TFD GROUP

TOOLS FOR DECISION

Spares Investment Cost Modelling in the Real (non steady state) World

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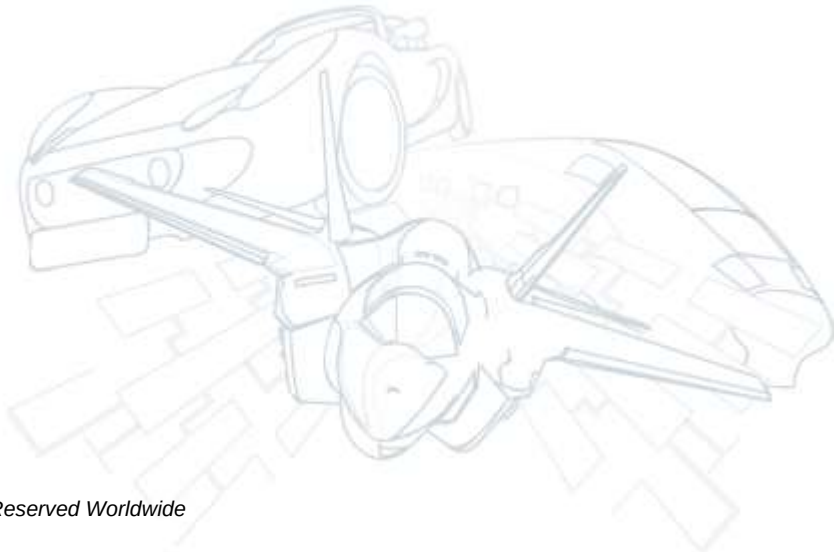
What I will cover

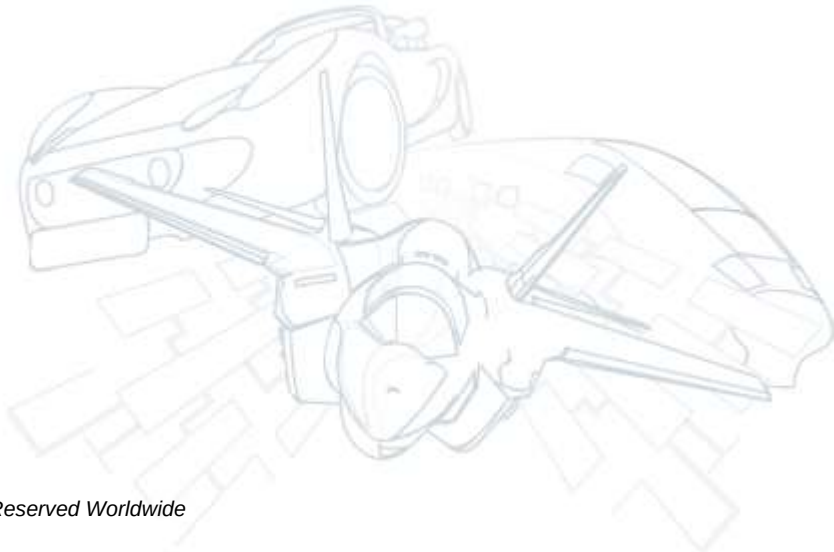
- Introduction to spares marginal optimisation
- Drawbacks of Steady State Models
  - Fleet build up & run down
  - In service inventory management problems
- The mechanics of spares optimisation with time
- Complex combinations of MOE/KPIs
- The impact of accounting for time
- Some research, findings and benefits

A brief history of spares computation



Inventory Management Decision Problems

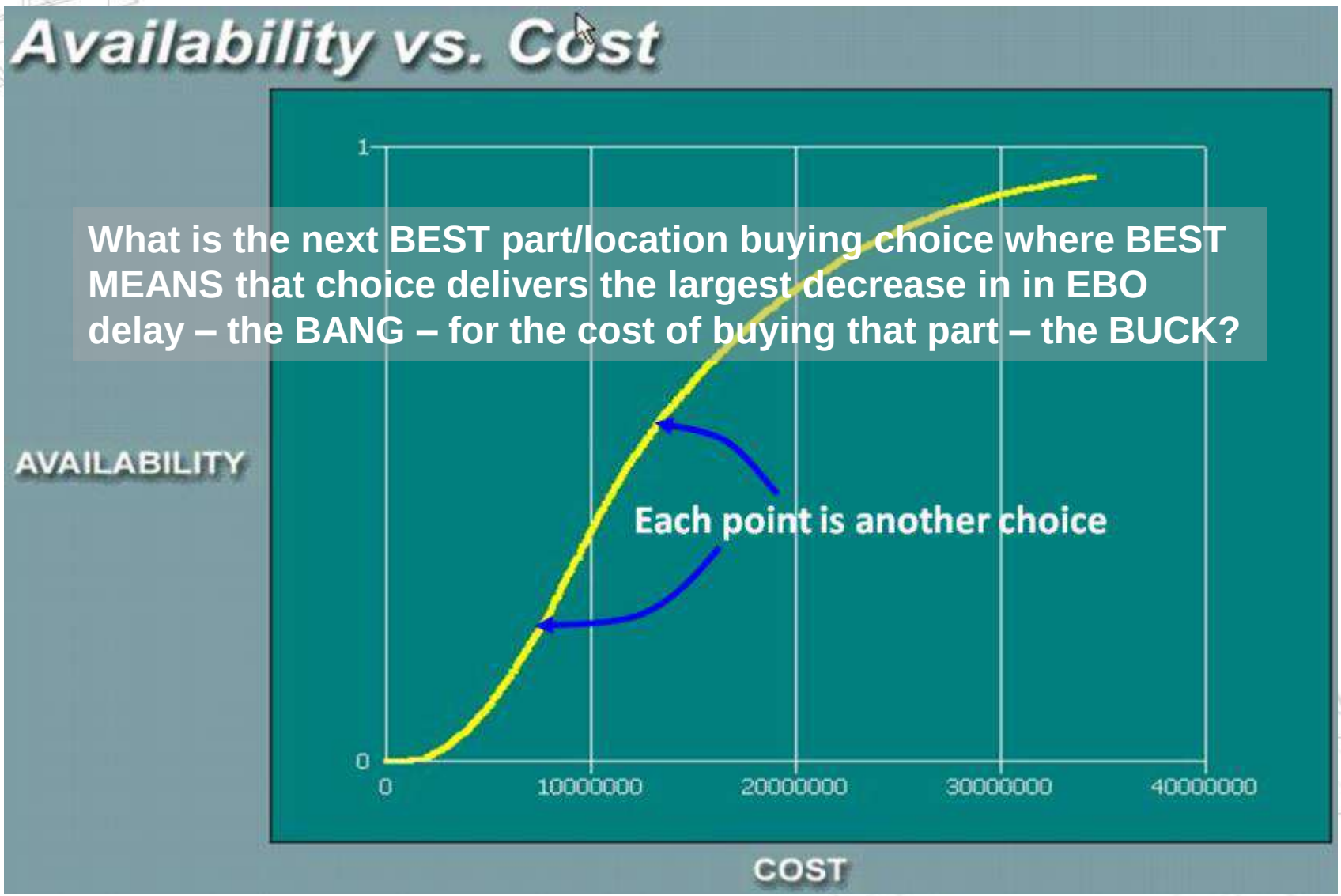
- Allocating inventory budgets between long and short lead time items
- Understanding the impact of maldistributed obsolescence (that's maldistrubuted in time)
- and working through the issues of multi-year inventory planning



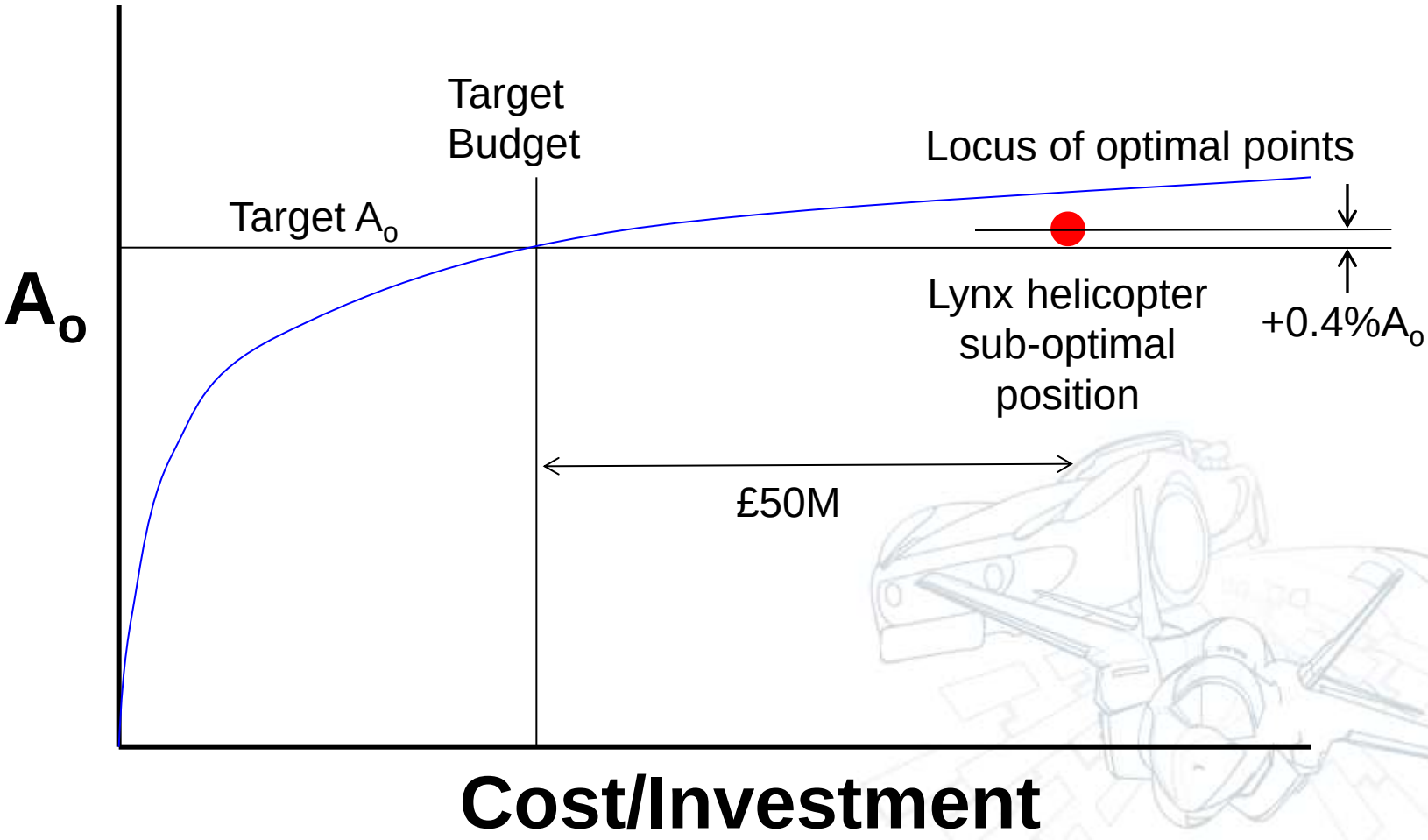
A Brief History

$$PV_0\left(\Delta EBO_{t_1 \ldots t_2}\right) = \sum_{t=t_1}^{t=t_2} PV_0(\Delta EBO_t)$$

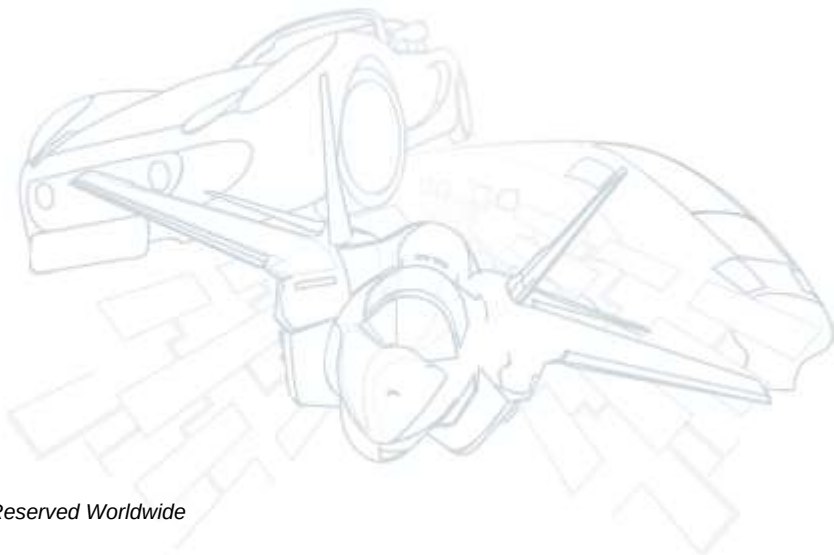
"Bang for Buck"



The Availability v Cost Relationship
Lynx Helos 2006

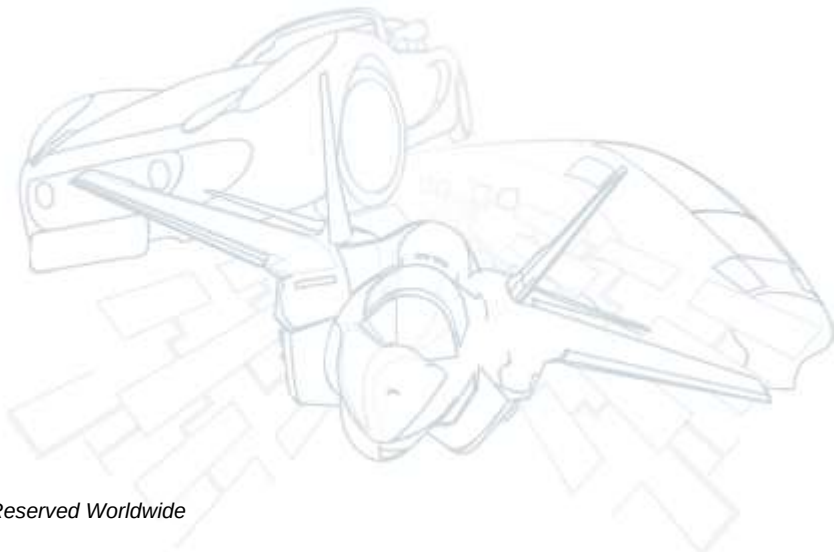


Time Based Inventory Optimisation

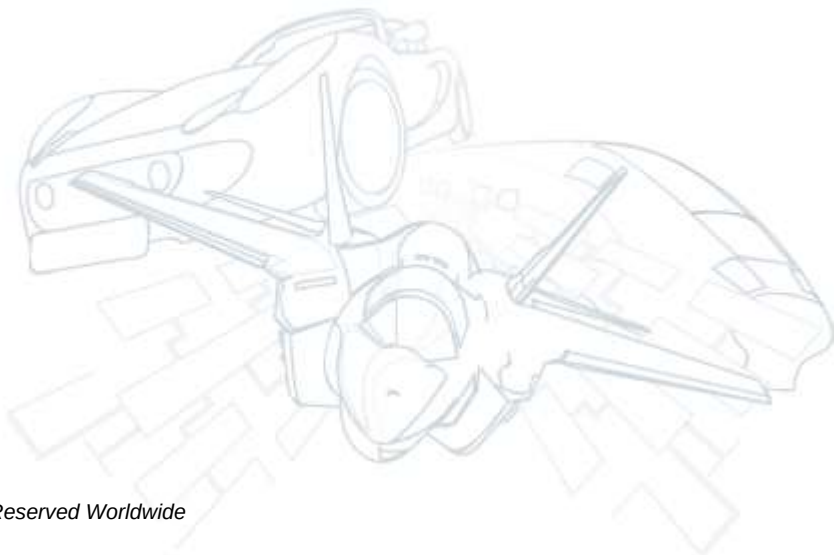


Inventory Management Decisions Problems With Time

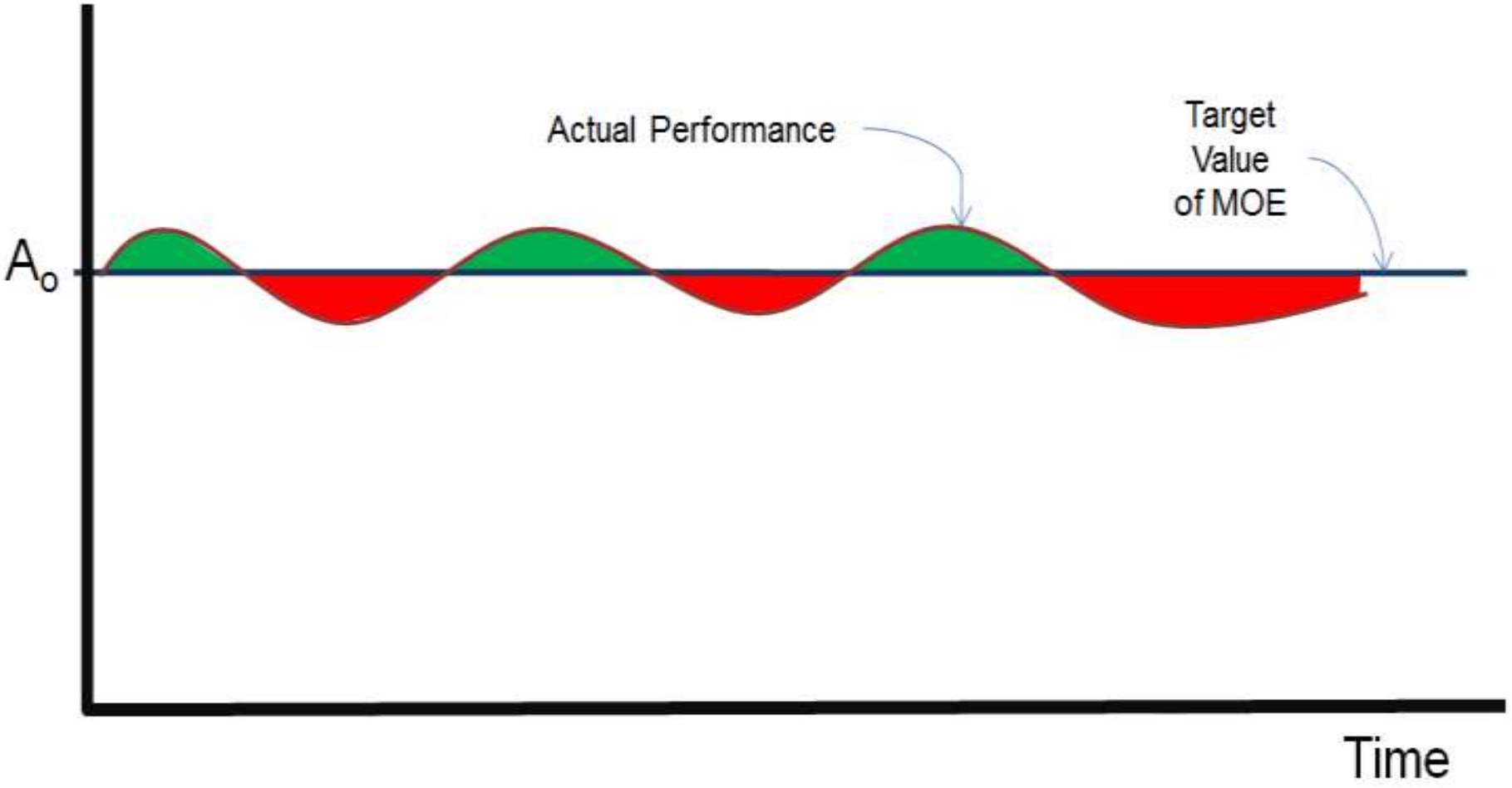
- Fleet build-up or multi-period initial provisioning
- Fleet run-down and end-of-life problems
- In-Service inventory problems
  - Long lead time items
  - Obsolescence



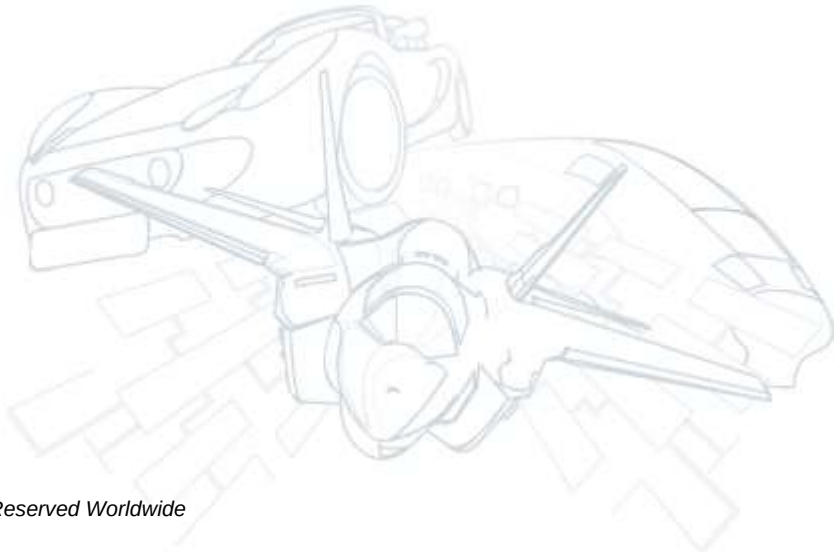
Drawbacks of Steady State Models



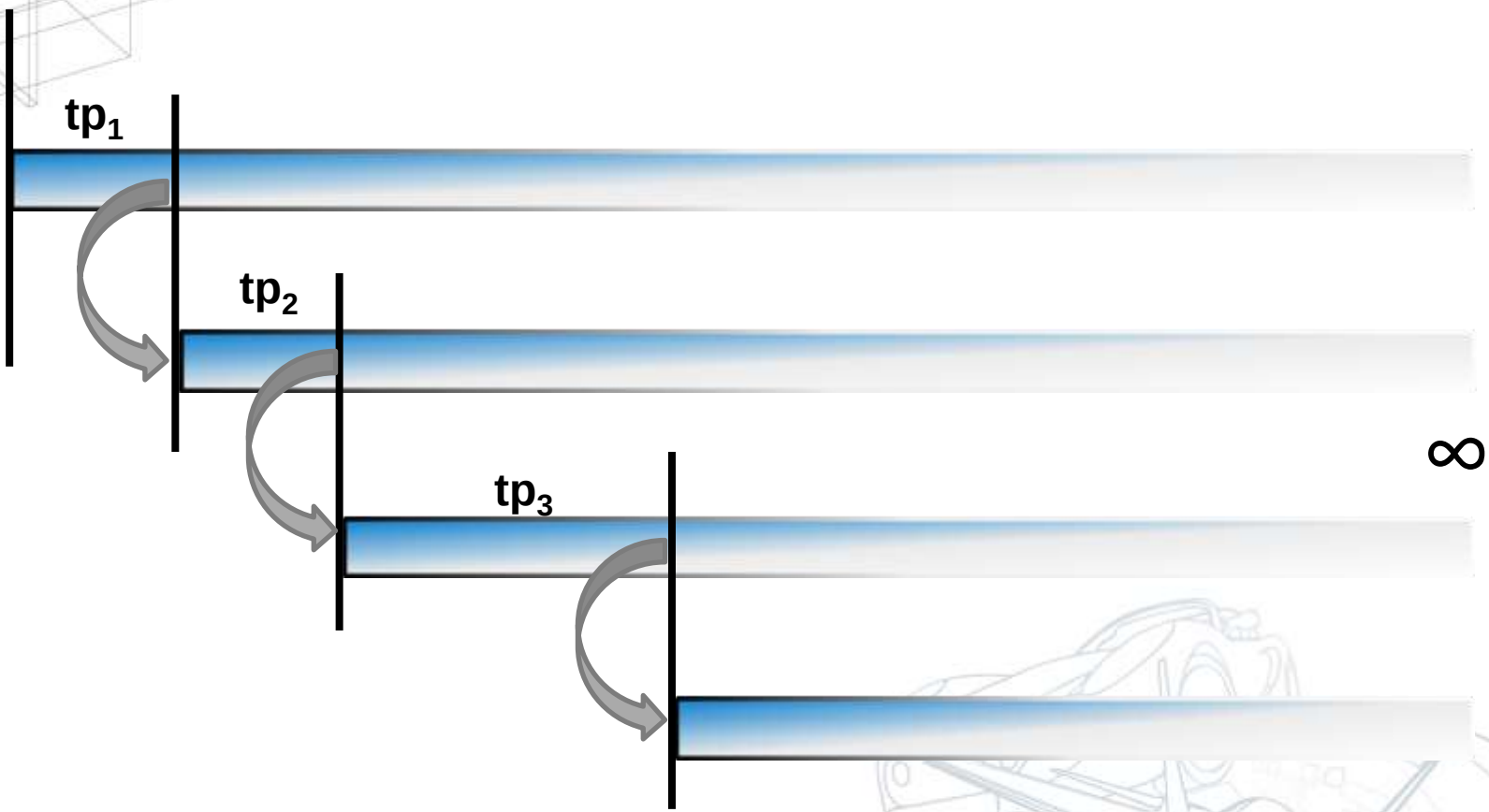
Ao Performance Over Time



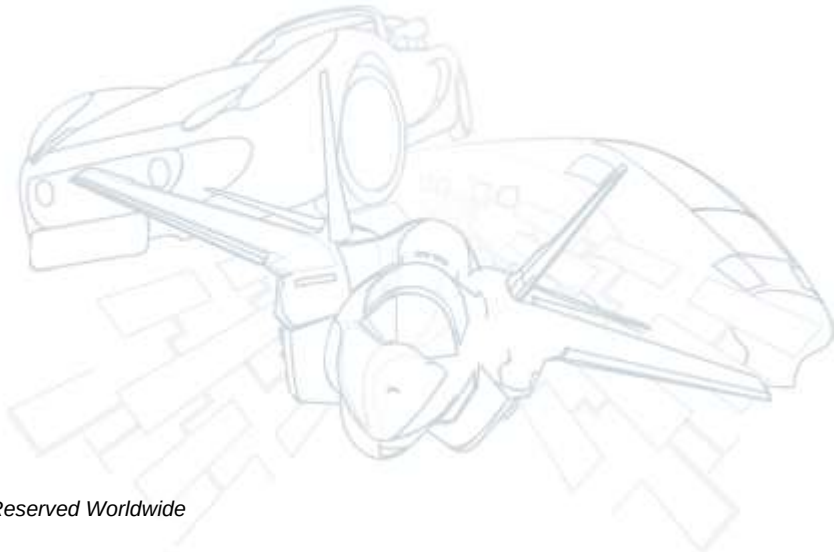
Fleet Build Up



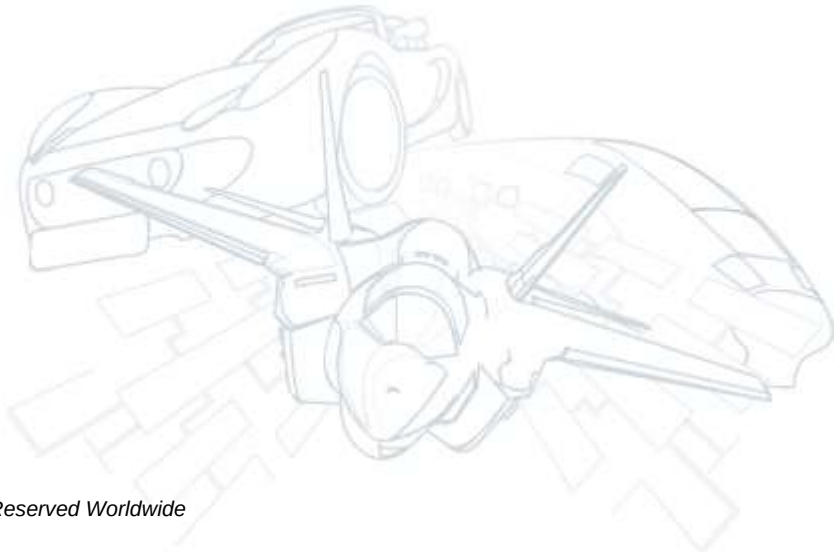
Multi-Run Steady State Modelling



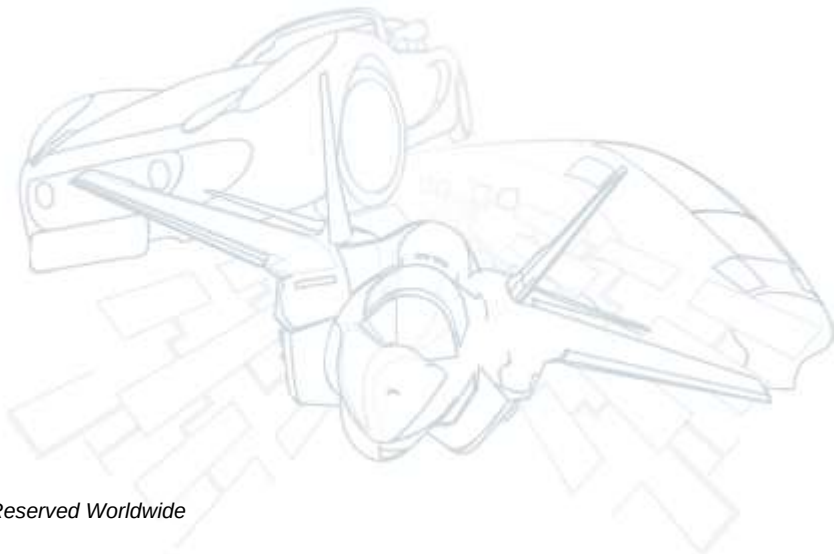
Fleet Run Down



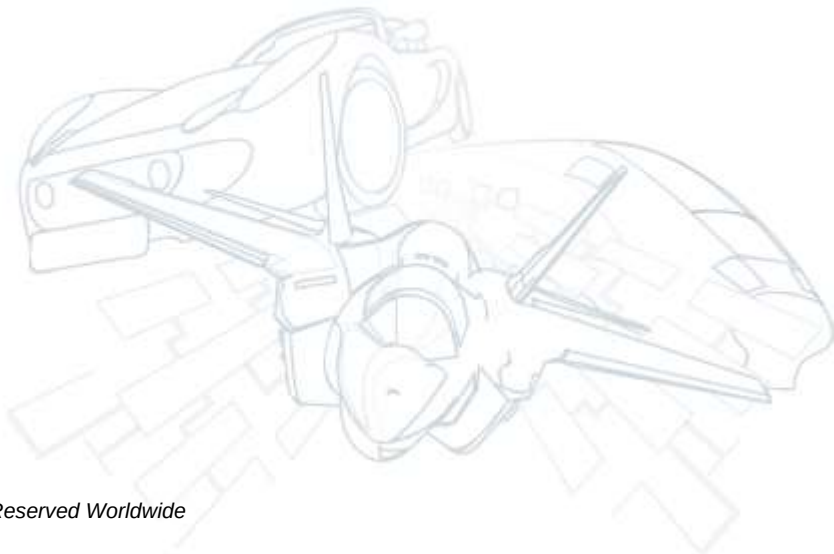
In Service Inventory Problems



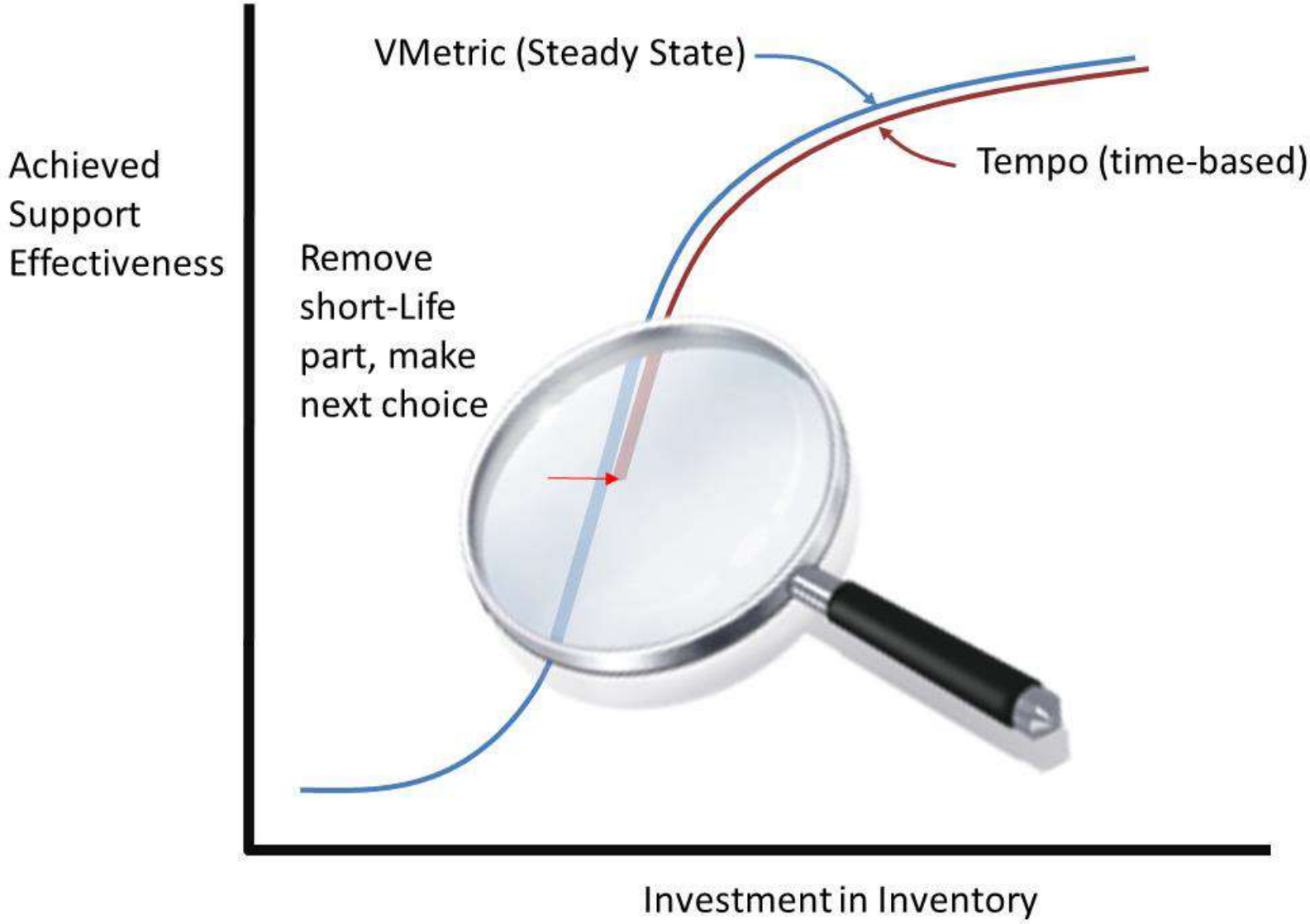
The Mechanics of Spares Optimisation with Time



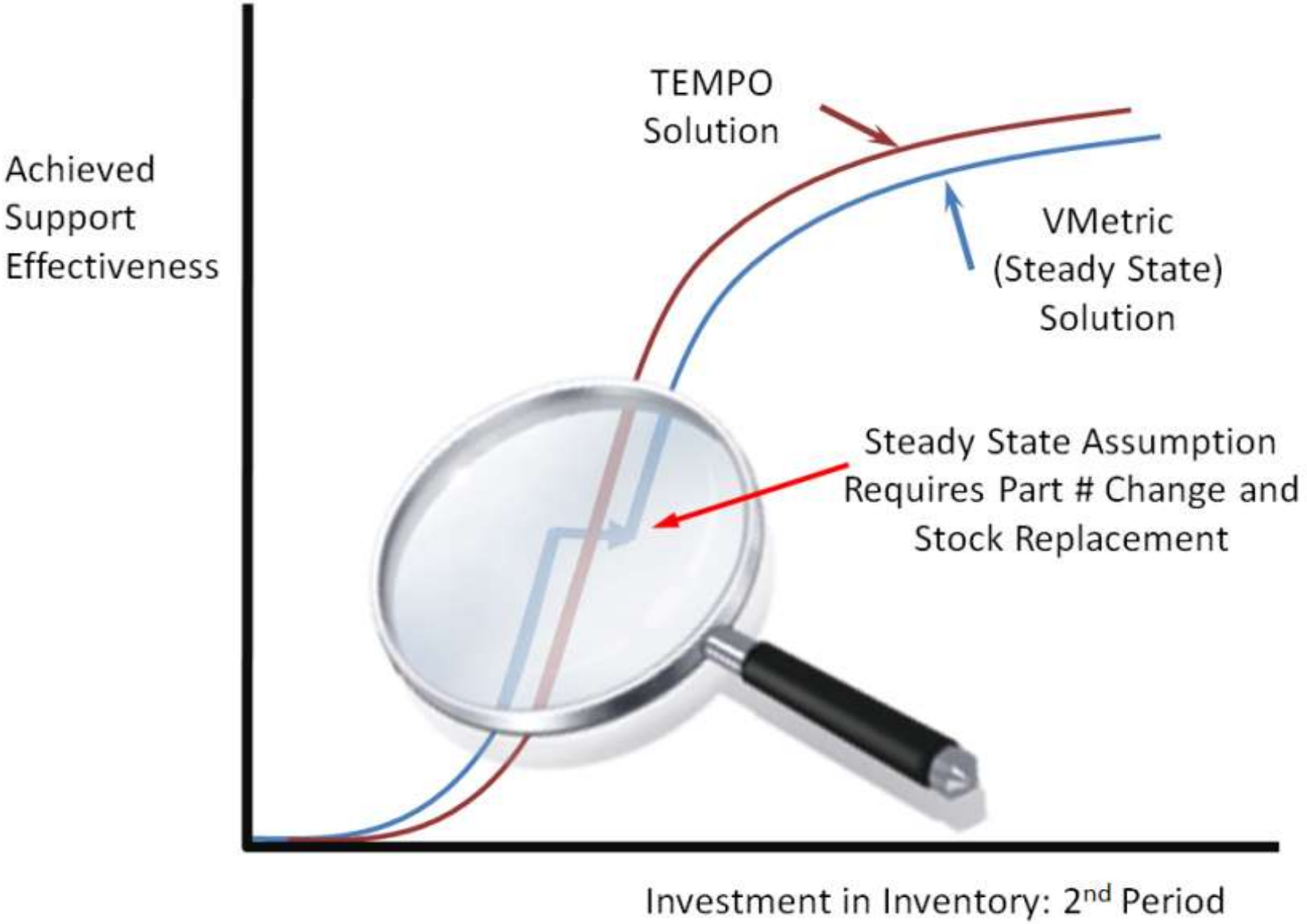
The Impact of Accounting for Time



Shifting from Optimal Locus in Tempo



TEMPO vs. VMetric 2nd Period Difference



Program Life v Mean Technological Life

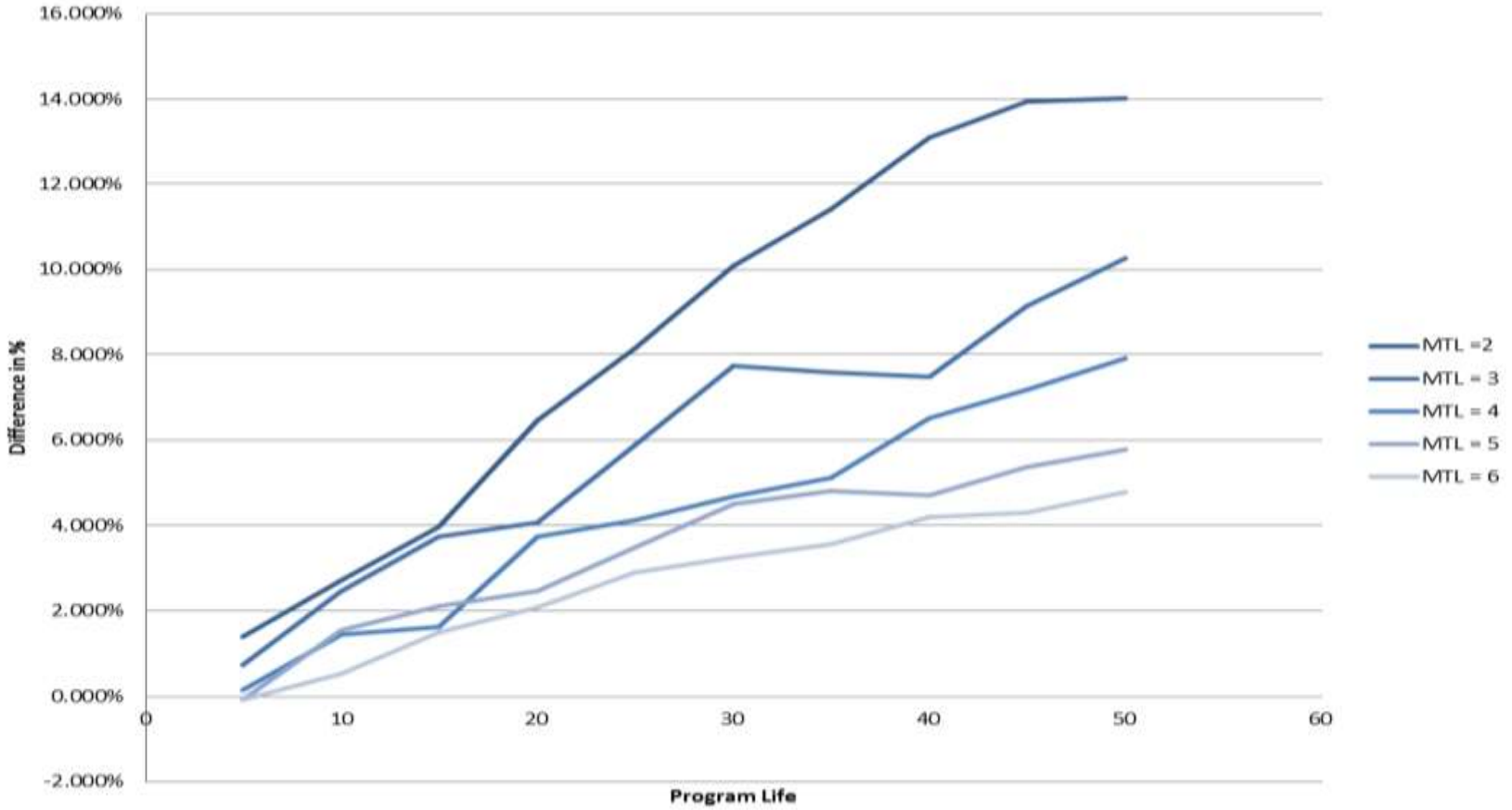


Figure 6: Program Life Versus MTL

Thank you
Questions?

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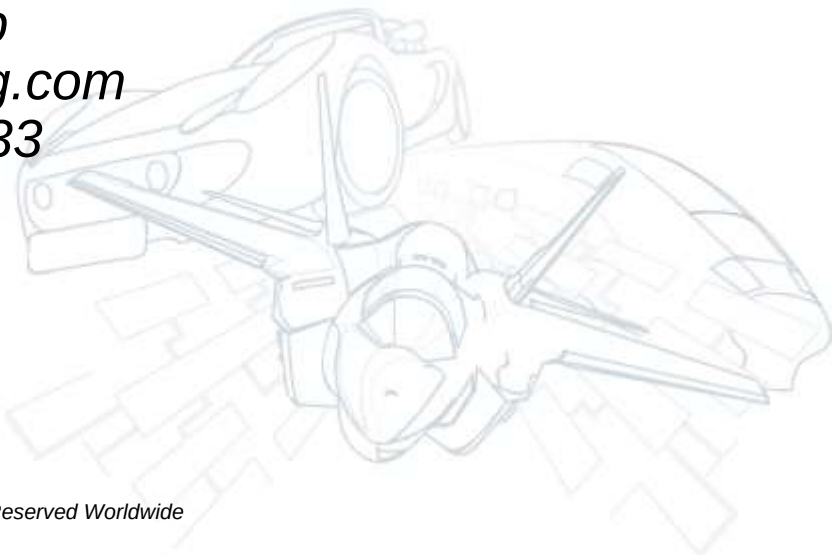


Time Based Optimisation
Benefits

A ***Tempo***-optimised solution is better than (or different from) those from steady state tools because it:

- Handles the inevitability of changing scenarios
- Avoids the errors implicit in steady-state models including over-stocking of life-limited parts and handles long-lead time items
- Avoids waste and maximises value of investment
- Optimises time-phased procurement to match fleet run-up, re-basing and re-role, and run-down for the optimum Whole-Life Inventory Cost
- Is ideal for assessing major programme mid-life upgrades that require new spares ranges and retires replaced items.
- Is ideal for capability transitions
- Deals explicitly with time to take out the drudgery of multi-period calculations

About TFD Group

- Established in 1976 specializing in defence economics and later became a software and solutions provider
- TFD Group is now a collection of companies in the US, UK, South Africa, China and Japan. We specialize in:
  - Economic optimization and logistic modeling
  - Logistic data management
  - Logistic process management
- Software at 1,000 license holders with 000's of skilled users. Our tools are in use world-wide on many equipment systems: aircraft, communications networks, tanks, ships, weather stations, trains, buses and vehicles.
- Major solutions include: General Dynamics, Parker Hannifin, Thales, Boeing, Northrop Grumman, Bell Helicopter, Lockheed Martin, Raytheon, BAE SYSTEMS, UK MoD, USAF, Montreal Rail, SNCF, UN CTBTO, NASA, ESA, NOAA and US Coast Guard.
- Strategic relationships: IFS, AAR, Fujitsu, MHI

TFD Products and Services

- Logistic Program Management tools
  - Logistic **Strategic** modeling and cost analysis – tools, training, services
    - ***EDCAS*** - Front-end design trades, Repair Level Analysis (LORA)
    - ***VMetric*** - Inventory optimization (Ranging and Scaling)
    - ***TEMPO -*** Accommodates changes over time in spares optimization.
    - ***MAAP*** - Total Ownership Cost, equipment level, multi-resource optimization
  - Logistic **Tactical** process management
    - ***SCO*** - Supply Chain Optimization
    - ***SIM*** - Serialized Item Management – particularly for aero-engines
  - Logistic **Data Management** – supporting both tactical and strategic tools
    - ***TFDdV*** - TFD Data Vault
- Services and Solutions
  - Consulting & training focused on Performance Based Logistics (PBL)
  - Tailored system development for large Users

Steady State Spares Optimisation

- Traditional spares optimisation tools assume long-term, steady-state
  - Long-term means *forever*
  - Steady State means the situation and input conditions remain unchanged *forever*
- But in the real world:
  - The situation *always* changes
  - Long-term average conditions are *never* experienced.
  - Steady-state models cannot distinguish between average results over time and results in each period
  - Management criteria and contractual obligations will be measured over time periods
- Variations cause spares deficiencies and excesses that translate to added cost, performance shortfalls and risk such as contract penalties
- Simulation only evaluates how spares packages optimised for one situation will perform in other circumstances. It cannot re-optimise the spares package

Tempo (TFD Engine for Multi-Period Optimization) is unique
It delivers a whole-life perspective to optimal inventory planning

What is Different inside ***Tempo*** - 1

- ***Tempo*** builds upon TFD's world-class ***VMetric*** spares optimisation engine - if nothing changes over time, ***Tempo*** produces the same results as ***VMetric***
- ***Tempo*** incorporates 7 important changes to take account of time:
- Captures changes to key variables over time
  - Predictable changes to hardware attributes – reliability, unit price etc
  - Foreseeable changes to fielding scenarios - fleet size, usage rates, etc
  - 'Evolutions' are used to define changes over time
- Evaluates each increase in stock against multiple performance targets to accommodate complex PBL contractual frameworks
  - Operational availability
  - Fill rate-based targets
  - Delay times
  - Hybrid performance targets

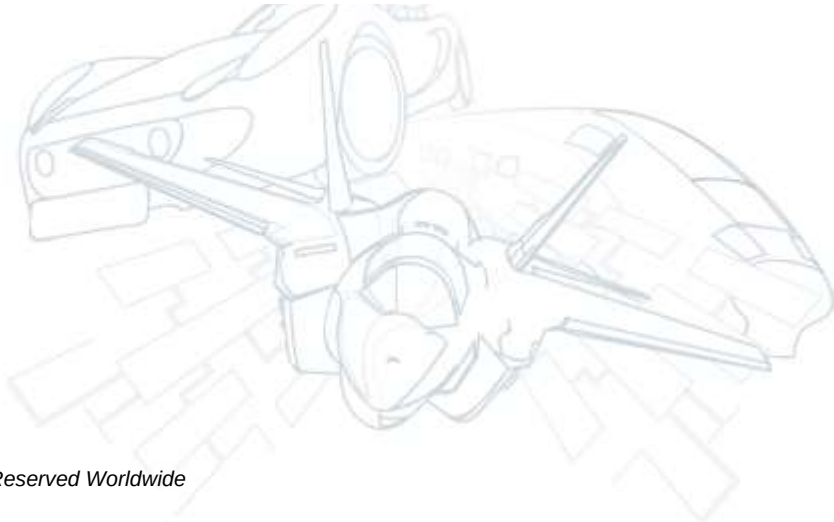
What is Different inside ***Tempo*** *- 2*

- Maintains a complex calendar to separate and account for:
  - Specific points at which inventory solutions are required
  - Budget cycles
  - New system delivery and phase-out schedules
  - Used-life data for systems and components
  - Mean technological life cycles
- Considers specifically the time period over which a spare part can be used
  - Procurement or repair lead times delay the delivery of benefit from a spare.
  - Obsolescence, or Mean Technological Life (MTL), shortens the usefulness and ROI of a spare
  - Approaching the end of system life has the same effect
  - 'Bang for the Buck' calculation modified to account for the useable time-base
- Develops an analytical engine that accommodates these changes over time
  - Translates all time-based values through discounting to present value
  - Time-Based Marginal Analysis – 'Bang for Buck over time'

What is Different inside ***Tempo*** - 3

- Automates the process of developing time-based inputs using business-rules to structure the analysis with automatic data flow between time-slice runs.
  - Analysts using steady-state model must split scenarios into multiple time-slices, one for each fixed condition, and load results from the last run as inputs to next
  - As change increases, complexity and workload grow exponentially
  - Quick turn-around analysis becomes increasingly difficult or impossible

  Tempo relieves the analyst of the drudge and error-prone work
- Produces new time-based analytical outputs showing comparative inventory and performance results through time to support the analyst



*What **Tempo** Does*

- Minimizes whole-life inventory cost (WLIC) – a new concept in inventory management
  - First period spares solution may be more expensive than steady-state solutions
  - Subsequent period solutions will be less costly as ***Tempo*** reduces the need to replace obsolete parts
- Decreases dependence on parts whose useful technological life is inappropriate
  - Buying fewer parts when system life exceeds the part's MTL
  - Buying fewer parts when the MTL is longer than remaining system life
- Supports structured change by tracing impact of planned changes to part attributes
  - Unit price changes from learning curve gains
  - Reliability improvement results for demand rates
  - Negotiated changes in procurement or repair lead times
  - Planned mid-life performance and life-extension upgrades
- Supports scenario adjustments over time
  - Fleet build-up, re-basing changes, usage changes, temporary deployments & expeditionary evolutions, and capability re-role
  - Support system changes
  - Transition between multiple systems:
    - Old system phase-out
    - New system phase-in
    - Parts commonality, depot changes, performance target changes

Tempo *Benefits*

A ***Tempo***-optimised solution is better than (or different from) those from steady state tools because ***Tempo***:

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Tempo Next Steps

- Tempo will be launched at DSEi in mid-September
- Tempo is currently in Beta testing
- Tempo principles will be taken forward into MAAP to incorporate all the support resources, not just spares
- New partners are welcome on the journey