CHAPTER 6

CONCLUSION AND RECOMMENDATION

6.1. Conclusion

From the analysis and discussion in improving work method in manual page sequencing division and determining the standard time in finishing department, it can be concluded that :

a. The new work method design is improved by eliminating, combining, simplifying, and changing the sequences. It consist of 10 work elements with the total time as big as 207.7 second.

b. The total standard time of finishing department is 12.701 per book.

6.2. Recommendation

This research is done only for determining the standard time for finishing department with the improvement in manual page sequencing process. For the next research, it can be used micromotion study for work motion analysis. The micromotion study use camera for recording the work motion so it can be more detail in the analysis. In determining the better work method, this research only improved for manual page sequencing but not for all of the division in finishing department. In the next research, it can be designed the work instruction for all of divisions in finishing department which related each other.

For the company, the standard time can be used for the tool to determine how many times the worker can finished the order. The standard time is hopefully reduce the overtime hours for the worker and certainly reduce the overtime cost. The better work method can be used as a tool to make the workers more effective, efficient, and productive in finishing their works.

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APPENDIX

APPENDIX 1

5.1.Data Analysis in Manual Page Sequencing Process

5.1.1. Current Work Method Analysis

2. Second Current Work Method Analysis

a. Amount of Subgroup

k = 1 + 3.3 log N

k = 1 + 3.3 log 45

k = 6.4556 ≈ 7

a. Average Value of Subgroup

Table of Average Value of Sub Group

Subgroup	Time							Average of Subgroup
1-7	258.112	265.512	264.637	261.553	264.738	261.053	258.454	262.008
8-14	267.564	263.476	257.191	268.113	259.001	260.038	263.455	262.691
15-22	260.033	259.32	265.137	264.561	259.285	264.581	259.095	261.716
23-29	262.747	269.744	261.453	264.082	267.012	263.578	263.413	264.576
30-36	265.395	264.451	262.384	261.504	261.342	265.822	263.133	263.433
36-42	265.549	260.559	266.878	262.354	264.673	260.034	263.761	263.401
42-45	262.381	263.499	260.53					262.137
							□	1839.962

$$\bar{\bar{X}} = \frac{\sum \overline{\overline{Xi}}}{k}$$

$$\bar{\bar{X}} = \frac{1839.962}{7}$$

$$\bar{\bar{X}} = 262.852$$

b. Standard Deviation of Time

Table of Standard Deviation of Time

No	Xi	Xi^2	$(Xi-\bar{\bar{X}})$	$(Xi-\bar{\bar{X}})^2$
1	258.112	66621.8	-4.803	23.072
2	265.512	70496.62	2.597	6.743
3	264.637	70032.74	1.722	2.964
4	261.553	68409.97	-1.362	1.856
5	264.738	70086.21	1.823	3.322
6	261.053	68148.67	-1.862	3.468
7	258.454	66798.47	-4.461	19.903
8	267.564	71590.49	4.649	21.610
9	263.476	69419.6	0.561	0.314
10	257.191	66147.21	-5.724	32.768
11	268.113	71884.58	5.198	27.016
12	259.001	67081.52	-3.914	15.322
13	260.038	67619.76	-2.877	8.279
14	263.455	69408.54	0.540	0.291
15	260.033	67617.16	-2.882	8.308
16	259.32	67246.86	-3.595	12.926
17	265.137	70297.63	2.222	4.936
18	264.561	69992.52	1.646	2.708
19	259.285	67228.71	-3.630	13.179
20	264.581	70003.11	1.666	2.774
21	259.095	67130.22	-3.820	14.595
22	262.747	69035.99	-0.168	0.028
23	269.744	72761.83	6.829	46.631
24	261.453	68357.67	-1.462	2.138
25	264.082	69739.3	1.167	1.361
26	267.012	71295.41	4.097	16.783
27	263.578	69473.36	0.663	0.439
28	263.413	69386.41	0.498	0.248
29	265.395	70434.51	2.480	6.149
30	264.451	69934.33	1.536	2.358
31	262.384	68845.36	-0.531	0.282
32	261.504	68384.34	-1.411	1.992
33	261.342	68299.64	-1.573	2.475
34	265.822	70661.34	2.907	8.449

No	Xi	Xi^2	$(Xi-\bar{X})$	$(Xi-\bar{\bar{X}})^2$
35	263.133	69238.98	0.218	0.047
36	265.549	70516.27	2.634	6.936
37	260.559	67890.99	-2.356	5.552
38	266.878	71223.87	3.963	15.703
39	262.354	68829.62	-0.561	0.315
40	264.673	70051.8	1.758	3.089
41	260.034	67617.68	-2.881	8.302
42	263.761	69569.87	0.846	0.715
43	262.381	68843.79	-0.534	0.286
44	263.499	69431.72	0.584	0.341
45	260.53	67875.88	-2.385	5.690
□	11831.19	3110962	-	362.6658

$$\sigma = \sqrt{\frac{\sum(Xi-\bar{\bar{X}})^2}{N-1}}$$

$$\sigma = \sqrt{\frac{362.843}{44}}$$

$$\sigma = 2.871$$

c. Standard deviation from sub group average distribution

$$\sigma_{\bar{X}} = \frac{\sigma}{\sqrt{n}}$$

$$\sigma_{\bar{X}} = \frac{2,871}{\sqrt{7}}$$

$$\sigma_{\bar{X}} = 1,085$$

d. Upper Control Limit (UCL) and Lower Control Limit (LCL)

$$\mathrm{UCL} = \overline{\mathrm{X}} + (3 \times \sigma_{\overline{\mathrm{X}}})$$

$$= 262.195 + (3 \times 1.085)$$

$$= 265.545$$

$$\mathrm{LCL} = \overline{\mathrm{X}} - (3 \times \sigma_{\overline{\mathrm{X}}})$$

$$= 262.195 - (3 \times 1.085)$$

$$= 258.940$$

Control data Test

LCL $\leq \overline{Xi} \leq$ UCL

258.940 ≤ 262.008 ≤ 265.545 ⟶ Data is consistent

258.940 ≤ 262.691 ≤ 265.545 ⟶ Data is consistent

258.940 ≤ 261.716 ≤ 265.545 ⟶ Data is consistent

258.940 ≤ 264.576 ≤ 265.545 ⟶ Data is consistent

258.940 ≤ 263.433 ≤ 265.545 ⟶ Data is consistent

258.940 ≤ 263.401 ≤ 265.545 ⟶ Data is consistent

258.940 ≤ 262.137 ≤ 265.545 ⟶ Data is consistent

e. Sufficiency data test

The test used 5 % for precision and 95% for confidence rate.

$$N' = \left[\frac{\frac{K}{S}\sqrt{N\sum X_i^2 - (\sum X_i)^2}}{\sum X_i}\right]^2$$

$$N' = \left[\frac{40\sqrt{N\sum X_i^2 - (\sum X_i)^2}}{\sum X_i}\right]^2$$

$$N' = \left[\frac{40\sqrt{45 \times 3110962 - 139977056.8}}{11831.19}\right]^2$$

$$N' = 0.139036142$$

N' □ N ; 0.1855 □ 45 ⟶ Data is sufficient

f. Cycle Time Average

$$Ct = \frac{\sum X_i}{N}$$

$$Ct = \frac{\sum X_i}{N}$$

$$Ct = \frac{11831.19}{45}$$

$Ct = 262.915$ second

3. Third Current Work Method Analysis

a. Amount of Subgroup

k = 1 + 3.3 log N

k = 1 + 3.3 log 45

k = 6.4556 ≈ 7

b. Average Value of Subgroup

Table of Average Value of Sub Group

Subgroup	Time (Xi)							Average of Subgroup
1-7	284.216	281.562	289.457	283.432	284.543	287.81	279.346	284.338
8-14	285.671	287.315	280.549	280.753	284.562	285.517	287.021	284.484
15-22	289.973	290.861	284.248	281.597	285.233	281.427	283.691	285.290
23-29	281.138	285.546	287.756	283.436	282.053	286.237	288.172	284.905
30-36	284.318	288.947	284.133	290.337	285.782	280.519	286.526	285.795
36-42	291.651	282.538	280.122	284.577	280.842	285.325	287.234	284.613
42-45	279.012	289.742	288.13					285.628
								1995.053

$$\bar{\bar{X}} = \frac{\sum \overline{Xi}}{k}$$

$$\bar{\bar{X}} = \frac{1995.053}{7}$$

$$\bar{\bar{X}} = 285.008$$

c. Standard Deviation of Time

Table of Standard Deviation of Time

No	Xi	Xi^2	$(Xi-\bar{X})$	$(Xi-\bar{\bar{X}})^2$
1	284.216	80778.73	-0.736	0.542
2	281.562	79277.16	-3.390	11.495
3	289.457	83785.35	4.505	20.291
4	283.432	80333.7	-1.520	2.312
5	284.543	80964.72	-0.409	0.168
6	287.81	82834.6	2.858	8.166
7	279.346	78034.19	-5.606	31.432
8	285.671	81607.92	0.719	0.516
9	287.315	82549.91	2.363	5.582
10	280.549	78707.74	-4.403	19.390
11	280.753	78822.25	-4.199	17.635
12	284.562	80975.53	-0.390	0.152
13	285.517	81519.96	0.565	0.319
14	287.021	82381.05	2.069	4.279
15	289.973	84084.34	5.021	25.206
16	290.861	84600.12	5.909	34.911
17	284.248	80796.93	-0.704	0.496
18	281.597	79296.87	-3.355	11.259
19	285.233	81357.86	0.281	0.079
20	281.427	79201.16	-3.525	12.429
21	283.691	80480.58	-1.261	1.591
22	281.138	79038.58	-3.814	14.550
23	285.546	81536.52	0.594	0.352
24	287.756	82803.52	2.804	7.860
25	283.436	80335.97	-1.516	2.300
26	282.053	79553.89	-2.899	8.407
27	286.237	81931.62	1.285	1.650
28	288.172	83043.1	3.220	10.366
29	284.318	80836.73	-0.634	0.403
30	288.947	83490.37	3.995	15.956
31	284.133	80731.56	-0.819	0.671
32	290.337	84295.57	5.385	28.993
33	285.782	81671.35	0.830	0.688
34	280.519	78690.91	-4.433	19.655
35	286.526	82097.15	1.574	2.476

No	Xi	Xi^2	$(Xi-\bar{X})$	$(Xi-\bar{\bar{X}})^2$
36	291.651	85060.31	6.699	44.871
37	282.538	79827.72	-2.414	5.830
38	280.122	78468.33	-4.830	23.333
39	284.577	80984.07	-0.375	0.141
40	280.842	78872.23	-4.110	16.896
41	285.325	81410.36	0.373	0.139
42	287.234	82503.37	2.282	5.205
43	279.012	77847.7	-5.940	35.289
44	289.742	83950.43	4.790	22.940
45	288.13	83018.9	3.178	10.097
□	12822.86	3654391	-	487.318

$$\sigma = \sqrt{\frac{\sum(Xi-\bar{\bar{X}})^2}{N-1}}$$

$$\sigma = \sqrt{\frac{487.318}{44}}$$

$$\sigma = 3.328$$

d. Standard deviation from sub group average distribution

$$\sigma_{\bar{X}} = \frac{\sigma}{\sqrt{n}}$$

$$\sigma_{\bar{X}} = \frac{3.328}{\sqrt{7}}$$

$$\sigma_{\bar{X}} = 1.258$$

e. Upper Control Limit (UCL) and Lower Control Limit (LCL)

$$\text{UCL} = \bar{\text{X}} + (3 \times \sigma_{\bar{\text{X}}})$$

$$= 284.952 + (3 \times 1.258)$$

$$= 288.726$$

$$\text{LCL} = \bar{\text{X}} - (3 \times \sigma_{\bar{\text{X}}})$$

$$= 284.952 - (3 \times 1.258)$$

$$= 281.178$$

Control data Test

LCL $\leq \overline{Xi} \leq$ UCL

281.178 ≤ 284.338 ≤ 288.726 ⟶ Data is consistent

281.178 ≤ 284.484 ≤ 288.726 ⟶ Data is consistent

281.178 ≤ 285.290 ≤ 288.726 ⟶ Data is consistent

281.178 ≤ 284.905 ≤ 288.726 ⟶ Data is consistent

281.178 ≤ 285.795 ≤ 288.726 ⟶ Data is consistent

281.178 ≤ 284.613 ≤ 288.726 ⟶ Data is consistent

281.178 ≤ 285.628 ≤ 288.726 ⟶ Data is consistent

f. Sufficiency data test

The test used 5 % for precision and 95% for confidence rate.

$$N' = \left[\frac{\frac{K}{S}\sqrt{N\sum X_i^2 - (\sum X_i)^2}}{\sum X_i}\right]^2$$

$$N' = \left[\frac{40\sqrt{N\sum X_i^2 - (\sum X_i)^2}}{\sum X_i}\right]^2$$

$$N' = \left[\frac{40\sqrt{45 \times 3654391 - 164425738.6}}{12822.86}\right]^2$$

$$N' = 0.213$$

N' □ N ; 0.213 □ 45 ⟶ Data is sufficient

g. Cycle Time Average

$$Ct = \frac{\sum X_i}{N}$$

$$Ct = \frac{12822.86}{45}$$

$Ct = 284.952$ second

5.1.2. Recommended Work Method Analysis

a. Amount of Subgroup

k = 1 + 3.3 log N

k = 1 + 3.3 log 135

k = 8.03 ≈ 9

b. Average Value of Subgroup

Table of Average Value of Sub Group

Subgroup	Time (Xi)															Average of Subgroup
1-15	208.513	212.452	208.283	206.551	209.391	211.792	208.291	207.492	212.398	211.645	207.635	213.291	209.403	211.909	209.337	209.892
16-30	210.732	209.381	214.372	207.289	209.461	217.28	207.227	213.291	208.554	209.381	210.521	211.281	212.37	212.492	213.281	211.128
31-45	208.502	216.402	210	211.293	208.482	209.738	209.536	207.482	209.303	211.871	212.008	213.441	208.529	209.287	212.982	210.563
46-60	211.378	208.771	210.991	209.619	213.291	211.002	210.831	210.388	210.091	213.409	210.293	207.382	213.328	208.377	208.774	210.528
61-75	213.442	213.09	208.529	210.211	205.328	211.809	208.548	210.2	209.395	209.59	208.102	213.308	208.137	209.219	207.387	209.753
76-90	209.113	212.391	210.529	210.273	210.891	209.717	212.002	214.281	210.901	207.539	211.04	207.381	212.387	207.873	210.3	210.441
91-105	209.464	211.017	206.531	210.814	208.665	212.338	209.832	210.183	212.844	207.549	208.662	209.552	208.529	210.302	208.329	209.641
106-120	208.281	207.072	214.291	213.881	212.246	207.106	212.382	212.795	210.871	211.528	210.238	211.808	211.489	207.378	210.731	210.806
121-135	209.639	209.49	208.973	210.492	208.221	209.001	209.223	209.381	208.635	211.302	210.838	210.391	212.84	211.296	212.193	210.128

$$\bar{\bar{X}} = \frac{\sum \overline{\overline{Xi}}}{k}$$

$$\bar{\bar{X}} = \frac{1892.880}{9}$$

$$\bar{\bar{X}} = 210.32$$

c. Standard Deviation of Time

Table of Standard Deviation of Time

No	Xi	Xi^2	(Xi-$\bar{X}$)	(Xi-$\bar{X}$)2
1	208.513	43477.67	-1.807	3.265
2	212.452	45135.85	2.132	4.545
3	208.283	43381.81	-2.037	4.149
4	206.551	42663.32	-3.769	14.205
5	209.391	43844.59	-0.929	0.863
6	211.792	44855.85	1.472	2.167
7	208.291	43385.14	-2.029	4.117
8	207.492	43052.93	-2.828	7.998
9	212.398	45112.91	2.078	4.318
10	211.645	44793.61	1.325	1.756
11	207.635	43112.29	-2.685	7.209
12	213.291	45493.05	2.971	8.827
13	209.403	43849.62	-0.917	0.841
14	211.909	44905.42	1.589	2.525
15	209.337	43821.98	-0.983	0.966
16	210.732	44407.98	0.412	0.170
17	209.381	43840.4	-0.939	0.882
18	214.372	45955.35	4.052	16.419
19	207.289	42968.73	-3.031	9.187
20	209.461	43873.91	-0.859	0.738

No	Xi	Xi^2	(Xi-$\bar{X}$)	(Xi-$\bar{X}$)2
21	217.28	47210.6	6.960	48.442
22	207.227	42943.03	-3.093	9.567
23	213.291	45493.05	2.971	8.827
24	208.554	43494.77	-1.766	3.119
25	209.381	43840.4	-0.939	0.882
26	210.521	44319.09	0.201	0.040
27	211.281	44639.66	0.961	0.924
28	212.37	45101.02	2.050	4.203
29	212.492	45152.85	2.172	4.718
30	213.281	45488.78	2.961	8.768
31	208.502	43473.08	-1.818	3.305
32	216.402	46829.83	6.082	36.991
33	210	43927.97	-0.730	0.533
34	211.293	44644.73	0.973	0.947
35	208.482	43464.74	-1.838	3.378
36	209.738	43990.03	-0.582	0.339
37	209.536	43905.34	-0.784	0.615
38	207.482	43048.78	-2.838	8.054
39	209.303	43807.75	-1.017	1.034
40	211.871	44889.32	1.551	2.406

No	Xi	Xi^2	$(Xi-\bar{X})$	$(Xi-\bar{X})2$
41	212.008	44947.39	1.688	2.849
42	213.441	45557.06	3.121	9.741
43	208.529	43484.34	-1.791	3.208
44	209.287	43801.05	-1.033	1.067
45	212.982	45361.33	2.662	7.086
46	211.378	44680.66	1.058	1.119
47	208.771	43585.33	-1.549	2.399
48	210.991	44517.2	0.671	0.450
49	209.619	43940.13	-0.701	0.491
50	213.291	45493.05	2.971	8.827
51	211.002	44521.84	0.682	0.465
52	210.831	44449.71	0.511	0.261
53	210.388	44263.11	0.068	0.005
54	210.091	44138.23	-0.229	0.052
55	213.409	45543.4	3.089	9.542
56	210.293	44223.15	-0.027	0.001
57	207.382	43007.29	-2.938	8.632
58	213.328	45508.84	3.008	9.048
59	208.377	43420.97	-1.943	3.775
60	208.774	43586.58	-1.546	2.390
61	213.442	45557.49	3.122	9.747
62	213.09	45407.35	2.770	7.673
63	208.529	43484.34	-1.791	3.208
64	210.211	44188.66	-0.109	0.012
65	205.328	42159.59	-4.992	24.920
66	211.809	44863.05	1.489	2.217
67	208.548	43492.27	-1.772	3.140
68	210.2	44184.04	-0.120	0.014
69	209.395	43846.27	-0.925	0.856
70	209.59	43927.97	-0.730	0.533
71	208.102	43306.44	-2.218	4.920
72	213.308	45500.3	2.988	8.928
73	208.137	43321.01	-2.183	4.765
74	209.219	43772.59	-1.101	1.212
75	207.387	43009.37	-2.933	8.602
76	209.113	43728.25	-1.207	1.457
77	212.391	45109.94	2.071	4.289
78	210.529	44322.46	0.209	0.044
79	210.273	44214.73	-0.047	0.002
80	210.891	44475.01	0.571	0.326

No	Xi	Xi^2	$(Xi-\bar{X})$	$(Xi-\overline{X})^2$
81	209.717	43981.22	-0.603	0.364
82	212.002	44944.85	1.682	2.829
83	214.281	45916.35	3.961	15.690
84	210.901	44479.23	0.581	0.338
85	207.539	43072.44	-2.781	7.734
86	211.04	44537.88	0.720	0.518
87	207.381	43006.88	-2.939	8.638
88	212.387	45108.24	2.067	4.272
89	207.873	43211.18	-2.447	5.988
90	210.3	44226.09	-0.020	0.000
91	209.464	43875.17	-0.856	0.733
92	211.017	44528.17	0.697	0.486
93	206.531	42655.05	-3.789	14.357
94	210.814	44442.54	0.494	0.244
95	208.665	43541.08	-1.655	2.739
96	212.338	45087.43	2.018	4.072
97	209.832	44029.47	-0.488	0.238
98	210.183	44176.89	-0.137	0.019
99	212.844	45302.57	2.524	6.371
100	207.549	43076.59	-2.771	7.678
101	208.662	43539.83	-1.658	2.749
102	209.552	43912.04	-0.768	0.590
103	208.529	43484.34	-1.791	3.208
104	210.302	44226.93	-0.018	0.000
105	208.329	43400.97	-1.991	3.964
106	208.281	43380.97	-2.039	4.158
107	207.072	42878.81	-3.248	10.550
108	214.291	45920.63	3.971	15.769
109	213.881	45745.08	3.561	12.681
110	212.246	45048.36	1.926	3.709
111	207.106	42892.9	-3.214	10.330
112	212.382	45106.11	2.062	4.252
113	212.795	45281.71	2.475	6.126
114	210.871	44466.58	0.551	0.304
115	211.528	44744.09	1.208	1.459
116	210.238	44200.02	-0.082	0.007
117	211.808	44862.63	1.488	2.214
118	211.489	44727.6	1.169	1.367
119	207.378	43005.63	-2.942	8.655
120	210.731	44407.55	0.411	0.169

No	Xi	Xi^2	(Xi-X)	(Xi-X)2
121	209.64	43948.51	-0.681	0.464
122	209.49	43886.06	-0.830	0.689
123	208.97	43669.71	-1.347	1.814
124	210.49	44306.88	0.172	0.030
125	208.22	43355.98	-2.099	4.406
126	209	43681.42	-1.319	1.740
127	209.22	43774.26	-1.097	1.203
128	209.38	43840.4	-0.939	0.882
129	208.64	43528.56	-1.685	2.839
130	211.3	44648.54	0.982	0.964
131	210.84	44452.66	0.518	0.268
132	210.39	44264.37	0.071	0.005
133	212.84	45300.87	2.520	6.350
134	211.3	44646	0.976	0.953
135	212.19	45025.87	1.873	3.508
□	28393	5972261	0.003	602.191

$$\sigma = \sqrt{\frac{\sum(Xi-\bar{\bar{X}})^2}{N-1}}$$

$$\sigma = \sqrt{\frac{602.191}{134}}$$

$$\sigma = 2.120$$

d. Standard deviation from sub group average distribution

$$\sigma_{\bar{X}} = \frac{\sigma}{\sqrt{n}}$$

$$\sigma_{\bar{X}} = \frac{2.120}{\sqrt{15}}$$

$$\sigma_{\bar{X}} = 0.547$$

e. Upper Control Limit (UCL) and Lower Control Limit (LCL)

$$UCL = \bar{X} + (3 \times \sigma_{\bar{X}})$$

$$= 210.32 + (3 \times 0.547)$$

$$= 211.961$$

$$LCL = \bar{X} - (3 \times \sigma_{\bar{X}})$$

$$= 210.32 - (3 \times 0.547)$$

$$= 208.679$$

Control data Test

$LCL \leq \overline{Xi} \leq UCL$

$208.679 \leq 209.892 \leq 211.961 \longrightarrow$ Data is consistent

$208.679 \leq 211.128 \leq 211.961 \longrightarrow$ Data is consistent

$208.679 \leq 210.563 \leq 211.961 \longrightarrow$ Data is consistent

$208.679 \leq 210.528 \leq 211.961 \longrightarrow$ Data is consistent

$208.679 \leq 209.753 \leq 211.961 \longrightarrow$ Data is consistent

$208.679 \leq 210.441 \leq 211.961 \longrightarrow$ Data is consistent

$208.679 \leq 210.806 \leq 211.961 \longrightarrow$ Data is consistent

$208.679 \leq 210.128 \leq 211.961 \longrightarrow$ Data is consistent

f. Sufficiency data test

The test used 5 % for precision and 95% for confidence rate.

$$N' = \left[\frac{\frac{K}{S}\sqrt{N\sum X_i^2 - (\sum X_i)^2}}{\sum X_i}\right]^2$$

$$N' = \left[\frac{40\sqrt{N\sum X_i^2 - (\sum X_i)^2}}{\sum X_i}\right]^2$$

$$N' = \left[\frac{40\sqrt{135 \times 5972261 - 806162449}}{28393}\right]^2$$

$$N' = 0.184$$

$N' \square N$; $0.814 \square 135$ ⟶ Data is sufficient

g. Cycle Time Average

$$Ct = \frac{\sum X_i}{N}$$

$$Ct = \frac{28393}{135}$$

$Ct = 210.318$ second

APPENDIX 2

5.4. Data Analysis in Packaging and Finishing

a. Amount of Subgroup

k = 1 + 3.3 log N

k = 1 + 3.3 log 30

k = 4.875 ≈ 5

b. Average Value of Subgroup

Table of Average Value of Sub Group

Subgroup	Time (Xi)						Average of Subgroup
1-6	45.98	51.34	47.62	46.56	52.57	43.78	47.975
7-12	45.69	43.76	49.05	46.21	50.04	48.77	47.253
13-19	52.39	47.45	45.92	51.28	48.91	46.58	48.755
19-24	46.02	50.26	51.45	45.34	47.73	46.56	47.893
25-30	48.11	45.39	51.49	47.56	49.56	52.37	49.080
							240.957

$$\bar{\bar{X}} = \frac{\sum \bar{X}\iota}{k}$$

$$\bar{\bar{X}} = \frac{240.957}{5}$$

$$\bar{\bar{X}} = 48.191$$

b. Standard Deviation of Time

Table of Standard Deviation of Time

No	Xi	Xi^2	$(Xi-\bar{\bar{X}})$	$(Xi-\bar{\bar{X}})^2$
1	45.98	2114.16	-2.211	4.890
2	51.34	2635.796	3.149	9.914
3	47.62	2267.664	-0.571	0.326
4	46.56	2167.834	-1.631	2.661
5	52.57	2763.605	4.379	19.173
6	43.78	1916.688	-4.411	19.460
7	45.69	2087.576	-2.501	6.257
8	43.76	1914.938	-4.431	19.637
9	49.05	2405.903	0.859	0.737
10	46.21	2135.364	-1.981	3.926
11	50.04	2504.002	1.849	3.418
12	48.77	2378.513	0.579	0.335
13	52.39	2744.712	4.199	17.629
14	47.45	2251.503	-0.741	0.550
15	45.92	2108.646	-2.271	5.159
16	51.28	2629.638	3.089	9.540
17	48.91	2392.188	0.719	0.516
18	46.58	2169.696	-1.611	2.596
19	46.02	2117.84	-2.171	4.715
20	50.26	2526.068	2.069	4.279
21	51.45	2647.103	3.259	10.619
22	45.34	2055.716	-2.851	8.130
23	47.73	2278.153	-0.461	0.213
24	46.56	2167.834	-1.631	2.661
25	48.11	2314.572	-0.081	0.007
26	45.39	2060.252	-2.801	7.847
27	51.49	2651.22	3.299	10.881
28	47.56	2261.954	-0.631	0.399
29	49.56	2456.194	1.369	1.873
30	52.37	2742.617	4.179	17.461
□	1445.74	69867.95	-	195.8087

$$\sigma = \sqrt{\frac{\sum(Xi-\bar{\bar{X}})^2}{N-1}}$$

$$\sigma = \sqrt{\frac{195.809}{29}}$$

$$\sigma = 2.644$$

c. Standard deviation from sub group average distribution

$$\sigma_{\bar{X}} = \frac{\sigma}{\sqrt{n}}$$

$$\sigma_{\bar{X}} = \frac{2.644}{\sqrt{6}}$$

$$\sigma_{\bar{X}} = 1.079$$

d. Upper Control Limit (UCL) and Lower Control Limit (LCL)

$$UCL = \bar{\bar{X}} + (3 \times \sigma_{\bar{X}})$$

$$= 48.191 + (3 \times 1.079)$$

$$= 51.428$$

$$LCL = \bar{\bar{X}} - (3 \times \sigma_{\bar{X}})$$

$$= 48.191 - (3 \times 1.079)$$

$$= 44.954$$

Control data Test

LCL ≤ $\overline{Xi}$ ≤ UCL

44.954 ≤ 47.975 ≤ 51.428 ⟶ Data is consistent

44.954 ≤ 47.253 ≤ 51.428 ⟶ Data is consistent

44.954 ≤ 48.755 ≤ 51.428 ⟶ Data is consistent

44.954 ≤ 47.893 ≤ 51.428 ⟶ Data is consistent

44.954 ≤ 49.08 ≤ 51.428 ⟶ Data is consistent

e. Sufficiency data test

The test used 5 % for precision and 95% for confidence rate.

$$N' = \left[\frac{\frac{K}{S}\sqrt{N\sum X_i^2 - (\sum X_i)^2}}{\sum X_i}\right]^2$$

$$N' = \left[\frac{40\sqrt{N\sum X_i^2 - (\sum X_i)^2}}{\sum X_i}\right]^2$$

$$N' = \left[\frac{40\sqrt{30 \times 69867.95 - 2090164.148}}{1445.74}\right]^2$$

$N' = 4.497$

N' □ N ; 4.497 □ 30 ⟶ Data is sufficient

f. Cycle Time Average

$$Ct = \frac{\sum X_i}{N}$$

$$Ct = \frac{\sum X_i}{N}$$

$$Ct = \frac{1445.74}{30}$$

$Ct = 48.191$ second

g. Rating Factor

Table 5.7. Rating Factor

No	Condition	Symbol	Rate
1	**Body parts used**		
	Upper arm. wirst. and fingers	C	2
2	**Foot Pedal**		
	Without Pedal	F	0
3	**Hand Used**		
	Hands help each other or work repetitively	H	0
4	**Coordination between eyes and hand**		
	Consistent and closely	K	4
5	**Equipment**		
	Can be controlled easily	N	0
6	**Weight (kg)**		
	5.85	B-10	27
		□	33%

Source : Based on Appendix 4.

The workers did the work in normally speed. so p1 has been valued by 1 or p1 = 1

P2 = 1 + 0.33

= 1.33

P = 1 x 1.33

= 1.33

h. Normal Time

Nt = Ct x p

= 48.191 x 1.33

= 64.094

i. Allowance Factor

Table 5.8. Allowance Factor

No.	Factor	Allowance (%)
1	**Energy Expenditures**	
	Neligible	4
2	**Work Position**	
	Sit	0.3
3	**Work Movement**	
	Normal	0
4	**Eye Fatigue**	
	Continuosly views with changeable focus	2
5	**Temperature**	
	Normal	6
6	**Atmosphere Condition**	
	Poor	7
7	**Good Environmental Condition**	
	Feel The Floor Vibration	8
		27.3

Source : Based on Appendix 5

For the personal needs = 1 %

For inevutable obstacles = 2 %

Allowance Factor = 27.3 % + 1 & + 2 &

= 30.3 %

w. Standard Time

St = Nt x (1 + a)

= 64.094 x 1.303

= 83.515 second

x. Standard Time for 30 box

St = 83.515 second x 30

= 2505.436 second

APPENDIX 3

5.5. Transport Time

5.5.1. Transport Time from Manual Page Sequencing Process to Binding Process

1. Amount of Subgroup

   k = 1 + 3.3 log N

   k = 1 + 3.3 log 20

   k = 5.293 ≈ 5

2. Average Value of Subgroup

Table of Average Value of Sub Group

Subgroup	Time (Xi)				Average of Subgroup
1-4	72.625	73.541	72.389	71.652	72.552
5-8	73.457	72.264	71.345	74.285	72.838
9-12	72.411	71.275	73.114	72.348	72.287
13-16	71.520	73.459	71.246	70.421	71.662
17-20	72.873	69.758	72.482	73.716	72.207
					361.545

$$\bar{\bar{X}} = \frac{\sum \overline{Xi}}{k}$$

$$\bar{\bar{X}} = \frac{361.545}{5}$$

$$\bar{\bar{X}} = 72.309$$

3. Standard Deviation of Time

Table of Standard Deviation of Time

No	Xi	Xi2	(Xi-X)	(Xi-X)2
1	72.625	5274.391	0.316	0.100
2	73.541	5408.279	1.232	1.518
3	72.389	5240.167	0.080	0.006
4	71.652	5134.009	-0.657	0.432
5	73.457	5395.931	1.148	1.318
6	72.264	5222.086	-0.045	0.002
7	71.345	5090.109	-0.964	0.929
8	74.285	5518.261	1.976	3.904
9	72.411	5243.353	0.102	0.010
10	71.275	5080.126	-1.034	1.069
11	73.114	5345.657	0.805	0.648
12	72.348	5234.233	0.039	0.002
13	71.52	5115.11	-0.789	0.623
14	73.459	5396.225	1.150	1.322
15	71.246	5075.993	-1.063	1.130
16	70.421	4959.117	-1.888	3.565
17	72.873	5310.474	0.564	0.318
18	69.758	4866.179	-2.551	6.508
19	72.482	5253.64	0.173	0.030
20	73.716	5434.049	1.407	1.980
□	1446.181	104597.4	0	25.413

$$\sigma = \sqrt{\frac{\sum(Xi-\bar{\bar{X}})^2}{N}}$$

$$\sigma = \sqrt{\frac{25.413}{20}}$$

$$\sigma = 1.127$$

4. Standard deviation from sub group average distribution

$$\sigma_{\bar{X}} = \frac{\sigma}{\sqrt{n}}$$

$$\sigma_{\bar{X}} = \frac{1.127}{\sqrt{4}}$$

$$\sigma_{\bar{X}} = 0.564$$

5. Upper Control Limit (UCL) and Lower Control Limit (LCL)

$$UCL = \bar{\bar{X}} + (3\ x\ \sigma_{\bar{X}})$$

$$= 72.309 + (3\ x\ 0.564)$$

$$= 74.001$$

$$LCL = \bar{\bar{X}} - (3\ x\ \sigma_{\bar{X}})$$

$$= 72.309 - (3\ x\ 0.564)$$

$$= 70.617$$

Control data Test

LCL $\leq \overline{Xi} \leq$ UCL

70.617 ≤ 72.552 ≤ 74.001 ⟶ Data is consistent

70.617 ≤ 72.838 ≤ 74.001 ⟶ Data is consistent

70.617 ≤ 72.287 ≤ 74.001 ⟶ Data is consistent

70.617 ≤ 71.662 ≤ 74.001 ⟶ Data is consistent

70.617 ≤ 72.207 ≤ 74.001 ⟶ Data is consistent

6. Sufficiency data test

The test used 5 % for precision and 95% for confidence rate.

$$N' = \left[\frac{\frac{K}{S}\sqrt{N\sum X_i^2 - (\sum X_i)^2}}{\sum X_i}\right]^2$$

$$N' = \left[\frac{40\sqrt{N\sum X_i^2 - (\sum X_i)^2}}{\sum X_i}\right]^2$$

$$N' = \left[\frac{40\sqrt{20 \times 104597.4 - 2091439.485}}{1446.181}\right]^2$$

$$N' = 0.389$$

N' □ N ; 0.389 □ 20 ⟶ Data is sufficient

7. Transport Time Average

$$Tt = \frac{\sum X_i}{N}$$

$$Tt = \frac{\sum X_i}{N}$$

$$Tt = \frac{1446.181}{20}$$

$Tt = 72.309$ second

5.5.2. Transport Time from Binding Process to Cutting Process

1. Amount of Subgroup

k = 1 + 3.3 log N

k = 1 + 3.3 log 20

k = 5.293 ≈ 5

2. Average Value of Subgroup

Table of Average Value of Sub Group

Subgroup	Time (Xi)				Average of Subgroup
1-4	44.138	42.355	42.591	45.246	43.583
5-8	41.276	43.588	42.617	43.542	42.756
9-12	42.052	43.528	44.382	41.201	42.791
13-16	43.511	45.379	42.001	43.627	43.630
17-20	41.982	40.077	44.291	42.389	42.185
					214.943

$$\bar{\bar{X}} = \frac{\sum \overline{\overline{Xi}}}{k}$$

$$\bar{\bar{X}} = \frac{214.943}{5}$$

$$\bar{\bar{X}} = 42.989$$

3. Standard Deviation of Time

Table of Standard Deviation of Time

No	Xi	Xi^2	$(Xi-\bar{\bar{X}})$	$(Xi-\bar{\bar{X}})^2$
1	44.138	1948.163	1.149	1.320
2	42.355	1793.946	-0.634	0.402
3	42.591	1813.993	-0.398	0.158
4	45.246	2047.201	2.257	5.094
5	41.276	1703.708	-1.713	2.934
6	43.588	1899.914	0.599	0.359
7	42.617	1816.209	-0.372	0.138
8	43.542	1895.906	0.553	0.306
9	42.052	1768.371	-0.937	0.878
10	43.528	1894.687	0.539	0.291
11	44.382	1969.762	1.393	1.940
12	41.201	1697.522	-1.788	3.197
13	43.511	1893.207	0.522	0.272
14	45.379	2059.254	2.390	5.712
15	42.001	1764.084	-0.988	0.976
16	43.627	1903.315	0.638	0.407
17	41.982	1762.488	-1.007	1.014
18	40.077	1606.166	-2.912	8.480
19	44.291	1961.693	1.302	1.695
20	42.389	1796.827	-0.600	0.360
□	859.773	36996.42	-	35.935

$$\sigma = \sqrt{\frac{\sum(Xi-\bar{\bar{X}})^2}{N}}$$

$$\sigma = \sqrt{\frac{35.935}{20}}$$

$$\sigma = 1.797$$

4. Standard deviation from sub group average distribution

$$\sigma_{\bar{X}} = \frac{\sigma}{\sqrt{n}}$$

$$\sigma_{\bar{X}} = \frac{1.797}{\sqrt{4}}$$

$$\sigma_{\bar{X}} = 0.898$$

5. Upper Control Limit (UCL) and Lower Control Limit (LCL)

$$UCL = \bar{\bar{X}} + (3 \times \sigma_{\bar{X}})$$

$$= 42.989 + (3 \times 0.898)$$

$$= 45.683$$

$$LCL = \bar{\bar{X}} - (3 \times \sigma_{\bar{X}})$$

$$= 42.989 - (3 \times 0.898)$$

$$= 40.295$$

Control data Test

LCL $\leq \overline{Xi} \leq$ UCL

40.295 ≤ 43.583 ≤ 45.683 ⟶ Data is consistent

40.295 ≤ 42.756 ≤ 45.683 ⟶ Data is consistent

40.295 ≤ 42.791 ≤ 45.683 ⟶ Data is consistent

40.295 ≤ 43.630 ≤ 45.683 ⟶ Data is consistent

40.295 ≤ 42.185 ≤ 45.683 ⟶ Data is consistent

6. Sufficiency data test

The test used 5 % for precision and 95% for confidence rate.

$$N' = \left[\frac{40\sqrt{N\sum X_i^2 - (\sum X_i)^2}}{\sum X_i}\right]^2$$

$$N' = \left[\frac{40\sqrt{20 \times 36966.42 - 739209.612}}{859.773}\right]^2$$

$$N' = 0.257$$

N' □ N ; 0.257 □ 20 ⟶ Data is sufficient

7. Transport Time Average

$$Tt = \frac{\sum X_i}{N}$$

$$Tt = \frac{\sum X_i}{N}$$

$$Tt = \frac{859.773}{20}$$

$Tt = 42.989$ second

5.5.3. Transport Time Cutting Process to Inspection and Packaging Process

1. Amount of Subgroup

k = 1 + 3.3 log N

k = 1 + 3.3 log 20

k = 5.293 ≈ 5

2. Average Value of Subgroup

Table of Average Value of Sub Group

Subgroup	Time (Xi)				Average of Subgroup
1-4	20.481	21.056	21.562	22.411	21.378
5-8	20.788	22.56	23.761	21.927	22.259
9-12	22.304	20.552	21.889	22.371	21.779
13-16	24.872	21.746	21.435	20.819	22.218
17-20	22.001	21.938	23.402	20.376	21.929
			□		109.563

$$\bar{\bar{X}} = \frac{\sum \overline{\overline{Xi}}}{k}$$

$$\bar{\bar{X}} = \frac{109.563}{5}$$

$$\bar{\bar{X}} = 21.913$$

3. Standard Deviation of Time

Table of Standard Deviation of Time

No	Xi	Xi^2	$(Xi-\bar{\bar{X}})$	$(Xi-\bar{\bar{X}})^2$
1	20.481	419.4714	-1.432	2.051
2	21.056	443.3551	-0.857	0.734
3	21.562	464.9198	-0.351	0.123
4	22.411	502.2529	0.498	0.248
5	20.788	432.1409	-1.125	1.266
6	22.56	508.9536	0.647	0.419
7	23.761	564.5851	1.848	3.415
8	21.927	480.7933	0.014	0.000
9	22.304	497.4684	0.391	0.153
10	20.552	422.3847	-1.361	1.852
11	21.889	479.1283	-0.024	0.001
12	22.371	500.4616	0.458	0.210
13	24.872	618.6164	2.959	8.756
14	21.746	472.8885	-0.167	0.028
15	21.435	459.4592	-0.478	0.228
16	20.819	433.4308	-1.094	1.197
17	22.001	484.044	0.088	0.008
18	21.938	481.2758	0.025	0.001
19	23.402	547.6536	1.489	2.217
20	20.376	415.1814	-1.537	2.362
□	438.251	9628.465	-	25.268

$$\sigma = \sqrt{\frac{\sum(Xi-\bar{\bar{X}})^2}{N}}$$

$$\sigma = \sqrt{\frac{25.268}{20}}$$

$$\sigma = 1.263$$

4. Standard deviation from sub group average distribution

$$\sigma_{\bar{X}} = \frac{\sigma}{\sqrt{n}}$$

$$\sigma_{\bar{X}} = \frac{1.263}{\sqrt{4}}$$

$$\sigma_{\bar{X}} = 0.632$$

5. Upper Control Limit (UCL) and Lower Control Limit (LCL)

$$UCL = \bar{\bar{X}} + (3 \times \sigma_{\bar{X}})$$

$$= 21.913 + (3 \times 0.632)$$

$$= 23.809$$

$$LCL = \bar{\bar{X}} - (3 \times \sigma_{\bar{X}})$$

$$= 21.913 - (3 \times 0.632)$$

$$= 20.017$$

Control data Test

LCL $\leq \overline{Xi} \leq$ UCL

20.017 $\leq$ 43.583 $\leq$ 23.809 ⟶ Data is consistent

20.017 $\leq$ 43.583 $\leq$ 23.809 ⟶ Data is consistent

20.017 $\leq$ 43.583 $\leq$ 23.809 ⟶ Data is consistent

20.017 ≤ 43.583 ≤ 23.809 ⟶ Data is consistent

20.017 ≤ 43.583 ≤ 23.809 ⟶ Data is consistent

6. Sufficiency data test

The test used 5 % for precision and 95% for confidence rate.

$$N' = \left[\frac{\frac{K}{S}\sqrt{N\sum X_i^2 - (\sum X_i)^2}}{\sum X_i}\right]^2$$

$$N' = \left[\frac{40\sqrt{N\sum X_i^2 - (\sum X_i)^2}}{\sum X_i}\right]^2$$

$$N' = \left[\frac{40\sqrt{20 \times 9628.465 - 192063.939}}{438.251}\right]^2$$

$$N' = 2.052$$

$N' \square N$; $2.052 \square 20$ ⟶ Data is sufficient

7. Transport Time Average

$$Tt = \frac{\sum X_i}{N}$$

$$Tt = \frac{438.251}{20}$$

$Tt = 21.912$ second

APPENDIX 4

OBJECTIVE RATING FACTOR TABLE

Condition	Symbol	Rating
Body Parts Used		
Fingers	A	0
Wrist hand from fingers	B	1
Lower Arm, Wrist Hand, and Fingers	C	2
Upper Arm, Lower Arm, etc	D	5
Body	E	6
Lift weight from the floor	E2	10
Foot Pedal		
Without pedal or one pedal with the point below the foot	F	0
One or two pedal with point is not below the foot	G	5
Hand Used		
hand help each other or work repetitively	H	0
Two of hands work with the same motion	H2	18
Coordination between eyes and hand		
Very small	I	0
Close enough	J	2
Constant and close	K	4
Very close	L	7
Smaller than 0,04 cm	M	10
Equipment		
Can be control easily	N	0
With few control	O	1
Need to control and pressure	P	2
Need to be solved carefully	Q	3
Easily broken	R	5
Weight (kg)		
0.45	B-1	2
0.90	B-2	5
1.35	B-3	6
1.80	B-4	10
2.25	B-5	13
2.70	B-6	15
3.15	B-7	17
3.60	B-8	19
4.05	B-9	20
4.50	B-10	22
4.95	B-11	24
5.40	B-12	25
5.85	B-13	27
6.30	B-14	28

Continue to Allowance Factor Table

Factor	Work Example	Allowance (%)	
E. Temperature **)	Temperature	Normal Weakness	Excessiveness
1.Freeze	Below 0	Above 10	above 12
2.Low	0-13	10-0	12 - 5
3. Medium	13-22	5-0	8 - 0
4. Normal	22-28	0-5	0 - 8
5. High	28-38	5-40	8 - 100
6. Very High	Above 38	Above 40	Above 100
F. Atmosphere Condition ***)			
1. Good	Good ventilation room, fresh air	0	
2. Fair	Poor ventilation, there is smell (not dangerous)	0 - 5	
3. Poor	Poisonous dust, or unpoisonous but in high quantity	5 - 10	
4. Bad	There is dangerous smell which must used breathing equipment	10 - 20	
G. Good Environmental Condition			
1. Clean, Health, Bright with low noise		0	
2. Repetitive work cycle between 5 -10		0 - 1	
3. Repetitive work cycle between 0 - 5		1 - 3	
4. Very noisy		0 - 5	
5. The influence factor can decrease the quality		0 - 5	
6. Feel the floor vibration		5 - 10	
7. Special condition (smell, clean, ect)		5 - 15	

*) Color contrast is noted

**) Depend on ventilation condition

***) Has been influenced by work place elevation and climate

Note : Allowance for male privacy = 0 - 2,5 % and woman = 2 - 5,0%

APPENDIX 5
Allowance Factor Table

Factor	Work Example		Allowance (%)	
A. Energy expenditure		Weight Equivalent (kg)	Male	Female
1.Negligible	Work in table, sit down	Without weight	0,0 - 6,0	0,0 - 6,0
2. Very light	Work in table, stand up	0,00-2,25	6,0 - 7,5	6,0 - 7,5
3. Light	Lightweight shovel	2,25-9,00	7,5 - 12,0	7,5 - 16,0
4. Medium	Hoe	9,00-18,00	12,0 - 19,0	16,0 - 30,0
5. Heavy	Swinging a heavy hammer	18,00-27,00	19,0 - 30,0	
6. Very Heavy	Shouldering weight	27,00-50,00	30,0 - 50,0	
7. Extraordinary Heavy	Carrying heavy sack	above 50		
B. Work Position				
1. Sit	Work with sit easily		0,0 - 1,0	
2.Stand on two leg	Upright body, supported on two leg		1,0 - 2,5	
3. Stand on one leg	One leg did the control		2,5 - 4,0	
4.Lie	On the body side, back, or front body		2,5 - 4,0	
5.Bend	Bend body relies on two leg		4,0 - 10,0	
C. Work Movement				
1. Normal	free swing of the hammer		0	
2, Rather limited	limited swing of the hammer		0 - 5,0	
3. Hard	carrying heavy weight with one hand		0 - 5,0	
4. In the limited body part	Work with hand upper the head		5,0 - 10	
5. All of body part is limited	Work in the hallway mining		10,0 - 15,0	
D. Eye Fatigue *)			Lighting	
			Good	Bad
1.Disjoint views	Read measurement tool		0	1
2. Almost Continuously views	Examined work		2	2
3. Continuously views with changeable focus	Check the defect on cloth		2	5
4. Continuously views with unchangeable focus	A very through examination		4	8

APPENDIX 6

Right Hand Left Hand Chart for 1st Current Work Method

RIGHT HAND LEFT HAND CHART

Job : **Manual page sequencing**

Department : **Finishing**

No Chart : **1**

Observer : **Randi Selo Abi**

Date : **January 3rd, 2011**

Current (v) **Recommended ( )**

1 : Bundle 1 5 : Bundle F : Finished Product

2 : Bundle 2 6 : Bundle 6

3 : Bundle 3 7 : Bundle 7

4 : Bundle 4 8 : Bundle 8

No	LEFT HAND			Symbol		RIGHT HAND		
	Description	Distance (cm)	Time (second)			Time (second)	Distance (cm)	Description
1	Reach bundle 5	72,5	0,7	RE	RE	0,7	60,5	Reach bundle 1
2	Reach bundle 6	74	0,7	RE	G	0,7		Hold bundle 1
3	Hold bundle 5 and 6		0,7	G	RE	0,7	75	Reach bundle 2
4	Reach bundle 7	55	0,7	RE	RE	0,7	71,5	Reach bundle 3
5	Hold bundle 5,6 and 7		0,7	G	RE	0,7	66	Reach bundle 4
6	Reach bundle 8	48,5	0,7	RE	G	0,7		Hold bundle 1,2,3, and 4
7	Put bundle 5,6,7, and 8 to the table		0,5	RL	G	0,5		Hold bundle 1,2,3, and 4
8	Idle		0,5	D	RL	0,5		Put bundle 1,2,3 and 4 to the table
9	Arrange the bundle into one		1	P	P	1		Arrange the bundle into one
11	Put the bundle vertically in table		0,6	RL	RL	0,6		Put the bundle vertically in table
12	Set the bundle vertically (2 x)		0,8	P	P	0,8		Set the bundle vertically (2 x)
13	Idle		240	D	RL	240	48,5	Put the bundle into the finish place (30 x)
14	Idle		1	D	G	1		Take the finish bundle
16	Bring the finished bundle to the pallet	137,5	8	M	M	8	137,5	Bring the finished bundle to the pallet
17	Put the finished bundle to the pallet		0,7	RL	RL	0,7		Put the finished bundle to the pallet
	TOTAL		**249,7**			**249,7**		

APPENDIX 7

Right Hand-Left Hand Chart of 2nd Current Work Method

RIGHT HAND LEFT HAND CHART

Job : **Manual page sequencing**

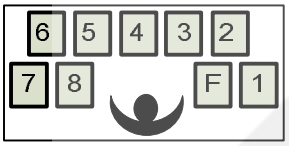
Department : **Finishing**

No Chart : **2**

Observer : **Randi Selo Abi**

Date : **January 3rd**

Current (v) **Recommended ( )**



1 : Bundle 5 : Bundle F : Finished Product

2 : Bundle 6 : Bundle 6

3 : Bundle 7 : Bundle 7

4 : Bundle 8 : Bundle 8

No	LEFT HAND			Symbol	RIGHT HAND		
	Description	Distance (cm)	Time (second)		Time (second)	Distance (cm)	Description
1	Reach bundle 5	72,5	0,7	R R	0,7	60,5	Reach bundle 1
2	Reach bundle 6	74	0,7	R G	0,7		Hold bundle 1
3	Hold bundle 5 and 6		0,7	G R	0,7	75	Reach bundle 2
4	Reach bundle 7	55	0,7	R G	0,7		Hold bundle 1 and 2
5	Hold bundle 5,6 and 7		0,7	G R	0,7	71,5	Reach bundle 3
6	Hold bundle 5,6 and 7		0,6	G R	0,6	66	Reach bundle 4
7	Reach bundle 8	48.5	0,4	R G	0,4		Hold bundle 1,2,3, and 4
8	Put bundle 5,6,7, and 8 to the table		0,5	RL G	0,5		Hold bundle 1,2,3, and 4
9	Idle		0,5	D RL	0,5		Put bundle 1,2,3 and 4 to the table
10	Arrange the bundle into one		1	P P	1		Arrange the bundle into one
12	Put the bundle vertically in table		0,4	RL RL	0,4		Put the bundle vertically in table
13	Set the bundle vertically (3 x)		0,8	P P	0,8		Set the bundle vertically (3 x)
14	Set the bundle horizontally		0,5	P P	0,5		Set the bundle horizontally
15	Idle		258	D RL	258	48,5	Put the bundle into the finish place (30 x)
16	Take the finished bundle		1	D G	1		Take the finish bundle
18	Bring the finished bundle to the pallet	137,5	8	M M	8	137,5	Bring the finished bundle to the pallet
19	Put the finished bundle to the pallet		0,7	RL RL	0,7		Put the finished bundle to the pallet
	TOTAL		267,7		267,7		

APPENDIX 8

Right Hand-Left Hand Chart of 3rd Current Work Method

RIGHT HAND LEFT HAND CHART

Job

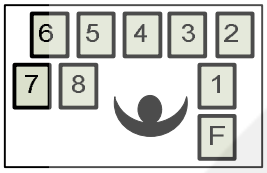
Department : Finishing

No Chart : 3

Obs erver : Randi Selo Abi

Dat e : January 3rd, 2011

Current (v) Recommended ( )



1 : Bundle 1 5 : Bundle 5 F : Finished Product

2 : Bundle 2 6 : Bundle 6

3 : Bundle 3 7 : Bundle 7

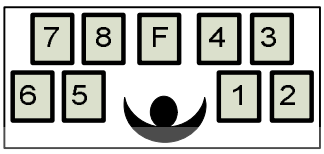
4 : Bundle 4 8 : Bundle 8

No	LEFT HAND			Symbol		RIGHT HAND	
	Description	Distance (cm)	Time (second)		Time (second)	Distance (cm)	Description
1	Idle		0,7	D R	0,7	45	Reach the bundle 1
2	Idle		0,7	D R	0,7	75	Reach the bundle 2
3	Reach the bundle 5	72,5	0,7	R R	0,7	74	Reach the bundle 3
4	Reach the bundle 6	74	0,7	R R	0,7	66	Reach the bundle 4
5	Reach the bundle 7	55	0,7	R G	0,7		Hold the bundle 1,2,3, and 4
6	Reach the bundle 8	48,5	0,5	R G	0,5		Hold the bundle 1,2,3, and 4
7	Put the bundle 5,6,7, and 8 to the table		0,4	RL D	0,4		Idle
8	Idle		0,4	D RL	0,4		Put the bundle 1,2,3, and 4 to the table
9	Arrange bundles into 1 bundle		1	P P	1		Arrange bundles into 1 bundle
10	Take the bundle from table		0,4	G G	0,4		Take the bundle from table
12	Put the bundle vertically		0,5	RL RL	0,5		Put the bundle vertically
13	Set the bundle vertically (2 x)		0,8	P P	0,8		Set the bundle vertically (2 x)
15	Rotate the bundle horizontally		0,4	P P	0,4		Rotate the bundle horizontally
16	Put the bundle horizontally		0,4	RL RL	0,4		Put the bundle horizontally
17	Set the bundle horizontally (2 x)		0,8	P P	0,8		Set the bundle horizontally (2 x)
18	Idle		273	D RL	273	43	Put the bundle to the finish place (30x)
19	Take the finished bundle		1	G G	1		Take the finished bundle
21	Bring the finished bundle to the pallet	137,5	8	M M	8	137,5	Bring the finished bundle to the pallet
22	Put the finished bundle to the pallet		0,7	RL RL	0,7		Put the finished bundle to the pallet
	TOTAL		282,7		282,7		

APPENDIX 9

Right Hand-Left Hand Chart of Recommended Work Method

RIGHT HAND LEFT HAND CHART



No	LEFT HAND			Symbol		RIGHT HAND		
	Description	Distance (cm)	Time (second)			Time (second)	Distance (cm)	Description
1	Reach bundle 5	72,5	0,9	R	R	0,9	60,5	Reach bundle 1
2	Reach bundle 6	74	0,9	R	R	0,9	74	Reach bundle 2
3	Reach bundle 7	71,5	0,9	R	R	0,9	71,5	Reach bundle 3
4	Reach bundle 8	48,5	0,8	R	R	0,8	66	Reach bundle 4
5	Arrange the bundle into one vertically		1,2	P	P	1,2		Arrange the bundle into one vertically
6	Set the bundle (2 x)		1,5	P	P	1,5		Set the bundle (2 x)
7	Idle		198	D	RL	198	45	Put the bundle to the finished bundle place (30 x)
8	Take the bundle from finished bundle place		1	G	G	1		Take the bundle from finished bundle place
9	Bring the finished bundle to the pallet	137,5	8	M	M	8	137,5	Bring the finished bundle to the pallet
10	Put the finished bundle to pallet		0,7	RL	RL	0,7		Put the finished bundle to pallet
	TOTAL		**207,7**			**207,7**		

APPENDIX 10

1st Work Method Analysis				
No	Left Hand		Right Hand	
	Recommended	Current	Current	Recommended
1	Reach bundle 5	Reach bundle 5	Reach bundle 1	Reach bundle 1
2	Reach bundle 6	Reach bundle 6	Hold bundle 1	Reach bundle 2
3	Reach Bundle 7	Hold bundle 5 and 6	Reach bundle 2	
4		Reach bundle 7	Reach bundle 3	Reach bundle 3
5	Reach bundle 8	Hold bundle 5,6 and 7	Reach bundle 4	Reach bundle 4
6		Reach bundle 8	Hold bundle 1,2,3, and 4	
7	Put bundle 5,6,7, and 8 to the table	Put bundle 5,6,7, and 8 to the table	Hold bundle 1,2,3, and 4	Put bundle 1,2,3 and 4 to the table
8		Idle	Put bundle 1,2,3 and 4 to the table	
9	Arrange the bundle into one	Arrange the bundle into one	Arrange the bundle into one	Arrange the bundle into one
10	-	Put the bundle vertically in table	Put the bundle vertically in table	-
11	Set the bundle vertically (2 x)	Set the bundle vertically (2 x)	Set the bundle vertically (2x)	Set the bundle vertically (2x)
12	Idle	Idle	Put the bundle into the finish place	Put the bundle into the finish place
13	Take the finished bundle	Take the finished bundle	Take the finished bundle	Take the finished bundle
14	Bring the finished bundle to the pallet	Bring the finished bundle to the pallet	Bring the finished bundle to the pallet	Bring the finished bundle to the pallet
15	Put the finished bundle to the pallet	Put the finished bundle to the pallet	Put the finished bundle to the pallet	Put the finished bundle to the pallet

Combine

Eliminate

Change The Sequence

Simplify

APPENDIX 11

2nd Work Method Analysis				
No	Left Hand		Right Hand	
	Recommended	Current	Current	Recommended
1	Reach bundle 5	Reach bundle 5	Reach bundle 1	Reach bundle 1
2	Reach bundle 6	Reach bundle 6	Hold bundle 1	Reach bundle 2
3	Reach bundle 7	Hold bundle 5 and 6	Reach bundle 2	
4		Reach bundle 7	Hold bundle 1 and 2	Reach bundle 3
5	Reach bundle 8	Hold bundle 5,6 and 7	Reach bundle 3	
6		Hold bundle 5,6 and 7	Reach bundle 4	Reach bundle 4
7		Reach bundle 8	Hold bundle 1,2,3, and 4	
8	Put bundle 5,6,7, and 8 to the table	Put bundle 5,6,7, and 8 to the table	Hold bundle 1,2,3, and 4	Put bundle 1,2,3 and 4 to the table
9		Idle	Put bundle 1,2,3 and 4 to the table	
10	Arrange the bundle into one	Arrange the bundle into one	Arrange the bundle into one	Arrange the bundle into one
11	-	Put the bundle vertically in table	Put the bundle vertically in table	-
12	Set the bundle vertically (2 x)	Set the bundle vertically (3 x)	Set the bundle vertically (3 x)	Set the bundle vertically (2 x)
13	-	Set the bundle horizontally	Set the bundle horizontally	-
14	Idle	Idle	Put the bundle into the finish place	Put the bundle into the finish place
15	Take the finished bundle	Take the finished bundle	Take the finish bundle	Take the finish bundle
16	Bring the finished bundle to the pallet	Bring the finished bundle to the pallet	Bring the finished bundle to the pallet	Bring the finished bundle to the pallet
17	Put the finished bundle to the pallet	Put the finished bundle to the pallet	Put the finished bundle to the pallet	Put the finished bundle to the pallet

Combine

Eliminate

Change The Sequence

Simplify

APPENDIX 12

3rd Work Method Analysis				
No	Left Hand		Right Hand	
	Recommended	Current	Current	Recommended
1	Reach the bundle 5	Idle	Reach the bundle 1	Reach the bundle 1
2		Idle	Reach the bundle 2	Reach the bundle 2
3		Reach the bundle 5	Reach the bundle 3	Reach the bundle 3
4	Reach the bundle 6	Reach the bundle 6	Reach the bundle 4	Reach the bundle 4
5	Reach the bundle 7	Reach the bundle 7	Hold the bundle 1,2,3, and 4	Put the bundle 1,2,3, and 4 to the table
6	Reach the bundle 8	Reach the bundle 8	Hold the bundle 1,2,3, and 4	
7	Put the bundle 5,6,7, and 8 to the table	Put the bundle 5,6,7, and 8 to the table	Idle	
8		Idle	Put the bundle 1,2,3, and 4 to the table	
9	Set bundle into 1 bundle	Set bundle into 1 bundle	Set 8 bundle into 1 bundle	Set 8 bundle into 1 bundle
10	-	Take the bundle from table	Take the bundle from table	-
11	-	Put the bundle vertically	Put the bundle vertically	-
12	Set the bundle vertically (2 x)	Set the bundle vertically (2 x)	Set the bundle vertically (2 x)	Set the bundle vertically (2 x)
13	-	Rotate the bundle horizontally	Rotate the bundle horizontally	-
14	-	Put the bundle horizontally	Put the bundle horizontally	-
15	-	Set the bundle horizontally (2 x)	Set the bundle horizontally (2 x)	-
16	Idle	Idle	Put the bundle to the finish place	Put the bundle to the finish place
17	Take the finished bundle	Take the finished bundle	Take the finished bundle	Take the finished bundle
18	Bring the finished bundle to the pallet	Bring the finished bundle to the pallet	Bring the finished bundle to the pallet	Bring the finished bundle to the pallet
19	Put the finished bundle to the pallet	Put the finished bundle to the pallet	Put the finished bundle to the pallet	Put the finished bundle to the pallet

Combine

Eliminate

Change The Sequence

Simplify

APPENDIX 13

FLOW DIAGRAM

Job	: Finishing Department
Chart No	:5
Current (v)	Recommended ( )
Created by	: Randi Selo Abi
Date	:January 3rd, 2011