

CHAPTER IV

DATA PROCESSING

4.1 Data Collection

4.1.1 Company's Maintenance Strategy

PG PS Madukismo was established by Sri Sultan Hamengku Buwono IX to decrease the unemployment. This sugar company was built on June 14th, 1955 which produces Sugar and Alcohol Spiritus. It is located in Padokan Village, Kasihan sub-district, Bantul, D.I. Yogyakarta. In 1958, PG Madukismo officially started as a private company or PT. It was starting to produce sugar in 1958 and 1959 for alcohol. Status of PT. Madukismo changed in 1962 to a national company when Indonesia claimed all company who basically focused on the farming area. In 1966, PG Madukismo decided to return to become a private company again by PT. Madubaru that led the PG Madukismo and PS Madukismo with Sri Sultan Hamengku Buwono IX as director.

Based on the agreement that signed on 14th March 1984, the ownership of PT. Madubaru was changed to Sri Sultan Hamengku Buwono X and PT. Rajawali Nusantara Indonesia (PT. RNI) as stakeholder with share of the 65% and 35%, respectively. On production period, more or less there are 1380 workers who are employed as permanent and non-permanent workers.

PG PS Madukismo is one of companies that run the preventive maintenance strategy. This strategy is applied for a company that has a business process with demands during production period without stopping the engines. Also, this company has the period

for overhaul maintenance itself. The maintenance is run by each sector of company. By this research, the researcher takes the front factory as the object of this research.

The maintenance activity in this factory is never being evaluated for its task scheduling. The parameter to fulfil the maintenance process in this factory is only by implementing the scheduling not later than the schedule arranged by the Head Department of Operational and Maintenance. Maintenance scheduling of this factory was divided by 4 groups Construction, Driller, Machines/Turbines and Contract. On period 2017-2018, the maintenance activity has involved 77 operators. The division of worker for each task are given by the Head department and team and the time to start of each activity for 120 days or 5 months of maintenance period.

4.1.2 Initial Maintenance Scheduling

The data on the number of workers and the duration of the company's work are grouped into several sub-activities, with a maximum number of workers on 1 day the company employs as many as 77 operators. While the time given to complete all the maintenance work is 120 active days (5 months). The division of groups is based on the location of the facilities and functions of the equipment, this aims to facilitate supervision of care. The number of workers and the duration of work for each group at the end of this report.

In scheduling data, the initial scheduling of the company is grouped into several sub-activities, with between work with one another does not have a working relationship that must take precedence. The division of groups is based on the location of the facilities and functions of the equipment, this aims to facilitate supervision of care. The initial maintenance scheduling in the table below:

Table 4. 1 Initial Maintenance Scheduling

No	Maintenance Activity	Man	Days	Start Date	End Date	Gap
	Group Silenderan/Rol Gilingan	22				
1	Pek. Jembatan/ Bordes	8	10	110	120	0
2	Pek. Mof dan As	5	15	6	21	0
3	Pek. Marsed Hidrolik I-V	4	50	56	108	2
4	Pek. Rol Gilingan I-V	8	90	14	104	0
5	Pek. Scraper atas dan bawah	4	25	91	117	1

No	Maintenance Activity	Man	Days	Start Date	End Date	Gap
6	Pek. Ampas plas dan Balk	8	90	20	109	-1
7	Pek. Standard, dudukan metal dan metal gilingan	5	90	2	93	1
8	Pek. Side cup rol bawah	3	70	3	73	0
9	Pek. Voeding rol	3	50	63	114	1
10	Pek. Open gear rol Gilingan I-V	5	45	8	58	5
	Group Turbine/Machine	12				
11	Pek. Kopling Sudu-sudu Turbin	6	35	3	39	1
12	Pek. Rotor Turbin Gil I-V dan Unigrator	6	50	7	56	-1
13	Pek. Gearbox Turbin Gil I-V	6	90	4	96	2
14	Pek. Unigrator dan Anvil	6	60	60	119	-1
15	Pek. Valve dan Kondesat Uap	3	44	74	119	1
16	Pek. Pompa Hidrolik	3	24	84	105	-3
17	Pek. Pisau Tebu	4	25	8	34	1
18	Pek. Header Gilingan	0	0			0
	Group Konstruksi	26				
19	Pek. Meja tebu dan Kickers	5	60	50	112	2
21	Pek. Rantai dan Krepyak CC 1 2 3	7	90	3	92	-1
22	Pek. Kran Demag 10 ton & 16 Ton	2	30	86	116	0
23	Pek. Kran putar Utarasetatan 5 ton	2	20	99	120	1
24	Pek. Derek penarik lori	2	10	93	103	0
25	Pek. Chute dan staging IMC I-IV	6	50	51	102	1
26	Pek. Rantai dan Garu IMC I-IV	4	75	4	80	1
27	Pek. Talang goyang dan Garu ampas halus	0	0	0	0	0
28	Pek. Saringan DSM dan Rotary Screen	4	75	27	104	2
29	Pek. Pompa Nira (RWS, DSM, SAP, BGS)	3	60	4	69	5
30	Pek. Pomba imbisi dan air panas	3	40	3	43	0
31	Pek. Coveyor pengembalian ampas	3	15	39	55	1
	Group Contract					
32	Bubut Roll Gilingan Baru	2	15	28	43	0
33	Bubut Roll Gilingan Lama	2	6	3	9	0
34	Talang IMC dan 1/2 dan 3/4	7	50	13	63	0
35	Lapis keras roll gilingan	4	7	41	48	0

No	Maintenance Activity	Man	Days	Start Date	End Date	Gap
36	Las Mopok Stang Hammer	2	1	3	4	0

4.1.3 Cost of Manpower for Maintenance

Cost of workers at the company PT. Madu Baru is divided into two parts, namely permanent workers and contract workers. Permanent workers are workers who work in the field of care for one full year either in the milling season or not. While contract workers are workers who are only assigned to carry out maintenance activities during the maintenance season before the milling season for 5 months. The labour costs are based on Raben (2018) as shown in Table below:

Table 4. 2 Cost Manpower

Man-power Status	Manpower Cost (Rp)
Permanent	1.900.000
Contract	1.300.000

4.2 Data Processing

4.2.1 Genetic Algorithm

In AG the stages of the process are the same as described in the previous chapter. The workmanship in each generation uses the Anaconda application, which is an application to run the Evolver programme that already arranged before. The results of the suggestion scheduling from data processing using AG that contains the start and end time for each maintenance job in 120 days as in Table 4. 1 while the finished results using the Anaconda Application at the end of the report.

4.2.2 Fitness Value

The chromosome length in Table 4.1 were 33 activities which are used for fitness calculations only, but when done generation only applies from numbers 1 to 34, so the length of the chromosome when inputted into the program is 33 genes. It aims to not change gene values in the assumptions made in Table 2. From the simulation results using as many as 1225 iterations, graphs are obtained for the best results and population averages as shown in Figure 4.3 as follows:

Table 4. 3 Initial Chromosome

No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Chromosomes	110	6	56	14	91	20	2	3	63	8	3	7	4	60	74	84

No	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Chromosomes	8	50	3	86	99	93	51	4	27	4	3	39	28	3	13	41	3

The chromosome length in Table 4.3 is 34 which is used for fitness calculations also used when iteration is done, so the length of the chromosome when inputted into GA Model is only 34 genes. It aims to not change gene values in the assumptions made in Table 4.3. From the simulation results using as many as 6740 generations, list of the maintenance scheduling is shown in Table 4.4.

Then, define the number of Manpower that company should provide for this scheduling maximum 75 and with minimum manpower that used in this scheduling is 56 in the last day. Actually, the generation meets the optimum solution if the gap between the maximum and minimum manpower is used to. But in this research, the researcher put the result of 6740 iterations represented the optimum solution. By seeing Figure 4.1 We assume that our Evolver programme is enough to get the highest fitness value because the fluctuation of fitness is low.

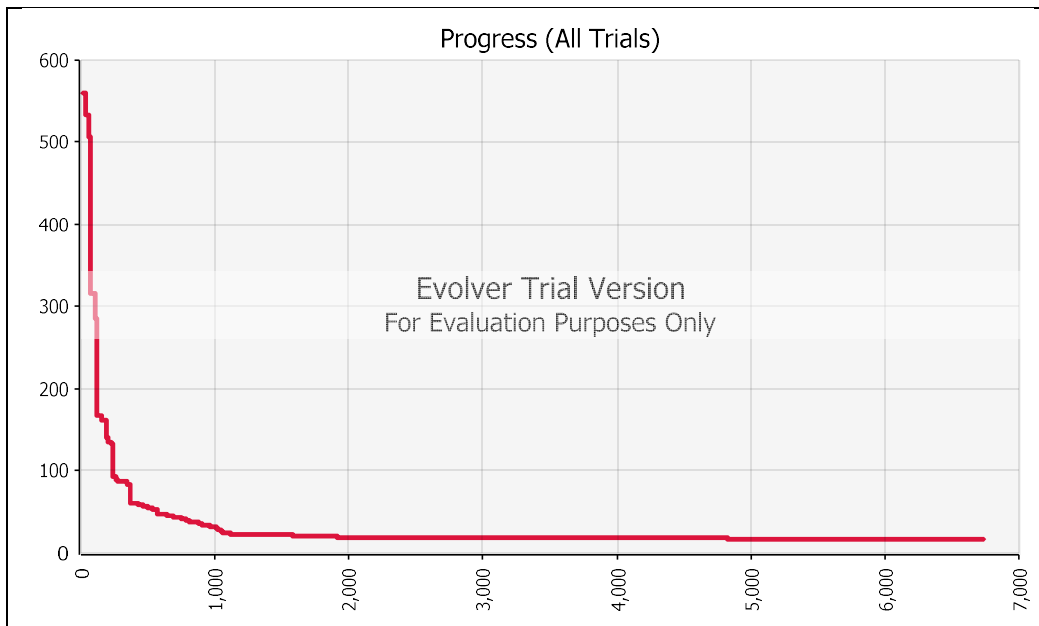


Figure 4. 1 History of fitness value

The programme succeeded in accelerating the execution time of our GA application up to a total number of 6740 of generations. From the results, it is emerged that there is a dependency between maintenance duration and the number of manpower. We observed that the execution time is directly proportional to the individual fitness value. There is an inferior limit for the evaluation time for the number of generations we conduct that makes the scheduling is already got the highest fitness value.

4.2.3 Maintenance Scheduling Suggestion

After the optimum fitness value has been found in which evolves in GA, then the result evolves as the maintenance scheduling suggestion. The results of the proposal scheduling from data processing using AG include the start and end time for each maintenance job in 120 days as in Table 4. 4 below:

Table 4. 4 Maintenance scheduling suggestion

No	Maintenance Activity	Man	Days	Start Date	End Date
Group Silenderan/Rol Gilingan					
1	Pek. Jembatan/ Bordes	8	10	111	120
2	Pek. Mof dan As	5	15	1	15

3	Pek. Marsed Hidrolik I-V	4	50	61	110
4	Pek. Rol Gilingan I-V	8	90	31	120
5	Pek. Scraper atas dan bawah	4	25	96	120
6	Pek. Ampas plas dan Balk	8	90	1	90
7	Pek. Standard, dudukan metal dan metal gilingan	5	90	31	120
8	Pek. Side cup rol bawah	3	70	1	70
9	Pek. Voeding rol	3	50	71	120
10	Pek. Open gear rol Gilingan I-V	5	45	1	45
Group Turbine/Machine					
11	Pek. Kopling Sudu-sudu Turbin	6	35	1	35
12	Pek. Rotor Turbin Gil I-V dan Unigrator	6	50	1	50
13	Pek. Gearbox Turbin Gil I-V	6	90	11	100
14	Pek. Unigrator dan Anvil	6	60	61	120
15	Pek. Valve dan Kondesat Uap	3	44	77	120
16	Pek. Pompa Hidrolik	3	24	1	24
17	Pek. Pisau Tebu	4	25	1	25
18	Pek. Header Gilingan	0	0	0	0
Group Konstruksi					
19	Pek. Meja tebu dan Kickers	5	60	61	120
20	Pek. Rantai dan Krepyak CC 1 2 3	7	90	26	115
21	Pek. Kran Demag 10 ton & 16 Ton	2	30	91	120
22	Pek. Kran putar Utaraselatan 5 ton	2	20	101	120
23	Pek. Derek penarik lori	2	10	1	10
24	Pek. Chute dan staging IMC I-IV	6	50	71	120
25	Pek. Rantai dan Garu IMC I-IV	4	75	1	75
26	Pek. Talang goyang dan Garu ampas halus	0	0	0	0

27	Pek. Saringan DSM dan Rotary Screen	4	75	46	120
28	Pek. Pompa Nira (RWS, DSM, SAP, BGS)	3	60	1	60
29	Pek. Pomba imbisi dan air panas	3	40	1	40
30	Pek. Coveyor pengembalian ampas	3	15	51	65
Group Contract					
31	Bubut Roll Gilingan Baru	2	90	16	30
32	Bubut Roll Gilingan Lama	2	60	41	40
33	Talang IMC dan 1/2 dan 3/4	7	95	31	120
34	Lapis keras roll gilingan	4	50	1	60
35	Las Mopok Stang Hammer	2	60	1	60

Table 4. 4 shows the start time and completion time data of 33 maintenance jobs that carried out for 120 days after using AG as a problem-solving solution. As an example, the results of each activity which initially started and finished on the task 6th is set up to start at day 27th and finish in day 116th. From the suggestion maintenance scheduling, the researcher found that the lowest allocation of worker per day is 56 and 75 workers as the highest allocation worker.

Table 4. 5 Cost estimation with suggestion schedule

Month	Maximum manpower		Manpower Cost (Rp)	
	Used per week		Before	After GA
	Before	After GA		
1	71	65	134900000	123500000
2	77	75	146300000	142500000
3	77	68	146300000	129200000
4	77	68	146300000	129200000
5	69	65	131100000	123500000
TOTAL			704900000	647900000

From the results of Table 4. 5 for permanent workers on the initial scheduling contracted within a period of 1 month, the total cost of Rp. 134,900,000 and total of the initial cost is Rp 704.900.000. While the scheduling of proposals contracted in a period of 1 month or for 5 months at the same time obtained a total cost of workers of Rp 682.100.000.