
# Modeling and Simulation for Army Sustainment: Depot Loading

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# DISCRETE-EVENT SIMULATION

## What is discrete-event simulation?

- Software engine which keeps track of a system timeline and events occurring along the timeline.
- Method to use computing power to handle complex situations – situations where using equations alone break down and can no longer adequately assess.

## History

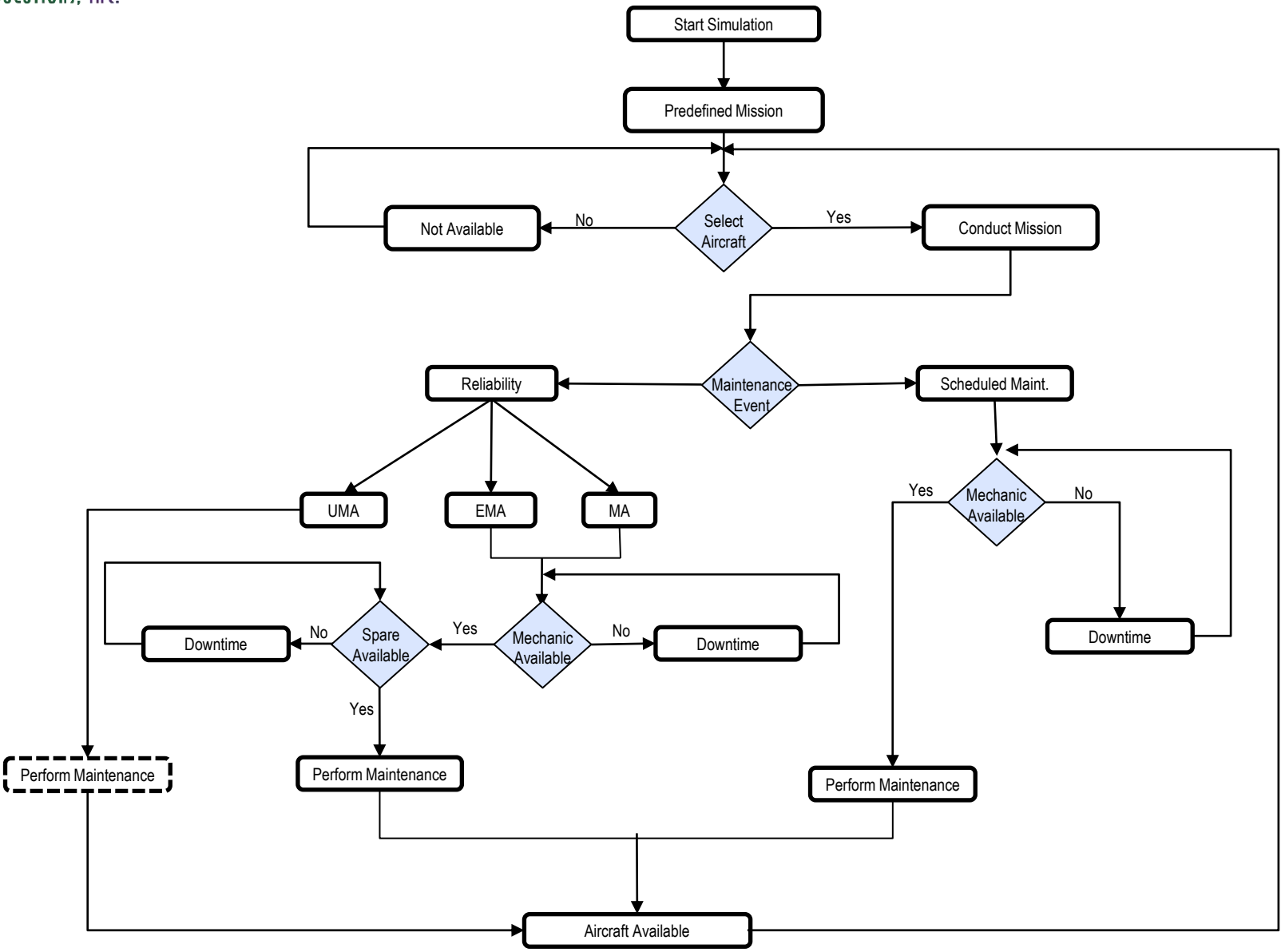
- Discrete-event simulation was invented in 1946 by physicists trying to understand the behavior of neutrons.
- By the 1970's, discrete-event simulation was widely used by tech giants and government agencies such as IBM and the Naval Air Missile Test Center.
- Discrete-event simulation is not new!

## Today

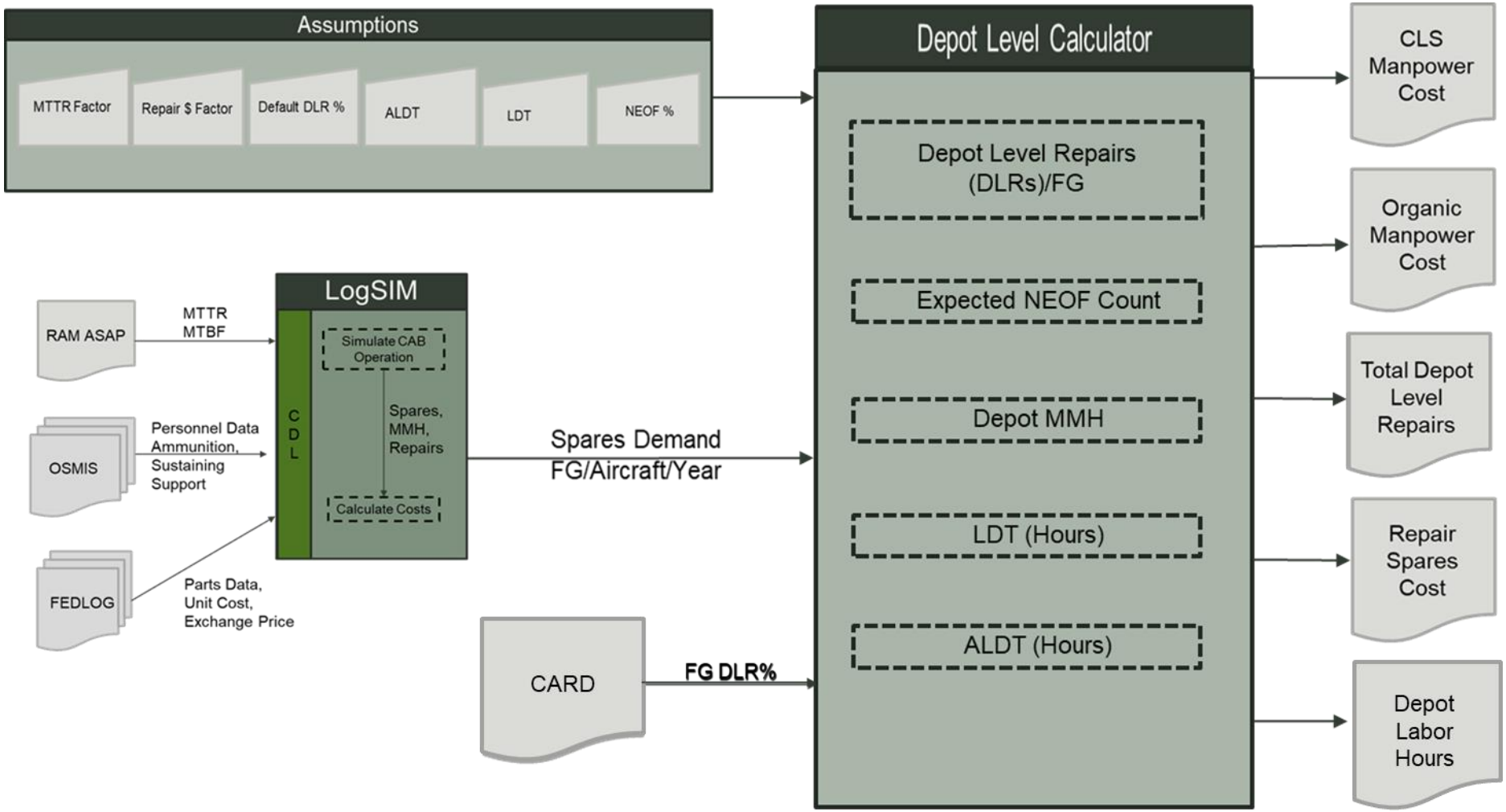
- What's new is simulating Army Aviation operations to analyze, learn, and pinpoint the variables which drive sustainment – both availability and affordability.
- What's new is creating a feedback loop showing how aircraft design decisions made today will impact sustainment 10-20-50 years down the road when these new aircraft are flying and being supported.

Discrete-event simulation is a trusted method to analyze extremely complex problems

# LOGSIM AVIATION SIMULATION LOGIC



# OPERATIONAL MODEL TO MAINTENANCE MODEL



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# LOGLAB FLEET-WIDE OPERATIONAL DEPOT-LEVEL MODEL

## Operational Model

- **> 500 Aircraft**
  - 25-year lifecycle per aircraft
  - Scheduled maintenance based on historical aircraft
- **45-year simulation based on OMS/MP (~ 400K hours)**
  - Complete Fielding schedule and demil
- **Mission Scenarios – OMS/MP**
  - 24 Aircraft per Unit
- **Each aircraft records ~10K flight hours**
  - Over 5 million total flight hours are generated across the entire fleet
- **Endless number of maintainers and spares quantity available**

## Depot Maintenance Model

- **50 Years of Depot Operations**
  - Generating over 4 million hours of Depot Man Hours
- **Includes On Condition Maintenance, Overhauls, Resets, and NEOF operations**

# DEPOT LEVEL FUNCTIONAL GROUP REPAIR PERCENTAGES

- **Fielding Ramp-up**
  - Reset depot maintenance events will not occur until after the aircraft operates in Multi-Domain Operation (MDO) OPTEMPO
  - Depot Maintenance Probabilities IOC for all FG:
    - OCM ~ 90%
    - RESET ~ 0%
    - OVERHAUL ~ 5%
    - NEOF ~ 5%
- **Depot Overhaul Maintenance Probabilities for years IOC + 4**

| Sub-System | Overhaul % | NEOF % | OCM % | Reset % |
|---|---|---|---|---|
| Sub-Sytem 1 | 80% | 5% | 10% | 0% |
| Sub-Sytem 2 | 30% | 5% | 60% | 0% |
| Sub-Sytem 3 | 95% | 5% | 0% | 0% |
| Sub-Sytem 4 | 95% | 5% | 0% | 0% |

Notional

- **Depot Reset Probabilities for years IOC + 9**

| Sub-System | Overhaul % | NEOF % | OCM % | Reset % |
|---|---|---|---|---|
| Sub-Sytem 1 | 80% | 5% | 10% | 3% |
| Sub-Sytem 2 | 30% | 5% | 2% | 60% |
| Sub-Sytem 3 | 0% | 5% | 0% | 93% |

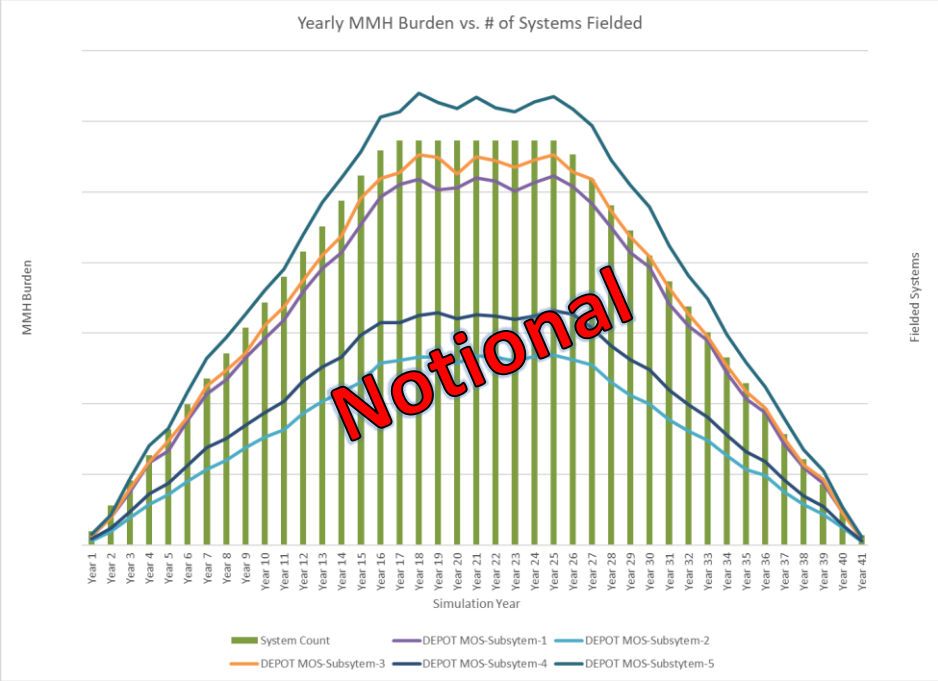
Notional

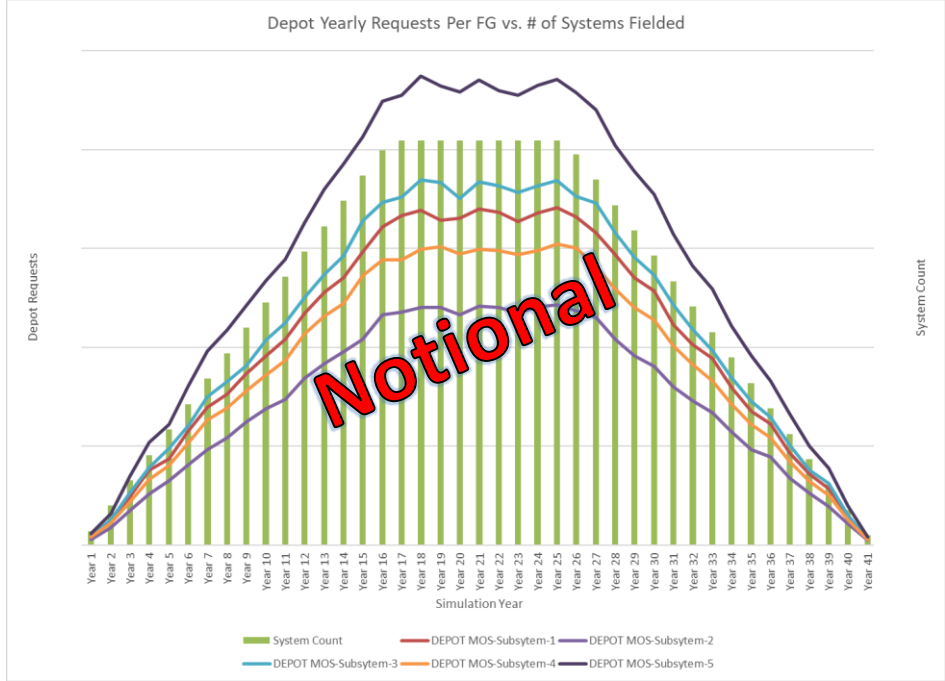
- **All FGs which do not have supporting RESET and Overhaul probabilities from Depot 1 have a NEOF rate of 5% and an OCM rate of 95%.**

# FULLY FIELDED DEPOT DEMAND


**~30% of the fleet-wide Depot demand is generated during the span where the aircraft is fully fielded**

# DEPOT DEMAND PER YEAR

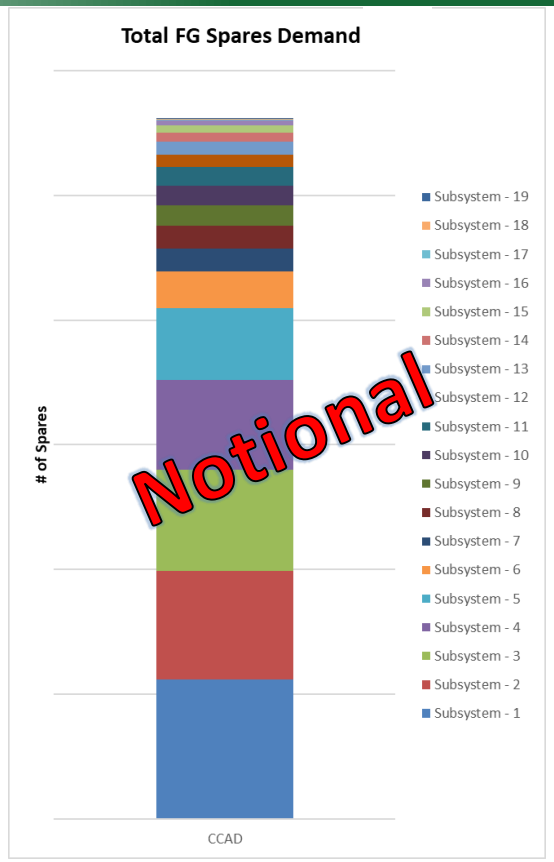


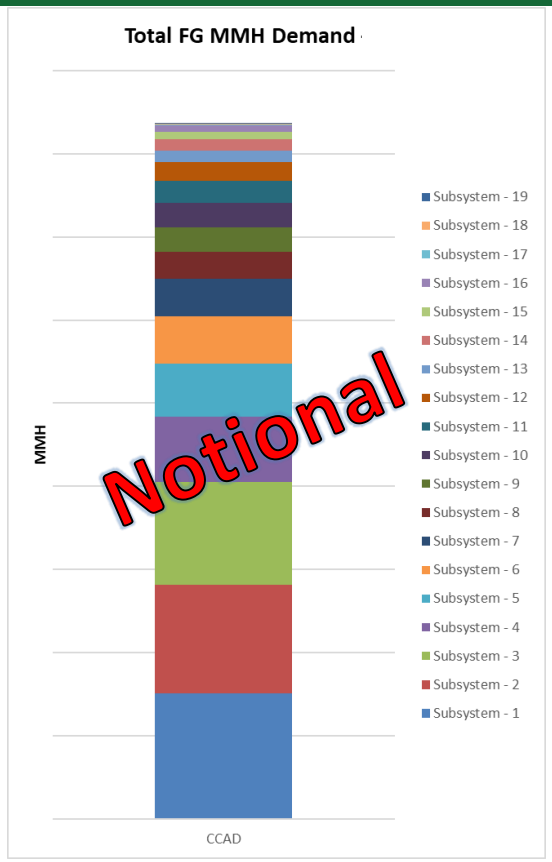




- **Each graph represents the depot burden per year for each of the Top 5 FGs based on the number of fielded systems over the lifecycle of the fleet**
- **One Functional Group creates the largest depot burden for spare parts and MMH**
  - 55% of all come from one FG's failures that require a spare are sent to the depot

# MAINTENANCE MAN HOURS DEMAND

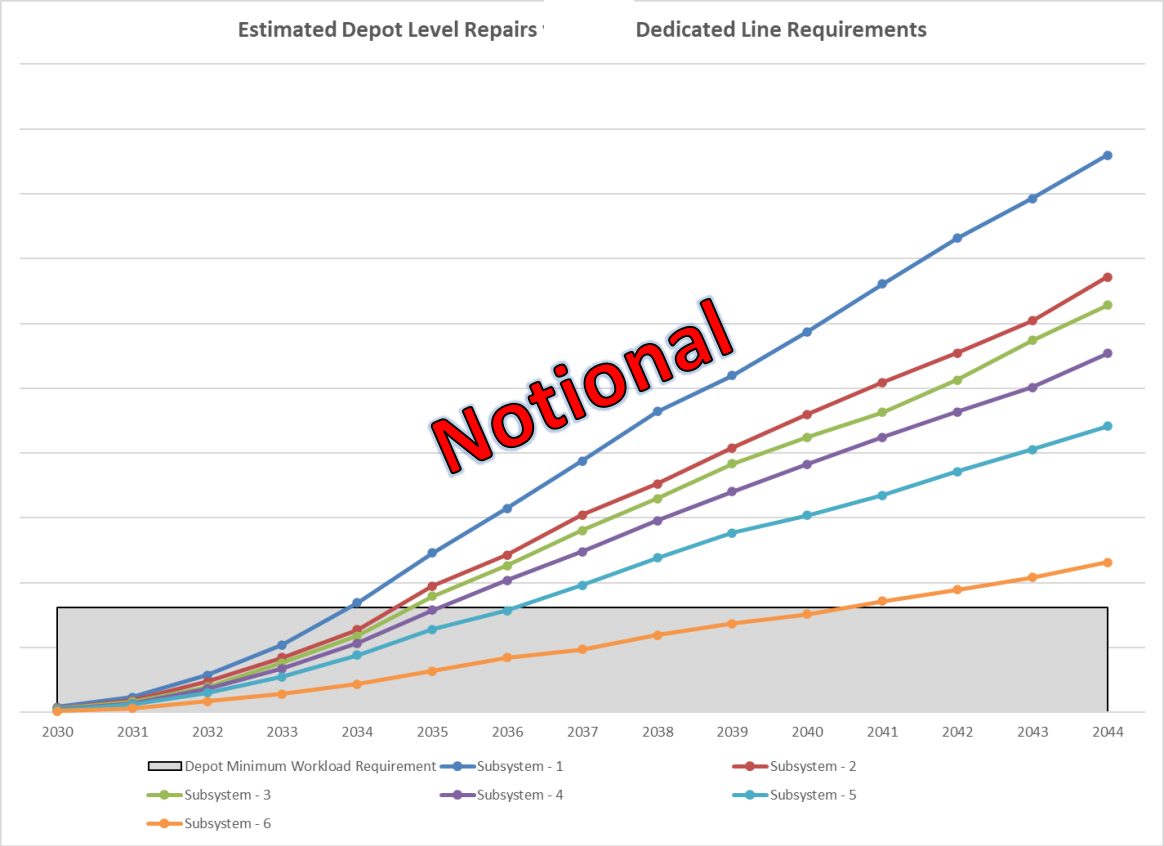

| Depot Locations | Number of Functional Groups |
|---|---|
| Depot 1 | 17 |
| Depot 2 | 2 |




- **SME defined which depot location each FG (for UH-60M/CH-47F) is sent to for repair**
- **Electronic subsystems are sent to Depot 2**
  - Remaining FG's sent to Depot 1
- **Greater than 250k depot level spares and 4 million depot MMH expected at Depot 1 over the lifecycle of the fleet**

# DEPOT MINIMUM WORKLOAD




- **Number of spares required to meet minimum depot workload requirement ~ 324 depot level spares/year**
  - Assumption based on minimum depot workload for a historical system
- **Some Functional Groups do not meet minimum depot workload during lifecycle of aircraft**
- **One Functional Group reaches the minimum depot level spares at Year 3 and sustains that workload for 37 years**

# SUMMARY AND QUESTIONS

- **By leveraging Army data and practices the LogLab has been effective in influencing the design of Army Aviation products with sustainment in mind**
- **The Logistics Engineering Laboratory has used this Depot Analysis to inform multiple documents during the design phase of the Army Acquisition process**
  - Core Logistics Analysis (CLA/CDA)
  - Business Case Analysis (BCA)
  - Data Rights Strategies
  - IP Evaluation
- **Questions?**

- **Contact:**
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