

Lampiran 1: Kode *Macro* untuk Perhitungan Penjadwalan *Job Shop*

```
Option Explicit 'every variables must be declared first
'Option Private Module
Option Base 1 'start arrays with one
Dim myData As JSSData
Dim mySolution As JSSSolution
Dim DESolution1, DESolution2, DESolution3, DESolution4 As JSSSolution
Dim SolutionAwals, SolutionBarus As Collection
Dim UrutanSolusiKontinyu() As Double
Dim TotalPanjangSolusi As Integer
Dim i, j, k, l As Integer
Dim indexTerbaik As Integer
Dim TotalBiayaTerbaik As Double
Dim jumlahIterasiTanpaPerbaikan As Integer
Dim Vector1, Vector2, Vector3 As Integer
Dim randTemp As Double
Dim TimeBefore, TimeAfter As Date

Sub RunAlgorithm()
TimeBefore = Now
'----- Randomize random number generator -----
Randomize
'----- Ambil data data data -----
Dim myData As New JSSData
myData.GetDataFromWorksheet
myData.PrintDataToWorksheet 'for debugging data input
'----- Buat initial random Solution -----
Set SolutionAwals = New Collection
For i = 1 To myData.JumlahPopulasi
    Dim mySolution As New JSSSolution
    mySolution.Initialize
    ' If i = 1 Then
    '     mySolution.GenerateJobSortedSolution
    ' ElseIf i = 2 Then
    '     mySolution.GenerateDueDateSortedSolution
    ' ElseIf i = 3 Then
    '     mySolution.GenerateHeuristicSolution
    ' ElseIf i = 4 Then
    '     mySolution.GeneratePenaltySortedSolution
    ' ElseIf i = 5 Then
    '     mySolution.GenerateResidualDueDateSortedSolution
    ' Else
    '     mySolution.GenerateRandomSolution
    ' End If
    SolutionAwals.Add mySolution
    Set mySolution = Nothing
Next i
'-----Tampilkan solusi awal terbaik -----
indexTerbaik = 1
TotalBiayaTerbaik = SolutionAwals(1).getTotalBiaya
For i = 2 To myData.JumlahPopulasi
    If SolutionAwals(i).getTotalBiaya < TotalBiayaTerbaik Then
        indexTerbaik = i
    End If
Next i
End Sub
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    TotalBiayaTerbaik = SolutionAwals(i).getTotalBiaya
End If
Next i
SolutionAwals(indexTerbaik).PrintDataToWorksheet "SolusiAwal"

'-----Mulai iterasi DE -----
Call mySolution.Initialize
Call mySolution.GenerateRandomSolution
TotalPanjangSolusi = mySolution.TotalPanjangSolusi
ReDim UrutanSolusiKontinyu(TotalPanjangSolusi)
For i = 1 To myData.JumlahIterasiMaksimum
    Dim SolutionBarus As New Collection
    For j = 1 To myData.JumlahPopulasi
        Dim mySolution2 As New JSSSolution
        mySolution2.Initialize
        Set DESolution1 = SolutionAwals(j)
        Set DESolution2 = SolutionAwals(Round(Rnd * (myData.JumlahPopulasi - 1)) + 1)
        Set DESolution3 = SolutionAwals(Round(Rnd * (myData.JumlahPopulasi - 1)) + 1)
        Set DESolution4 = SolutionAwals(Round(Rnd * (myData.JumlahPopulasi - 1)) + 1)
        For k = 1 To TotalPanjangSolusi
            If Rnd <= myData.TingkatCrossover Then
                UrutanSolusiKontinyu(k) = DESolution2.AmbilUrutanSolusiKontinyu(k) +
myData.FaktorMutasi * (DESolution3.AmbilUrutanSolusiKontinyu(k) -
DESolution4.AmbilUrutanSolusiKontinyu(k))
            Else
                UrutanSolusiKontinyu(k) = DESolution1.AmbilUrutanSolusiKontinyu(k)
            End If
        Next k
        mySolution2.SetUrutanKontinyu UrutanSolusiKontinyu

'perform local search
For k = 1 To myData.JumlahLocalSearch
    Dim mySolution3 As New JSSSolution
    mySolution3.Initialize
    UrutanSolusiKontinyu = mySolution2.GetUrutanSolusiKontinyu
    mySolution3.SetUrutanKontinyu UrutanSolusiKontinyu
    randTemp = Rnd
    If randTemp < 0.33 Then
        mySolution3.PerformLocalSearch2Opt
    ElseIf randTemp < 0.66 Then
        mySolution3.PerformLocalSearchChange
    Else
        mySolution3.PerformLocalSearchInsert
    End If
    If mySolution3.getTotalBiaya < mySolution2.getTotalBiaya Then
        Set mySolution2 = mySolution3
    End If
    Set mySolution3 = Nothing
Next k
If mySolution2.getTotalBiaya < DESolution1.getTotalBiaya Then
    SolutionBarus.Add mySolution2
Else
    SolutionBarus.Add DESolution1
End If
Set mySolution2 = Nothing
Next j

Set SolutionAwals = SolutionBarus

```

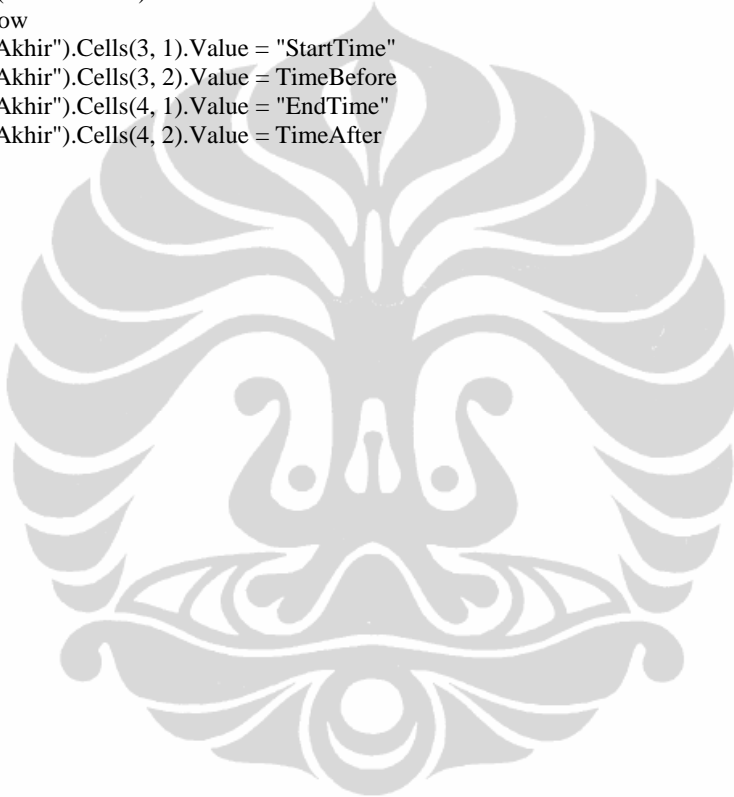
```

Set SolutionBarus = Nothing
Next i

'----- Tampilkan solusi terbaik -----
indexTerbaik = 1
TotalBiayaTerbaik = SolutionAwals(1).getTotalBiaya
For i = 2 To myData.JumlahPopulasi
  If SolutionAwals(i).getTotalBiaya < TotalBiayaTerbaik Then
    indexTerbaik = i
    TotalBiayaTerbaik = SolutionAwals(i).getTotalBiaya
  End If
Next i
SolutionAwals(indexTerbaik).PrintDataToWorksheet "SolusiAkhir"
TimeAfter = Now
Sheets("SolusiAkhir").Cells(3, 1).Value = "StartTime"
Sheets("SolusiAkhir").Cells(3, 2).Value = TimeBefore
Sheets("SolusiAkhir").Cells(4, 1).Value = "EndTime"
Sheets("SolusiAkhir").Cells(4, 2).Value = TimeAfter

End Sub

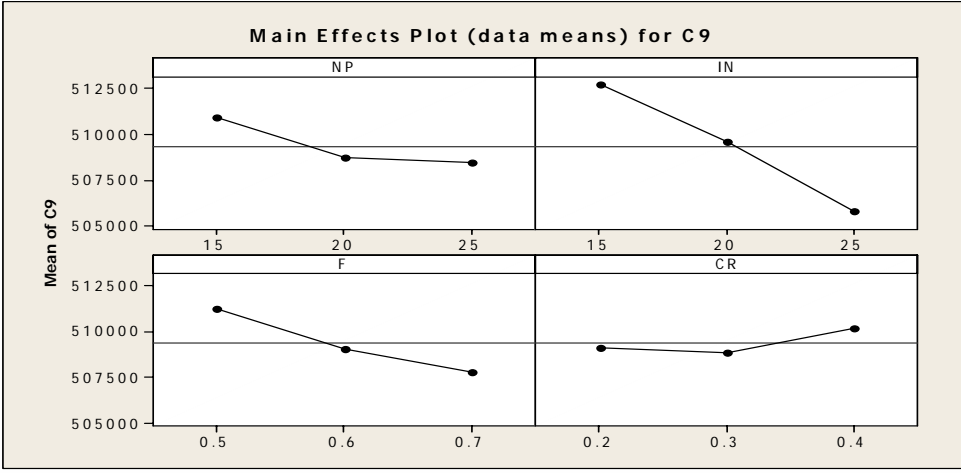
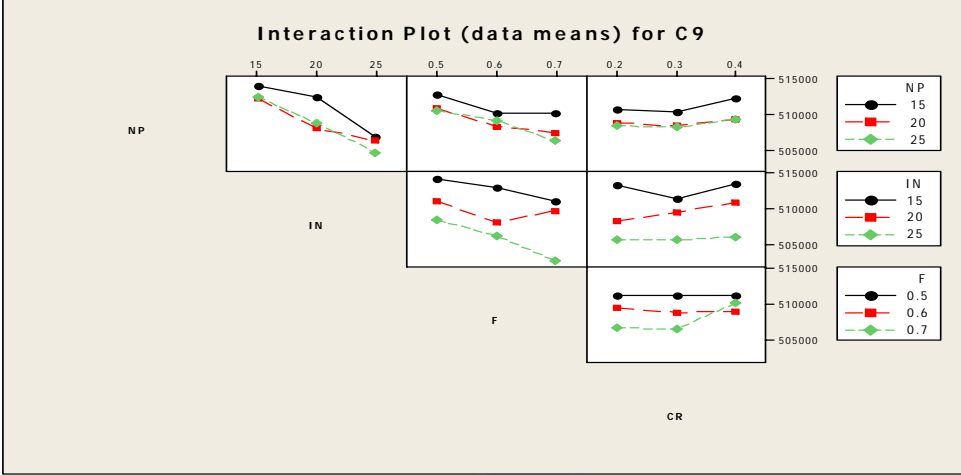
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Lampiran 6: Anova, Interaksi 2 Faktor dan Faktor Utama pada Skenario 1

Analysis of Variance for C9, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
NP	2	492415833	492415833	246207916	6.22	0.002
IN	2	3253856646	3253856646	1626928323	41.08	0.000
F	2	811192484	811192484	405596242	10.24	0.000
CR	2	129632138	129632138	64816069	1.64	0.196
NP*IN	4	199639091	199639091	49909773	1.26	0.286
NP*F	4	106697416	106697416	26674354	0.67	0.611
NP*CR	4	15137213	15137213	3784303	0.10	0.984
IN*F	4	369992283	369992283	92498071	2.34	0.055
IN*CR	4	143903819	143903819	35975955	0.91	0.459
F*CR	4	279307729	279307729	69826932	1.76	0.136
NP*IN*F	8	239398859	239398859	29924857	0.76	0.642
NP*IN*CR	8	199416422	199416422	24927053	0.63	0.753
NP*F*CR	8	164408384	164408384	20551048	0.52	0.842
IN*F*CR	8	321324999	321324999	40165625	1.01	0.425
NP*IN*F*CR	16	927241504	927241504	57952594	1.46	0.111
Error	324	12833222639	12833222639	39608712		
Total	404	20486787461				





Lampiran 8: Jadwal Lama – Total Biaya Produksi dan *Makespan*

Job No	Item	ET	DD	A	P	C	B	
		End Time	Due Date	ET-DD	Penalti	A * P	(Biaya)	B * C
1	CASING HD BODY C-22-BP-ET 13 3/8 SC	14,8	92,0	0,0	1,0	0,0	1.680,3	1.680,3
2	CASING HD BODY C-22-BP-ET 13 3/8 SC	21,0	92,0	0,0	1,0	0,0	1.680,3	1.680,3
3	CASING HD BODY C-22-BP-ET 13 3/8 SC	27,2	92,0	0,0	1,0	0,0	1.680,3	1.680,3
4	CASING HD BODY C-22-BP-ET 13 3/8 SC	33,4	92,0	0,0	1,0	0,0	1.680,3	1.680,3
33	ADAPTER BD, A-3-D, 3 X 3, 5,047 CTRS	50,4	92,0	0,0	1,8	0,0	3.031,5	3.031,5
34	ADAPTER BD, A-3-D, 3 X 3, 5,047 CTRS	66,6	92,0	0,0	1,8	0,0	3.031,5	3.031,5
35	ADAPTER BD, A-3-D, 3 X 3, 5,047 CTRS	82,8	92,0	0,0	1,8	0,0	3.031,5	3.031,5
36	ADAPTER BD, A-3-D, 3 X 3, 5,047 CTRS	99,0	92,0	7,0	1,8	12,5	3.031,5	3.044,0
68	SPCL TBG HD BD TC-60-ET-FS 9 5/8 OD	111,8	92,0	19,7	5,9	116,1	9.896,0	10.012,1
69	SPCL TBG HD BD TC-60-ET-FS 9 5/8 OD	141,8	92,0	49,7	5,9	292,8	9.896,0	10.188,8
70	SPCL TBG HD BD TC-60-ET-FS 9 5/8 OD	171,8	92,0	79,7	5,9	469,5	9.896,0	10.365,5
71	SPCL TBG HD BD TC-60-ET-FS 9 5/8 OD	201,8	92,0	109,7	5,9	646,2	9.896,0	10.542,2
42	CLAMP BODY CIW #13 13 5/8-5K CLP H	105,1	115,1	0,0	2,4	0,0	4.074,7	4.074,7
43	CLAMP BODY CIW #13 13 5/8-5K CLP H	111,2	115,1	0,0	2,4	0,0	4.074,7	4.074,7
44	CLAMP BODY CIW #13 13 5/8-5K CLP H	117,4	115,1	2,3	2,4	5,6	4.074,7	4.080,3
45	CLAMP BODY CIW #13 13 5/8-5K CLP H	123,5	115,1	8,4	2,4	20,5	4.074,7	4.095,1
21	CLAMP BODY CIW #10 11-5000 HUB	130,0	115,1	14,9	1,4	21,2	2.389,4	2.410,6
22	CLAMP BODY CIW #10 11-5000 HUB	136,5	115,1	21,4	1,4	30,4	2.389,4	2.419,8
23	CLAMP BODY CIW #10 11-5000 HUB	143,0	115,1	27,9	1,4	39,7	2.389,4	2.429,1
24	CLAMP BODY CIW #10 11-5000 HUB	149,5	115,1	34,4	1,4	48,9	2.389,4	2.438,3
80	BD GV D-2-S 3 1/8 X 3 1/8-5K ON 5.046 C	280,8	199,3	81,5	6,0	485,0	10.002,1	10.487,1
81	BD GV D-2-S 3 1/8 X 3 1/8-5K ON 5.046 C	323,1	199,3	123,8	6,0	736,7	10.002,1	10.738,8
62	TUBING HD BD, TC-60-ET 9 5/8 DBL FS	187,0	199,3	0,0	4,5	0,0	7.518,0	7.518,0
63	TUBING HD BD, TC-60-ET 9 5/8 DBL FS	283,3	199,3	84,0	4,5	375,3	7.518,0	7.893,3
17	CLAMP BODY CIW #10 11-5000 HUB	289,8	199,3	90,5	1,4	128,5	2.389,0	2.517,5
18	CLAMP BODY CIW #10 11-5000 HUB	296,3	199,3	97,0	1,4	137,7	2.389,0	2.526,7
58	CASING HEAD BODY, C-29, 20 SLIP-LO	299,5	199,3	100,2	2,7	268,4	4.511,0	4.779,4
59	CASING HEAD BODY, C-29, 20 SLIP-LO	302,7	199,3	103,4	2,7	277,0	4.511,0	4.788,0
72	SPCL TBG HD BD TC-60-ET-FS 9 5/8 OD	346,1	230,1	116,0	5,9	683,2	9.896,0	10.579,2
73	SPCL TBG HD BD TC-60-ET-FS 9 5/8 OD	376,1	230,1	146,0	5,9	859,9	9.896,0	10.755,9
74	SPCL TBG HD BD TC-60-ET-FS 9 5/8 OD	406,1	230,1	176,0	5,9	1.036,6	9.896,0	10.932,6
75	SPCL TBG HD BD TC-60-ET-FS 9 5/8 OD	436,1	230,1	206,0	5,9	1.213,3	9.896,0	11.109,3
5	CASING HD BODY C-22-BP-ET 13 3/8 SC	313,9	230,1	83,8	1,0	83,8	1.680,3	1.764,0
6	CASING HD BODY C-22-BP-ET 13 3/8 SC	318,4	230,1	88,3	1,0	88,3	1.680,3	1.768,5
7	CASING HD BODY C-22-BP-ET 13 3/8 SC	322,9	230,1	92,8	1,0	92,8	1.680,3	1.773,0
8	CASING HD BODY C-22-BP-ET 13 3/8 SC	349,1	230,1	119,0	1,0	119,0	1.680,3	1.799,3
37	ADAPTER BD, A-3-D, 3 X 3, 5,047 CTRS	318,9	230,1	88,8	1,8	159,8	3.031,5	3.191,3
38	ADAPTER BD, A-3-D, 3 X 3, 5,047 CTRS	335,1	230,1	105,0	1,8	188,9	3.031,5	3.220,4
39	ADAPTER BD, A-3-D, 3 X 3, 5,047 CTRS	351,3	230,1	121,2	1,8	218,1	3.031,5	3.249,6
40	ADAPTER BD, A-3-D, 3 X 3, 5,047 CTRS	367,5	230,1	137,4	1,8	247,2	3.031,5	3.278,7
46	CLAMP BODY CIW #13 13 5/8-5K CLP H	373,6	268,0	105,6	2,4	256,5	4.074,7	4.331,2
47	CLAMP BODY CIW #13 13 5/8-5K CLP H	379,7	268,0	111,7	2,4	271,4	4.074,7	4.346,1
48	CLAMP BODY CIW #13 13 5/8-5K CLP H	385,8	268,0	117,8	2,4	286,3	4.074,7	4.360,9
49	CLAMP BODY CIW #13 13 5/8-5K CLP H	391,9	268,0	123,9	2,4	301,1	4.074,7	4.375,8
82	BD GV D-2-S 3 1/8 X 3 1/8-5K ON 5.046 C	515,2	345,0	170,2	6,0	1.012,4	10.002,1	11.014,5
83	BD GV D-2-S 3 1/8 X 3 1/8-5K ON 5.046 C	557,5	345,0	212,5	6,0	1.264,1	10.002,1	11.266,2
25	CLAMP BODY CIW #10 11-5000 HUB	398,4	345,0	53,4	1,4	75,9	2.389,4	2.465,3
26	CLAMP BODY CIW #10 11-5000 HUB	404,9	345,0	59,9	1,4	85,1	2.389,4	2.474,5
27	CLAMP BODY CIW #10 11-5000 HUB	411,4	345,0	66,4	1,4	94,3	2.389,4	2.483,7
28	CLAMP BODY CIW #10 11-5000 HUB	417,9	345,0	72,9	1,4	103,6	2.389,4	2.493,0
64	TUBING HD BD, TC-60-ET 9 5/8 DBL FS	422,4	345,0	77,4	4,5	346,1	7.518,0	7.864,1
65	TUBING HD BD, TC-60-ET 9 5/8 DBL FS	426,9	345,0	81,9	4,5	366,2	7.518,0	7.884,2
54	CASING HD BODY, C-22 13 3/8 SOW	429,4	345,0	84,4	2,5	211,1	4.206,0	4.417,1
55	CASING HD BODY, C-22 13 3/8 SOW	431,9	345,0	86,9	2,5	217,3	4.206,0	4.423,3
76	SPCL TBG HD BD TC-60-ET-FS 9 5/8 OD	559,0	460,2	98,7	5,9	581,6	9.896,0	10.477,6
77	SPCL TBG HD BD TC-60-ET-FS 9 5/8 OD	560,5	460,2	100,3	5,9	590,5	9.896,0	10.486,4
78	SPCL TBG HD BD TC-60-ET-FS 9 5/8 OD	566,1	460,2	105,9	5,9	623,8	9.896,0	10.519,7
79	SPCL TBG HD BD TC-60-ET-FS 9 5/8 OD	596,1	460,2	135,9	5,9	800,5	9.896,0	10.696,4

Lampiran 8. (sambungan)

Job No	Item	ET	DD	A	P	C	B	
		End Time	Due Date	ET-DD	Penalti	A * P	(Biaya)	B * C
84	BD GV D-2-S 3 1/8 X 3 1/8-5K ON 5.046 C	675.2	460.2	215.0	6.0	1,279.0	10,002.1	11,281.0
85	BD GV D-2-S 3 1/8 X 3 1/8-5K ON 5.046 C	717.5	460.2	257.3	6.0	1,530.6	10,002.1	11,532.7
50	CLAMP BODY CIW #13 13 5/8-5K CLP H	438.1	460.2	0.0	2.4	0.0	4,074.7	4,074.7
51	CLAMP BODY CIW #13 13 5/8-5K CLP H	444.2	460.2	0.0	2.4	0.0	4,074.7	4,074.7
52	CLAMP BODY CIW #13 13 5/8-5K CLP H	450.3	460.2	0.0	2.4	0.0	4,074.7	4,074.7
53	CLAMP BODY CIW #13 13 5/8-5K CLP H	456.4	460.2	0.0	2.4	0.0	4,074.7	4,074.7
9	CASING HD BODY C-22-BP-ET 13 3/8 SC	547.1	460.2	86.9	1.0	86.9	1,680.3	1,767.2
10	CASING HD BODY C-22-BP-ET 13 3/8 SC	551.6	460.2	91.4	1.0	91.4	1,680.3	1,771.7
11	CASING HD BODY C-22-BP-ET 13 3/8 SC	569.1	460.2	108.9	1.0	108.9	1,680.3	1,789.2
12	CASING HD BODY C-22-BP-ET 13 3/8 SC	573.6	460.2	113.4	1.0	113.4	1,680.3	1,793.7
13	CASING HANGER, MANDREL, FLUTED	678.4	460.2	218.2	2.1	453.8	3,501.8	3,955.6
14	CASING HANGER, MANDREL, FLUTED	695.9	460.2	235.7	2.1	490.2	3,501.8	3,992.0
15	CASING HANGER, MANDREL, FLUTED	713.4	460.2	253.2	2.1	526.6	3,501.8	4,028.4
16	CASING HANGER, MANDREL, FLUTED	730.9	460.2	270.7	2.1	563.0	3,501.8	4,064.8
41	CLAMP BODY CIW #13 13 5/8-5K CLP H	543.0	460.2	82.8	2.4	201.3	4,074.7	4,275.9
56	CASING HD BODY, C-22 13 3/8 SOW	736.9	536.9	200.0	2.5	499.9	4,206.0	4,705.9
66	TUBING HD BD, TC-60-ET 9 5/8 DBL FS	751.1	536.9	214.2	4.5	957.5	7,518.0	8,475.5
67	TUBING HD BD, TC-60-ET 9 5/8 DBL FS	763.4	536.9	226.5	4.5	1,012.2	7,518.0	8,530.2
60	CASING HEAD BODY, C-29, 20 SLIP-LO	768.4	536.9	231.5	2.7	620.3	4,511.0	5,131.3
61	CASING HEAD BODY, C-29, 20 SLIP-LO	774.7	536.9	237.8	2.7	637.2	4,511.0	5,148.2
19	CLAMP BODY CIW #10 11-5000 HUB	781.2	536.9	244.3	1.4	346.8	2,389.4	2,736.2
20	CLAMP BODY CIW #10 11-5000 HUB	787.7	536.9	250.8	1.4	356.1	2,389.4	2,745.5
57	CASING HD BODY, C-22 13 3/8 SOW	790.2	536.9	253.3	2.5	633.1	4,206.0	4,839.1
29	ADAPTER BD, A-3-D, 3 X 3, 5.047 CTRS	806.4	536.9	269.5	1.8	485.0	3,031.5	3,516.5
30	ADAPTER BD, A-3-D, 3 X 3, 5.047 CTRS	822.6	536.9	285.7	1.8	514.2	3,031.5	3,545.7
31	ADAPTER BD, A-3-D, 3 X 3, 5.047 CTRS	838.8	536.9	301.9	1.8	543.3	3,031.5	3,574.8
32	ADAPTER BD, A-3-D, 3 X 3, 5.047 CTRS	855.0	536.9	318.1	1.8	572.5	3,031.5	3,604.0
Jumlah Pesanan yang tidak terlambat :					14	Total Biaya :		440,144.3

Lampiran 9: Hasil Simulasi dengan Penambahan Jumlah Mesin pada Mesin no 1

Nomor Mesin	Item (Urutan Job ke)																							
	Job number	75	62	29	55	57	68	35	74	43	47	3	81	13	37	61	7	84	36	19	78	17	48	
1	Start Time	0	7	15.5	20.8	25.3	29.8	36.8	42.1	49.1	54.6	60.1	66.3	71.8	78.3	83.6	91.7	97.9	103	109	113	120	125	
	End Time	7	15.5	20.8	25.3	29.8	36.8	42.1	49.1	54.6	60.1	66.3	71.8	78.3	83.6	91.7	97.9	103	109	113	120	125	130	
	Job number	24	33	34	50	46	31	22	63	32	73	12	2	66	82	4	38	30	8	11	1	14		
	Start Time	130	135	140	145	151	156	162	166	175	180	187	193	199	208	213	220	225	230	236	243	249		
	End Time	135	140	145	151	156	162	166	175	180	187	193	199	208	213	220	225	230	236	243	249	255		
1	Job number	80	58	83	69	44	27	59	28	23	39	51	79	25	70	54	77	18	45	20	65	49	41	
	Start Time	0	5.5	13.6	19.1	26.1	31.6	36.1	44.2	48.7	53.2	58.5	64	71	75.5	82.5	87	94	98.5	104	109	117	123	
	End Time	5.5	13.6	19.1	26.1	31.6	36.1	44.2	48.7	53.2	58.5	64	71	75.5	82.5	87	94	98.5	104	109	117	123	128	
	Job number	9	56	5	21	64	53	26	15	10	85	76	52	67	42	60	71	6	72	16	40			
	Start Time	128	134	139	145	149	158	163	168	174	181	186	193	199	207	213	221	228	234	241	247			
End Time	134	139	145	149	158	163	168	174	181	186	193	199	207	213	221	228	234	241	247	253				
2	Job number	80	75	58	62	83	69	68	59	29	75	27	43	3	55	79	28	77	80	37	70	45	47	
	Start Time	5.5	9	13.6	27.8	38.3	41.8	45.8	49.8	64	68.1	76.4	77.9	80.2	84.3	89.8	93.8	95.3	99.3	108	112	116	119	
	End Time	9	13	27.8	38.3	41.8	45.8	49.8	64	68.1	76.4	77.9	80.2	84.3	89.8	93.8	95.3	99.3	108	112	116	119	121	
	Job number	69	44	7	25	83	84	19	65	23	74	17	41	39	51	48	49	63	81	53	78	18	64	
	Start Time	121	129	132	136	137	146	150	151	162	163	167	169	171	175	177	180	182	192	196	198	202	204	
	End Time	129	132	136	137	146	150	151	162	163	167	169	171	175	177	180	182	192	196	198	202	204	214	
	Job number	73	46	42	24	68	79	34	21	82	50	20	67	57	70	30	32	35	22	56	9	84	72	
	Start Time	214	218	221	223	224	233	241	245	246	250	252	254	264	270	278	282	286	290	292	297	301	310	
	End Time	218	221	223	224	233	241	245	246	250	252	254	264	270	278	282	286	290	292	297	301	310	314	
	Job number	2	52	85	36	73	66	26	54	82	5	77	76	12	11	61	33	78	74	60	4	10	31	
	Start Time	314	318	321	324	328	337	347	349	354	363	367	375	379	384	388	402	406	414	422	437	441	445	
	End Time	318	321	324	328	337	347	349	354	363	367	375	379	384	388	402	406	414	422	437	441	445	449	
	Job number	16	71	72	38	13	1	6	81	8	76	40	15	14	85	71								
	Start Time	449	459	463	472	476	486	490	495	504	508	516	520	530	541	562								
	End Time	459	463	472	476	486	490	495	504	508	516	520	530	541	550	571								
3	Job number	75	58	80	83	68	69	62	59	79	75	80	70	77	69	7	55	65	83	63	81	3	84	
	Start Time	13	27.8	34.1	41.8	49.8	54.3	58.8	71.1	93.8	98.3	109	137	141	146	156	161	164	177	205	217	221	225	
	End Time	17.5	34.1	38.1	45.8	54.3	58.8	71.1	77.4	98.3	109	137	141	146	156	161	164	177	205	217	221	225	229	
	Job number	64	68	79	73	78	82	70	67	74	56	57	84	73	2	66	82	11	77	54	72	85	5	
	Start Time	229	242	252	263	267	272	278	288	301	305	309	312	340	351	355	367	395	400	410	414	418	422	
End Time	242	252	263	267	272	276	288	301	305	309	312	340	351	355	367	395	400	410	414	418	422	427		
Job number	12	76	61	60	74	78	72	13	4	10	8	76	71	81	15	9	85	71	6	14	16	1		
Start Time	427	431	436	442	449	459	472	486	504	508	513	517	528	532	560	578	582	610	621	625	643	660		
End Time	431	436	442	449	459	470	482	504	508	513	517	528	532	560	578	582	610	621	625	643	660	665		
4	Job number	75	80	83	69	68	79	77	70	84	73	82	78	74	81	72	76	85	71					
	Start Time	17.5	47.5	67.5	87.5	118	148	178	208	238	267	297	317	347	377	418	448	478	532					
	End Time	47.5	67.5	87.5	118	148	178	208	238	258	297	317	347	377	397	448	478	498	562					
5	Job number																							
	Start Time																							
	End Time																							
6	Job number																							
	Start Time																							
	End Time																							
7	Job number	43	59	28	29	37	45	44	17	23	47	62	39	58	49	18	48	63	53	65	41	42	27	
	Start Time	80.2	86.3	95.3	102	118	134	140	169	175	182	188	192	208	212	218	224	230	235	241	245	252	258	
	End Time	86.3	89.5	102	118	134	140	146	175	182	188	192	208	212	218	224	230	235	241	245	252	258	264	
	Job number	64	46	55	24	34	22	21	32	35	67	25	56	51	36	66	52	54	20	30	19	50	26	
	Start Time	264	269	275	277	284	300	307	313	329	345	350	356	359	365	381	386	414	416	423	439	446	452	
End Time	269	275	277	284	300	307	313	329	345	350	356	359	365	381	386	392	416	423	439	446	452	458		
Job number	33	57	31	61	60	38	40																	
Start Time	458	474	477	493	496	500	520																	
End Time	474	477	493	496	500	516	536																	
8	Job number	75	69	80	83	68	79	70	73	84	82	77	74	78	72	76	81	71	85					
	Start Time	109	156	158	205	252	263	288	351	352	395	438	459	470	482	528	560	621	622					
	End Time	110	158	200	247	254	264	290	352	395	438	439	461	471	484	529	603	622	665					



Nomor Job	Biaya Produksi	DueDate	EndTime	Jumlah Waktu Keterlambatan	Biaya Penalty persatuan waktu	Biaya Penalty	Total Biaya
1	1,680.25	92.04	664.8	572.76	1	572.76	2,253.01
2	1,680.25	92.04	355.2	263.16	1	263.16	1,943.41
3	1,680.25	92.04	225.25	133.21	1	133.21	1,813.46
4	1,680.25	92.04	508.3	416.26	1	416.26	2,096.51
5	1,680.25	230.1	426.95	196.85	1	196.85	1,877.10
6	1,680.25	230.1	625.3	395.2	1	395.20	2,075.45
7	1,680.25	230.1	160.75	0	1	-	1,680.25
8	1,680.25	230.1	517.3	287.2	1	287.20	1,967.45
9	1,680.25	460.2	582.3	122.1	1	122.10	1,802.35
10	1,680.25	460.2	512.8	52.6	1	52.60	1,732.85
11	1,680.25	460.2	399.95	0	1	-	1,680.25
12	1,680.25	460.2	431.45	0	1	-	1,680.25
13	3,501.83	460.2	503.8	43.6	2.08	90.69	3,592.52
14	3,501.83	460.2	642.8	182.6	2.08	379.81	3,881.64
15	3,501.83	460.2	577.8	117.6	2.08	244.61	3,746.44
16	3,501.83	460.2	660.3	200.1	2.08	416.21	3,918.04
17	2,389.41	199.29	175.1	0	1.42	-	2,389.41
18	2,389.41	199.29	224.24	24.95	1.42	35.43	2,424.84
19	2,389.41	536.9	445.65	0	1.42	-	2,389.41
20	2,389.41	536.9	422.95	0	1.42	-	2,389.41
21	2,389.41	115.05	313.04	197.99	1.42	281.15	2,670.56
22	2,389.41	115.05	306.54	191.49	1.42	271.92	2,661.33
23	2,389.41	115.05	181.6	66.55	1.42	94.50	2,483.91
24	2,389.41	115.05	283.84	168.79	1.42	239.68	2,629.09
25	2,389.41	345	356.44	11.44	1.42	16.24	2,405.65
26	2,389.41	345	458.27	113.27	1.42	160.84	2,550.25
27	2,389.41	345	264.22	0	1.42	-	2,389.41
28	2,389.41	345	101.75	0	1.42	-	2,389.41
29	3,031.50	536.9	117.95	0	1.8	-	3,031.50
30	3,031.50	536.9	439.15	0	1.8	-	3,031.50
31	3,031.50	536.9	493.17	0	1.8	-	3,031.50
32	3,031.50	536.9	329.24	0	1.8	-	3,031.50
33	3,031.50	92.04	474.47	382.43	1.8	688.37	3,719.87
34	3,031.50	92.04	300.04	208	1.8	374.40	3,405.90
35	3,031.50	92.04	345.44	253.4	1.8	456.12	3,487.62
36	3,031.50	92.04	381.26	289.22	1.8	520.60	3,552.10
37	3,031.50	230.1	134.15	0	1.8	-	3,031.50
38	3,031.50	230.1	515.77	285.67	1.8	514.21	3,545.71
39	3,031.50	230.1	208.42	0	1.8	-	3,031.50
40	3,031.50	230.1	536.15	306.05	1.8	550.89	3,582.39
41	4,075.00	460.2	251.6	0	2.43	-	4,075.00
42	4,074.65	115.05	257.72	142.67	2.43	346.69	4,421.34
43	4,074.65	115.05	86.27	0	2.43	-	4,074.65

Nomor Job	Biaya Produksi	DueDate	EndTime	Jumlah Waktu Keterlambatan	Biaya Penalty persatuan waktu	Biaya Penalty	Total Biaya
44	4,074.65	115.05	146.39	31.34	2.43	76.16	4,150.81
45	4,074.65	115.05	140.27	25.22	2.43	61.28	4,135.93
46	4,074.65	268	274.84	6.84	2.43	16.62	4,091.27
47	4,074.65	268	187.72	0	2.43	-	4,074.65
48	4,074.65	268	230.36	0	2.43	-	4,074.65
49	4,074.65	268	217.74	0	2.43	-	4,074.65
50	4,074.65	460.2	451.77	0	2.43	-	4,074.65
51	4,074.65	460.2	365.06	0	2.43	-	4,074.65
52	4,074.65	460.2	391.88	0	2.43	-	4,074.65
53	4,074.65	460.2	240.98	0	2.43	-	4,074.65
54	4,206.00	345	416.45	71.45	2.5	178.63	4,384.63
55	4,206.00	345	277.34	0	2.5	-	4,206.00
56	4,206.00	536.9	358.94	0	2.5	-	4,206.00
57	4,206.00	536.9	476.97	0	2.5	-	4,206.00
58	4,511.38	199.29	211.62	12.33	2.68	33.04	4,544.42
59	4,511.38	199.29	89.47	0	2.68	-	4,511.38
60	4,511.38	536.9	499.57	0	2.68	-	4,511.38
61	4,511.38	536.9	496.37	0	2.68	-	4,511.38
62	7,517.69	199.29	192.22	0	4.47	-	7,517.69
63	7,517.69	199.29	234.86	35.57	4.47	159.00	7,676.69
64	7,517.69	345	268.72	0	4.47	-	7,517.69
65	7,517.69	345	245.48	0	4.47	-	7,517.69
66	7,517.69	536.9	385.76	0	4.47	-	7,517.69
67	7,517.69	536.9	349.94	0	4.47	-	7,517.69
68	9,895.96	92.04	253.5	161.46	5.89	951.00	10,846.96
69	9,895.96	92.04	157.75	65.71	5.89	387.03	10,282.99
70	9,895.96	92.04	289.95	197.91	5.89	1,165.69	11,061.65
71	9,895.96	92.04	622.3	530.26	5.89	3,123.23	13,019.19
72	9,895.96	230.1	483.7	253.6	5.89	1,493.70	11,389.66
73	9,895.96	230.1	352.2	122.1	5.89	719.17	10,615.13
74	9,895.96	230.1	460.55	230.45	5.89	1,357.35	11,253.31
75	9,895.96	230.1	110.25	0	5.89	-	9,895.96
76	9,895.96	460.2	529.3	69.1	5.89	407.00	10,302.96
77	9,895.96	460.2	439.25	0	5.89	-	9,895.96
78	9,895.96	460.2	471.05	10.85	5.89	63.91	9,959.87
79	9,895.96	460.2	264	0	5.89	-	9,895.96
80	10,002.09	199.29	200.05	0.76	5.95	4.52	10,006.61
81	10,002.09	199.29	602.6	403.31	5.95	2,399.69	12,401.78
82	10,002.09	345	437.75	92.75	5.95	551.86	10,553.95
83	10,002.09	345	246.8	0	5.95	-	10,002.09
84	10,002.09	460.2	394.5	0	5.95	-	10,002.09
85	10,002.09	460.2	664.6	204.4	5.95	1,216.18	11,218.27
Jumlah Pesanan yang tidak terlambat :				39			
Total Biaya Produksi :							433,418.48

## Lampiran 10: Hasil Simulasi dengan Penambahan Jumlah Mesin pada Mesin no 2

No Mesin		Urutan Mesin Ke																															
1	Job number	29	32	23	22	12	10	11	53	52	72	59	55	13	27	19	60	45	83	58	57	64	43										
	Start Time	0	7	14	22.5	28	35	42	49	53.5	62	68.5	74	81	86.5	94.6	99.1	104.6	110.1	115.4	122.4	129.4	134.9										
	End Time	7	14	22.5	28	35	42	49	53.5	62	68.5	74	81	86.5	94.6	99.1	104.6	110.1	115.4	122.4	129.4	134.9	140.4										
		140.4	145.9	154.4	158.9	164.4	171.4	175.9	181.2	185.7	191	197.2	205.3	213.8	220.8	227	232.3	237.8	242.3	248.5	253.8	262.3	266.8										
		145.9	154.4	158.9	164.4	171.4	175.9	181.2	185.7	191	197.2	205.3	213.8	220.8	227	232.3	237.8	242.3	248.5	253.8	262.3	266.8	273.8										
		81	20	47	76	74	80	14	62	50	9	70	8	61	42	34	79	82	36	71	85	21	16										
		273.8	278.3	282.8	287.3	295.8	300.3	304.8	310.3	315.8	320.3	327.3	333.8	339.1	344.6	350.1	356.3	360.8	366.1	372.3	378.8	384.1	389.6										
		278.3	282.8	287.3	295.8	300.3	304.8	310.3	315.8	320.3	327.3	333.8	339.1	344.6	350.1	356.3	360.8	366.1	372.3	378.8	384.1	389.6	395.1										
		63	33	1	3	5	67	35	78	17	44	46	28	7	37	68	69	65	84	18													
		395.1	400.6	406.8	413	419.2	424.5	430.7	436.9	445	449.5	455	460.5	468.6	473.9	479.2	485.4	491.9	498.1	503.4	507.9												
	400.6	406.8	413	419.2	424.5	430.7	436.9	445	449.5	455	460.5	468.6	473.9	479.2	485.4	491.9	498.1	503.4	507.9														
2	Job number	32	23	11	29	10	32	13	45	27	83	60	59	43	57	54	15	51	40	48	2	64	45										
	Start Time	14	22.5	49	53	61.25	75.5	86.5	110.1	113.6	127.8	131.9	135.4	140.4	142.7	158.9	164.4	166.7	181.2	185.7	197.2	201.3	205.5										
	End Time	18	33	53	61.25	65.25	83.75	88.8	113.6	127.8	131.9	135.4	138.9	142.7	146.7	164.4	166.7	177.2	185.3	187.2	201.3	203.6	214.5										
		24	77	73	55	39	41	38	20	14	50	70	57	61	74	31	9	79	71	30	34	21	31										
		214.5	225	239.2	275.5	283.75	287.85	290.15	294.25	310.3	320.3	333.8	344.3	352.55	354.85	360.35	364.35	368.35	378.8	395.5	403.75	407.85	435.6										
		225	239.2	241.5	283.75	287.85	290.15	294.25	295.75	312.6	321.8	344.3	352.55	354.85	360.35	364.35	368.35	369.85	389.3	403.75	407.85	411.35	443.85										
		44	7	69	46	18																											
		455	473.9	491.9	513.6	522.6																											
		457.3	478	502.4	522.6	524.1																											
3	Job number	29	32	23	22	12	11	29	10	52	53	32	22	45	72	11	12	60	27	59	55	10	54										
	Start Time	11	18	33	45.25	49.25	53.75	61.25	71.75	76.25	88.5	92	104.5	132.5	136.5	154	164.5	175	179	185.3	189.3	193.8	204.3										
	End Time	15.5	22.5	45.25	49.25	53.75	58.25	71.75	76.25	88.5	92	102.5	132.5	136.5	154	164.5	175	179	185.3	189.3	193.8	204.3	207.8										
		58	2	57	51	56	24	45	60	30	77	55	75	76	59	56	57	31	58	33	4	74	30										
		207.8	212.3	216.8	221.3	233.55	238.05	250.3	278.3	306.3	310.8	317.1	327.6	339.85	352.1	380.1	390.6	401.1	405.6	416.1	420.6	425.1	428.6										
		212.3	216.8	221.3	233.55	238.05	250.3	278.3	306.3	310.8	317.1	327.6	339.85	352.1	380.1	390.6	401.1	405.6	416.1	420.6	425.1	428.6	439.1										
		9	81	31	66	21	67	78	35	34	46	71	9	1	28	68	46	65	3	21	70	69	36										
		439.1	443.6	447.1	457.6	462.1	466.1	470.6	476.9	481.4	485.9	489.9	507.4	517.9	522.4	528.7	533.2	561.2	565.7	570.2	598.2	615.7	633.2										
		443.6	447.1	457.6	462.1	466.1	470.6	476.9	481.4	485.9	489.9	507.4	517.9	522.4	528.7	533.2	561.2	565.7	570.2	598.2	615.7	633.2	637.7										
	4	Job number	29	32	22	11	12	10	45	60	59	55	56	57	58	30	31	9	21	46													
Start Time		15.5	45.5	75.5	95.5	125.5	155.5	185.5	205.5	225.5	245.5	275.5	305.5	335.5	365.5	395.5	435.6	473.6	493.6														
End Time		45.5	75.5	95.5	125.5	155.5	185.5	205.5	225.5	245.5	275.5	305.5	335.5	365.5	395.5	435.6	473.6	493.6	513.6														
5	Job number																																
	Start Time																																
	End Time																																
6	Job number																																
	Start Time																																
	End Time																																
7	Job number	13	23	19	53	83	52	26	27	15	6	40	64	48	43	51	54	49	24	25	73	41	20										
	Start Time	88.8	94.92	110	116.5	131.9	148.1	177.4	185.3	188.5	197.85	214.05	230.25	236.37	242.87	248.99	253.49	255.99	262.49	266.9	274.8	280.9	296.27										
	End Time	94.92	99.42	116.5	119	148.1	152.6	183.9	188.5	194.62	214.05	230.25	236.37	242.87	248.99	253.49	255.99	262.49	266.99	274.8	280.9	296.27	302.77										
		38	47	14	50	77	8	42	61	79	62	76	75	16	85	5	39	44	82	81	78	7	74										
		302.77	318.97	325.47	331.59	338.09	343.2	359.4	365.52	371.64	378.14	384.26	388.76	397.4	403.52	428.6	444.8	461	467.12	483.32	485.82	489.02	505.22										
		318.97	325.47	331.59	338.09	341.29	359.4	365.52	371.64	378.14	384.26	388.76	393.26	403.52	419.72	444.8	461	467.12	483.32	485.82	489.02	505.22	507.72										
		37	63	18	28	80	17	84																									
		507.72	523.92	530.04	536.54	539.74	546.24	552.74																									
		523.92	530.04	536.54	539.74	546.24	552.74	568.94																									
	8	Job number	22	29	32	11	12	10	45	60	59	57	55	56	58	30	31	9	46	21													
Start Time		132.5	174.8	176.3	177.8	179.3	204.3	278.3	320.6	380.1	422.4	423.9	425.4	426.9	439.1	457.6	517.9	561.2	603.5														
End Time		174.8	176.3	177.8	179.3	180.8	205.8	320.6	362.9	422.4	423.9	425.4	426.9	428.4	440.6	459.1	519.4	603.5	645.8														

maksud : 645.8 nm

Nomor Job	Biaya Produksi	Due Date	End Time	Jumlah Waktu Keterlambatan	Biaya Penalty persatuan waktu	Biaya Penalty	Total Biaya
1	1680.3	92.04	522.4	430.36	1	430.4	2110.6
2	1680.3	92.04	216.8	124.76	1	124.8	1805.0
3	1680.3	92.04	570.2	478.16	1	478.2	2158.4
4	1680.3	92.04	425.1	333.06	1	333.1	2013.3
5	3031.5	92.04	444.8	352.76	1.8	635.0	3666.5
6	3031.5	92.04	214.05	122.01	1.8	219.6	3251.1
7	3031.5	92.04	505.22	413.18	1.8	743.7	3775.2
8	3031.5	92.04	359.4	267.36	1.8	481.2	3512.7
9	9896.0	92.04	519.4	427.36	5.89	2517.2	12413.1
10	9896.0	92.04	205.8	113.76	5.89	670.0	10566.0
11	9896.0	92.04	179.3	87.26	5.89	514.0	10409.9
12	9896.0	92.04	180.8	88.76	5.89	522.8	10418.8
13	4074.7	115.05	94.92	0	2.43	0.0	4074.7
14	4074.7	115.05	331.59	216.54	2.43	526.2	4600.8
15	4074.7	115.05	194.62	79.57	2.43	193.4	4268.0
16	4074.7	115.05	403.52	288.47	2.43	701.0	4775.6
17	2389.4	115.05	552.74	437.69	1.42	621.5	3010.9
18	2389.4	115.05	536.54	421.49	1.42	598.5	2987.9
19	2389.4	115.05	116.5	1.45	1.42	2.1	2391.5
20	2389.4	115.05	302.77	187.72	1.42	266.6	2656.0
21	10002.1	199.29	645.8	446.51	5.95	2656.7	12658.8
22	10002.1	199.29	174.8	0	5.95	0.0	10002.1
23	7517.7	199.29	99.42	0	4.47	0.0	7517.7
24	7517.7	199.29	266.99	67.7	4.47	302.6	7820.3
25	2389.4	199.29	274.8	75.51	1.42	107.2	2496.6
26	2389.4	199.29	183.9	0	1.42	0.0	2389.4
27	4511.4	199.29	188.5	0	2.68	0.0	4511.4
28	4511.4	199.29	539.74	340.45	2.68	912.4	5423.8
29	9896.0	230.1	176.3	0	5.89	0.0	9896.0
30	9896.0	230.1	440.6	210.5	5.89	1239.8	11135.8
31	9896.0	230.1	459.1	229	5.89	1348.8	11244.8
32	9896.0	230.1	177.8	0	5.89	0.0	9896.0
33	1680.3	230.1	420.6	190.5	1	190.5	1870.8
34	1680.3	230.1	485.9	255.8	1	255.8	1936.1
35	1680.3	230.1	481.4	251.3	1	251.3	1931.6
36	1680.3	230.1	637.7	407.6	1	407.6	2087.9
37	3031.5	230.1	523.92	293.82	1.8	528.9	3560.4
38	3031.5	230.1	318.97	88.87	1.8	160.0	3191.5
39	3031.5	230.1	461	230.9	1.8	415.6	3447.1
40	3031.5	230.1	230.25	0.15	1.8	0.3	3031.8
41	4074.7	268	296.27	28.27	2.43	68.7	4143.3
42	4074.7	268	365.52	97.52	2.43	237.0	4311.6
43	4074.7	268	248.99	0	2.43	0.0	4074.7

Nomor Job	Biaya Produksi	Due Date	End Time	Jumlah Waktu Keterlambatan	Biaya Penalty persatuan waktu	Biaya Penalty	Total Biaya
44	4074.7	268	467.12	199.12	2.43	483.9	4558.5
45	10002.1	345	320.6	0	5.95	0.0	10002.1
46	10002.1	345	603.5	258.5	5.95	1538.1	11540.2
47	2389.4	345	325.47	0	1.42	0.0	2389.4
48	2389.4	345	242.87	0	1.42	0.0	2389.4
49	2389.4	345	262.49	0	1.42	0.0	2389.4
50	2389.4	345	338.09	0	1.42	0.0	2389.4
51	7517.7	345	253.49	0	4.47	0.0	7517.7
52	7517.7	345	152.6	0	4.47	0.0	7517.7
53	4206.0	345	119	0	2.5	0.0	4206.0
54	4206.0	345	255.99	0	2.5	0.0	4206.0
55	9896.0	460.2	425.4	0	5.89	0.0	9896.0
56	9896.0	460.2	426.9	0	5.89	0.0	9896.0
57	9896.0	460.2	423.9	0	5.89	0.0	9896.0
58	9896.0	460.2	428.4	0	5.89	0.0	9896.0
59	10002.1	460.2	422.4	0	5.95	0.0	10002.1
60	10002.1	460.2	362.9	0	5.95	0.0	10002.1
61	4074.7	460.2	371.64	0	2.43	0.0	4074.7
62	4074.7	460.2	384.26	0	2.43	0.0	4074.7
63	4074.7	460.2	530.04	69.84	2.43	169.7	4244.4
64	4074.7	460.2	236.37	0	2.43	0.0	4074.7
65	1680.3	460.2	565.7	105.5	1	105.5	1785.8
66	1680.3	460.2	462.1	1.9	1	1.9	1682.2
67	1680.3	460.2	470.6	10.4	1	10.4	1690.7
68	1680.3	460.2	533.2	73	1	73.0	1753.3
69	3501.8	460.2	633.2	173	2.08	359.8	3861.7
70	3501.8	460.2	615.7	155.5	2.08	323.4	3825.3
71	3501.8	460.2	507.4	47.2	2.08	98.2	3600.0
72	3501.8	460.2	154	0	2.08	0.0	3501.8
73	4074.7	460.2	280.9	0	2.43	0.0	4074.7
74	4206.0	536.9	507.72	0	2.5	0.0	4206.0
75	7517.7	536.9	393.26	0	4.47	0.0	7517.7
76	7517.7	536.9	388.76	0	4.47	0.0	7517.7
77	4511.4	536.9	341.29	0	2.68	0.0	4511.4
78	4511.4	536.9	489.02	0	2.68	0.0	4511.4
79	2389.4	536.9	378.14	0	1.42	0.0	2389.4
80	2389.4	536.9	546.24	9.34	1.42	13.3	2402.7
81	4206.0	536.9	485.82	0	2.5	0.0	4206.0
82	3031.5	536.9	483.32	0	1.8	0.0	3031.5
83	3031.5	536.9	148.1	0	1.8	0.0	3031.5
84	3031.5	536.9	568.94	32.04	1.8	57.7	3089.2
85	3031.5	536.9	419.72	0	1.8	0.0	3031.5
Jumlah pesanan yang tidak terlambat :				38			
Total Biaya Produksi :						433,828.49	

Lampiran 11: Hasil Simulasi dengan Penambahan Jumlah Mesin pada Mesin no 3

No Mesin	Item	Urutan Mesin Ke																			
1	Job number	29	55	11	33	77	60	52	31	53	45	19	32	28	24	6	81	12	26	27	
	Start Time	0	7	14	21	27.2	35.3	40.8	49.3	56.3	60.8	66.3	70.8	77.8	85.9	94.4	99.7	104	111	116	
	End Time	7	14	21	27.2	35.3	40.8	49.3	56.3	60.8	66.3	70.8	77.8	85.9	94.4	99.7	104	111	116	124	
	Job number	7	22	38	39	46	56	73	18	51	43	8	49	62	10	16	76	50	9	83	
	Start Time	124	129	135	140	145	151	158	163	168	176	182	187	192	197	204	210	218	223	230	
	End Time	129	135	140	145	151	158	163	168	176	182	187	192	197	204	210	218	223	230	235	
	Job number	2	48	44	37	74	23	54	61	4	30	21	17	5	79	63	57	42	13	84	
	Start Time	235	241	246	251	256	261	269	274	279	286	293	298	303	308	312	318	325	330	336	
	End Time	241	246	251	256	261	269	274	279	286	293	298	303	308	312	318	325	330	336	341	
	Job number	64	35	66	14	36	3	20	59	40	25	58	47	1	78	15	75	70	65	72	
Start Time	341	347	353	359	365	371	377	381	387	392	397	404	408	414	423	428	437	443	449		
End Time	347	353	359	365	371	377	381	387	392	397	404	408	414	423	428	437	443	449	456		
Job number	85	34	69	41	68	80	67	71	82												
Start Time	456	461	467	474	479	485	490	496	503												
End Time	461	467	474	479	485	490	496	503	508												
2	Job number	29	55	11	33	77	60	29	52	31	45	53	11	19	24	32	6	60	12	28	
	Start Time	7	14	21	27.2	35.3	49.5	53	61.3	71.8	75.8	79.3	84.8	93	94.5	105	109	113	122	126	
	End Time	11	18	25	31.3	49.5	53	61.3	71.8	75.8	79.3	84.8	93	94.5	105	109	113	122	126	140	
	Job number	31	27	81	46	26	39	38	73	7	8	45	56	51	18	62	43	22	16	55	
	Start Time	140	149	163	168	172	173	177	181	184	188	192	201	205	215	217	219	222	225	227	
	End Time	149	163	168	172	173	177	181	184	188	192	201	205	215	217	219	222	225	227	236	
	Job number	32	12	10	46	9	44	23	37	54	22	83	2	74	61	49	30	10	4	48	
	Start Time	236	244	252	256	265	269	271	282	286	292	301	305	309	314	317	318	322	330	334	
	End Time	244	252	256	265	269	271	282	286	292	301	305	309	314	317	318	322	330	334	336	
	Job number	57	21	42	50	79	17	76	64	13	66	14	35	5	3	30	36	63	9	58	
Start Time	336	340	343	346	347	349	350	361	363	365	369	372	376	380	384	392	396	399	407		
End Time	340	343	346	347	349	350	361	363	365	369	372	376	380	384	392	396	399	407	411		
Job number	20	40	84	47	59	1	21	75	57	65	15	78	34	25	41	68	72	80	85		
Start Time	411	412	416	421	422	426	430	439	449	457	462	464	478	482	484	486	490	501	502		
End Time	412	416	421	422	426	430	439	449	457	462	464	478	482	484	486	490	501	502	506		
Job number	67	70	56	58	59	82	71	69													
Start Time	506	510	521	529	537	546	550	561													
End Time	510	521	529	537	546	550	561	571													
3	Job number	29	31	11	24	29	60	27	28	52	51	32	46	9	23	55	2	54	30	74	
	Start Time	11	75.8	93	105	117	128	163	169	175	215	244	265	293	298	310	320	325	328	333	
	End Time	15.5	80.3	104	117	128	156	169	175	188	228	254	293	298	310	320	325	328	333	336	
	Job number	21	76	35	3	30	66	75	57	34	68	59	72	56	59	69					
	End Time	343	361	376	384	392	403	449	461	482	490	495	501	529	546	574					
3	Job number	11	55	60	77	33	45	53	32	12	31	46	45	81	12	22	10	22	10	57	
	Start Time	25	29.5	53	57	63.3	79.3	84.8	109	126	149	172	201	229	252	263	267	301	330	341	
	End Time	29.5	34	57	63.3	67.8	83.3	88.3	114	131	159	176	229	232	263	267	271	329	341	345	
	Job number	4	36	9	1	58	56	21	78	65	67	70	58	71							
	End Time	345	396	407	430	434	439	443	478	484	510	521	538	561							
4	Job number	29	11	60	31	45	32	55	12	46	22	10	9	30	21	57	58	56	59		
	Start Time	15.5	45.5	75.5	95.5	126	146	176	206	236	267	287	317	347	377	397	439	469	499		
	End Time	45.5	75.5	95.5	126	146	176	206	236	256	287	317	347	377	397	427	469	499	519		
5	Job number																				
	Start Time																				
6	Job number																				
	Start Time																				
7	Job number	77	24	6	19	27	26	28	38	39	7	8	62	16	53	18	52	44	51	43	
	Start Time	63.3	117	122	138	169	173	180	183	199	215	232	248	254	260	262	269	273	280	284	
	End Time	66.5	122	138	144	172	180	183	199	215	232	248	254	260	262	269	273	280	284	290	
	Job number	37	23	73	83	54	49	42	64	14	81	13	61	48	50	79	20	17	40	63	
	Start Time	290	310	314	320	337	339	346	352	369	378	380	386	393	399	406	412	419	425	442	
	End Time	306	314	320	337	339	346	352	369	378	380	386	393	399	406	412	419	425	442	448	
	Job number	47	76	74	84	75	41	25	15	5	80	78	82	85							
	Start Time	448	454	459	461	477	486	492	499	505	521	527	550	567							
	End Time	454	459	461	477	482	492	499	505	521	527	531	567	583							
	8	Job number	11	29	60	31	45	12	32	46	55	10	22	30	9	57	21	56	58	59	
Start Time		104	128	156	198	229	271	273	293	335	341	342	403	417	472	473	539	549	574		
End Time		105	129	198	200	271	273	274	335	337	342	385	404	419	473	516	541	550	617		
		Makespan										:	616.5	Jam							

Nomor <i>Job</i>	Biaya Produksi	<i>DueDate</i>	<i>EndTime</i>	Jumlah Waktu Keterlam- batan	Biaya Penalty persatuan waktu	Biaya Penalti	Total Biaya
1	1680.3	92.04	434.15	342.11	1	342.1	2022.4
2	1680.3	92.04	324.85	232.81	1	232.8	1913.1
3	1680.3	92.04	388.45	296.41	1	296.4	1976.7
4	1680.3	92.04	349.75	257.71	1	257.7	1938.0
5	3031.5	92.04	520.84	428.8	1.8	771.8	3803.3
6	3031.5	92.04	137.95	45.91	1.8	82.6	3114.1
7	3031.5	92.04	231.55	139.51	1.8	251.1	3282.6
8	3031.5	92.04	247.75	155.71	1.8	280.3	3311.8
9	9896.0	92.04	418.85	326.81	5.89	1924.9	11820.9
10	9896.0	92.04	342.25	250.21	5.89	1473.7	11369.7
11	9896.0	92.04	105	12.96	5.89	76.3	9972.3
12	9896.0	92.04	272.75	180.71	5.89	1064.4	10960.3
13	4074.7	115.05	386.39	271.34	2.43	659.4	4734.0
14	4074.7	115.05	377.77	262.72	2.43	638.4	4713.1
15	4074.7	115.05	504.64	389.59	2.43	946.7	5021.4
16	4074.7	115.05	259.99	144.94	2.43	352.2	4426.9
17	2389.4	115.05	425.35	310.3	1.42	440.6	2830.0
18	2389.4	115.05	268.99	153.94	1.42	218.6	2608.0
19	2389.4	115.05	144.45	29.4	1.42	41.7	2431.2
20	2389.4	115.05	418.85	303.8	1.42	431.4	2820.8
21	10002.1	199.29	515.7	316.41	5.95	1882.6	11884.7
22	10002.1	199.29	384.55	185.26	5.95	1102.3	11104.4
23	7517.7	199.29	314.35	115.06	4.47	514.3	8032.0
24	7517.7	199.29	121.75	0	4.47	0.0	7517.7
25	2389.4	199.29	498.52	299.23	1.42	424.9	2814.3
26	2389.4	199.29	179.75	0	1.42	0.0	2389.4
27	4511.4	199.29	172.25	0	2.68	0.0	4511.4
28	4511.4	199.29	182.95	0	2.68	0.0	4511.4
29	9896.0	230.1	129.25	0	5.89	0.0	9896.0
30	9896.0	230.1	404.2	174.1	5.89	1025.4	10921.4
31	9896.0	230.1	199.55	0	5.89	0.0	9896.0
32	9896.0	230.1	274.25	44.15	5.89	260.0	10156.0
33	1680.3	230.1	67.8	0	1	0.0	1680.3
34	1680.3	230.1	486.6	256.5	1	256.5	1936.8
35	1680.3	230.1	380.25	150.15	1	150.2	1830.4
36	1680.3	230.1	400.8	170.7	1	170.7	1851.0
37	3031.5	230.1	306.43	76.33	1.8	137.4	3168.9
38	3031.5	230.1	199.15	0	1.8	0.0	3031.5
39	3031.5	230.1	215.35	0	1.8	0.0	3031.5
40	3031.5	230.1	441.55	211.45	1.8	380.6	3412.1
41	4074.7	268	492.02	224.02	2.43	544.4	4619.0
42	4074.7	268	351.77	83.77	2.43	203.6	4278.2
43	4074.7	268	290.23	22.23	2.43	54.0	4128.7
44	4074.7	268	279.61	11.61	2.43	28.2	4102.9

Nomor Job	Biaya Produksi	DueDate	EndTime	Jumlah Waktu Keterlambatan	Biaya Penalty persatuan waktu	Biaya Penalti	Total Biaya
45	10002.1	345	271.25	0	5.95	0.0	10002.1
46	10002.1	345	335.4	0	5.95	0.0	10002.1
47	2389.4	345	454.17	109.17	1.42	155.0	2544.4
48	2389.4	345	399.01	54.01	1.42	76.7	2466.1
49	2389.4	345	345.65	0.65	1.42	0.9	2390.3
50	2389.4	345	405.51	60.51	1.42	85.9	2475.3
51	7517.7	345	284.11	0	4.47	0.0	7517.7
52	7517.7	345	273.49	0	4.47	0.0	7517.7
53	4206.0	345	262.49	0	2.5	0.0	4206.0
54	4206.0	345	339.15	0	2.5	0.0	4206.0
55	9896.0	460.2	336.9	0	5.89	0.0	9896.0
56	9896.0	460.2	540.95	80.75	5.89	475.6	10371.6
57	9896.0	460.2	473.4	13.2	5.89	77.7	9973.7
58	9896.0	460.2	550.2	90	5.89	530.1	10426.1
59	10002.1	460.2	616.5	156.3	5.95	930.0	10932.1
60	10002.1	460.2	198.05	0	5.95	0.0	10002.1
61	4074.7	460.2	392.51	0	2.43	0.0	4074.7
62	4074.7	460.2	253.87	0	2.43	0.0	4074.7
63	4074.7	460.2	447.67	0	2.43	0.0	4074.7
64	4074.7	460.2	369.07	0	2.43	0.0	4074.7
65	1680.3	460.2	488.8	28.6	1	28.6	1708.9
66	1680.3	460.2	407.2	0	1	0.0	1680.3
67	1680.3	460.2	514.7	54.5	1	54.5	1734.8
68	1680.3	460.2	494.5	34.3	1	34.3	1714.6
69	3501.8	460.2	591.7	131.5	2.08	273.5	3775.4
70	3501.8	460.2	538.2	78	2.08	162.2	3664.1
71	3501.8	460.2	578.3	118.1	2.08	245.6	3747.5
72	3501.8	460.2	518	57.8	2.08	120.2	3622.1
73	4074.7	460.2	320.45	0	2.43	0.0	4074.7
74	4206.0	536.9	461.17	0	2.5	0.0	4206.0
75	7517.7	536.9	481.87	0	4.47	0.0	7517.7
76	7517.7	536.9	458.67	0	4.47	0.0	7517.7
77	4511.4	536.9	66.5	0	2.68	0.0	4511.4
78	4511.4	536.9	530.54	0	2.68	0.0	4511.4
79	2389.4	536.9	412.01	0	1.42	0.0	2389.4
80	2389.4	536.9	527.34	0	1.42	0.0	2389.4
81	4206.0	536.9	380.27	0	2.5	0.0	4206.0
82	3031.5	536.9	566.5	29.6	1.8	53.3	3084.8
83	3031.5	536.9	336.65	0	1.8	0.0	3031.5
84	3031.5	536.9	477.37	0	1.8	0.0	3031.5
85	3031.5	536.9	582.7	45.8	1.8	82.4	3113.9
Jumlah pesanan tidak terlambat				33			
Total Biaya Produksi							432236.6