Connecting With Users Around the World

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Opus Evo

Hur evolutionära algoritmer, simulering och digitala tvillingmodeller av system och logistiska supportscenarier kan användas för taktisk och operativ optimering

Olle Wijk

by Systecon opus suite

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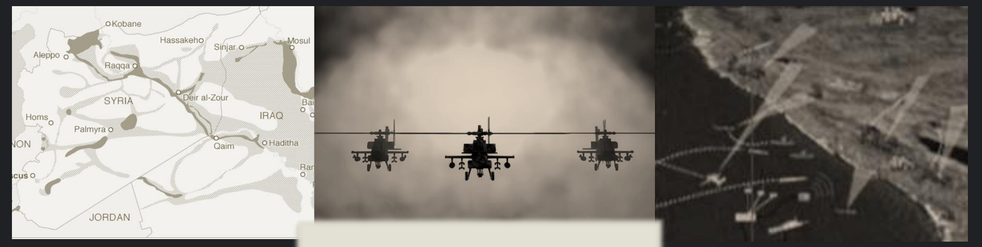
LCM Analysis with an evolving model / digital twin

- The model – A backbone for multi-purpose decision support through the life cycle
  - Make use of available information and knowledge
- Holistic perspective – three main areas to consider
- Evolving through iterative
  - update – analyze – learn
    repeat
- Quick access to decision s
  - Adjust for context, application, data availability, etc



OPERATIONS

"DIGITAL TWIN"

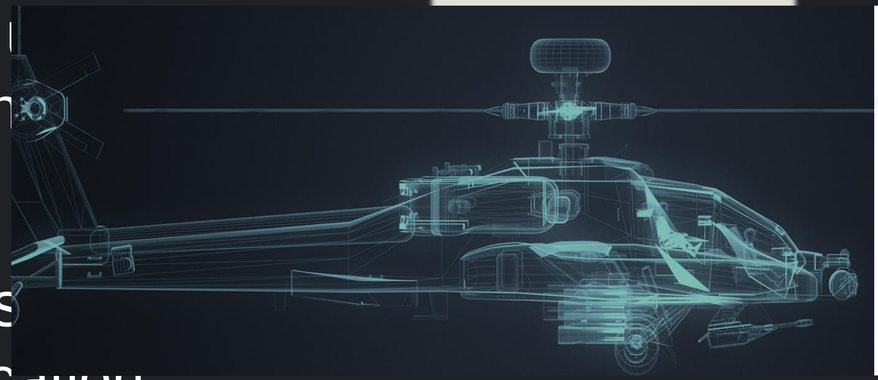
READINESS

MISSION SUCCESS

COST EFFECTIVENESS

"DIGITAL TWIN"

"DIGITAL TWIN"



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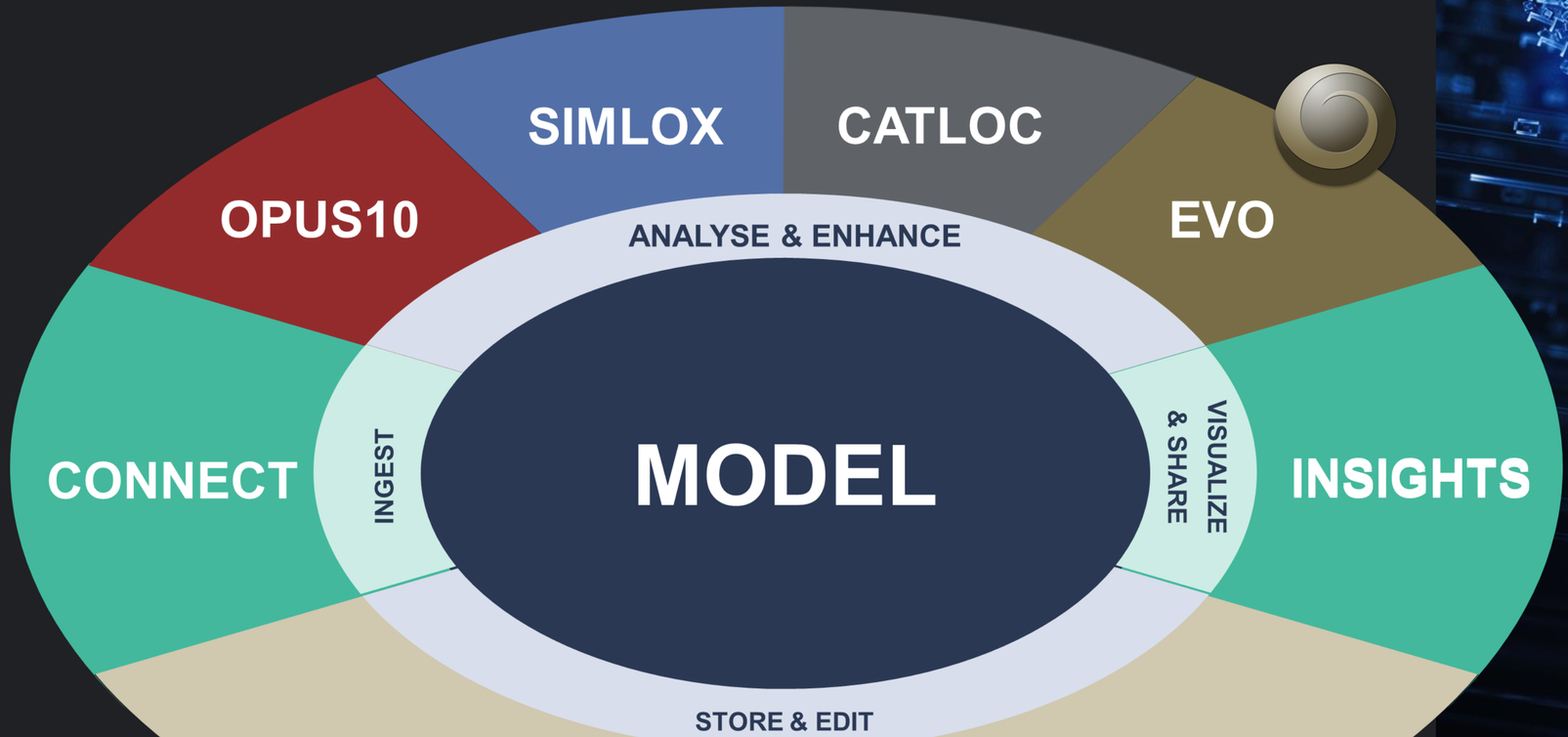
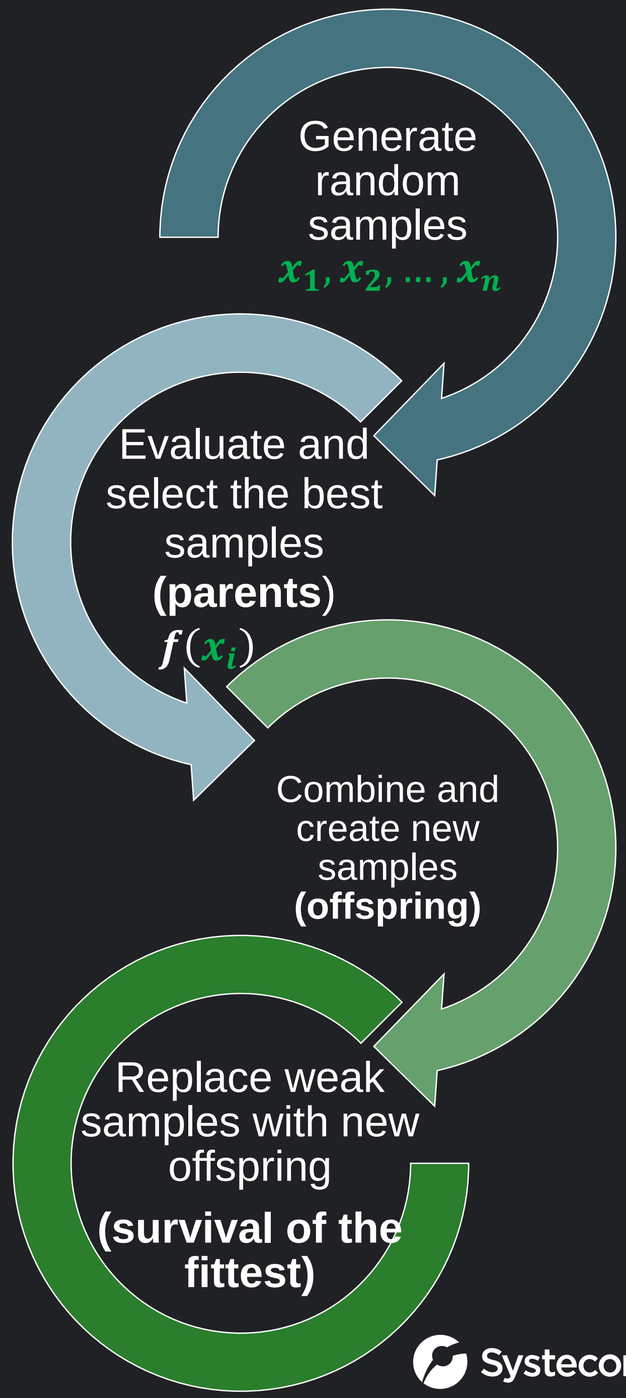
Opus Evo

- Unlocks new spectrum of capabilities
  - Evolutionary Algorithms + Simulation (or other evaluator)
- Strong complement to the other Opus Suite software
  - Tactical/operational optimization
  - Using the same Opus Suite model and data set
  - Incorporate dynamic aspects - non steady state



Heuristics: Evolutionary Algorithms

- **General (robust) optimization algorithms**
  - Evolution based iterative approaches
- **Used in a range of applications**
  - Cancer treatment
  - Scheduling
  - Logistics
- **Multi-processor & multi-core friendly**
  - Scales (almost) linearly
- **Black-box optimization**
  - Uninhibited by mathematical constraints
  - Optimize any parameter..
  - …any objective
  - *If you can evaluate, you can optimize*



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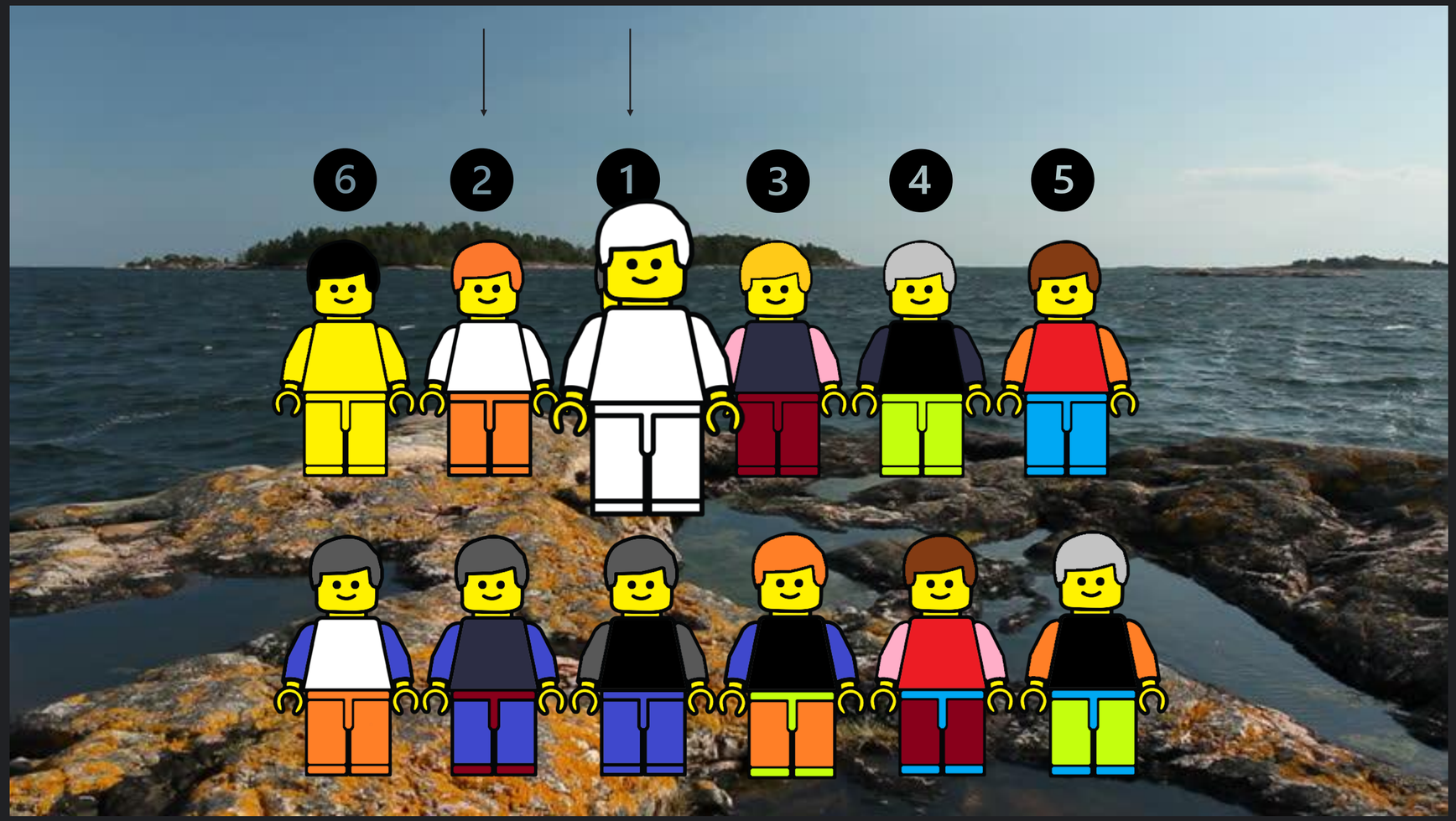
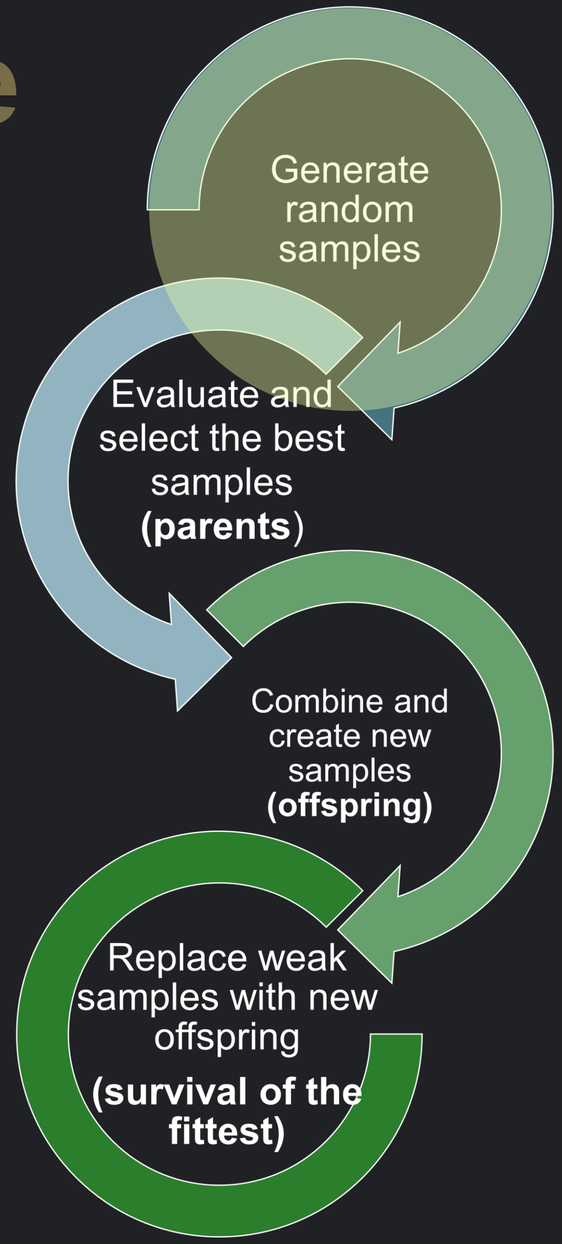
Example 1: Create a camouflage



x_i = (Hair color, Arm color, Torso color, Leg color, Shoe color)

$f(x_i)$ = How easily am I spotted?



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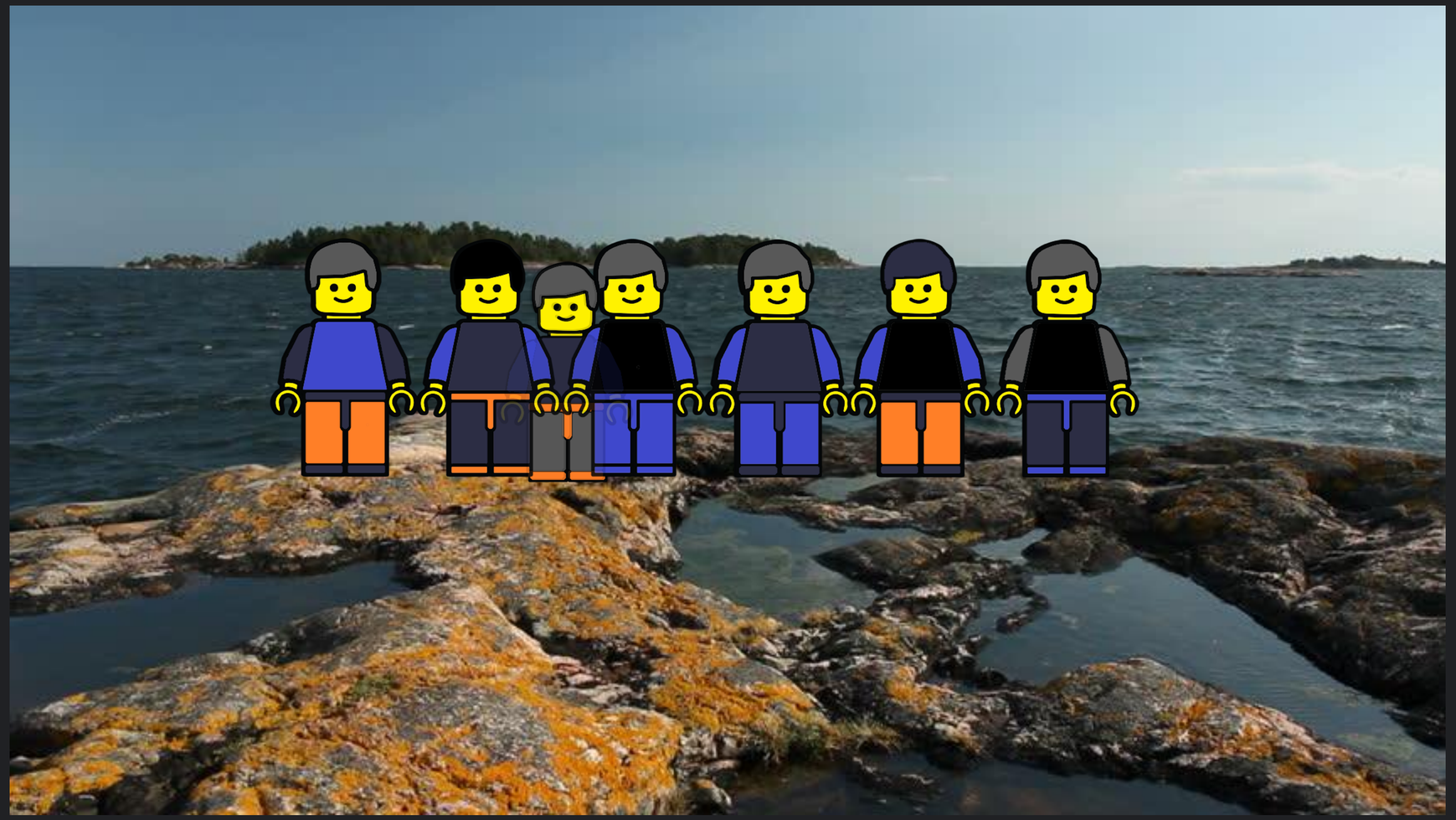

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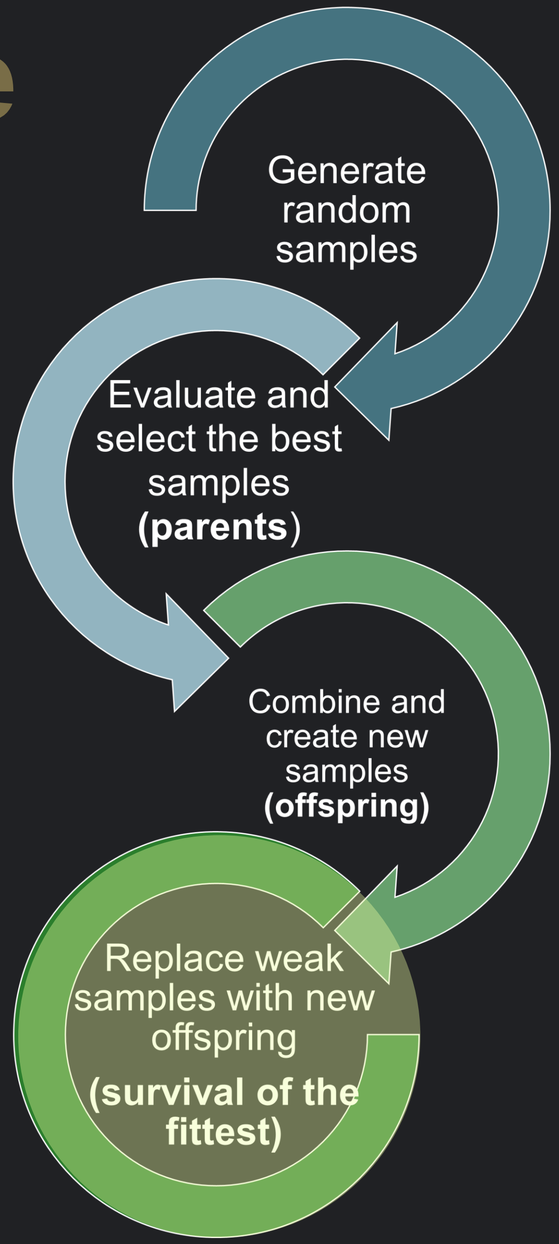

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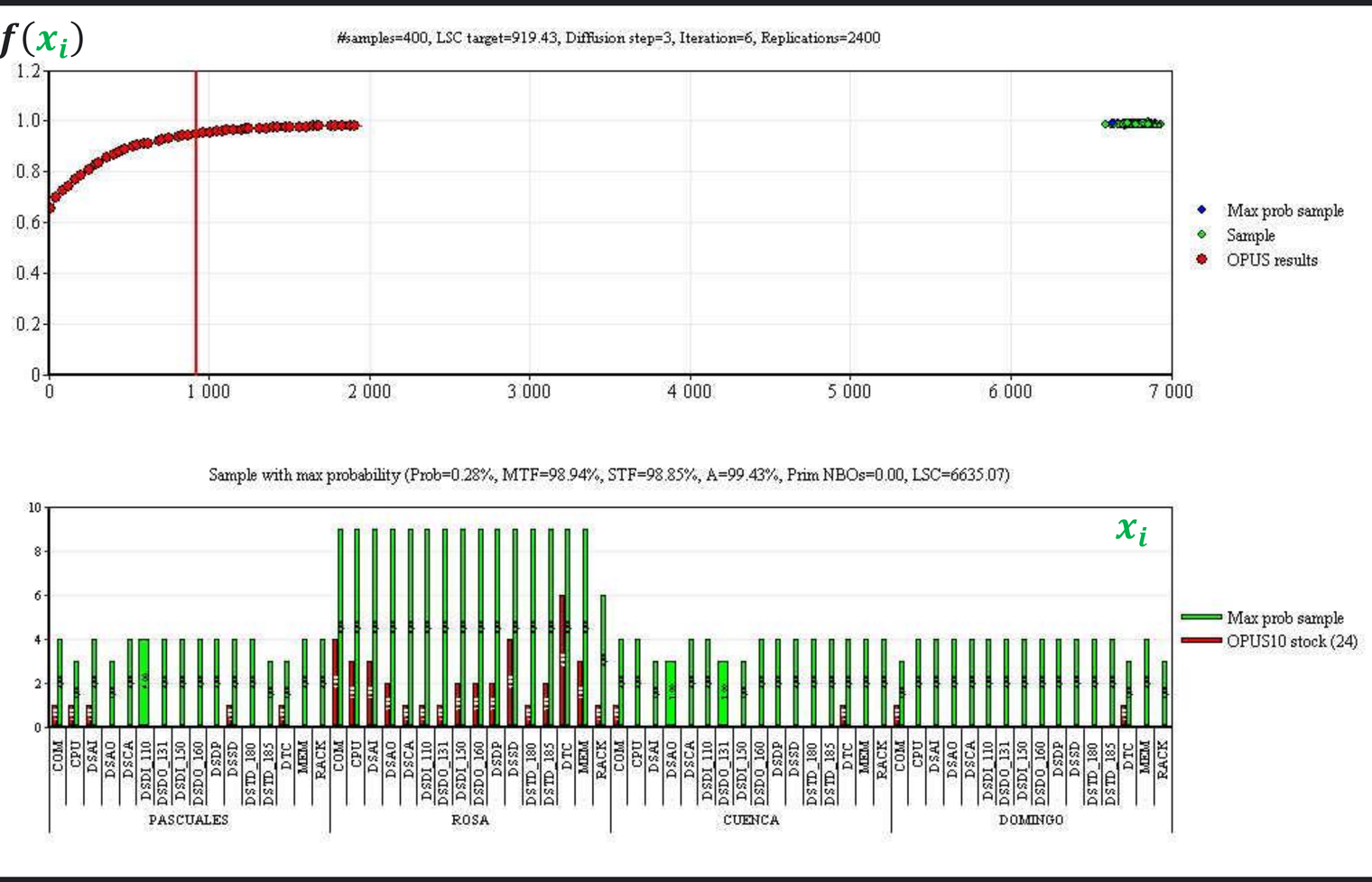
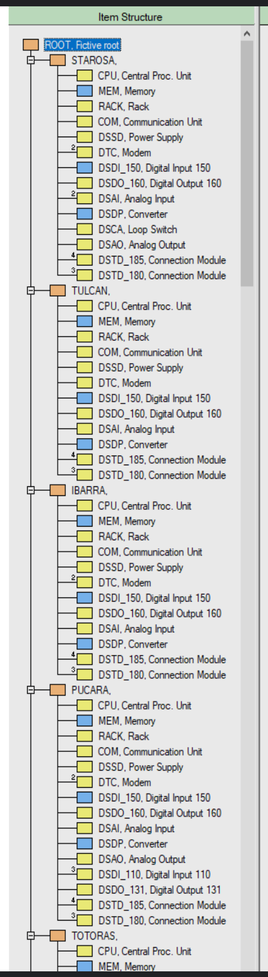
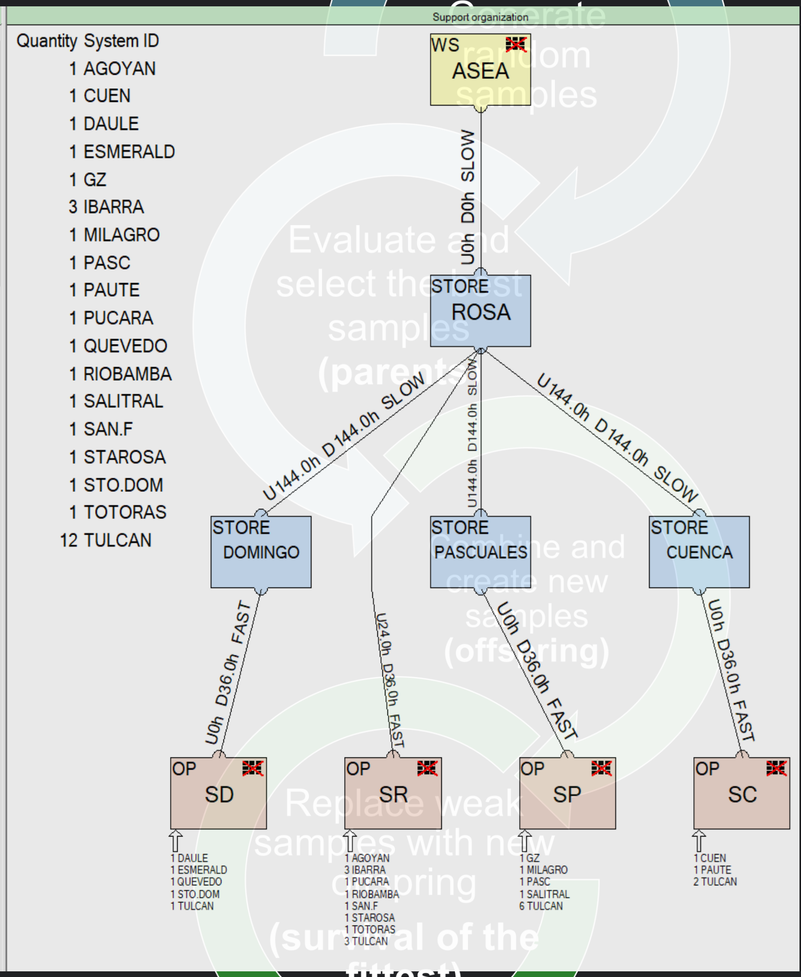
Example 2: Spares optimization







x_i = (#COM at PASCUALES, #CPU at PASCUALES, …, #RACK at DOMINGO)

$f(x_i)$ = How much system time is produced?

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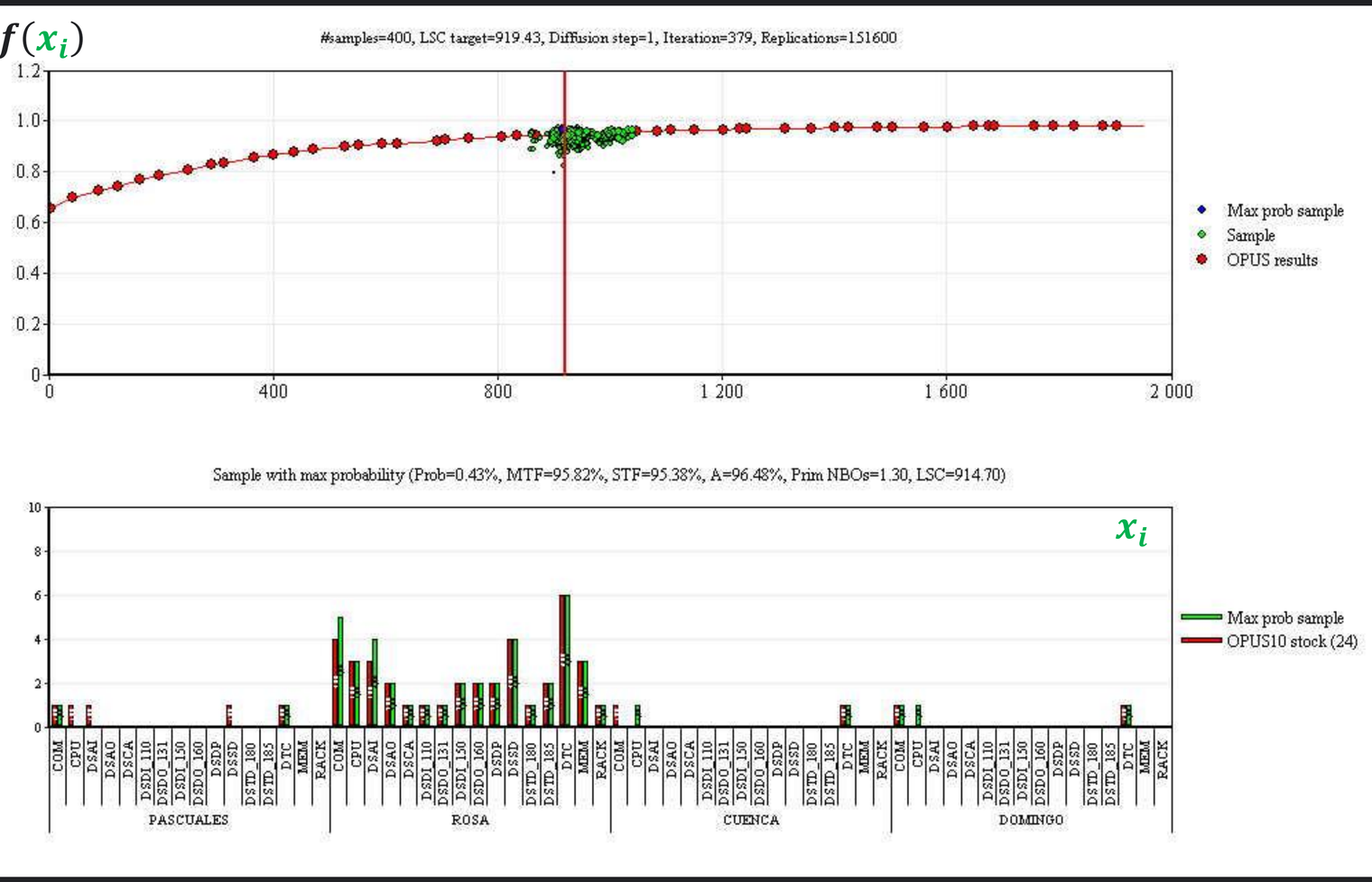
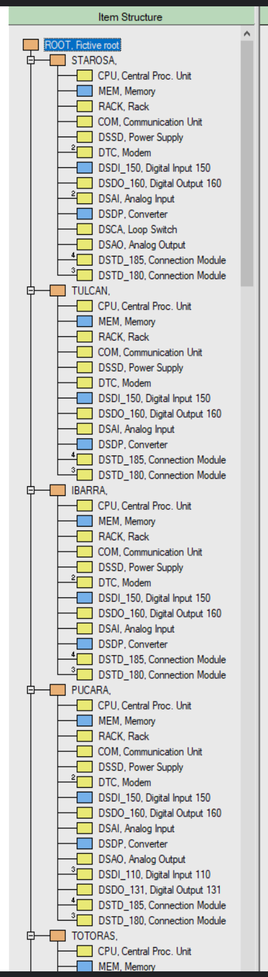
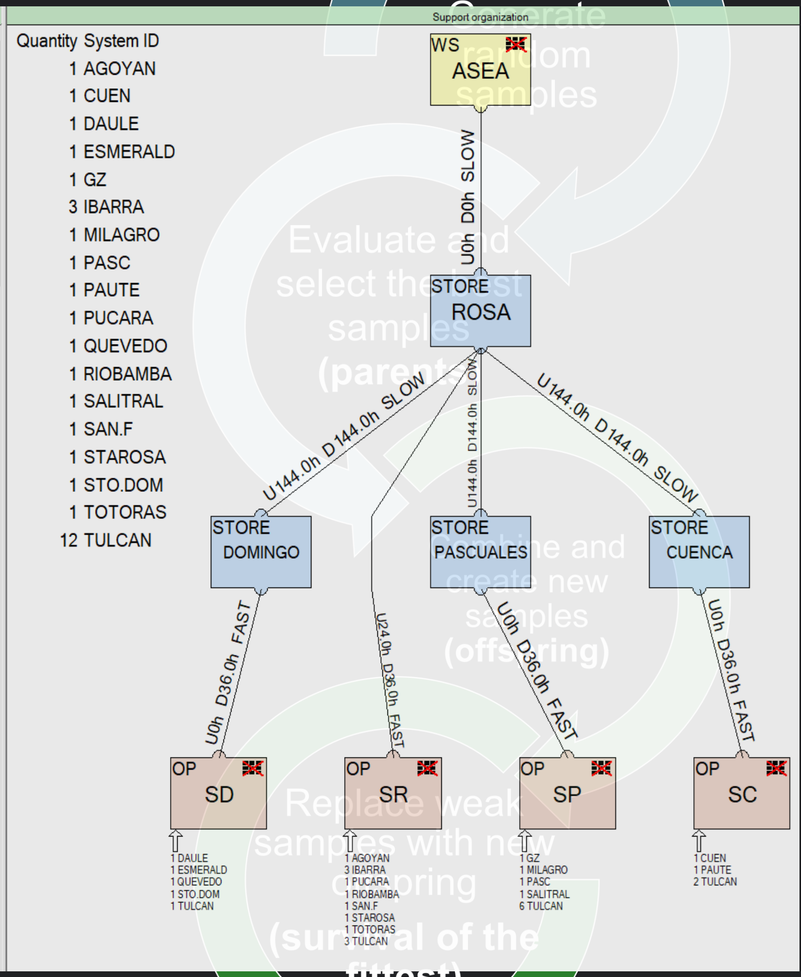
Example 2: Spares optimization







x_i = (#COM at PASCUALES, #CPU at PASCUALES, …, #RACK at DOMINGO)

$f(x_i)$ = How much system time is produced?

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Opus Evo

- Virtually any parameter or aspect in the Opus Suite model can be optimized:

  “if you can model it, you can evaluate it
  if you can evaluate it, you can optimize it”

- **First two products currently available:**
  - Opus Evo Deployed Operations Planner (DOP)
  - Opus Evo Tactical Logistics Support Procurement Optimizer (LPO)

Opus Evo DOP: Deployed Operations Planner

- Maximize mission success and logistics support responsiveness during deployed operations
- Determine optimal set of systems, spares and support resources given the expected mission profiles and time frame
- Tactical/operational optimization ideal for
  - short to medium time frame
  - incorporating impact of dynamic aspects
  - accommodating operational objectives and priorities

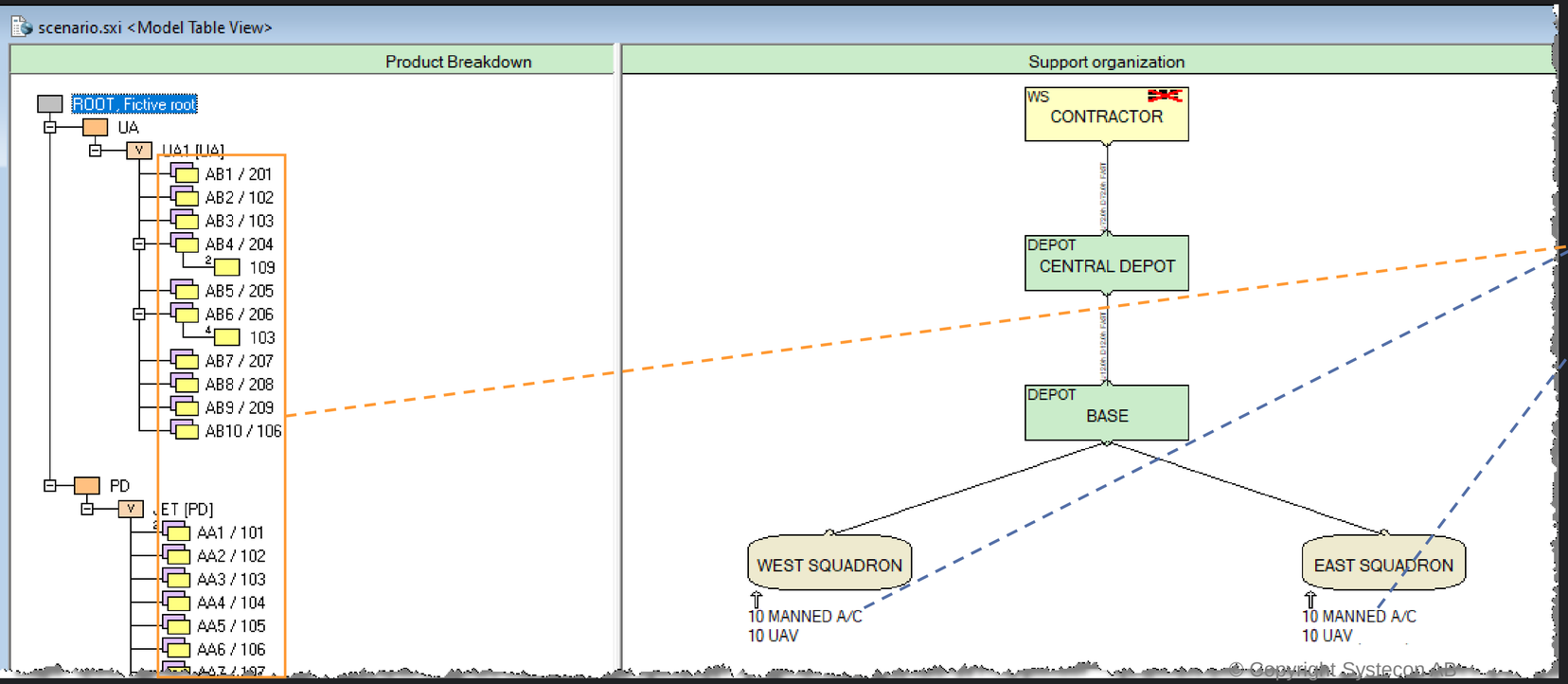
Opus EVO LPO: Tactical Logistics Support Procurement Optimizer

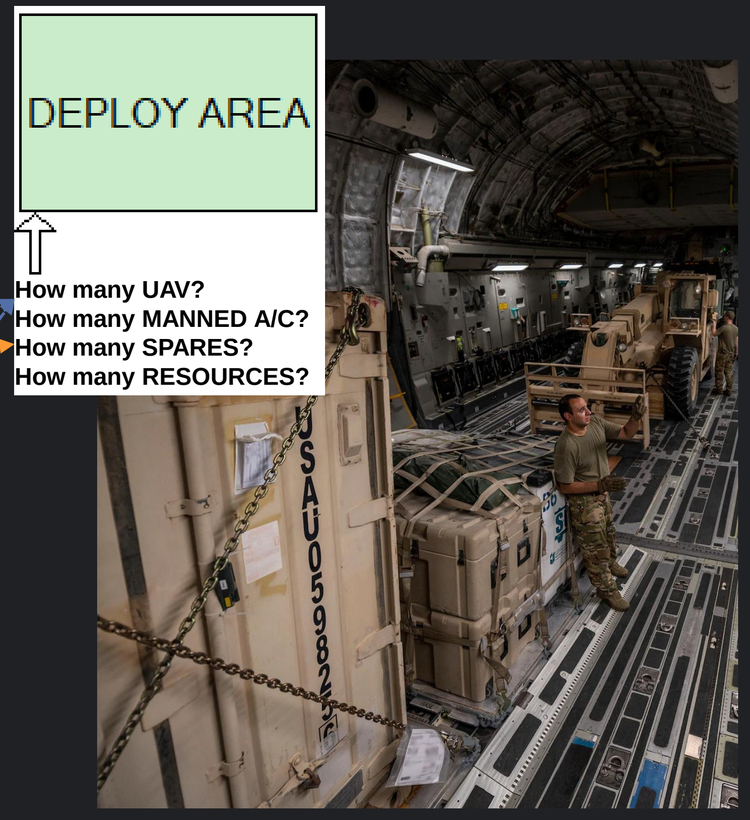
- Determine when to buy what spares and support equipment
- Make optimal use of the maintenance budget for the upcoming budget period, and preliminary planning for future budget periods.
- Adapt procurement planning based on budget increase / decrease, to maximize fleet performance and ability to meet operational requirement
- Tactical optimization that incorporates
  - procurement lead times for each spare part / support equipment
  - Varying budgets, operations and other constraints
  - impact on fleet performance and readiness during the budget period and beyond

Example:
Opus Evo DOP optimization
followed by
Opus Evo LPO optimization

Scenario

- 20 manned A/C and 20 UAV operated at two squadrons
- Plan for next 3 years of operation
  1. We know a 30-day deployed operation will happen soon. How do we plan for this?
     - ✓ Opus Evo DOP: Find sample x_i = {#systems, #spares, #resources} that maximizes $f(x_i)$ = mission time fraction given a cost constraint
  2. After 30-day deployment operation, systems return but need to be maintained (spares are lost). How can we quickly restore normal operation at WEST / EAST SQUADRON?
     - ✓ Opus Evo LPO: Find sample x_i = {#spares to buy} that maximizes $f(x_i)$ = system time fraction given a funding time plan

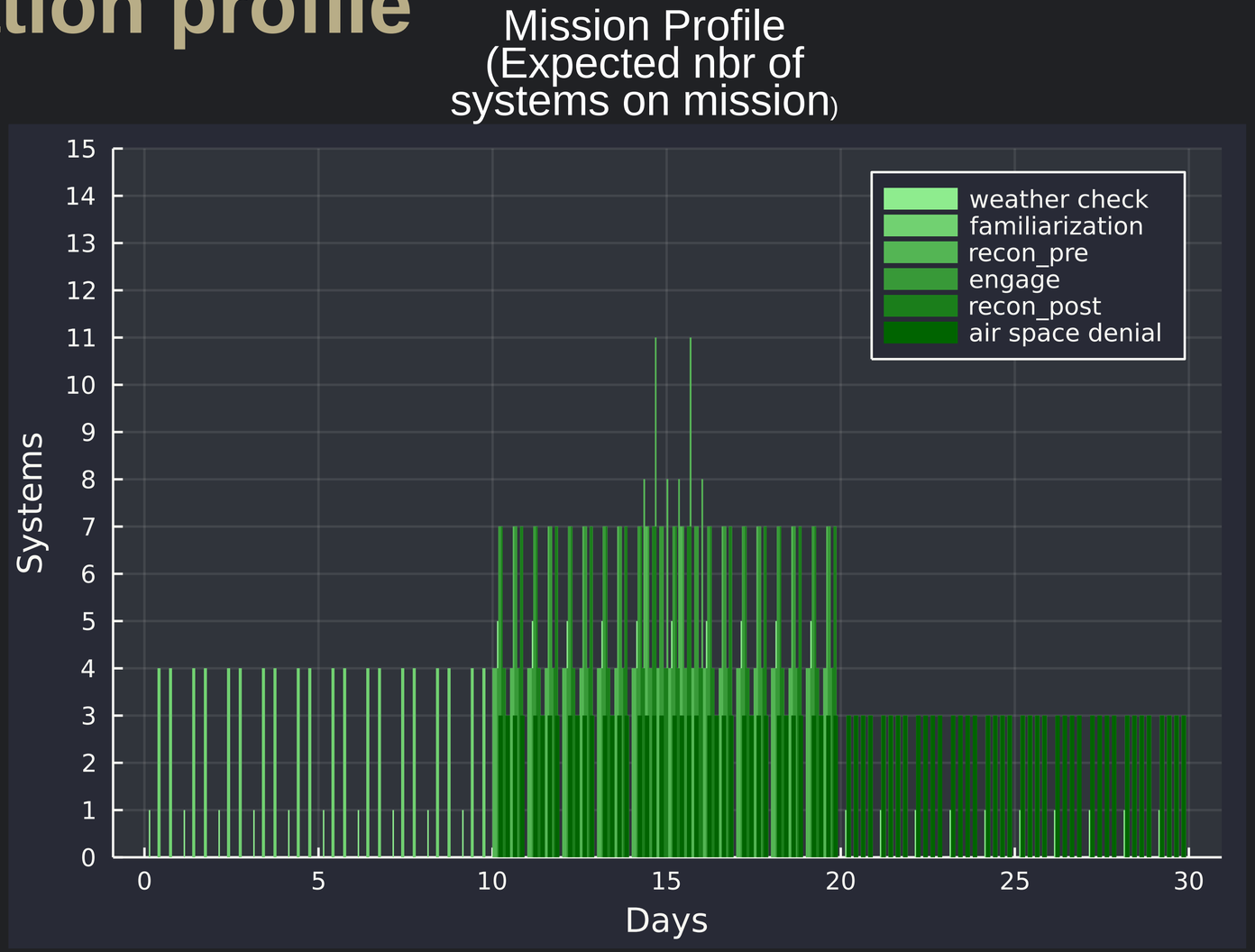




Scenario: Deployed operation profile

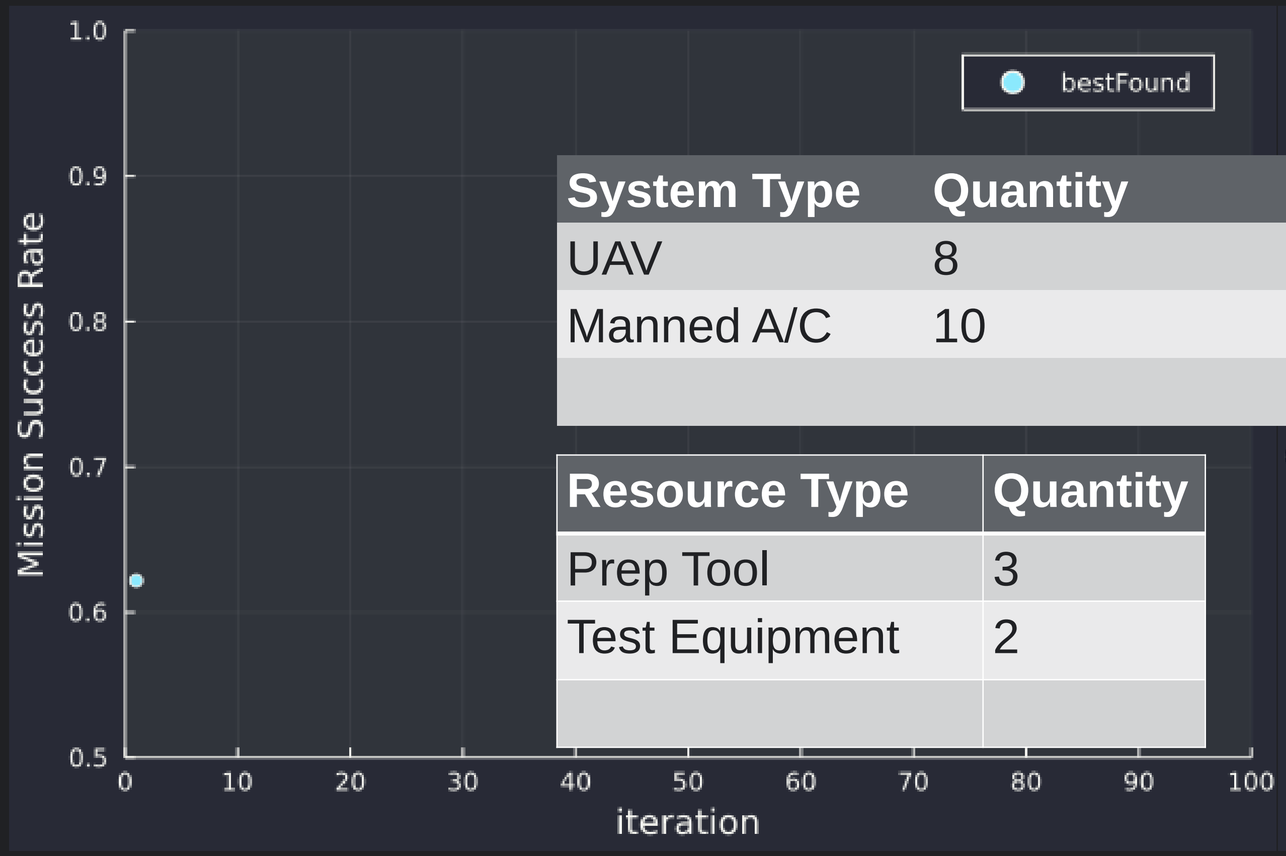
- **Three Phases (six different missions)**
  - **Low**
    - Familiarization
  - **High**
    - Pre recon
    - Engagement
    - Post recon
    - Airspace denial
  - **Medium**
    - Airspace denial
  - Weather check each day

- **30 days with differing utilization**
  - Different system requirements per missions



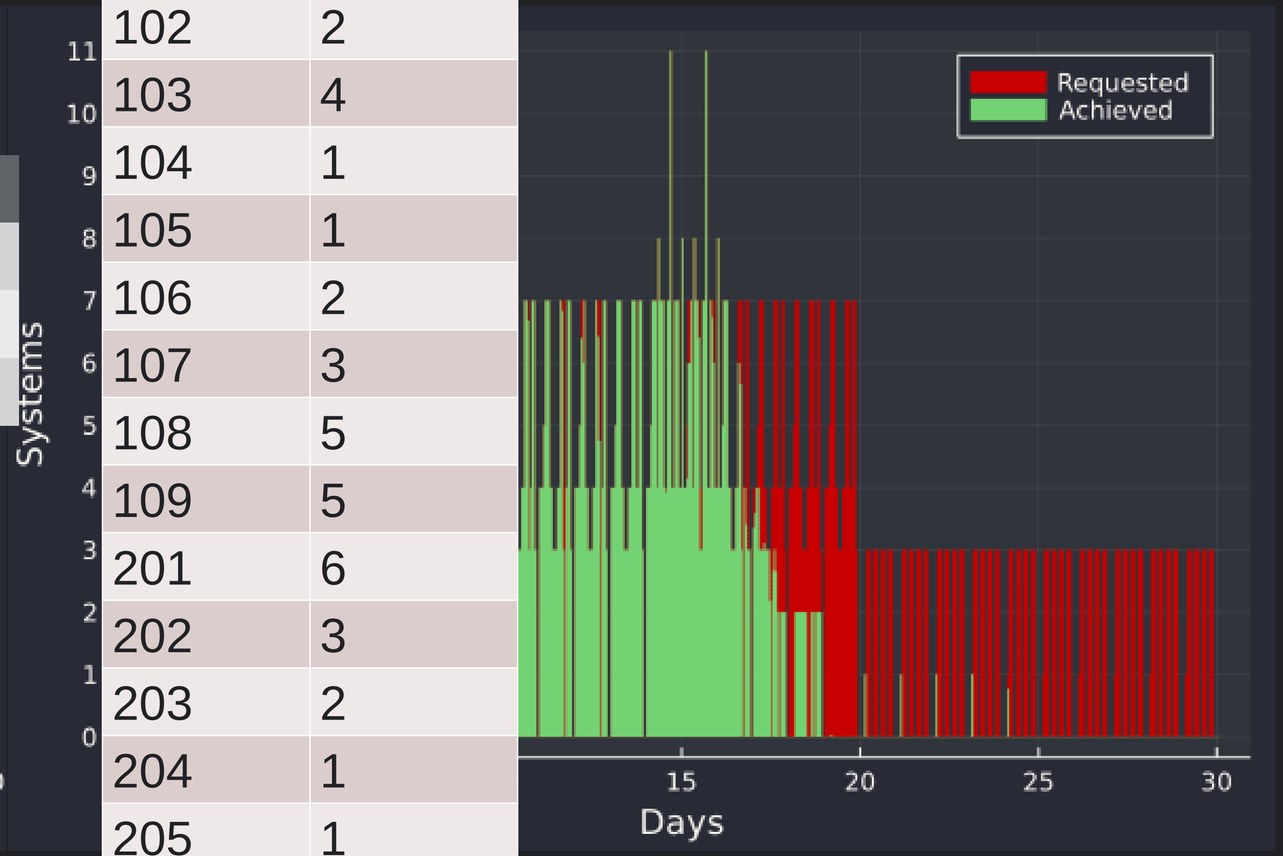
Opus Evo DOP (Deployed Operations Planner)

Opus Evo DOP optimization



System Type	Quantity
UAV	8
Manned A/C	10

Resource Type	Quantity
Prep Tool	3
Test Equipment	2



Item	Qty
101	13
102	2
103	4
104	1
105	1
106	2
107	3
108	5
109	5
201	6
202	3
203	2
204	1
205	1

- **Opus Evo DOP: Find sample x_i = {#systems, #spares, #resources} that maximizes $f(x_i)$ = mission time fraction given the cost constraint $11 000 000**

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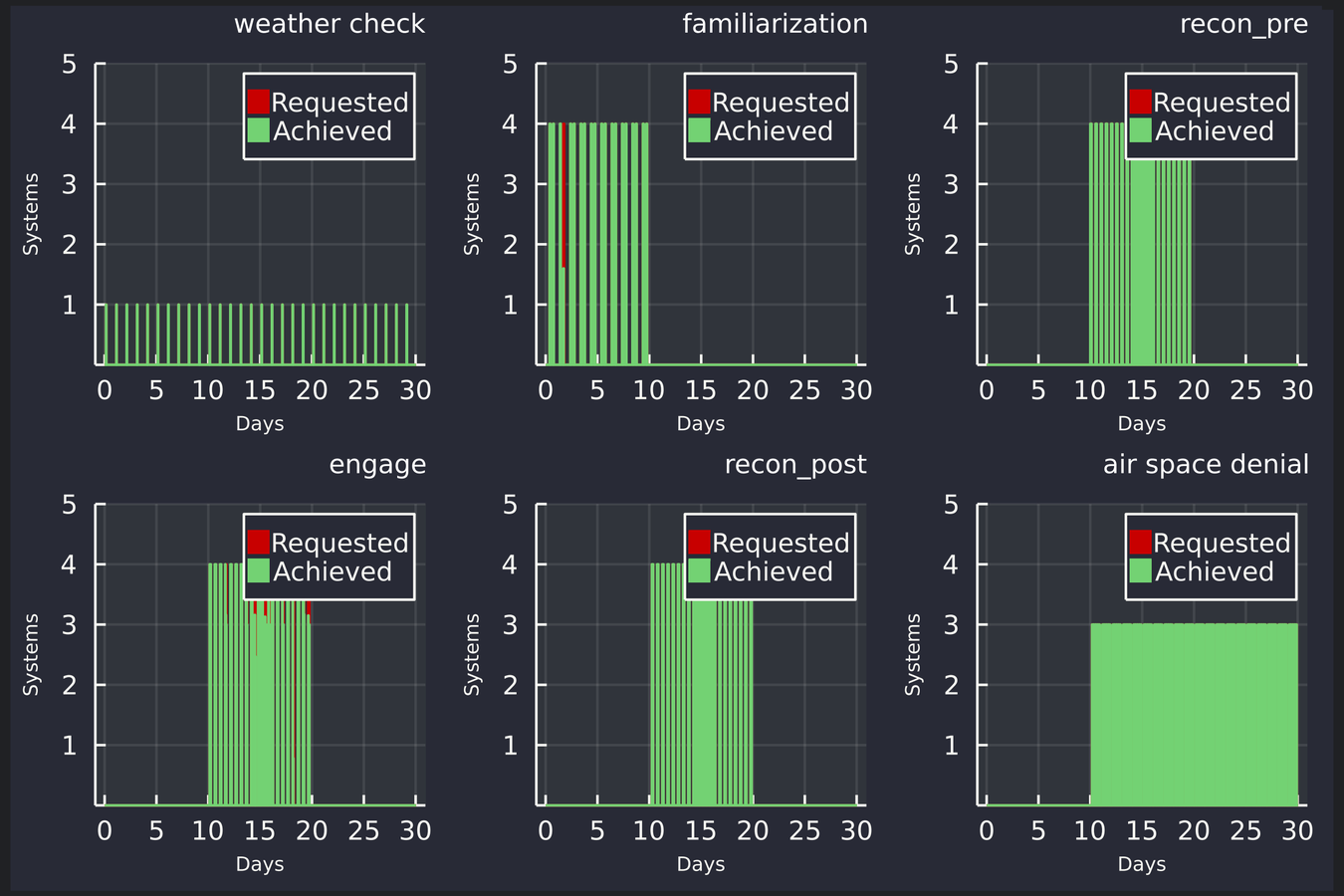
Results

- **Mission Success rate 98%**
  - Risk of failed mission in high phase very low

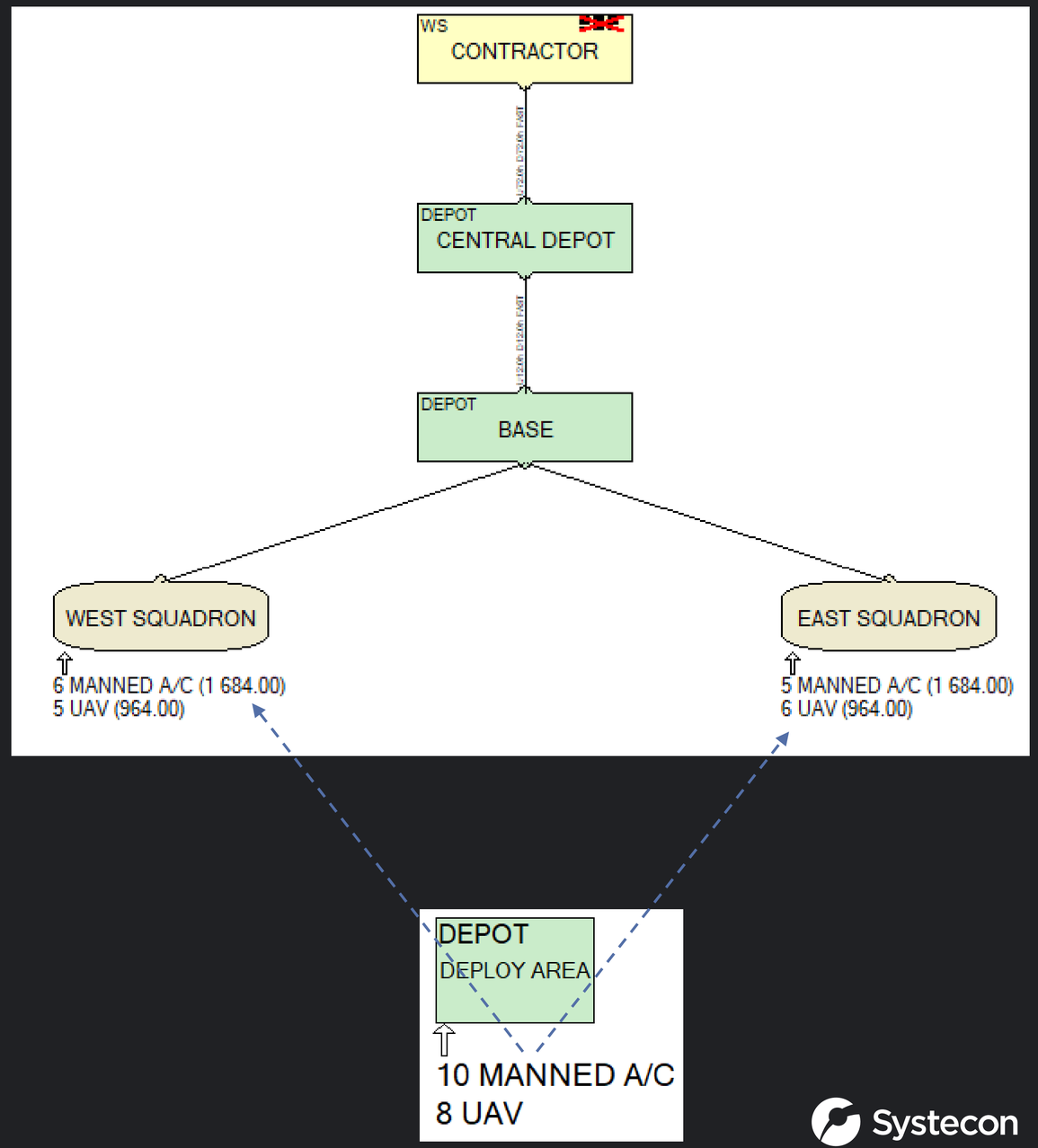


What next?

- **The System readiness at the home base is low with only 22 systems in operation**
  - **18 systems from deployed operation returning, but need maintenance**
  - **Spares from deployed operation lost**

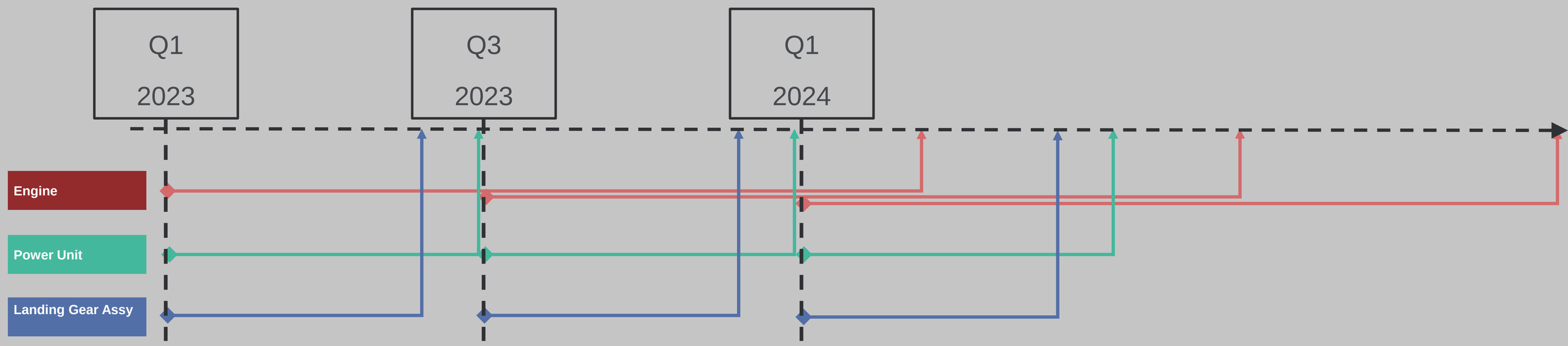
- **We need to buy new spares (long lead times) to improve the situation at home**

Time	Budget
Q1 2023	3 000 000
Q3 2023	2 500 000
Q1 2024	1 500 000



Opus Evo: Tactical Logistics Support Procurement Optimizer (LPO)

Opus Evo LPO: Budgets and Lead Times



- **Opus Evo LPO: Find sample**
  x_i = {#spares to buy at Q1 2023, #spares to buy at Q3 2023, #spares to buy at Q1 2024}
  that maximizes
  $f(x_i)$ = system time fraction
  given a
  funding plan

Time	Budget
Q1 2023	3 000 000
Q3 2023	2 500 000
Q1 2024	1 500 000

- NOTE:
  - After we have done the Opus Evo LPO optimization, we are only interested in the *first* purchase point (Q1 2023)
  - When we get close to the *second* purchase point (Q3 2023), facts may have changed (updated prices, failure rates, other mission assignments etc.) which means that we need to do redo the Opus EVO LPO optimization…

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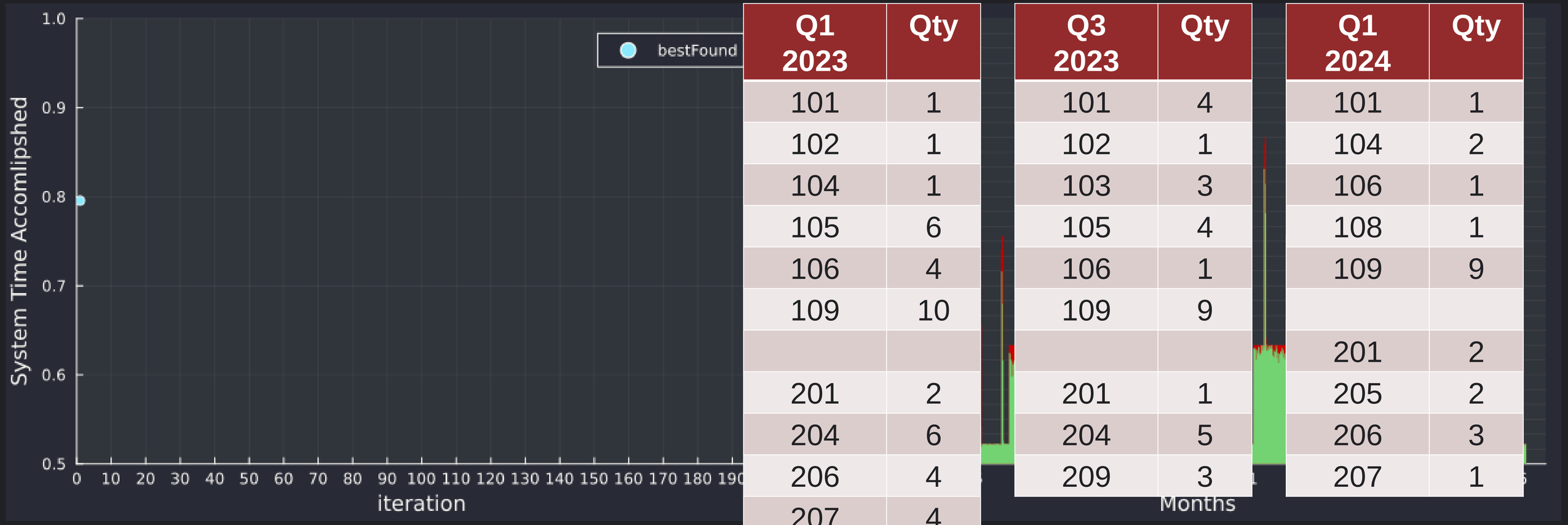
Opus Evo LPO



Q1 2023	Qty
101	1
102	1
104	1
105	6
106	4
109	10
201	2
204	6
206	4
207	4
208	5
209	6

Q3 2023	Qty
101	4
102	1
103	3
105	4
106	1
109	9
201	1
204	5
209	3

Q1 2024	Qty
101	1
104	2
106	1
108	1
109	9
201	2
205	2
206	3
207	1

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Thank you.

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