

# CHAPTER 4

## EXISTING PROBLEM ANALYSIS

Refer to case study survey at jacket process, scrap and down time which occurred during set up time were the highest. So set up time analysis had been done in order to analyze the concerned problem.

### 4.1 Existing machine set-up time analysis

Machine set up time analysis had been done by doing time study and checked the result of it. The existing machine set up time had collected at jacket process machine number Ex-302 and Ex-303 in power cable production.

#### 4.1.1 Time study

##### 4.1.1.1. Step of time study

In this thesis, step of time study had been set in order to collect the data of set up time in cable production had shown as below.

1. After study step of set up time, the step of set up time of main operator had been separated into 8 steps.

Step 1: Take out and cleaning die, die holder, nipple, and setting die set.  
(At cross-head)

Step 2: Take out and cleaning nipple holder and master core. (At cross-head)

Step 3: Take out and cleaning breaker plate, set spacing, adjust center and overflow compound. (At cross-head)

Step 4: Take out and cleaning breaker plate, set spacing, adjust center and overflow compound. (At Sub-extrude)

Step 5: Change pay-off bobbin and joint conductor.

Step 6: Pull out conductor. (Pass-line)

Step 7: Start and adjust center.

Step 8: Speed up and adjust center.

2. For Sub operator, the step of set up time had been separated into 6 steps.

Step 1: Set printing equipment

Step 2: Change take up bobbin

Step 3: Check compound & conductor, clean hopper, counter set and take data in check sheet .

Step 4: Pull out conductor,

Step 5: Check product centering

Step 6: Adjust printing, check product centering after speed up and put data in check sheet

3. The activities for machine set up operation could be classified into 7 categories depending on machine items changed as shown in Table 4.1. And each of main activities were divided into 2 sub activities.

4. Set up time check list had been issued to cable production for collecting necessary data.

5. Whenever operator change products, process leader should check the set up timing and fill the form one time for each changing product type per shift.

6. Data had been started to collect on July,1997. After that data were analyzed to develop problem solution.

7. The problem solution had been implemented during August,1997 to end of September,1997.

8. Data of set up time had been continued to collect on October.1997 and November.1997 to compare the result with data on July.1997.

9. The result had been evaluated on Aug.98

#### 4.1.2 Result of time study

For machine Ex-302, every typical of set up time had been collected separately followed the step operation both main operator and sub operator. Because this machine was often planed to change the type of power cable products So more data should be collected than machine Ex-303 which was fixed the type of product to be parallel but it needed to change only size and color of cable only. Then the set up time was collected from Ex-302 to check the existing set up operation time.

The data of set up time both main operator and sub operator in July,1997 which were collected from machine Ex-302 were shown as Appendix F and H.

The average of set up time of each type of product change for machine Ex-302 in July'97 was shown in Table 4.2.

From the data of machine Ex-302, the average of set up time type "A" which was collected on July'97 was 57minutes. Set up time of operation for type "A" took the longest set up time so it was used to consider to improve.

The average of each step of set up time type "A" of main operator and sub operator for machine Ex-302 were shown in Table 4.3 and Table 4.4 respectively.

Table 4.3 showed the result of the average of each step of main operator set up time type "A". The data of this table had been plot in Figure 4.1. The step 1-4 which concerned cross-head took about 18 minutes, step 6 which concerned pull out conductor and pass-line was also taken about 19 minutes and step 7 concerned start adjust also took high set up time which was about 10 minutes.

Table 4.4 showed the result of the average of each step of sub operator set up time type "A". The data of this table had been plot in Figure 4.2. The printing unit setting in step 1 was taken the longest set up time which was 18 minutes.

Table 4.1 : Showing the typical activities of machine set up operations when product were changed.

Typical activity		Items changed					Explanation
Main	Sub	Die	Nipple	Conductor	Sub-Extrud	Compound	For main operator
A	A1	*	*	*	*	*	Step 1-8
	A2	*	*	*	*		
B	B1	*	*	*		*	Except step 4
	B2	*	*	*			
C	C1	*	*		*	*	Except step 5
	C2	*	*		*		
D	D1	*	*			*	Except step 4, 5
	D2	*	*				
E	E1	*			*	*	Except step.5
	E2	*			*		
F	F1	*				*	Except step 4, 5
	F2	*					
G	G1				*	*	Except step 1, 2, 3, 5
	G2				*		

Remark : 1) \* Capable

2) \*\* Main and sub activities were different to compound changing.

Table 4.2 : Average of set up time of each type of product change for Ex-302 on July'97

Type of product change	Average of set up time (min)
A	57
B	59
C	39
D	25
E	49
F	35
G	25

Table 4.3 : Average of each step of set up time type "A" of main operator for Ex-302 on July'97

Step of product change	Average of set up time (min)
1	5
2	4
3	6
4	4
5	3
6	19
7	10
8	6
Total	57

Table 4.4 : Average of each step of set up time type "A" of sub operator for Ex-302 on July'97

Step of product change	Average of set up time (min)
1	18
2	1
3	10
4	5
5	8
6	10
Total	57

Fig 4.1 EX302 Lot change time analysis for main operator  
in July 1997

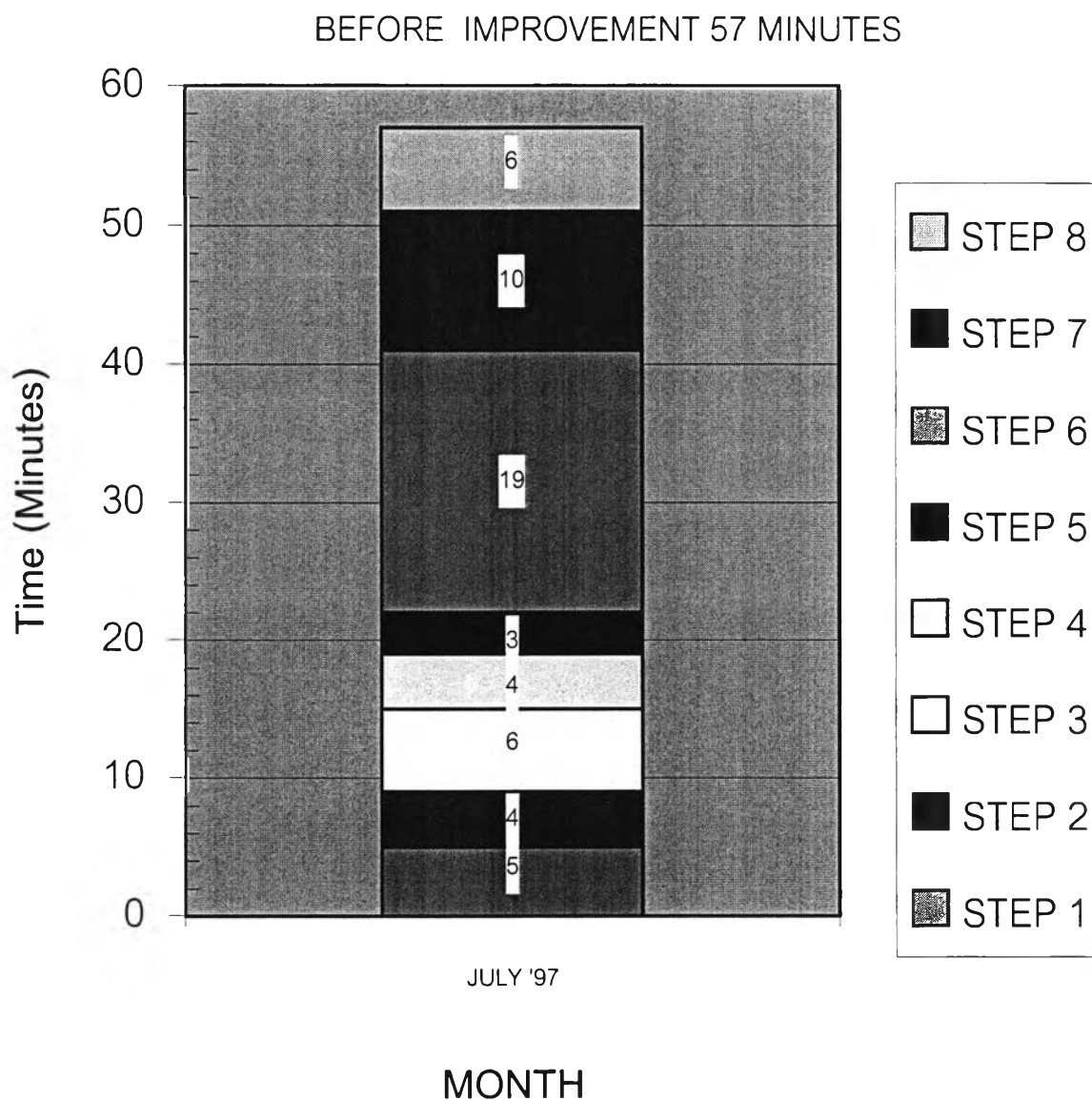
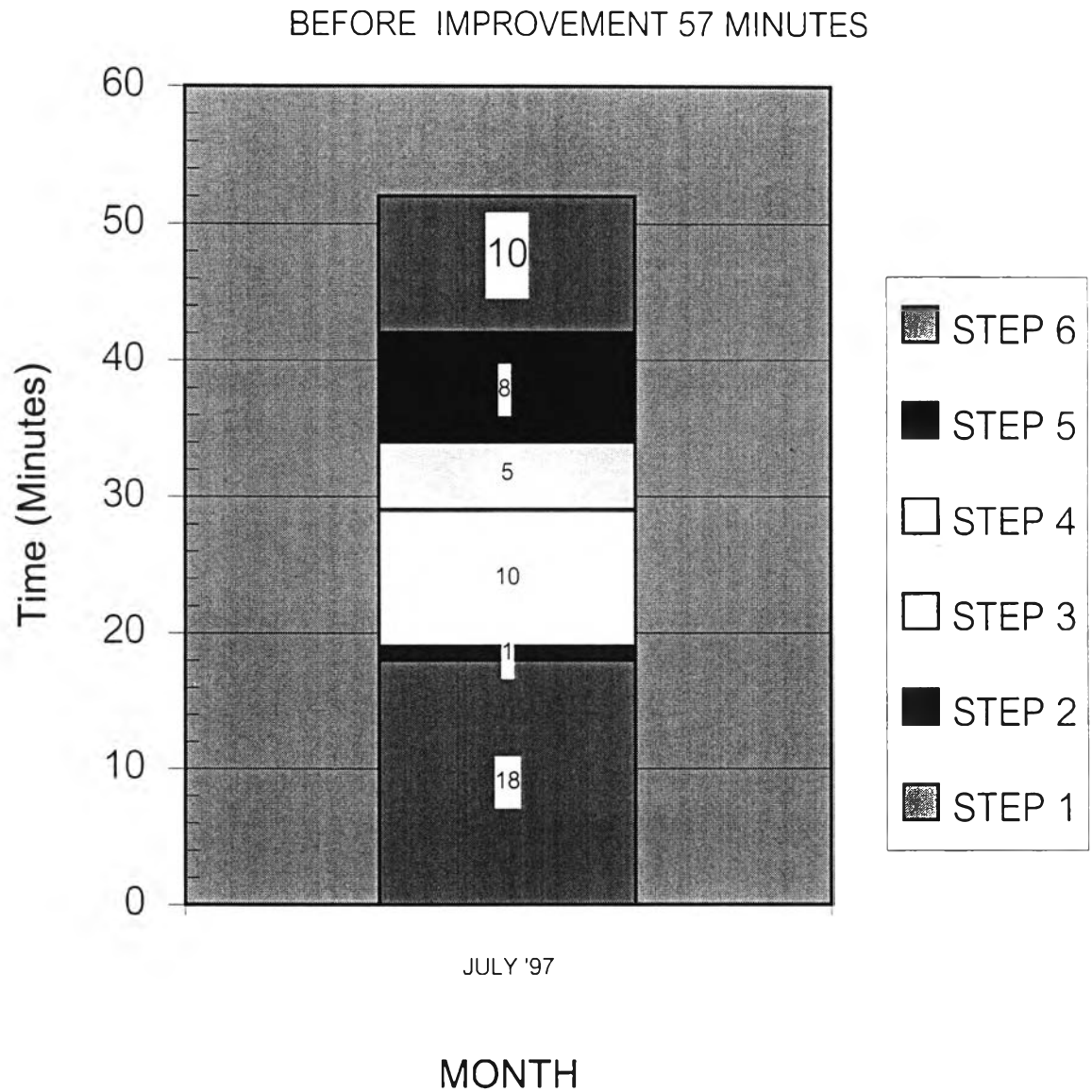


Fig 4.2 EX302 Lot change time analysis for sub-operator  
in July 1997





## 4.2 Cause of problem analysis

### 4.2.1 Brain storming technique analysis

After the data had got on July,97, the causes of problems were analyzed by brain storming technique among supervisors, senior operators, engineers, production managers and engineering managers. So the causes of problems which were the long time for machine set up operation were divided into 7 units.

#### 1. Pay off

The causes of long time operation at pay off were as follows.

- Conductor jointing took long time because of no skill operator and conductor quality no good.
- It was difficult to pull out the short length conductor.
- There was no tooling box near operation area.
- Operator needed to check many points of conductor properties and compound properties before setting at pay off unit.

#### 2. Printing unit

The causes of long set up time at printing unit were as the following.

- It needed to clean many parts of printing unit such as blade, side blade, blade and side blade holder, shaft roller and ink bath because it did not have the spare.
- It needed to check and adjust ink viscosity when setting printing unit.
- It needed to adjust printing roller speed in the same speed of machine speed.

#### 3. Water tank

The causes of problem were as the following.

- It was difficult to take sample cable from water tank to check quality of cable due to high machine speed.
- It needed to check many points concerning cable quality such as dimensions, appearance, some physical properties such as elongation, pulling force etc.
- It needed to adjust pass-line in water tank due to cable twisting problem.

#### 4. Take up

The cause of long set up time at take up unit was as the following reason.

- It needed to input many information concerning cable quality, machine properties and machine conditions in check sheet.

#### 5. Hopper

The cause of long set up time at hopper was as the following reason.

- It was difficult to clean hopper due to no good of the design of hopper.

#### 6. Talc bath

The cause of long set up time was as the following.

- It was difficult to open air valve due to its location

#### 7. Extruder

The causes of long set up time operation for extruder were as follows.

- It was difficult to pass line due to conductor broken.
- It was necessary to clean die, nipple, die holder, nipple holder and breaker plate of main extruder and sub extruder during hot Because it did not have spare and it was difficult to clean out the compound which stick on it if it was cool.
- Area to keep tool was far so operator should walked to get it.

- Band heat was difficult to tight.
- Lead wire was difficult to pull out because it was high tension after pass through die and nipple. It would be more difficult, if operator did not have an experience to select die and nipple.
- bolt and nut stock area was far and lack of stock.
- master core cleaning time and take out time was long.
- heat bolt take out time was long.
- Keeping area of air gun was not suitable. It was too high so it was difficult to use.
- time to over flow compound was long because of many air bubbles and contamination.

#### 4.2.2 Flow process chart analysis

A flow- process chart was used to explain the process operation which was useful to find out operations which could be eliminated or combined to another. The chart began with the raw material entering the factory and follows it through every step, such as transportation from storage, inspection, machining operations, and delay.

Main operator flow process chart and sub operator flow process chart were recorded as in table 4.5 and 4.6 respectively. And the summaries of flow process chart of main operator and sub operator was shown in Table 4.7.

##### 1. Flow process chart of main operator

From Table 4.5, they had 1 storage operations, 3 transportation which absorbed 4 minutes, 9 operations which took 50 minutes, 1 inspection which took about 3 minutes but It did not have delay

The transportation time and operation time were high. So they were checked and eliminated.

## 2. Flow process chart of sub operator

From Table 4.6, they had 1 storage operations, 8 transportation which absorbed 15 minutes, 10 operations which took 40 minutes and 2 inspection which took about 2 minutes.

The transportation time and operation time were high which same as flow process chart of main operator. So they were also check and eliminated.

### 4.2.3 Man-Machine chart analysis

Man-machine chart analysis used to check the activities of man comparing with machine. It could tell the status of man and machine during working.

Man-machine chart was started from the operators set up operation, Then machine started working automatically. During machine working time, operators should check product quality all appearance and dimensions as specification and check machine condition.

Man and machine chart of set up activities before improvement was written as in Table 4.8. And the summaries of man-machine chart was showed as in Table 4.9.

The chart showed that during main operator and sub operator operated the set up time operation, machine were gotten idle which took time about 57 minutes. After that machine had been operated while both of operators checked the machine condition and product quality. So the machine idle time should be reduced by reducing the set up operation time.

Table 4.5 : Flow chart of main operator for set up operation before improvement

Distance (m)	Time (min)	Chart symbols	Process Description
15	2		Storage at tooling box
	26		Transportation to cross-head
3	1		Cross-head cleaning and setting
	1		Open overflow compound
5	1		Transportation to pay-off
	3		Change pay-off bobbin
5	2		Joint conductor
	12		Pull out conductor
5	1		Transportation to cross-head
	1		Start machine
5	2		Adjust center
	1		Speed up machine
5	2		Adjust center
	3		Check product quality

The below is a flow chart show sub operator for set up time.

Table 4.6 : Flow chart of sub-operator for set up operation before improvement

Distance (m)	Time (min)	Chart symbols	Process Description
			Storage at tooling box
10	1		Transportation to printing unit
	18		Printing unit cleaning and setting
6	1		Transportation to take up
	2		Chang take up bobbin
25	3		Transportation to pay-off
	6		Check compound and conductor
	3		Hopper cleaning and setting
10	1		Transportation to cross-head
	2		Counter set
25	3		Transportation to take up
	1		Input data in check sheet

Table 4.6 : Flow chart of sub-operator for set up operation before improvement (cont.)

Distance (m)	Time (min)	Chart symbols	Process Description
22	3		Transportation to cross-head
	4		Pull out conductor
20	2		Transportation to take up
	1		Input data to check sheet
	1		Check product centering after starting
	2		Adjust printing
5	1		Check product centering after speed up
	1		Transportation to take up
	1		Input data in check sheet

Table 4.7 : Summary of flow process chart of main operator and sub operator before improvement.

Item	Main operator		Sub operator	
	No. of Operation (times)	Time (min)	No. of Operation (times)	Time (min)
Storage	1	0	1	0
Transportation	3	4	8	15
Operation	9	50	10	40
Inspection	1	3	2	2
Delay	NO	NO	NO	NO
Total	14	57	21	57



Table 4.8 : Man and machine chart of Jacket Extruder machine before improvement

Man-1 (Main Operator)	Man-2 (Sub Operator)	Machine	Time (min)
<ul style="list-style-type: none"> <li>● Take out die holder, die, nipple and clean</li> <li>● Take out nipple holder and clean</li> </ul>	<ul style="list-style-type: none"> <li>● Set printing unit</li> </ul>	Idle	18
<ul style="list-style-type: none"> <li>● Set die, nipple, die holder, nipple holder and adjust center</li> <li>● Take out breaker plate, clean, set and overflow compound</li> </ul>	<ul style="list-style-type: none"> <li>● Change take up bobbin</li> </ul>	Idle	1
<ul style="list-style-type: none"> <li>● Take out breaker plate, clean, set and overflow compound of sub-extruder</li> <li>● Change pay-off bobbin and joint conductor</li> </ul>	<ul style="list-style-type: none"> <li>● Check material, put compound into hopper, counter setting and input data in check sheet</li> </ul>	Idle	11
<ul style="list-style-type: none"> <li>● Pull out conductor</li> </ul>	<ul style="list-style-type: none"> <li>● Pull out conductor</li> </ul>	Idle	10
<ul style="list-style-type: none"> <li>● Start and adjust center</li> </ul> <p>Speed up and check product quality</p>	<ul style="list-style-type: none"> <li>● Check product center</li> </ul> <p>Adjust printing, check product center, change take up bobbin and input data in check sheet</p>	Idle	17

Table 4.8 : Man and machine chart of Jacket machine before improvement (Cont.)			
Man-1 (Main Operator)	Man-2 (Sub Operator)	Machine	Time (min)
Check product quality	Write down check sheet	Working	5
Check machine and controller at extruder and pay-off	Check machine and controller at printing unit and take up	Working	20
Check product quality	Write down check sheet	Working	5
Check machine and controller at extruder and pay-off	Check machine and controller at printing unit and take up	Working	20
Check product quality	Write down check sheet	Working	5
Check machine and controller at extruder and pay-off	Check machine and controller at printing unit and take up	Working	20
Check product quality	Write down check sheet	Working	5
Check machine and controller at extruder and pay-off	Check machine and controller at printing unit and take up	Working	20
Check product quality	Write down check sheet	Working	5
Check machine and controller at extruder and pay-off	Check machine and controller at printing unit and take up	Working	20
Check product quality	Write down check sheet	Working	5
Check machine and controller at extruder and pay-off	Check machine and controller at printing unit and take up	Working	20
Check product quality	Write down check sheet	Working	5
Check machine and controller at extruder and pay-off	Check machine and controller at printing unit and take up	Working	20
If it had been reached customer order quantity			
Stop all buttons for stop machine	Prepare new bobbins	Working	1

Table 4.9 : Summary man and machine chart of Jacket machine before improvement

Man-1 (Main Operator)	Man-2 (Sub Operator)	Machine	Time (min)
-Do set up machine	-Do set up machine	Idle	57
Check product quality, Check machine and controller at extruder and pay-off	Write down check sheet, Check machine and controller at printing unit and take up	Working	Until finished
If it had been reached customer order quantity			
Stop all buttons for stop machine	Prepare new bobbins	Working	1