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Simulation as support for decision making in PBL negotiations

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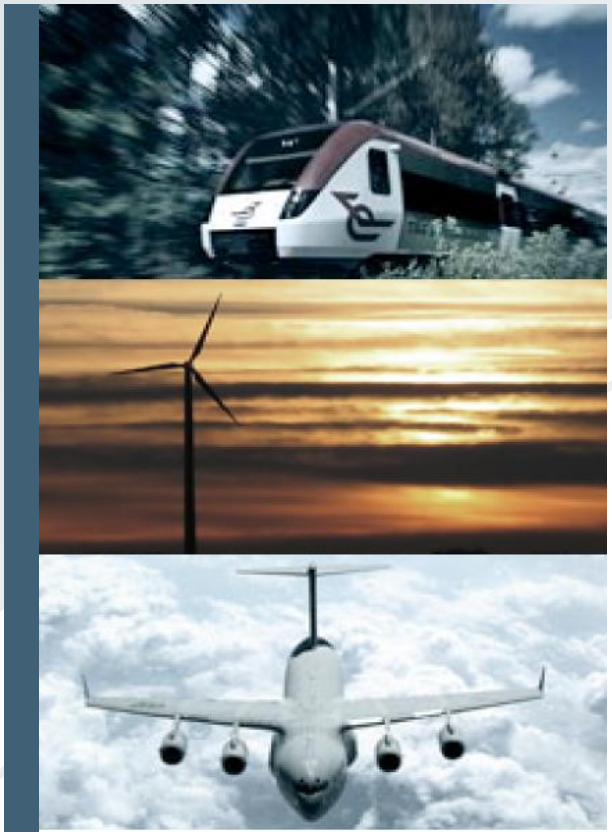
INTELLIGENT SOLUTIONS FOR ENHANCED PERFORMANCE.



- Combination of expert consultancy and a strong software suite for resource optimization and financial analysis.
- Founded in 1970, an independent, partner owned company. Serving multinational industry leaders worldwide.
- Offices in Sweden and the UK. International network of representatives.

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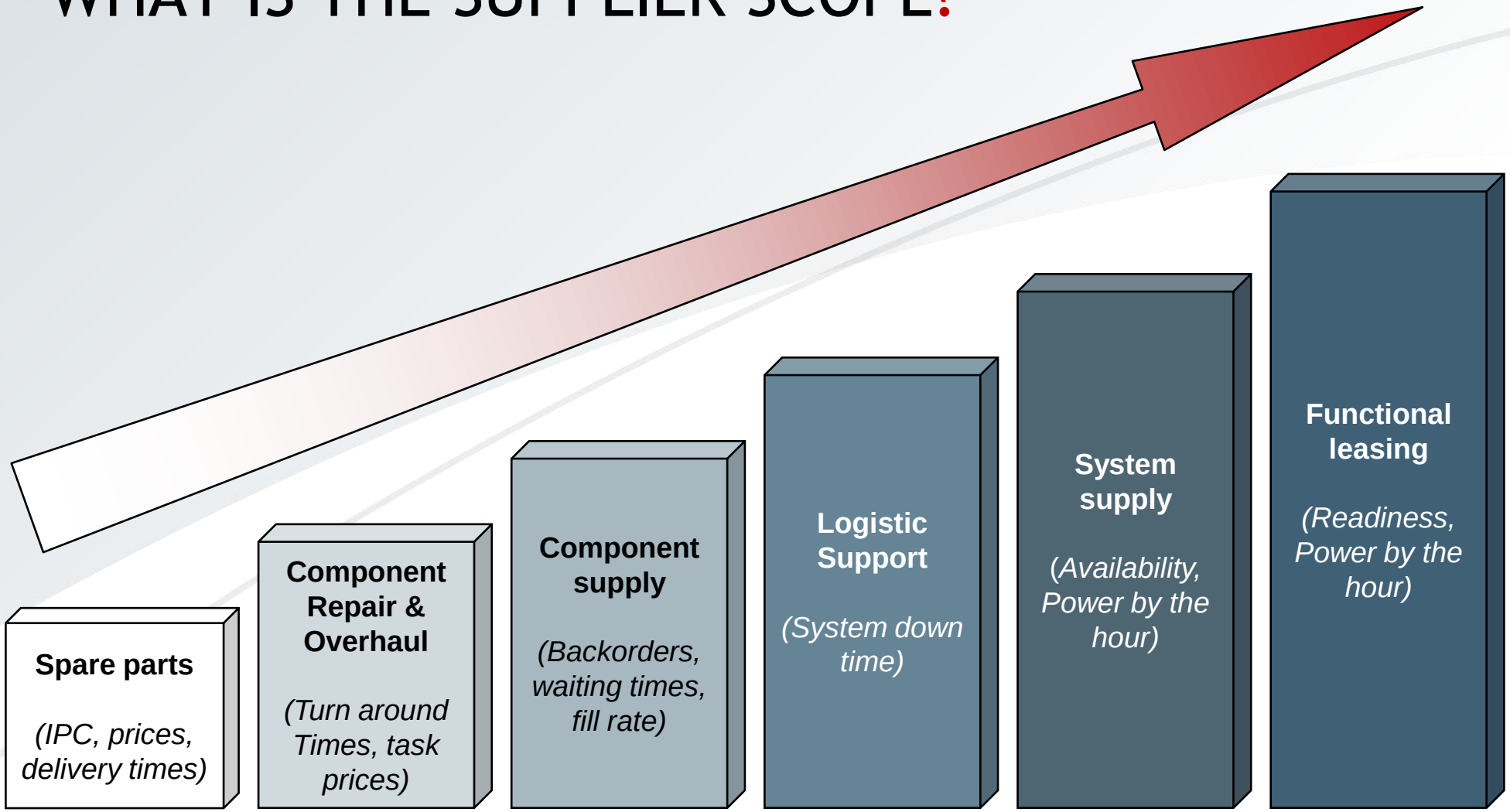
PERFORMANCE-BASED LOGISTICS (PBL).

- The DoD's preferred support strategy for weapons systems.
- Seeks to deliver product support as an integrated, affordable performance package designed to optimize system readiness.
- A support structure based on long-term performance agreements with clear lines of authority and responsibility.
- DoD program managers are required to develop and implement performance-based life-cycle (PBL) support strategies for weapons systems.
- These strategies should optimize total system availability while minimizing cost and logistics footprint. Trade-off decisions involve cost, useful service, and effectiveness.
- The selection of the specific performance metrics should be carefully considered and supported by an operationally-oriented analysis.

WHAT IS THE SUPPLIER SCOPE?



HOW TO DEFINE BALANCED PERFORMANCE REQUIREMENTS AND REWARD MODELS?

- A complex problem
  - need for efficient analysis models
- The customer
  - Wants to secure that his operational needs will be met without risking to pay too much
- The supplier
  - Wants to assess the resources needed to fulfill the commitment
    and the risks and economical consequences
- You want to create a Win-Win situation!

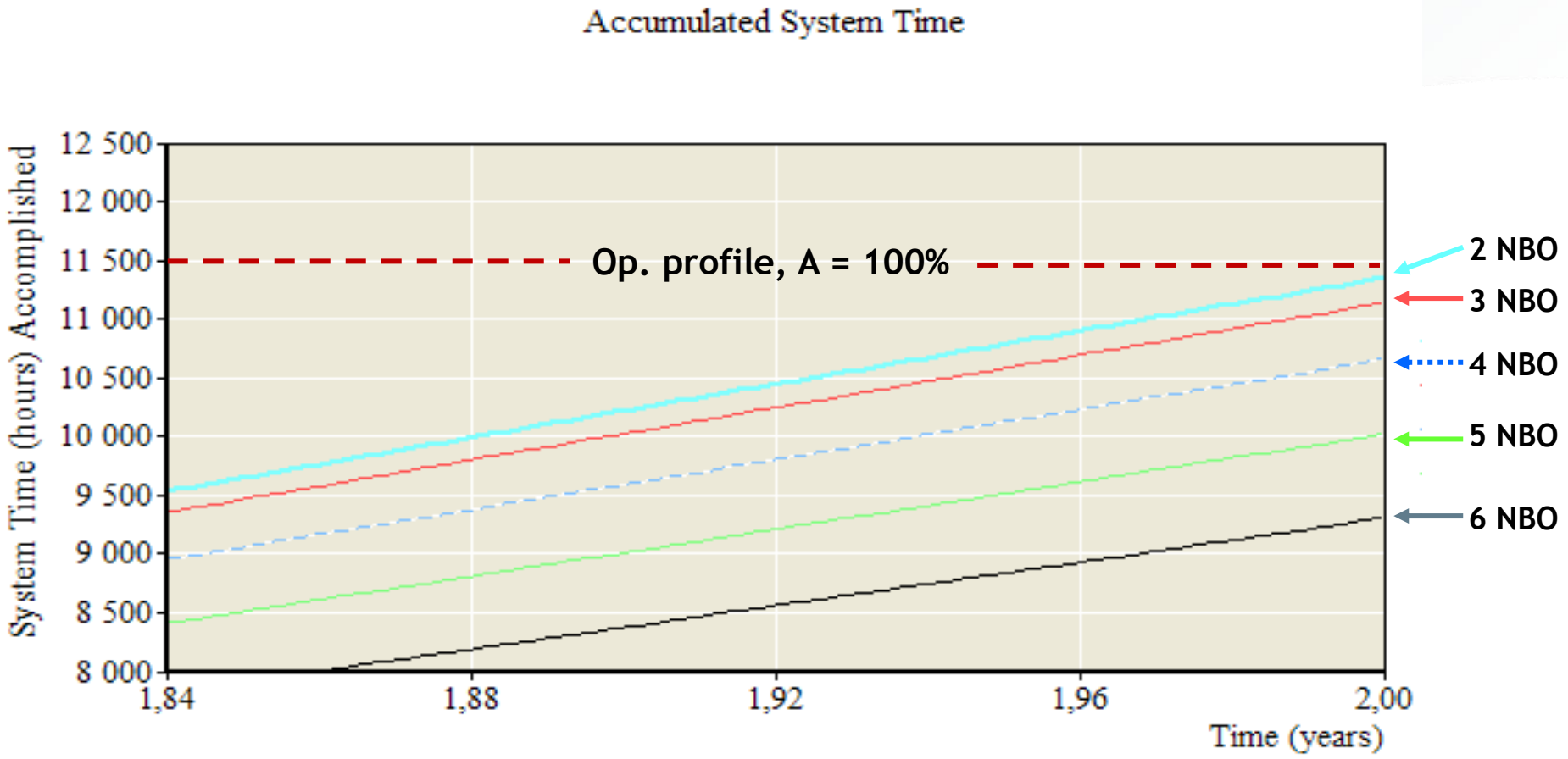
USE MODELS AND SIMULATION?

- Simulation tools like SIMLOX
  - Evaluates the operational performance that the customer can achieve given a certain contractual performance level…

    …and the probability of meeting that performance level given a certain logistics solution.

- Optimization tools like OPUS10®
  - Defines the most cost effective spares parts solution to meet the objectives
  - Calculates the logistics support cost to meet a certain performance level

Example: SIMULATION OF PBL LEVELS FOR A COMPONENT SUPPLY AGREEMENT.



Conclusion:

- **2 Backorders don't influence operations at all**
- **3 Backorders is acceptable!**
- **4 Backorders limit operational capability**
- **5 Backorders is not acceptable**

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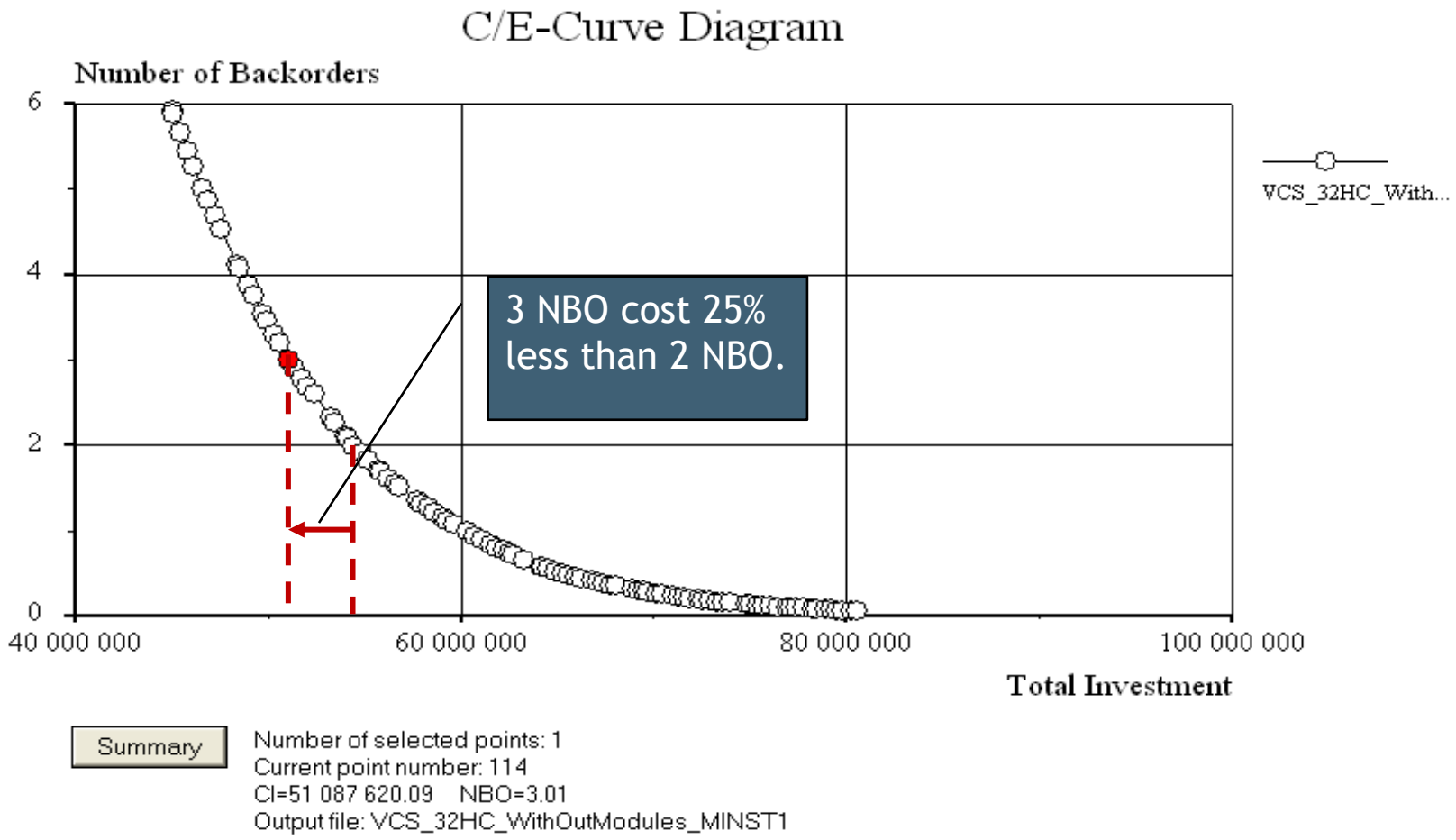
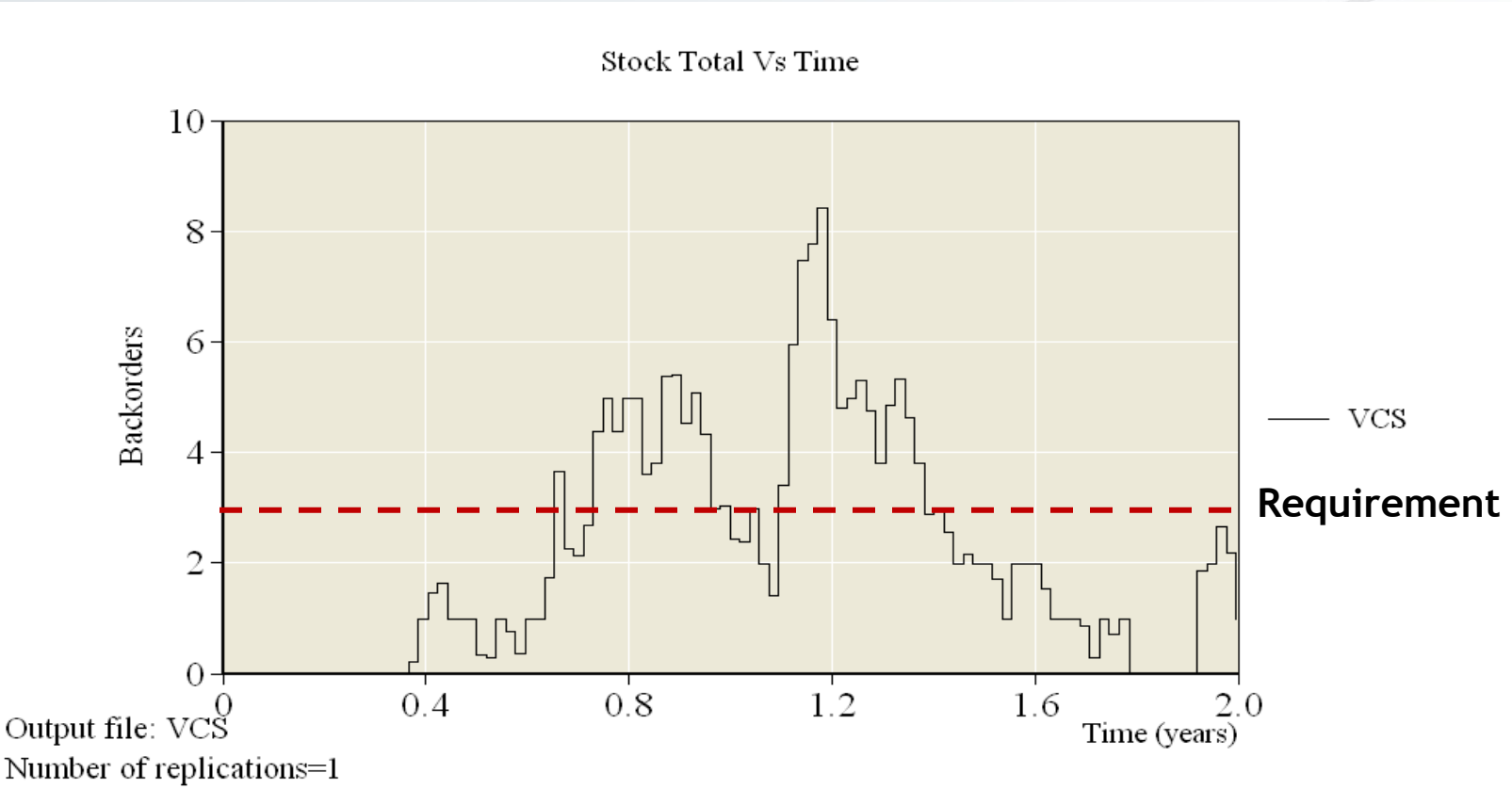
Example: ARE THE BACKORDER LEVELS AFFORDABLE?



Conclusion:

- **Spares stock needed to meet 3 backorders will cost 51 millions**
- **To reach 2 backorders will cost 25% more**
- **How much can you afford/how much are the extra flight hours worth?**

Example: WHAT IS THE RISK OF NOT ACHIEVING THE BACKORDER LEVELS REQUIRED?



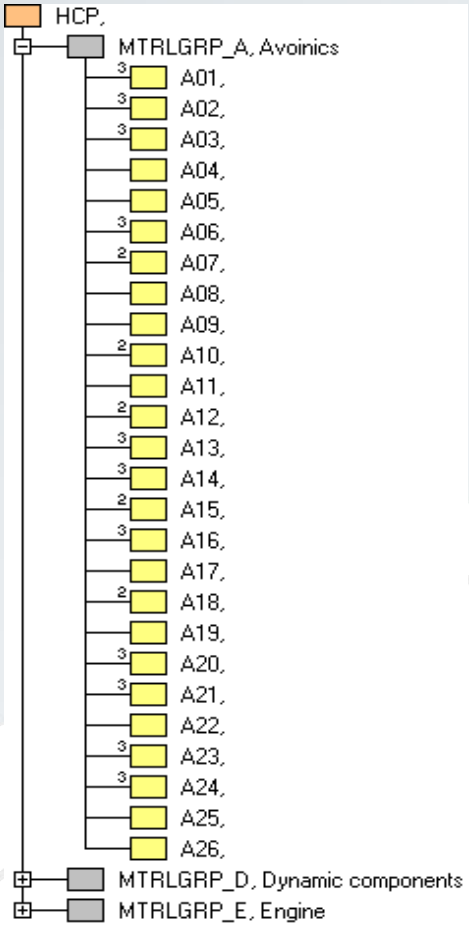
Conclusion:

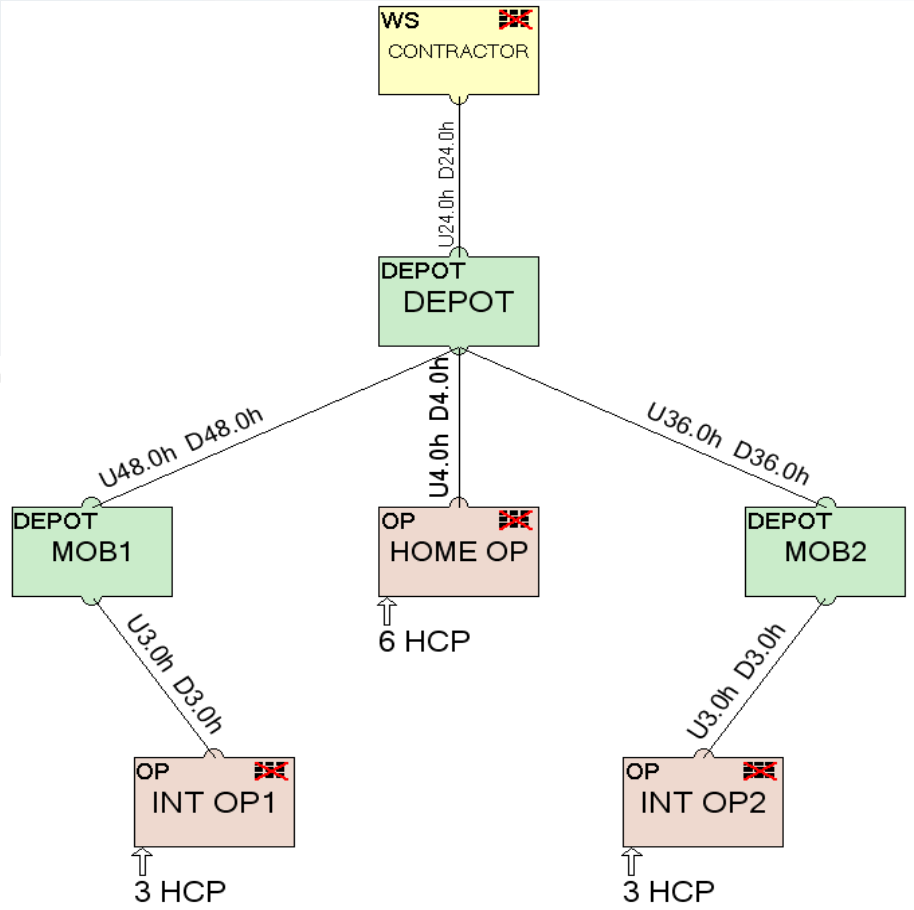
- **Backorder levels will differ much over time**
- **Even though the average backorder level meets the requirement, the risk of not reaching the monthly average is quite high**

HOW TO ASSESS A REWARD MODEL.

- What type of reward function should be used?
- How does the reward distribution look like,
  i.e. how large reward can be expected?
- What is the probability for getting the full reward?
- What is the risk that the reward becomes less than 70 %?
- other consequences…

OUR SCENARIO.





- 3 operative locations, One at home and two abroad
- In total 12 helicopters
- Each operative location is evaluated on a yearly basis
- Scenario length: 10 years

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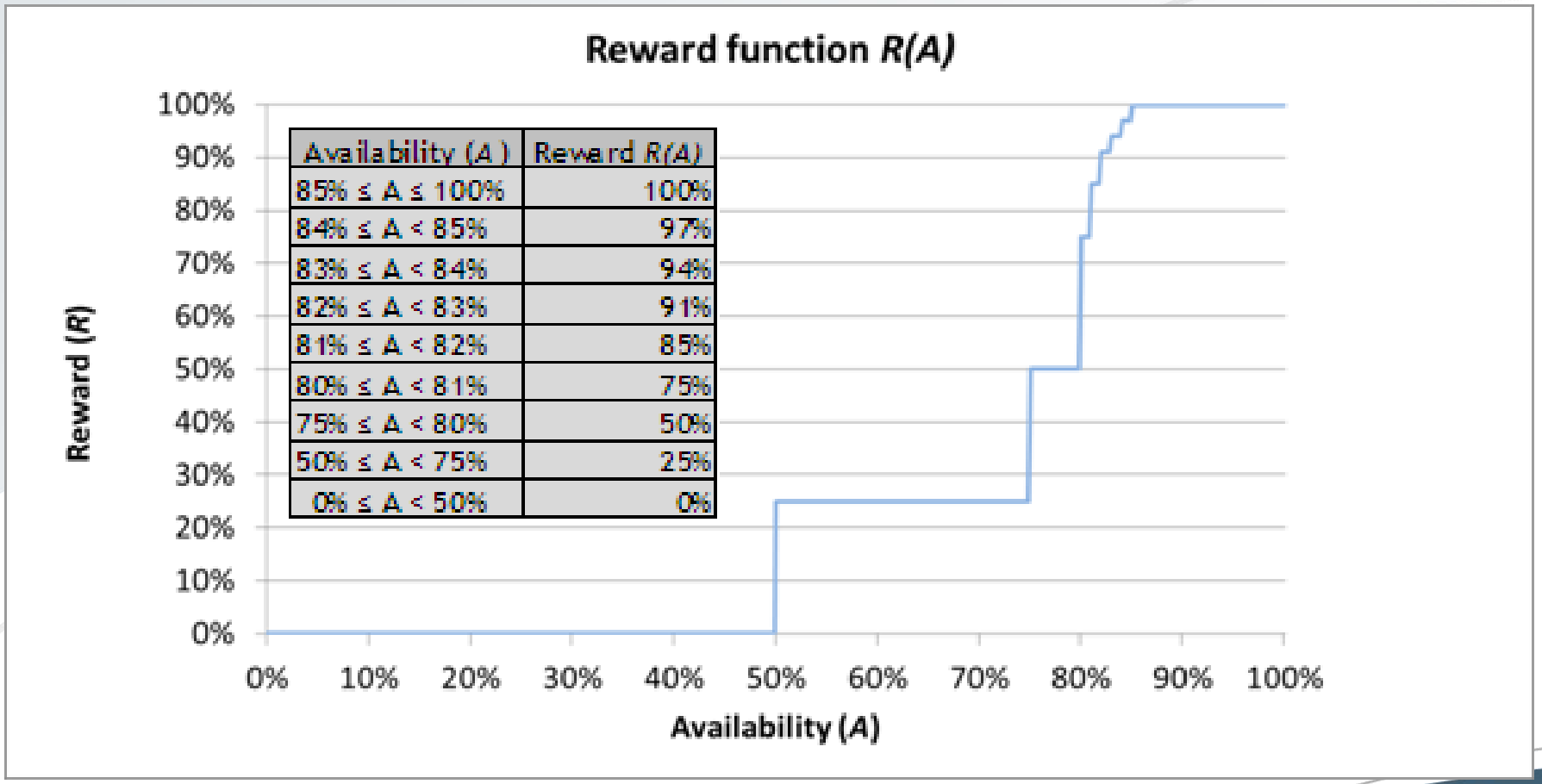
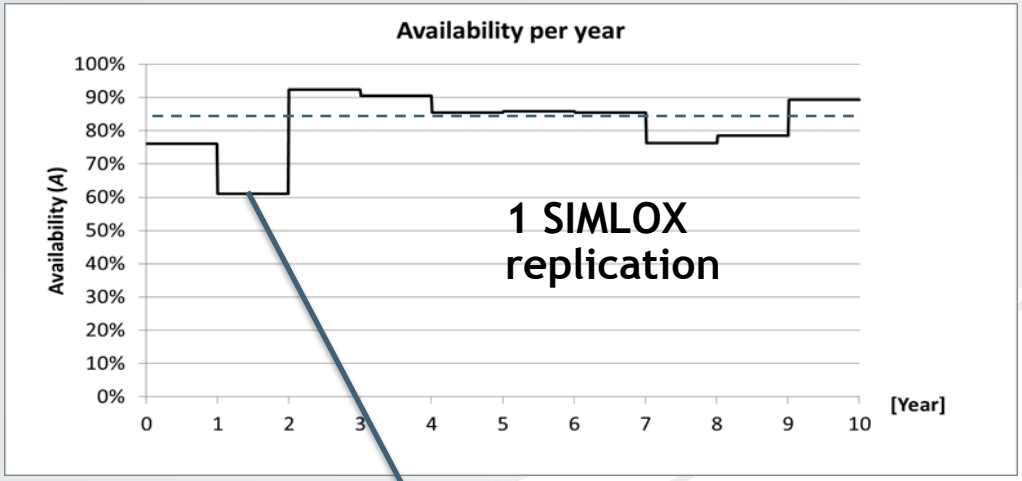
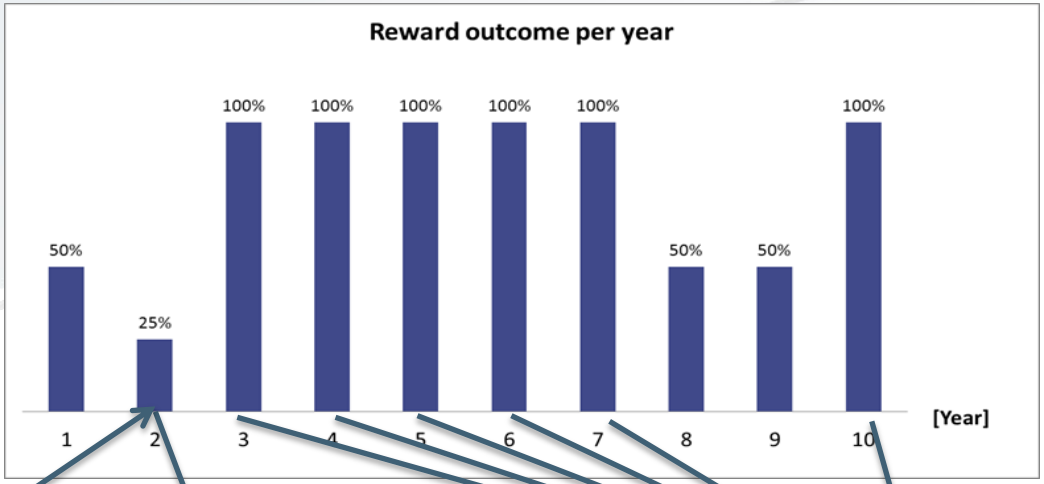
EXAMPLE OF A REWARD FUNCTION FOR A PBL CONTRACT FOR AVAILABILITY.

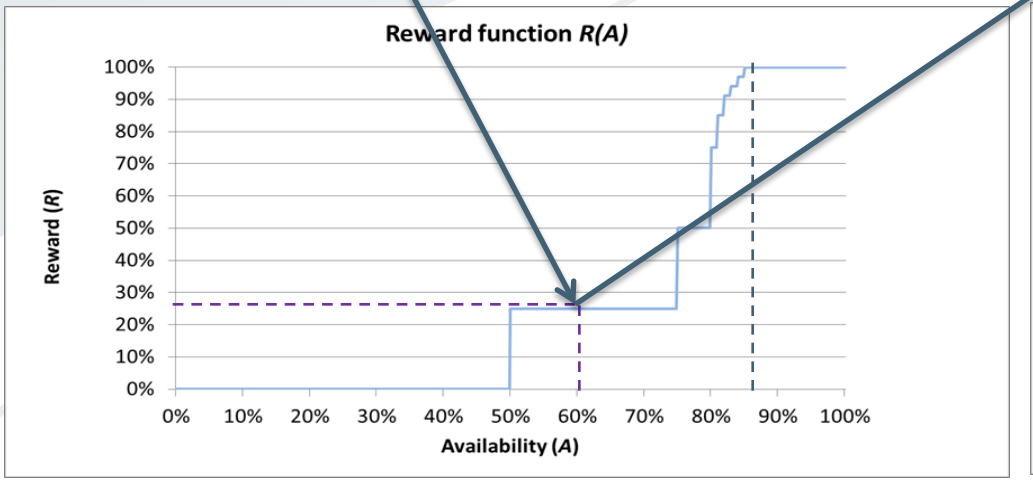


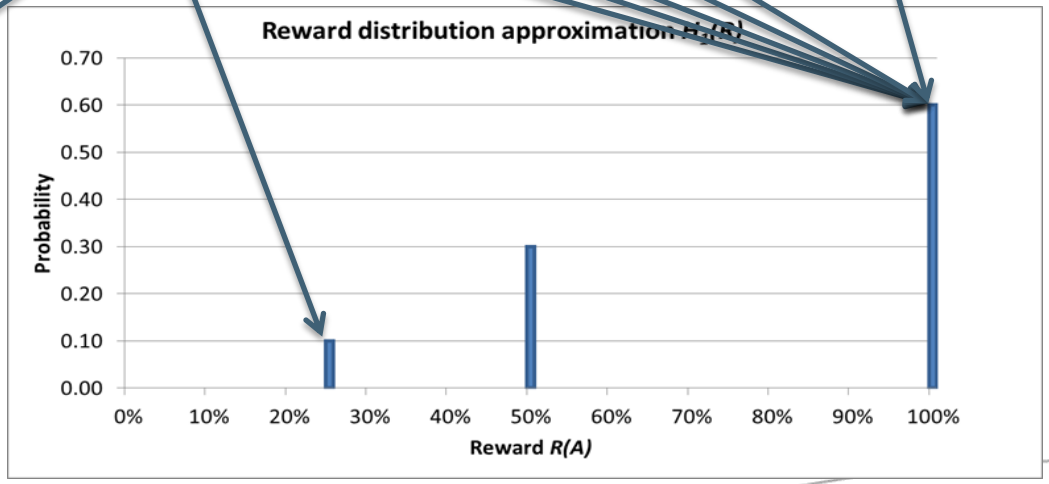
Availability (*A*)	Reward *R(A)*
85% ≤ A ≤ 100%	100%
84% ≤ A < 85%	97%
83% ≤ A < 84%	94%
82% ≤ A < 83%	91%
81% ≤ A < 82%	85%
80% ≤ A < 81%	75%
75% ≤ A < 80%	50%
50% ≤ A < 75%	25%
0% ≤ A < 50%	0%

SIMULATE AND EVALUATE THE REWARD FUNCTION.









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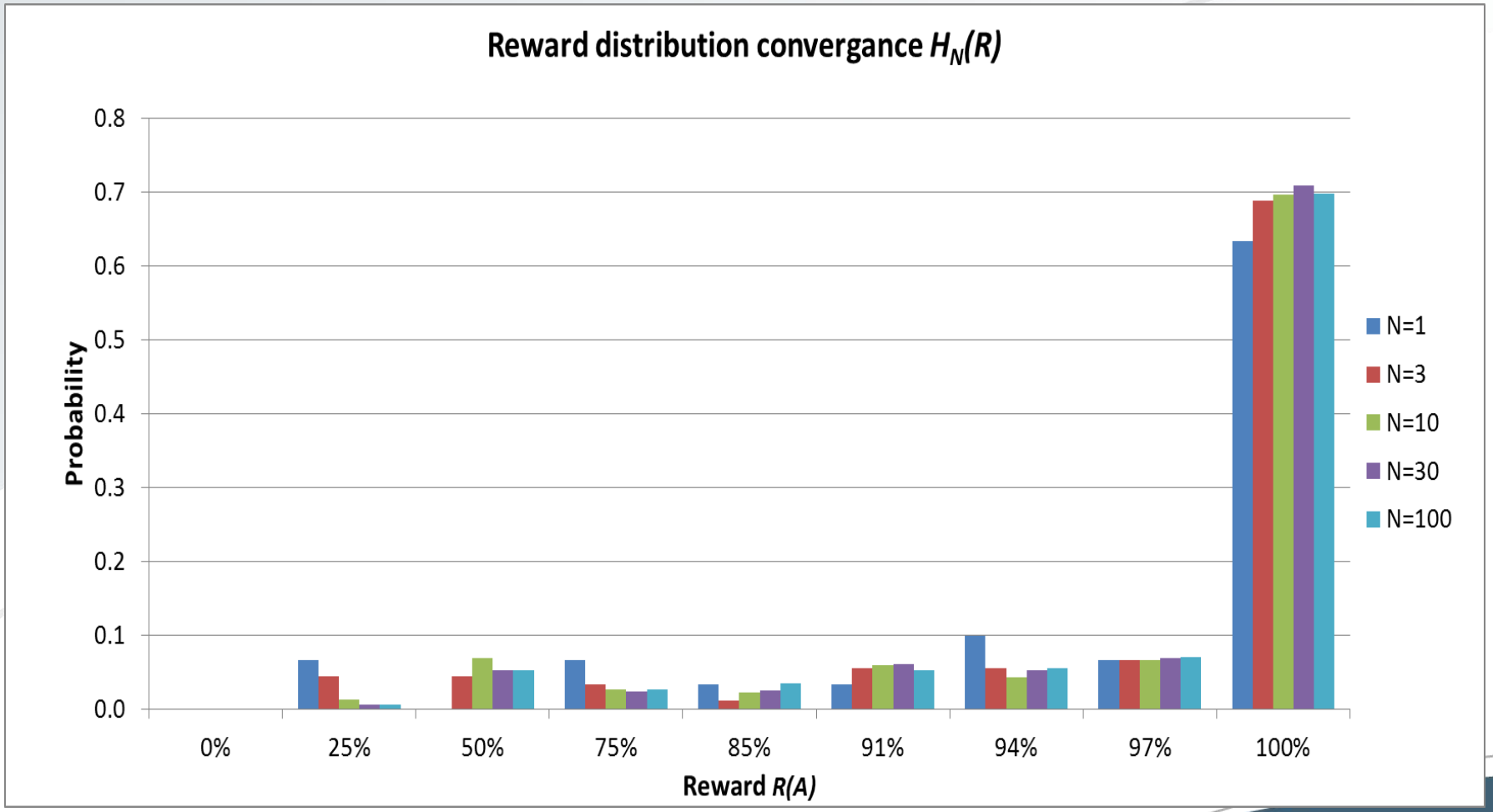
RESULT CONVERGENCE WHEN RUNNING MULTIPLE SIMULATIONS.

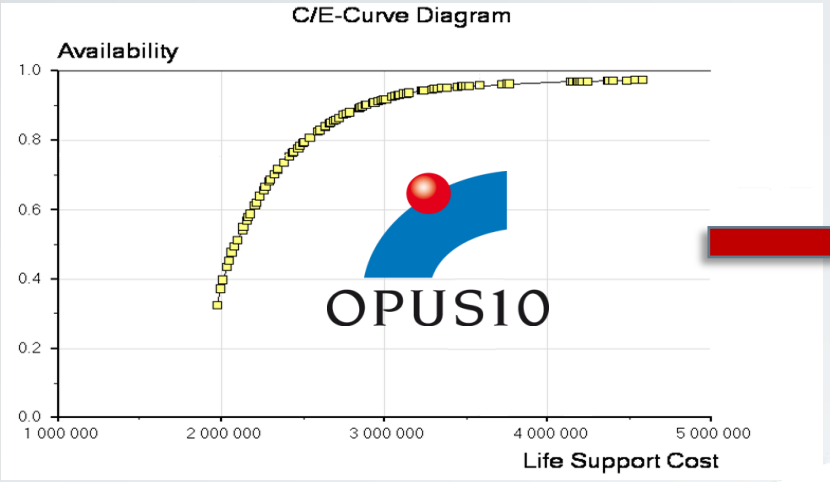


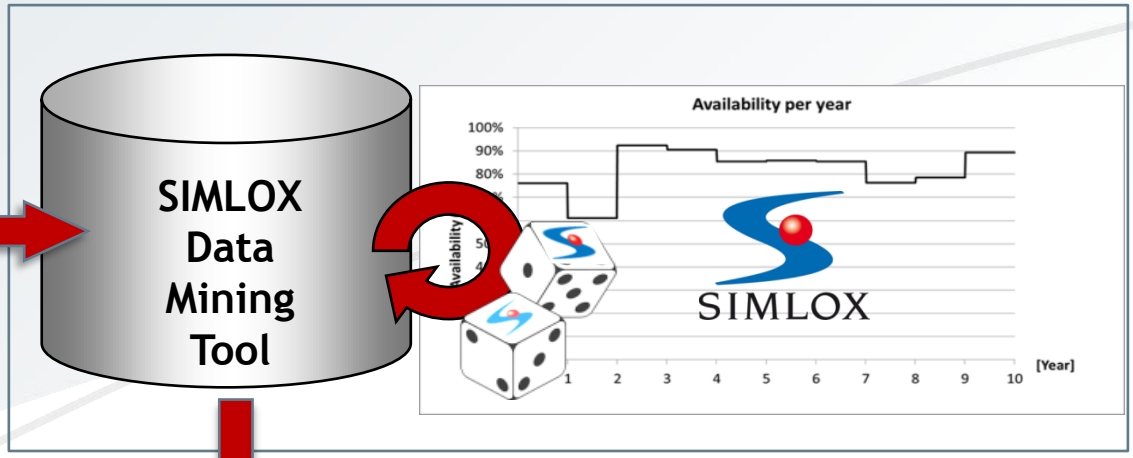
CONCLUSION.

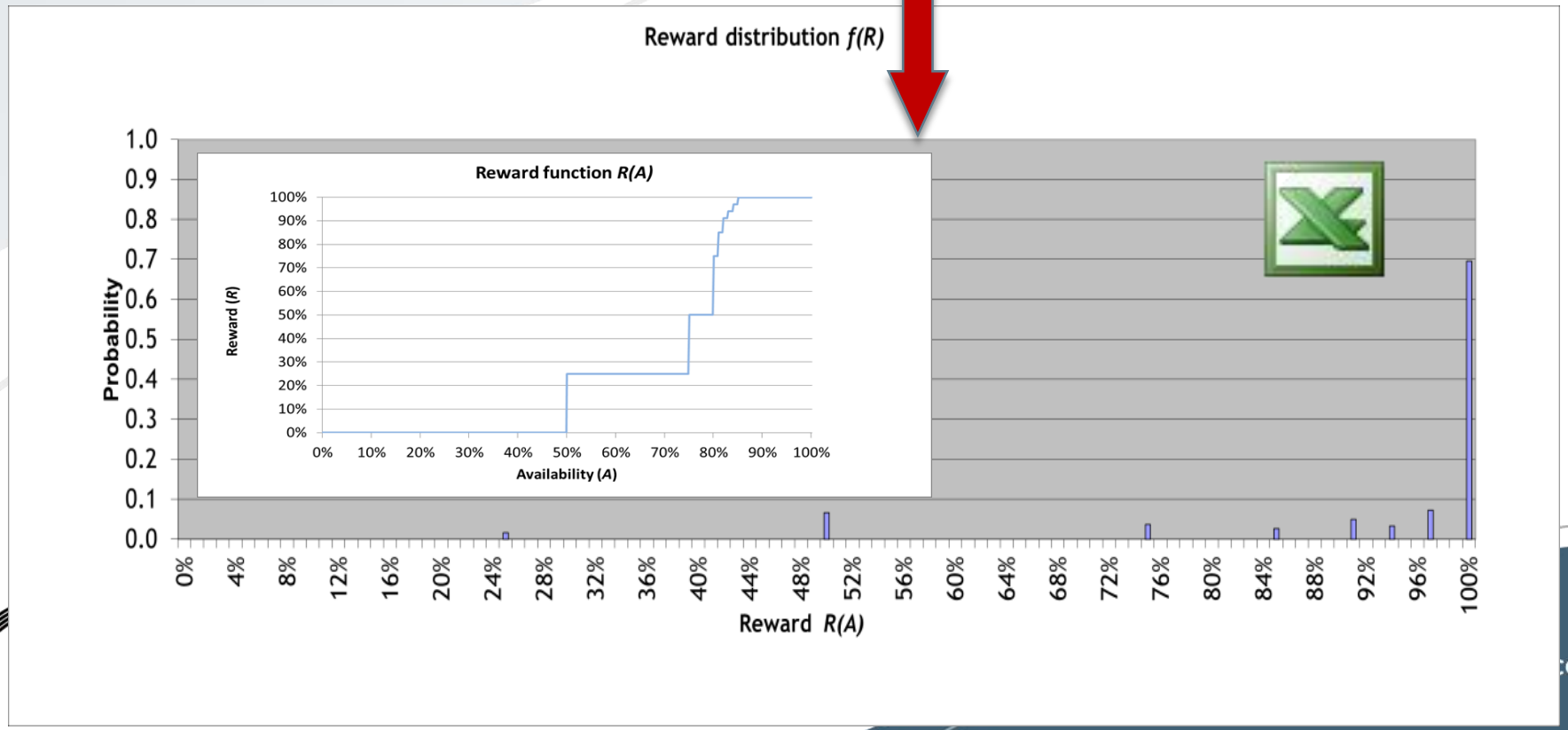
- The analyses should be based on more than one replication to give enough confidence in the results

- There is a need to automate the analysis process

OUR WORK FLOW.







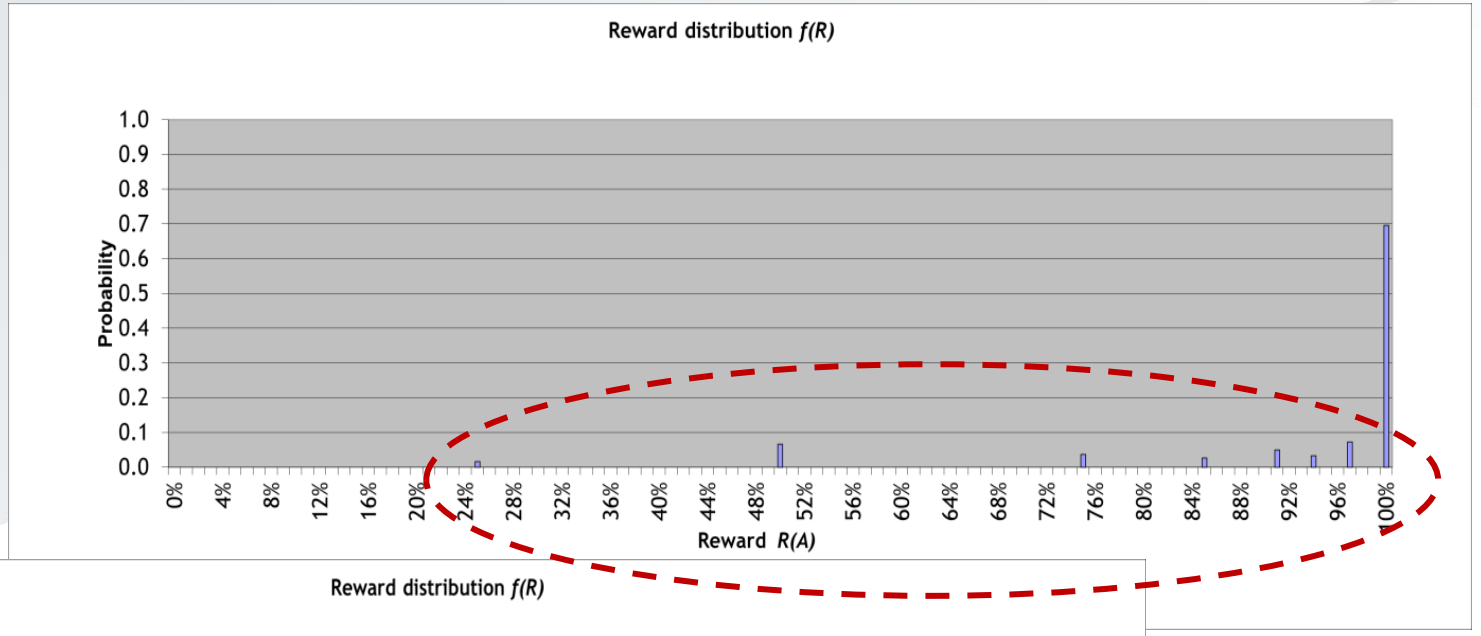
SORRY, NO TIME FOR A DEMO.
PLEASE VISIT US AT THE DISPLAY.

NEGOTIATING ALTERNATIVE REWARD FUNCTIONS.

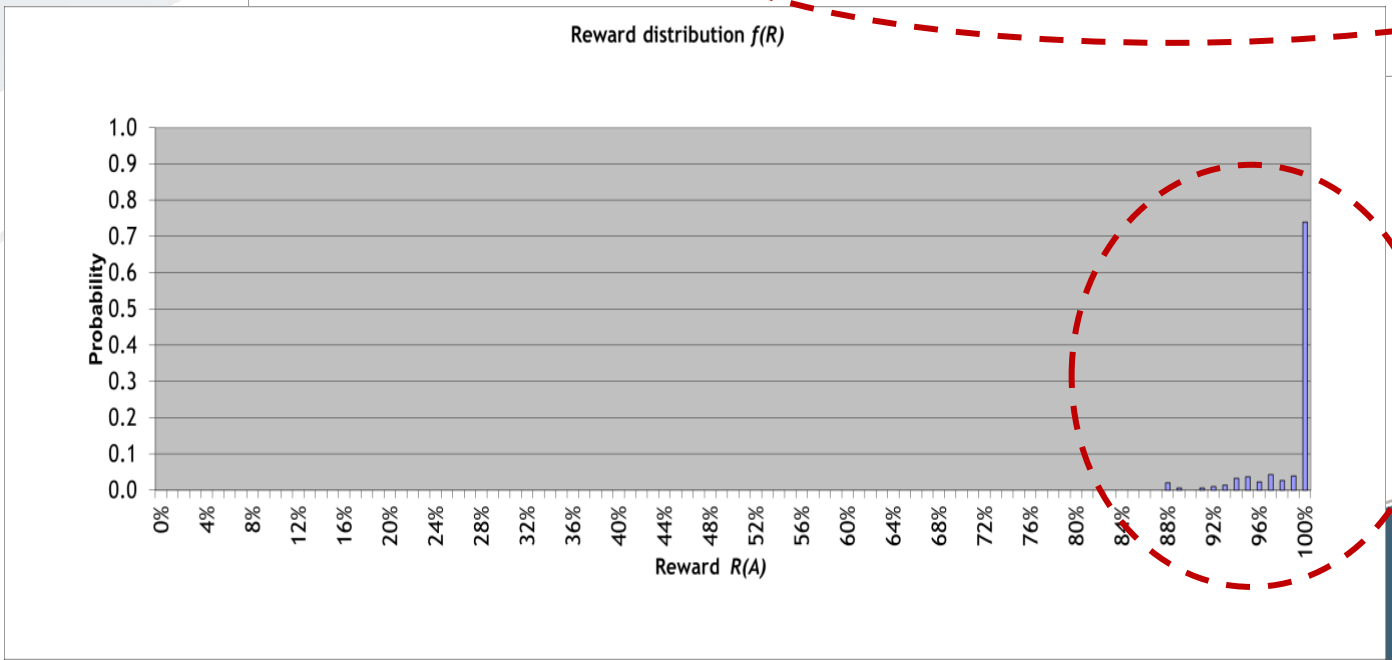
Supplier

Customer

EVALUATING THE PROPOSALS.



Customer

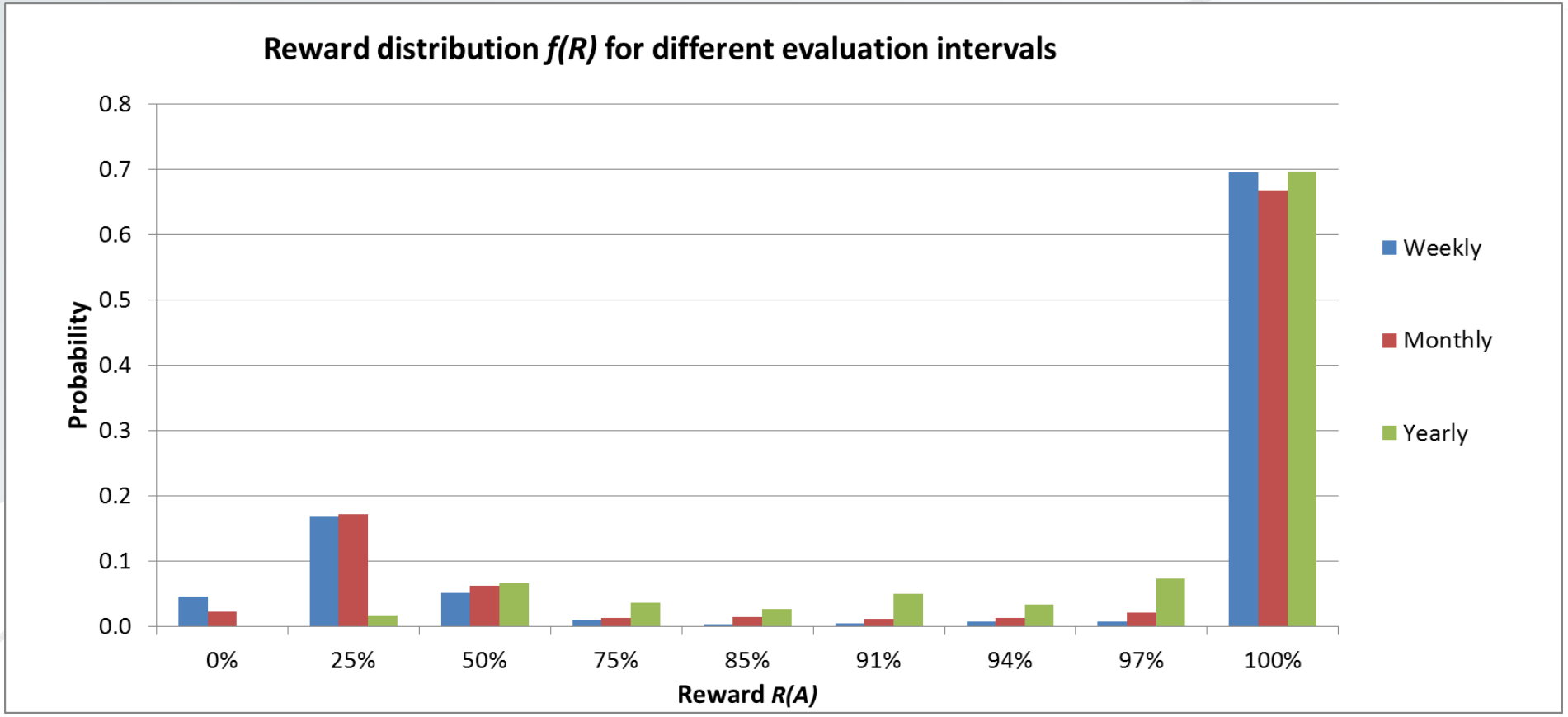


Supplier

CONCLUSION.

- The supplier's proposal generates a greater reward more quickly compared with the reward function proposed by the customer
- The supplier's proposal also gives a lower incentive for meeting the customer's requirements due to a low reward decrease rate below the target availability
- surprised?

EVALUTATION OF DIFFERENT MEASURING INTERVALS.



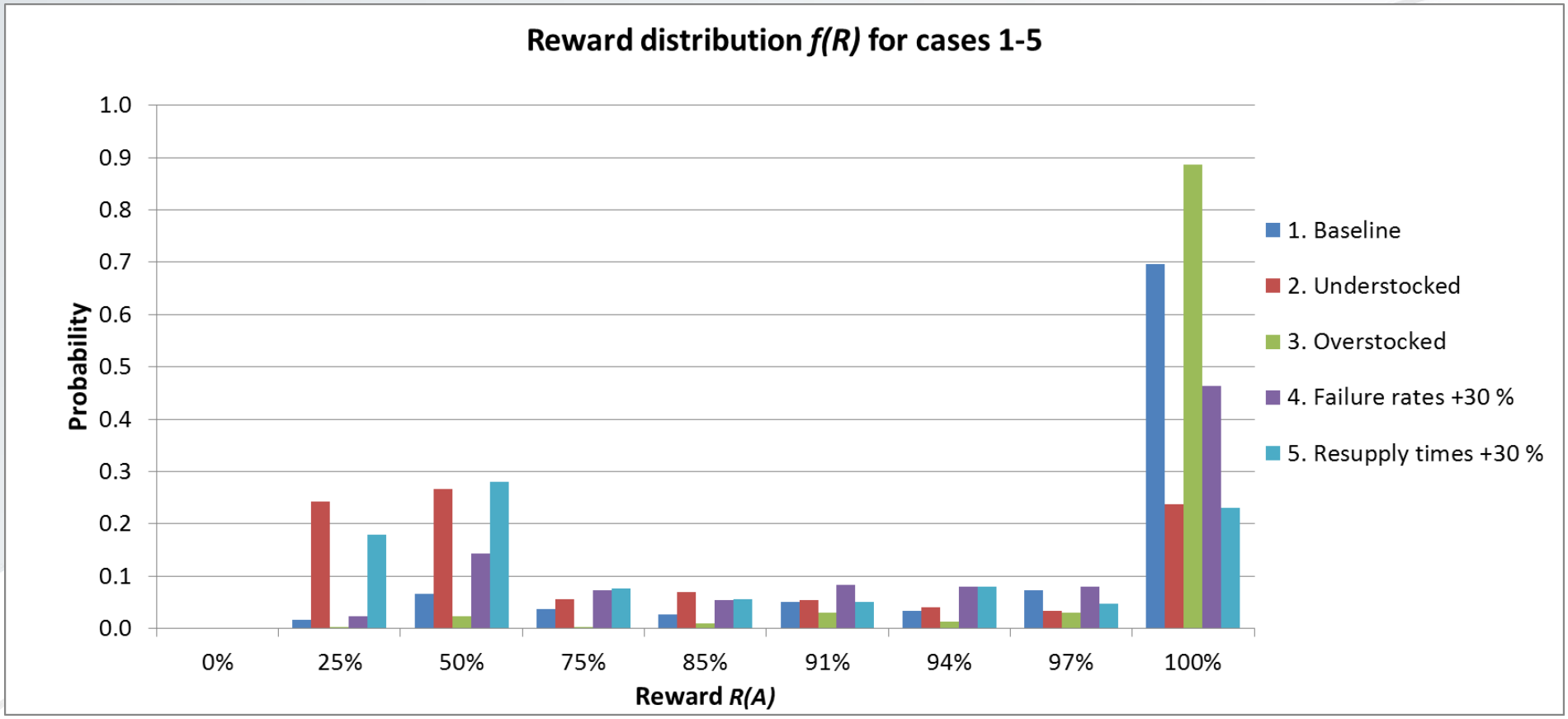
CONCLUSION.

- The variance of a reward function parameter is usually greater when measured over shorter time intervals compared to a longer time interval

- A temporary decrease in performance during a short period are evened up when measuring the performance over a longer time interval resulting in a higher reward compared to when measuring over shorter intervals.

- One could say that shorter measuring intervals are better for the customer and longer intervals are better for the supplier

SENSITIVITY ANALYSIS.



Case 1: Baseline (optimized stock from OPUS10 for *A*=85 %
Case 2: Understocked (optimized OPUS10 stock for *A*=70 %)
Case 3: Overstocked (optimized OPUS10 stock for *A*=90 %)
Case 4: Baseline, but Item failure rate 30 % higher
Case 5: Baseline but, resupply times 30 % higher

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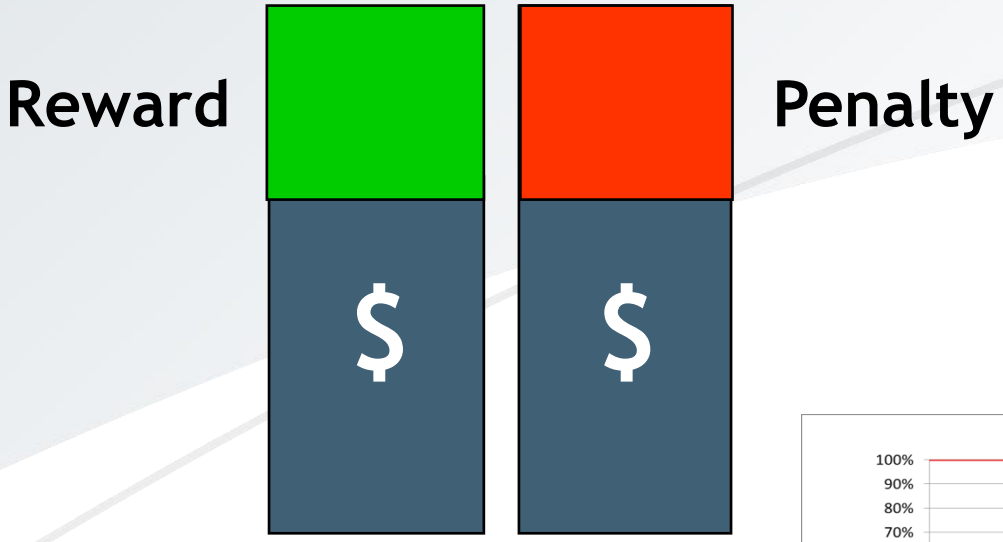
CONCLUSION.

Case	*P(R ≥ 90 %)*
1: Baseline	0.85
2: Understocked	0.36
3: Overstocked	0.96
4: Failure rates +30 %	0.71
5: Resupply times +30 %	0.41

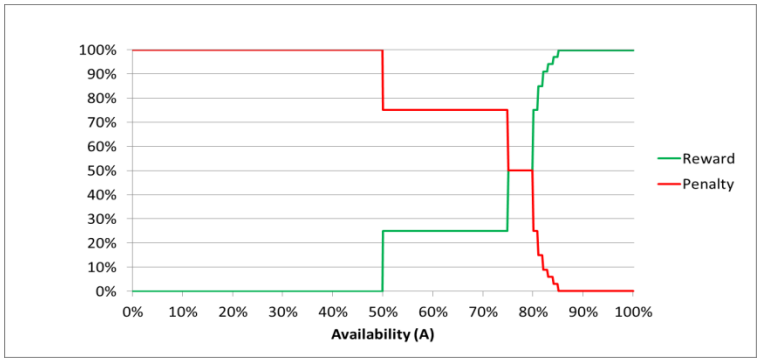
- The understocked scenario gives only a 36 % probability of achieving a reward above 90 %.
- The result also shows that it is important to avoid long resupply time

- **If the supplier wants to have a high reward, stocking enough spares and managing the resupply times should be a priority.**
- **This approach makes it possible to optimize the balance between cost and reward.**

REWARD OR PENALTY?



Does it matter since P(x)=1-R(x)?



- Who should have the financial risk?
- In general Customers should favor rewards and Suppliers penalties
- A reward function creats a more positive atmosphere –
  You get a motivating reward for achieving your objectives rather than being driven by the negative mindset of trying to avoid a penalty
- **So – the best solution might be to have both at the same time...**

SUMMARY.

- Modeling & simulation are essential in understanding the consequences of a PBL contract and in designing reward functions that gives the supplier incentives to meet the objectives
- The proposed method provides the decision maker with an efficient decision support tool that can be used for instantaneous evaluations in a contract negotiation
- The method makes it easy for both customers and suppliers to evaluate the probable reward in a PBL contract and assess the risks for not meeting the contract objectives.
- The same methodology can also be used by the supplier to design and optimize the logistic support solution

REFERENCE PROJECTS.

- **Nordic Standard Helicopter Program – NH90**
- **Saab Dynamics**
- **BAE Systems Hägglunds**

THANK YOU FOR LISTENING.

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