Warner Robins Air Logistics Complex

Using a High-Level Template to Increase Model Development Speed

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AnyLogic Simulation Conference
5 & 6 September 2023

Overview

- Overview of WR-ALC
- Art of the Possible
- Modeling each “Gate”
- Utilization concerns
- Hold – Delay – Queue
- Restrict area start / end
- How fast is the template to use
- KPI dashboard

WR-ALC – Warner Robins - Air Logistics Complex, KPI – Key Performance Indicator

Overview of WR-ALC

- **Robins Air Force Base, GA**
  - **Warner Robins Air Logistics Complex (WR-ALC) is one of many tenant units on Robins AFB**
  - **WR-ALC is part of the Air Force Sustainment Center (AFSC)**
  - **Repairs and overhaul’s the United States Air Forces’ largest aircraft**
  - **Due to the nature of depot level repair and overhaul WR-ALC operates much like a manufacturing company**

C-5	feet	meter
Length	247	75
Wingspan	228	70

C-17	feet	meter
Length	174	53
Wingspan	170	52

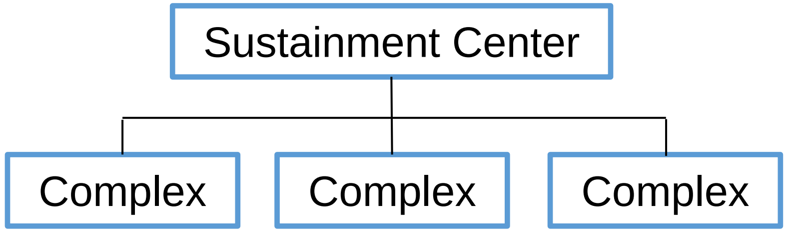
C-130	feet	meter
Length	96	29
Wingspan	130	40

F-15	feet	meter
Length	64	19.5
Wingspan	43	13

WR-ALC – Warner Robins - Air Logistics Complex, AFSC – Air Force Sustainment Center

Air Force Sustainment Center
"The way we do business"

- **Art of the Possible AFSC Handbook, AFSCH60-101, Dec 2021 is publicly available.**



- **With hundreds of different processes, high level descriptions are necessary to streamline management decision making.**
- **In the Art of the Possible (AoP) management system, this is called a "gated process" or "gated machine."**

Available Time (Days)	Required Output	Takt (Days)	Gate 1 (Pre-dock)	Gate 2 (Inspect Dock)	Gate 3 (Structures)	Gate 4 (System Ops)	Gate 5 (Post Dock)	TOTALS	
365	64	5.7	2	3	10	3	5	23	WIP
	Req'd Flowtime (Days):		11	17	57	17	29	131	Cal Days

AoP – Art of the Possible, AFSC – Air Force Sustainment Center ,Takt – Pace: time to produce one item, WIP – Work in Process

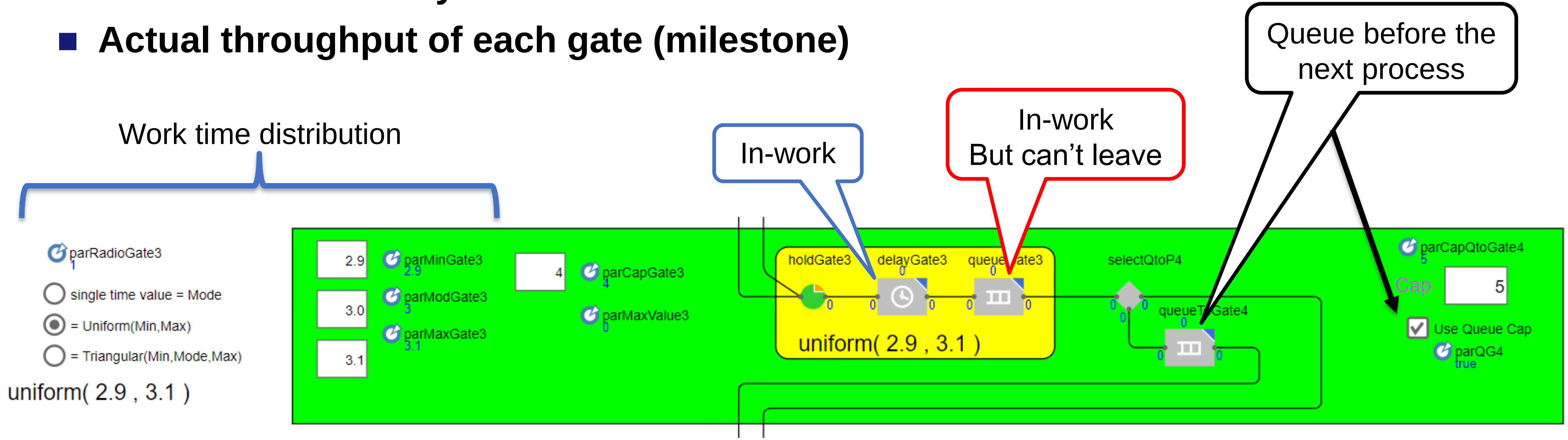
- When process flowtime and WIP levels are set and variation is introduced in the gated process, it is difficult to predict how the process will perform.

- Solution
  - A standardized template was designed in AnyLogic
  - This template enables engineers to easily model their gated machines rather than create them from scratch.

WIP – Work in Process

Modeling Each Gate

- Effects of Variation & Dependencies
  - In-work utilization
  - How queues fill
  - Actual time in the system
  - Actual throughput of each gate (milestone)

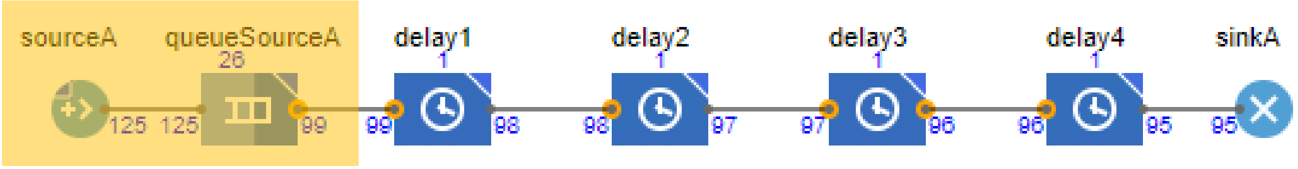


The Biggest Problem

In-work Utilization

- **When the delay time is finished,**
  It keeps counting the utilization

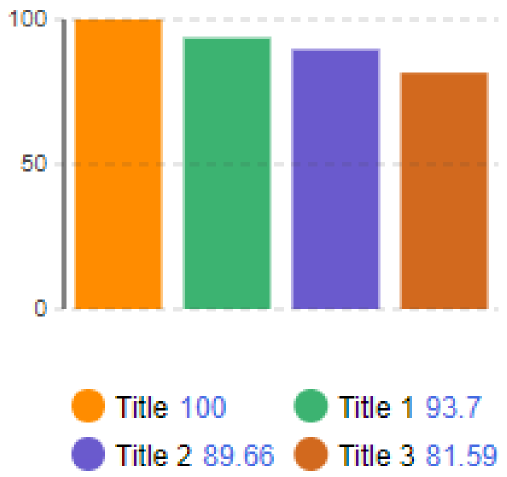
To feed the model



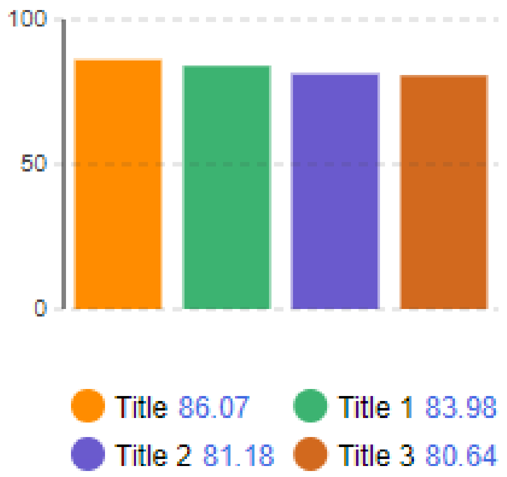
- **Finished items should go into a queue**

Station	Not real	Real	Difference
Delay 1	100	86.1	13.9
Delay 2	93.7	84.0	9.7
Delay 3	89.7	81.2	8.5
Delay 4	81.6	80.7	0.9

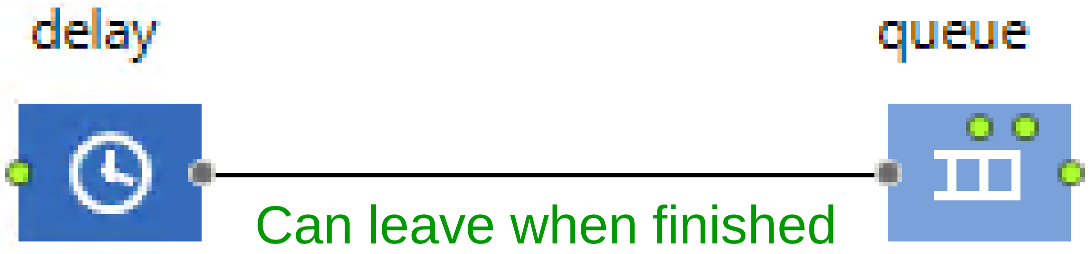
Not Real

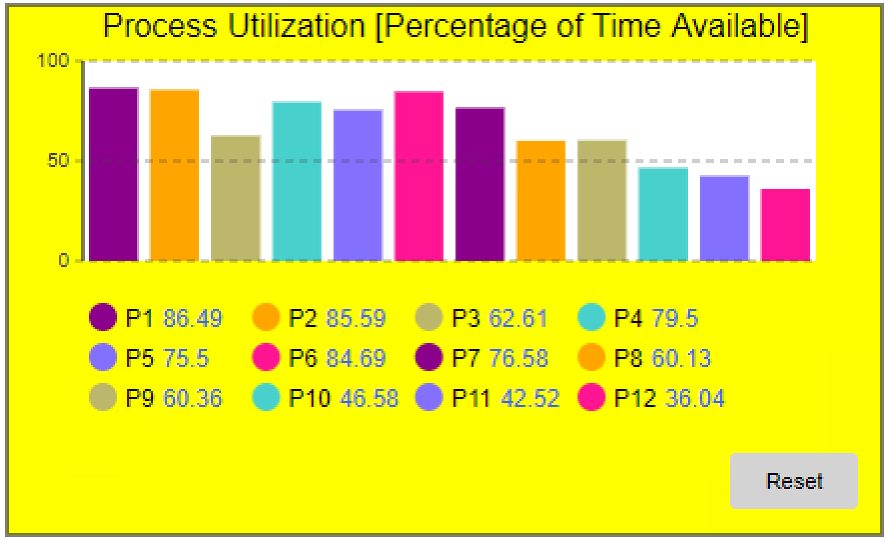


Real Utilization



Getting the Real Process Utilization

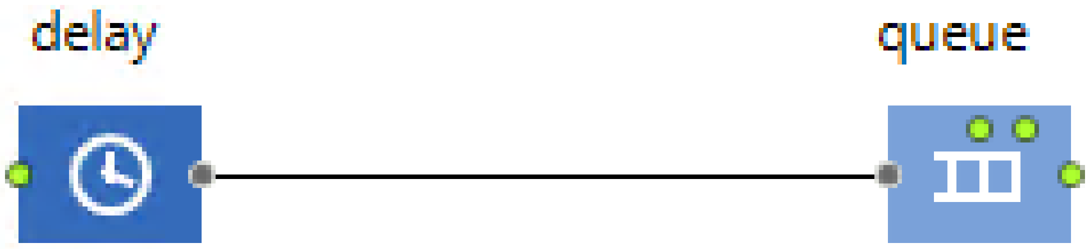





```
delay.statsUtilization.mean() * 100
```

Getting the Real Process Utilization

- I want to know about my excess capacity



Delay block

- Utilization = size()/capacity

- If the delay is finished but the agent can't leave, then the utilization increases
  - This is not processing utilization

Queue block

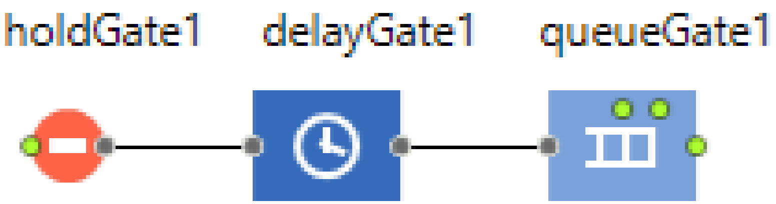
- Accepts agents that are finished

- If the next step is blocked
  - Holds the finished agent
  - It shows bottlenecks in the entire process

Control Capacity with a HOLD Block

- Hold, On enter

```
holdGate1.block();
```



- Queue, On exit

```
holdGate1.unblock();
```

- Delay, On enter

```
// Let another one in if PROCESS is not full
if( (delayGate1.size() + queueGate1.size() ) < delayGate1.capacity )
{
    holdGate1.unblock();
}
```

- Delay, On at exit

```
if( (delayGate1.size() + queueGate1.size() ) < delayGate1.capacity )
{
    holdGate1.unblock();
}
```

Total capacity is based on this

Control Capacity the Easy Way

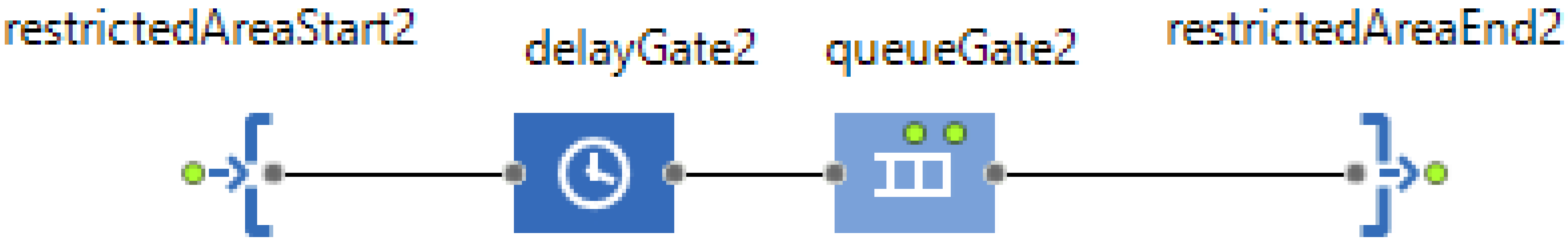
- **No enter and exit coding needed**

Set your max capacity

Capacity

☑ Max cap

Choose start object



How much to allow in

How many can you work at the same time

Template KPI Dashboard

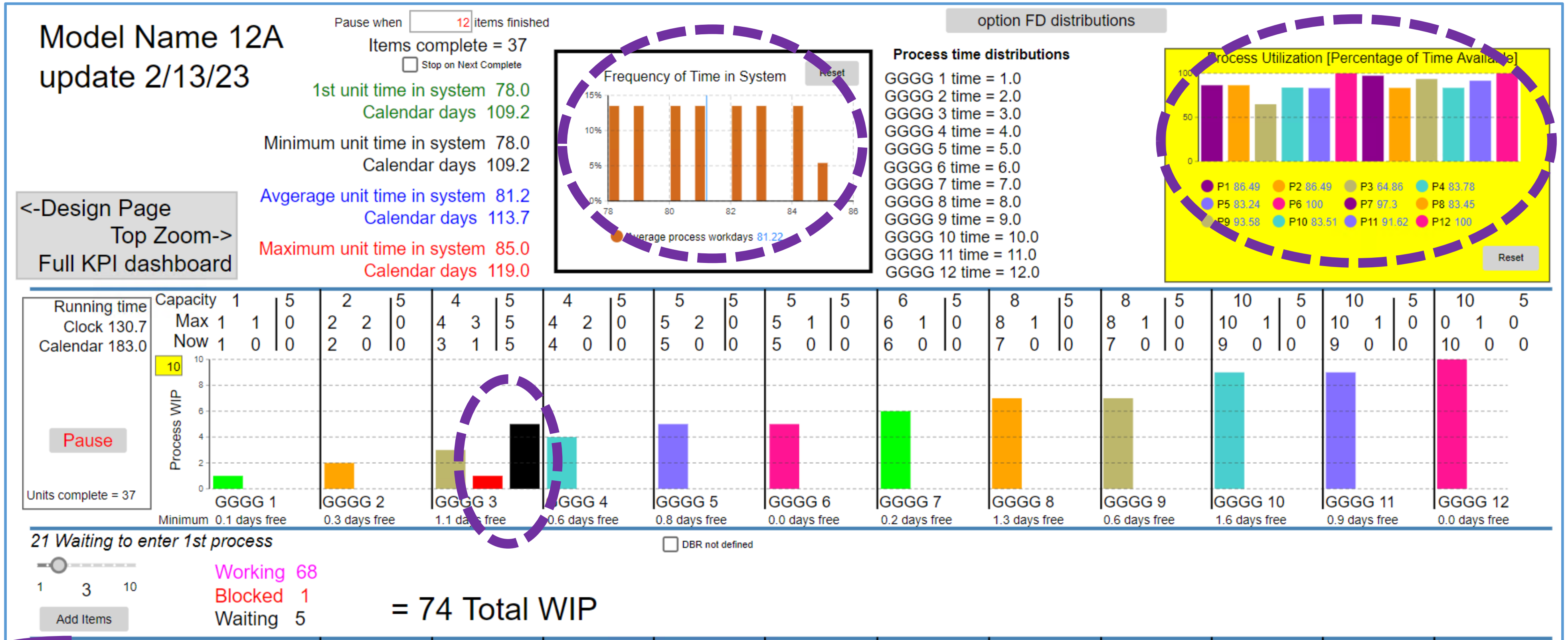
Questions answered

Actual time in the system

In-work utilization

How queues fill

Actual throughput of each Gate



Process →	GGGG 1	GGGG 2	GGGG 3	GGGG 4	GGGG 5	GGGG 6	GGGG 7	GGGG 8	GGGG 9	GGGG 10	GGGG 11	GGGG 12
work day TAKT Time →	1.0 days/unit	1.0	0.75	1.0	1.0	1.2	1.17	1.0	1.13	1.0	1.1	1.2 days/unit
Actual Pace →	1.19	1.21	1.24	1.38	1.45	1.54	1.65	1.82	2.01	2.33	2.78	3.53
Theoretical Throughput →	20.0 Units per	20.0	26.67	20.0	20.0	16.67	17.14	20.0	17.78	20.0	18.18	16.67 Units per
Actual Throughput →	16.83	16.53	16.07	14.54	13.77	13.01	12.09	11.02	9.95	8.57	7.19	5.66
per 20 days												
After fed 43.9	GGGG 1	GGGG 2	GGGG 3	GGGG 4	GGGG 5	GGGG 6	GGGG 7	GGGG 8	GGGG 9	GGGG 10	GGGG 11	GGGG 12
Actual Pace →	0.4	0.41	0.43	0.47	0.49	0.52	0.56	0.62	0.69	0.8	0.95	1.22
Actual Throughput →	49.65	48.74	46.92	42.82	40.54	38.26	35.53	32.34	29.15	25.05	20.95	16.4

Modeling Steps

- Six steps for model design
  - Modeling work already done by the template
    1. Design the logic
    2. Create visual output to understand what the model is doing
    3. Validate and verify the model design
  - AoP already knows process data for the gated machine
    4. Collect and verify process data
  - Method to fill in the template
    5. Input data into the model
  - 10% of the remaining time
    6. Fine tune the model with newly found dependencies

Timeframe

Weeks

A week

2 hours

Another week

AoP – Art of the Possible

Method to Fill In the Template

- Modeler and Process Engineer meet
  - Both are familiar with gated process structures
  - Both are familiar with the process to be modeled
- Modeler explains the template
  - 30 minutes
- Both people step through the template and gate design
  - 1.5 hours
  - 90% of the model design is complete
- Discover things to add to the model later
  - Find where dependencies and resource constraints need to be added
  - Flow or worktime change based on aircraft model


C-5 Gated Repair Process

C-130 Gated Repair Process


C-130 Fuel Bladder Inspection & Repair

WARNER ROBINS ALC

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