

2024-05-14 | Turin

# Improved Support for LCM Analytics:

## What's new in the Opus Suite?

Axel Nyberg, PhD.  
Principal Research Scientist  
Systecon Group

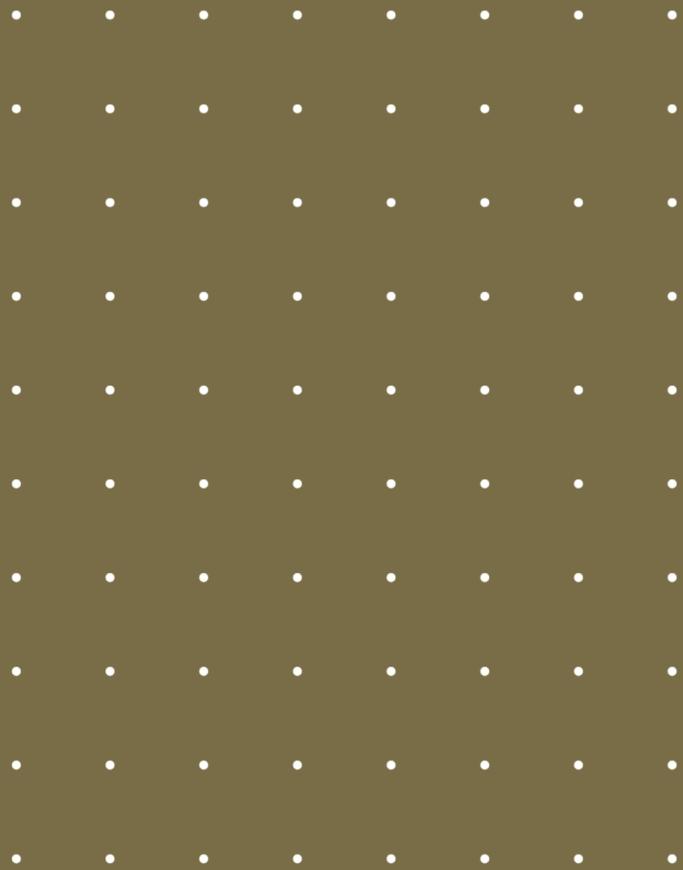


# Agenda – What's new?



- **SIMLOX:**
  - Mission Capability
  - Result Viewer
- **OPUS10:**
  - CFILL
  - LORA-XT - Remake with enhanced performance.
- **OPUS EVO:**
  - Support for multiple constraints over many sites

# Mission Capability



# Mission Capability

## What?

- New type of results in SIMLOX –  
*Capability results*
- Extended input data model to capture capabilities in the simulation
- Report to show capability results
- Result graphs to show capability results



# Mission Capability

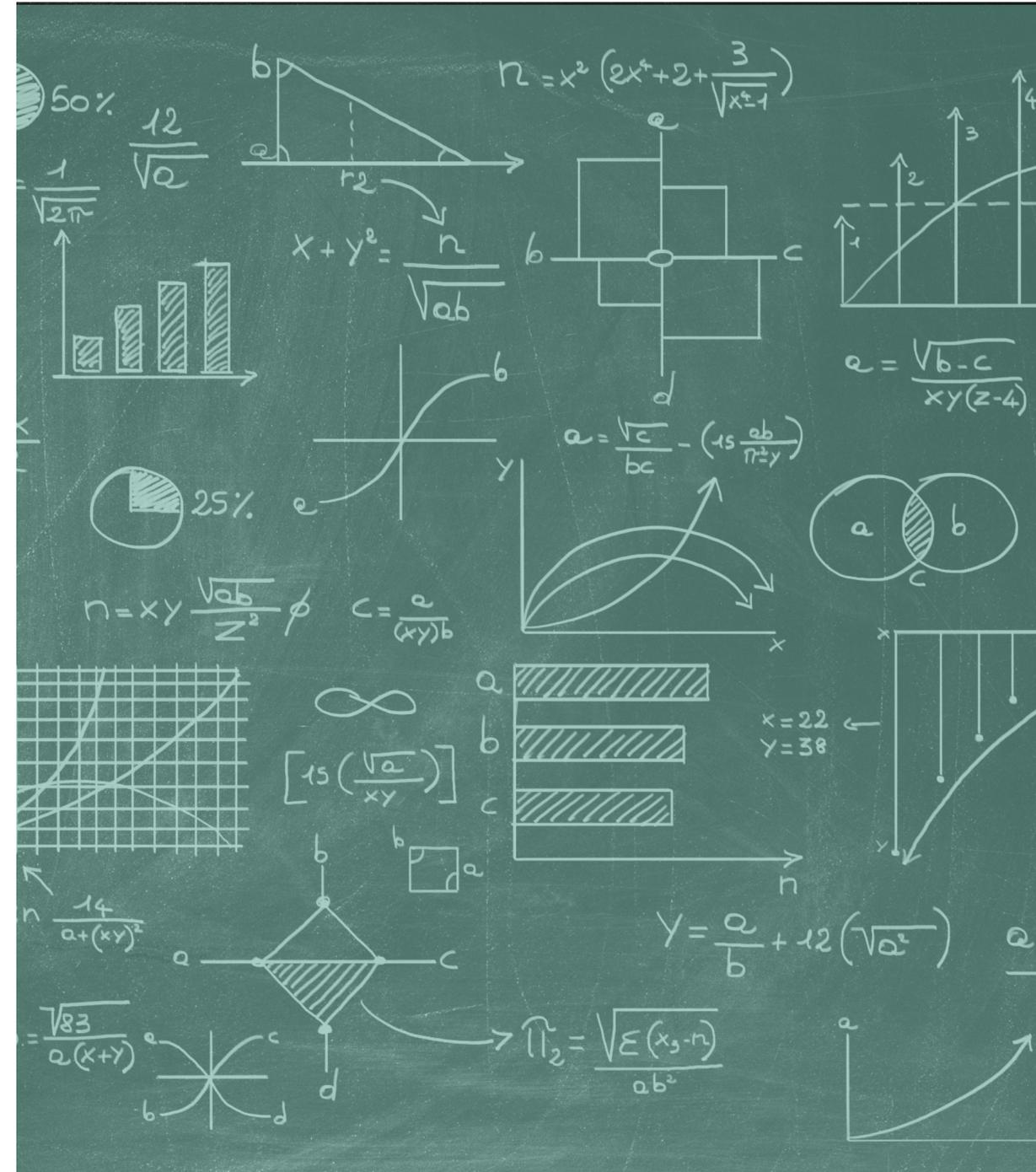
## Why?

Previous SIMLOX versions:

- Captures the state for each system
- Shows mission capability for the missions performed
- Only allows collection of results due to your actual operations

Requested feature:

- Understand what capability the systems and subsystems have for other types of missions
- Separate the mission operations from mission capabilities





Jack H. Lucas (DDG-125) underway in the Gulf of Mexico in April 2023. HII Photo



Jack H. Lucas (DDG-125) underway in the Gulf of Mexico in April 2023. HII Photo

# Demo



Open

Public > Public Documents > Systecon > SIMLOX 2024.0 > Demo > Modeling Examples > Operational Modes

Search Operational Modes

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Name	Date modified	Type	Size
ModEx_CapabilityOperationalModes_Aircraft.sxi	2024-03-04 17:37	SIMLOX input file	214 KB
ModEx_CapabilityOperationalModes_FBD.sxi	2024-03-04 17:37	SIMLOX input file	180 KB
ModEx_CapabilityOperationalModes_Ship.sxi	2024-03-04 17:37	SIMLOX input file	246 KB
ModEx_NonCriticalSets.sxi	2024-03-04 17:37	SIMLOX input file	225 KB
ModEx_UsageRates.sxi	2024-03-04 17:37	SIMLOX input file	172 KB

Downloads Documents Pictures Music Videos OT\_41\_OPUS10\_B: OT\_40\_ResultRefe 01a\_TotalCostAnc testviewer

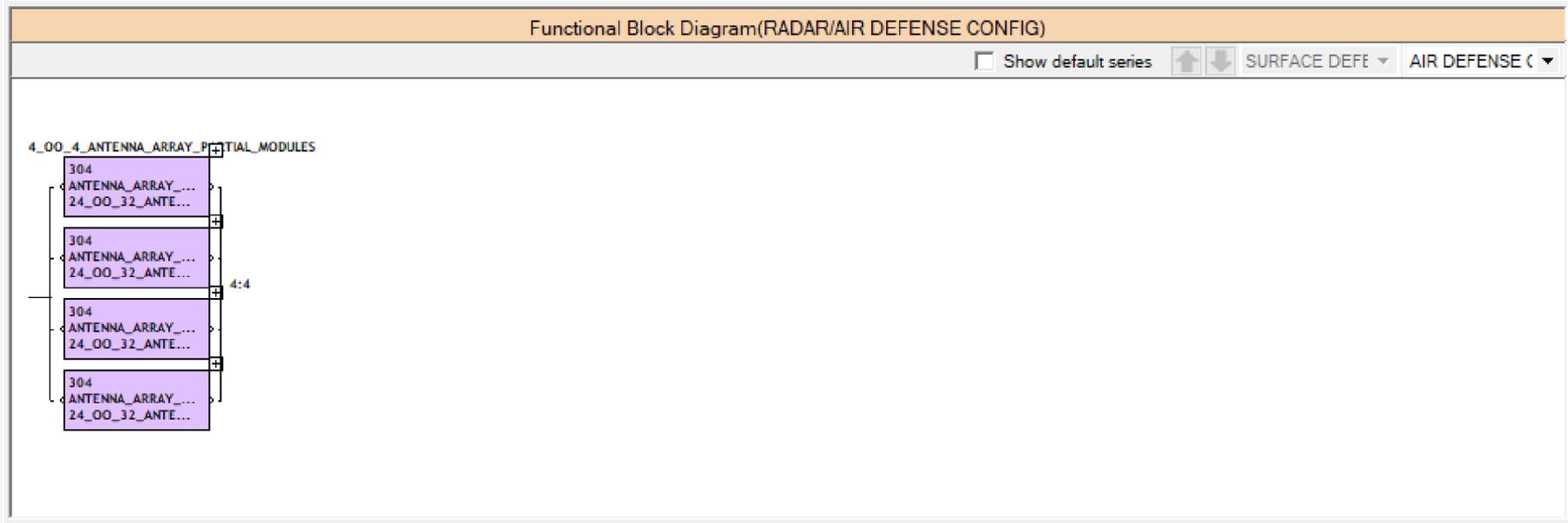
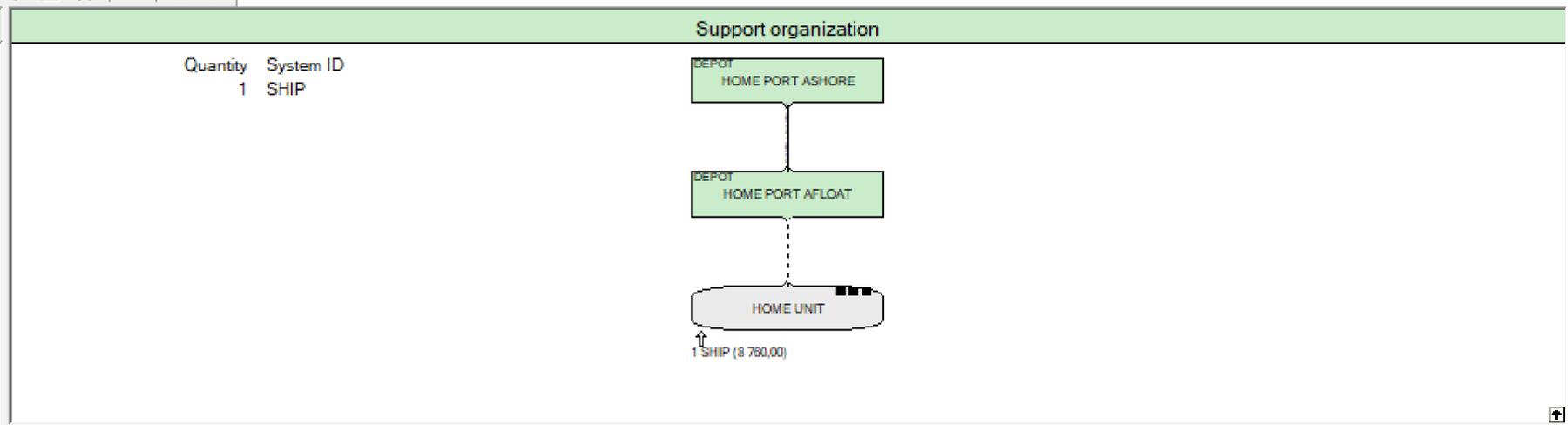
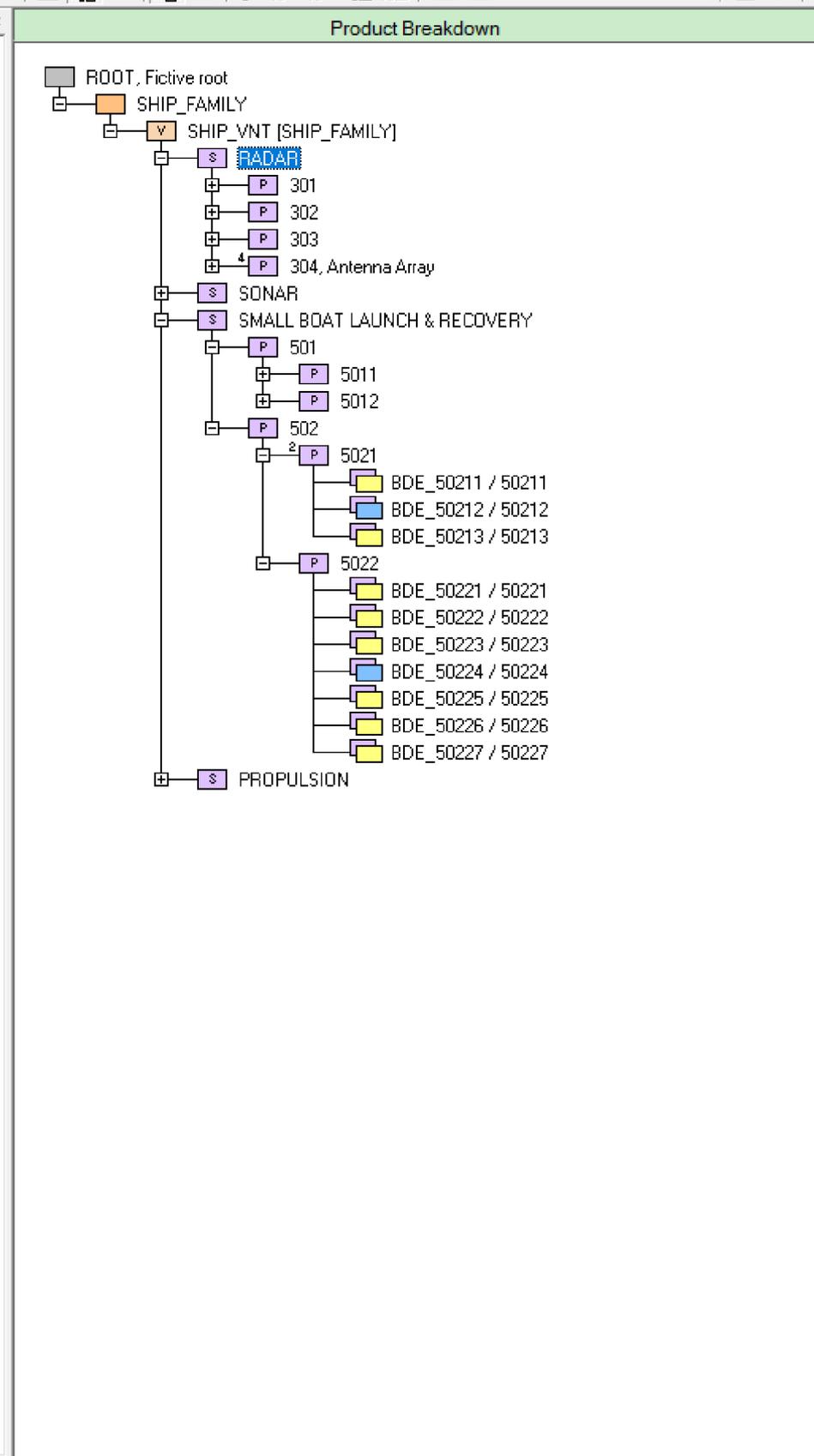
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File name: SIMLOX Input Files (\*.sxi)

Open Cancel

Open File...

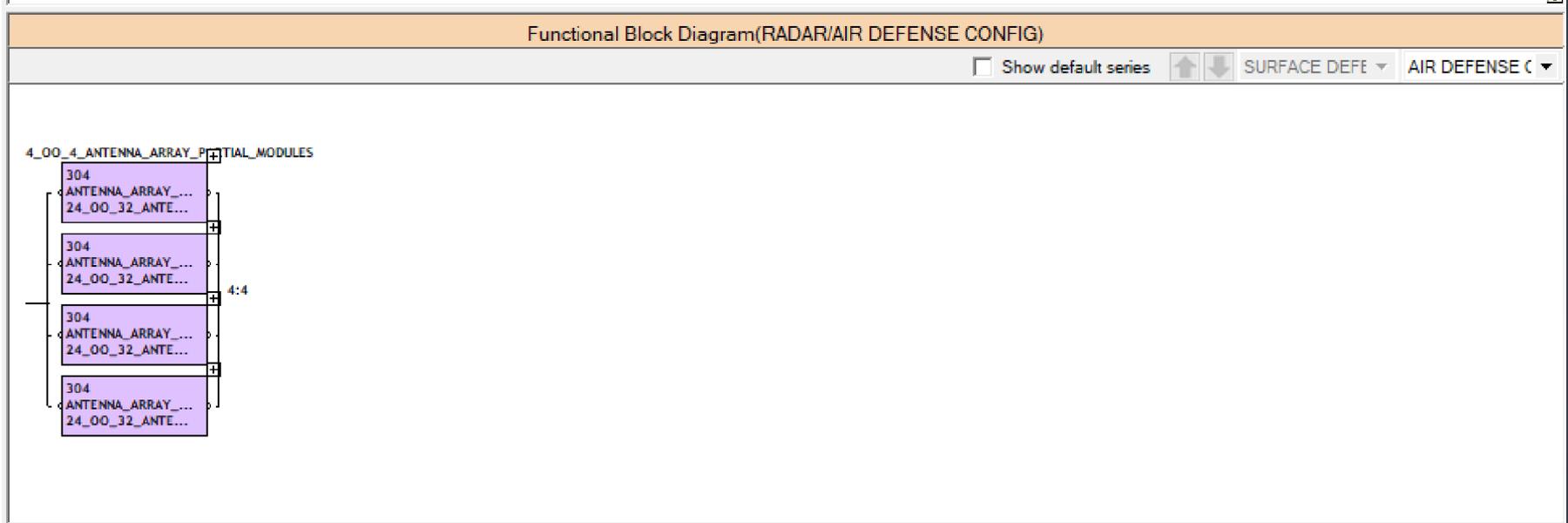
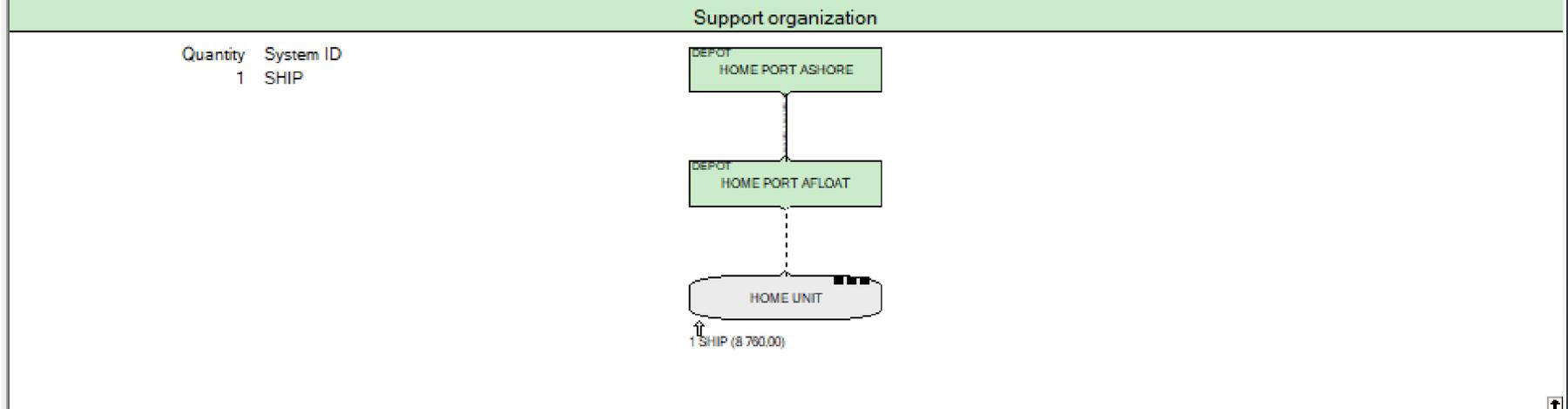
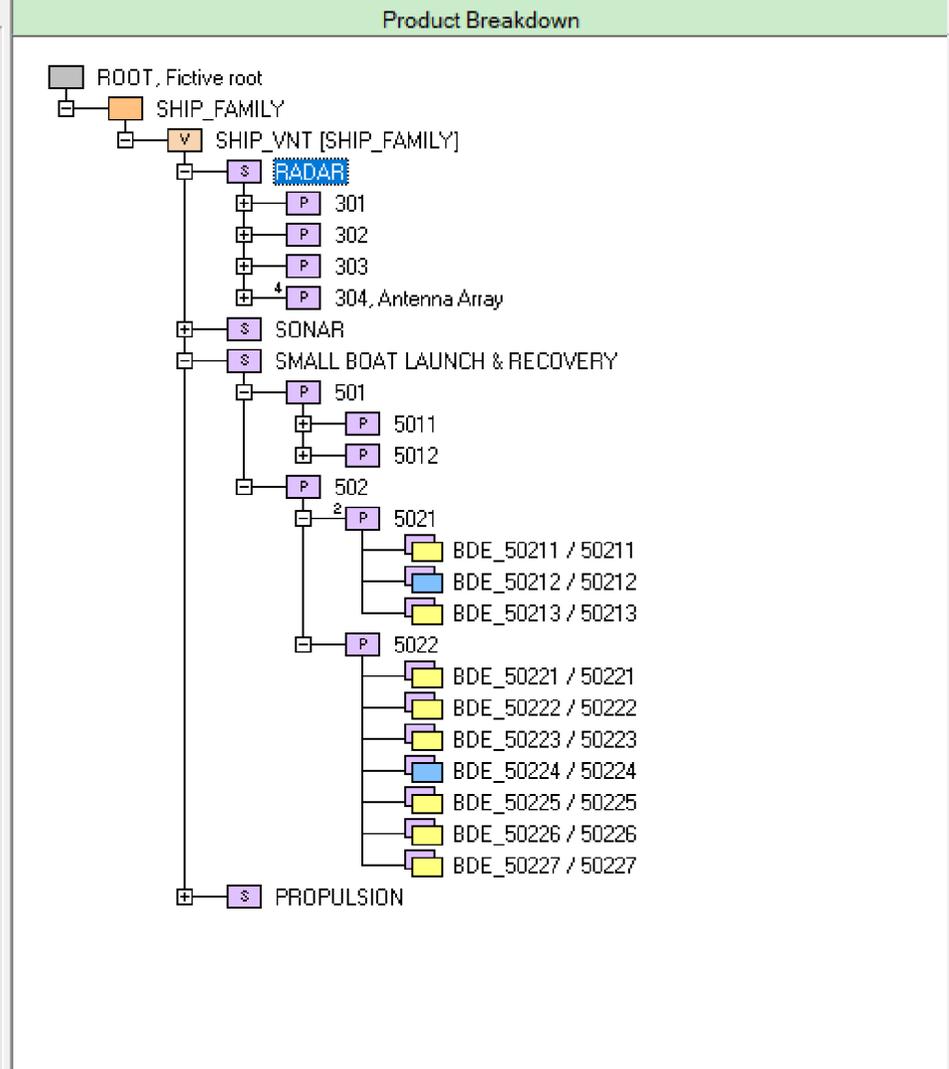
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    - Maintenance
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    - Units
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      - OperationalMode
      - OperationProfile
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      - NonCriticalSetBreakdownElement
      - UtilizationProfile
  - FBD
    - FBDProductVariant
    - FBDFunctionalConfiguration
    - FBDBreakdownElement
    - FBDParallel
    - FBDParallelStructure
  - Allocations
    - StockAllocation



### MissionOperationalMode

	MTID	SID	OPMID	OPMPRI	OPMCAP	NOTE
	Mission type identifier	System identifier	Operational mode identifier	Operational mode priority <1>	Operational mode capability <FULLY CAPABLE>	User note
1	REF MISSION 1	SHIP	CRUISE	1	FULLY CAPABLE	
2	REF MISSION 1	SHIP	<DEFAULT>	2	NOT CAPABLE	
3	REF MISSION 2	SHIP	PATROL	1	FULLY CAPABLE	
4	REF MISSION 2	SHIP	<DEFAULT>	2	NOT CAPABLE	
5	REF MISSION 3	SHIP	ENGAGE	1	FULLY CAPABLE	
6	REF MISSION 3	SHIP	<DEFAULT>	2	NOT CAPABLE	
7	REF MISSION 4	SHIP	ENGAGE	1	FULLY CAPABLE	
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9	REF MISSION 5	SHIP	PATROL	1	FULLY CAPABLE	
10	REF MISSION 5	SHIP	<DEFAULT>	2	NOT CAPABLE	
11	REF MISSION 6	SHIP	CRUISE	1	FULLY CAPABLE	
12	REF MISSION 6	SHIP	<DEFAULT>	2	NOT CAPABLE	

- Open File...
- ModEx\_CapabilityOperationalModes\_Ship
  - Input
    - Profile View
    - Program Control
    - Products
    - Items
    - Failures
    - Maintenance
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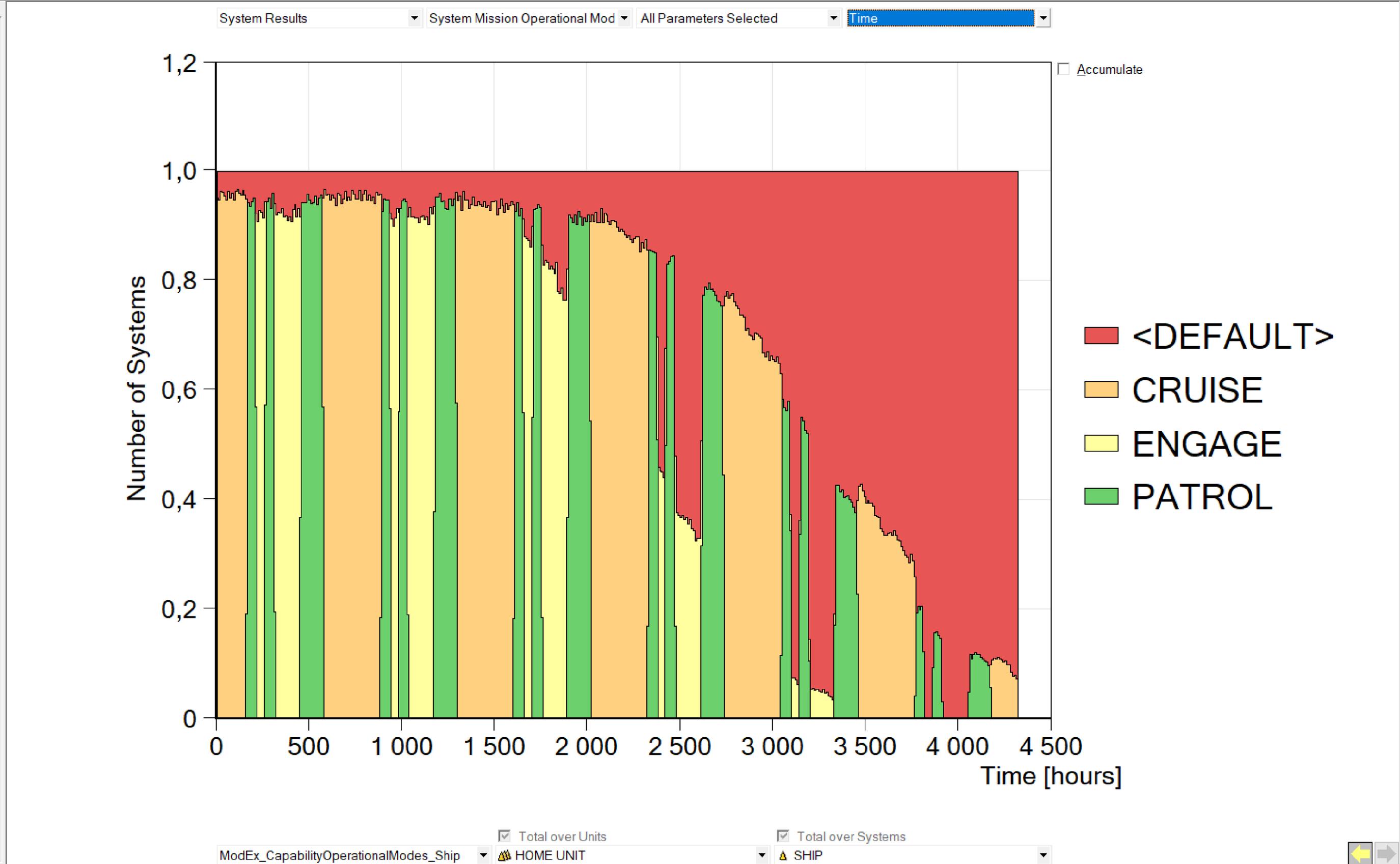


### SystemOperationalMode

SID	OPMID	NCID	ENCOR	NOTE
System identifier	Operational mode identifier	Non Critical set identifier	Enable capability operational mode results <Y>	User note
1	SHIP	<DEFAULT>	N	
2	SHIP	CRUISE	N	
3	SHIP	ENGAGE	N	
4	SHIP	PATROL	N	
5				
6	SHIP	MISSILE DEFENSE		
7	SHIP	AIR DEFENSE		
8	SHIP	SURFACE DEFENSE		
9	SHIP	ANTI-SUBMARINE WARFARE		
10	SHIP	BOARD AND INSPECT		

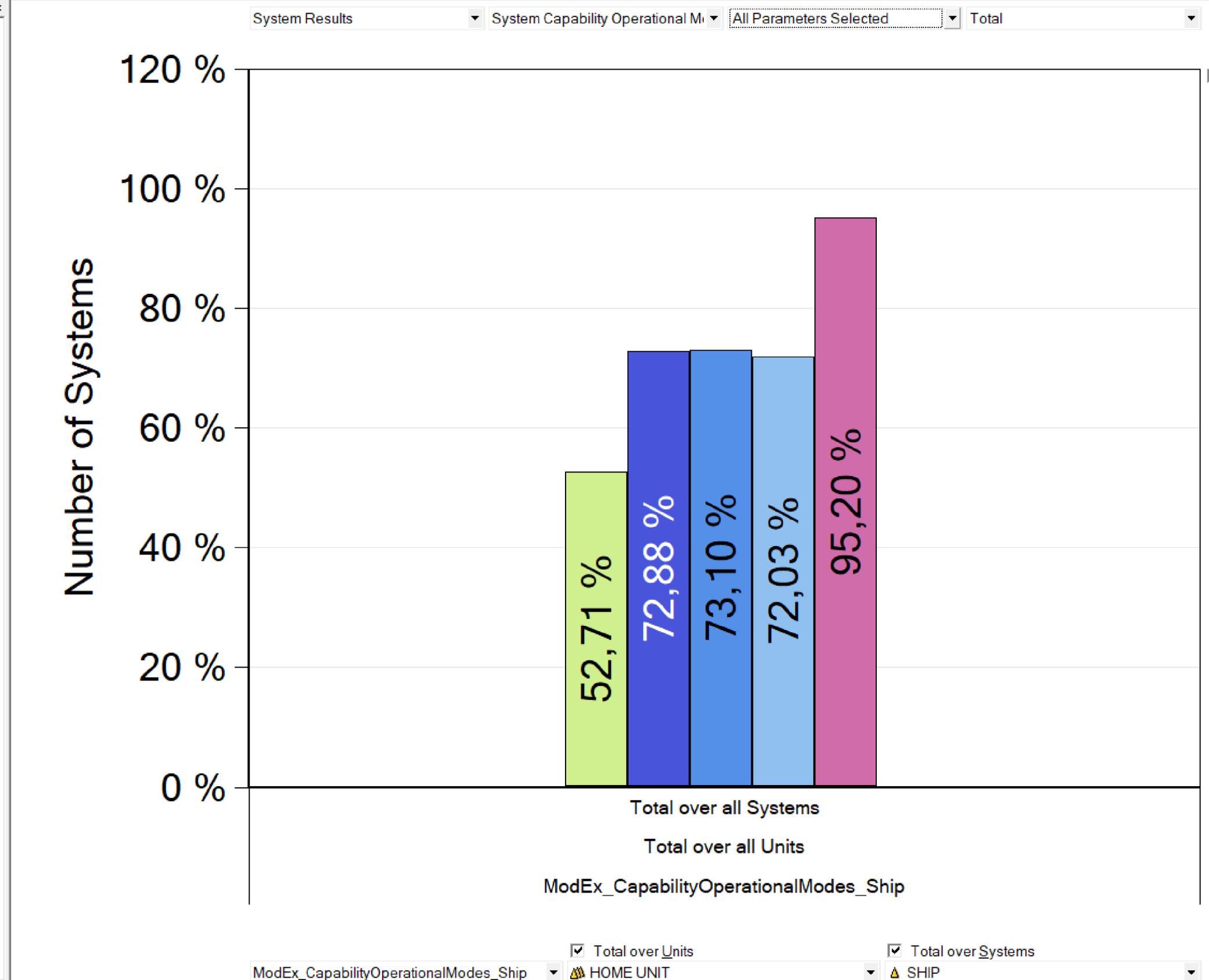
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ModEx\_CapabilityOperationalModes\_Ship

- Input
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  - Program Control
  - Products
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  - Failures
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- Result

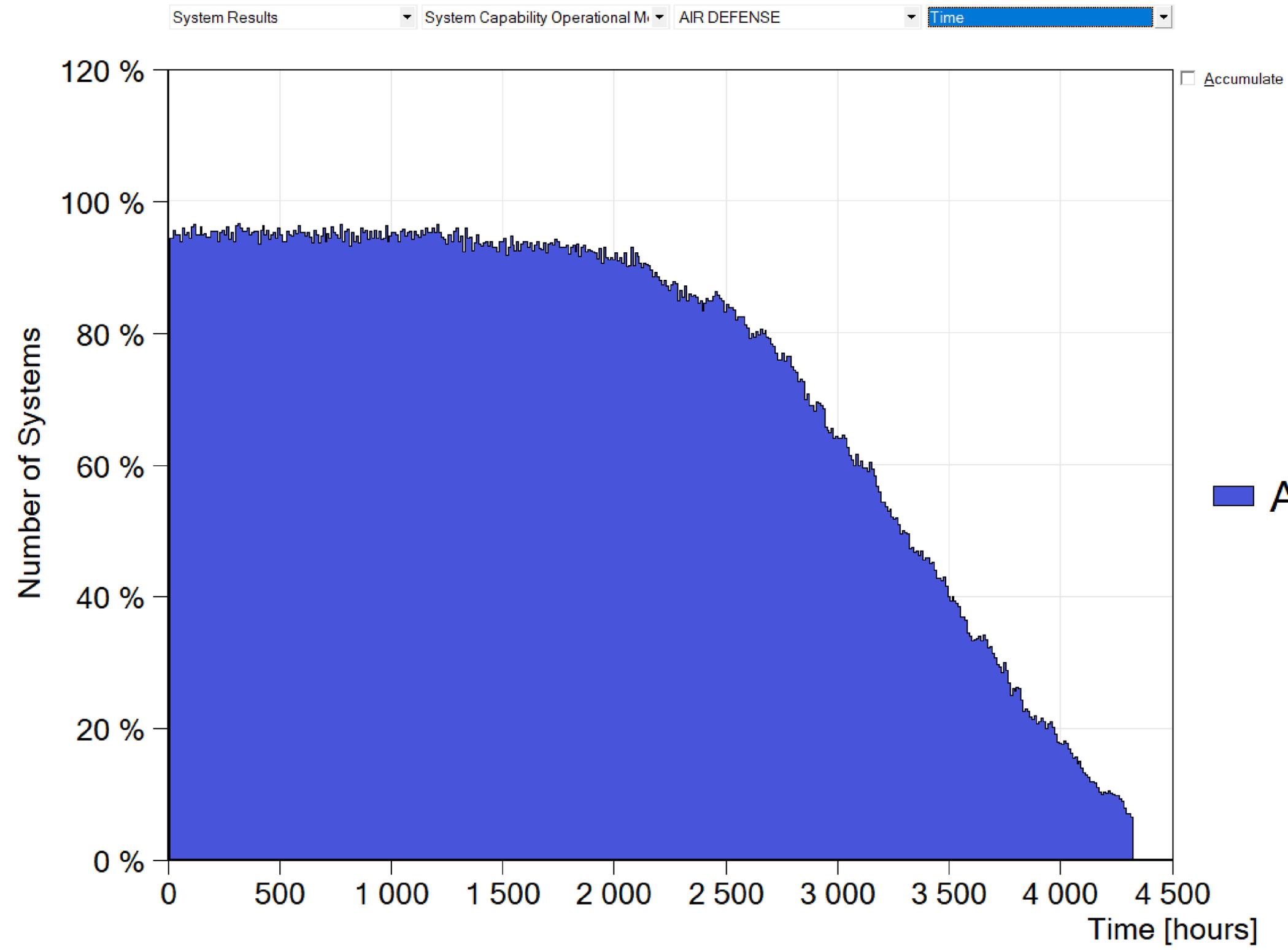


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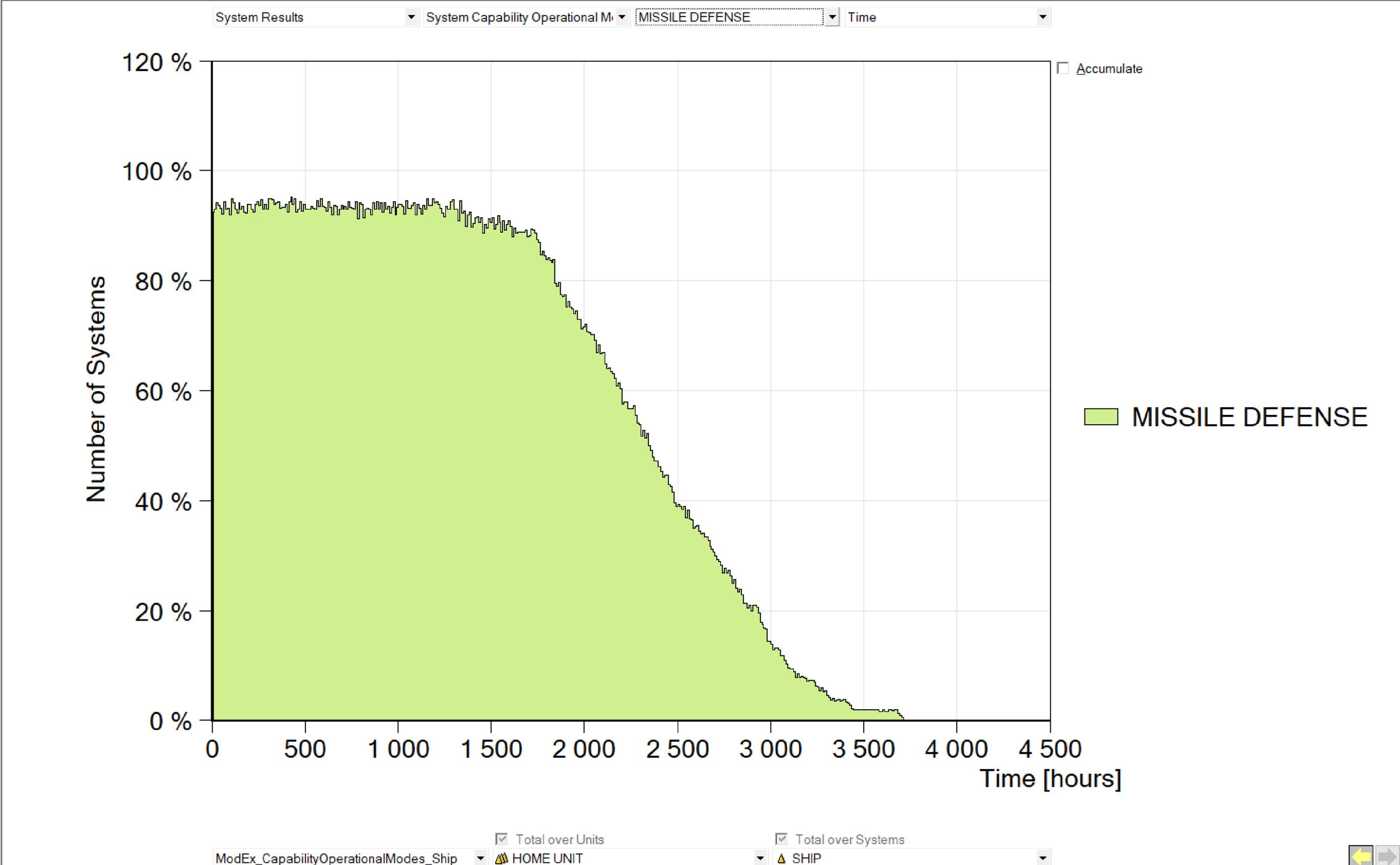


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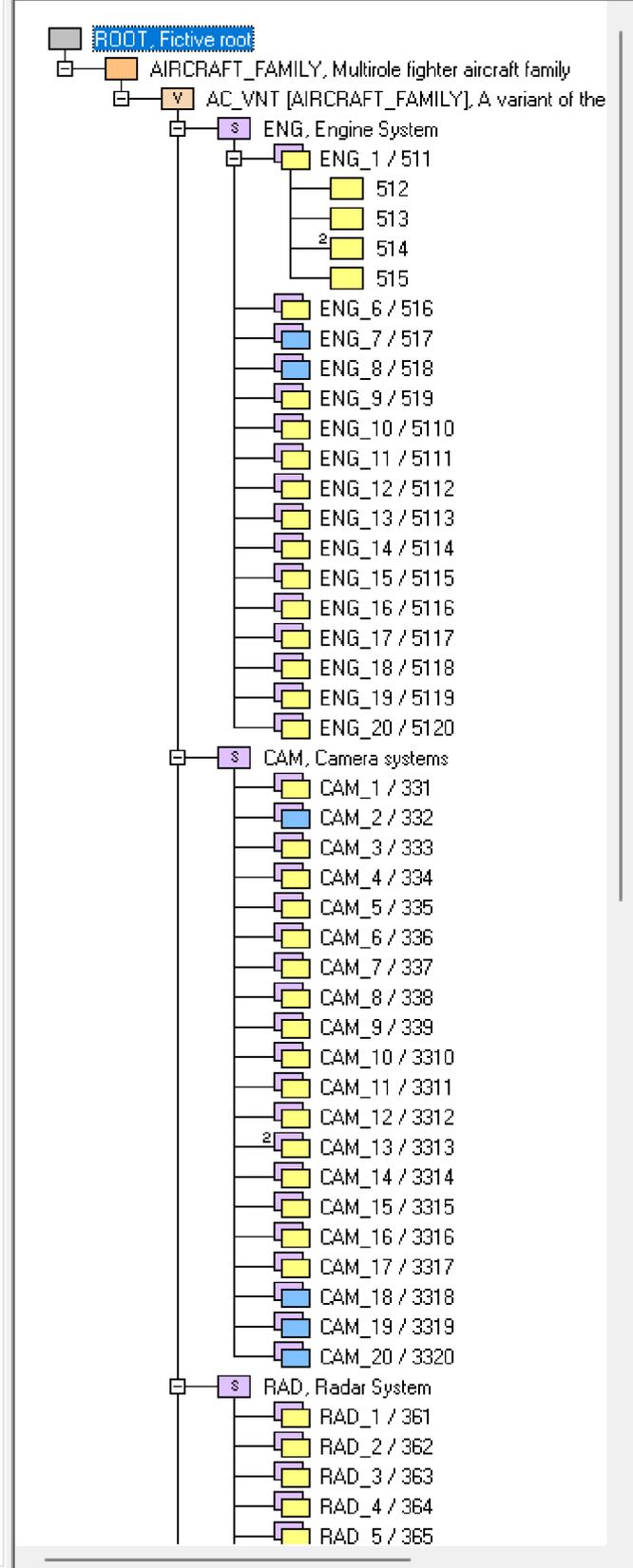
# A/C example with SIMLOX result viewer



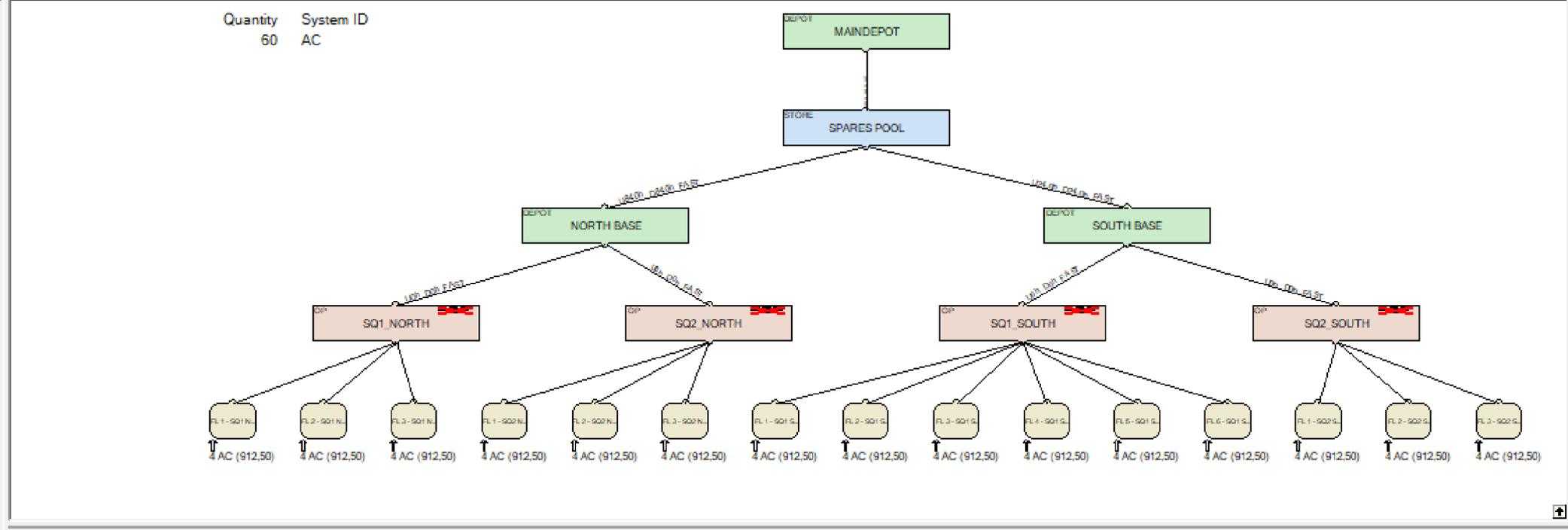
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  - Failures
  - Maintenance
    - Task
    - MaintenanceLevel
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    - OperationProfile
    - NonCriticalSet
    - NonCriticalSetBreakdownElement
    - SystemOperationalMode**
    - OperationalMode
    - MissionOperationalMode
  - Allocations
    - StockAllocation
- Result

Product Breakdown



Support organization

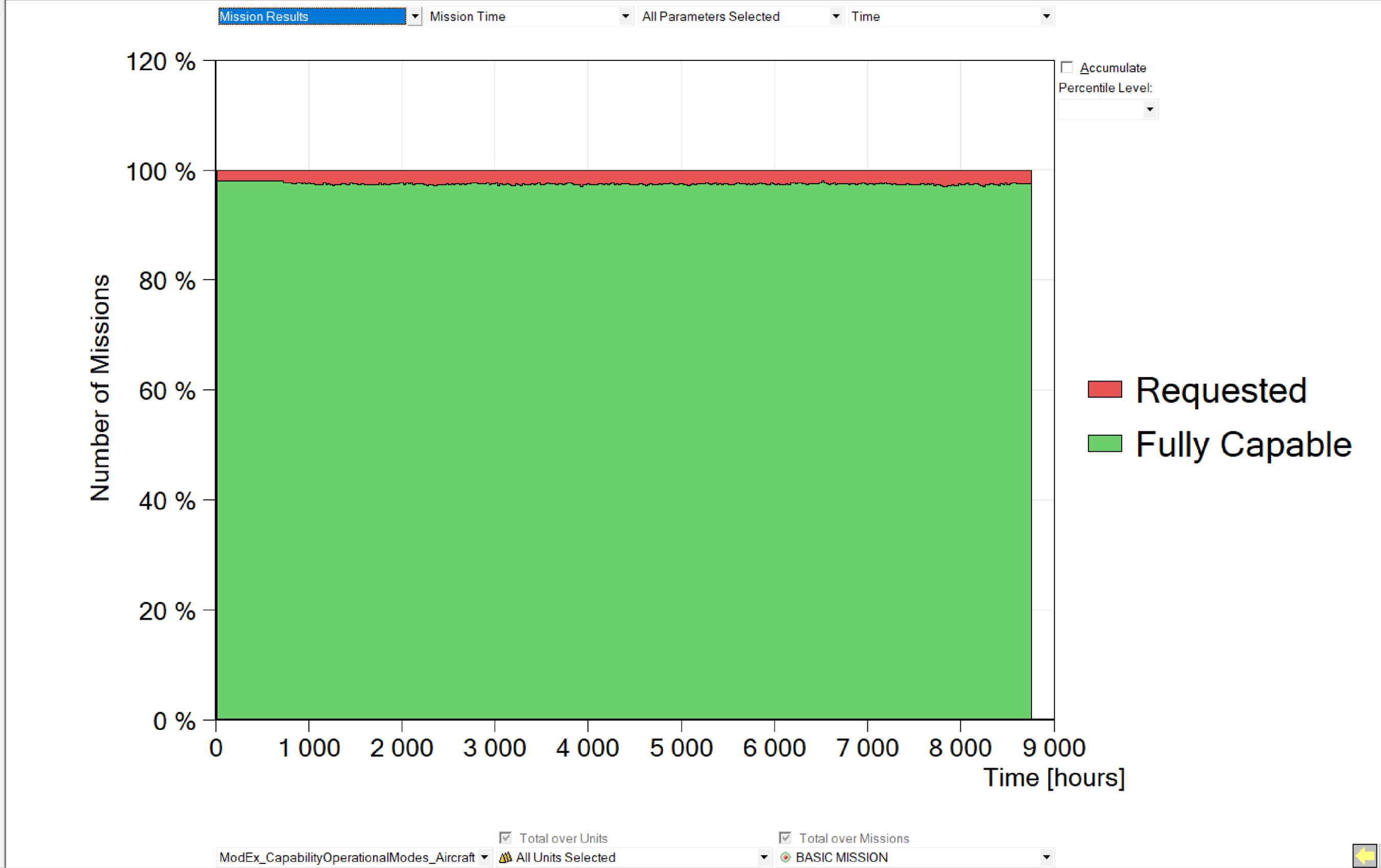


SystemOperationalMode

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1 AC	BASIC FLIGHT	NCS_ENG_CRITICAL		
2 AC	AIR-TO-AIR	NCS_ENG_RAD_CRITICAL		
3 AC	AIR-TO-GROUND	NCS_ENG_CAM_CRITICAL		
4 AC	RECONNAISSANCE	NCS_ENG_ANT_CRITICAL		

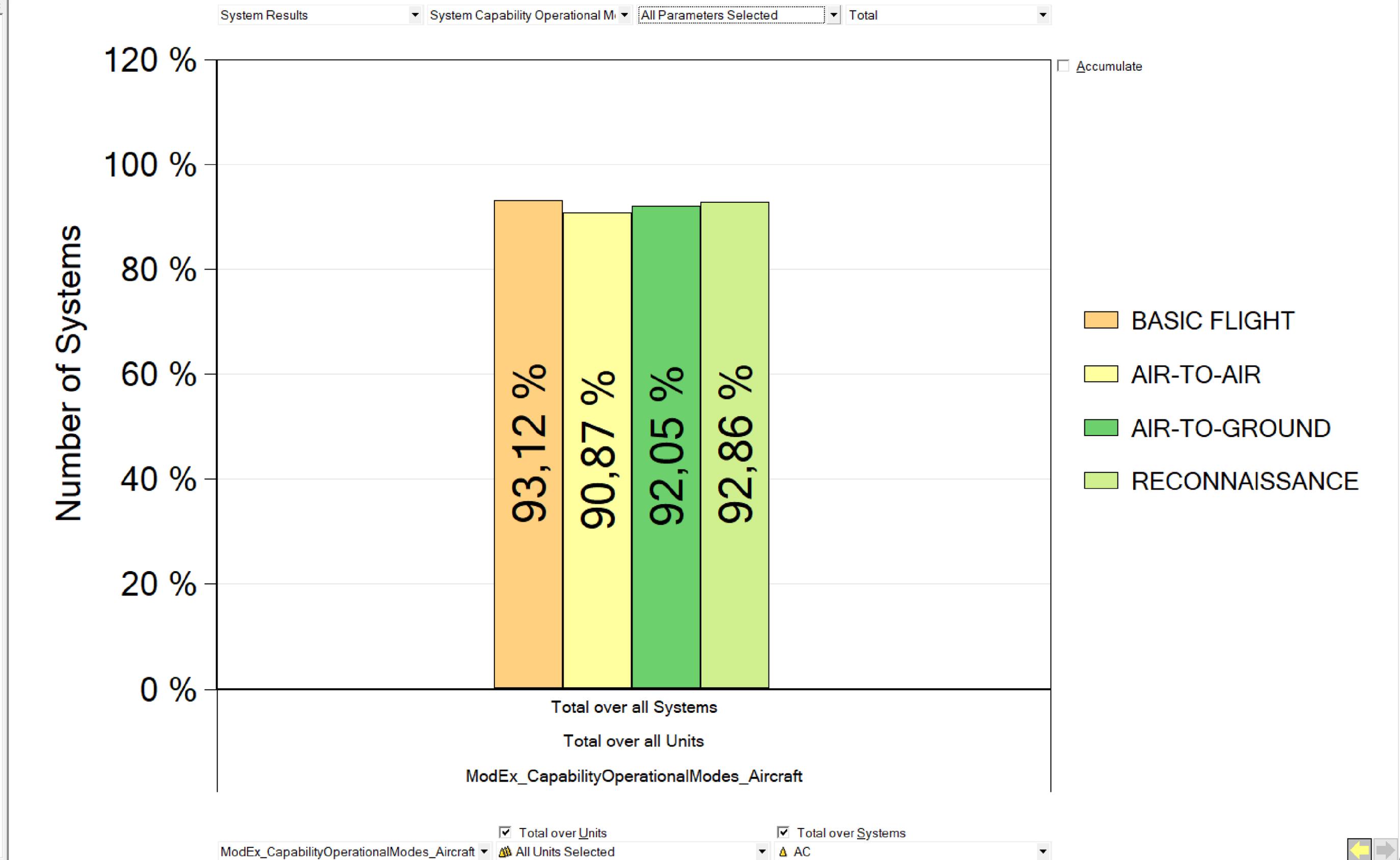
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      - StockAllocation
  - Result

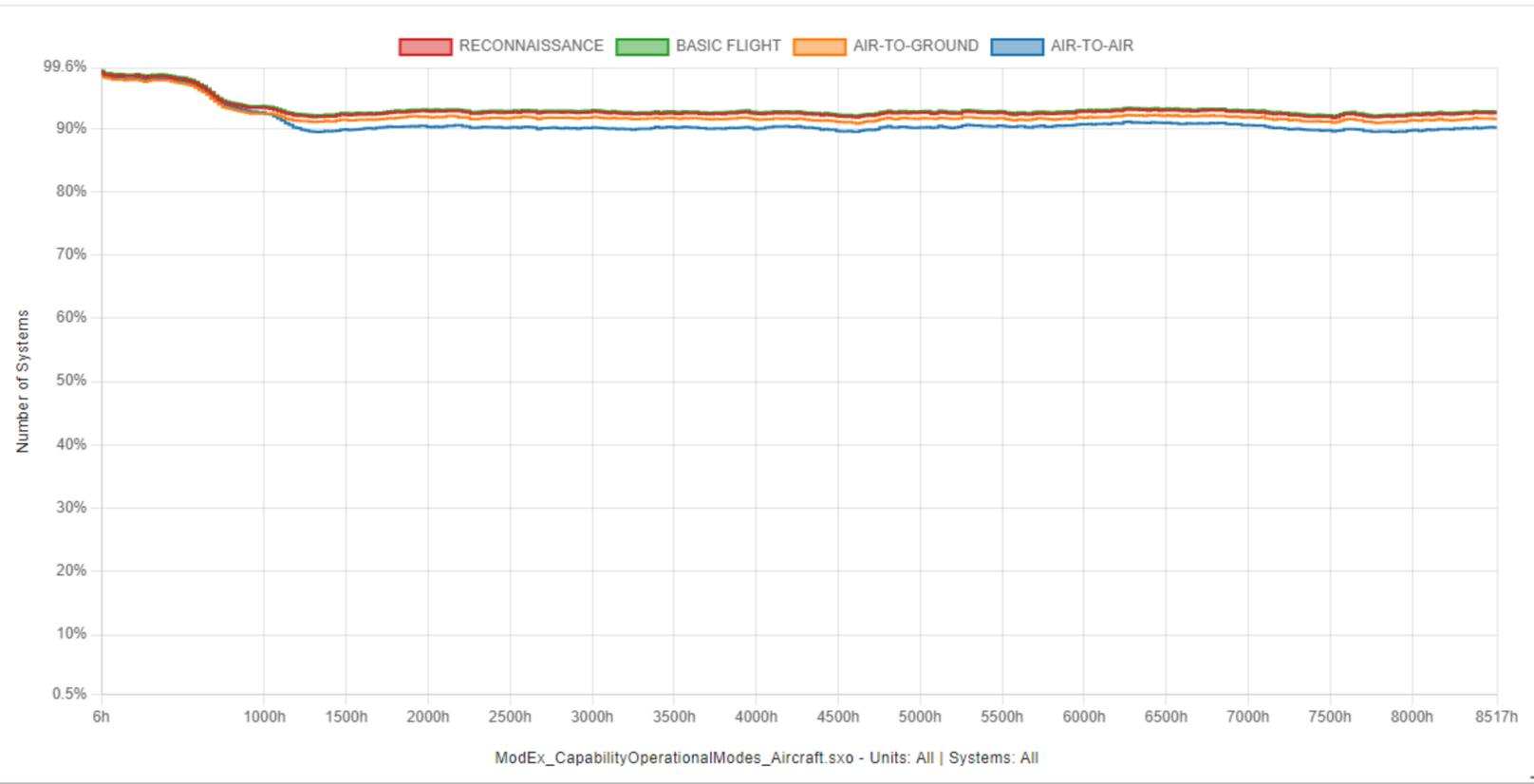


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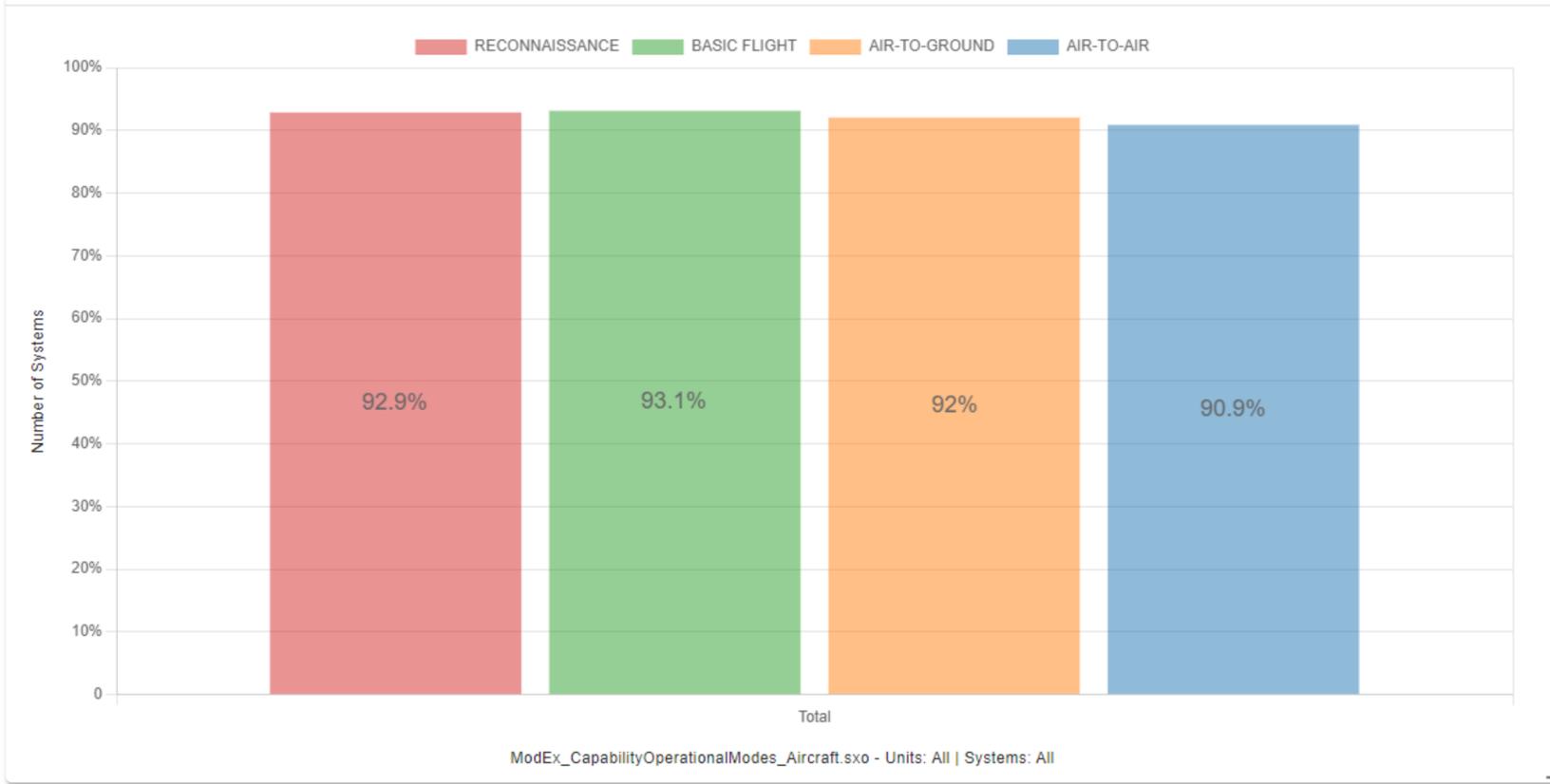
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    - Maintenance
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      - StationStructure
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      - StationGroupContent
      - ReorderCapability
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    - Allocations
      - StockAllocation
  - Result



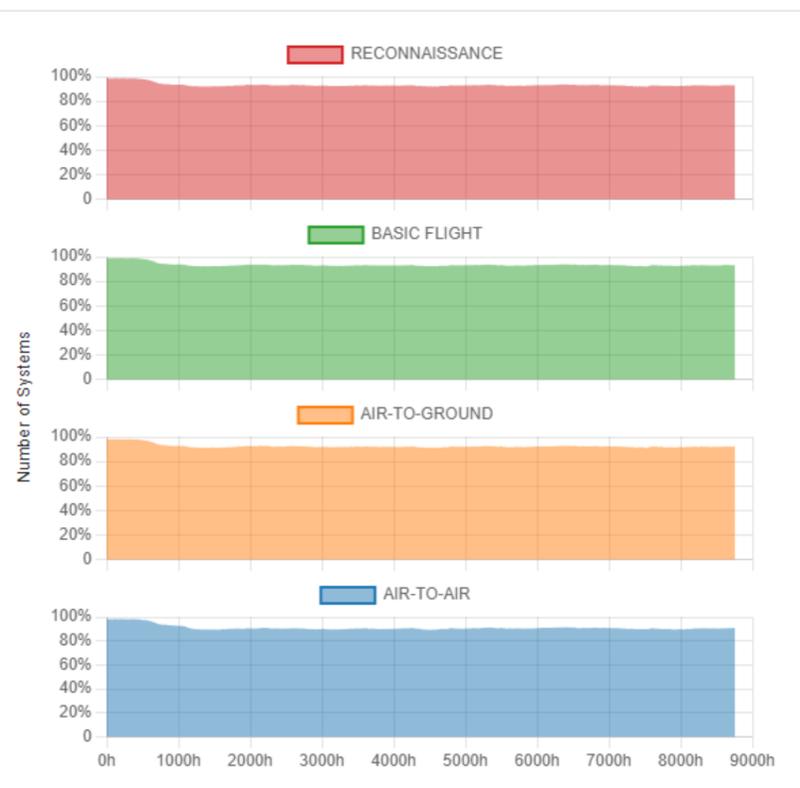
System Capability Operational Mode - time interval average



System Capability Operational Mode - scenario average

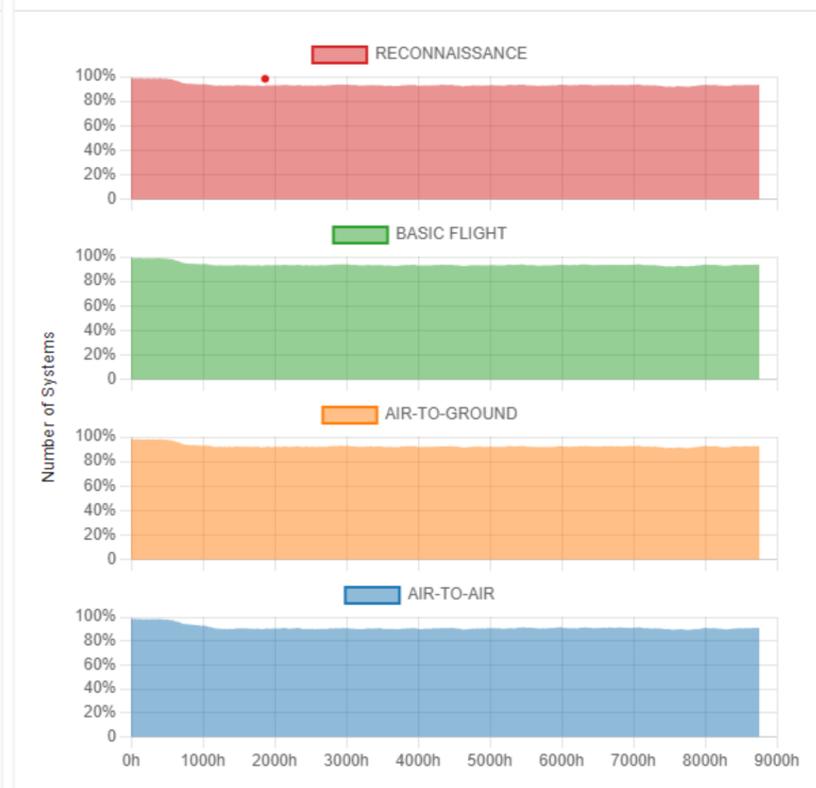


System Capability Operational Mode - time interval average



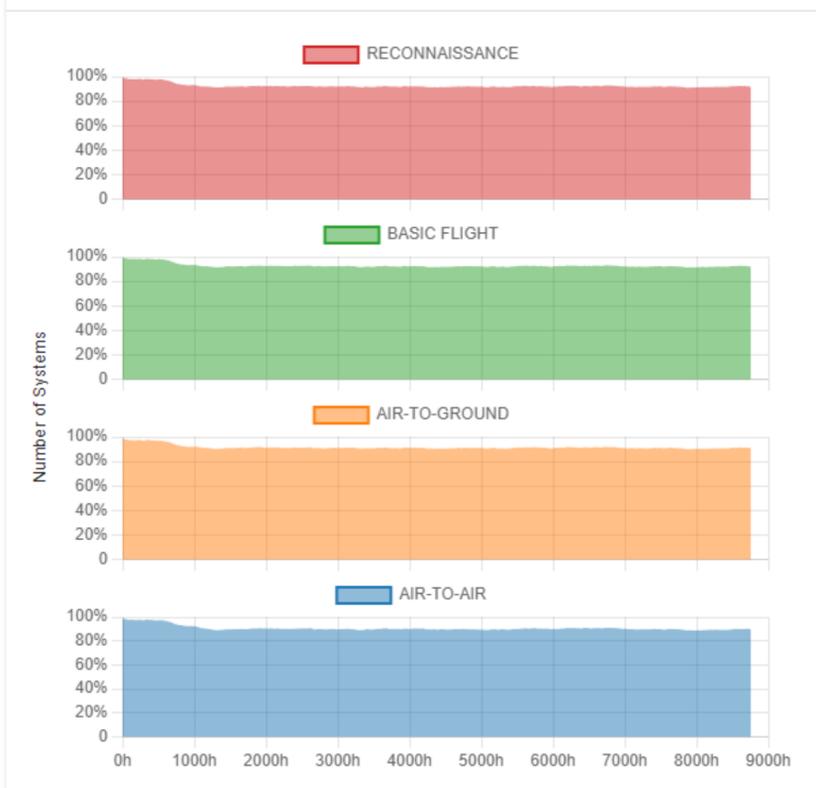
SQ1 SOUTH

System Capability Operational Mode - time interval average



SQ2 SOUTH

System Capability Operational Mode - time interval average

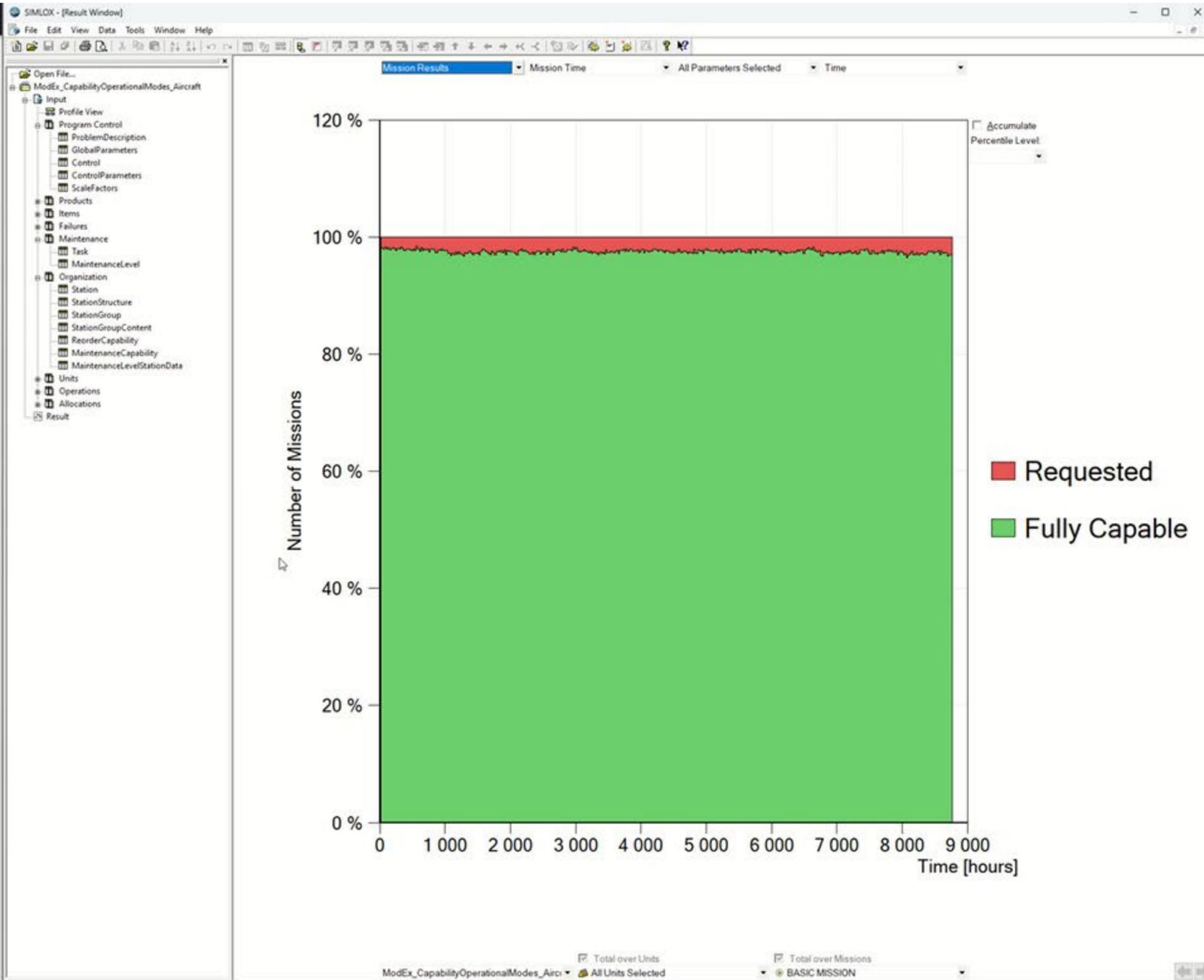
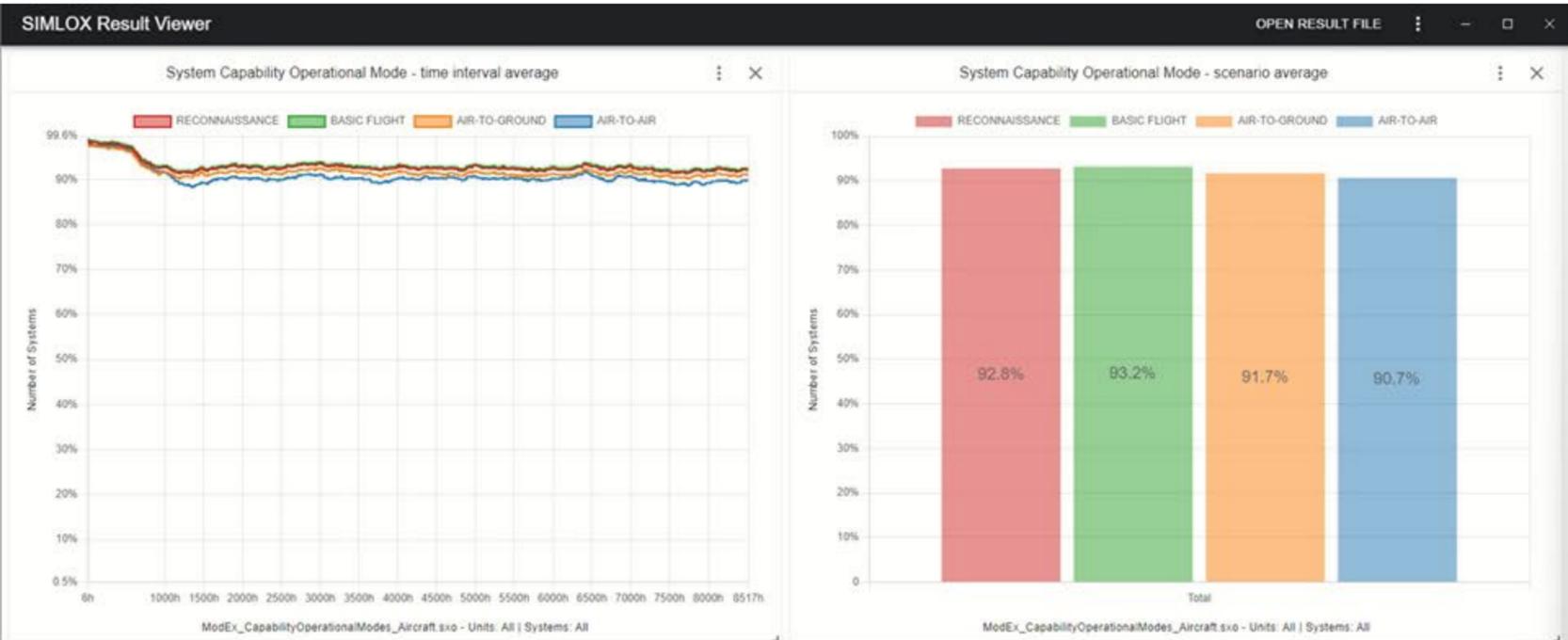


SQ1 NORTH

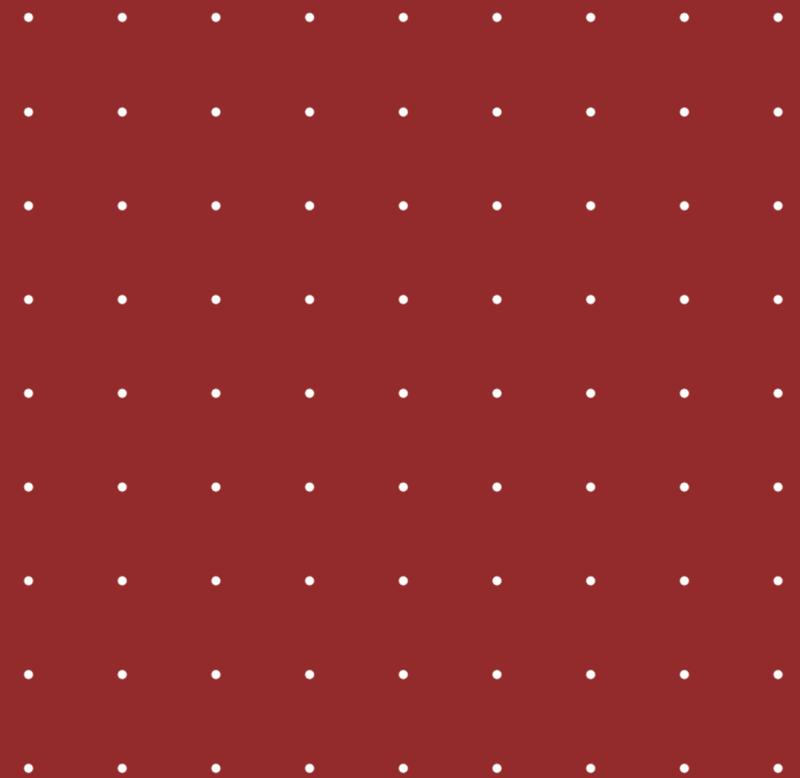
System Capability Operational Mode - time interval average



SQ2 NORTH



# OPUS10: Curve Fill



# CFILL – Curve Filling



ON/OFF

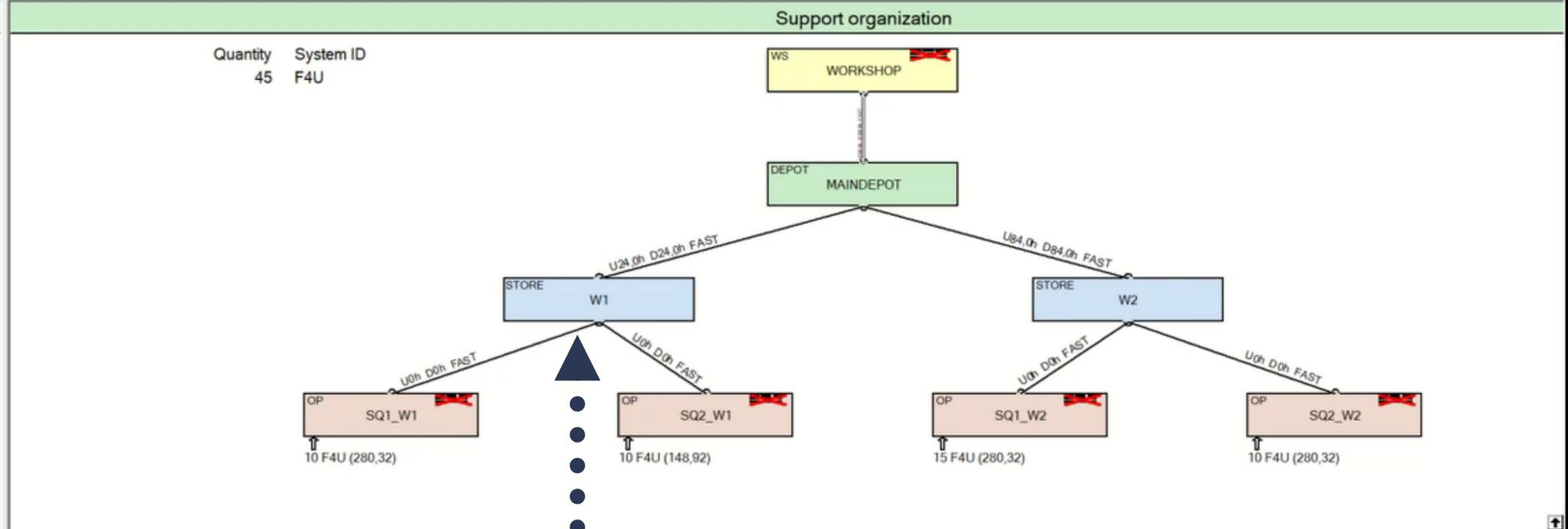
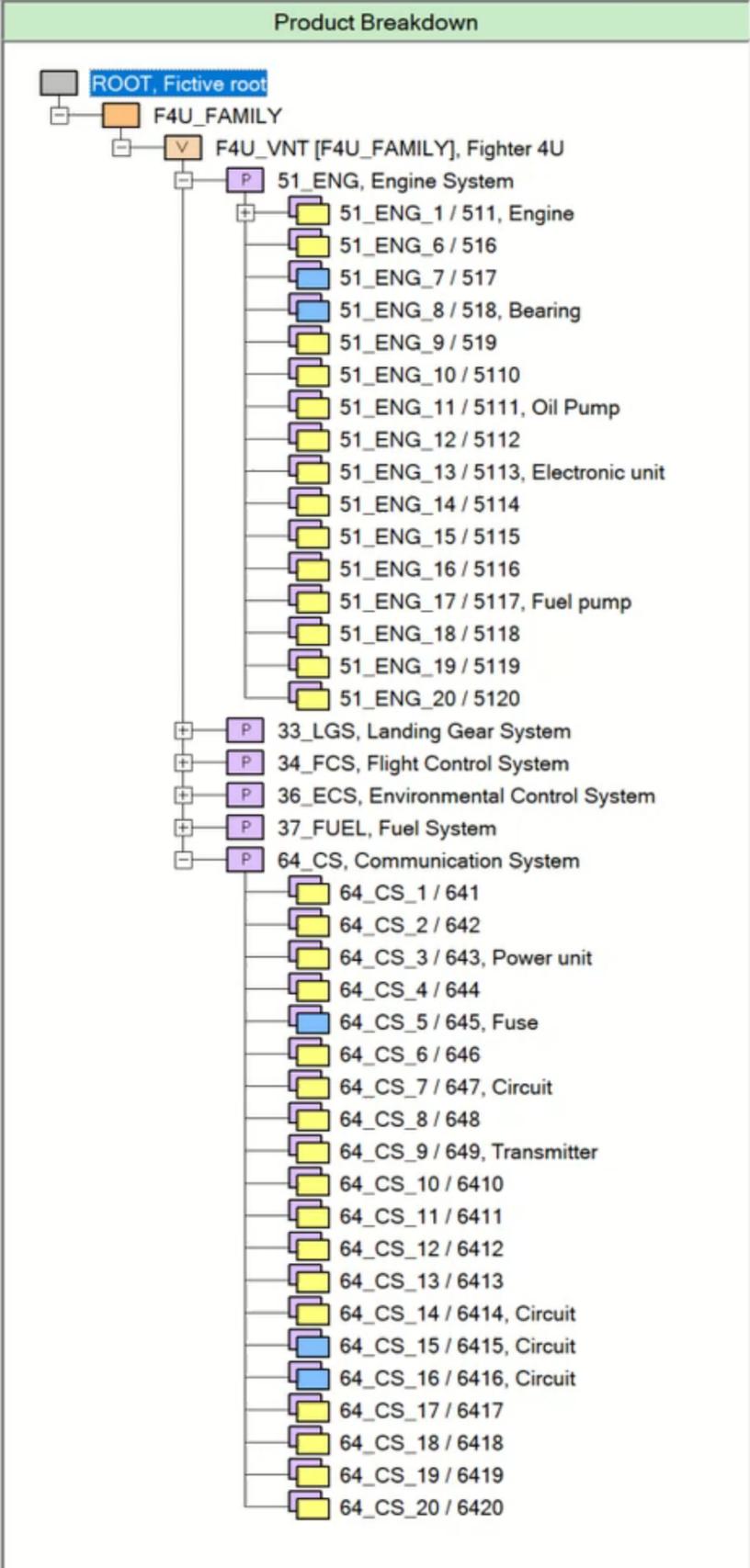
# CFILL – Curve Filling



ON/OFF

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      - ProblemDescription
      - GlobalParameters
      - ControlParameters
    - Products
    - Items
    - Failures
    - PM
    - Maintenance
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    - Resources
    - Allocations
  - Result

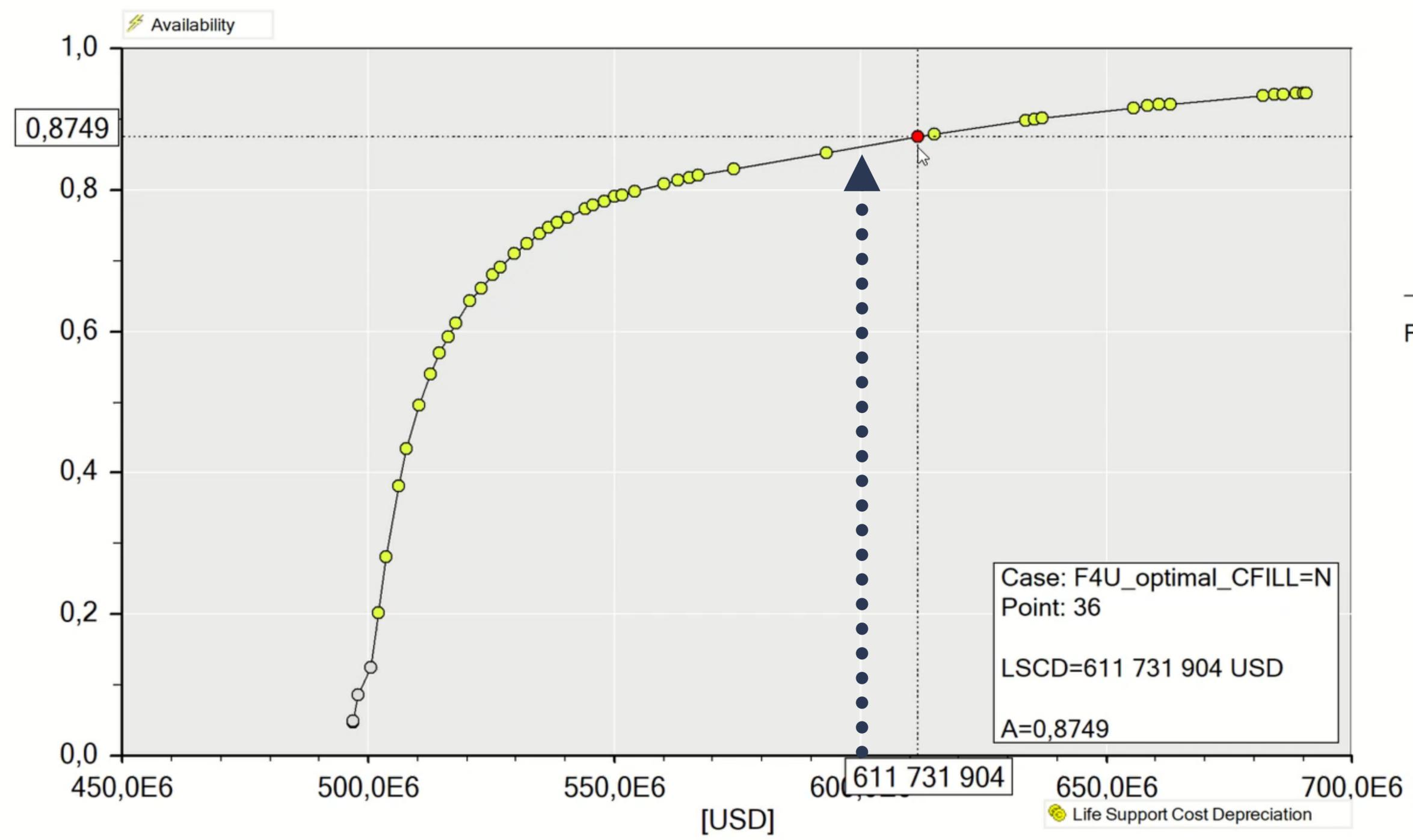


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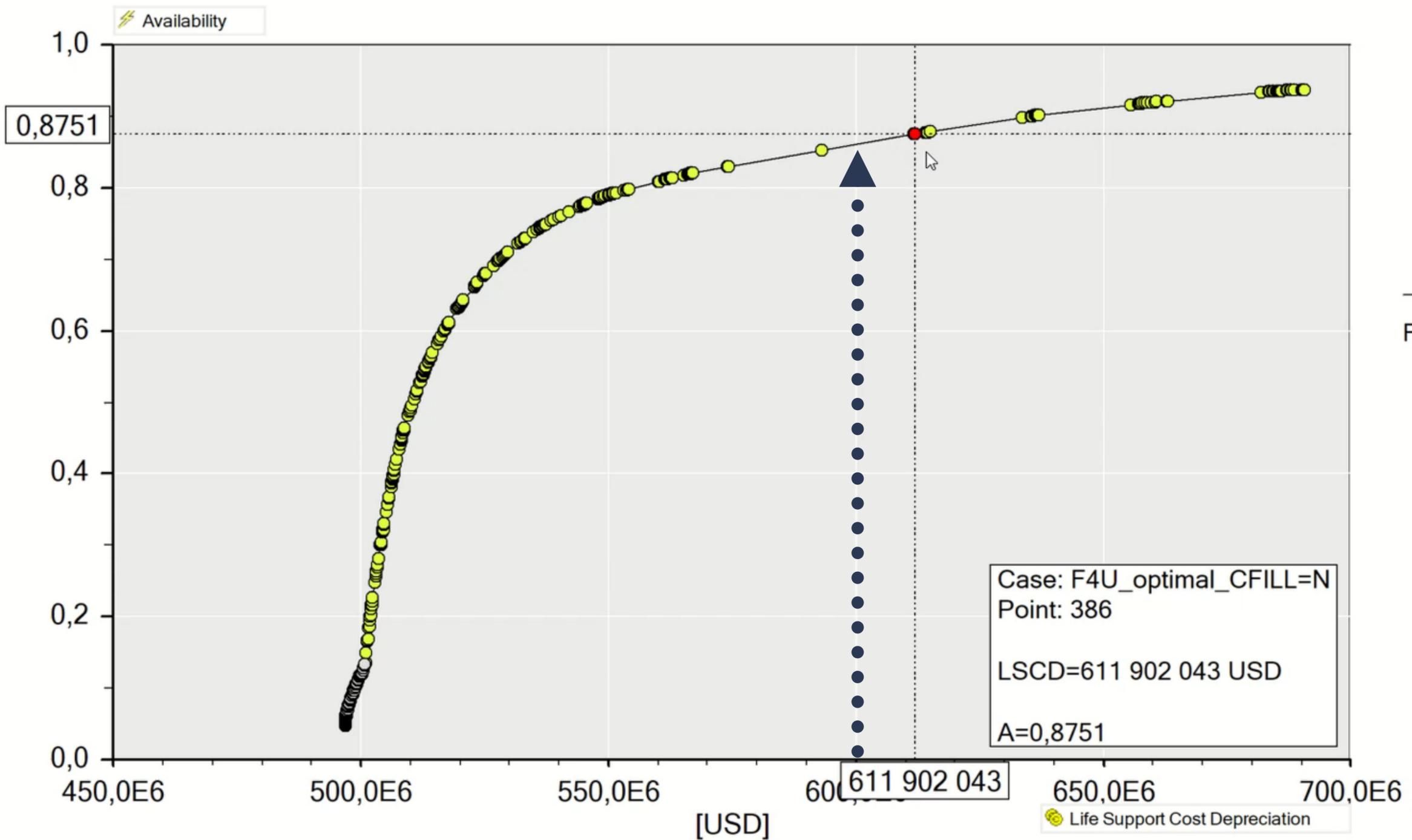
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PTYPE	Spares problem type	<INITIAL>
LORA-XT	Extended LORA problem scope	<N>
PHASC	Phase scenario problem scope	<N>
NITER	Number of iterations	
APID	Allocation point identifier	
PRMOE	Primary MoE	<A>
NPOINT	Number of points	<200>
MINLSC	Minimal LSC	
MAXLSC	Maximal LSC	700 000 000,0
MINMOE	Minimal MoE	
MAXMOE	Maximal MoE	
STEXP	Stock policy explicitly declared	<N>
INCEX	Include existing stock and existing resources in investment	<Y>
FOMRC	First-order model for resupply cycle	<N>
STARC	Start optimization at NRSC	<N>
OPROS	Minimize risk of shortage	<N>
ENDEM	Endurance MoE at end of period	<N>
PREAL	Partial reallocation	<N>
APLIM	Lower limit on NRSC0 for autopack	
RICCS	Reorder items cost calculation stock	<AVERAGE>
CFILL	Enable curve filling	<Y>
ENPR	Enable parallel replacements	<N>
ENFBD	Enable functional breakdown	<Y>

- Open File...
- F4U\_optimal\_CFILL=N
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      - ProblemDescription
      - GlobalParameters
      - ControlParameters
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    - Items
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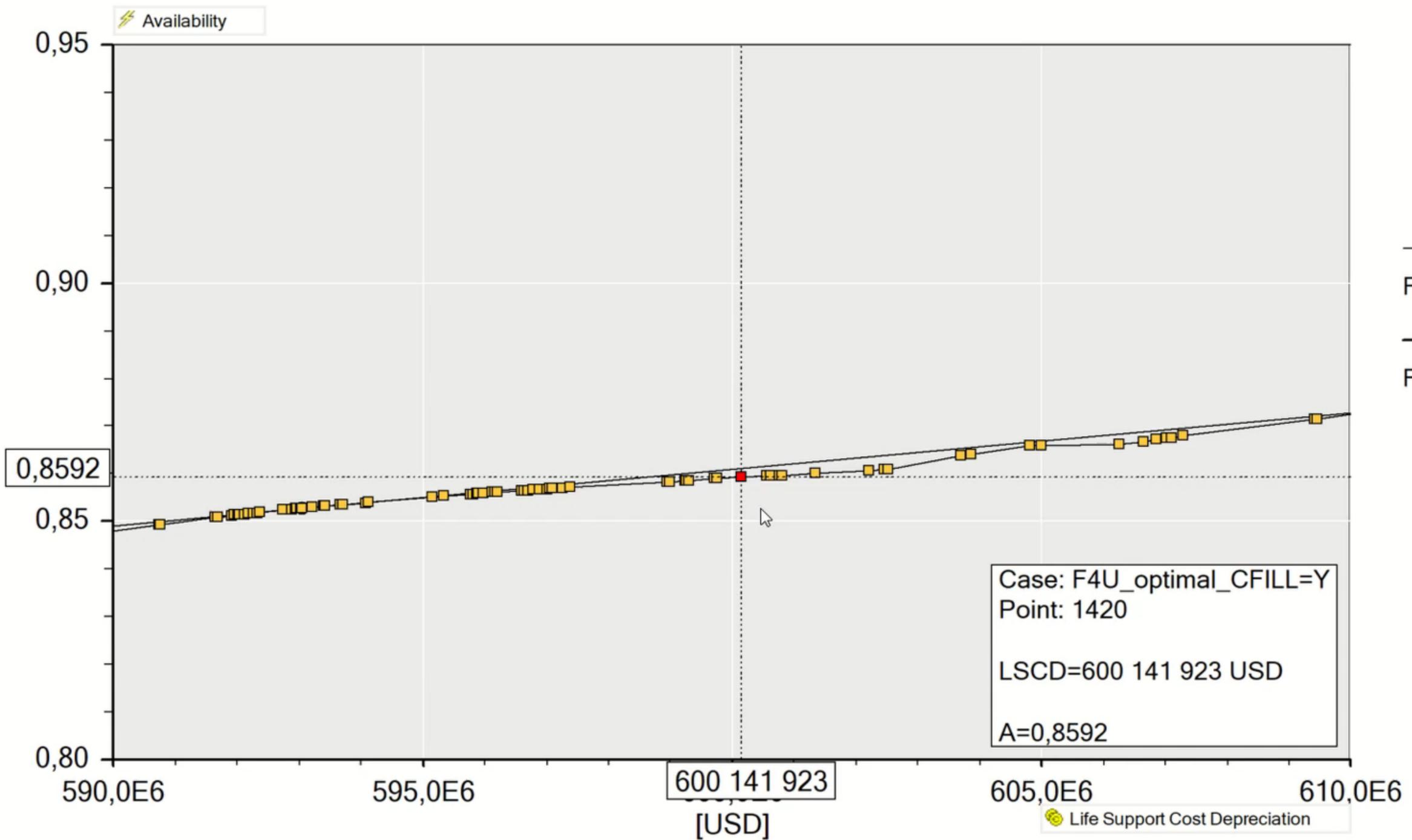
# C/E-Curve Diagram



# C/E-Curve Diagram



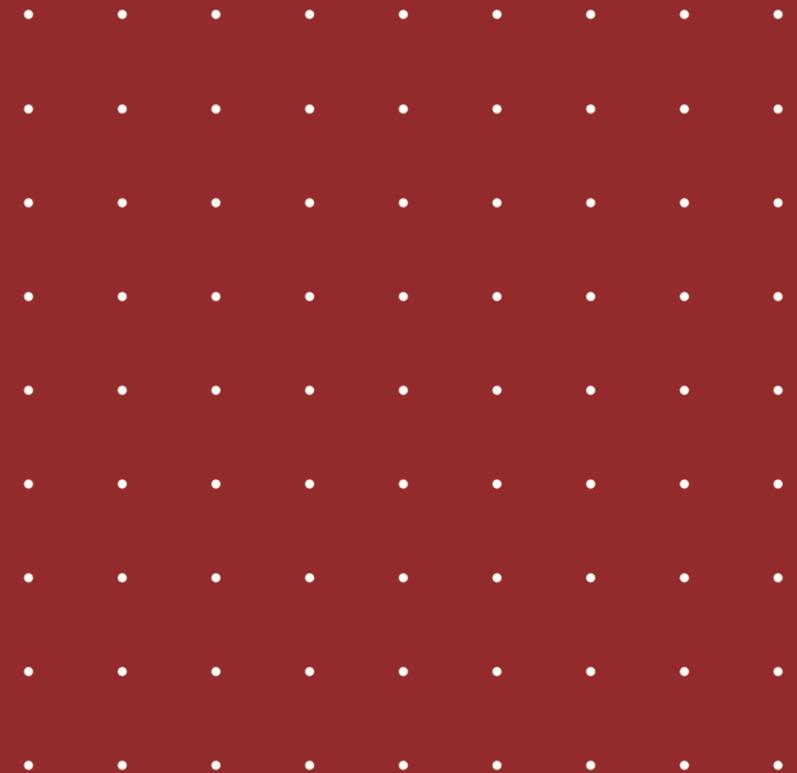
# C/E-Curve Diagram



F4U\_optimal\_CFILL...  
F4U\_optimal\_CFILL...

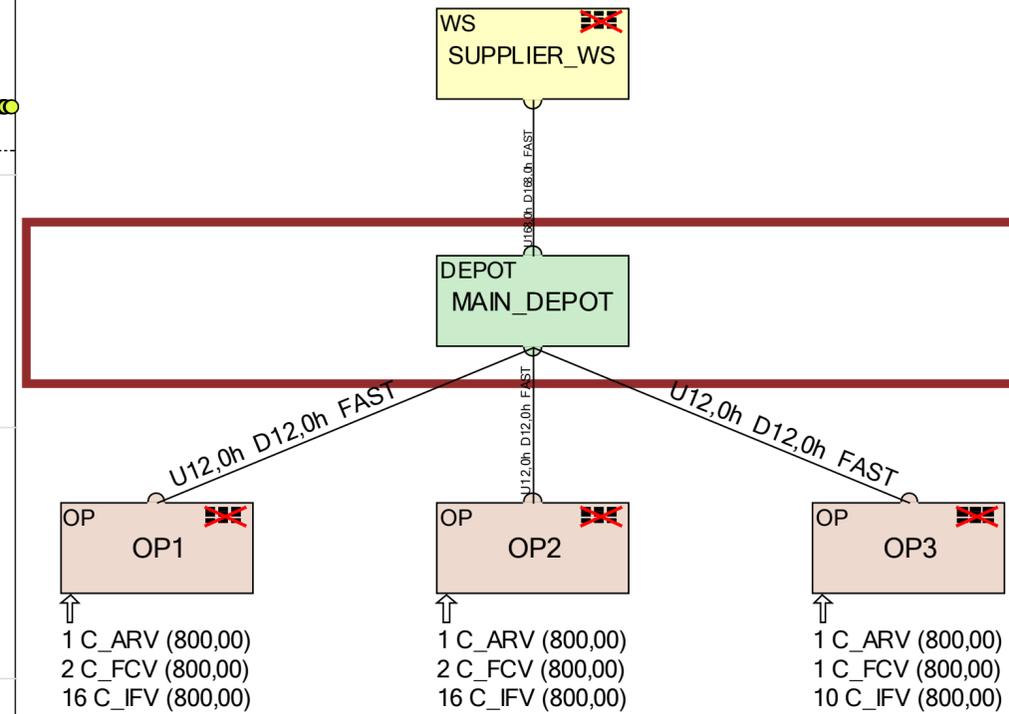
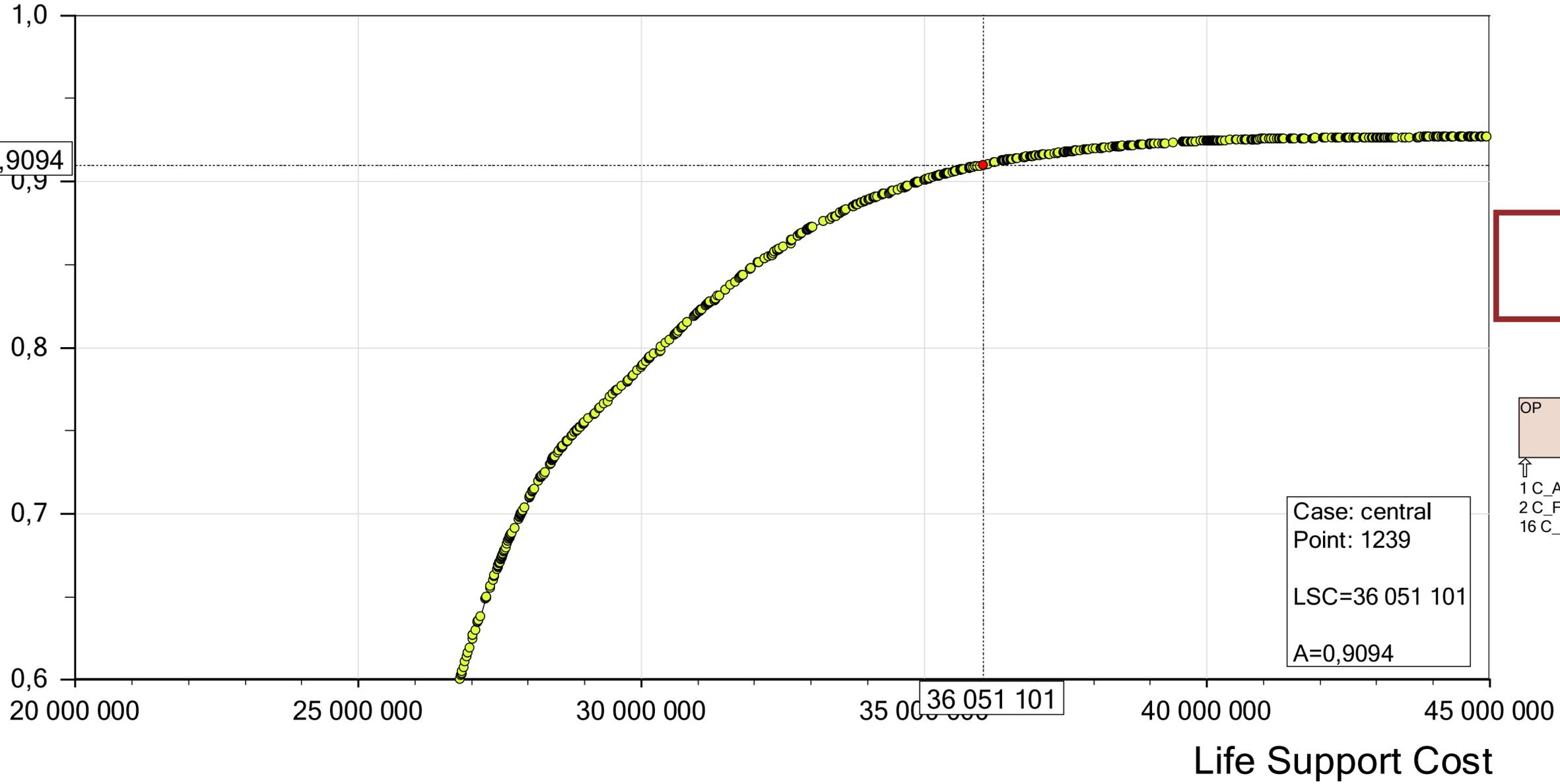
# OPUS10: Improved LORA-XT

From Level of Repair Analysis to Maintenance Concept Optimization



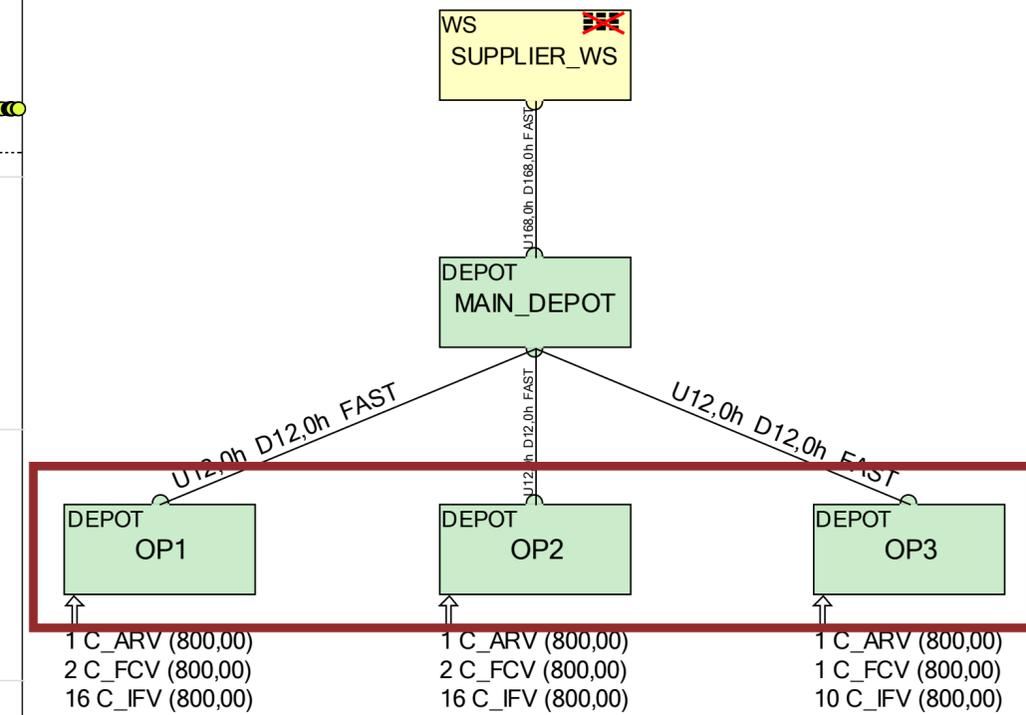
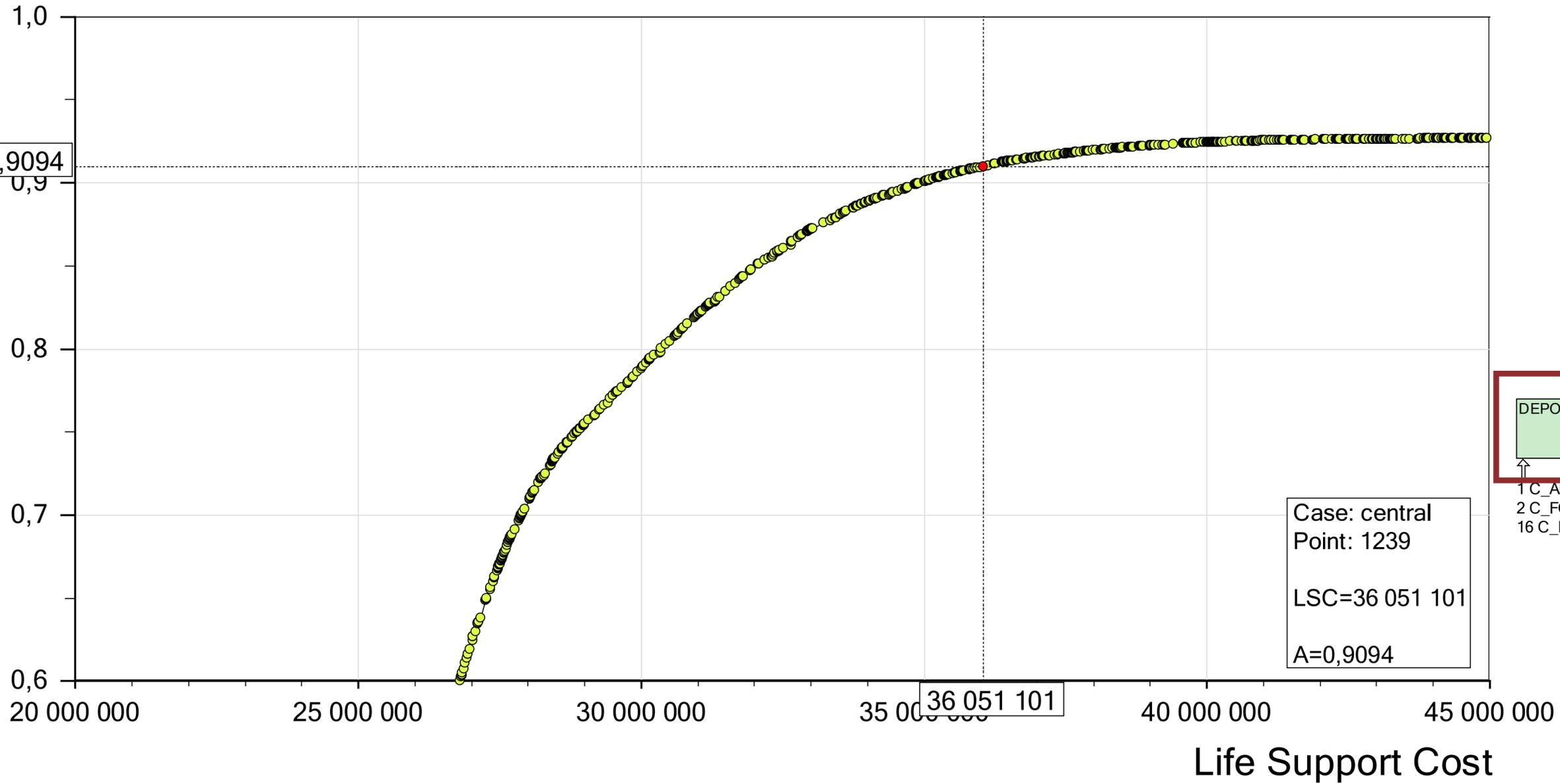
# C/E-Curve Diagram

Availability



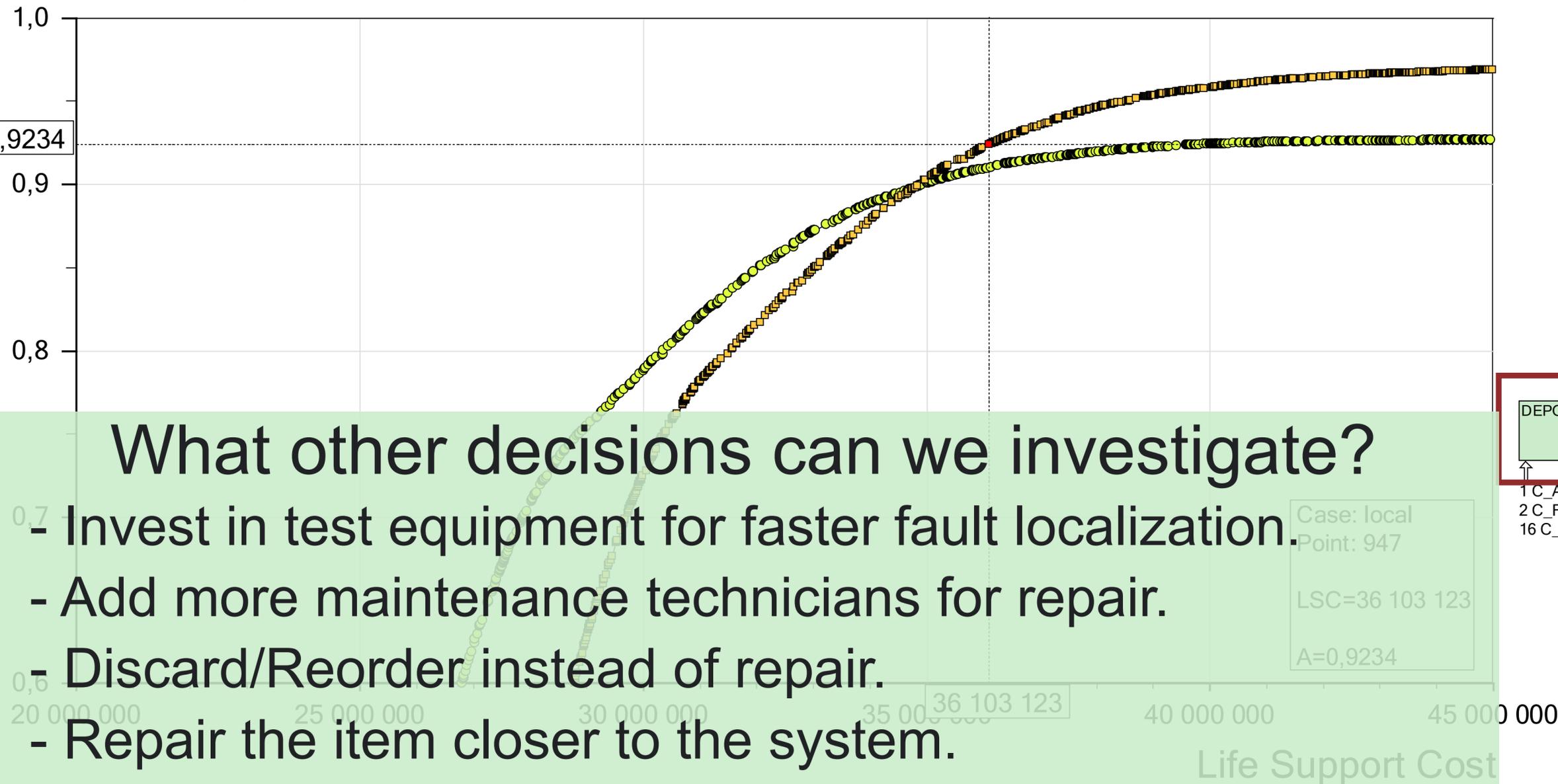
# C/E-Curve Diagram

Availability



# C/E-Curve Diagram

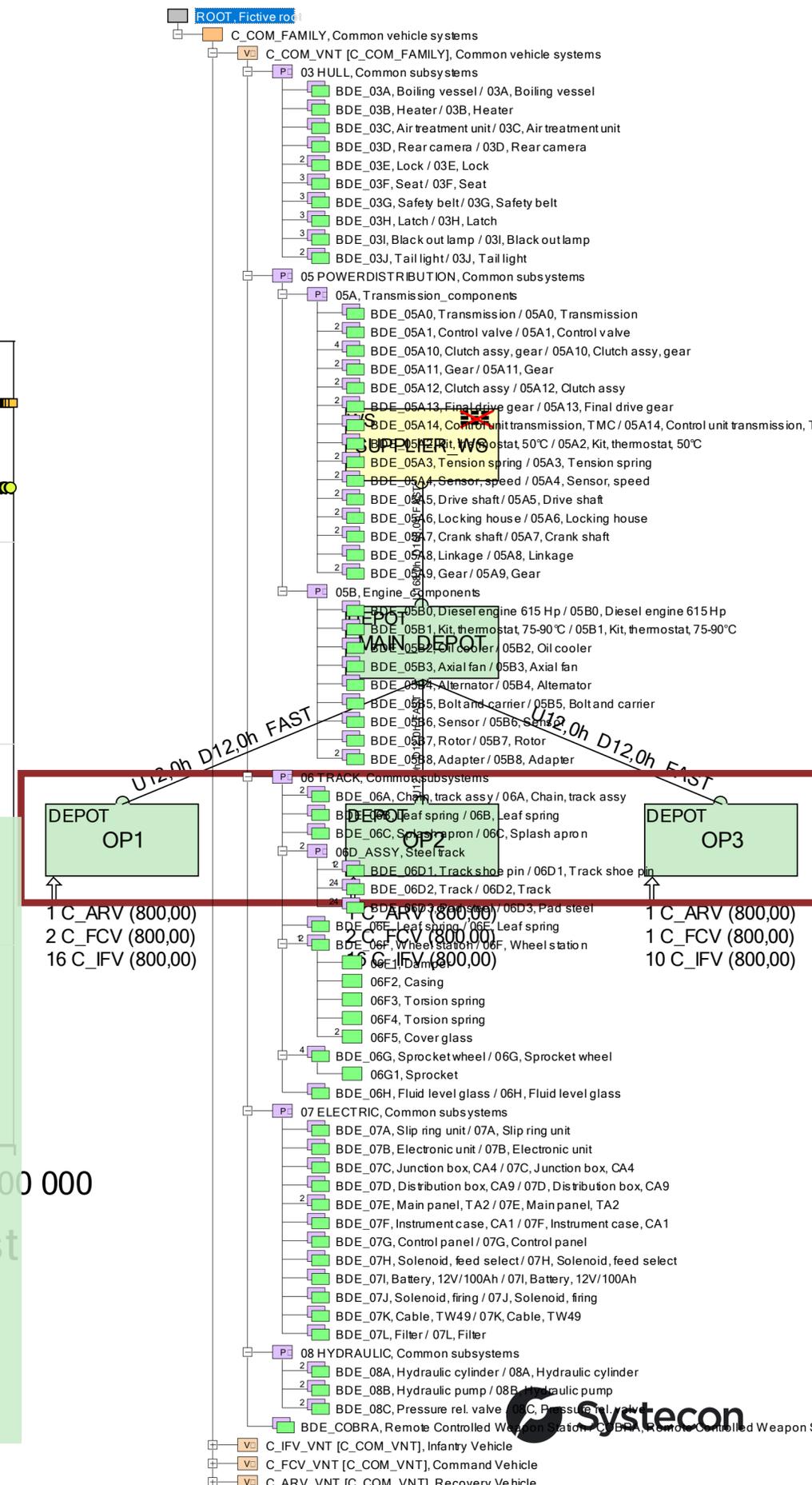
Availability



What other decisions can we investigate?

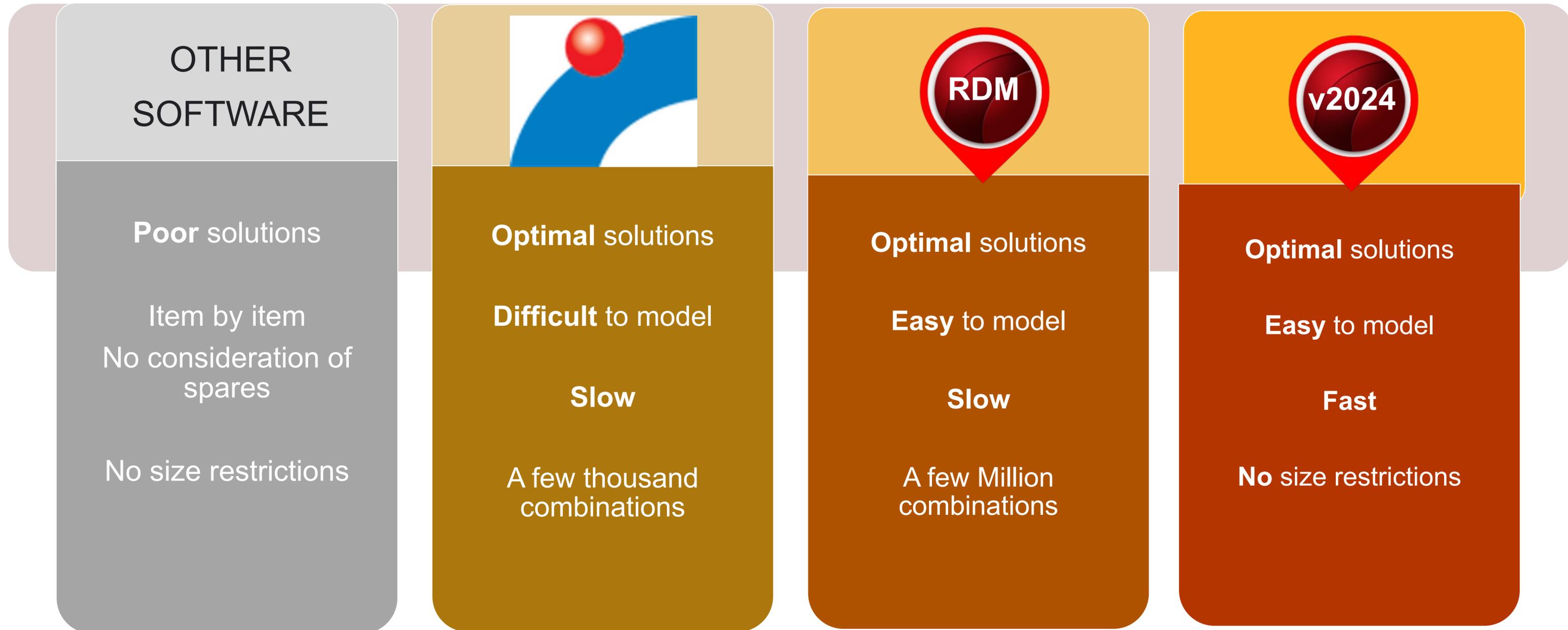
- Invest in test equipment for faster fault localization.
- Add more maintenance technicians for repair.
- Discard/Reorder instead of repair.
- Repair the item closer to the system.

Life Support Cost



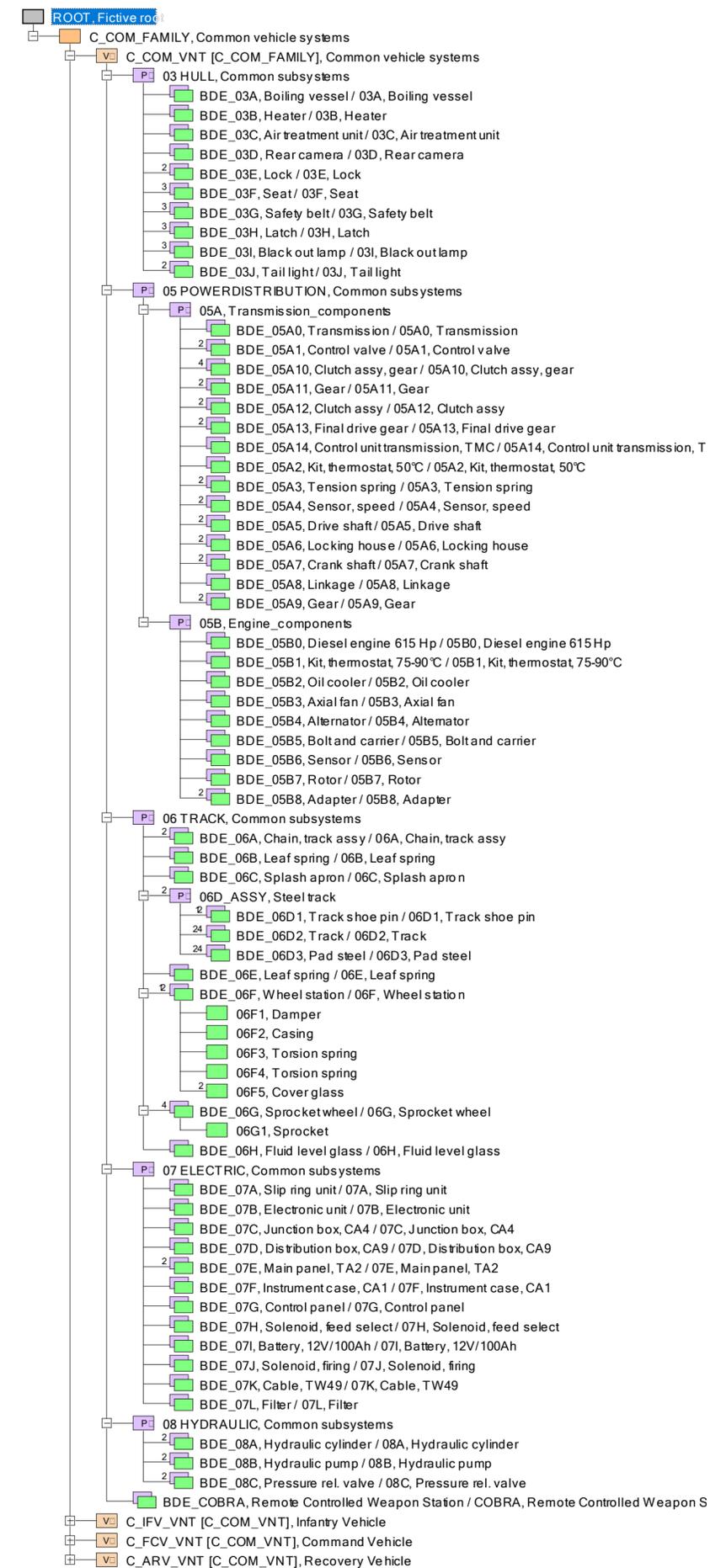
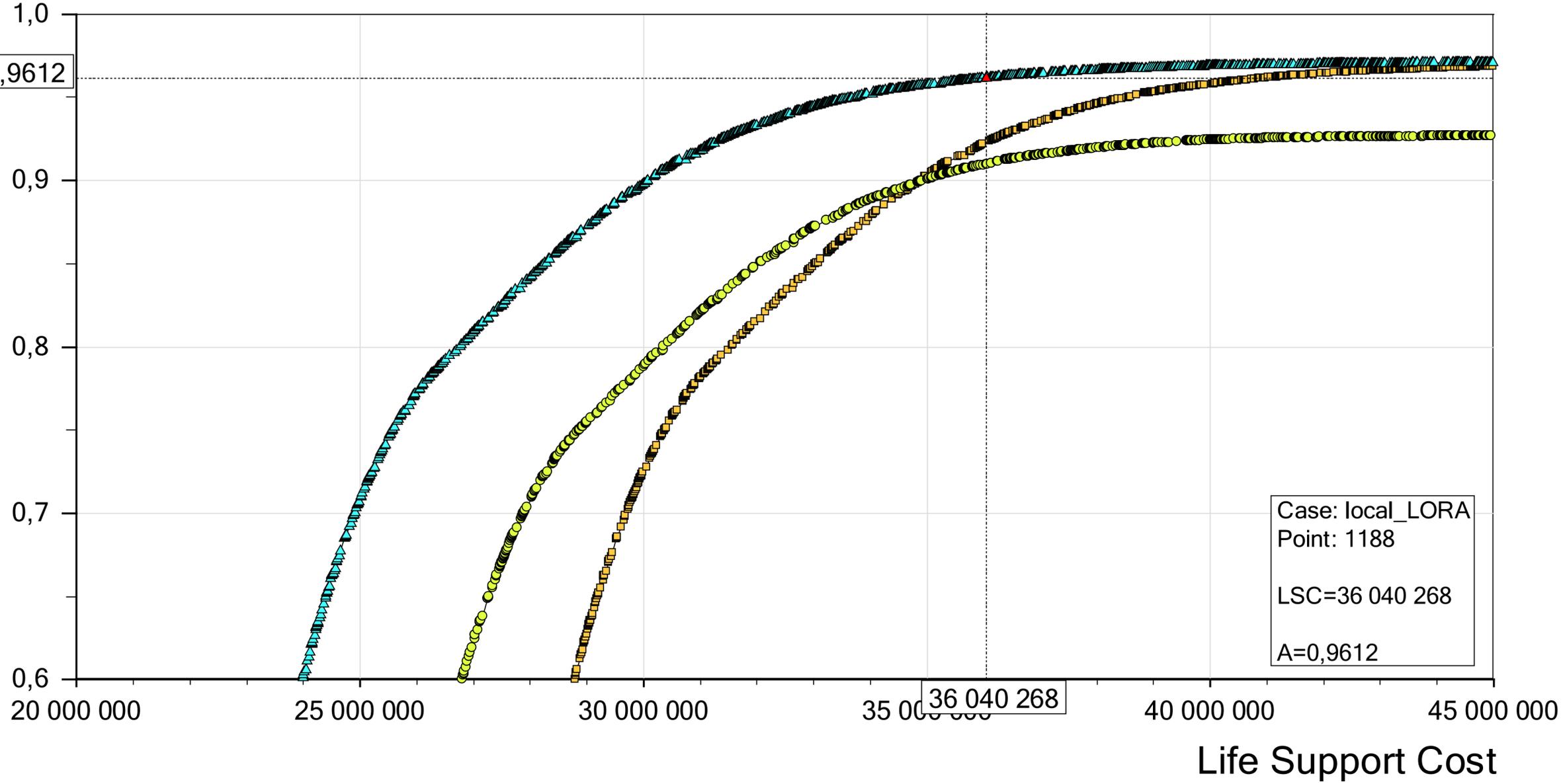
This should be done together with spares optimization

# LORA-XT



# C/E-Curve Diagram

Availability

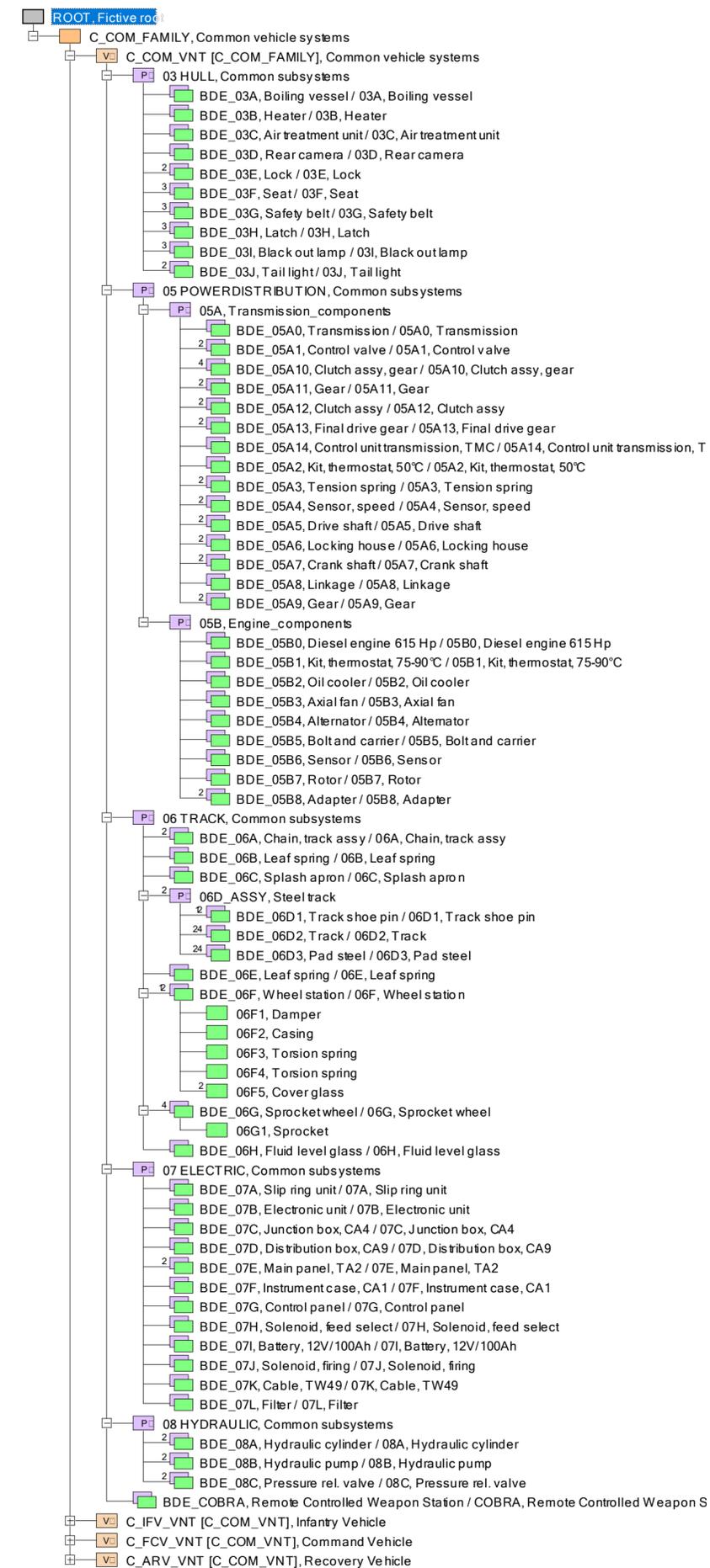


# Availability



Item ID	Maintenance strategy
05B0	REPAIR_05B0
05B1	<REORDER>
05B2	<REORDER>
05B3	<REORDER>
05B4	<REORDER>
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05B7	<REORDER>
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06F1	<REORDER>

# Life Support Cost



# Summary

## Added features:

- Capability results
- Result Viewer
- Filling gaps on the C/E-curve
- Enhanced performance for LORA-XT problems

## Additional features:

- Opus Evo: multi-constraints
- Filter functions in input tables
- Automatic item generation

# Coming soon...

## Features currently being worked on:

- OPUS10 Result Viewer
- Downtime drivers
- ...



# Thank you.

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