

CHAPTER 1

INTRODUCTION



1.1 Background

To survive in the competitive markets, company should do several activities such as improve quality, reduce cost and increase products value added or improve productivity.

This sample company is the one of company which is now facing problems such as high cost, many competitors from China and Taiwan, sales decrease etc. Hence they must do everything to survive in the competitive markets. Their top management would like to select productivity improvement to solve their problems.

This sample company established in 1984 with the capital 1,100 million bath in the reasons for begin a subsidiary for electronic wire manufacturing. This company is a full owned subsidiary of Japan's company, Now there are more than 3,600 employees. The major products are electronic component, wire harness, interface cable assembly, coil cord assembly, hard disk drive component, electronic wire and cable, supplying such as printer cable, monitor cable, SCSI cable, mouse cable and all cable for office automation among well-known companies such as IBM, HP, NEC, Epson, Motorola, Nokia, Sun-micro, Panasonic and others.

The rising problem of the company is rising cost of good sold which icame from direct cost base and this leads to declining overall performance such as net operation margin, gross margin, return on equity and return on capital employed.

Company has a rising cost of good sold, it may cause from

1) Labour cost increasing according to minimum wages and overtime increasing.

2) Defect ratio increasing according to unskilled of new operators and new products which use new technologies increasing.

3) Direct materials cost increasing.

4) Processing cost increasing according to new machine using.

5) Manufacturing overhead cost increasing.

Now company are using a cost leadership strategy. So the suitable strategies that company should emphasized sales activities to increase sales amount and get more profitability, expand strategic products to get new business, consider for material cost reduction, process cost reduction, and overhead cost reduction to get more competitive price, quality improvement for customer satisfaction.

So the management have a plan to increase sales, In the same time company must decrease cost of goods sold in order to get more profit and survive in the competitive market. Company is in the serious competitive market because so many new companies have established for making computer and computer accessory. So all company employees should pay attention in order to improve and survive in the competitive market.

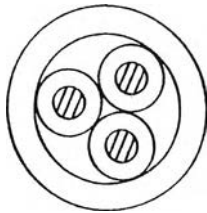
1.2 Statement of the problems

Power cable is one kind of product which has sales amount about 15%. There are 4 groups of power cable which are round cable, parallel type 1, parallel type 2 and parallel type 3. The different product dimension, conductor size and type of printing of each group are about 30 products.

1.2.1 Product Characteristics

The product characteristic of all 4 groups of power cable are as below.

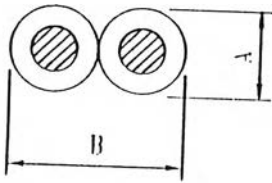
1. Round cable



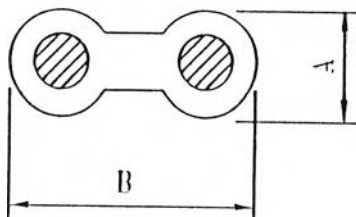
conductor dia. 3.12 - 6.24 mm.

Overall dia. 6.5 - 10.1 mm.

2. Parallel type 1



3. Parallel type 2



Conductor dia. 3.12 - 6.24 mm.

A = 2.7 - 5.4 mm.

B = 6.1 - 13.7 mm.

4. Parallel type 3

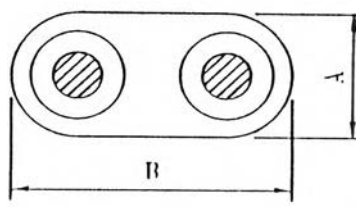


Figure 1.1: Flow chart for round cable

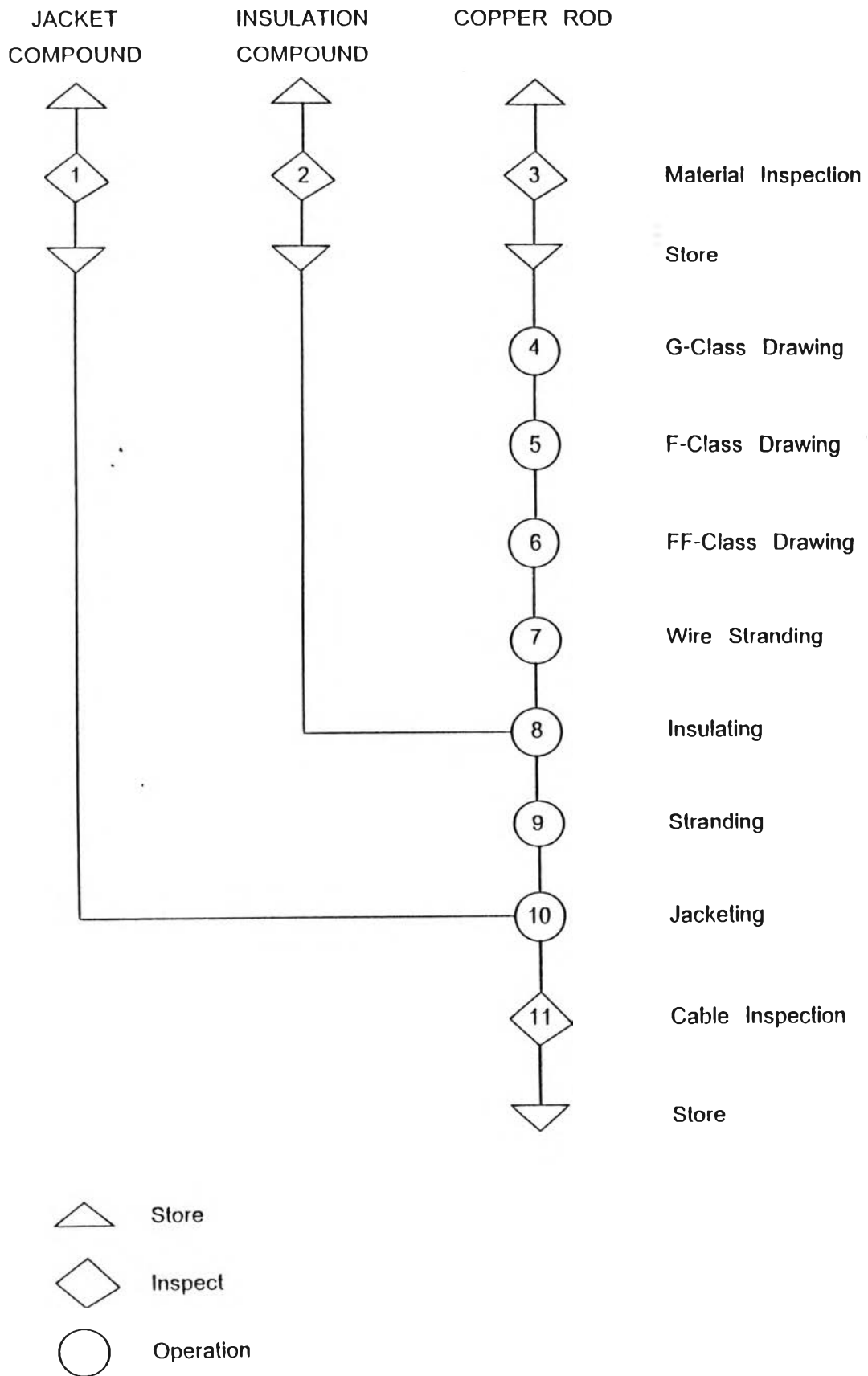
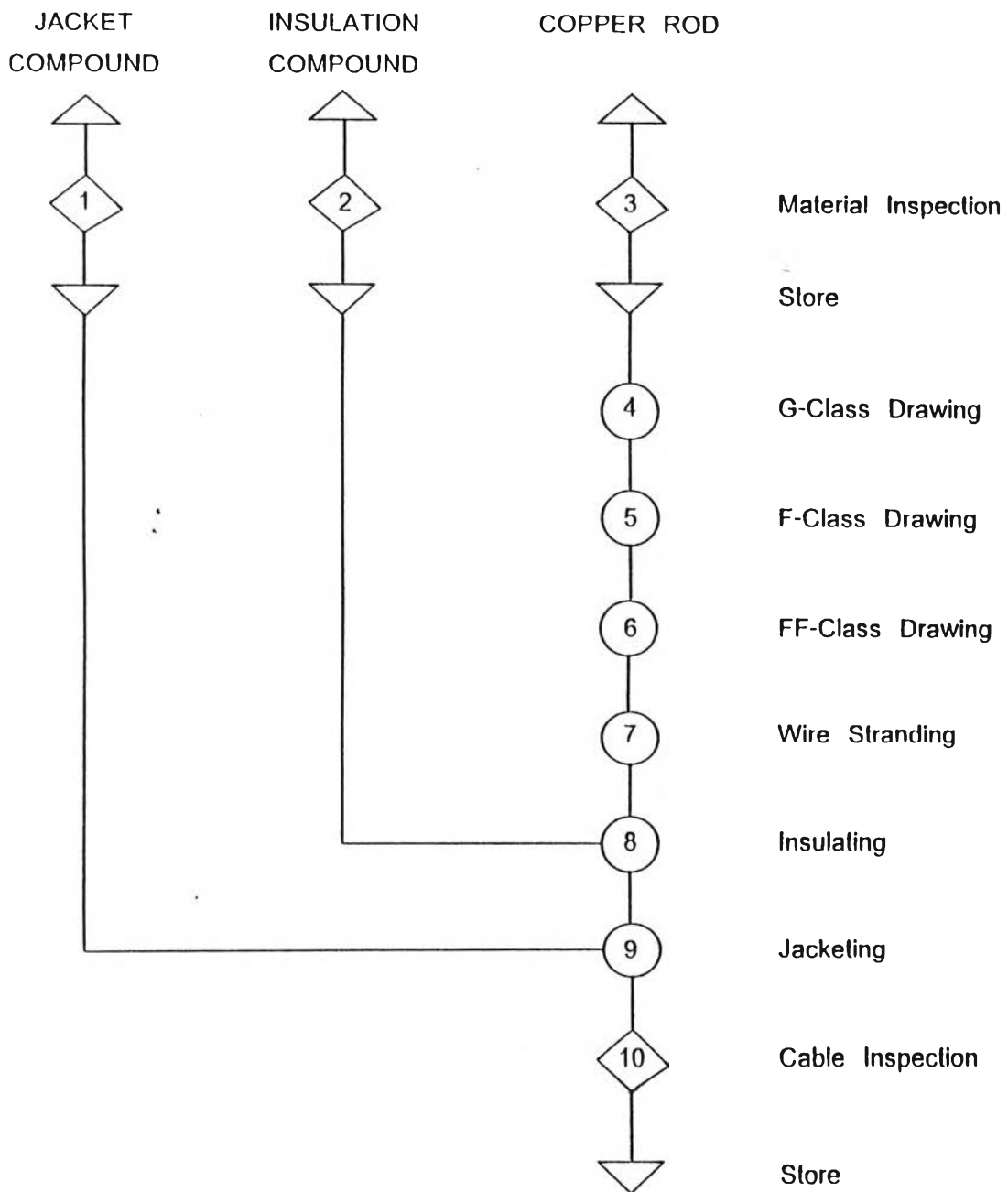





Figure 1.2: Flow chart for parallel cable



-  Store
-  Inspect
-  Operation

1.2.2 Product components

All of power cable compose of 3 kinds of materials.

1. Conductor

Copper rod dia. 8 mm. Is drawn into 0.35 mm., 0.4 mm., 0.5 mm. or 0.75 mm. as customer specification.

2. Compound

PVC is used to extrude for insulated conductor. There are many PVC types and colors used in power cable production.

3. Ink

Ink is used for printing on cable in order to identify cable specification followed Under UL Standard and Japanese international Standard (JIS Standard). The printing colors are required by customer.

1.2.3 Processing of products

Power cable processing for round cable has 5 Process as below.

1. Drawing Process

Copper rod is drawn to reduce size from dia. 8 mm. to be 0.75 mm., or 0.35 mm. Drawing Process is composed of 3 Sub-processed which are (1) G-Class process, (2) F-Class process, (3) FF-Multi Process.

2. Wire Stranding Process

Some individual wired will be twisted together before sent to insulation Process

3. Insulation Process

Wire which stranding together is insulated with PVC compound by extrusion insulation machine.

4. Cabling Process

One or more insulated wires are twisted together.

5. Jacket Process

One or more insulated wires are extruded with PVC compound by extrusion Jacketing machine. In this process sometimes it has marking process which ink should be marked the detail of cable spec. or manufacturer name on jacket.

Figure 1.1 and Figure 1.2 were shown the flow chart of power cable processing for round cable and parallel cable respectively. There are similarities except that power cable processing for parallel cable is without cabling process. So it remains only 4 process.

1.2.4 Company problems

Now company face many problems as the following.

1. High scrap

The percentage of scrap of copper and compound during the physical year 1995 and 1996 were 5.02-5.40% and 3.82-3.76% respectively, as shown in Table 1.1. The data of the scrap shown in Table 1.1 was plot in Figure 1.3. Company had set target of scrap of copper and compound to be less than 3%. So the scrap of copper and compound in power cable production were higher than company policy. It should be reduced.

Table 1.1 : Copper and Compound scrap report in power cable production

	Output (kg)		Scrap (kg)		% of scrap	
	(1)		(2)		(2)x100/(1)	
Materials	Copper	Compound	Copper	Compound	Copper	Compound
Month						
Apr'96	102,308	124,888	4,496.13	5,032.80	4.40	4.03
May'96	101,216	144,732	6,211.07	6,094.29	6.14	4.21
Jun'96	118,196	138,742	6,721.32	5,436.86	5.69	3.92
Jul'96	124,090	161,377	6,674.05	5,883.84	5.38	3.65
Aug'96	140,700	195,940	7,393.06	5,934.22	5.25	3.03
Sep'96	128,565	196,793	7,314.23	5,519.33	5.69	2.80
Oct'96	161,357	217,236	7,626.81	6,710.11	4.73	3.09
Nov'96	116,808	183,673	7,256.50	6,490.13	6.21	3.53
Dec'96	97,054	139,331	6,068.57	5,874.04	6.25	4.22
Jan'97	115,876	192,424	6,577.80	6,480.22	5.68	3.37
Feb'97	136,307	160,436	6,625.73	7,603.35	4.86	4.74
Mar'97	119,350	168,634	6,007.81	7,647.40	5.03	4.53
Total	1,461,827	2,024,206	78,973.08	74,706.59		
Average	121,819	168,684	6,581.09	6,225.55	5.40	3.76
Year'95	1,441,902	1,855,063	72,345	70,783		
Average	120,159	154,589	6029	5,899	5.02	3.82

Remark: The starting of the physical year 1995 is April,1995 to March,1996.

Table 1.2 : Scrap of compound in Power Cable Production depending on process

Month	Scrap in Process (kg)			Total (kg)
	Insulation Process	Cabling Process	Jacketing Process	
Apr'96	479.48	41.72	4,511.60	5,032.80
May'96	756.33	57.57	5,280.39	6,094.29
Jun'96	598.92	79.60	4,758.34	5,436.86
Jul'96	822.24	335.51	4,726.09	5,883.84
Aug'96	506.82	73.34	5,354.06	5,934.22
Sep'96	580.90	66.67	4,871.76	5,519.33
Oct'96	590.84	55.18	6,064.09	6,710.11
Nov'96	915.84	31.09	5,543.20	6,490.13
Dec'96	890.17	97.38	4,886.49	5,874.04
Jan'97	709.43	84.00	5,686.79	6,480.22
Feb'97	1,069.13	30.80	6,503.42	7,603.35
Mar'97	840.28	89.10	6,718.02	7,647.40
Total	8,760.38	1,041.96	64,904.25	74,706.59
Average	730.79	86.83	5,408.69	6,225.55
% of scrap	11.73	1.39	86.88	100.00

Table 1.3 : Scrap of copper in Power Cable Production depending on process

Month '96	Scrap in Process (kg)					Total (kg)
	Drawing process	Stranding process	Insulation process	Cabling process	Jacketing process	
Apr'96	605.0	713.3	376.73	59.58	2,593.52	4,496.13
May'96	1,205.0	1,331.5	588.36	82.23	3,095.68	6,211.07
Jun'96	1,441.0	1,620.4	499.85	113.60	3,210.27	6,721.32
Jul'96	1,624.5	1,312.8	637.15	479.29	3,137.31	6,674.05
Aug'96	1,624.0	1,867.2	608.92	104.76	3,230.38	7,393.06
Sep'96	998.9	1,330.0	738.26	95.23	3,670.44	7,314.23
Oct'96	1,517.2	1,650.4	639.07	78.82	3,675.52	7,626.81
Nov'96	1,881.5	1,915.4	768.38	44.41	2,945.41	7,256.50
Dec'96	1,453.0	1,414.2	715.34	139.12	2,521.11	6,068.57
Jan'97	999.6	1,047.2	670.63	116.00	3,497.37	6,577.80
Feb'97	710.1	995.7	892.68	70.20	3,691.75	6,625.73
Mar'97	906.3	838.2	618.22	108.90	3,408.19	6,007.81
Total	14,505.8	16,036.3	7,853.59	1,492.14	38,676.95	78,973.08
Average	1,208.8	1,336.4	646.13	124.35	3,223.08	6,581.09
% of scrap	18.4	20.3	9.90	1.90	49.50	100.00

Figure 1.3 Copper and Compound scrap in power cable production

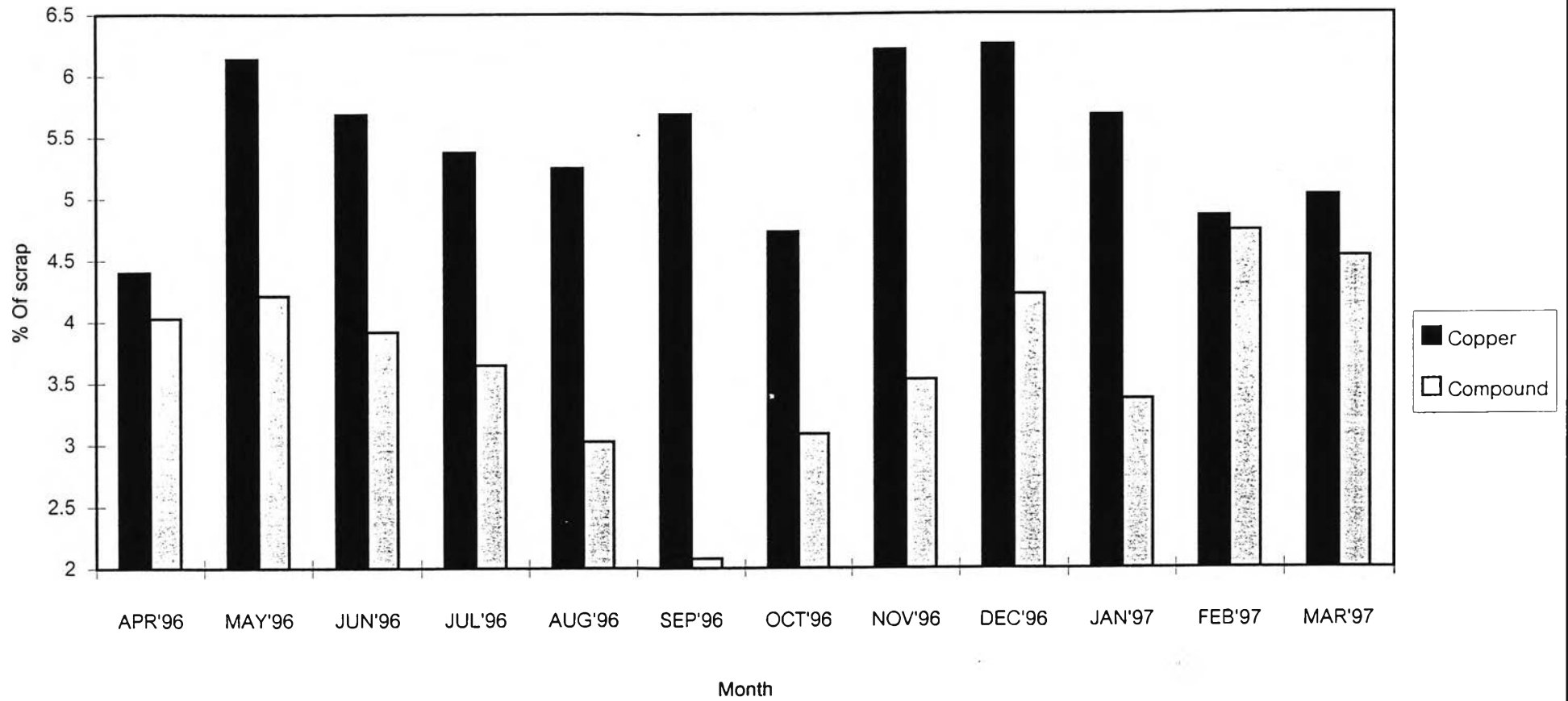


Figure 1.4 Copper and Compound Scrap in process of power cable production

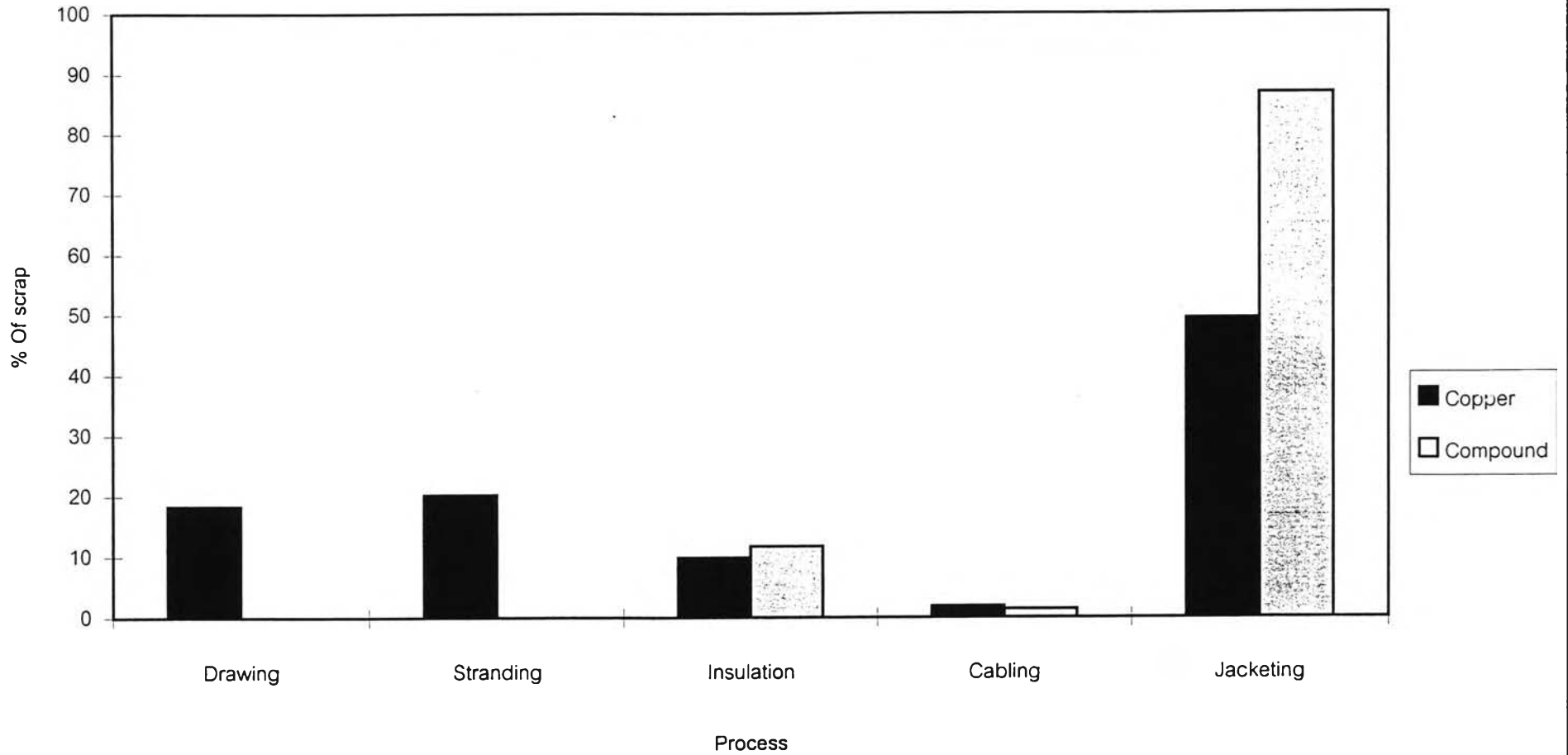


Table 1.2 and Table 1.3 showed the comparative scrap of compound and copper for each process such as Insulation, Cabling and Jacketing process. The Jacketing Process provided the relatively high scrap of compound and copper which were 86.88% and 49.5% respectively. The average percentage of scraps of compound and copper for each processes were summarized in Figure 1.4.

2. High down time

The available times, operational times and down times of the processes which were G-class, F-class, FF-multi, Standing, insulation, Cabling and Jacketing were observed during April,1996 to March,1997 were shown in Table 1.4. The down time analysis of each process were shown in Figure 1.5. Company had set the target of down time in each process should less than 10%. The percentage of down time of insulation process and jacket process were higher than company policy. Especially for jacket process had the highest percentage of down time comparing with others process. So down time of jacket process should be reduced at first.

1.3 Objective of the study

To improve machine set up operation time for power cable production.

1.4 Scopes of the study

The scope of study was in the power cable production department being the section of Jacketing process. The production lines in Jacketing process were the extrusion line number of Ex-302 and Ex-303. The improving machine set up time is performed using the method of work study.

TABLE 14: DOWN TIME ANALYSIS FOR POWER CABLE PRODUCTION

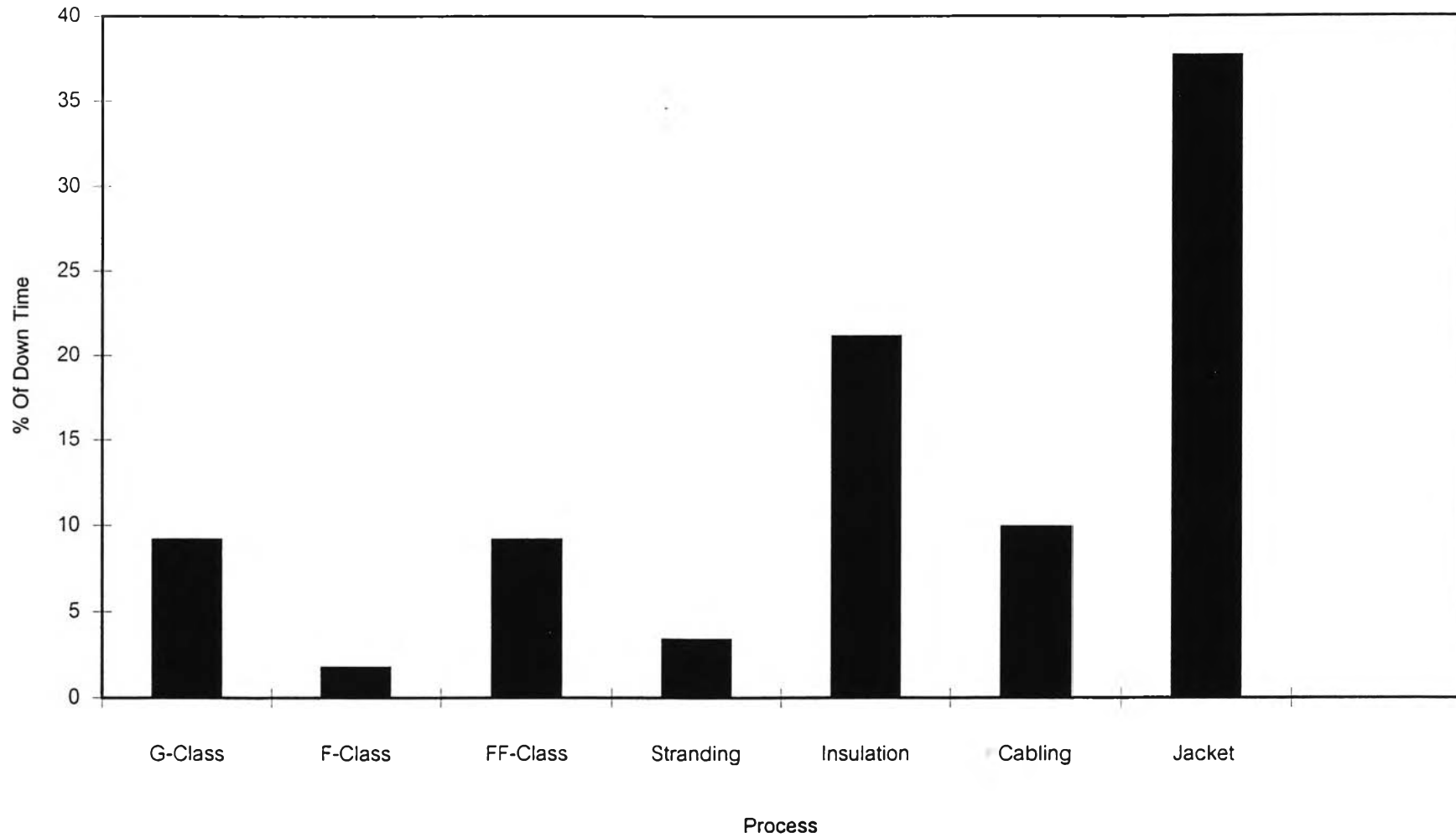
Process	No. or M / C	Unit	1996 1 half Actual							1996 2 half Actual							96 Total	
			Apr '96	May '96	Jun '96	Jul '96	Aug '96	Sep '96	1 Half '96	Oct '96	Nov '96	Dec '96	Jan '97	Feb '97	Mar '97	2 Half '96		
G Class Process	1	Available Time	HR/M	75.00	83.00	96.75	87.00	99.50	105.75	547.00	130.50	96.50	80.00	100.75	105.50	104.00	617.25	1,164.25
		Operation Time	HR/M	70.34	77.06	88.33	79.80	90.64	94.06	500.23	113.83	91.28	71.77	92.56	93.66	93.97	557.07	1,057.30
		Down Time	HR/M	4.66	5.94	8.42	7.20	8.86	11.69	46.77	16.67	5.22	8.23	8.19	11.84	10.03	60.18	106.95
		Down Time	%	6.21	7.16	8.70	8.28	8.90	11.05	8.55	12.77	5.41	10.29	8.13	11.22	9.64	9.75	9.19
		Operation Ratio	%	93.79	92.84	91.30	91.72	91.10	88.95	91.45	87.23	94.59	89.71	91.87	88.78	90.36	90.25	90.81
		Load Ratio	%	14.65	14.59	16.73	14.46	16.42	17.81	15.79	21.56	16.54	13.59	17.53	19.51	17.02	17.58	16.69
		Max.Available	HR/M	480.00	528.00	528.00	552.00	552.00	528.00	3,168.00	528.00	552.00	528.00	528.00	480.00	552.00	3,168.00	6,336.00
F Class Process	2	Available Time	HR/M	465.50	504.50	549.00	536.25	582.75	620.75	3,258.75	889.25	667.25	573.25	566.75	618.00	566.50	3,881.00	7,139.75
		Operation Time	HR/M	457.45	488.71	539.43	525.54	576.61	611.26	3,199.00	876.43	658.82	564.81	554.98	599.67	561.98	3,816.69	7,015.69
		Down Time	HR/M	8.05	15.79	9.57	10.71	6.14	9.49	59.75	12.82	8.43	8.44	11.77	18.33	4.52	64.31	124.06
		Down Time Ratio	%	1.73	3.13	1.74	2.00	1.05	1.53	1.83	1.44	1.26	1.47	2.08	2.97	0.80	1.66	1.74
		Operation Ratio	%	98.27	96.87	98.26	98.00	98.95	98.47	98.17	98.56	98.74	98.53	97.92	97.03	99.20	98.34	98.26
		Load Ratio	%	47.65	46.28	51.08	47.60	52.23	57.88	50.49	83.00	59.68	53.49	52.55	62.47	50.90	60.24	55.36
		Max.Available	HR/M	960.00	1,056.00	1,056.00	1,104.00	1,104.00	1,056.00	6,336.00	1,056.00	1,104.00	1,056.00	1,056.00	960.00	1,104.00	6,336.00	12,672.00
FF-Multi Process	3	Available Time	HR/M	857.00	968.50	1,058.75	1,000.00	1,217.50	1,183.50	6,285.25	1,389.00	1,133.00	900.00	1,061.75	1,254.75	1,110.50	6,849.00	13,134.25
		Operation Time	HR/M	819.72	857.86	963.00	917.80	1,091.23	1,036.92	5,686.53	1,292.87	984.48	830.30	967.86	1,143.82	1,021.30	6,240.63	11,927.16
		Down Time	HR/M	37.28	110.64	95.75	82.20	126.27	146.58	598.72	96.13	148.52	69.70	93.89	110.93	89.20	608.37	1,207.09
		Down Time Ratio	%	4.35	11.42	9.04	8.22	10.37	12.39	9.53	6.92	13.11	7.74	8.84	8.84	8.03	8.88	9.19
		Operation Ratio	%	95.65	88.58	90.96	91.78	89.63	87.61	90.47	93.08	86.89	92.26	91.16	91.16	91.97	91.12	90.81
		Load Ratio	%	56.93	54.16	60.80	55.42	65.90	65.46	59.83	81.62	59.45	52.42	61.10	79.43	61.67	65.66	62.75
		Max.Available	HR/M	1,440.00	1,584.00	1,584.00	1,656.00	1,656.00	1,584.00	9,504.00	1,584.00	1,656.00	1,584.00	1,584.00	1,440.00	1,656.00	9,504.00	19,008.00
Strandin Process	8	Available Time	HR/M	3,143.00	3,456.00	3,824.00	4,182.00	4,517.75	4,322.50	23,445.25	4,836.50	3,966.75	3,108.75	3,865.25	4,053.25	3,816.50	23,647.00	47,092.25
		Operation Time	HR/M	3,044.64	3,326.79	3,676.54	4,041.41	4,347.02	4,157.75	22,594.15	4,693.74	3,835.54	3,024.87	3,739.56	3,901.23	3,714.54	22,909.48	45,503.63
		Down Time	HR/M	98.36	129.21	147.46	140.59	170.73	164.75	851.10	142.76	131.21	83.88	125.69	152.02	101.96	737.52	1,588.62
		Down Time Ratio	%	3.13	3.74	3.86	3.36	3.78	3.81	3.63	2.95	3.31	2.70	3.25	3.75	2.67	3.12	3.37
		Operation Ratio	%	96.87	96.26	96.14	96.64	96.22	96.19	96.37	97.05	96.69	97.30	96.75	96.25	97.33	96.88	96.63
		Load Ratio	%	79.29	78.76	87.04	91.52	98.44	98.43	89.15	111.12	86.86	71.61	88.53	101.59	84.12	90.39	89.77
		Max.Available	HR/M	3,840.00	4,224.00	4,224.00	4,416.00	4,416.00	4,224.00	25,344.00	4,224.00	4,416.00	4,224.00	4,224.00	3,840.00	4,416.00	25,344.00	50,688.00

TABLE 14: DOWN TIME ANALYSIS FOR POWER CABLE PRODUCTION (CONTINUE)

Process	No. of M / C	Unit	1996 1 half Actual								1996 2 half Actual							96 Total
			Apr '96	May '96	Jun '96	Jul '96	Aug '96	Sep '96	1 Half '96	Oct '96	Nov '96	Dec '96	Jan '97	Feb '97	Mar '97	2 Half '96		
Insulation Process	1	Available Time	HR/M	381.00	430.00	372.50	445.50	444.50	514.00	2,587.50	558.00	582.50	462.50	483.00	473.00	444.50	3,003.50	5,591.00
		Operation Time	HR/M	326.06	354.55	309.86	368.24	367.91	366.26	2,092.88	402.44	433.78	345.89	396.97	393.52	343.00	2,315.60	4,408.48
		Down Time	HR/M	54.94	75.45	62.64	77.26	76.59	147.74	494.62	155.56	148.72	116.61	86.03	79.48	101.50	687.90	1,182.52
		Down Time Ratio	%	14.42	17.55	16.82	17.34	17.23	28.74	19.12	27.88	25.53	25.21	17.81	16.80	22.83	22.90	21.15
		Operation Ratio	%	85.58	82.45	83.18	82.66	82.77	71.26	80.88	72.12	74.47	74.79	82.19	83.20	77.17	77.10	78.85
		Load Ratio	%	67.93	67.15	58.69	66.71	66.65	69.37	66.06	76.22	78.58	65.51	75.18	81.98	62.14	73.09	69.58
		Max. Available	HR/M	480.00	528.00	528.00	552.00	552.00	528.00	3,168.00	528.00	552.00	528.00	528.00	480.00	552.00	3,168.00	6,336.00
Cabling Process	2	Available Time	HR/M	421.00	471.50	551.00	434.00	537.50	475.00	2,390.00	852.50	631.00	645.00	625.75	631.50	633.50	4,019.25	6,909.25
		Operation Time	HR/M	375.48	419.41	504.52	395.73	490.24	439.70	2,625.08	776.57	568.49	586.22	563.61	565.74	536.50	3,597.13	6,222.21
		Down Time	HR/M	45.52	52.09	46.48	38.27	47.26	35.30	264.92	75.93	62.51	58.78	62.14	65.76	97.00	422.12	687.04
		Down Time Ratio	%	10.81	11.05	8.44	8.82	8.79	7.43	9.17	8.91	9.91	9.11	9.93	10.41	15.31	10.50	9.94
		Operation Ratio	%	89.19	88.95	91.56	91.18	91.21	92.57	90.83	91.09	90.09	90.89	90.07	89.59	84.69	89.50	90.06
		Load Ratio	%	39.11	39.72	47.78	35.85	44.41	41.64	41.43	73.54	51.49	55.51	53.37	58.93	48.60	56.77	49.10
		Max. Available	HR/M	960.00	1,056.00	1,056.00	1,104.00	1,104.00	1,056.00	6,336.00	1,056.00	1,104.00	1,056.00	1,056.00	960.00	1,104.00	6,336.00	12,672.00
Jacket Process (B-Fac.)	2	Available Time	HR/M	854.50	989.50	1,024.00	1,132.50	1,174.50	1,098.50	6,273.50	1,192.00	1,035.50	961.00	1,103.00	1,091.00	1,107.00	6,489.50	12,763.00
		Operation Time	HR/M	681.91	799.59	792.13	876.09	942.81	896.16	4,988.69	963.57	852.41	760.51	875.17	875.08	879.52	5,206.26	10,194.95
		Down Time	HR/M	172.59	189.91	231.87	256.41	231.69	202.34	1,284.81	228.43	183.09	200.49	227.83	215.92	227.48	1,283.24	2,568.05
		Down Time Ratio	%	20.20	19.19	22.84	22.84	19.73	18.42	20.48	19.16	17.68	20.86	20.66	19.79	20.55	19.77	20.12
		Operation Ratio	%	79.80	80.81	77.36	77.36	80.27	81.58	79.52	80.84	82.32	79.14	79.34	80.21	79.45	80.23	79.88
		Load Ratio	%	71.03	75.72	75.01	79.36	85.40	84.86	78.74	91.25	77.21	72.02	82.88	91.15	79.67	82.17	80.45
		Max. Available	HR/M	960.00	1,056.00	1,056.00	1,104.00	1,104.00	1,056.00	6,336.00	1,056.00	1,104.00	1,056.00	1,056.00	960.00	1,104.00	6,336.00	12,672.00
Jacket Process (A-Fac.)	1	Available Time	HR/M	262.00	181.00	209.50	260.25	287.00	235.00	1,434.75	378.75	242.50	158.00	261.50	272.50	334.50	1,647.75	3,082.50
		Operation Time	HR/M	217.00	155.17	181.55	224.92	244.52	200.26	1,223.42	333.66	212.42	118.00	205.00	183.00	265.00	1,317.08	2,540.50
		Down Time	HR/M	45.00	25.83	27.95	35.33	42.48	34.74	211.33	45.09	30.08	40.00	56.50	89.50	69.50	330.67	542.00
		Down Time Ratio	%	17.18	14.27	13.34	13.58	14.80	14.78	14.73	11.90	12.40	25.32	21.61	32.84	20.78	20.07	17.58
		Operation Ratio	%	82.82	85.73	86.66	86.42	85.20	85.22	85.27	88.10	87.60	74.68	78.39	67.16	79.22	79.93	82.42
		Load Ratio	%	45.21	29.39	34.38	40.75	44.30	37.93	38.62	63.19	38.48	22.35	38.83	38.13	48.01	41.57	40.10
		Max. Available	HR/M	480.00	528.00	528.00	552.00	552.00	528.00	3,168.00	528.00	552.00	528.00	528.00	480.00	552.00	3,168.00	6,336.00

Max. Available : Monthly Working Day x 24 hrs
 Down Time : Available Time - Operation Time
 Down Time Ratio : Down Time / Available Time
 Load Ratio : Available Time / Max. Available Time

Figure 1.5 : Down Time in Process of Power Cable Production In Apr'96 - Mar'97



1.5 Benefits of the study

The expected benefits of the study were as following

1. Getting lower cost of power cable
2. Getting more profit in power cable
3. Probably getting more order in power cable
4. Increasing productivity of power cable production department

1.6 Study Procedure

The study procedure was prepared as following.

1. Literature survey : to review the literature which is related with the work operation improvement and study the operation of machine set-up as existing in the department of power cable manufacturing.

2. Collect data : to collect necessary data which were total set up time and motion and time study of machine set-up operation of workers.

3. Data Analysis : to analyze the collected data in order to improve the operation which covers (1) Set-up equipment and preparation time, (2) Machine part changing operation time, (3) Machine adjustment operation time, (4) Transportation time.

4. Operation development : to develop the machine set-up operation in order to improve the productivity.

5. Implementation : to implement the process operation which is desinged developed.

6. Evaluation and Correction : to evaluate the process operation design after the implementation and problem correction.

7. Conclusion : to conclude the result of study

8. Report preparation : to prepare report