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Force Expansion Curves

a way to model future capability

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Other authors

- Andrew Nicholls, Office of the Minister for Defence
- David Cox, Air Operations Division
- Richard Bartholomeusz, Air Vehicles Division

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Structure of talk

- How does the ADF manage capability?
- What are Force Expansion Curves?
- Case study: Maritime Patrol Group
- How can we use Force Expansion Curves?

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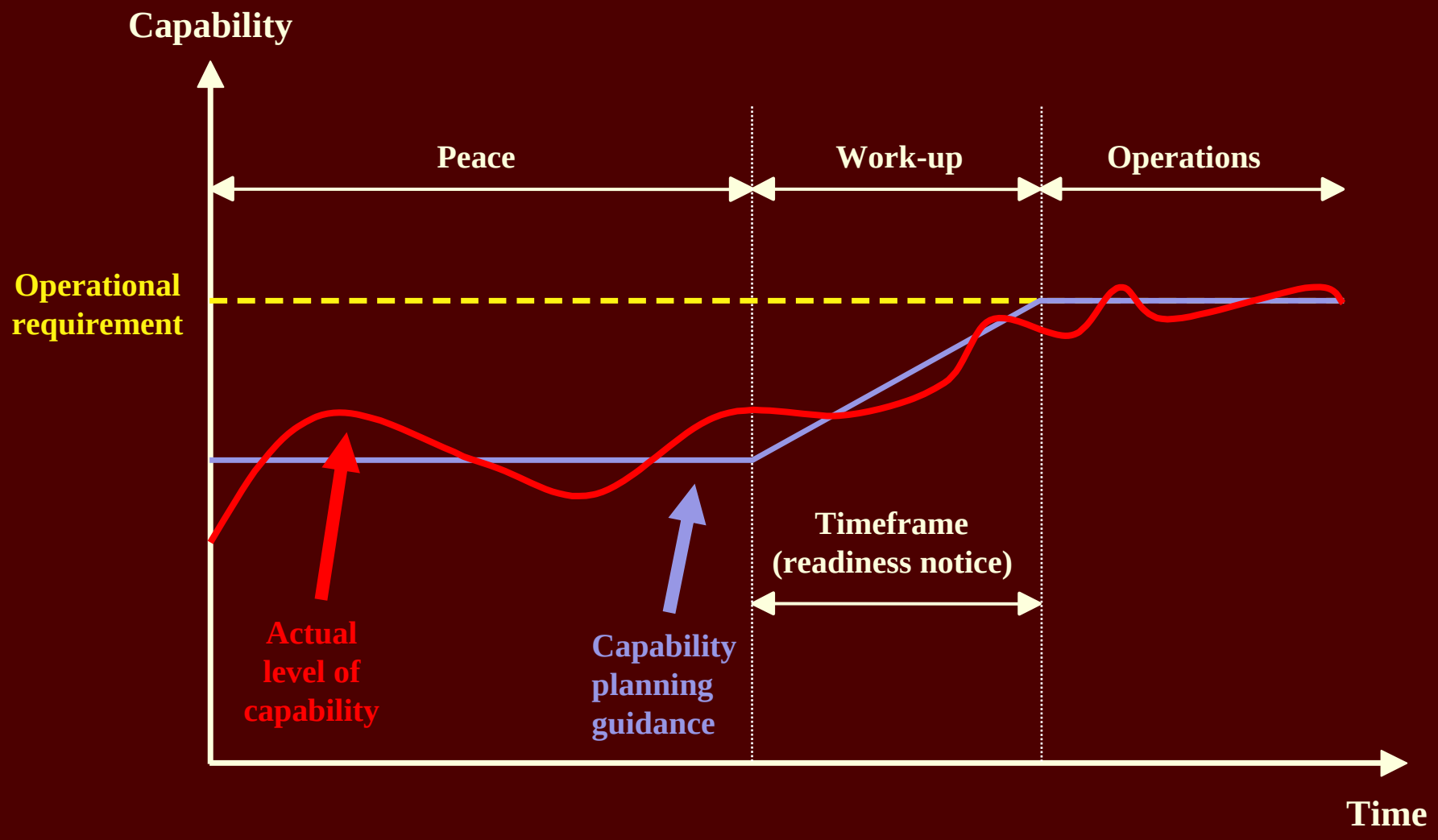
How does the ADF manage capability?

Levels of capability



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What are Force Expansion Curves?

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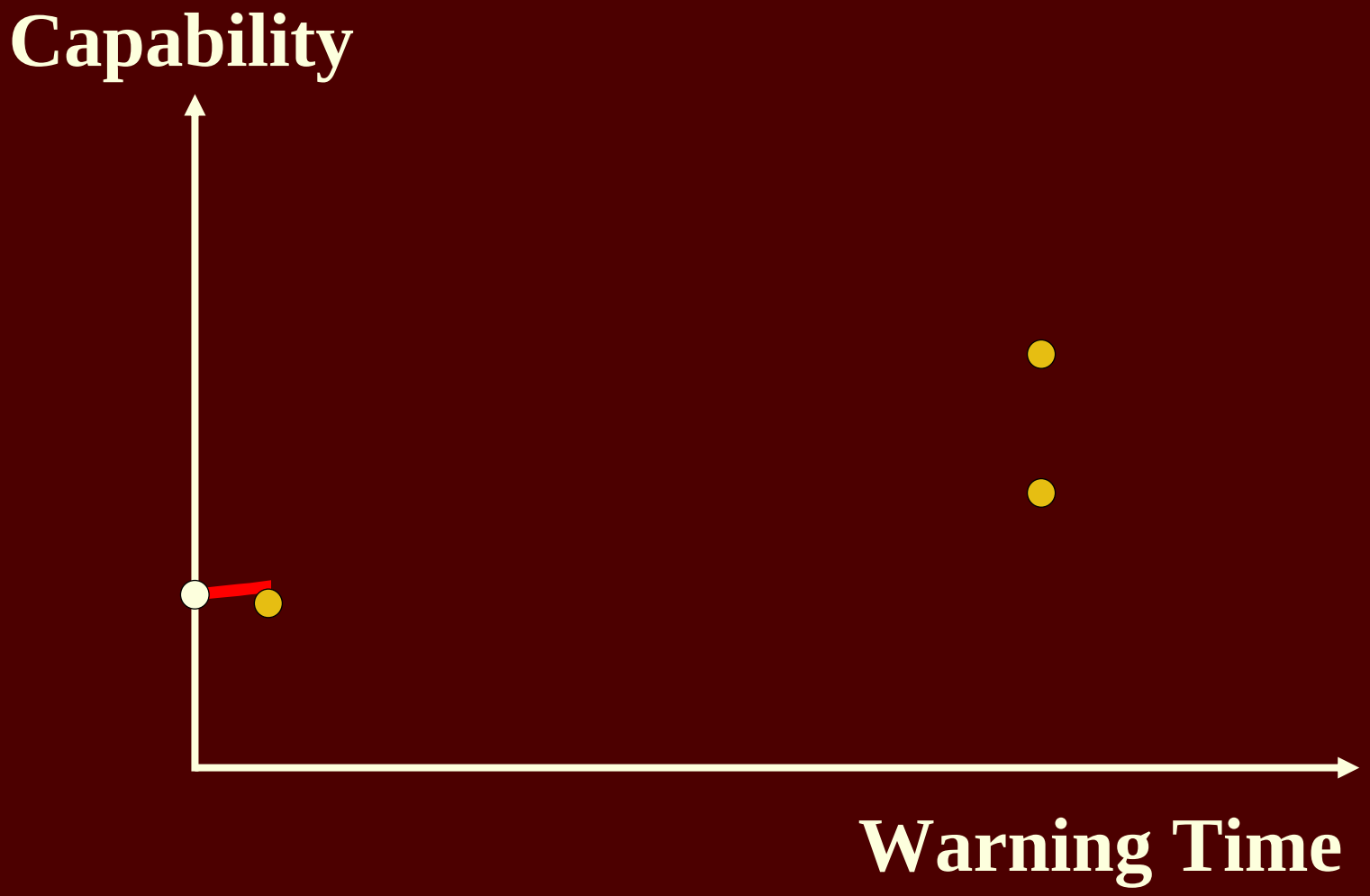
Motivat

Motivating example



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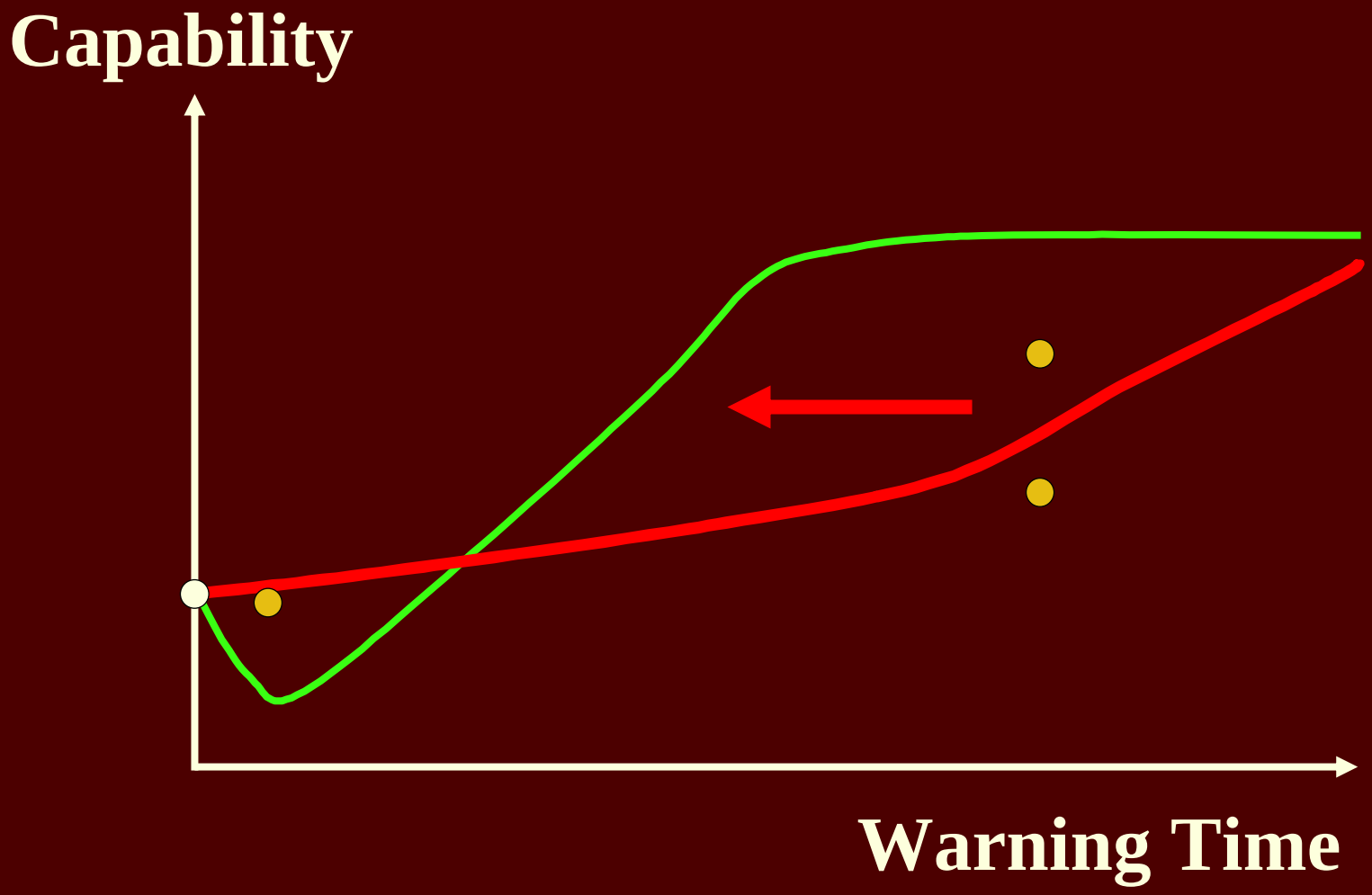
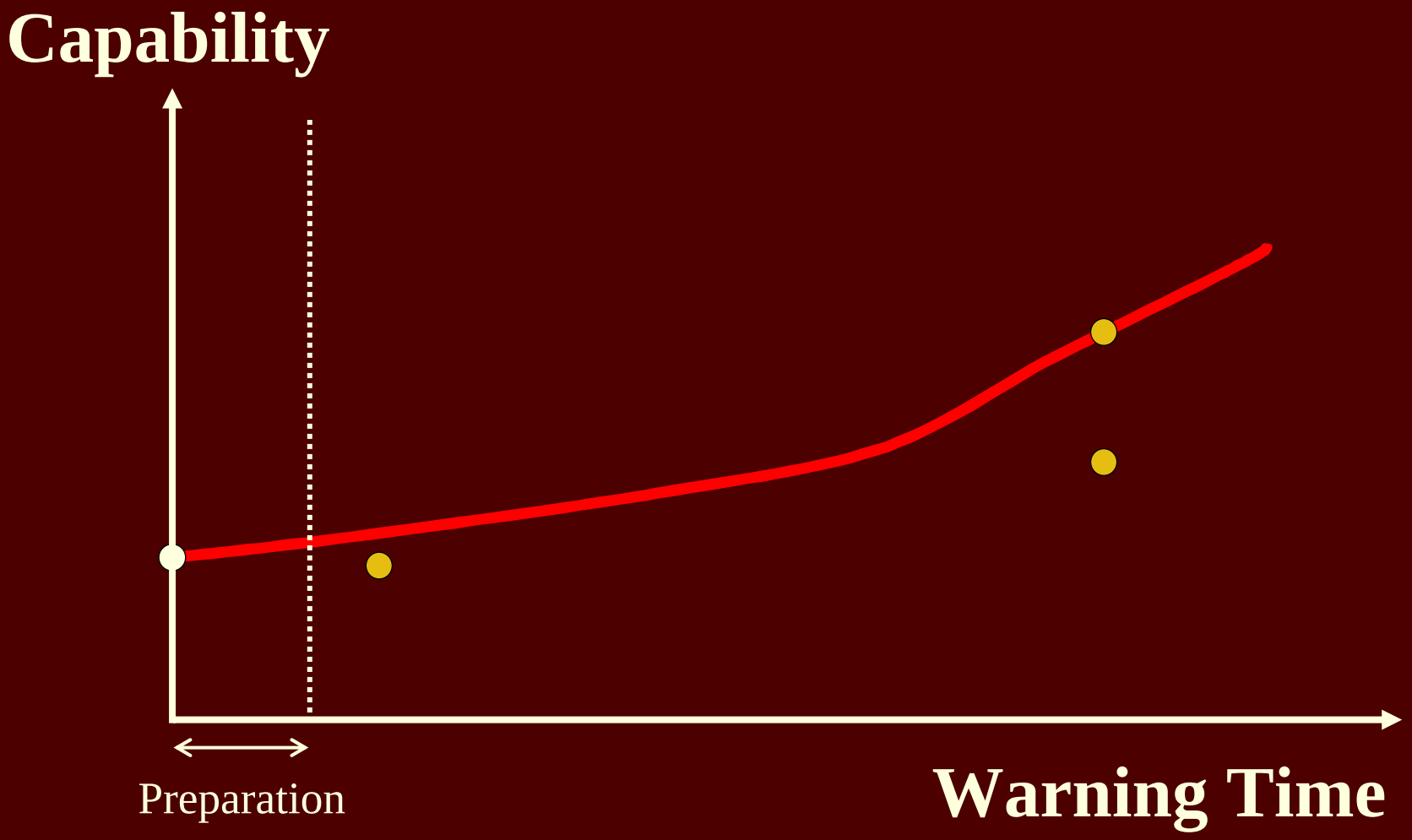
Motivating example



Motivating example



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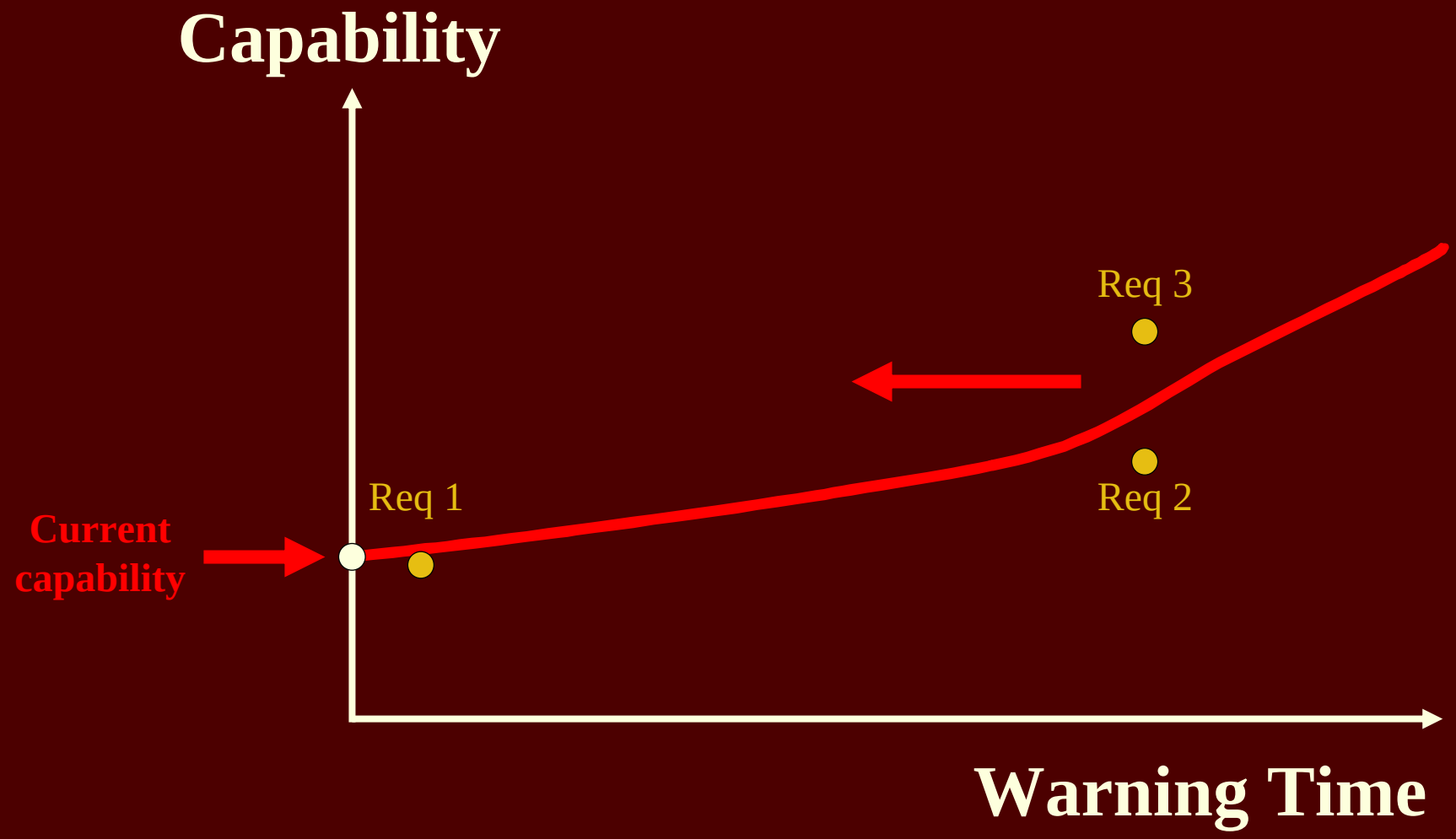
Military context



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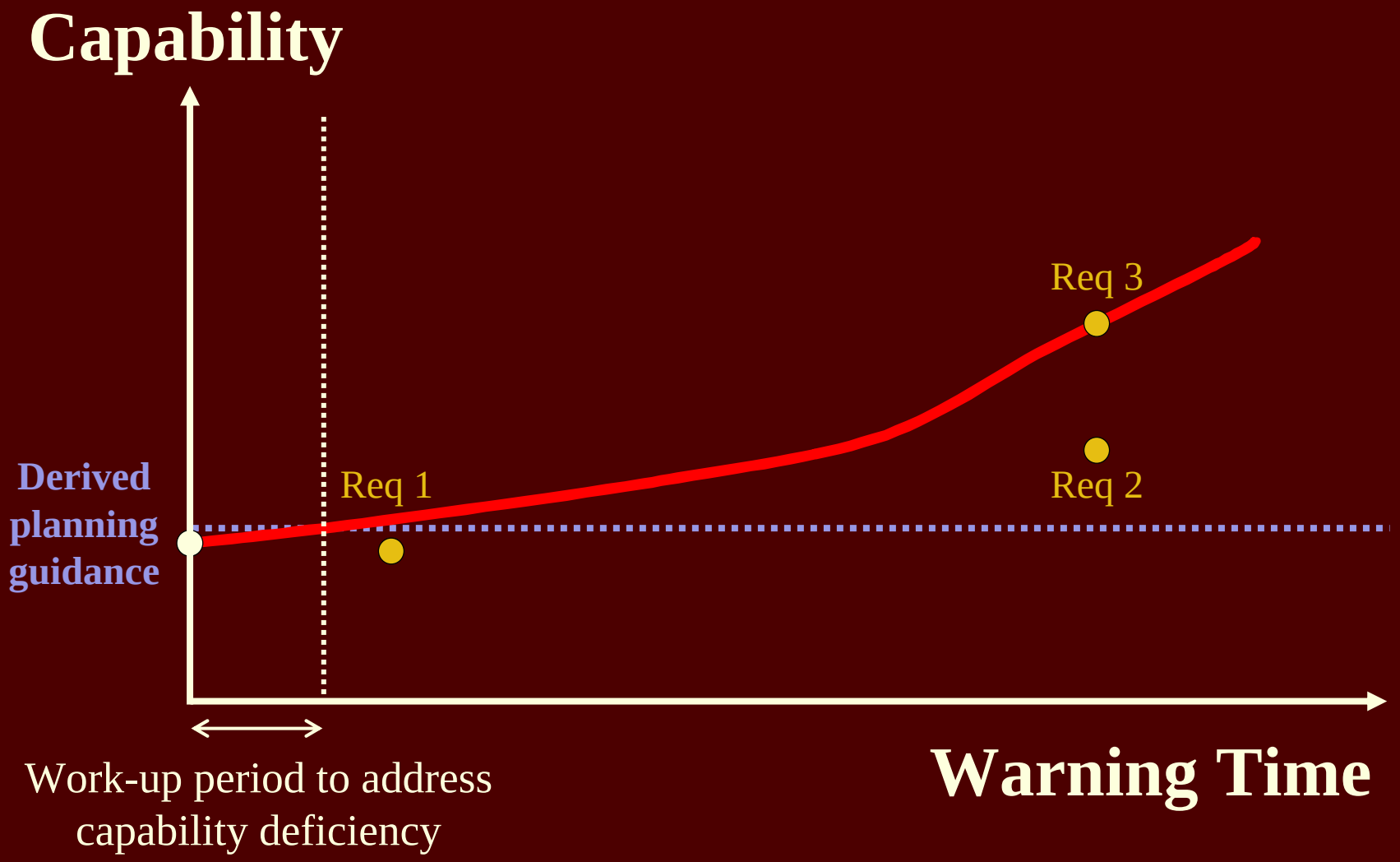
Military context



Key questions

- How do we measure capability?
- How do we interpret strategic guidance?
  - Hard constraints (optimisation)
  - Soft constraints (goal programming)
- How do we create Force Expansion Curves?

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Case study: Maritime Patrol Group

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- In 2000, DSTO study of preparedness recommends the development of Force Expansion Curves
- Maritime Patrol Group was chosen:
  - Continuity
  - Good data
  - Enthusiasm and support

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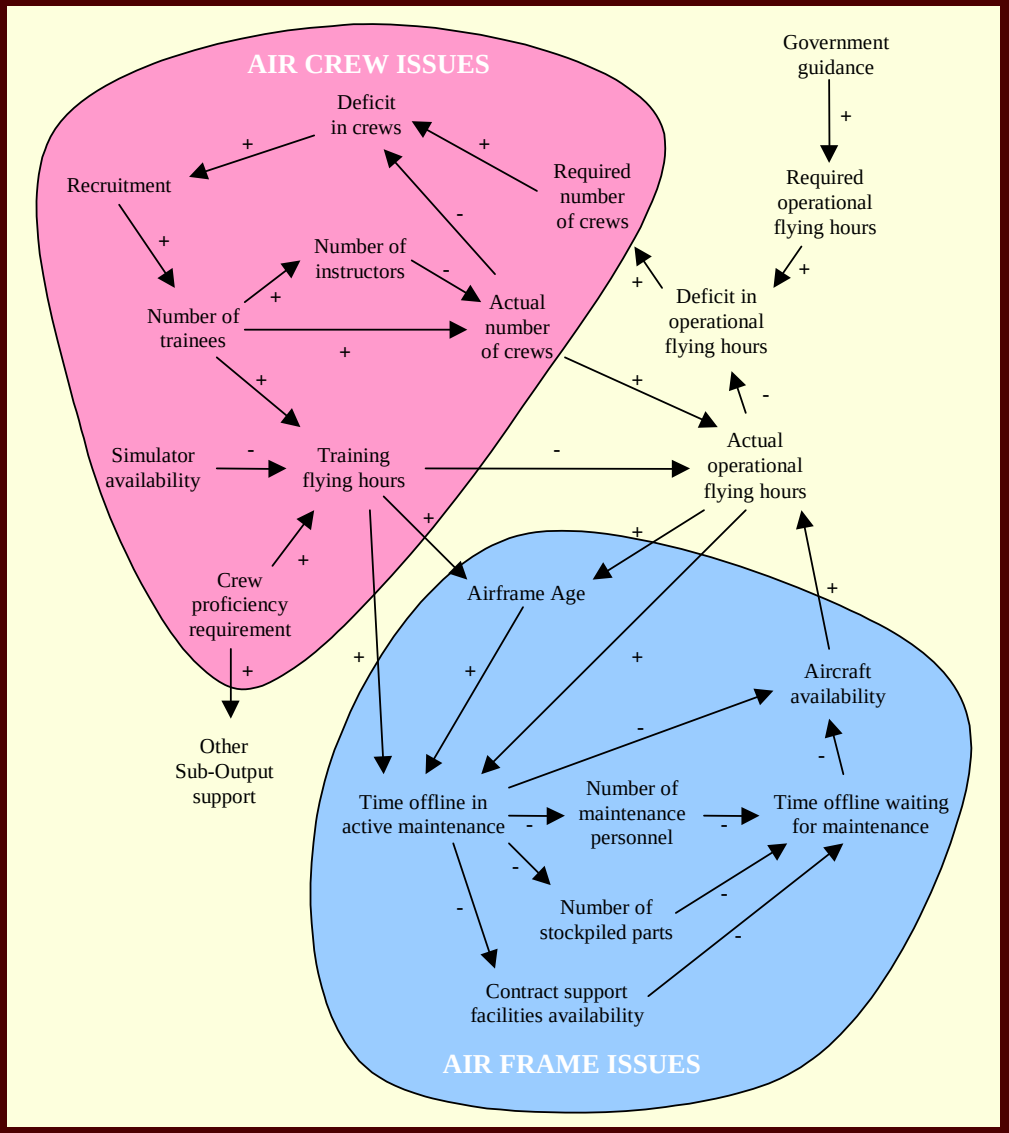
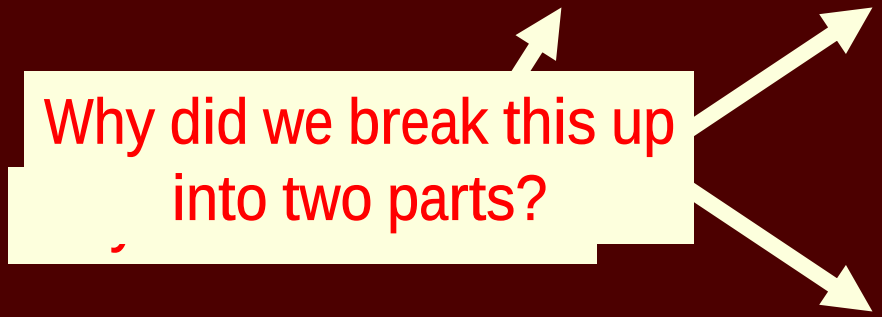
Influence Diagram



General approach

- Simulate the crew training and posting cycle



- Test the feasibility of the resulting flying program

Variables and parameters

- Capability measure: Number of crews
- Variables (controls):
  - Capacity of simulators
  - Number of instructors
  - Recruitment
  - Course lengths and posting lengths

EXTEND

- Simulation environment
- Both continuous time and discrete event models
- Features:
  - Good graphical user interface
  - Hierarchical blocks
  - Monte Carlo simulation
  - Sensitivity analysis
  - Heuristic optimisation (genetic algorithm)
  - Compatible with MS Excel

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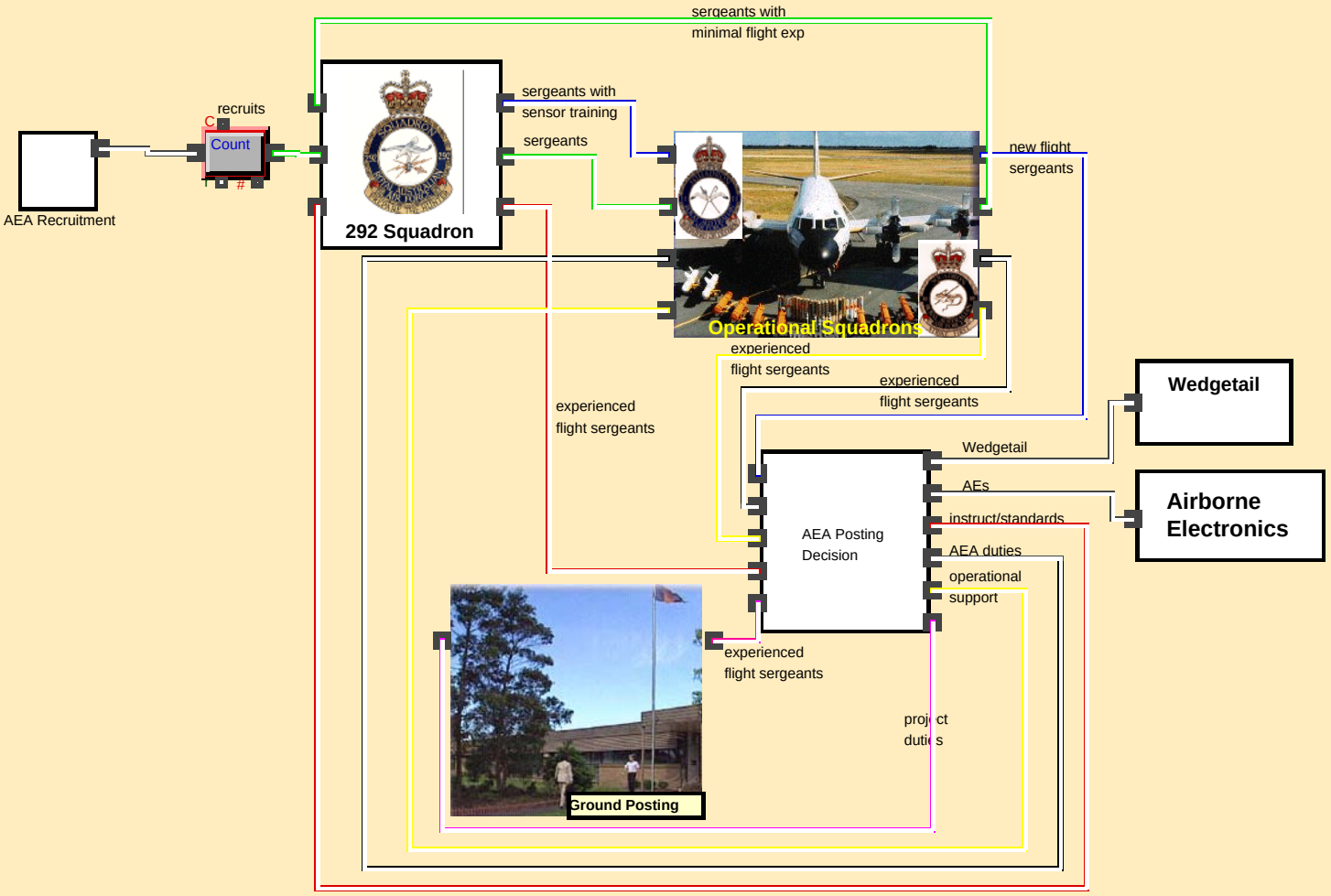
Personnel Model

- Personnel pipelines modelled as a production line
  - People modelled as items
  - Events modelled as machines
- Current and future MPG personnel practices are included

Personnel Model

Airborne Electronic Analysts



Personnel Model

- Crew:
  - 2 Pilots
  - 2 Navigators
  - 1 Airborne Electronics
  - 5 Airborne Electronic Analysts
  - 2 Flight Engineers

Personnel Model

- Each role has a separate module
  - Easily understood and validated
  - Caters to time limitations
- Roles combine into crews
- Other modules:
  - Initialisation
  - Controls
  - Outputs

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Personnel Model

- Predicts future crew levels
  - Baseline: current personnel practices
  - ‘What if’ analysis: altered system
- Indicates critical factors and bottlenecks

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Sample Personnel Results

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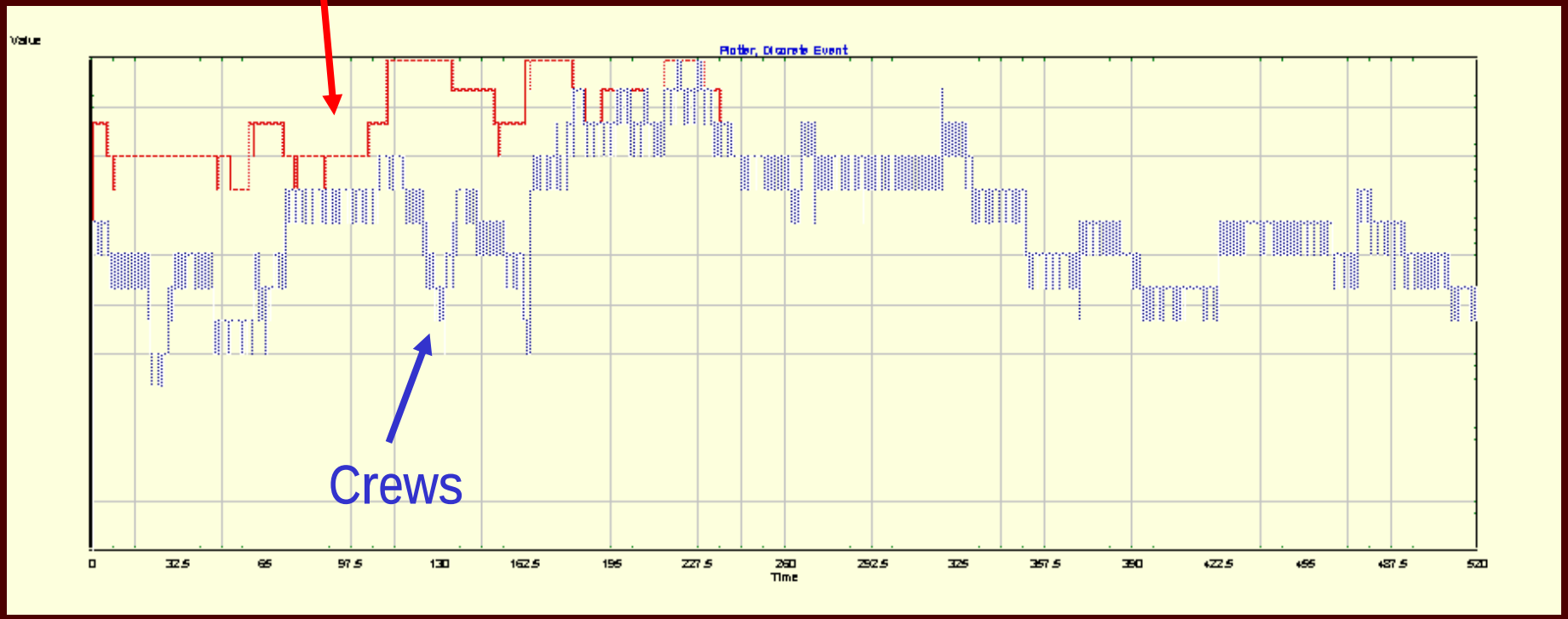
Sample Personnel Results

Airborne Electronics



ASTOR

Air Force Simulation of Tactics and Operational Resources

- Developed by the Swedish Air Force and the RAAF
- Used by MPG to manage P-3C logistics
- Tests a predetermined flying program for feasibility
- Constraints:
  - Maintenance crews
  - Maintenance equipment
  - Spare parts
  - Aircraft reliability

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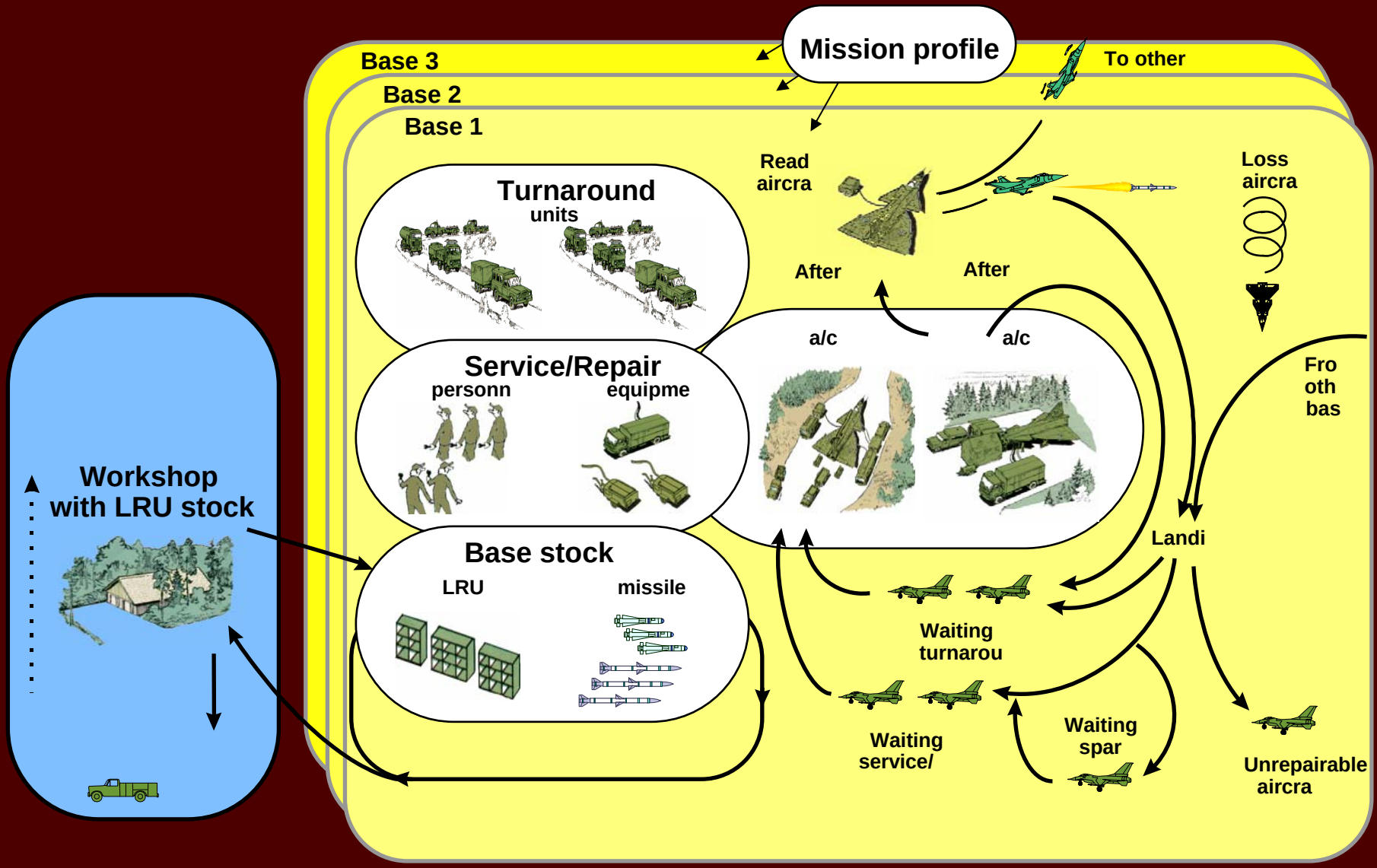
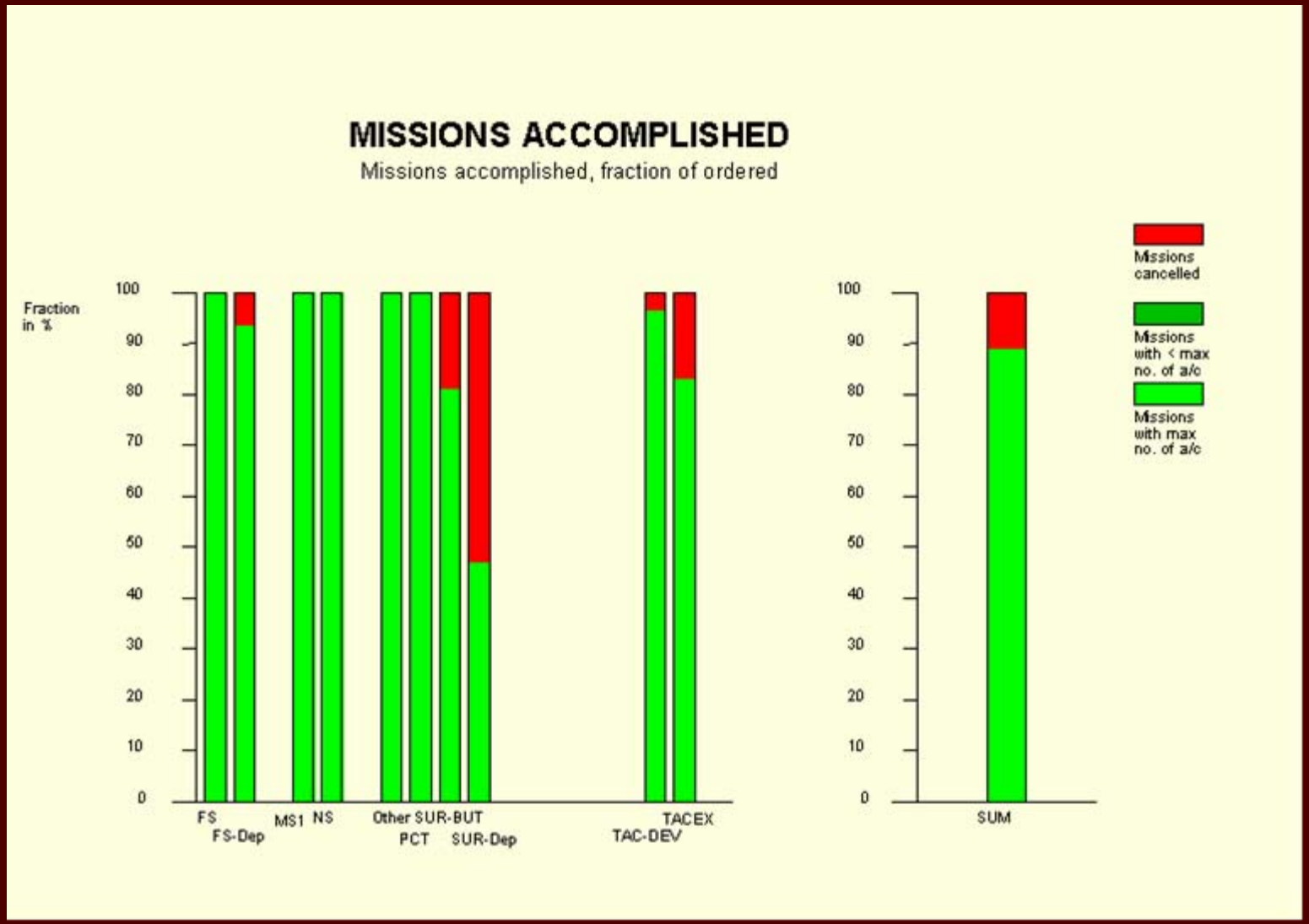
ASTOR



ASTOR

- Outputs:
  - Aircraft availability
  - Proportion of missions accomplished
  - Spare parts consumption
  - Repair and maintenance time

Sample ASTOR results



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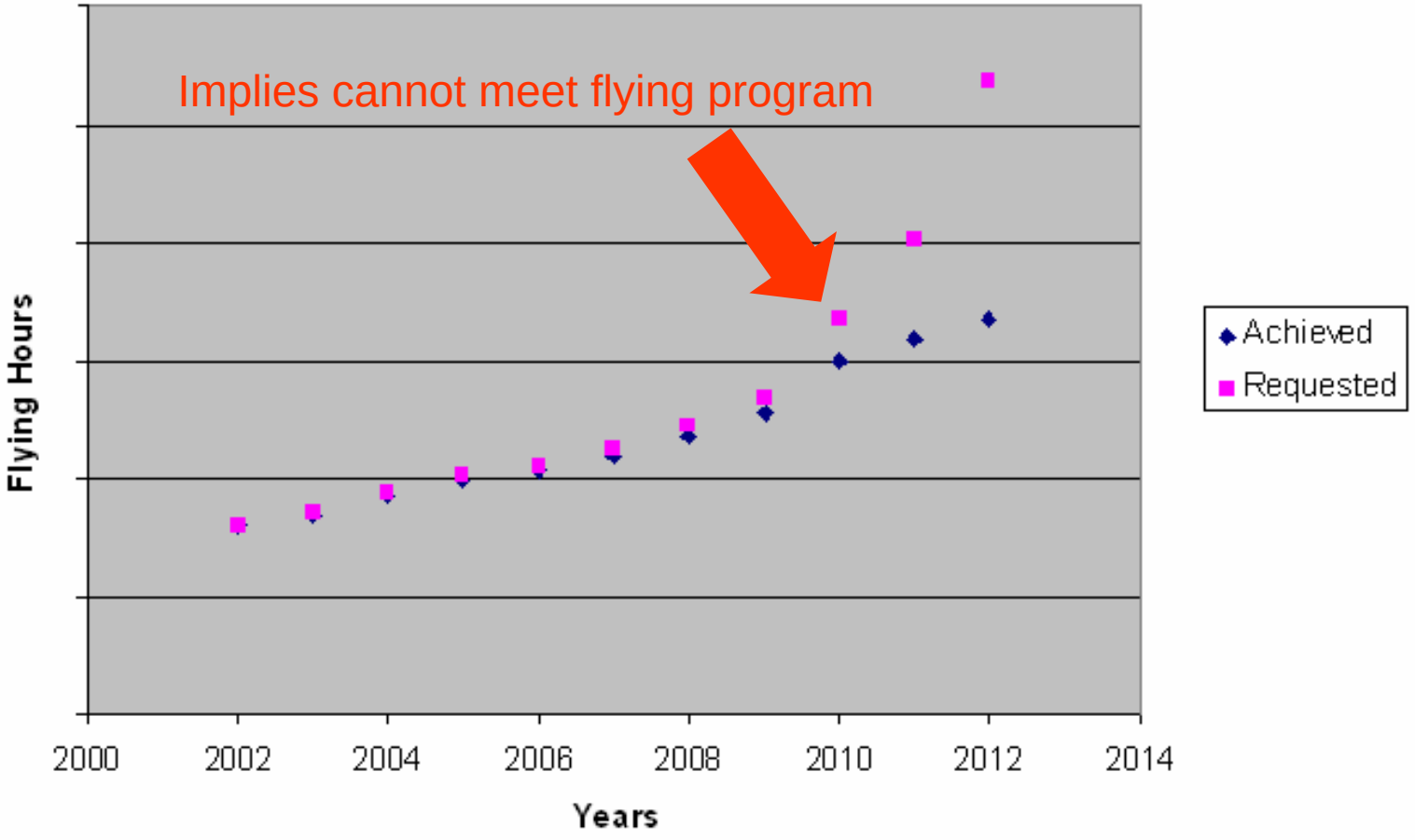
Using ASTOR to Support the Personnel Model



How can we use Force Expansion Curves?

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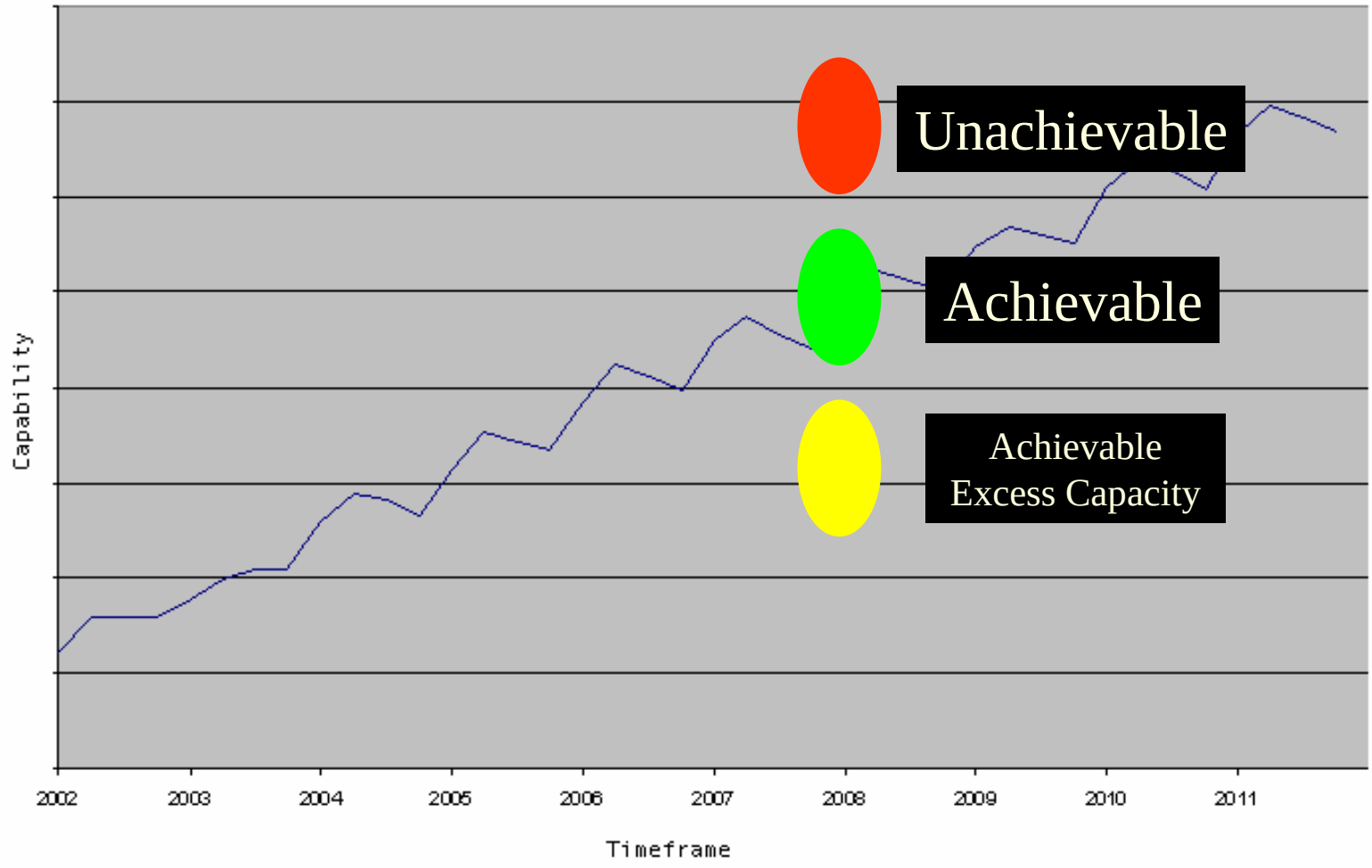
Assistance to medium term preparedness planning



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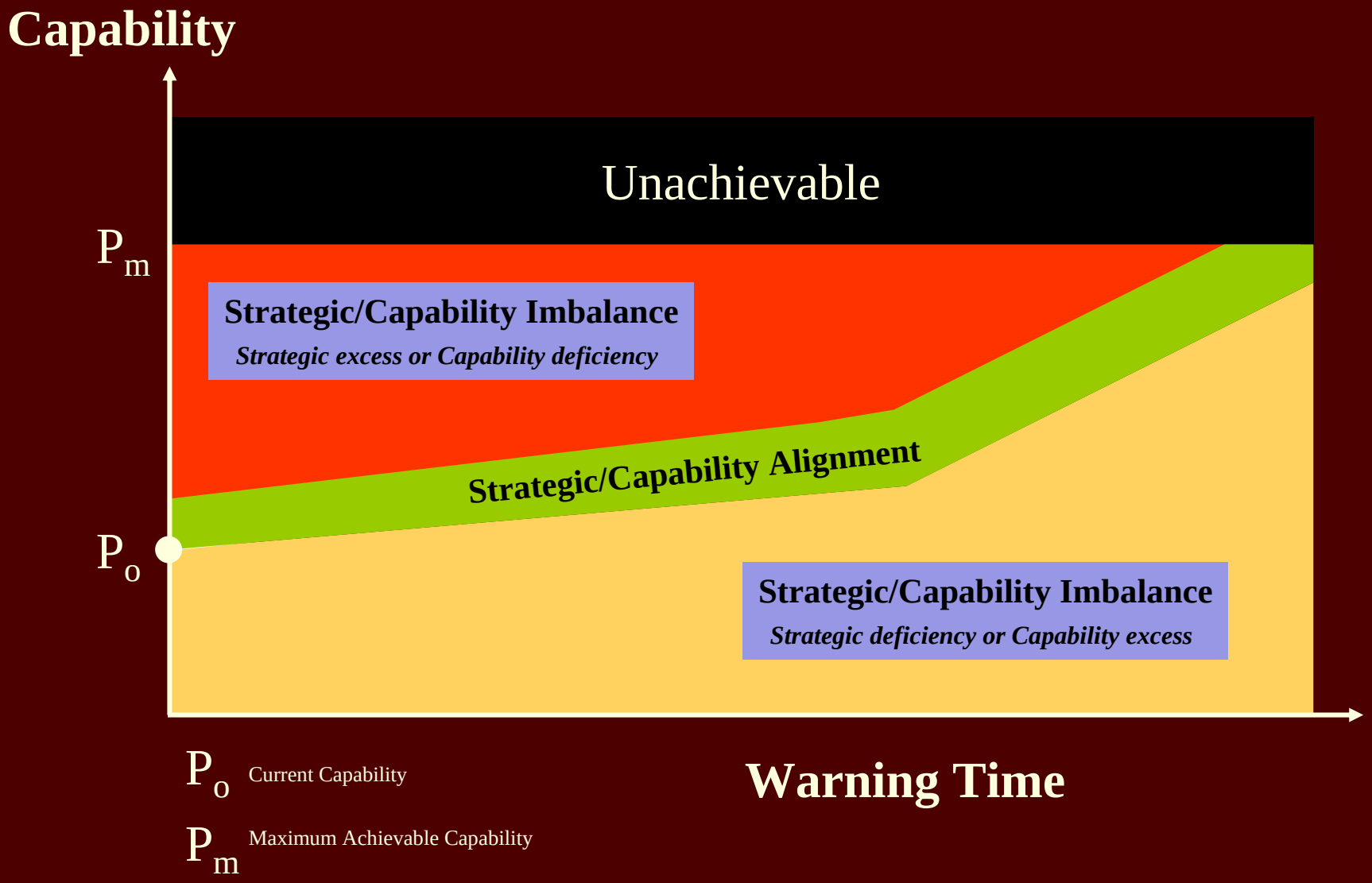

P_o Current Capability

P_m Maximum Achievable Capability

Conclusions

- Force Expansion Curves can improve capability management by:
  - Illustrating different expansion strategies
  - Demonstrating rate and extent of expansion
  - Quantifying the effect of controls
  - Allowing costing of different options