

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 (Majoritas 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. Repost 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.

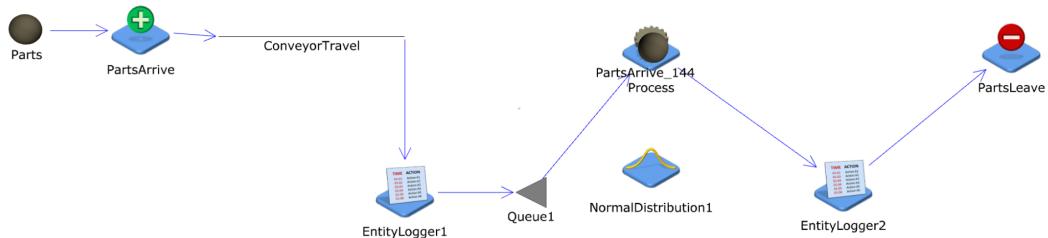
Tugas:

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 Pendefinisan 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	<i>None</i>	PartsArrive
Description	<i>None</i>	
NextComponent	<i>None</i>	ConveyorTravel
FirstArrivalTime	0.0 h	
InterArrivalTime	2.777777777777777...	5 min
EntitiesPerArrival	1	
PrototypeEntity	<i>None</i>	Parts
BaseName	<i>Generator Name</i>	
MaxNumber	<i>Infinity</i>	
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	<i>None</i>	ConveyorTravel
Description	<i>None</i>	
NextComponent	<i>None</i>	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	2.777777777777777...	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					▼

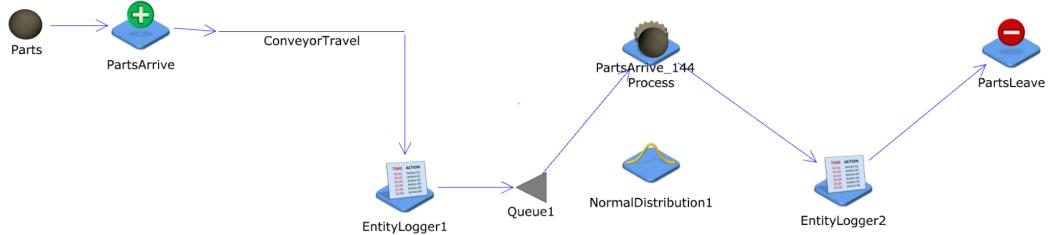
"The system runs for 12 hours.":

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		
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



1970-Jan-01 12:00:00.000

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 X +  
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  
0.1833333333333332 PartsArrive_3 660.0  
0.266666666666666666 PartsArrive_4 960.0  
0.35 PartsArrive_5 1260.0  
0.4333333333333335 PartsArrive_6 1560.0  
0.5166666666666667 PartsArrive_7 1860.0000000000002  
0.6 PartsArrive_8 2160.0  
0.683333333333333 PartsArrive_9 2460.0  
0.7666666666666667 PartsArrive_10 2760.0  
0.85 PartsArrive_11 3060.0  
0.933333333333333 PartsArrive_12 3360.0
```

```
Activity7-EntityLogger2.log X +  
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  
0.1631227172222222 PartsArrive_2 587.241782 232.320453544766  
0.2247366105555555 PartsArrive_3 809.051798 206.67389791806966  
0.3354266158333333 PartsArrive_4 1207.535817 328.09569855372695  
0.4045442363888887 PartsArrive_5 1456.359250999999 252.00758760770302  
0.49630735611111104 PartsArrive_6 1786.706481999998 295.8367070818273  
0.5812443033333333 PartsArrive_7 2092.479492 157.48421189467018  
0.6622936616666666 PartsArrive_8 2384.257182 227.86010264608154  
0.7473746127777777 PartsArrive_9 2690.548606 294.5316781924275  
0.8153675269444445 PartsArrive_10 2935.323097 351.6708162184125  
0.9533415097222222 PartsArrive_11 3432.029435 274.31752884859235  
0.9805381325 PartsArrive_12 3529.937277 271.61073160003656  
1.0712882722222223 PartsArrive_13 3856.637780000005 316.4059433276682  
1.1626458966666666 PartsArrive_14 4185.525227999995 278.93912340143874  
1.249454003055554 PartsArrive_15 4498.034411 164.50338162539052  
1.3134902977777777 PartsArrive_16 4728.565071999999 285.02880915137496  
1.4088594519444442 PartsArrive_17 5071.894026999999 243.7453204162314  
1.5237211941666666 PartsArrive_18 5485.396299 339.05946657325967
```

Cara Pemrosesan:

Rata-rata Panjang Antrean

Metode 1, Berdasarkan Weighted Sum:

https://docs.google.com/spreadsheets/d/17FoV1xIfJ_l8SZZCvmp5M_1M9ByFqxS5z/edit?usp=sharing&ouid=102426845364381063047&rtpof=true&sd=true

Analisa Queue Length (Metode 1)					
No	Time Interval (detik)		Duration (d) Salaha ini harus bulat	Queue Length (L(t))	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).

λ = Rata-rata tingkat kedatangan (part per detik).

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

Kita bisa menghitung λ dan W_q dari log.

https://docs.google.com/spreadsheets/d/17FoV1xIfJ_l8SZZCvmp5M_1M9ByFqxS5z/edit?usp=sharing&ouid=102426845364381063047&rtpof=true&sd=true

Analisa Queue Length (Metode 2)	
Rata-rata Panjang Antrean	
Hukum Little: $L_q = \lambda * W_q$	
L_q = Rata-rata Panjang Antrean (yang kita cari).	
λ = 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_l8SZZCvmp5M_1M9ByFqxS5z/edit?usp=sharing&ouid=102426845364381063047&rtpof=true&sd=true

Analisa Queue Time			
No	Queue Time		
1	0	123	0
2	0	124	0
3	0	125	0
4	0	126	0
5	0	127	0
6	0	128	14.179695
7	0	129	0
8	0	130	0
9	0	131	0
10	0	132	0
11	0	133	0
12	72.029435	134	0
13	0	135	0
14	0	136	0
15	0	137	100.538859
16	0	138	44.824555
17	0	139	0
18	0	140	0
19	25.396299	141	0
20	0	142	0
		143	19.545054
		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).

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

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

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
Input Values	
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 X +
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
0.1833333333333332 PartsArrive_3 660.0
0.266666666666666666 PartsArrive_4 960.0
0.35 PartsArrive_5 1260.0
0.4333333333333335 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 X +
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
0.1631227172222222 PartsArrive_2 587.241782 232.320453544766
0.2247366105555555 PartsArrive_3 809.05198 206.67389791806966
0.3354266158333333 PartsArrive_4 1207.535817 328.09569855372695
0.40454423638888887 PartsArrive_5 1456.359250999999 252.00758760770302
0.49630735611111104 PartsArrive_6 1786.706481999998 295.8367070818273
0.5812443033333333 PartsArrive_7 2092.479492 157.48421189467018
0.6622936616666666 PartsArrive_8 2384.257182 227.86010264608154
0.7473746127777777 PartsArrive_9 2690.548606 294.5316781924275
0.8153675269444445 PartsArrive_10 2935.323097 351.6708162184125
0.9533415097222222 PartsArrive_11 3432.029435 274.31752804859235
0.9805381325 PartsArrive_12 3529.937277 271.61073160003656
1.0712882722222223 PartsArrive_13 3856.637780000005 316.40594332766862
1.1626458966666666 PartsArrive_14 4185.5252279999995 278.93912340143874
1.2494540030555554 PartsArrive_15 4498.034411 164.50338162539052
1.3134902977777776 PartsArrive_16 4728.565071999999 285.02880915137496
1.4088594519444442 PartsArrive_17 5071.894026999999 243.7453204162314
1.5237211941666666 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

Entity Logger 2 (Setelah Selesai Proses)			Entity Logger 1 (Sebelum Masuk Antrian)			Analisa Queue Time	
No	this.SimTime/1[h]	[Process].ServiceTime/1[h]*3600 (Error Kerena JaamSim)	No	this.SimTime/1[h]	this.obj	No	Queue Time
1	0.01666666667	PartsArrive_1	1	60		1	0
2	0.1	PartsArrive_2	2	360		2	0
3	0.18333333333	PartsArrive_3	3	660		3	0
4	0.26666666667	PartsArrive_4	4	960		4	0
5	0.35	PartsArrive_5	5	1260		5	0
6	0.43333333333	PartsArrive_6	6	1560		6	0
7	0.51666666667	PartsArrive_7	7	1860		7	0
8	0.6	PartsArrive_8	8	2160		8	0
9	0.68333333333	PartsArrive_9	9	2460		9	0
10	0.76666666667	PartsArrive_10	10	2760		10	0
11	0.85	PartsArrive_11	11	3060		11	0
12	0.93333333333	PartsArrive_12	12	3360		12	72.029435
13	1.01666666667	PartsArrive_13	13	3660		13	0

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]}
StateEntity	
State	"Idle"
WorkingState	false
WorkingTime	9.28805 h
StateTimes	{"Idle"=2.71195[h], "Working"=9.28805[h]}
TotalTime	12.0000 h
AbstractStateUserEntity	
Idle	true
Working	false
Setup	false
Setdown	false
Maintenance	false
Breakdown	false

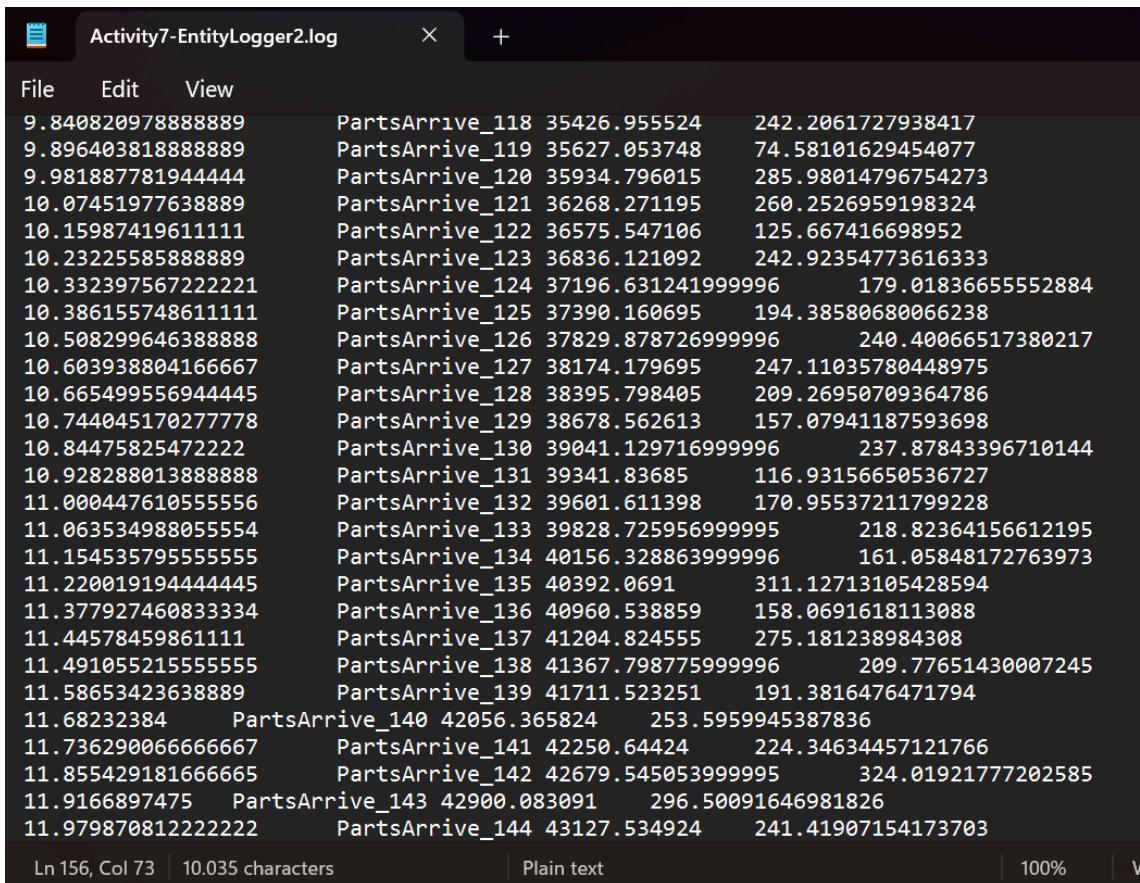
WorkingTime = **9.28805 h**. Artinya adalah Total Waktu Proses yang berjalan adalah 9.28805 jam. Sehingga bisa didapatkan Rata-rata waktu pemrosesan per part yaitu $9.28805 \text{ jam} / 144 \text{ part} = 0.06450034722 \text{ h}$.

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 $9.28805 \text{ jam} / 144 \text{ part} = 0.06450034722 \text{ h}$.

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

Berdasarkan EntityLogger2,

Cara Pemrosesan:



```
Activity7-EntityLogger2.log X +  
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  
11.97987081222222 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	{}
StateEntity	
State	"None"
WorkingState	false
WorkingTime	0.00000 h
StateTimes	{"None"=12.0000[h]}
TotalTime	12.0000 h
LinkedComponent	
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**.