufacturing group, Information system strategy, 1998

The following example shows the relations of process, activity and task within the catering equipment's manufacturing process.

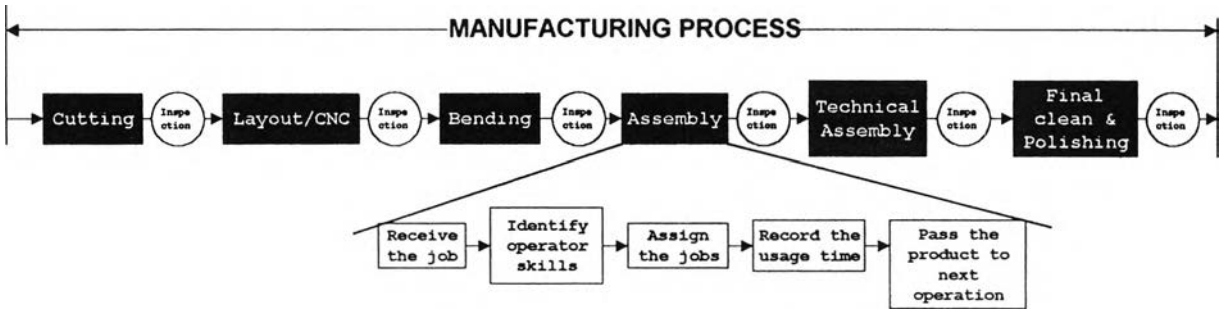

Figure 6.3: Manufacturing process breakdown

In addition analyzing the activities, the flow of cost information will be carried out though the process.

6.2.1.2 Activity based analysis tool and technique: IDEF0

This technique was developed and used by the US air force to describe their large and complex operation system. IDEF stands for Information DEFinition, which deals with top-to-bottom for covering the information flow, through IDEF block and structure as shown in figure 6.4, 6.5.

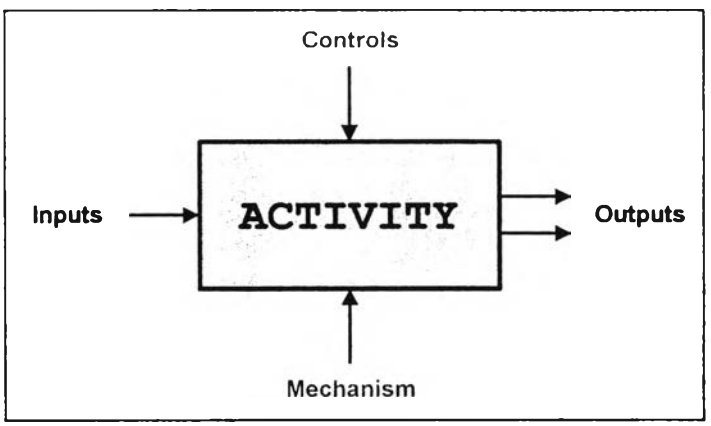

Figure 6.4: IDEF block

Source: Warwick Manufacturing group, Information system strategy, 1998

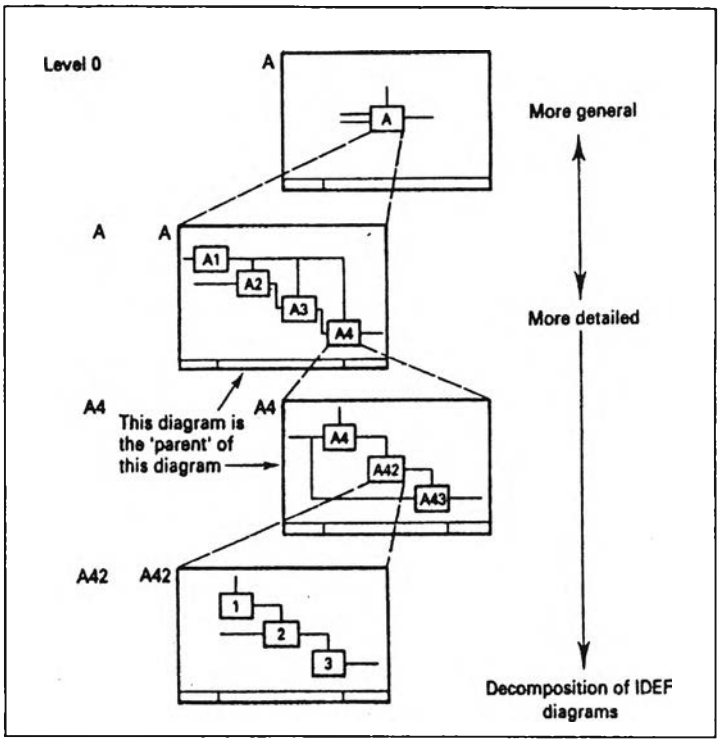

Figure 6.5: IDEF structure

6.2.1.3 Using IDEF0 process modeling to create activity model

As mention about the factory, it had many activities both primary and secondary. For example: the primary activity was in the manufacturing process, while the secondary activities were in the supporting process such as purchasing, accounting and delivery and etc. It well understood that each activity would be combined together, so called a process.

In the plant, there are many processes: manufacturing, finance & accounting, purchasing and others. Due to the topic, this paper will be discussing only on manufacturing process. The following shows the relations of processes and activities in the plant and in a manufacturing process.

A0 Produce catering equipment
- **A1** Production planning
- **A2** Detail design
- **A3** Manage materials
- **A4** Manufacturing process
  - **A41** Front-line operation
    - A411 Cutting

A412 Inspection 1

A413 Layout/CNC

A414 Inspection 2

A415 Bending

A416 Inspection 3

A417 Assembly

A418 Inspection 4

A42 Polishing

A43 Technical assembly

A431 Assembly

A432 Inspection and Testing

A44 Refrigeration system assembly

A45 Final inspection

A46 Manage rejects

A461 Examining the reject part

A462 Reject disposition

A463 Corrective and preventive planning

A5 Packaging

A6 Store finished goods

A7 Delivery

Though discussing of the figures 6.6 to 6.10, they show the IDEF0 flow of the above decompositions.

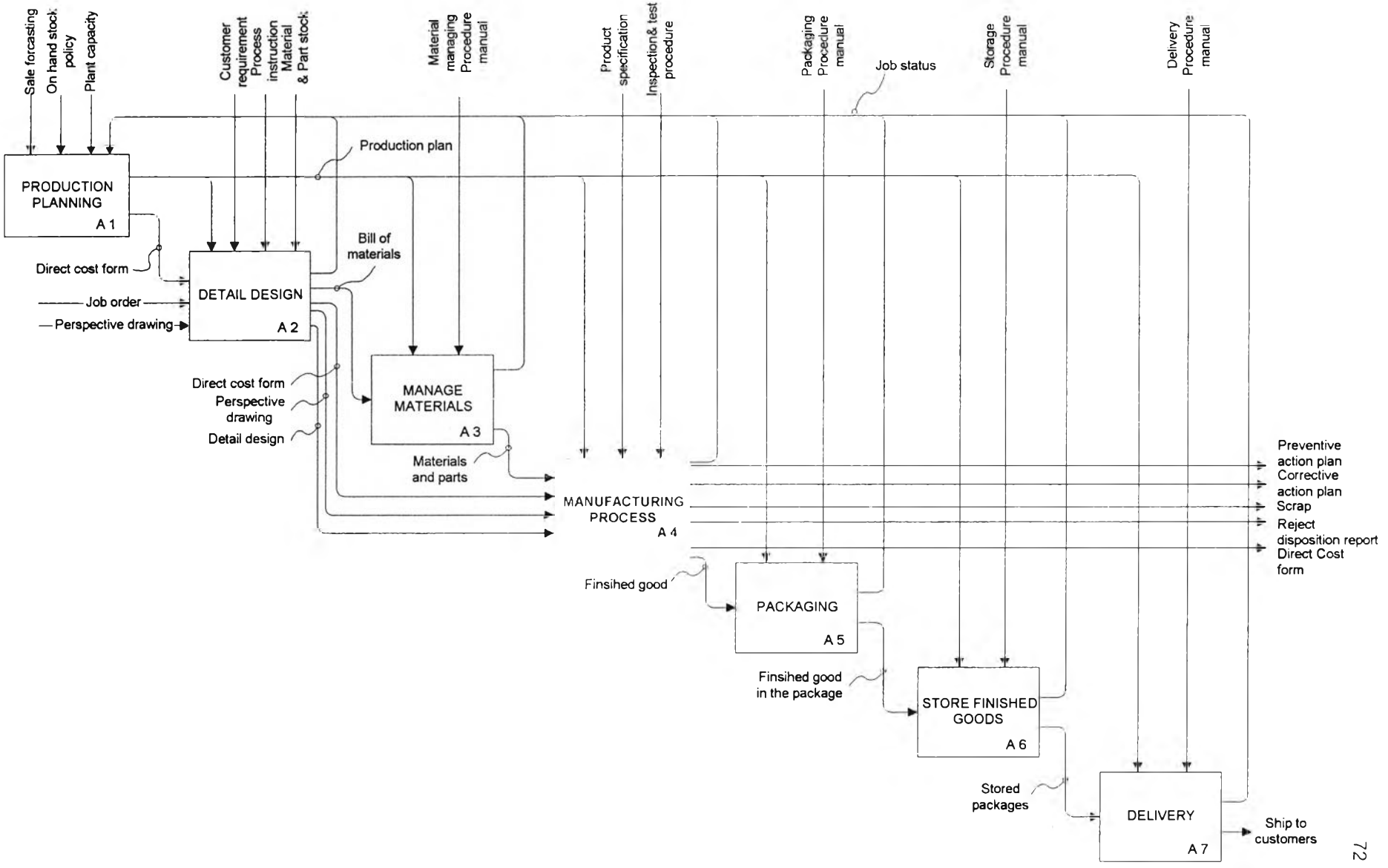

Figure 6.6: The activity of catering equipment production within the factory: A0

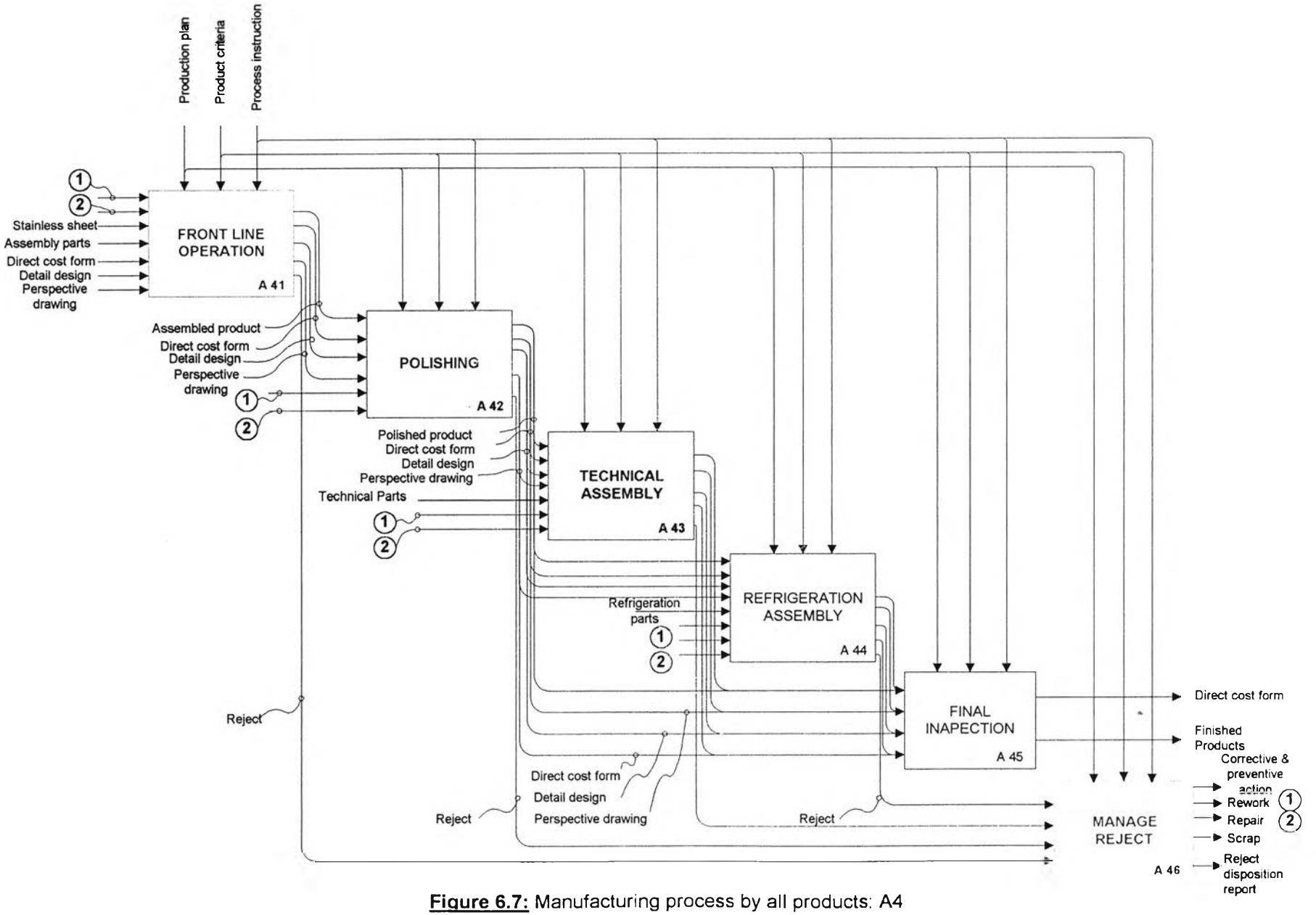

Figure 6.7: Manufacturing process by all products: A4

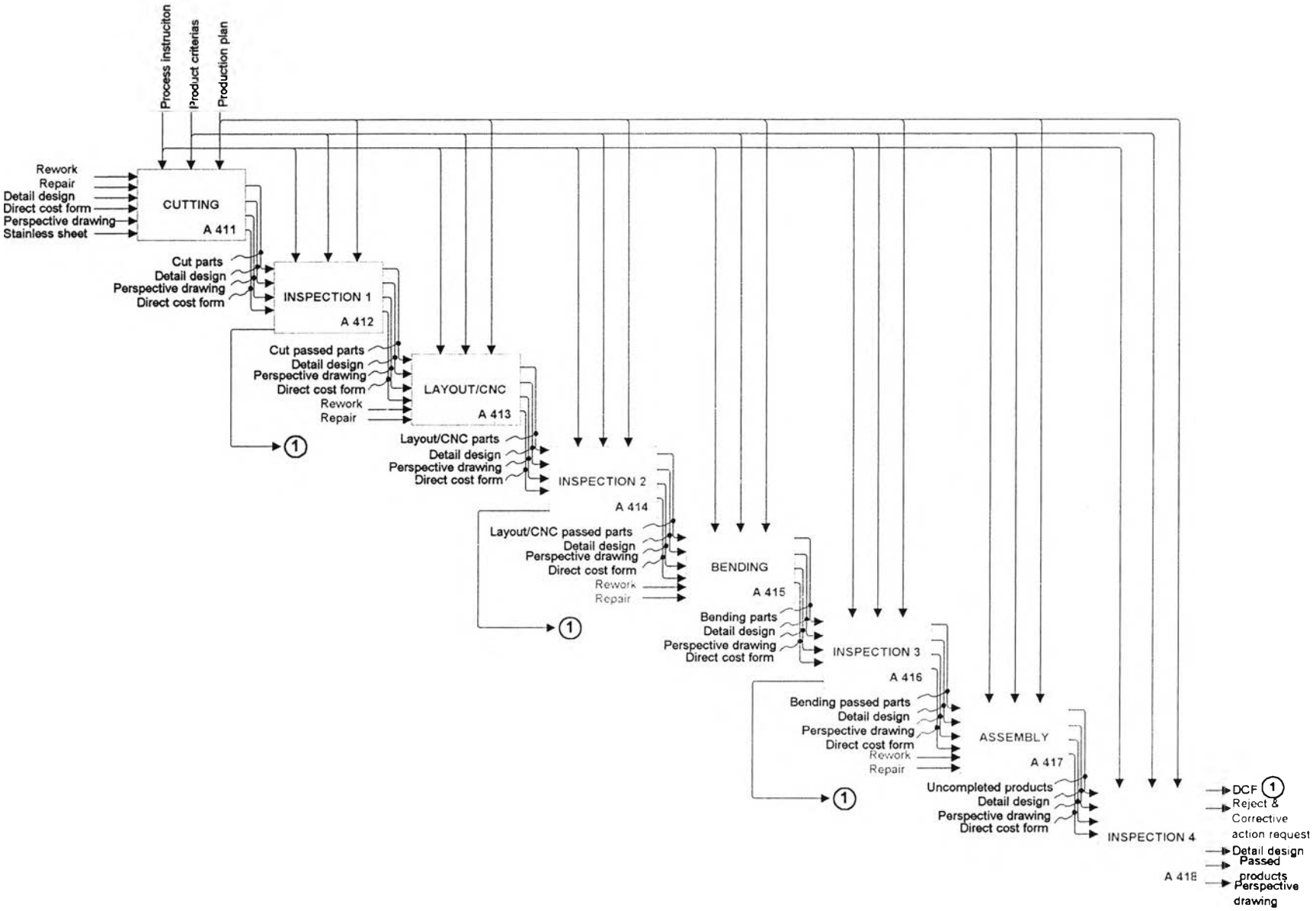

Figure 6.8: Front line operation activity: A41

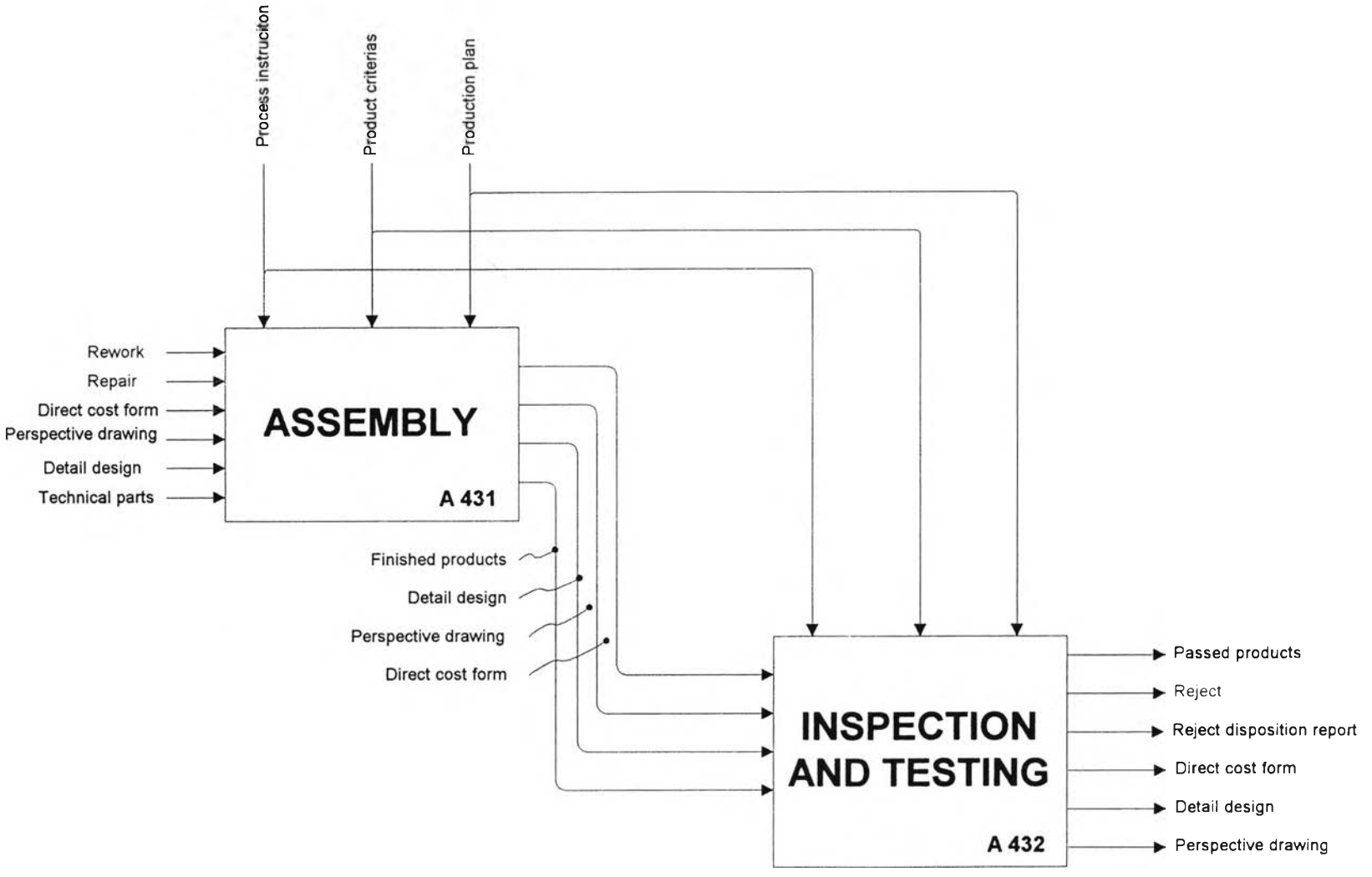

Figure 6.9: Technical assembly activity: A43

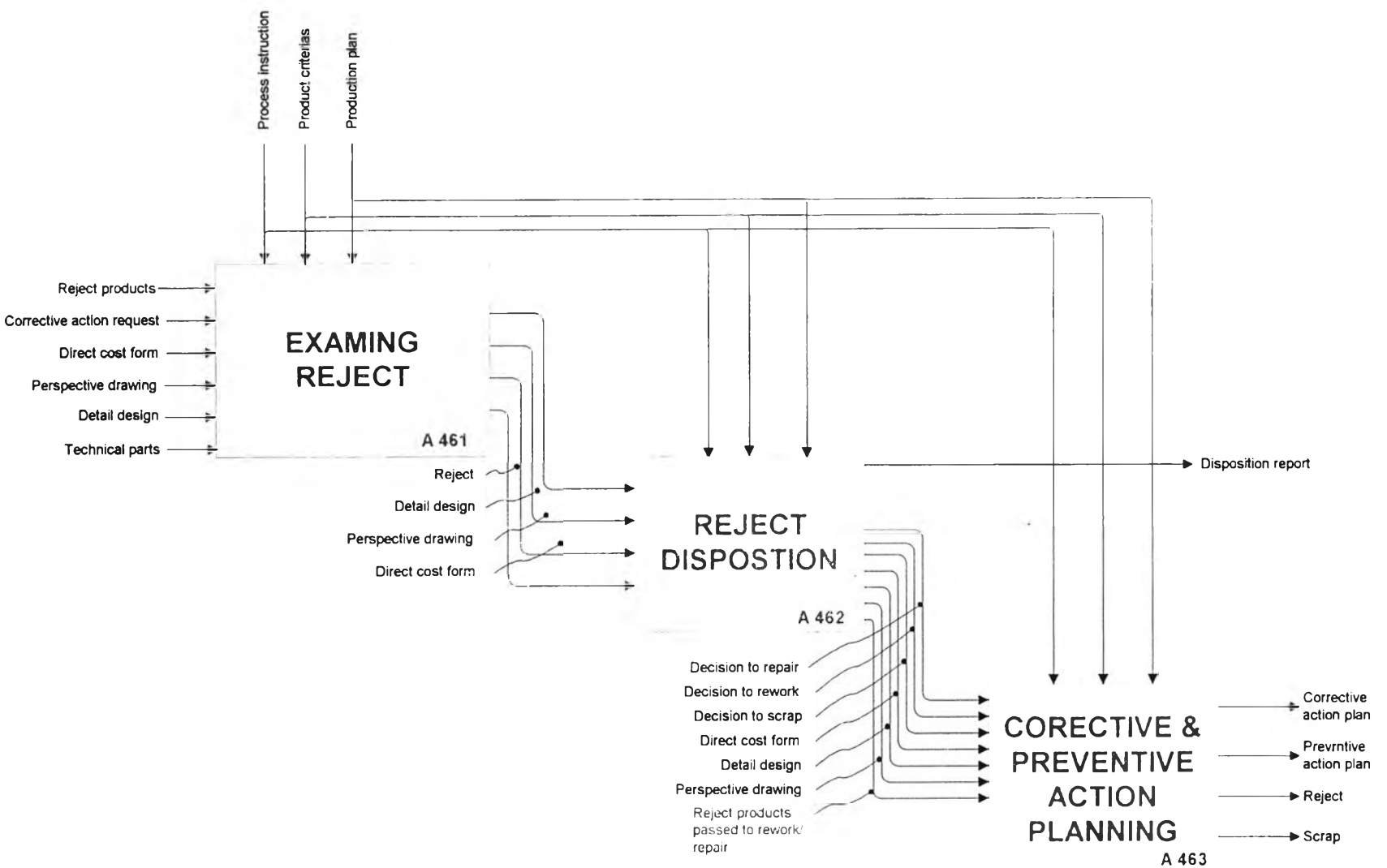

Figure 6.10: Final inspection and manage reject activity: A46

6.2.2 Stage 2: Cost of quality model and Activity based cost setting up

This stage was extremely important step to setup a quality cost program, since the traditional cost would be segregated into activity based costing. Then, the cost would be identified to establish the performance measurements, which were used to calculate the manufacturing costs.

The performance measurement provided the essential information to control, including monitor the manufacturing process and especially quality cost. One of monitoring tool was recording form and reporting. In this stage, the both of them would be discussed.

6.2.2.1 Cost of quality model

The model of quality cost in this study is referred to BS: 6143, which has several model. Two of them are selected for this study that is:

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

And,

Hidden cost = Total actual cost - Standard cost - Prevention cost - Appraisal Cost – Other Failure cost

6.2.2.2 Cost accounting development: Activity Based Costing

This stage was the cost accounting development, since the existing system did not available for quality cost collection. The development was composed of 3 steps: The analysis of Activity based costing area, cost categories and elements and cost driven selection.

1) Cost areas analysis

This was the earlier step to identify activity-based area from several activities in manufacturing process and their impact on costs. During the stage, IDEFO would be examined in term of activities and its cost concerns. The IDEFO describes the manufacturing process into 5 main activities: Front line operation, Technical assembly, Refrigeration system assembly, Final inspection and manage reject staffs. Some of them contain various sub activities for instant: the front line operation has 8 sub-activities.

To define the area of activities based costing from the all of activities and sub-activities, the key questions were:

1.1) What are the activities that involve 3 common costs: direct material, direct labor and factory overhead.

1.2) Which are the sections that the cost implied.

The cost area can be determined as exhibited in table 6.1.

Table 6.1: Activity based costing areas

		TYPES OF COST CONCERNS			
		Direct material, DM	Direct labor, DL	Factory overhead, FOH	Cost areas
A411	Cutting	☑	☑	☑	Cutting section
A412	Inspection 1		☑	☑	Quality control section
A413	Layout/CNC		☑	☑	Layout section
A414	Inspection 2		☑	☑	Quality control section
A415	Bending		☑	☑	Bending section
A416	Inspection 3		☑	☑	Quality control section
A417	Assembly	☑	☑	☑	Assembly section
A418	Inspection 4		☑	☑	Quality control section
A421	Order the parts	☑	☑		Technical assembly section
A422	Assembly	☑	☑	☑	Technical assembly section
A423	Inpsection & Testing		☑	☑	Quality control section

Consequently, the areas of quality cost were the section of cutting, layout/CNC, Bending, Assembly, Technical assembly and quality control. These areas helped to assign that cost into properly area, since currently the cost was assigned to only one area that is manufacturing process.

In short, the areas of cost were 7 areas: the sections of cutting, layout/CNC, Bending, Assembly, Technical assembly, polishing and quality control. These sections would be assigned the cost depended upon their activities.

2) Cost categories and elements

As mention in previous cost area analysis, the activity cost that were determined in to the area's cost and charged into the manufacturing department. That is helping to identify the problem's area and taking action in case of people concerns. Secondly, the cost categories and its elements would be analyzed because they were used to find out how to the performance indicator for measuring, which would be discussed in next step.

By theory, the cost categories should be big enough the measurement and monitoring as mentioned in chapter III, table 6.1 and table 6.2. In

that table, they explored the categories of quality costs including their elements. In this paper, the IDEF0 also helps to identify the categories.

Referring to the IDEF0, the cost categories and its elements would be broken down from the process decomposition. The main activities could be grouped into categories based on cost concerns, while the cost element could be grouped through the sub-activity respectively.

For examples: cutting activity is a part of A4, which involves the cost such as DM, DL and FOH. Consequently, manufacturing cost could be counted as a category of cost, which has many elements for instant cutting, bending and so on.

According to the quality cost model in chapter III, the quality costs come up with the 2 parts of costs: Direct and indirect production cost. The previous example shows that the manufacturing cost is direct production cost. In addition, the indirect relation to production cost is quality system cost, which quality management cost is a category of the cost, which has various elements such as inspection and testing, rework, repair, scrap, manage reject products and etc. These elements contribute through the manufacturing cost as illustrate in figure 6.11.

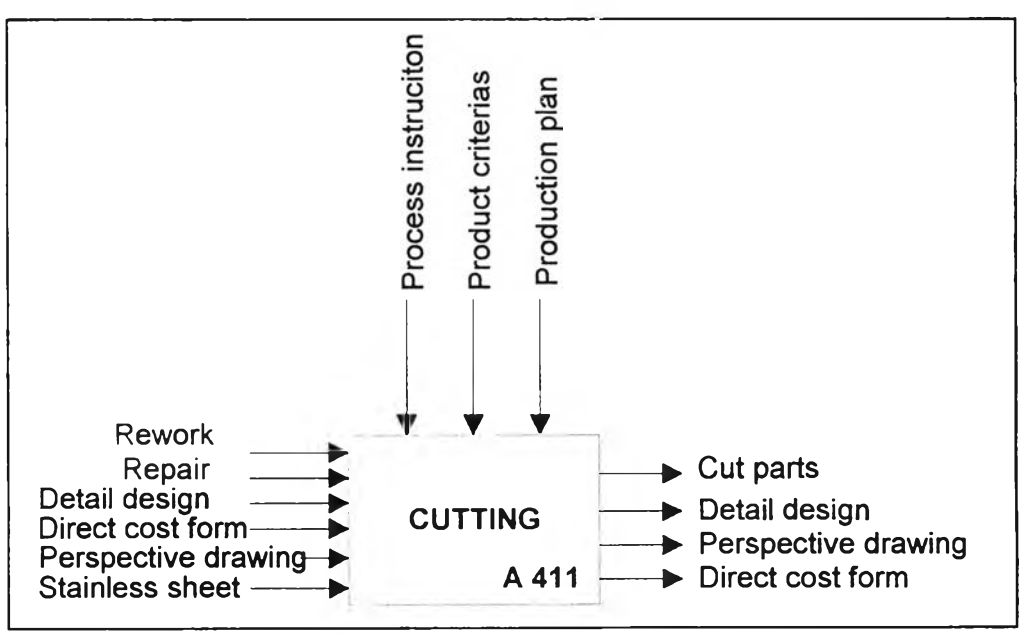

Figure 6.11: Quality cost element contribute to the manufacturing cost

In short, the categories and elements could be examined as shown following table.

Table 6.2: Cost categories and cost elements

Cost catagories	Cost elements
Manufacturing process	
1. Manufacturing cost	1) Cutting 2) Layout/CNC 3) Bending 4) Assembly 5) Polishing 6) Technical assembly
Quality management cost	
2. Appraisal cost	1) Inspection and testing
3. Failure cost	1) Rework 2) Repair 3) Scrap 4) Hidden cost
4. Prevention cost	1) Education and training 2) Maintenance 3) Quality improvement

In table 6.2, the cost was grouped into 4 categories: manufacturing cost, appraisal cost, failure cost and prevention cost, based on the direct production concerns and indirect production concerns. In case of direct production concerns, they were divided into 6 elements: cutting, layout/CNC, Bending, Assembly, Polishing and technical assembly. Whereas, the indirect production concerns were separated into 3 categories and 9 elements.

3) Cost driven analysis

This was the third step of developing the cost accounting to identify how to measure the cost categories and their elements through DM, DL and FOH. By theory, the direct material (DM) is usually measured through all kinds of main materials, while the direct labor (DL) is typically measured through man-hour multiplied by hour rate.

Besides, the factory overhead (FOH) is measured through indirect cost, which composes of variable and fixed cost. The variable costs are such as sand paper, electric welding wire and etc., and the fixed costs are such as machine cost and its depreciation, tools and equipments.

3.1) Manufacturing costs:

According to, this type of cost involves directly to manufacturing processes, which typically has involved raw materials, parts, machine and direct operator. This results the cost contains all of the common costs that are Direct material, Direct labor and factory overhead. Consequently, the cost driver could be classified as following:

Direct materials:

1. Stainless sheets	Part number	R1120320
2. Drawer rails	Part number	P3125202
3. Switch and holder	Part number	P2145216
4. Ceramic heater	Part number	P1123125
5. Lamp with holder	Part number	P1134511
6. Pilot lamp	Part number	P1134534
7. Footings	Part number	P3145270

The direct material cost came from bill of material, BOM of the French-fries station, where as the direct labor cost and factory overhead cost was collected from the cost which occurring in each section.

Direct labors:

These costs were collected from the number of direct operators cost in each section.

1. Cutting section	Man-hour rate	25 Baht/hour
2. Layout/CNC	Man-hour rate	25 Baht/hour
3. Bending section	Man-hour rate	25 Baht/hour
4. Assembly section	Man-hour rate	36 Baht/hour
5. Polishing section	Man-hour rate	20.5Baht/hour
6. Technical assembly	Man-hour rate	36 Baht/hour

Factory overhead cost: (Focusing on manufacturing process only)

These costs were collected from several factors such as: Manager salary, supervisor salaries, indirect materials and indirect expenses, which are composed of water supply, electric usage, telephone, paper and other expenses. These costs would be assigned to section and then conducted to the product cost later.

1. Cutting section	Rate	115 Baht/hour
2. Layout/CNC	Rate	134 Baht/hour

3. Bending section Rate 136 Baht/hour
4. Assembly section Rate 310 Baht/hour
5. Polishing section Rate 99.5 Baht/hour
6. Technical assembly Rate 260 Baht/hour

The manufacturing cost would be occurred whenever producing the product.

3.2) Appraisal costs:

This cost involved significantly on quality control section, since it had directly responsibility to inspection and testing. The cost did not concern the direct material cost and direct labor cost, since it was in a supporting department. As a result, it had concerned only the factory overhead, which inspection activities were happened. By using the time-based basic, the appraisal costs could be calculated in hour rate that is 300 Baht/ Man-hour.

3.3) Failure costs:

The costs of failure were composed of rework, repair and scrap including hidden cost. Analyzing the cost driven, rework, repair and scrap were actuated from the manufacturing costs whenever the error was happened. This results the method of calculating the cost is the same as manufacturing cost method.

One important thing of quality cost system as referring by American Society for quality, ASQ, is hidden cost. Hidden cost came from the cost, which was unknown source of problems. In this paper, the hidden means the deviation from the standard, which would be addressed further in standard cost.

Usually, the costs of error are not only the rework repair and scrap but also the delay, and other errors, which were charged into the actual cost. This makes the actual cost higher than the standard cost in some cases.

3.4) Prevention costs:

The cost of prevention was such as maintenance, quality improvement and training cost. These costs are to reduce the problems and the cost of product, especially to increase the manufacturing efficiency. The cost would be calculated project by project, leaning on DM, DL and FOH.

6.2.2.2 Develop cost collection form and cost reporting

Colleting the quality cost, the form and reporting were both major step, since they were designed to monitor and control the performance indicators,

which the company required the know their information. However, designing both of them had to understanding how we record the information and analyze them easily.

In previous step, the costs were separated into categories and elements that helped to group the cost by arrangement of cost elements into the categories of manufacturing, prevention, appraisal and failure. One important thing, the categorizations of cost help to identify where the cost occur in different areas and purposes.

In term of accounting, all cost information has to have an identification number, so called accounting number, since it is to easy record and computerizing. In this step, the account number and form would be shown.

1) Setting Accounts number:

The accounting number, which we would like to address in 2 parts: Department and cost categories and elements.

1.1) Establishment accounts number for manufacturing sections:

Currently, the accounting number does not separate into section, as a result the company cannot collect the information about where the area of problem. Consequently, the accounting number of manufacturing process had to slit into 7 accounts. The accounting numbers were shown in table below:

Table 6.3: Accounting number of manufacturing process

Accounting No.	Descriptions
61250	Cutting section
61251	Layout/CNC section
61252	Bending section
61253	Assembly section
61254	Polishing section
61255	Technical section
61256	Quality control section

These accounting numbers helps to assign the cost to the section, which make the product and defects.

1.2) Establishment accounts numbers for cost categories and elements

In addition, the traditional accounting only provide the accounting number for their resources, but also did not provide the cost categories in term of quality cost. The cost categories and elements could be defined the accounting number as shown in table 6.4.

Table 6.4: Accounting number of cost categories and elements

Accounting No.	Descriptions
65100	Manufacturing cost
651001	Cuttting cost
651002	Layout/CNC cost
651003	Bending cost
651004	Assembly cost
651005	Polishing cost
651006	Technical assembly cost
65101	Appraisal cost
651011	Inspection and testing cost
65102	Failure cost
651021	Rework cost
651022	Repair cost
651023	Scrap cost
651024	Hidden cost
65103	Prevention cost
651031	Education and training cost
651032	Maintenance cost
651033	Quality improvement cost

In table 6.4, the cost categories were defined by adding the accounting number from 1(manufacturing cost) to 4, and identify the cost elements by extending 1 digit in continuous number.

2) Develop cost collection form

Developing the cost collection form, there was several required information that were such as:

1. Date
2. Job number
3. Product description
4. Model
5. Serial number
6. Production Planning Identification (Planning ID)

7. Cost areas
8. Cost categories
9. Cost elements
10. Types of direct materials
11. Direct material usages
12. Direct labor usages

This information could be translated into cost collection form, and resulting to the current forms was developed. Comparing to existing forms in manufacturing process they had only 2 forms (Material requisition form and direct cost form) that were cost concerns. They still did not have the item 5,7,8 and 9.

To develop the cost collection forms, adding the cost area, elements and types of direct material usage and labor usage into that form is the first step. In addition, all of cost collection should be linked to information through that form. The following figure shows the new development of 2 types of form comparing to the existing form. In addition, Appendix IV shows the developed form.

Figure 6.12: Existing direct cost form

DIRECT COST FORM

FOOD WORLD Co., LTD.

Planning ID Customer Name Date Require

Date Start

Item No Q'ty Of Q'ty Date Finish

Description French - fries Station

STORE RECIEVING RECORD

Manufacuring Suervisor	Finished Goods Store Supervisor
Date...../...../.....	Date...../...../.....

Material				Material			
Specification	Sq.m. (m^2)	Unit Price (Baht)	Total (Baht)	Specification	Sq.m. (m^2)	Unit Price (Baht)	Total (Baht)
14 GA.SS				20 GA.EG			
16 GA.SS				22 GA.EG			
18 GA.SS							
20 GA.SS							
22 GA.SS							
18 GA.(304-HL)							
20 GA.(304-HL)							
22 GA.(430-HL)							
22 GA.(430-BA)							
18 GA. GI							
20 GA.GI							
22 GA.GI							
20 GA.MS							
16 GA.EG							
18 GA.EG							
					Total		

Labor							Remarks:
Section	Date		Time Usage		Operator	Supervisor	
	Start	Finish	NT	OT			
Cutting							
Lay - Out							
CNC							
Bending							
Assembly							
Polishing							
Painting							
Technical Assembly							
Refrigeration							
	Total						

Figure 6.13: New direct cost form

DIRECT COST FORM

FOOD WORLD Co., LTD.

Planning ID	Customer Name		Date Require
Job Order			Date Start
Item No	Q'ty	Of Q'ty	Date Finish
Description		Model No.	Serial No.

STORE RECIEVING RECORD	FINAL APPROVAL Quality Control Results
Manufacuring Suervisor Date...../...../.....	Finished Goods Store Supervisor Date...../...../.....
	Authorised Signature Date...../...../.....

Material				Material			
Specification	Sq.m. (m^2)	Unit Price (Baht)	Total (Bath)	Specification	Sq.m. (m^2)	Unit Price (Baht)	Total (Bath)
14 GA.SS				20 GA.GI			
16 GA.SS				22 GA.GI			
18 GA.SS				20 GA.MS			
20 GA.SS				16 GA.EG			
22 GA.SS				18 GA.EG			
18 GA.(304-HL)				20 GA.EG			
20 GA.(304-HL)				22 GA.EG			
22 GA.(430-HL)							
22 GA.(430-BA)							
18 GA. GI							
				Total			

Labor Information							Quality Control	
Section	Date		Time Usage		No. of Operator	Supervisor E/N	Inspector E/N	Results
	Start	Finish	NT	OT				
Cutting								
Lay - Out								
CNC								
Bending								
Assembly								
Polishing								
Technical Assembly								
Total								

Comparing traditional and modern direct cost form, the cost quality information could be gathered accurately, and corrective action is rather effective than the previous, since they could track deeply to the operator.

Figure 6.14: new material requisition form

MANUAL REQUISITION FORM

Requsition No. ☐

☐ order material/Parts ☐ Recall materials/Parts ☐ Balance the account

Request person Name______________ E/N ☐☐☐☐☐☐ Account No. ☐☐☐☐☐

Job Order ☐/☐☐☐ item ☐☐☐ Planning ID ☐☐☐☐☐☐☐

Product Name______________ Date require Date ☐☐ Month ☐☐ Year ☐☐

Purpose [01] Mormal operation [02] Rework [03] Repair [04] In - process stock [05] Others_____

item No.	Part number	Description	Q'ty	From Lot Number	Q'ty	Cost/unit

Approved By__________________ E/N ☐☐☐☐☐☐ Signature_______ Date....../....../........

Received / Recalled By______________ E/N ☐☐☐☐☐☐ Signature_______ Date....../....../........

Issued / Received / Balanced By________ E/N ☐☐☐☐☐☐ Signature_______ Date....../....../........

In figure 6.14, the direct material costs were assigned to the account number, which is a cost center.

For reject management cost, the corrective action request and corrective action plan were issued to collect the cost during the manufacturing process. In figure 6.15 and 6.16 the reject management cost was collected in many details.

Figure 6.15: Corrective action request

CORRECTIVE ACTION REQUEST
FOOD WORLD Co., LTD.

Planning ID	Customer Name	Date Require
Job Order		Date Start
Item No	Q'ty Of Q'ty	Date Finish
Description		

Problems	Date ...../...../.....	Detail

Problems area	cutting	Inspect1	Layout/CNC
☒ Found at	Inspect2	Bending	Inspect 3
	Assy	Inspect4	Polishing
☑ The Problem come from	Inspect5	Tech. Assy	Inspect & Testing
	Final Inspection	Other	

Figure 6.16: Corrective action plan

CORRECTIVE ACTION FORM

FOOD WORLD Co., LTD.

Planning ID	Customer Name	Date Require
Job Order		Date Start
Item No	Q'ty Of Q'ty	Date Finish
Description		

Problems	Date ...../...../.....	Detail

Problems area			
☒ Found at	cutting	Inspect 1	Layout/CNC
	Inspect 2	Bending	Inspect 3
	Assy	Inspect 4	Polishing
☑ The Problem come from	Inspect 5	Tech. Assy	Inspect & Testing
	Final Inspection	Other	

Type of Action	Action Details
☐ Rework	
☐ Repair	
☐ Scrap	
☐ Other	

Resource Planning

Section	No. of operator	Time Usage NT	Time Usage OT	Priority	Remarks :	Authorized by
Cutting				[ ] emmergency		
Layout				[ ] within 24 Hrs.		
CNC				[ ] within 3 days		_____
Bending				[ ] within 7 days		
Assembly				[ ] within 15 days		Date ...../...../.....
Technical Assembly				[ ] within .....days		

Actual Performance

Section	Date Start	Date Finish	Time Usage NT	Time Usage OT 1	OT 1.5	OT 2	OT 3	Operator E/N	E/N	Supervisor E/N	Quality Control Inspector E/N	Quality Control Result
Cutting												
Layout												
CNC												
Bending												
Assembly												
Polishing												
Technical Assembly												
Total												

Operation Report

Job closing code	☐ Complete	☐ Not Complete	☐ Job cancel	☐ Others
Problems	Causes		Action	

3) Design cost reporting form

The cost report could be designed in several ways depended upon the information which were required. From surveying, the managers and operators want to know the reporting by cost categories, by date, by section. For examples: the cost categories report could be illustrated in figure 6.17.

Figure 6.17: Cost reporting format

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This report provides detailed cost of quality information

COQ detail report - By cost catagories, all cost catagories

From January 2000 *to* Febuary 2000

As of 3/1/00

Product name *French-fries station*

Cost catagories	Cost elements	Cost	% of total costs
Manufacturing	Cutting	430310	32.31
	Layout/CNC	46604	3.50
	Bending	57580	4.32
	Assembly	329360	24.73
	Polishing	34632	2.60
	Technical assembly	332490	24.96
	Total	**1230976**	**92.41**
Appraisal cost	Inspection and testing	4734.6	0.36
	Total	**4734.6**	**0.36**
Failure cost	Rework	17500	1.31
	Repair	54315	4.08
	Scrap	15025	1.13
	Total	**96309.2**	**7.23**
Prevention cost	Education and trainning	0	0
	Maintenance	0	0
	Quality improvement	0	0
	Total	**0**	0
Total actual cost		**1332020**	100.00
Standard cost		**979735**	
Failure cost	Hidden cost	**-251241**	**-18.86**

3.1) Reporting by cost categories and their elements:

This type of report benefited to identify the portion of investment through investing in manufacturing appraisal and prevention cost. In figure 6.13 showed that the company emphasized significantly on manufacturing investment, as

a result the failure cost are rather high around 26.45%, 7.59% from measured failure cost and 18.86% from the unmeasured failure cost, so called hidden.

In addition, the report could be grouped briefly into 3 categories: Prevention, Appraisal and Failure, and presented in graphic form.

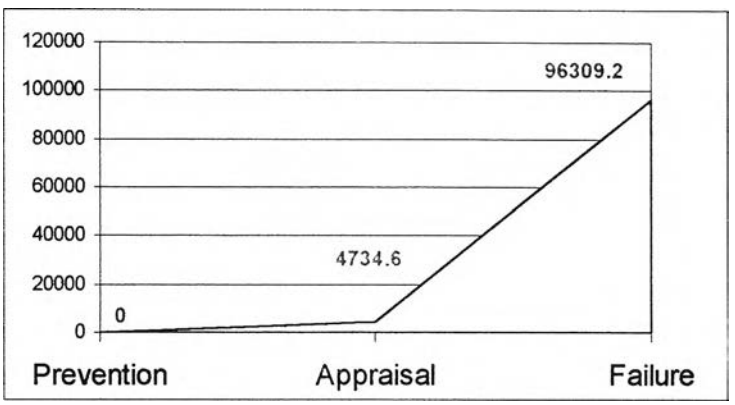

Figure 6.18: Quality cost categories

In figure 6.14, it shows the current problem is usually happen and monitoring by inspectors though appraisal cost, but the Failure cost is the largest cost because it is ignored from any prevention.

6.2.2.4 Information flow

Analyzing the IDEF0, the cost information was fluxed though 6 forms: Direct cost form, Material requisition form, Corrective action request and corrective action plan, preventive action request and preventive action plan. Including many types of reports that were reject disposition report, several cost reports.

6.2.3 Stage 3: Standard cost of product

To measure something, the standard significantly was needed to know how far the problems are. One important thing, the standard came from the managerial team, which composed of production planning, purchasing, accounting, manufacturing and quality control as well as engineering. This team was settled up to set up and review the standard of product at least every 2 months.

According to, the standard had a majority involves to the cost, which would be compared to actual. Consequently the standard cost was verified and evaluated several time to get the effective standard that came from many years of experience and knowledge.

The product costs standard are focused based on cost element and activity of the French-fries station's product based on its direct material cost, direct labor cost and overhead. Especially, it is cost of good produced only in manufacturing process, not all the plant, since the cost would be measured only at the focusing areas, such manufacturing. It was so called micro quality cost.

Comparing the standard product cost in manufacturing process, the hidden cost and other problem costs usually were explored and heated up by management to find out the preventive solution, not corrective solution anymore. In figure 6.19, the actual cost was variance from the standard cost. The deviation was composed of failure cost and hidden cost.

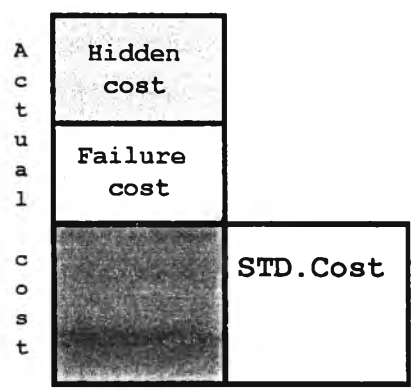

Figure 6.19: Actual cost VS standard cost in manufacturing process

In this paper, the standard would be based on the cost of a product unit as shown below. The cost components could be grouped into 4 items: direct material, direct labor, factory overhead and other costs, which involves quality investment cost.

6.2.3.1 Direct materials

A unit of product could be grouped the materials in to 7 categories such as:

1. Stainless steel	9420 Baht/ product Unit
2. Drawer rails	388.5 Baht/ product Unit
3. Switch and holder	1432 Baht/ product Unit
4. Ceramic heater	3340 Baht/ product Unit
5. Lamp and holder	438 Baht/ product Unit
6. Pilot lamp	250 Baht/ product Unit
7. Footings	330 Baht/ product Unit

6.2.3.2 Direct labors

As mention before, the direct labor would be different from the previous cost concept, which the direct labor had only 1 rate that is 163.5 Baht per hour. This result, the cost was not accurate. For example: whenever the problems were occurring especially in highest direct labor cost, the cost was extremely deviated. Fortunately, the activity-based costs provide us to separate the cost into activity, which was such as cutting, layout/CNC and bending and etc.

The following standard labor costs were calculated from the hour usages, which a French-fries station was produced, and then multiplied by hour rate in each activities as mention in Stage 2.

1. Cutting section 150 Baht/ product Unit
2. Layout/CNC 300 Baht/ product Unit
3. Bending section 400 Baht/ product Unit
4. Assembly section 864 Baht/ product Unit
5. Polishing section 205 Baht/ product Unit
6. Technical assembly 540 Baht/ product Unit

6.2.3.3 Factory Overheads: Manufacturing focus

With the same concepts as direct labor, the factory overhead was separated into activities, as a result the cost would be counted by activity usages, which was calculated by hour rate. This overhead was defined only manufacturing overhead, not total factory overhead.

1. Cutting section 345 Baht/ product Unit
2. Layout/CNC 536 Baht/ product Unit
3. Bending section 544 Baht/ product Unit
4. Assembly section 3729 Baht/ product Unit
5. Polishing section 487.5 Baht/ product Unit
6. Technical assembly 1300 Baht/ product Unit

6.2.3.4 Other costs: Prevention, Appraisal

The other costs, which were referred into this paper, were composed of quality investment costs such as prevention and appraisal cost. One important thing, this cost would be allocated to the manufactured product.

Because of, there are several products that were manufactured in the projects such as Burger station, Holding cabinet and Display unit. To allocate that cost, the prevention and appraisal cost were sharing depended upon the ratio of

product, which was planned in that month. The following is a sample plan for January' 2000.

Table 6.5: Production time's planning (Hour.)

Type of products	Requirement in Jan.	Percentage
Marinator	1560	23%
Display unit	1210	18%
Burger station	1200	18%
Holding cabinet	1230	18%
French Fries station	1560	23%

In chapter 5, investment planning described that the investment in first year was around 158325 Baht, this results the other expense in each month was 13193.75 Baht. Analyzing the production plan's ratio, the French-fries station was 23 percents of total production, consequently the monthly cost of its was around 3034.60 Baht, which was 121.40 Baht per unit.

In short, the total product cost per unit was 25,121.40 Baht. This cost was defined as standard, and compared to the actual cost. Then, the problem costs would be discovered for further actions.

Besides, the standard cost could help to analyzing the problem area deeply into the section (Cutting, bending, and etc.), which was cost element in manufacturing categories. Consequently, the hidden cost and failure cost were becoming an attraction part for beyond corrective and preventive action.

6.2.4 Stage 4: Implementation

The implementation step is a cardinal step, since the developer had trained the existing employee to understand the flow of information and collection forms including reporting. This stage is not complicate, since the system concerns slightly in manufacturing process. The new collection form was different in case of more detail.

The training program was included the following:

1) Overview to new cost system
2) Quality improvement year: Quality Policy and how to achieve
3) Modern cost collection process

In addition, the implementation should be implemented in small group first, and then become to larger group till to whole the plant respectively. The start of implementation might interrupt the normal time, especially the correction process. However, the learning time is just one month. However, the learning time did not effect to the cost anymore.