

# LAPORAN TUGAS ACTIVITY 7

Pemodelan Simulasi (B)

Conveyor and Processing Problem

**Dosen: Prof. Dr. Ir. Joko Lianto Buliali, M.Sc.**



Penyusun:

Hans Sanjaya Yantono	5025231034	Hadir
Ahmad Muqorrobin	5025231254	Hadir
Muhammad Faisal Rafi	5025231295	Hadir

DEPARTEMEN TEKNIK INFORMATIKA  
FAKULTAS TEKNOLOGI DAN INFORMATIKA CERDAS  
INSTITUT TEKNOLOGI SEPULUH NOPEMBER  
SURABAYA  
2025

## Conveyor and Processing Problem (Mayoritas NRP Genap)

### Gambaran Simulasi:

*A small manufacturing system consisting of a conveyor and a processing tool. Raw parts arrive at regular intervals, move along a conveyor, and are processed by a single machine before being sent out of the system. Parts arrive every 5 minutes (deterministic arrival). The conveyor transports each part to the machine; the conveyor travel is 1 minute (deterministic arrival). The machine processes each part for a normally distributed time with: mean = 4 minutes, Standard deviation = 1 minute. The system runs for 12 hours. The machine can only process one part at a time. If the machine is busy, arriving parts must wait in a queue before processing.*

### Task:

- 1. Report the average queue length before the machine*
- 2. Report the average processing time per part*
- 3. Report the number of parts completed by the end of simulation*

Sebuah sistem manufaktur kecil terdiri dari sebuah *conveyor* dan sebuah alat pemrosesan. Suku cadang mentah tiba secara berkala, bergerak di sepanjang conveyor, dan diproses oleh satu mesin sebelum dikirim keluar dari sistem. Suku cadang tiba setiap 5 menit secara deterministik. *Conveyor* mengangkut setiap suku cadang ke mesin; waktu tempuh *conveyor* adalah 1 menit secara deterministik. Mesin memproses setiap suku cadang dengan waktu yang berdistribusi normal dengan: rata-rata = 4 menit, Standar deviasi = 1 menit. Sistem berjalan selama 12 jam. Mesin hanya dapat memproses satu suku cadang pada satu waktu. Jika mesin sedang sibuk, suku cadang yang tiba harus menunggu dalam antrian sebelum diproses.

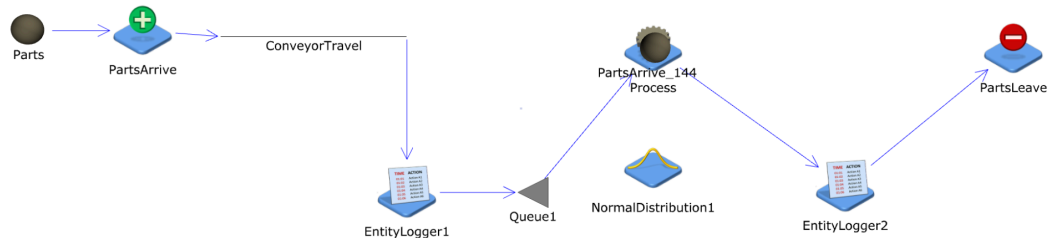
### Tugas:

1. Laporkan rata-rata panjang antrian sebelum mesin
2. Laporkan rata-rata waktu pemrosesan per suku cadang
3. Laporkan jumlah suku cadang yang selesai pada akhir simulasi

## Bentuk Simulasi Dan Pendefinisian Pada ‘JaamSim’

**Struktur Model** (“A small manufacturing system consisting of a conveyor and a processing tool. Raw parts arrive at regular intervals, move along a conveyor, and are processed by a single machine before being sent out of the system.”):

### Conveyor And Processing Problem



1970-Jan-01 12:00:00.000

**“Parts arrive every 5 minutes (deterministic arrival)”:**

Input Editor - PartsArrive		
Key Inputs Options Thresholds Maintenance Format Graphics		
Keyword	Default	Value
Name	None	PartsArrive
Description	None	
NextComponent	None	ConveyorTravel
FirstArrivalTime	0.0 h	
InterArrivalTime	2.777777777...	5 min
EntitiesPerArrival	1	
PrototypeEntity	None	Parts
BaseName	Generator Name	
MaxNumber	Infinity	
InitialNumber	0	

**“The conveyor transports each part to the machine; the conveyor travel is 1 minute (deterministic arrival)”:**

Input Editor - ConveyorTravel		
Key Inputs Options Thresholds Maintenance Format Graphics		
Keyword	Default	Value
Name	None	ConveyorTravel
Description	None	
NextComponent	None	EntityLogger1
TravelTime	0.0 h	1 min
Length	0.0 m	
EntitySpace	0.0 m	
AccumulationLength	0.0 m	
Accumulating	FALSE	
MaxValidNumber	10000	

***“The machine processes each part for a normally distributed time with: mean = 4 minutes, Standard deviation = 1 minute.”:***

Input Editor - NormalDistribution1 ✕

Key Inputs Options Graphics

Keyword	Default	Value
Name	None	NormalDistribution1
Description	None	
UnitType	None	TimeUnit
RandomSeed	None	1
MinValue	-Infinity h	0 min
MaxValue	Infinity h	
Mean	0.0 h	4 min
StandardDeviation	2.7777777777...	1 min

Input Editor - Process ✕

Key Inputs Options Thresholds Maintenance Format Graphics

Keyword	Default	Value
Name	None	Process
Description	None	
NextComponent	None	PartsLeave
WaitQueue	None	Queue1
Match	None	
SelectionCondition	None	
NextEntity	None	
WatchList	None	
ServiceTime	0.0 h	NormalDistribution1 <span>▼</span>

***“The system runs for 12 hours.”:***

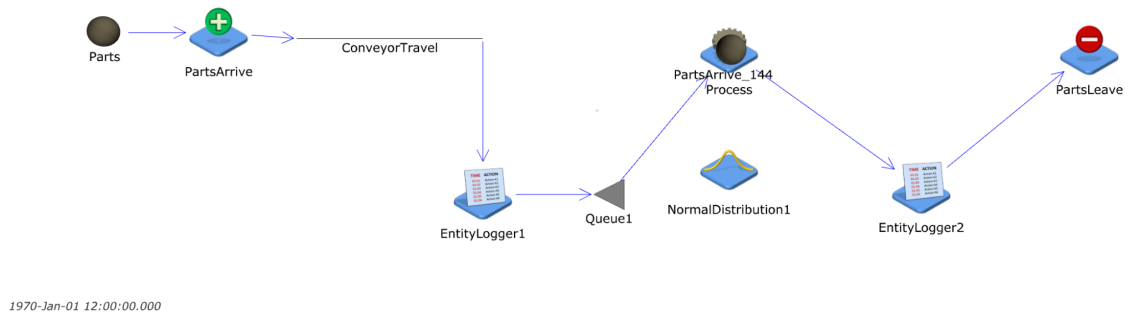
Input Editor - Simulation ✕

Key Inputs Options Multiple Runs

Keyword	Default	Value
Name	None	Simulation
Description	None	'Simulation run control inputs'
RunDuration	8760.0 h	12 h <span>▼</span>
InitializationDuration	0.0 h	
ExitAtStop	FALSE	
GlobalSubstreamSeed	this.ReplicationNu	
PrintReport	FALSE	
ReportDirectory	Configuration	
RunOutputList	None	
RunParameterList	None	

***“The machine can only process one part at a time. If the machine is busy, arriving parts must wait in a queue before processing.”:***

#### Conveyor And Processing Problem



#### Pengaturan EntityLogger1 dan EntityLogger2 Untuk Proses Analisa:

Input Editor - EntityLogger1		
Key Inputs	Options	Graphics
Keyword	Default	Value
Name	None	EntityLogger1
Description	None	
DataSource	None	{ 'this.SimTime/1[h] * 3600' }
SeparateFiles	FALSE	
IncludeInitialization	TRUE	
StartTime	0.0 h	
EndTime	Infinity h	
NextComponent	None	Queue1
TraceEntityStates	FALSE	<input type="checkbox"/>

Input Editor - EntityLogger2		
Key Inputs	Options	Graphics
Keyword	Default	Value
Name	None	EntityLogger2
Description	None	
DataSource	None	{ 'this.SimTime/1[h] * 3600' } { '[Process].ServiceTime/1[h] * 3600' }
SeparateFiles	FALSE	
IncludeInitialization	TRUE	
StartTime	0.0 h	
EndTime	Infinity h	
NextComponent	None	PartsLeave
TraceEntityStates	FALSE	<input type="checkbox"/>

## Laporan Analisa Tugas

### 1. Report the average queue length before the machine:

Berdasarkan EntityLogger,

```
Activity7-EntityLogger1.log

File Edit View

Simulation SoftwareName JaamSim -
Simulation SoftwareVersion 2025-08 -
Simulation ConfigurationFile D:\JaamSim\Activity7.cfg
Simulation ScenarioNumber 1.0 -
Simulation ScenarioIndex { 1 } -
Simulation ReplicationNumber 1.0 -
Simulation RunNumber 1.0 -
Simulation RunIndex { 1 } -
Simulation PresentTimeAndDate Nov 01, 2025 17:33 -
Simulation PresentSimulationTime 0.0 h
Simulation RunDuration 12.0 h
Simulation InitializationDuration 0.0 h

this.SimTime/1[h] this.obj this.SimTime/1[h] * 3600
0.016666666666666666 PartsArrive_1 60.0
0.1 PartsArrive_2 360.0
0.18333333333333332 PartsArrive_3 660.0
0.26666666666666666 PartsArrive_4 960.0
0.35 PartsArrive_5 1260.0
0.43333333333333335 PartsArrive_6 1560.0
0.51666666666666667 PartsArrive_7 1860.0000000000002
0.6 PartsArrive_8 2160.0
0.68333333333333333 PartsArrive_9 2460.0
0.76666666666666667 PartsArrive_10 2760.0
0.85 PartsArrive_11 3060.0
0.93333333333333333 PartsArrive_12 3360.0
```

```
Activity7-EntityLogger2.log

File Edit View

Simulation SoftwareName JaamSim -
Simulation SoftwareVersion 2025-08 -
Simulation ConfigurationFile D:\JaamSim\Activity7\Activity7.cfg -
Simulation ScenarioNumber 1.0 -
Simulation ScenarioIndex { 1 } -
Simulation ReplicationNumber 1.0 -
Simulation RunNumber 1.0 -
Simulation RunIndex { 1 } -
Simulation PresentTimeAndDate Nov 10, 2025 18:12 -
Simulation PresentSimulationTime 0.0 h
Simulation RunDuration 12.0 h
Simulation InitializationDuration 0.0 h

this.SimTime/1[h] this.obj this.SimTime/1[h] * 3600 [Process].ServiceTime/1[h] * 3600
0.09557320305555556 PartsArrive_1 344.063531 220.38481551038728
0.16312271722222222 PartsArrive_2 587.241782 232.320453544766
0.22473661055555555 PartsArrive_3 809.051798 206.67389791806966
0.33542661583333333 PartsArrive_4 1207.535817 328.09569855372695
0.40454423638888887 PartsArrive_5 1456.3592509999999 252.00758760770302
0.49630735611111104 PartsArrive_6 1786.7064819999998 295.8367070818273
0.58124430333333333 PartsArrive_7 2092.479492 157.48421189467018
0.66229366166666666 PartsArrive_8 2384.257182 227.86010264608154
0.74737461277777777 PartsArrive_9 2690.548606 294.5316781924275
0.81536752694444445 PartsArrive_10 2935.323097 351.6708162184125
0.95334150972222222 PartsArrive_11 3432.029435 274.31752804859235
0.9805381325 PartsArrive_12 3529.937277 271.61073160003656
1.0712882722222223 PartsArrive_13 3856.6377800000005 316.4059433276682
1.16264589666666666 PartsArrive_14 4185.5252279999995 278.93912340143874
1.24945400305555554 PartsArrive_15 4498.034411 164.50338162539052
1.31349029777777776 PartsArrive_16 4728.5650719999999 285.02880915137496
1.40885945194444442 PartsArrive_17 5071.8940269999999 243.7453204162314
1.52372119416666666 PartsArrive_18 5485.396299 339.05946657325967
```

**Cara Pemrosesan:****Rata-rata Panjang Antrean**

Metode 1, Berdasarkan Weighted Sum:

[https://docs.google.com/spreadsheets/d/17FoV1xIfJ\\_l8SZCvmp5M\\_1M9ByFqxS5z/edit?usp=sharing&ouid=102426845364381063047&rtpof=true&sd=true](https://docs.google.com/spreadsheets/d/17FoV1xIfJ_l8SZCvmp5M_1M9ByFqxS5z/edit?usp=sharing&ouid=102426845364381063047&rtpof=true&sd=true)

Analisa Queue Length (Metode 1)					
No	Time Interval (detik)		Duration (d)	Queue Length (L(t)) Salaha ini harus bulat	d x L(t)
	Awal	Akhir			
1	0	3360	3360	0	0
2	3360	3432.029435	72.029435	1	72.029435
3	3432.029435	5460	2027.970565	0	0
4	5460	5485.396299	25.396299	1	25.396299
5	5485.396299	10860	5374.603701	0	0
6	10860	10906.83854	46.838543	1	46.838543
7	10906.83854	15960	5053.161457	0	0
8	15960	16023.20713	63.207133	1	63.207133
9	16023.20713	16260	236.792867	0	0
10	16260	16371.54739	111.547385	1	111.547385
11	16371.54739	18960	2588.452615	0	0
12	18960	18980.44236	20.442362	1	20.442362
13	18980.44236	19860	879.557638	0	0
14	19860	19906.78549	46.785486	1	46.785486
15	19906.78549	22860	2953.214514	0	0
16	22860	22860.03581	0.0358089999	1	0.0358089999
17	22860.03581	25260	2399.964191	0	0
18	25260	25314.62629	54.626286	1	54.626286
19	25314.62629	25560	245.373714	0	0
20	25560	25627.12286	67.122861	1	67.122861
21	25627.12286	25860	232.877139	0	0
22	25860	25881.61927	21.619271	1	21.619271

44	40860	40960.53886	100.538859	1	100.538859
45	40960.53886	41160	199.461141	0	0
46	41160	41204.82456	44.824555	1	44.824555
47	41204.82456	42660	1455.175445	0	0
48	42660	42679.54505	19.545054	1	19.545054
49	42679.54505	43200	520.454946	0	0

Weighted Sum (Total d x L(t))					1140.068766
Average Queue Length (Weighted Sum/Total waktu) (No 1)					0.02639048069

Metode 2, Berdasarkan Hukum Little.

Hukum Little:  $L_q = \lambda * W_q$

$L_q$  = Rata-rata Panjang Antrean (yang kita cari).

$\lambda$  = Rata-rata tingkat kedatangan (part per detik).

$W_q$  = Rata-rata Waktu Tunggu di Antrean (detik per part).

Kita bisa menghitung  $\lambda$  dan  $W_q$  dari log.

[https://docs.google.com/spreadsheets/d/17FoV1xIfJ\\_l8SZCvmp5M\\_1M9ByFqxS5z/edit?usp=sharing&ouid=102426845364381063047&rtpof=true&sd=true](https://docs.google.com/spreadsheets/d/17FoV1xIfJ_l8SZCvmp5M_1M9ByFqxS5z/edit?usp=sharing&ouid=102426845364381063047&rtpof=true&sd=true)

Analisa Queue Length (Metode 2)	
<b>Rata-rata Panjang Antrean</b>	
Hukum Little: $L_q = \lambda * W_q$	
$L_q$ = Rata-rata Panjang Antrean (yang kita cari).	
$\lambda$ = Rata-rata tingkat kedatangan (part per detik).	
$W_q$ = Rata-rata Waktu Tunggu di Antrean (detik per part).	
$\lambda = 144 \text{ part} / 43200 \text{ detik} =$	0.003333333333
$W_q =$	7.917144208
$L_q =$	0.02639048069
Average Queue Length (Weighted Sum/Total waktu) (No 1)	0.02639048069

Hitung  $W_q$  (Average Queue Time):

$W_q = \text{Total\_WaktuTunggu}(n) / \text{banyak part}$ .

Jika waktu sampai antrian ( $\text{WaktuSampai}(n)$ ) lebih cepat ( $<$ ) dari waktu part sebelumnya selesai diproses ( $\text{WaktuSelesai}(n-1)$ ), maka  $\text{WaktuTunggu}(n) = \text{WaktuSelesai}(n-1) - \text{WaktuSampai}(n)$ , selain itu maka tidak mengantri  $\text{WaktuTunggu}(n) = 0$ .

Proses Perhitungan :

Untuk Part 1:

$\text{WaktuSampai}(1) = 60 \text{ s}$

$\text{WaktuSelesai}(0) = 0 \text{ s}$

$\text{WaktuSampai}(1) > \text{WaktuSelesai}(0)$

$\text{WaktuTunggu}(1) = 0 \text{ s}$  (tidak menunggu)

...

Untuk Part 12:

$\text{WaktuSampai}(12) = 3360 \text{ s}$

$\text{WaktuSelesai}(11) = 3432.029435 \text{ s}$

$\text{WaktuSampai}(12) < \text{WaktuSelesai}(11)$

$\text{WaktuTunggu}(12) = \text{WaktuSelesai}(11) - \text{WaktuSampai}(12)$

$\text{WaktuTunggu}(12) = 3432.029435 \text{ s} - 3360 \text{ s} = 72.029435 \text{ s}$



Hasil:

[https://docs.google.com/spreadsheets/d/17FoV1xIfJ\\_l8SZCvmp5M\\_1M9ByFqxS5z/edit?usp=sharing&ouid=102426845364381063047&rtpof=true&sd=true](https://docs.google.com/spreadsheets/d/17FoV1xIfJ_l8SZCvmp5M_1M9ByFqxS5z/edit?usp=sharing&ouid=102426845364381063047&rtpof=true&sd=true)

Analisa Queue Time		123	0
No	Queue Time	124	0
1	0	125	0
2	0	126	0
3	0	127	0
4	0	128	14.179695
5	0	129	0
6	0	130	0
7	0	131	0
8	0	132	0
9	0	133	0
10	0	134	0
11	0	135	0
12	72.029435	136	0
13	0	137	100.538859
14	0	138	44.824555
15	0	139	0
16	0	140	0
17	0	141	0
18	0	142	0
19	25.396299	143	19.545054
20	0	144	0
		Total QT (No 1)	1140.068766 sec
			19.0011461 min
			0.3166857683 hour
		Average QT (No 1)	7.917144208 sec
			0.1319524035 min
			0.002199206725 hour

$$W_q = 1140.068766 \text{ s} / 144 \text{ part} = 7.917144208 \text{ s}$$

Hitung lambda (Tingkat Kedatangan): 144 part tiba di EntityLogger1 selama 12 jam (43200 detik).

$$\lambda = 144 \text{ part} / 43200 \text{ detik} = 0.00333... \text{ part/detik}$$

$$L_q = \lambda * W_q = 144 \text{ part} / 43200 \text{ detik} * 7.917144208 \text{ s} = 0.02639048069$$

### Cross Check Berdasarkan Output Viewer di Queue,

Output Viewer - Queue1	
Output	Value
QueueLength	0
QueueList	{}
QueueTimes	{}
PriorityValues	{}
MatchValues	{}
QueueLengthAverage	0.0263905
QueueLengthStandardD...	0.160294
QueueLengthMinimum	0
QueueLengthMaximum	1
QueueLengthTimes	{11.6833[h], 0.316686[h]}
QueueLengthFractions	{0.973610, 0.0263905}
QueueLengthCumulativ...	{0.973610, 1.00000}
AverageQueueTime	0.00219921 h
MatchValueCount	0
UniqueMatchValues	{}
MatchValueCountMap	{}
MatchValueMap	{}
NumberReneged	0
QueuePosition	-1
<b>Input Values</b>	
StateAssignment	""

QueueLengthAverage = 0.0263905. Artinya, secara rata-rata, panjang antrian sebelum mesin adalah 0.0263905 part. Nilai yang sangat kecil ini menunjukkan bahwa antrian hampir selalu kosong.

AverageQueueTime = 0.00219921 h. Artinya, secara rata-rata, waktu tunggu setiap part di dalam antrian adalah 0.00219921 jam.

**Kesimpulan:** Setelah melakukan cross check dengan analisis EntityLogger 1 dan 2 didapatkan kesamaan jawaban sehingga dapat disimpulkan panjang antrian sebelum mesin adalah **0.02639048069 part**. Dengan Rata-rata Waktu Tunggu **0.002199206725 jam**. Ini sama persis dengan **QueueLengthAverage = 0.0263905** dan **AverageQueueTime= 0.00219921 h**.

## 2. Report the average processing time per part: Berdasarkan EntityLogger,

```
Activity7-EntityLogger1.log

File Edit View

Simulation SoftwareName JaamSim -
Simulation SoftwareVersion 2025-08 -
Simulation ConfigurationFile D:\JaamSim\Activity7.cfg
Simulation ScenarioNumber 1.0 -
Simulation ScenarioIndex { 1 } -
Simulation ReplicationNumber 1.0 -
Simulation RunNumber 1.0 -
Simulation RunIndex { 1 } -
Simulation PresentTimeAndDate Nov 01, 2025 17:33 -
Simulation PresentSimulationTime 0.0 h
Simulation RunDuration 12.0 h
Simulation InitializationDuration 0.0 h

this.SimTime/1[h] this.obj this.SimTime/1[h] * 3600
0.016666666666666666 PartsArrive_1 60.0
0.1 PartsArrive_2 360.0
0.18333333333333332 PartsArrive_3 660.0
0.26666666666666666 PartsArrive_4 960.0
0.35 PartsArrive_5 1260.0
0.43333333333333335 PartsArrive_6 1560.0
0.51666666666666667 PartsArrive_7 1860.0000000000002
0.6 PartsArrive_8 2160.0
0.6833333333333333 PartsArrive_9 2460.0
0.76666666666666667 PartsArrive_10 2760.0
0.85 PartsArrive_11 3060.0
0.9333333333333333 PartsArrive_12 3360.0
```

```
Activity7-EntityLogger2.log

File Edit View

Simulation SoftwareName JaamSim -
Simulation SoftwareVersion 2025-08 -
Simulation ConfigurationFile D:\JaamSim\Activity7\Activity7.cfg -
Simulation ScenarioNumber 1.0 -
Simulation ScenarioIndex { 1 } -
Simulation ReplicationNumber 1.0 -
Simulation RunNumber 1.0 -
Simulation RunIndex { 1 } -
Simulation PresentTimeAndDate Nov 10, 2025 18:12 -
Simulation PresentSimulationTime 0.0 h
Simulation RunDuration 12.0 h
Simulation InitializationDuration 0.0 h

this.SimTime/1[h] this.obj this.SimTime/1[h] * 3600 [Process].ServiceTime/1[h] * 3600
0.09557320305555556 PartsArrive_1 344.063531 220.38481551038728
0.16312271722222222 PartsArrive_2 587.241782 232.320453544766
0.22473661055555555 PartsArrive_3 809.051798 206.67389791806966
0.33542661583333333 PartsArrive_4 1207.535817 328.09569855372695
0.40454423638888887 PartsArrive_5 1456.3592509999999 252.00758760770302
0.49630735611111104 PartsArrive_6 1786.7064819999998 295.8367070818273
0.58124430333333333 PartsArrive_7 2092.479492 157.48421189467018
0.66229366166666666 PartsArrive_8 2384.257182 227.86010264608154
0.74737461277777777 PartsArrive_9 2690.548606 294.5316781924275
0.81536752694444445 PartsArrive_10 2935.323097 351.6708162184125
0.95334150972222222 PartsArrive_11 3432.029435 274.31752804859235
0.9805381325 PartsArrive_12 3529.937277 271.61073160003656
1.0712882722222223 PartsArrive_13 3856.6377800000005 316.4059433276682
1.16264589666666666 PartsArrive_14 4185.5252279999995 278.93912340143874
1.24945400305555554 PartsArrive_15 4498.034411 164.50338162539052
1.31349029777777776 PartsArrive_16 4728.5650719999999 285.02880915137496
1.40885945194444442 PartsArrive_17 5071.8940269999999 243.7453204162314
1.52372119416666666 PartsArrive_18 5485.396299 339.05946657325967
```

### Cara Pemrosesan:

Karena menggunakan '[Process].ServiceTime/1[h] \* 3600' di Entity\_logger\_2 terjadi error dan malah dihasilkan angka random lain yang tidak menunjukkan lama proses tiap part, kita bisa memanfaatkan Waktu Tunggu yang sebelumnya kita catat.

$$\text{WaktuKeluarProses}(n) = \text{WaktuSampai}(n) + \text{WaktuTunggu}(n) + \text{WaktuProses}(n)$$

sehingga:

$$\text{WaktuProses}(n) = \text{WaktuKeluarProses}(n) - \text{WaktuSampai}(n) - \text{WaktuTunggu}(n).$$

Perhitungan (Contoh):

- Untuk Part 1:
  - $\text{WaktuKeluarProses}(1) = 344.063531 \text{ s}$
  - $\text{WaktuSampai}(1) = 60 \text{ s}$
  - $\text{WaktuTunggu}(1) = 0 \text{ s}$
  - $\text{WaktuProses}(n) = \text{WaktuKeluarProses}(n) - \text{WaktuSampai}(n) - \text{WaktuTunggu}(n)$
  - $\text{WaktuProses}(1) = 344.0635 \text{ s} - 60 \text{ s} - 0 \text{ s} = 284.063531 \text{ s}$
- Untuk Part 2:
  - $\text{WaktuKeluarProses}(2) = 587.241782 \text{ s}$
  - $\text{WaktuSampai}(2) = 360 \text{ s}$
  - $\text{WaktuTunggu}(2) = 0 \text{ s}$
  - $\text{WaktuProses}(2) = 587.241782 \text{ s} - 360 \text{ s} - 0 \text{ s} = 227.241782 \text{ s}$
- ...
- Untuk Part 12:
  - $\text{WaktuKeluarProses}(12) = 3529.937277 \text{ s}$
  - $\text{WaktuSampai}(12) = 3360 \text{ s}$
  - $\text{WaktuTunggu}(12) = 72.029435 \text{ s}$
  - $\text{WaktuProses}(12) = 3529.937277 \text{ s} - 3360 \text{ s} - 72.029435 \text{ s} = 97.907842 \text{ s}$

### Hasil:

[https://docs.google.com/spreadsheets/d/17FoV1xIfJ\\_l8SZCvmp5M\\_1M9ByFqxS5z/edit?usp=sharing&ouid=102426845364381063047&rtpof=true&sd=true](https://docs.google.com/spreadsheets/d/17FoV1xIfJ_l8SZCvmp5M_1M9ByFqxS5z/edit?usp=sharing&ouid=102426845364381063047&rtpof=true&sd=true)

Entity Logger 2 (Setelah Selesai Proses)			Entity Logger 1 (Sebelum Masuk Antrian)				Analisa Queue Time	
this.SimTime/1[h] * 3600	[Process].ServiceTime/1[h] * 3600 (Error Karena JaamSim)	[Process].ServiceTime * 3600 / 1[h] Revised	No	this.SimTime/1[h]	this.obj	this.SimTime/1[h] * 3600	No	Queue Time
344.063531	220.3848155	284.063531	1	0.01666666667	PartsArrive_1	60	1	
587.241782	232.3204535	227.241782	2	0.1	PartsArrive_2	360	2	
809.051798	206.6738979	149.051798	3	0.1833333333	PartsArrive_3	660	3	
1207.535817	328.0956986	247.535817	4	0.2666666667	PartsArrive_4	960	4	
1456.559251	252.0075876	196.559251	5	0.35	PartsArrive_5	1260	5	
1786.706482	295.8367071	226.706482	6	0.4333333333	PartsArrive_6	1560	6	
2092.479492	157.4842119	232.479492	7	0.5166666667	PartsArrive_7	1860	7	
2384.257182	227.8601026	224.257182	8	0.6	PartsArrive_8	2160	8	
2690.548606	294.5316782	230.548606	9	0.6833333333	PartsArrive_9	2460	9	
2935.323097	351.6708162	175.323097	10	0.7666666667	PartsArrive_10	2760	10	
3432.029435	274.317528	372.029435	11	0.85	PartsArrive_11	3060	11	
3529.937277	271.6107316	97.907842	12	0.9333333333	PartsArrive_12	3360	12	72.029435
3856.637778	316.4050433	196.637778	13	1.0166666667	PartsArrive_13	3660	13	

Setelah melakukan perhitungan ini untuk semua 144 part yang selesai, menjumlahkan semua WaktuProses(n), lalu membaginya dengan 144.

Total Waktu Proses = 33436.98726 s = 557.283121 min = **9.288052017 h**

Rata-rata waktu proses tiap part = 33436.98726 s / 144 = 232.2013004 s = 3.870021674 min = **0.06450036123 h**

***Cross Check Berdasarkan Output Viewer Process:***

Output Viewer - Process	
Output	Value
Orientation	0.0 0.0 0.0 [deg]
Alignment	0.0 0.0 0.0
Show	true
GraphicalLength	1.00000 m
ObserverList	{}
NextList	{[EntityLogger2]}
PreviousList	{[Queue1]}
EntityReferenceList	{[EntityLogger2], [Queue1], [NormalDistribution1]}
<b>StateEntity</b>	
State	"Idle"
WorkingState	false
WorkingTime	9.28805 h
StateTimes	{"Idle"=2.71195[h], "Working"=9.28805[h]}
TotalTime	12.0000 h
<b>AbstractStateUserEntity</b>	
Idle	true
Working	false
Setup	false
Setdown	false
Maintenance	false
Breakdown	false

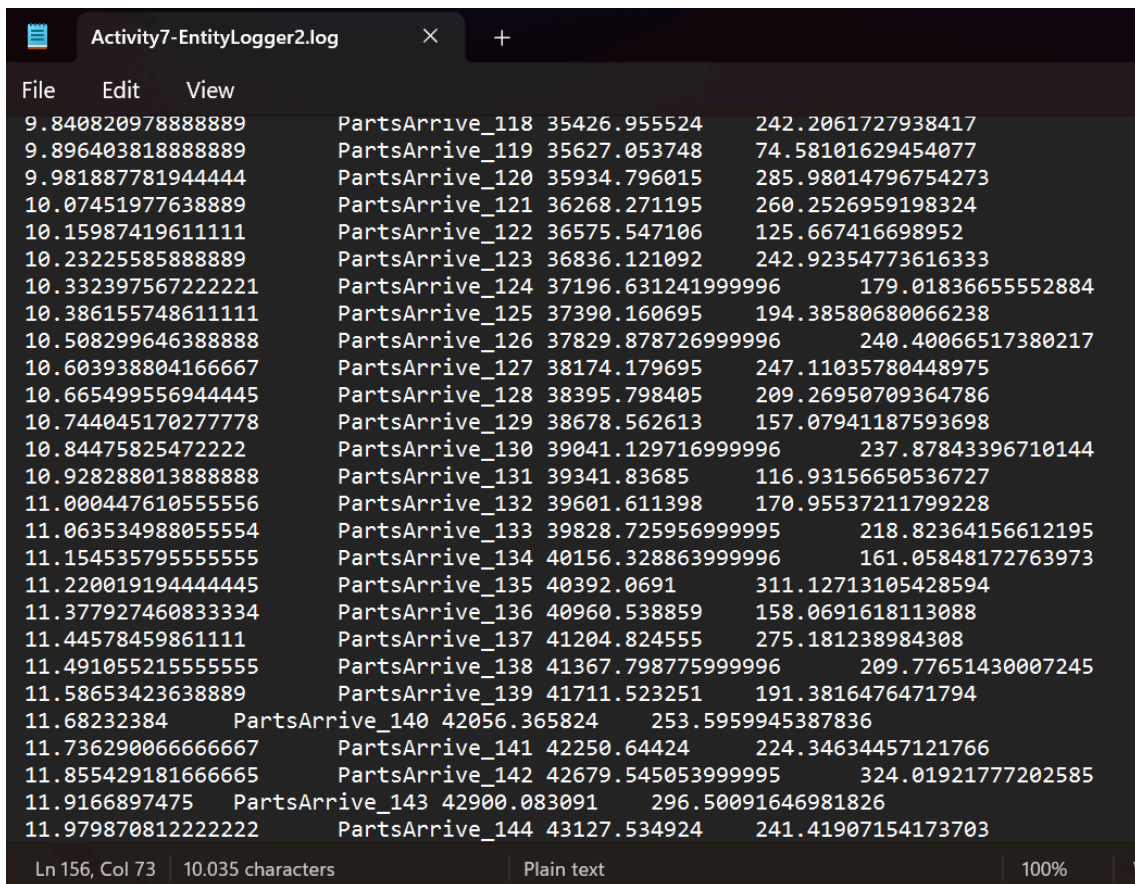
WorkingTime = **9.28805 h**. Artinya adalah Total Waktu Proses yang berjalan adalah 9.28805 jam. Sehingga bisa didapatkan Rata-rata waktu pemrosesan per part yaitu  $9.28805 \text{ jam} / 144 \text{ part} = \mathbf{0.06450034722 \text{ h}}$ .

**Kesimpulan:** Setelah melakukan cross check dengan analisis EntityLogger 1 dan 2 didapatkan kesamaan jawaban sehingga dapat disimpulkan Total Waktu Proses adalah **9.288052017 h**. Dengan Rata-rata waktu proses tiap part **0.06450036123 h**. Ini sama persis dengan **WorkingTime = 9.28805 h** dan berbeda sedikit karena pembulatan dengan rata-rata waktu pemrosesan per part yaitu  $9.28805 \text{ jam} / 144 \text{ part} = \mathbf{0.06450034722 \text{ h}}$ .

### 3. Repost the number of parts completed by the end of simulation

Berdasarkan EntityLogger2,

Cara Pemrosesan:



File	Edit	View
9.840820978888889	PartsArrive_118	35426.955524 242.2061727938417
9.896403818888889	PartsArrive_119	35627.053748 74.58101629454077
9.981887781944444	PartsArrive_120	35934.796015 285.98014796754273
10.07451977638889	PartsArrive_121	36268.271195 260.2526959198324
10.15987419611111	PartsArrive_122	36575.547106 125.667416698952
10.23225585888889	PartsArrive_123	36836.121092 242.92354773616333
10.332397567222221	PartsArrive_124	37196.631241999996 179.01836655552884
10.386155748611111	PartsArrive_125	37390.160695 194.38580680066238
10.508299646388888	PartsArrive_126	37829.878726999996 240.40066517380217
10.603938804166667	PartsArrive_127	38174.179695 247.11035780448975
10.665499556944445	PartsArrive_128	38395.798405 209.26950709364786
10.744045170277778	PartsArrive_129	38678.562613 157.07941187593698
10.84475825472222	PartsArrive_130	39041.129716999996 237.87843396710144
10.928288013888888	PartsArrive_131	39341.83685 116.93156650536727
11.000447610555556	PartsArrive_132	39601.611398 170.95537211799228
11.063534988055554	PartsArrive_133	39828.725956999995 218.82364156612195
11.154535795555555	PartsArrive_134	40156.328863999996 161.05848172763973
11.220019194444445	PartsArrive_135	40392.0691 311.12713105428594
11.377927460833334	PartsArrive_136	40960.538859 158.0691618113088
11.44578459861111	PartsArrive_137	41204.824555 275.181238984308
11.491055215555555	PartsArrive_138	41367.798775999996 209.77651430007245
11.58653423638889	PartsArrive_139	41711.523251 191.3816476471794
11.68232384	PartsArrive_140	42056.365824 253.5959945387836
11.736290066666667	PartsArrive_141	42250.64424 224.34634457121766
11.855429181666665	PartsArrive_142	42679.545053999995 324.01921777202585
11.9166897475	PartsArrive_143	42900.083091 296.50091646981826
11.979870812222222	PartsArrive_144	43127.534924 241.41907154173703

Ln 156, Col 73 | 10.035 characters | Plain text | 100% | V

**Hasil:** Berdasarkan EntityLogger2, hanya ada terdapat 144 parts (suku cadang) yang menyelesaikan proses.

**Cross Check Berdasarkan Output Viewer PartsLeave:**

Output Viewer - PartsLeave	
Output	Value
Orientation	0.0 0.0 0.0 [deg]
Alignment	0.0 0.0 0.0
Show	true
GraphicalLength	1.00000 m
ObserverList	{}
NextList	{}
PreviousList	{[EntityLogger2]}
EntityReferenceList	{}
<b>StateEntity</b>	
State	"None"
WorkingState	false
WorkingTime	0.00000 h
StateTimes	{"None"=12.0000[h]}
TotalTime	12.0000 h
<b>LinkedComponent</b>	
obj	[PartsArrive_144]
NumberAdded	144
NumberProcessed	144
NumberInProgress	0
ProcessingRate	0.00333333 /s
ReleaseTime	11.9799 h

NumberAdded = 144. Artinya berarti 144 entitas (parts) telah tiba di objek PartsLeave. Jumlah total parts yang telah menyelesaikan semua stasiun kerja dalam model dan sampai di pintu keluar.

NumberProcessed = 144. Artinya berarti 144 entitas (parts) telah dihilangkan dari simulasi oleh objek PartsLeave.

**Kesimpulan:** Karena hasil crosscheck menunjukkan hasil yang sama, dengan demikian dapat disimpulkan jumlah suku cadang yang selesai pada akhir simulasi ada **144 suku cadang**.