Optimizing Operations and Logistics Support Using Heuristic Optimization Techniques

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Content

Model Based Capabilities

Predictive Analytics for Life Cycle Sustainment

- Model and simulate impact of decisions
- Risk management:
  - Cost vs. performance

Analysis of Alternatives

- Location of Repair Analysis
- Resource Dimensioning

Influencing the Current State

- Identification of cost and availability drivers
- Spares optimization

Opus Suite

OPUS10

- Spare parts optimization
- Logistics support

SIMLOX

- Mission performance over time

CATLOC

- Life cycle cost analysis

Opus Suite Connect

- Standards (GEIA-Std-0007, S3000L to Opus Suite)

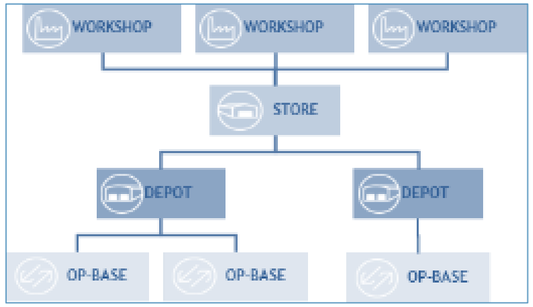
Opus EVO

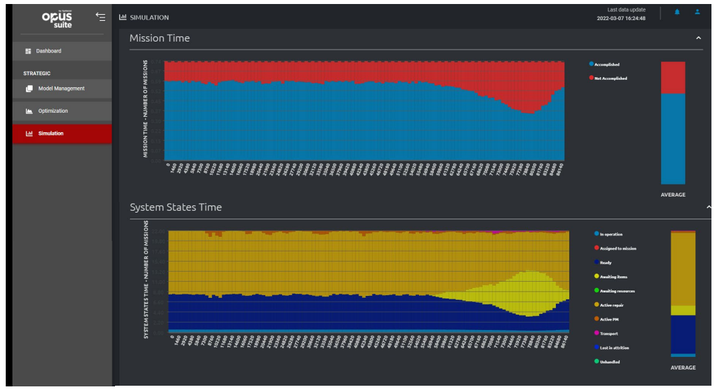
- Optimization using simulation

Domain Model

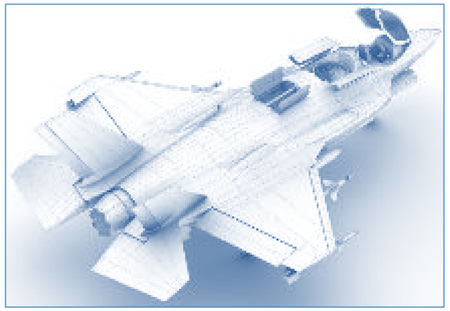
STATE & PREDICTIONS

SUPPORT SOLUTION →





← TECHNICAL SYSTEM



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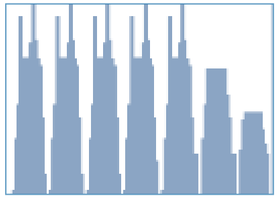
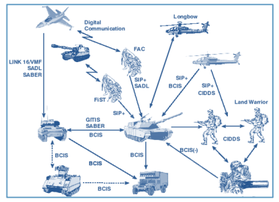
OPERATIONAL CONCEPT



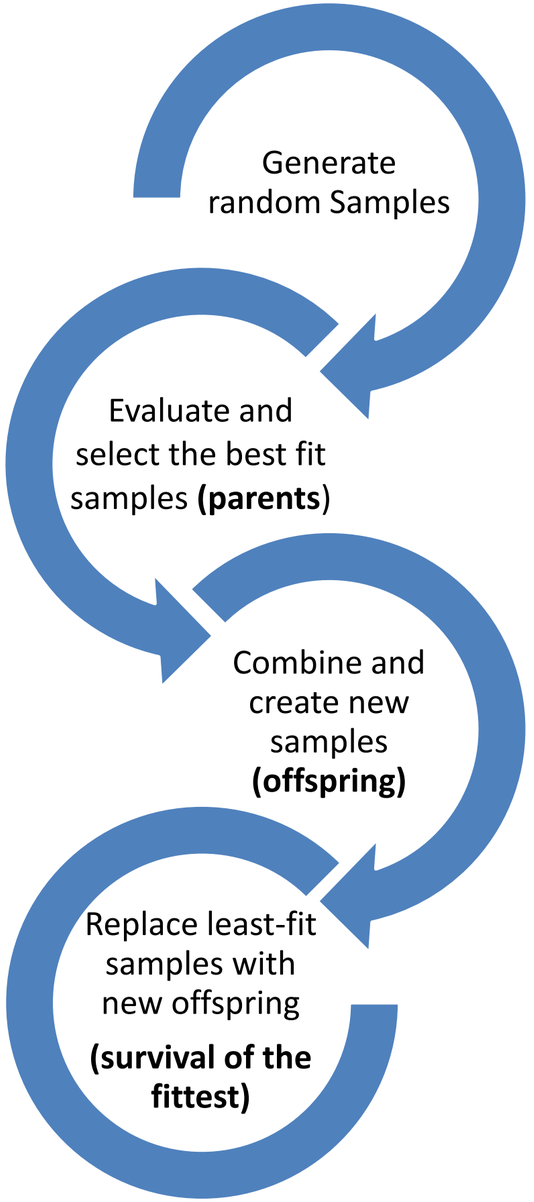


Domain Model

- What Scenarios do we model?
  - **Optimize** the number of spares
  - **Optimize** the maintenance strategy
- With SIMLOX we can **analyze** scenarios and different what ifs:
  - … we invest in an additional resource
  - … we deploy an extra system on the mission
  - … we invest in quicker transport
  - … we prolong the interval for preventive maintenance
- What if we want to optimize (any of) the above instead?

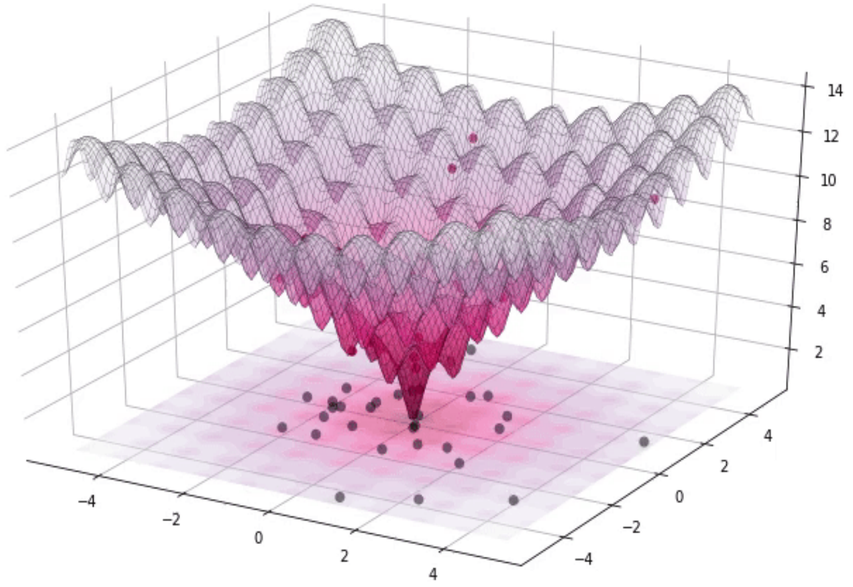
Evolutionary Algorithms

- Heuristic optimization algorithms
- Can “solve” anything that is evaluable (fitness function)
- Inspired by nature
  - Genetic algorithms
  - Differential evolution
- Scale well
- Quick implementations



Opus Evo

- **Differential evolution algorithm**
- **Opus Suite domain representation**
- **Domain to vector mapping**
- **Simulation as fitness function**
- **Computing orchestrator**

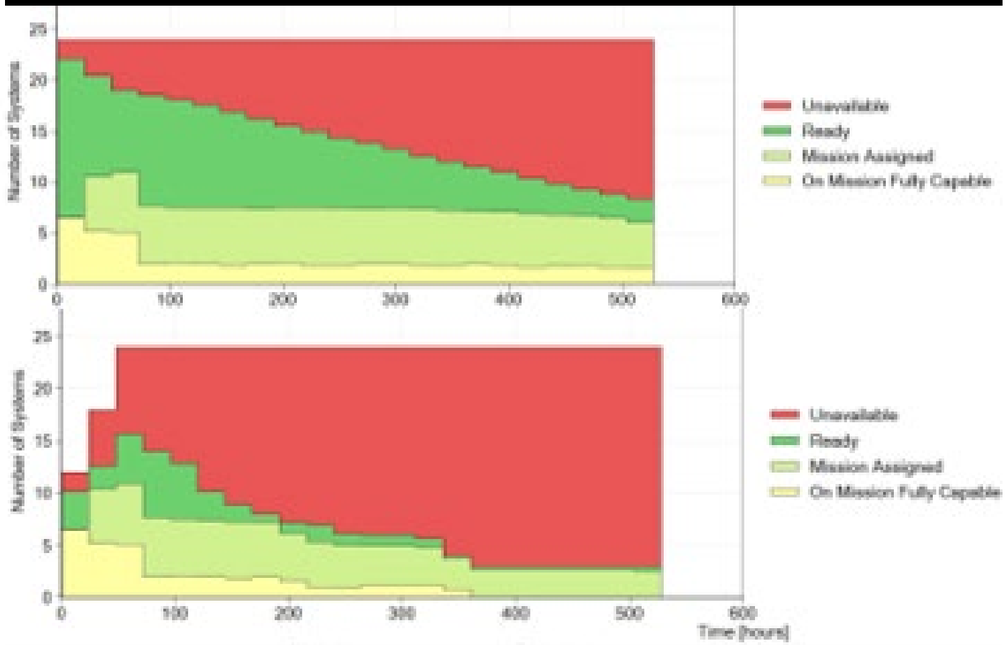


Case Study: Deployed Operations

- Scenario
  - Deployment of Fighter SQN
- Supply
  - Disconnected Ops
- Requirements
  - Exceed Capability/Decrease Footprint

Case Study: Deployed Operations

OPTIMIZATION MODEL RESULTS



MODEL BASED ON AF DEPLOYED PARTS

- Performance Modeling
  - Utilizing Maintenance Significant Items
  - Projected Flight Requirements

Next Steps and Future Work

- Tailored Results
- Tactical vs. Strategic
- Optimization outside of Cost vs Availability

Summary & Conclusion

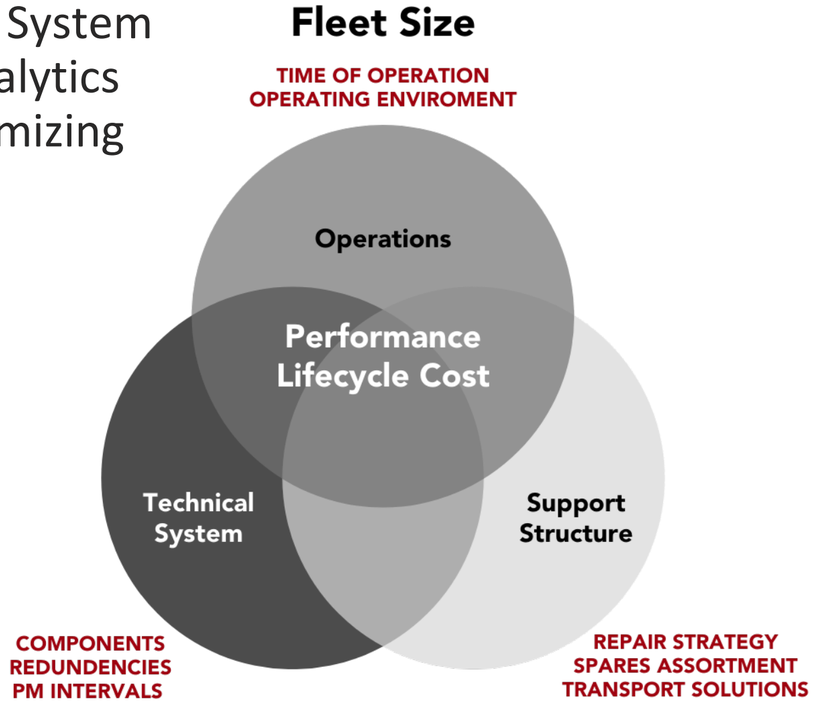
- *Method for evaluation of system availability and mission readiness*
- *Extended with optimization capabilities*
- *Optimization through simulation*
- *Case study for deployed operations*

”If it can be modeled, it can be evaluated. If it can be evaluated, it can be optimized”

About Systecon

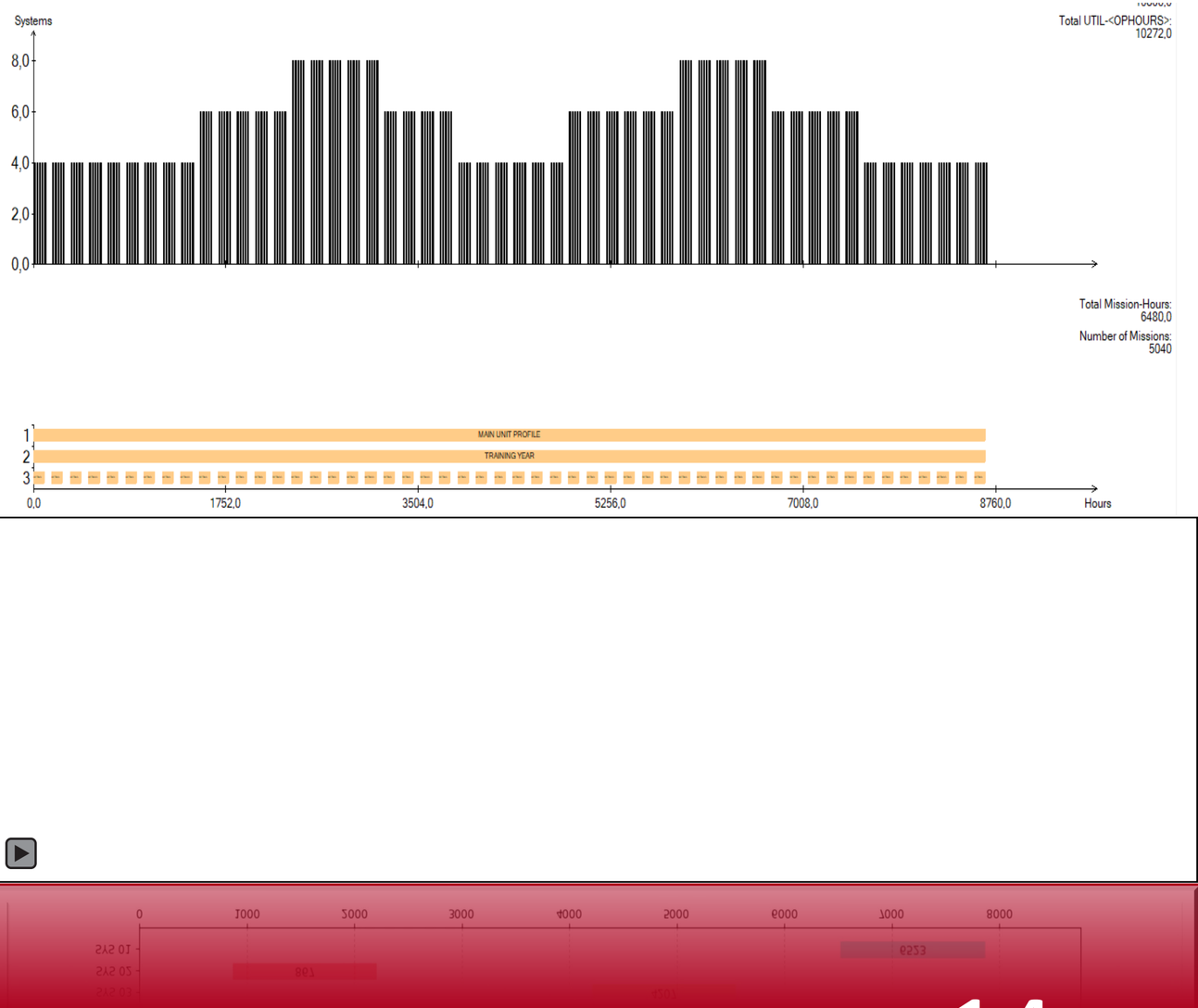
Systecon is the premier provider of software for System Cost/Performance Optimization & Predictive Analytics transforming the way customers approach maximizing the readiness and lowering operations costs of technically complex systems

by Systecon
opus suite

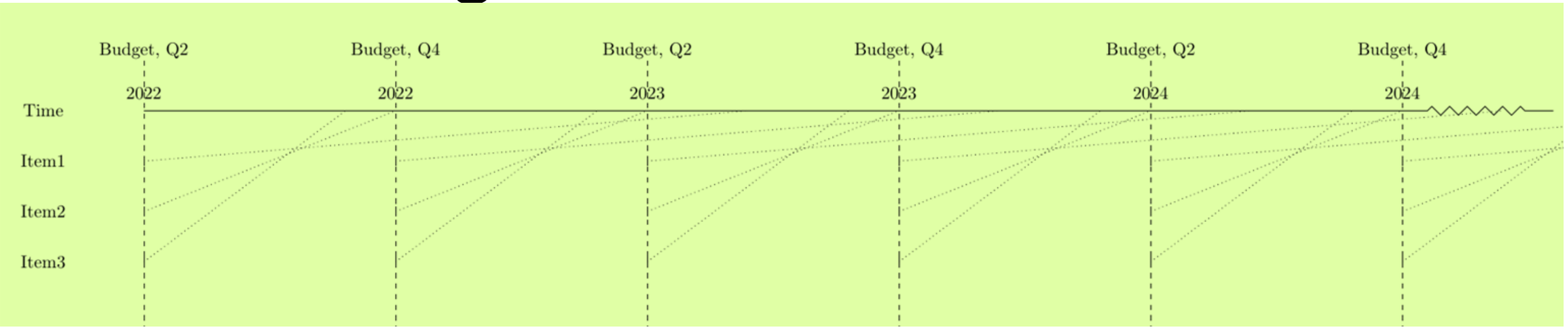


Example Case: Maintenance Scheduling

- One year Scenario
- Twelve Systems (40 parts)
- Operational scenario with mission profiles requesting 4 to 8 simultaneous systems
- During the year, each system is to undergo an upgrade, which makes the system unavailable during a two-month period
- The optimization problem is to determine when each system is upgraded
- Objective: Minimize the sum of lost mission time (squared), over all time periods



Case study: Sparing with long lead times and budget constraints



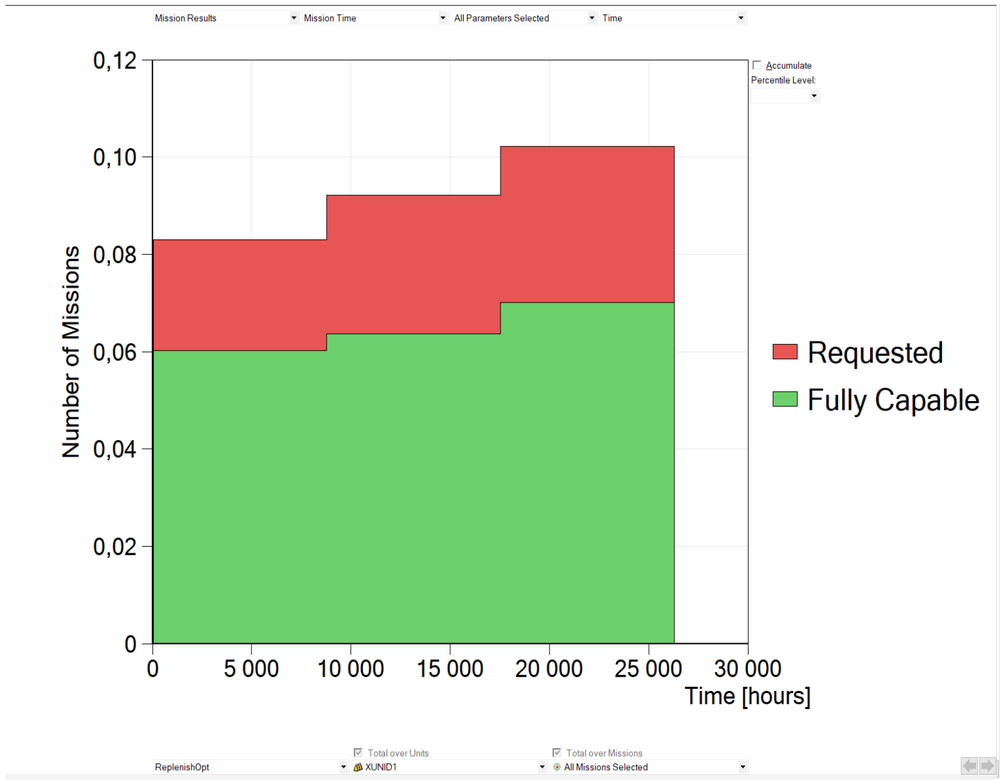
- **Spares purchases with bi-annual budget**
  - Long lead times
- **Multi-stage Optimization**
  - Decisions at each timepoint influences all other decisions.
- **Extension:** Include repairs in the analysis
  - How much of the budget should be put on repairs vs replenishment?

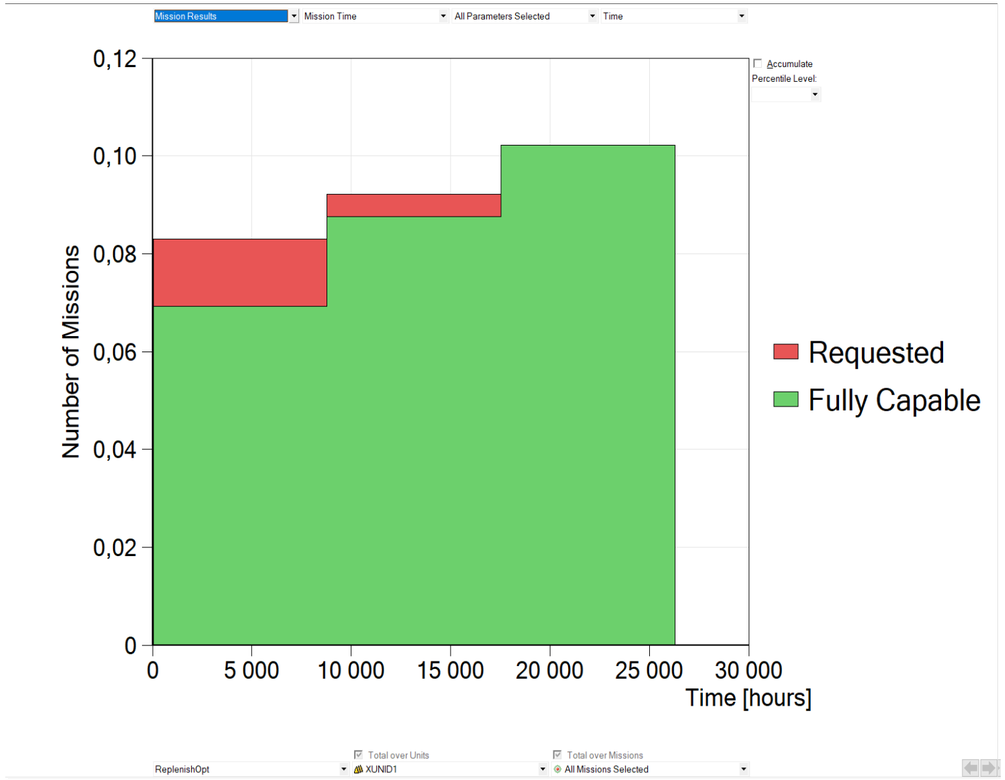
Case Study: Pack-up kit for deployed operations

- **Scenario**
  - Aircraft to perform 20 days of deployed combat operations
  - Mission require 8 available aircraft
- **Supply**
  - Aircraft to deploy with what is available
  - Plan for no external/continuing resupply at deployed location
- **Requirements**
  - Achieve best Air Vehicle Availability (AVA) / Mission Capability (MC) for deployed aircraft given short notice deployment with limited resupply support from Deployed Spares Package (DSP)
  - Review DSP sent aircraft and recommend adjustments based on performance outcome

Case study: Sparing with long lead times and budget constraints

- 20 systems, 16 maintenance significant items
- Yearly increase of utilization ~10%
- Three-year period
- 70% MTF with no additional spares





Conclusion

- Opus Evo enables optimization of any data element in the domain model.

- Flexible Capabilities:
  - Generic optimization approach
  - Easy to change variable and/or objective

”If it can be modeled, it can be evaluated.
If it can be evaluated, it can be optimized”