CHAPTER 6
CONCLUSION AND RECOMMENDATION

This chapter aim to describe the final conclusion that is created to answer the research objectives and recommendation for the further research to analyze other factors that are not considered in this research.

6.1. Conclusion

Based on the analysis and discussion that were conducted related to the production capacity in a furniture manufacturer, the conclusion is mentioned below.

a. The standard time for common products such as Chair Dining (Wood) is 7.675 hours, Table Dining (Wood) is 15.336 hours, and Table Side (Wood) is 9.339 hours. The shortest processing time is for producing Wood Sheet which have value of 1.195 hours, and the longest is Wood Table Dining Big (55.238 hours).

b. The average production workload 1087.996 hours for Woodworking department, 923.771 hours for Sanding department, 1113.765 hours for Finishing department, and 122.807 hours for Packing department. While the production capacity for Woodworking department is 1280 hours, 2080 hours for Sanding department, 1280 hours for Finishing department and 160 hours for Packing department.

c. There are two alternatives that can be used in the company. The first alternative is by moving three workers from Sanding to Finishing department, add one additional workers to each of Woodworking, Finishing and Packing department. In short, the total number of the workers are 9 persons, 10 persons, 12 persons and 2 persons in Woodworking, Sanding, Finishing and Packing department respectively. The average utilization for each department are 75.56% (Woodworking), 57.74% (Sanding), 58.01% (Finishing), and 38.38% (Packing).

The second alternative is by merging the task of Finishing and Packing department to one person and laying off one person either the Finisher or Packer from the first alternative. It means that the total workers in Finishing and Packing are 13 persons. The average utilization for each department are 75.56% (Woodworking), 57.74% (Sanding), 60.53% (Finishing), and 51.17% (Packing). Excessive percentages of 0.53% in Finishing department are still acceptable to be handled by the company.

6.2. Recommendation

Based on the observation and analysis in this research, there are several recommendation as it is explained below.

a. There is no any improvement in the working method of the production processes. There may be some inefficient working method on those processes that need to be analyzed and improved.

b. The utilization of each production department are less than 100%. It may be caused by several factor such as improper working procedure, less motivation of the workers, bad quality of machine and tools, and other factors. Those factors may be needed to be analyzed and find the root cause in order to increase their productivity.

c. In order to implement proposed solution of 'Alternative 2', further analysis about scheduling should be held since there is one person who work on two different job and workstations alternately.

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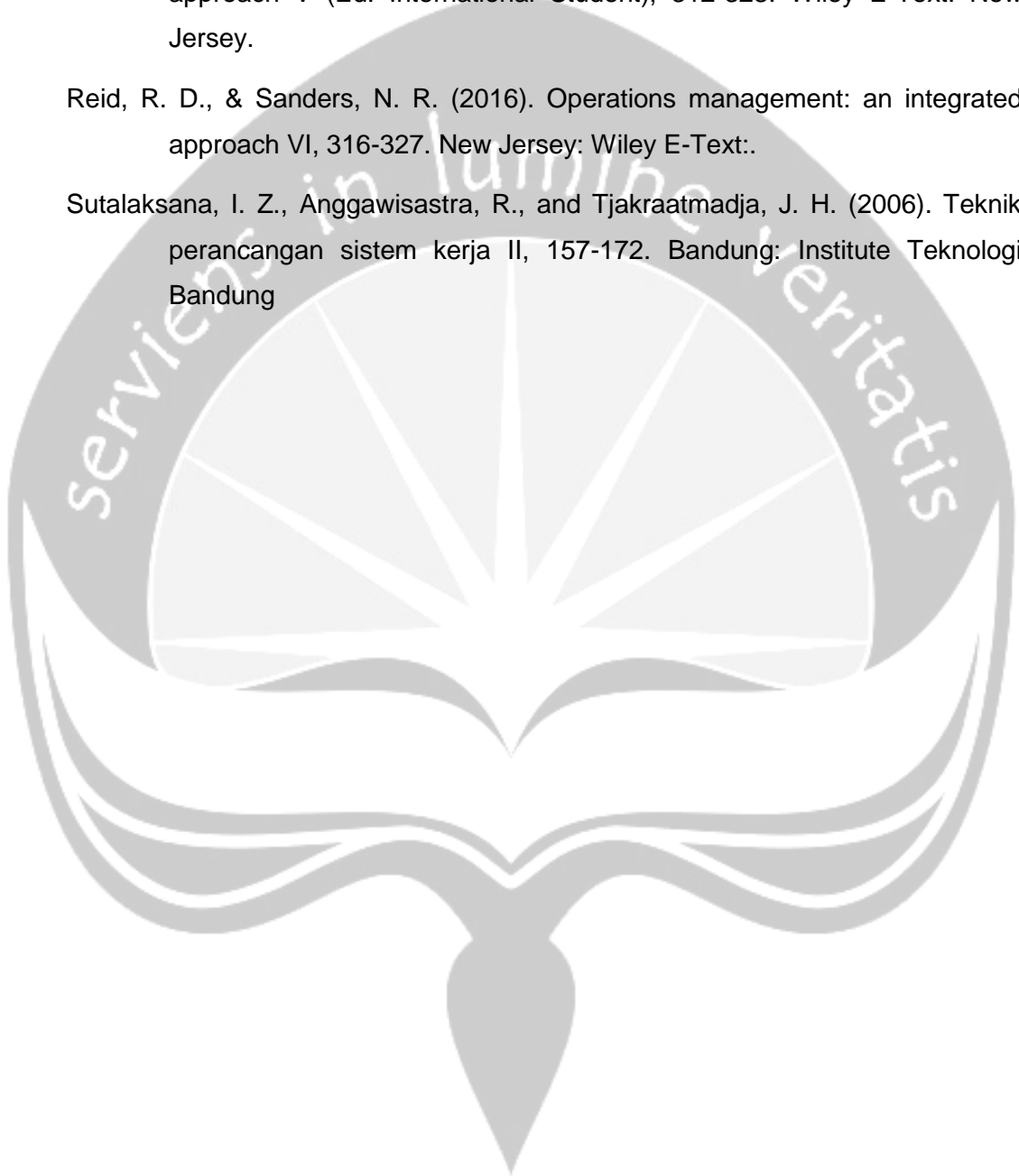
APPENDIXES

1. Result from Time Study Analysis

a. Splitting Process (Wood Product)

The result of observation:

Table 1. Cycle Time of Splitting Process for Wood Products

Cycle	Time	Product Size (cm)	Time / 100 cm
1	13	150	8.67
2	14	150	9.33
3	12	150	8.00
4	13	150	8.67
5	12	150	8.00
6	15	150	10.00
7	14	150	9.33
8	13	150	8.67
9	14	150	9.33
10	16	150	10.67
11	12	150	8.00
12	16	150	10.67
13	15	150	10.00
14	13	150	8.67
15	12	150	8.00
16	14	150	9.33
17	12	150	8.00
18	14	150	9.33
19	14	150	9.33
20	12	150	8.00
21	16	151	10.60
22	15	152	9.87
23	17	153	11.11
24	14	154	9.09
25	15	155	9.68
		Average	**9.21**
		SD	**0.95**

The number of cycles needed:

$$n \geq \left[\frac{1.96}{0.05} \; x \; \frac{0.95}{9.21} \right]^2$$

$$n \geq 16.4037 \approx 17$$

Table 2. Performance Rating of Splitting Process

Factor	Category	Value	Reason
Skill	Good Skill	0.06	Good experience and knowledge
Effort	Good Effort	0.02	Awareness of the responsibility
Condition	Average	0	Normal condition
Consistency	Good	0.01	More or less similar to each other
Total		**0.09**	

Calculation of the normal time:

$$Normal\ time = Cycle\ time\ x\ p$$

$$Normal\ time = 9.21\ seconds\ x\ 1.09$$

$$Normal\ time = 10.0389\ seconds$$

Table 3. Allowances of Splitting Process

Factor	Category	Value (%)	Reason
Energy	Very light	6.5	Standing, load of ± 1 kg, man
Posture	Standing on both leg	1.75	Average value for standing position
Movement	A bit limited	2.5	Following specific movement
Eyestrain	Discontinuous Stare	3.0	Discontinuous stare, normal lighting
Personal	Man	1.25	Average value for male personal allowances
Total		**15**	

Calculation of the standard time:

$$Standard\ time = Normal\ time\ x\ (1 +\ Allowances)$$

$$Standard\ time = 10.0389\ seconds\ x\ 1.15$$

$$Standard\ time = 11.5447\ seconds\ \text{(for a one-meter length part)}$$

b. Side's Planner Process (Wood Product)

The result of observation:

Table 4. Cycle Time of Side's Planer Process for Wood Products

Cycle	Time	Product Size (cm)	Time / 100 cm
1	12	150	8.00
2	11	150	7.33
3	12	150	8.00
4	13	150	8.67
5	14	150	9.33
6	12	150	8.00
7	13	150	8.67
8	11	150	7.33
9	12	150	8.00
10	14	150	9.33
11	15	151	9.93
12	11	152	7.24
13	12	153	7.84
14	14	154	9.09
15	12	155	7.74
16	15	156	9.62
17	13	157	8.28
18	14	158	8.86
19	13	159	8.18
20	12	160	7.50
21	11	161	6.83
22	15	162	9.26
23	14	163	8.59
24	13	164	7.93
25	12	165	7.27
		Average	**8.27**
		SD	**0.83**

The number of cycles needed:

$$n \geq \left[\frac{1.96}{0.05} \ x \ \frac{0.83}{8.27} \right]^2$$

$$n \geq 15.54118 \approx 16$$

Table 5. Performance Rating of Side's Planner Process

Factor	Category	Value	Reason
Skill	Good Skill	0.06	Good experience and knowledge
Effort	Good Effort	0.02	Awareness of the responsibility
Condition	Average	0	Normal condition
Consistency	Good	0.01	More or less similar to each other
Total		**0.09**	

Calculation of the normal time:

$$Normal\ time = Cycle\ time\ x\ p$$

$$Normal\ time = 8.27\ seconds\ x\ 1.09$$

$$Normal\ time = 9.0143\ seconds$$

Table 6. Allowances of Side's Planner Process

Factor	Category	Value (%)	Reason
Energy	Very light	6.5	Standing, load of $\pm$ 1 kg, man
Posture	Standing on both leg	1.75	Average value for standing position
Movement	A bit limited	2.5	Following specific movement
Eyestrain	Discontinuous Stare	3.0	Discontinuous stare, normal lighting
Personal	Man	1.25	Average value for male personal allowances
Total		**15**	

Calculation of the standard time:

$$Standard\ time = Normal\ time\ x\ (1 +\ Allowances)$$

$$Standard\ time = 9.0143\ seconds\ x\ 1.15$$

$$Standard\ time = 10.3664\ seconds\ \text{(for a one-meter length part)}$$

c. Cutting Process (Wood Product)

The result of observation:

Table 7. Cycle Time of Cutting Process for Wood Products

Cycle	Time	Product Size (cm)	Time / 100 cm
1	20	15	133.33
2	23	15	153.33
3	25	15	166.67
4	24	15	160.00
5	23	15	153.33
6	22	15	146.67
7	22	15	146.67
8	25	15	166.67
9	24	15	160.00
10	21	15	140.00
11	24	15	160.00
12	23	15	153.33
13	21	15	140.00
14	25	15	166.67
15	20	15	133.33
16	21	15	140.00
17	23	15	153.33
18	24	15	160.00
19	21	15	140.00
20	24	15	160.00
21	23	15	153.33
22	22	15	146.67
23	24	15	160.00
24	25	15	166.67
25	21	15	140.00
		Average	**152.00**
		SD	**10.72**

The number of cycles needed:

$$n \geq \left[\frac{1.96}{0.05} \ x \ \frac{10.72}{152} \right]^2$$
$$n \geq 7.6363 \approx 8$$

Table 8. Performance Rating of Cutting Process

Factor	Category	Value	Reason
Skill	Good Skill	0.06	Good experience and knowledge
Effort	Good Effort	0.02	Awareness of the responsibility
Condition	Average	0	Normal condition
Consistency	Good	0.01	More or less similar to each other
Total		**0.09**	

Calculation of the normal time:

$$Normal\ time = Cycle\ time\ x\ p$$

$$Normal\ time = 152\ seconds\ x\ 1.09$$

$$Normal\ time = 165.68\ seconds$$

Table 9. Allowances of Cutting Process

Factor	Category	Value (%)	Reason
Energy	Very light	6.5	Standing, load of ± 1 kg, man
Posture	Standing on both leg	1.75	Average value for standing position
Movement	A bit limited	2.5	Following specific movement
Eyestrain	Discontinuous Stare	3.0	Discontinuous stare, normal lighting
Personal	Man	1.25	Average value for male personal allowances
Total		**15**	

Calculation of the standard time:

$$Standard\ time = Normal\ time\ x\ (1 + \ Allowances)$$

$$Standard\ time = 165.68\ seconds\ x\ 1.15$$

$$Standard\ time = 190.532\ seconds\ \text{(for a one-meter length part)}$$

d. Assembly 1 (Wood Product)

The result of observation:

Table 10. Cycle Time of Assembly 1 Process for Wood Products

Cycle	Time	Product Size
1	217	1 layer
2	205	1 layer
3	220	1 layer
4	210	1 layer
5	224	1 layer
6	208	1 layer
7	225	1 layer
8	204	1 layer
9	215	1 layer
10	221	1 layer
11	209	1 layer
12	219	1 layer
13	228	1 layer
14	202	1 layer
15	234	1 layer
16	215	1 layer
17	221	1 layer
Average	**216.2941**	
SD	**9.012247**	

The number of cycles needed:

$$n \geq \left[\frac{1.96}{0.05} \; x \; \frac{9.0122}{216.2941}\right]^2$$

$$n \geq 2.6677 \approx 3$$

Table 11. Performance Rating of Assembly 1 Process

Factor	Category	Value	Reason
Skill	Average	0	Good knowledge
Effort	Good Effort	0.02	Awareness of the responsibility
Condition	Average	0	Normal condition
Consistency	Good	0.01	More or less similar to each other
Total		**0.03**	

Calculation of the normal time:

$$Normal\ time = Cycle\ time \; x \; p$$

$$Normal\ time = 216.2941\ seconds \; x \; 1.03$$

$$Normal\ time = 222.7829\ seconds$$

Table 12. Allowances of Assembly 1 Process

Factor	Category	Value (%)	Reason
Energy	Very light	6.5	Standing, load of ± 1 kg, man
Posture	Standing on both leg	1.75	Average value for standing position
Movement	A bit limited	2.5	Following specific movement
Eyestrain	Discontinuous Stare	3.0	Discontinuous stare, normal lighting
Personal	Man	1.25	Average value for male personal allowances
Total		**15**	

Calculation of the standard time:

$$Standard\ time = Normal\ time\ x\ (1 +\ Allowances)$$

$$Standard\ time = 222.7829\ seconds\ x\ 1.15$$

$$Standard\ time = 256.2003\ seconds\ \text{(for joining each layer of part)}$$

e. Planner After Assembly (Wood Product)

The result of observation:

Table 13. Cycle Time of Planer After Assembly Process for Wood Products

Cycle	Time (s)	Product Size (m2)	Time / m2 (s)
1	469	1.2	390.8333
2	499	1.2	415.8333
3	537	1.2	447.5000
4	525	1.2	437.5000
5	478	1.2	398.3333
6	475	1.2	395.8333
7	490	1.2	408.3333
8	507	1.2	422.5000
9	474	1.2	395.0000
10	514	1.2	428.3333
11	476	1.2	396.6667
12	517	1.2	430.8333
13	501	1.2	417.5000
14	464	1.2	386.6667
15	478	1.2	398.3333
		Average	**411.3333**
		SD	**18.78977263**

The number of cycles needed:

$$n \geq \left[\frac{1.96}{0.05} \; x \; \frac{18.7898}{411.3333} \right]^2$$

$$n \geq 3.2065 \approx 4$$

Table 14. Performance Rating of Planner After Assembly Process

Factor	Category	Value	Reason
Skill	Good Skill	0.03	Quite fast and have good experiences
Effort	Good Effort	0.02	Awareness of the responsibility
Condition	Average	0	Normal condition
Consistency	Good	0.01	More or less similar to each other
Total		**0.06**	

Calculation of the normal time:

$$Normal\ time = Cycle\ time\ x\ p$$

$$Normal\ time = 411.333\ seconds\ x\ 1.06$$

$$Normal\ time = 436.0132\ seconds$$

Table 15. Allowances of Planner After Assembly Process

Factor	Category	Value (%)	Reason
Energy	Very light	6.5	Standing, load of $\pm$ 1 kg, man
Posture	Standing on both leg	1.75	Average value for standing position
Movement	A bit limited	2.5	Following specific movement
Eyestrain	Discontinuous Stare	3.0	Discontinuous stare, normal lighting
Personal	Man	1.25	Average value for male personal allowances
Total		**15**	

Calculation of the standard time:

$$Standard\ time = Normal\ time\ x\ (1 + \ Allowances)$$

$$Standard\ time = 436.0132\ seconds\ x\ 1.15$$

$$Standard\ time = 501.4152\ seconds\ \text{(an one-meter square part)}$$

f. Assembly 2 (Wood Product)

The result of observation:

Table 16. Cycle Time of Assembly 2 Process for Wood Products

Cycle	Time (s)	Product Size (5x)	Time / 1x (s)
1	37	5	7.40
2	26	5	5.20
3	30	5	6.00
4	33	5	6.60
5	27	5	5.40
6	32	5	6.40
7	31	5	6.20
8	33	5	6.60
9	28	5	5.60
10	30	5	6.00
11	31	5	6.20
12	36	5	7.20
13	32	5	6.40
14	27	5	5.40
15	29	5	5.80
16	33	5	6.60
17	30	5	6.00
18	31	5	6.20
19	38	5	7.60
20	28	5	5.60
21	26	5	5.20
22	35	5	7.00
23	34	5	6.80
24	39	5	7.80
25	32	5	6.40
		Average	**6.30**
		SD	**0.72**

The number of cycles needed:

$$n \geq \left[\frac{1.96}{0.05} \ x \ \frac{0.72}{6.30} \right]^2$$

$$n \geq 20.25116 \approx 21$$

Table 17. Performance Rating of Assembly 2 Process

Factor	Category	Value	Reason
Skill	Good Skill	0.03	Quite fast and have good experiences
Effort	Good Effort	0.02	Awareness of the responsibility
Condition	Average	0	Normal condition
Consistency	Excellent	0.03	The observed time is approximately similar one to each others.
Total		**0.08**	

Calculation of the normal time:

$$Normal\ time = Cycle\ time\ x\ p$$

$$Normal\ time = 6.30\ seconds\ x\ 1.08$$

$$Normal\ time = 6.804\ seconds$$

Table 18. Allowances of Assembly Process

Factor	Category	Value (%)	Reason
Energy	Very light	6.5	Standing, load of $\pm$ 1 kg, man
Posture	Standing on both leg	1.75	Average value for standing position
Movement	A bit limited	2.5	Following specific movement
Eyestrain	Discontinuous Stare	3.0	Discontinuous stare, normal lighting
Personal	Man	1.25	Average value for male personal allowances
Total		**15**	

Calculation of the standard time:

$$Standard\ time = Normal\ time\ x\ (1 +\ Allowances)$$

$$Standard\ time = 6.804\ seconds\ x\ 1.15$$

$$Standard\ time = 7.8246\ seconds\ \text{(for every nail)}$$

g. Sanding *Sonokeling* G10/BS10/S15/18/24 (Wood Product)

The result of observation:

Table 19. Cycle Time of Sanding *Gerinda* 100 / Bed Sander 100 / Sander 150/180/240 Process for Wood Products (*Sonokeling*)

Cycle	Time (s)	Product Size (m2)	Time / m2 (s)
1	748	1.2	623.3333
2	815	1.2	679.1667
3	774	1.2	645.0000
4	737	1.2	614.1667
5	769	1.2	640.8333
6	835	1.2	695.8333
7	792	1.2	660.0000
8	813	1.2	677.5000
9	865	1.2	720.8333
10	831	1.2	692.5000
		Average	**664.9167**
		SD	**34.17332817**

The number of cycles needed:

$$n \geq \left[\frac{1.96}{0.05} \ x \ \frac{34.1733}{664.9167} \right]^2$$

$$n \geq 4.058936 \approx 5$$

Table 20. Performance Rating of Sanding *Gerinda* 80 / Bed Sander 100 / Sander 150/180/240 Process (*Sonokeling*)

Factor	Category	Value	Reason
Skill	Good Skill	0.03	Quite fast and have good experiences
Effort	Average	0	Doing the job, does not care much about suggestion/improvement
Condition	Fair	-0.03	Tiny dust in the surrounding area
Consistency	Excellent	0.03	The observed time is approximately similar one to each others.
Total		**0.03**	

Calculation of the normal time:

$$Normal \ time = Cycle \ time \ x \ p$$

$$Normal \ time = 664.9167 \ seconds \ x \ 1.03$$

$$Normal \ time = 684.864 \ seconds$$

Table 21. Allowances of Sanding *Gerinda* 80 / Bed Sander 100 / Sander 150/180/240 Process (*Sonokeling*)

Factor	Category	Value (%)	Reason
Energy	Can be ignored	3.0	Sitting position, woman
Posture	Sitting	0.5	Average value for sitting position
Movement	A bit limited	2.5	Following specific movement
Eyestrain	Continuous Stare	6.25	Continuous stare, normal lighting
Personal	Woman	3.5	Average value for female personal allowances
Total		**15.75**	

Calculation of the standard time:

$$Standard\ time = Normal\ time\ x\ (1 +\ Allowances)$$

$$Standard\ time = 684.864\ seconds\ x\ 1.1575$$

$$Standard\ time = 792.7301\ seconds\ \text{(for a one-meter square product)}$$

h. Sanding Jati S8 (Wood Product)

The result of observation:

Table 22. Cycle Time of Sander 80 Process for Wood Products (*Jati*)

Cycle	Time (s)	Product Size (m2)	Time / m2 (s)
1	2445	1.2	2037.5000
2	2493	1.2	2077.5000
3	2389	1.2	1990.8333
4	2513	1.2	2094.1667
5	2537	1.2	2114.1667
6	2422	1.2	2018.3333
7	2525	1.2	2104.1667
8	2307	1.2	1922.5000
9	2596	1.2	2163.3333
10	2557	1.2	2130.8333
11	2652	1.2	2210.0000
12	2457	1.2	2047.5000
13	2555	1.2	2129.1667
14	2604	1.2	2170.0000
15	2568	1.2	2140.0000
		Average	**2090.0000**
		SD	**75.7940767**

The number of cycles needed:

$$n \geq \left[\frac{1.96}{0.05} \, x \, \frac{75.7941}{2090} \right]^2$$

$$n \geq 2.0209 \approx 3$$

Table 23. Performance Rating of Sander 80 Process (*Sonokeling*)

Factor	Category	Value	Reason
Skill	Good Skill	0.03	Quite fast and have good experiences
Effort	Average	0	Doing the job, does not care much about suggestion/improvement
Condition	Fair	-0.03	Tiny dust in the surrounding area
Consistency	Good	0.01	More or less similar to each other
Total		**0.01**	

Calculation of the normal time:

$$Normal\ time = Cycle\ time\ x\ p$$

$$Normal\ time = 2090\ seconds\ x\ 1.01$$

$$Normal\ time = 2110.9\ seconds$$

Table 24. Allowances of Sander 80 Process (*Jati*)

Factor	Category	Value (%)	Reason
Energy	Can be ignored	3.0	Sitting position, woman
Posture	Sitting	0.5	Average value for sitting position
Movement	A bit limited	2.5	Following specific movement
Eyestrain	Continuous Stare	6.25	Continuous stare, normal lighting
Personal	Woman	3.5	Average value for female personal allowances
Total		**15.75**	

Calculation of the standard time:

$$Standard\ time = Normal\ time\ x\ (1 + \ Allowances)$$

$$Standard\ time = 2110.9\ seconds\ x\ 1.1575$$

$$Standard\ time = 2443.3668\ seconds\ \text{(for a one-meter square product)}$$

i. Sanding *Sonokeling* S10 (Wood Product)

The result of observation:

Table 25. Cycle Time of Sander 100 Process for Wood Products

(*Sonokeling*)

Cycle	Time (s)	Product Size (m2)	Time / m2 (s)
1	3137	1.2	2614.1667
2	3215	1.2	2679.1667
3	3318	1.2	2765.0000
4	3275	1.2	2729.1667
5	3178	1.2	2648.3333
6	3219	1.2	2682.5000
7	3156	1.2	2630.0000
8	3306	1.2	2755.0000
9	3272	1.2	2726.6667
10	3429	1.2	2857.5000
		Average	**2708.7500**
		SD	**73.43138437**

The number of cycles needed:

$$n \geq \left[\frac{1.96}{0.05} \ x \ \frac{73.4314}{2708.75} \right]^2$$

$$n \geq 1.12927 \approx 2$$

Table 26. Performance Rating of Sander 100 Process (*Sonokeling*)

Factor	Category	Value	Reason
Skill	Good Skill	0.03	Quite fast and have good experiences
Effort	Average	0	Doing the job, does not care much about suggestion/improvement
Condition	Fair	-0.03	Tiny dust in the surrounding area
Consistency	Good	0.01	More or less similar to each other
Total		**0.01**	

Calculation of the normal time:

$$Normal\ time = Cycle\ time\ x\ p$$

$$Normal\ time = 2708.75\ seconds\ x\ 1.01$$

$$Normal\ time = 2735.8375\ seconds$$

Table 27. Allowances of Sander 100 Process (*Sonokeling*)

Factor	Category	Value (%)	Reason
Energy	Can be ignored	3.0	Sitting position, woman
Posture	Sitting	0.5	Average value for sitting position
Movement	A bit limited	2.5	Following specific movement
Eyestrain	Continuous Stare	6.25	Continuous stare, normal lighting
Personal	Woman	3.5	Average value for female personal allowances
Total		**15.75**	

Calculation of the standard time:

$$Standard\ time = Normal\ time\ x\ (1+\ Allowances)$$

$$Standard\ time = 2735.8375\ seconds\ x\ 1.1575$$

$$Standard\ time = 3116.7319\ seconds\ \text{(for a one-meter square product)}$$

j. Finishing Sanding Jati (Wood Product)

The result of observation:

Table 28. Cycle Time of Finishing of Sanding Process for Wood Products (*Jati*)

Cycle	Time (s)	Product Size (m2)	Time / m2 (s)
1	1797	1.2	1498
2	1862	1.2	1552
3	1718	1.2	1432
4	1818	1.2	1515
5	1893	1.2	1578
6	1825	1.2	1521
7	1877	1.2	1564
8	1784	1.2	1487
9	1745	1.2	1454
10	1855	1.2	1546
		Average	**1515**
		SD	**47.6147088**

The number of cycles needed:

$$n \geq \left[\frac{1.96}{0.05}\ x\ \frac{47.6147}{1515}\right]^2$$

$$n \geq\ 1.5189 \approx 2$$

Table 29. Performance Rating of Finishing of Sanding Process (*Jati*)

Factor	Category	Value	Reason
Skill	Good Skill	0.06	Good experience and knowledge
Effort	Average	0	Doing the job, does not care much about suggestion/improvement
Condition	Fair	-0.03	Tiny dust in the surrounding area
Consistency	Good	0.01	More or less similar to each other
Total		**0.04**	

Calculation of the normal time:

$$Normal\ time = Cycle\ time\ x\ p$$

$$Normal\ time = 1515\ seconds\ x\ 1.04$$

$$Normal\ time = 1575.08\ seconds$$

Table 30. Allowances of Finishing of Sanding Process (*Jati*)

Factor	Category	Value (%)	Reason
Energy	Very light	6.5	Standing, load of ± 1 kg, woman
Posture	Standing on both leg	1.75	Average value for standing position
Movement	A bit limited	2.5	Following specific movement
Eyestrain	Continuous Stare	6.25	Continuous stare, normal lighting
Personal	Woman	3.5	Average value for female personal allowances
Total		**20.5**	

Calculation of the standard time:

$$Standard\ time = Normal\ time\ x\ (1 +\ Allowances)$$

$$Standard\ time = 1575.08\ seconds\ x\ 1.205$$

$$Standard\ time = 1897.97\ seconds\ \text{(for a one-meter square product)}$$

k. Finishing Sanding Sonokeling (Wood Product)

The result of observation:

Table 31. Cycle Time of Finishing of Sanding Process for Wood Products (*Sonokeling*)

Cycle	Time (s)	Product Size (m2)	Time / m2 (s)
1	2731	1.2	2276
2	2778	1.2	2315
3	2831	1.2	2359
4	2638	1.2	2198
5	2755	1.2	2296
6	2854	1.2	2378
7	2631	1.2	2193
8	2673	1.2	2228
9	2719	1.2	2266
10	2842	1.2	2368
		Average	**2288**
		SD	**68.25401901**

The number of cycles needed:

$$n \geq \left[\frac{1.96}{0.05} \ x \ \frac{68.254}{2288} \right]^2$$

$$n \geq \ 1.3679 \approx 2$$

Table 32. Performance Rating of Finishing of Sanding Process (*Sonokeling*)

Factor	Category	Value	Reason
Skill	Good Skill	0.06	Good experience and knowledge
Effort	Average	0	Doing the job, does not care much about suggestion/improvement
Condition	Fair	-0.03	Tiny dust in the surrounding area
Consistency	Good	0.01	The observed time is approximately similar one to each others.
Total		**0.04**	

Calculation of the normal time:

$$Normal \ time = Cycle \ time \ x \ p$$

$$Normal \ time = 2288 \ seconds \ x \ 1.04$$

$$Normal \ time = 2379.173 \ seconds$$

Table 33. Allowances of Finishing of Sanding Process (*Sonokeling*)

Factor	Category	Value (%)	Reason
Energy	Very light	6.5	Standing, load of $\pm$ 1 kg, woman
Posture	Standing on both leg	1.75	Average value for standing position
Movement	A bit limited	2.5	Following specific movement
Eyestrain	Continuous Stare	6.25	Continuous stare, normal lighting
Personal	Woman	3.5	Average value for female personal allowances
Total		**20.5**	

Calculation of the standard time:

$$Standard\ time = Normal\ time\ x\ (1 + \ Allowances)$$

$$Standard\ time = 2379.173\ seconds\ x\ 1.205$$

$$Standard\ time = 2866.904\ seconds\ \text{(for a one-meter square product)}$$

l. Finishing Paintbrush (Wood Product)

The result of observation:

Table 34. Cycle Time of Finishing (Paintbrush) Process for Wood Products

Cycle	Time (s)	Product Size (m2)	Time / m2 (s)
1	755	1.2	629
2	777	1.2	648
3	798	1.2	665
4	786	1.2	655
5	766	1.2	638
6	759	1.2	633
7	810	1.2	675
8	835	1.2	696
9	791	1.2	659
10	843	1.2	703
		Average	**660**
		SD	**25.16304855**

The number of cycles needed:

$$n \geq \left[\frac{1.96}{0.05}\ x\ \frac{25.163}{660}\right]^2$$

$$n \geq \ 2.2336 \approx 3$$

Table 35. Performance Rating of Finishing (Paintbrush) Process

Factor	Category	Value	Reason
Skill	Good Skill	0.06	Good experience and knowledge
Effort	Good Effort	0.02	Awareness of the responsibility
Condition	Fair	-0.03	Tiny dust in the surrounding area
Consistency	Excellent	0.03	The observed time is approximately similar one to each others.
Total		**0.08**	

Calculation of the normal time:

$$Normal\ time = Cycle\ time\ x\ p$$

$$Normal\ time = 660\ seconds\ x\ 1.08$$

$$Normal\ time = 712.8\ seconds$$

Table 36. Allowances of Finishing (Paintbrush) Process

Factor	Category	Value (%)	Reason
Energy	Very light	6.5	Standing, load of ± 1 kg, man
Posture	Standing on both leg	1.75	Average value for standing position
Movement	A bit limited	2.5	Following specific movement
Eyestrain	Continuous Stare	6.25	Continuous stare, normal lighting
Personal	Man	1.25	Average value for male personal allowances
Total		**18.25**	

Calculation of the standard time:

$$Standard\ time = Normal\ time\ x\ (1 + \ Allowances)$$

$$Standard\ time = 712.8\ seconds\ x\ 1.1825$$

$$Standard\ time = 842.886\ seconds\ \text{(for a one-meter square product)}$$

m. Finishing Spray (Wood Product)

The result of observation:

Table 37. Cycle Time of Finishing (Spray) Process for Wood Products

Cycle	Time (s)	Product Size (m2)	Time / m2 (s)
1	287	1.2	239.1667
2	333	1.2	277.5000
3	312	1.2	260.0000
4	318	1.2	265.0000
5	295	1.2	245.8333
6	318	1.2	265.0000
7	324	1.2	270.0000
8	293	1.2	244.1667
9	307	1.2	255.8333
10	323	1.2	269.1667
11	312	1.2	260.0000
12	323	1.2	269.1667
13	295	1.2	245.8333
14	289	1.2	240.8333
15	280	1.2	233.3333
		Average	**256.0556**
		SD	**13.55641748**

The number of cycles needed:

$$n \geq \left[\frac{1.96}{0.05} \ x \ \frac{13.5564}{256.0556} \right]^2$$

$$n \geq \ 4.3072 \approx 5$$

Table 38. Performance Rating of Finishing (Spray) Process

Factor	Category	Value	Reason
Skill	Good Skill	0.06	Good experience and knowledge
Effort	Good Effort	0.02	Awareness of the responsibility
Condition	Fair	-0.03	Tiny dust in the surrounding area
Consistency	Excellent	0.03	The observed time is approximately similar one to each others.
Total		**0.08**	

Calculation of the normal time:

$$Normal \ time = Cycle \ time \ x \ p$$

$$Normal \ time = 256.0556 \ seconds \ x \ 1.08$$

$$Normal \ time = 276.54 \ seconds$$

Table 39. Allowances of Finishing (Spray) Process

Factor	Category	Value (%)	Reason
Energy	Very light	6.5	Standing, load of ± 1 kg, man
Posture	Standing on both leg	1.75	Average value for standing position
Movement	A bit limited	2.5	Following specific movement
Eyestrain	Continuous Stare	6.25	Continuous stare, normal lighting
Personal	Man	1.25	Average value for male personal allowances
Total		**18.25**	

Calculation of the standard time:

$$Standard\ time = Normal\ time\ x\ (1 + \ Allowances)$$

$$Standard\ time = 276.54\ seconds\ x\ 1.1825$$

$$Standard\ time = 327.0086\ seconds\ \text{(for a one-meter square product)}$$

n. Finishing Manual Sanding 18/40/100 (Wood Product)

The result of observation:

Table 40. Cycle Time of Finishing (Manual Sanding 180 / 400 / 1000) Process for Wood Products

Cycle	Time (s)	Product Size (m2)	Time / m2 (s)
1	688	1.2	573
2	715	1.2	596
3	637	1.2	531
4	648	1.2	540
5	669	1.2	558
6	645	1.2	538
7	708	1.2	590
8	726	1.2	605
9	738	1.2	615
10	651	1.2	543
		Average	569
		SD	31.11917058

The number of cycles needed:

$$n \geq \left[\frac{1.96}{0.05}\ x\ \frac{31.1192}{569}\right]^2$$

$$n \geq \ 4.60029 \approx 5$$

Table 41. Performance Rating of Finishing (Manual Sanding 180 / 400 / 1000) Process

Factor	Category	Value	Reason
Skill	Good Skill	0.06	Good experience and knowledge
Effort	Average	0	Doing the job, does not care much about suggestion/improvement
Condition	Fair	-0.03	Tiny dust in the surrounding area
Consistency	Excellent	0.03	The observed time is approximately similar one to each others.
Total		**0.06**	

Calculation of the normal time:

$$Normal\ time = Cycle\ time\ x\ p$$

$$Normal\ time = 569\ seconds\ x\ 1.06$$

$$Normal\ time = 602.875\ seconds$$

Table 42. Allowances of Finishing (Manual Sanding 180 / 400 / 1000) Process

Factor	Category	Value (%)	Reason
Energy	Can be ignored	3.0	Sitting position, woman
Posture	Sitting	0.5	Average value for sitting position
Movement	A bit limited	2.5	Following specific movement
Eyestrain	Continuous Stare	6.25	Continuous stare, normal lighting
Personal	Woman	3.5	Average value for female personal allowances
Total		**18.25**	

Calculation of the standard time:

$$Standard\ time = Normal\ time\ x\ (1 + Allowances)$$

$$Standard\ time = 602.875\ seconds\ x\ 1.1825$$

$$Standard\ time = 712.8997\ seconds\ \text{(for a one-meter square product)}$$

o. Finishing Manual Sanding 24 (Wood Product)

The result of observation:

Table 43. Cycle Time of Finishing (Manual Sanding 240) Process for Wood Products

Cycle	Time (s)	Product Size (m2)	Time / m2 (s)
1	927	1.2	773
2	952	1.2	793
3	971	1.2	809
4	982	1.2	818
5	966	1.2	805
6	944	1.2	787
7	959	1.2	799
8	934	1.2	778
9	1001	1.2	834
10	947	1.2	789
		Average	799
		SD	18.73322295

The number of cycles needed:

$$n \geq \left[\frac{1.96}{0.05} \ x \ \frac{18.7332}{799}\right]^2$$

$$n \geq 0.84558 \approx 1$$

Table 44. Performance Rating of Finishing (Manual Sanding 240) Process

Factor	Category	Value	Reason
Skill	Good Skill	0.03	Quite fast and have good experiences
Effort	Average	0	Doing the job, does not care much about suggestion/improvement
Condition	Fair	-0.03	Tiny dust in the surrounding area
Consistency	Excellent	0.03	The observed time is approximately similar one to each others.
Total		0.03	

Calculation of the normal time:

$$Normal \ time = Cycle \ time \ x \ p$$

$$Normal \ time = 799 \ seconds \ x \ 1.03$$

$$Normal \ time = 822.5408 \ seconds$$

Table 45. Allowances of Finishing (Manual Sanding 240) Process

Factor	Category	Value (%)	Reason
Energy	Can be ignored	3.0	Sitting position, woman
Posture	Sitting	0.5	Average value for sitting position
Movement	A bit limited	2.5	Following specific movement
Eyestrain	Continuous Stare	6.25	Continuous stare, normal lighting
Personal	Woman	3.5	Average value for female personal allowances
Total		**18.25**	

Calculation of the standard time:

$$Standard\ time = Normal\ time\ x\ (1 + \ Allowances)$$

$$Standard\ time = 986.74\ seconds\ x\ 1.1825$$

$$Standard\ time = 972.6545\ seconds\ \text{(for a one-meter square product)}$$

p. Packing (for Small Product)

The result of observation:

Table 46. Cycle Time of Packing (for Small Product) Process

Cycle	Time (s)	Product Size (unit)	Time / m2 (s)
1	355	1	355
2	372	1	372
3	337	1	337
4	363	1	363
5	350	1	350
6	359	1	359
7	371	1	371
8	384	1	384
9	395	1	395
10	329	1	329
		Average	361.5000
		SD	20.18938115

The number of cycles needed:

$$n \geq \left[\frac{1.96}{0.05}\ x\ \frac{20.1894}{361.500}\right]^2$$

$$n \geq \ 4.7929 \approx 5$$

Table 47. Performance Rating of Packing (for Small Product) Process

Factor	Category	Value	Reason
Skill	Good Skill	0.03	Quite fast and have good experiences
Effort	Good Effort	0.05	High awareness of the responsibility
Condition	Average	0	Normal condition
Consistency	Excellent	0.03	The observed time is approximately similar one to each others.
Total		**0.11**	

Calculation of the normal time:

$$Normal\ time = Cycle\ time\ x\ p$$

$$Normal\ time = 361.5\ seconds\ x\ 1.11$$

$$Normal\ time = 401.265\ seconds$$

Table 48. Allowances of Packing (for Small Product) Process

Factor	Category	Value (%)	Reason
Energy	Very light	6.5	Standing, load of $\pm$ 1 kg, man
Posture	Standing on both leg	1.75	Average value for standing position
Movement	A bit limited	2.5	Following specific movement
Eyestrain	Discontinuous Stare	3.0	Discontinuous stare, normal lighting
Personal	Woman	3.5	Average value for female personal allowances
Total		**17.25**	

Calculation of the standard time:

$$Standard\ time = Normal\ time\ x\ (1 + \ Allowances)$$

$$Standard\ time = 401.265\ seconds\ x\ 1.1725$$

$$Standard\ time = 470.4833\ seconds\text{(for a one-meter part)}$$

q. Splitting Process (Plywood Product)

The result of observation:

Table 49. Cycle Time of Splitting Process for Plywood Parts

Cycle	Time (s)	Product Size (m)	Time / m (s)
1	17	1.2	14.1667
2	19	1.2	15.8333
3	20	1.2	16.6667
4	15	1.2	12.5000
5	16	1.2	13.3333
6	17	1.2	14.1667
7	18	1.2	15.0000
8	18	1.2	15.0000
9	16	1.2	13.3333
10	19	1.2	15.8333
11	15	1.2	12.5000
12	17	1.2	14.1667
13	18	1.2	15.0000
14	19	1.2	15.8333
15	16	1.2	13.3333
16	15	1.2	12.5000
17	18	1.2	15.0000
18	20	1.2	16.6667
19	19	1.2	15.8333
20	17	1.2	14.1667
		Average	**14.5417**
		SD	**1.3376**

The number of cycles needed:

$$n \geq \left[\frac{1.96}{0.05} \; x \; \frac{1.3376}{14.5417} \right]^2$$

$$n \geq 13.00111 \approx 14$$

Table 50. Performance Rating of Splitting Process (Plywood)

Factor	Category	Value	Reason
Skill	Good Skill	0.06	Good experience and knowledge
Effort	Good Effort	0.02	Awareness of the responsibility
Condition	Average	0	Normal condition
Consistency	Good	0.01	More or less similar to each other

Total	**0.09**	

Calculation of the normal time:

$$Normal\ time = Cycle\ time\ x\ p$$

$$Normal\ time = 14.5417\ seconds\ x\ 1.09$$

$$Normal\ time = 15.85\ seconds$$

Table 51. Allowances of Splitting Process (Plywood)

Factor	Category	Value (%)	Reason
Energy	Very light	6.5	Standing, load of $\pm$ 1 kg, man
Posture	Standing on both leg	1.75	Average value for standing position
Movement	A bit limited	2.5	Following specific movement
Eyestrain	Discontinuous Stare	3.0	Discontinuous stare, normal lighting
Personal	Man	1.25	Average value for male personal allowances
Total		**15**	

Calculation of the standard time:

$$Standard\ time = Normal\ time\ x\ (1 + \ Allowances)$$

$$Standard\ time = 15.85\ seconds\ x\ 1.15$$

$$Standard\ time = 18.2275\ seconds\ \text{(for a one-meter length part)}$$