Abstract

- Fed up with being reactive to cost estimating and forecasting requests? Had enough of being last in the queue for time and resources? Dismayed at being consulted at the last minute for an opinion on the cost? Seeking a new approach to cost predictions? Consider the proactive approach!
- Rather than waiting for requests for an estimate at the end of a bid or study it is time to start leading. Cost staff are a value-adding commodity, they have the ability to predict the future; well, almost!
- This paper will explore some of the options and alternatives which as a cost community we should be pursuing. It will examine the programme, procurement and technical options that we should present ahead of the remainder of the engineering and project management scrum. It will examine the big, first order assumptions which we should be considering to ensure that we have a voice and that the cost is considered at the forefront of the decision process.
- As an example the paper will consider the options for a sixth generation fighter capability. It will explore the alternatives from a cost perspective and set a direction for the future direction of travel with regards to the air domination capability. In short, it will set a proactive estimating case study to ensure that the cost community is forward leaning and not the last people to be asked an opinion on the topic. Though based upon an air project the approach will be equally applicable for land, sea and space capabilities.

Proactive estimating: an analysis of air superiority

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Managing Consultant

35th International Symposium on Military Operational Research (35 ISMOR)
17-20 July 2018
QINETIQ/18/01124

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Agenda

1	QinetiQ and Advisory Services
2	Proactive estimating
3	Options analysis
4	Case study – 6th Generation air capability
5	Summary

Caveat – all figures and analysis are for presentation purposes only and will require review and scrutiny prior to use!

QinetiQ and Advisory Services

Dale Shermon | QinetiQ Fellow

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Our vision and strategy

“The chosen partner around the world for mission-critical solutions, innovating for our customers’ advantage”

UK

Lead and modernise the UK Defence Test and Evaluation enterprise, by working in partnership with Government and Prime contractors

International

Build an international company that delivers value to our customers by developing our home markers, creating new home markets and exporting

Innovation

Invest in and apply our core competence for customer advantage in defence and commercial markets

QinetiQ Advisory services

Diagnose

- A range of products and tools designed to assist customer in understanding and defining the problem, identifying weaknesses, risks and gaps and highlighting strengths.

Analyse

- Impartial and robust analysis of the evidence, assumptions, data and factors surrounding an issue to optimise customer's evidence-based decision making

Advise

- Delivery of knowledge and expert advice by providing key specialists and subject matter experts to support customers in the conduct of specific tasks

Support

- Provision of training, mentoring, coaching to transfer skills or the provision of skilled or expert staff to enable customer to deliver a task successfully.

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QinetiQ Advisory services

Australian Force Structure Review

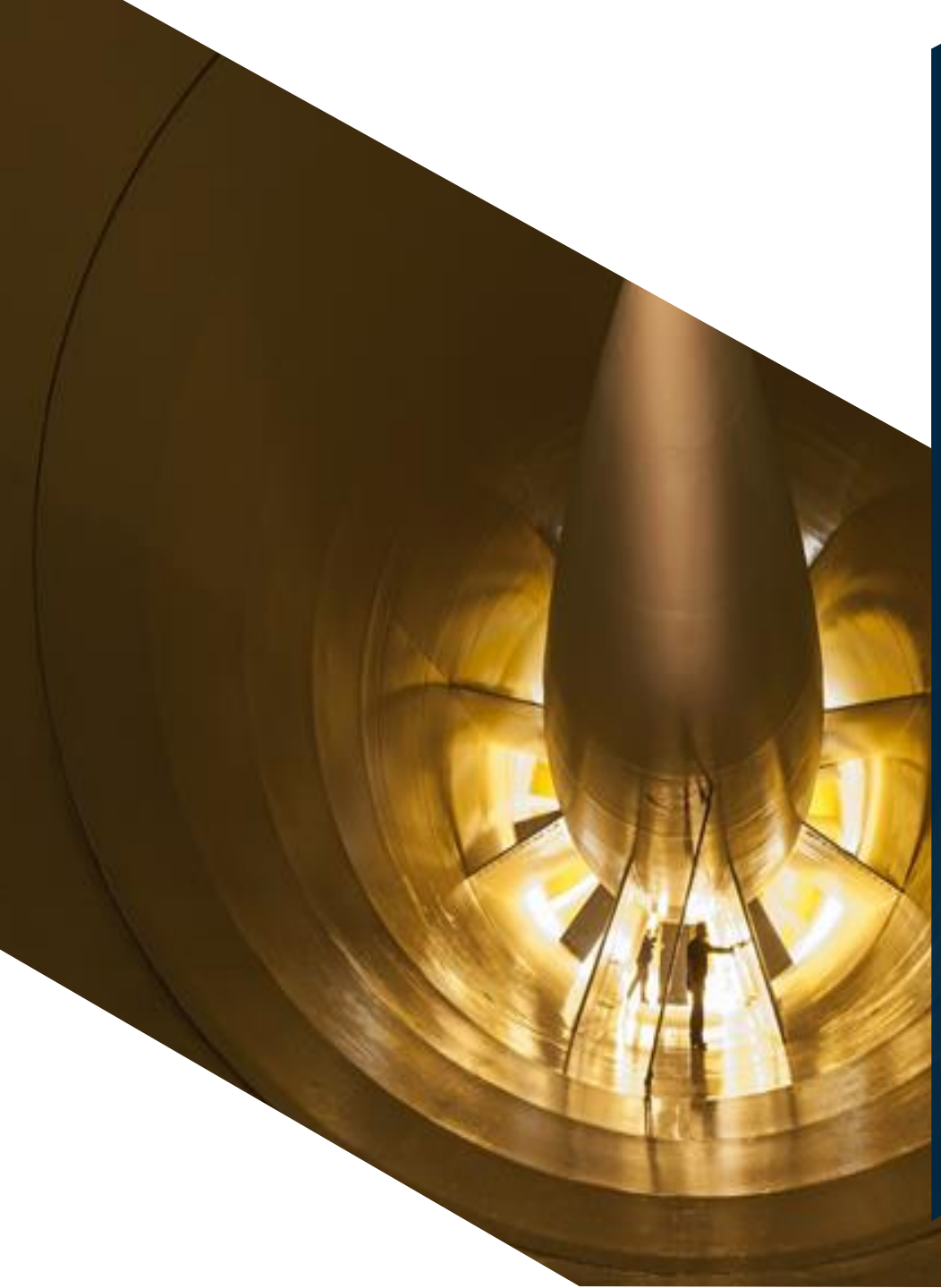
- Application of high level cost estimating methodology to review budgets and generate independent cost estimates (ICE)

CDM Cost Challenge

- Review of the budget of the top UK MOD projects to align budget with requirements for the Chief of Defence Material (CDM).

CCG Fleet Review

- Created a robust audit trail and evidence for a revised Fleet Renewal Plan (FRP) 2017 across 119 vessels in 43 home ports of the Canadian Coast Guard (CCG)



Proactive estimating

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Proactive Estimating – the problem

Pricing review, Design review, Analysis of Alternatives, Proposal scrutiny

Proposal manager,
Bid Manager,
Project Manager

Design Manager,
Systems Engineering
Technical team

Cost Engineer
Cost Estimator
Cost Analyst

Proactive Estimating

- Frequently the cost estimate is the last activity in a bid / study / project schedule.
- This has some justification as you need a design to estimate; you can't estimate a requirements.
- However, it is often too late to influence the technical, programmatic and procurement decisions that have been made.
- At the Bid review, preliminary design review or critical design review stage the solution is frozen.
- There needs to be an agile approach; design | cost | design | cost ……
- To ensure value for money (VfM) there needs to be a balance and **cost needs to be heard**.

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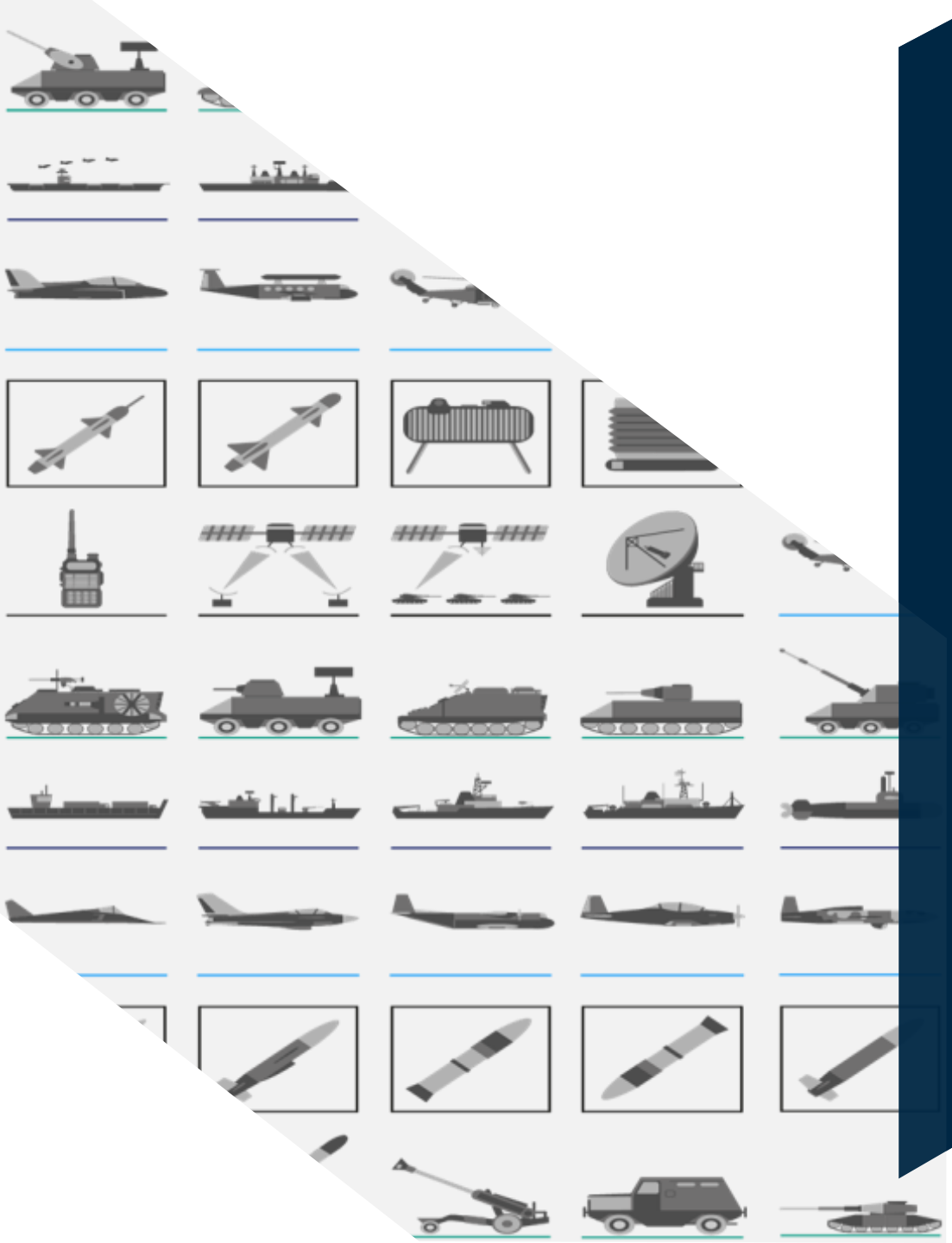
Proactive Estimating – The balance

Proposal manager,
Bid Manager,
Project Manager

Design Manager,
Systems Engineering
Technical team

Cost Engineer
Cost Estimator
Cost Analyst



Options analysis

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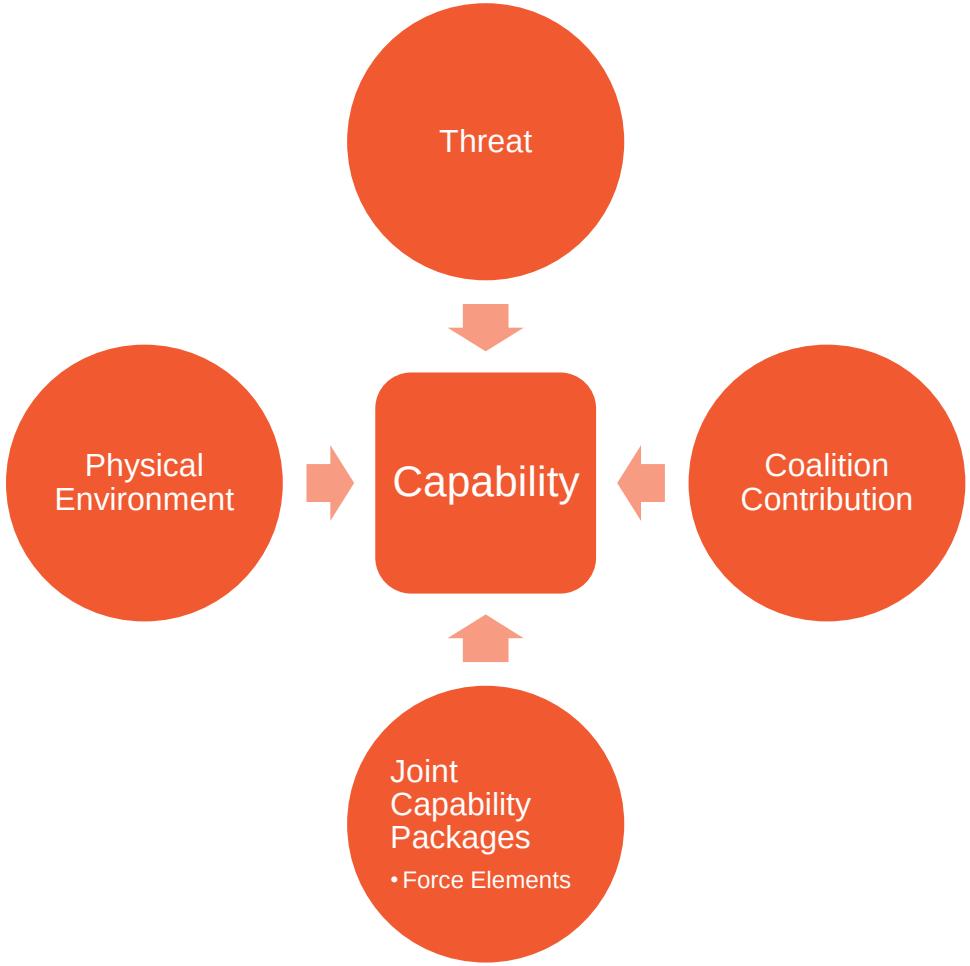
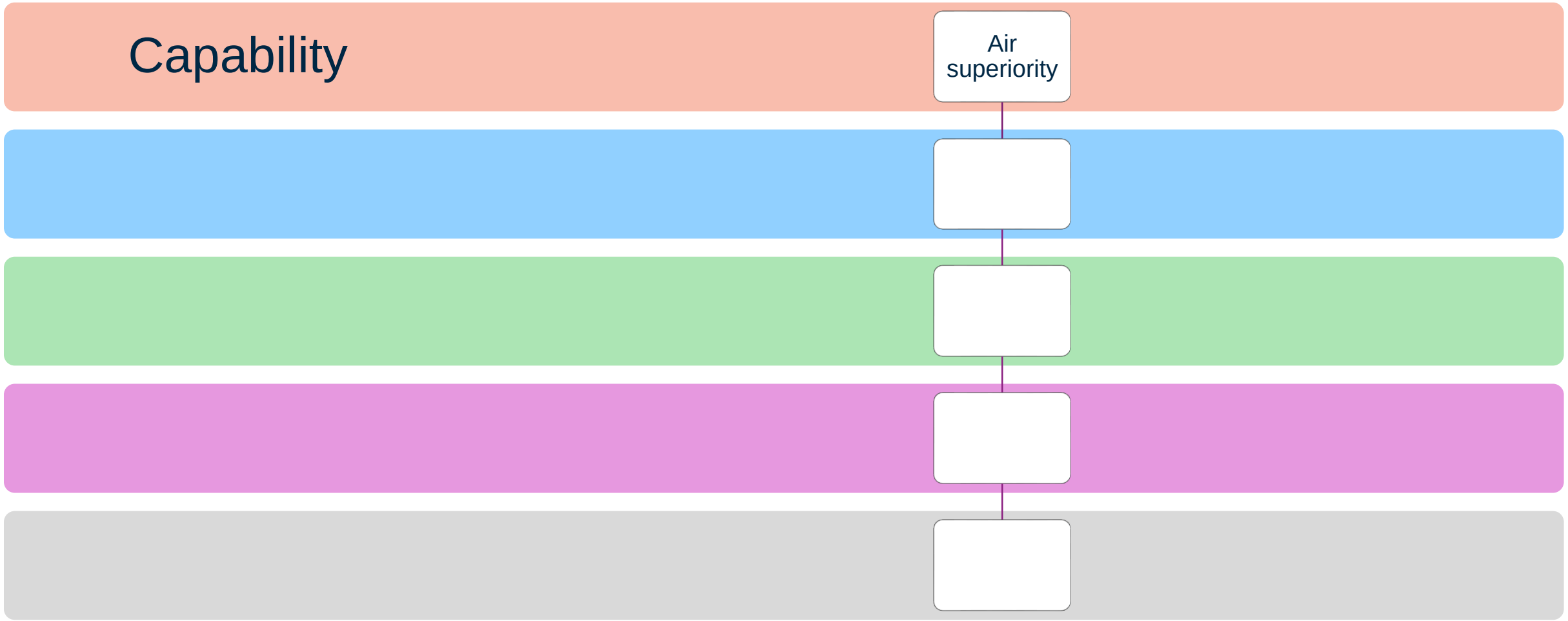
Options analysis - Capability

- Capability is *the continuing ability to generate a desired operational outcome or effect which is relative to the threat, physical environment and the contributions of coalition partners*.
- Capability is not a particular system or equipment.
- Capability is delivered by Force Elements combined into packages by Joint Force Commanders and tailored for particular operations or missions.



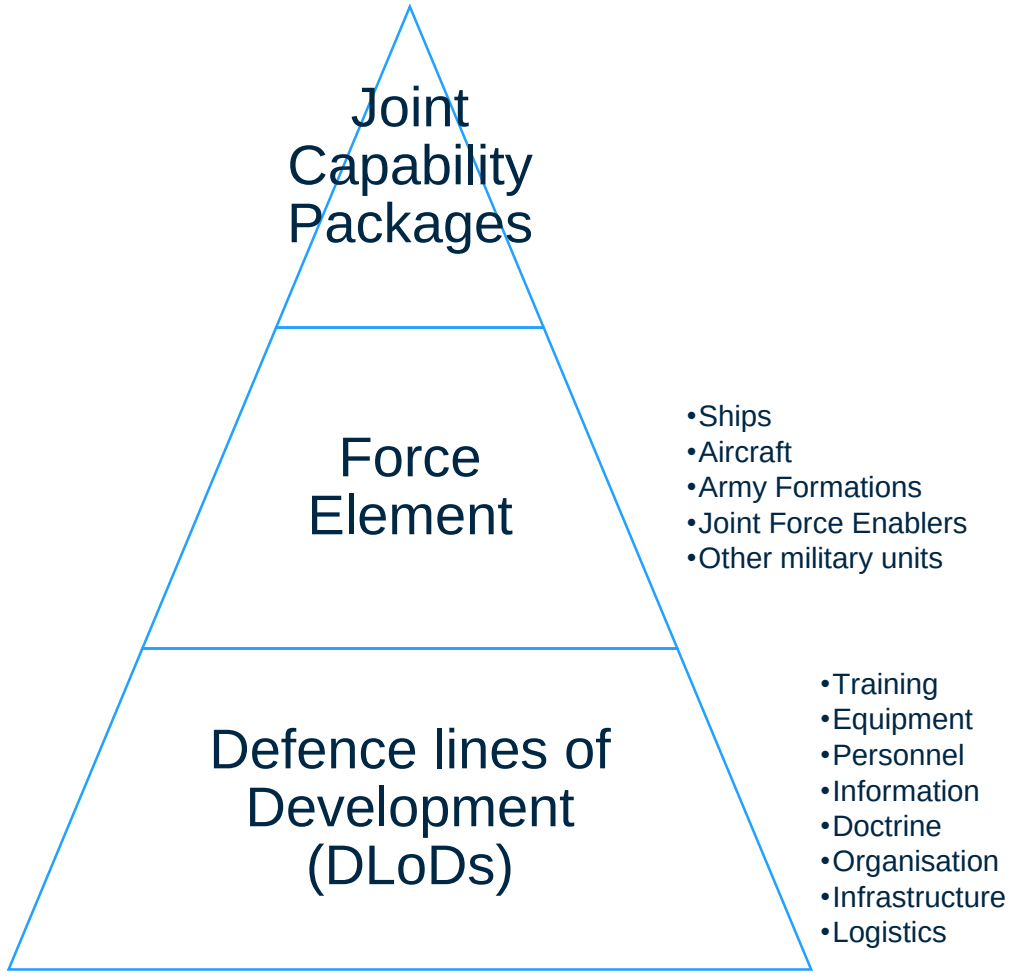
Source: Centre for Defence Acquisition, Cranfield University, Innovative UK Approaches to Acquisition Management, dated May 2009

Options analysis



Options analysis - Force Element

- Force Elements are typically ships, aircraft or ground force sub-units (company / battery / squadron).
- The Force Elements are:
  - Ships
  - Aircraft
  - Army formations
  - other Military Units
  - Force Enablers.
- Each Force Element is delivered by either:
  - a single service, or
  - by a joint organisation.



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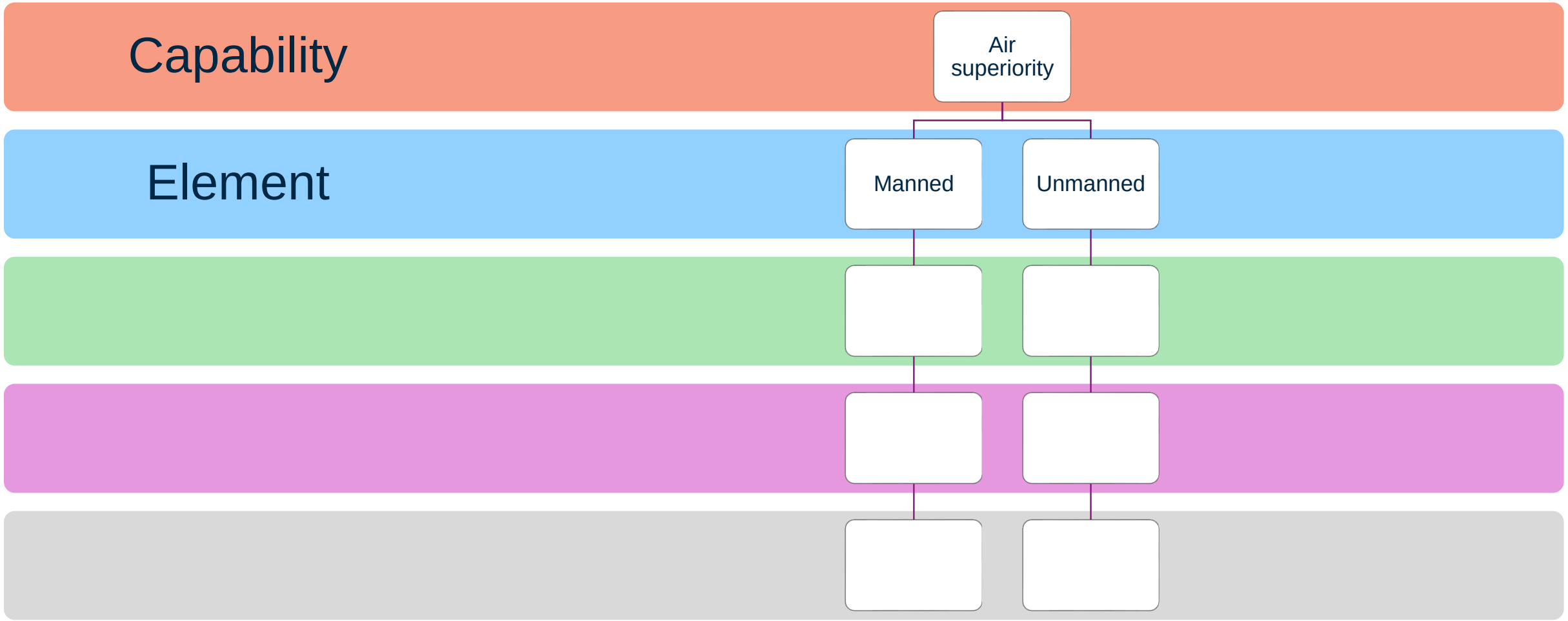
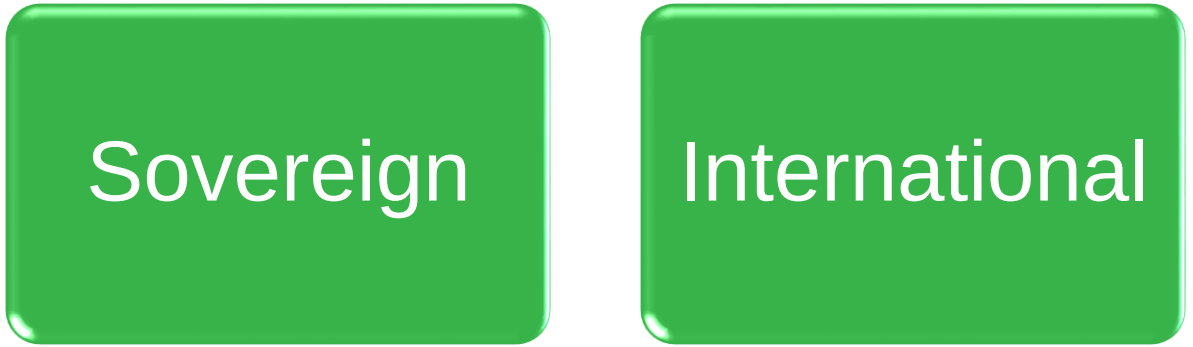
Options analysis

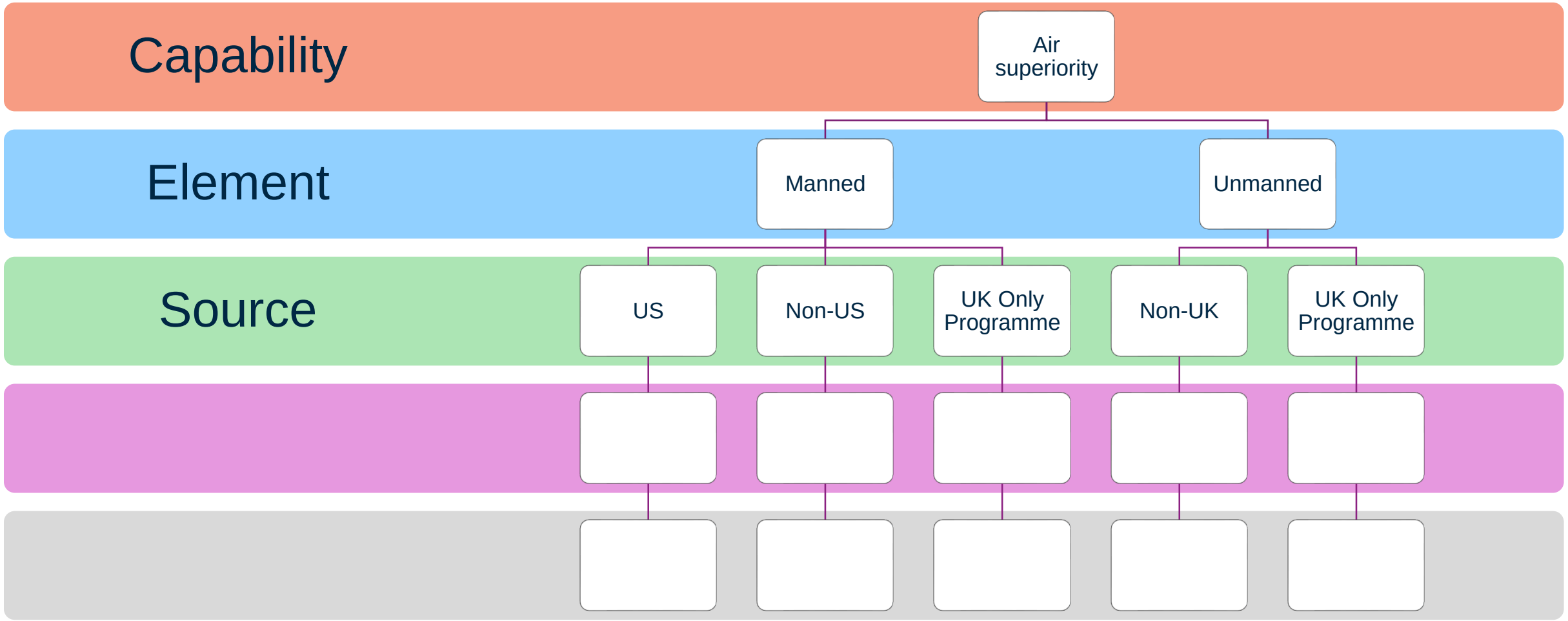


Options analysis - Source

- The options are geographical in terms of consideration. It considers the source of the intellectual property (IP), design or ownership:
- Sovereign – the Force Elements will be acquired from a business within the home country, for example, United Kingdom
- International – the Force Elements will be acquired from a business outside the home country.

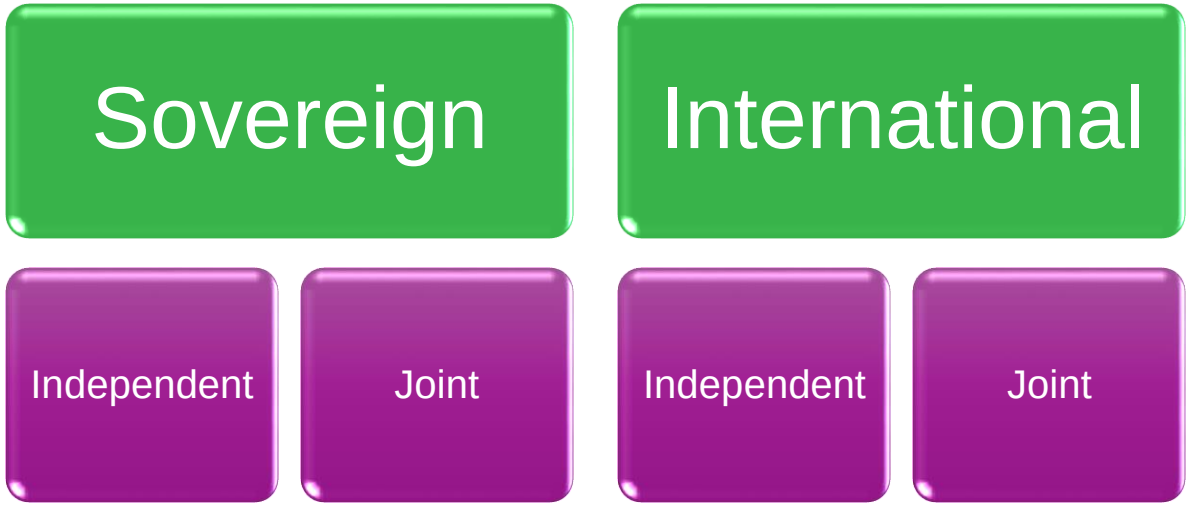


Options analysis



Options analysis - Collaboration

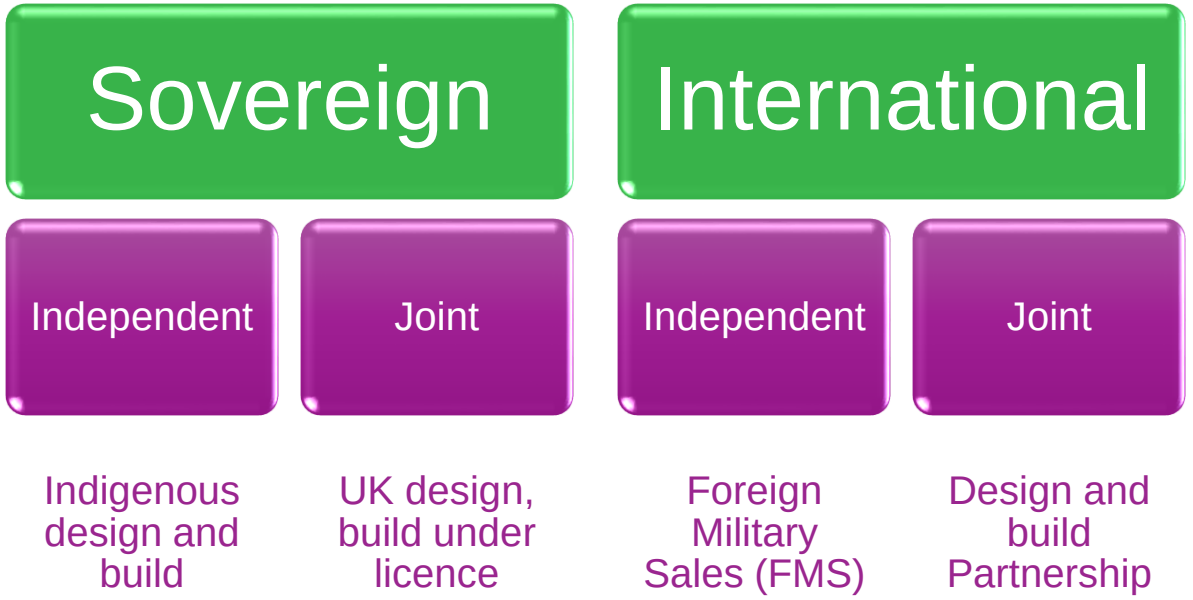
- Next there is the consideration on the collaborative nature of the options. In this sense the options need to consider:
- Independent – the Force Elements will be acquired from a single entity.
- Joint – the Force Elements will be acquired from multiple entities.



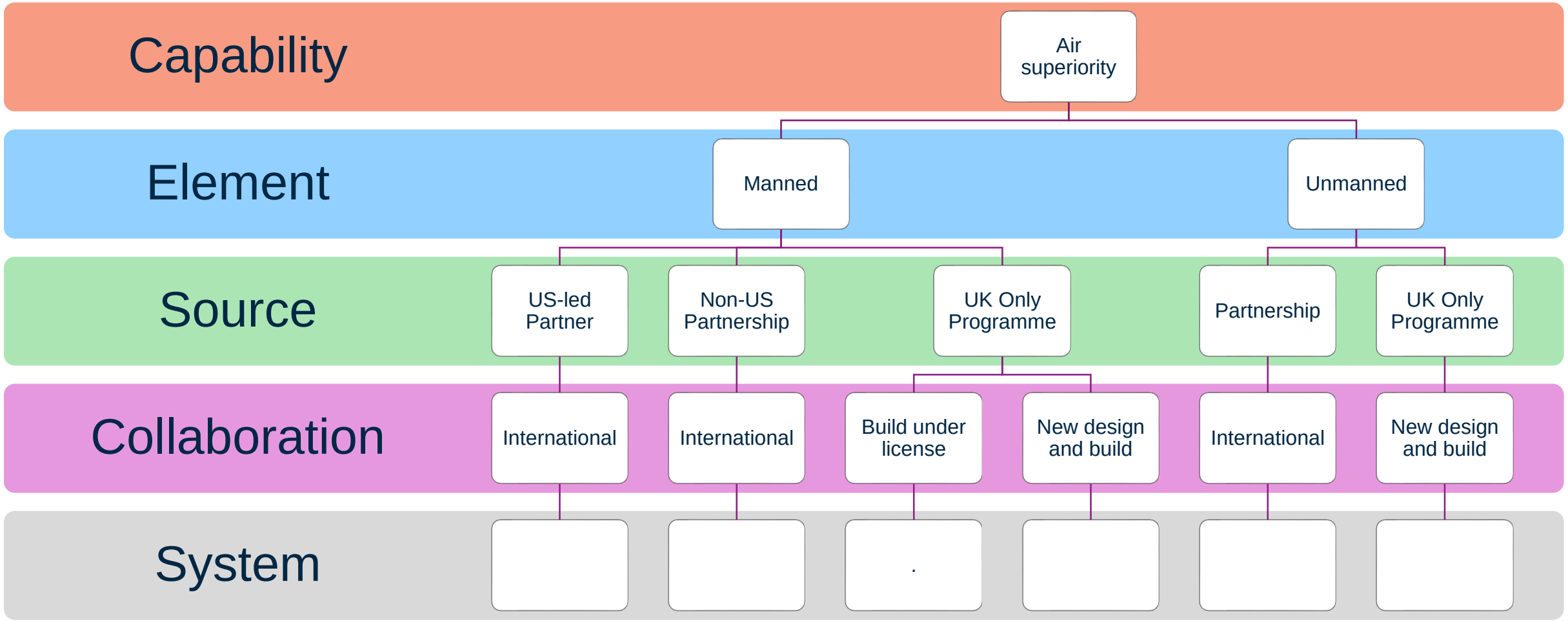
Options analysis - Collaboration

This leads to the following examples:

- Independent – could be:
  - **Sovereign** - which could lead to indigenous design and build programme (Buccaneer), or
  - **International** - could involve a Foreign Military Sale (FMS) or a military off-the-shelf (MOTS) solution (Phantom).
- Joint – could be:
  - **Sovereign** - which could lead to a indigenous design, built by a partner overseas (Harrier AV-8B), or
  - **International** - which could be a solution designed and built as part of a partnership with workshare understood (F-35).



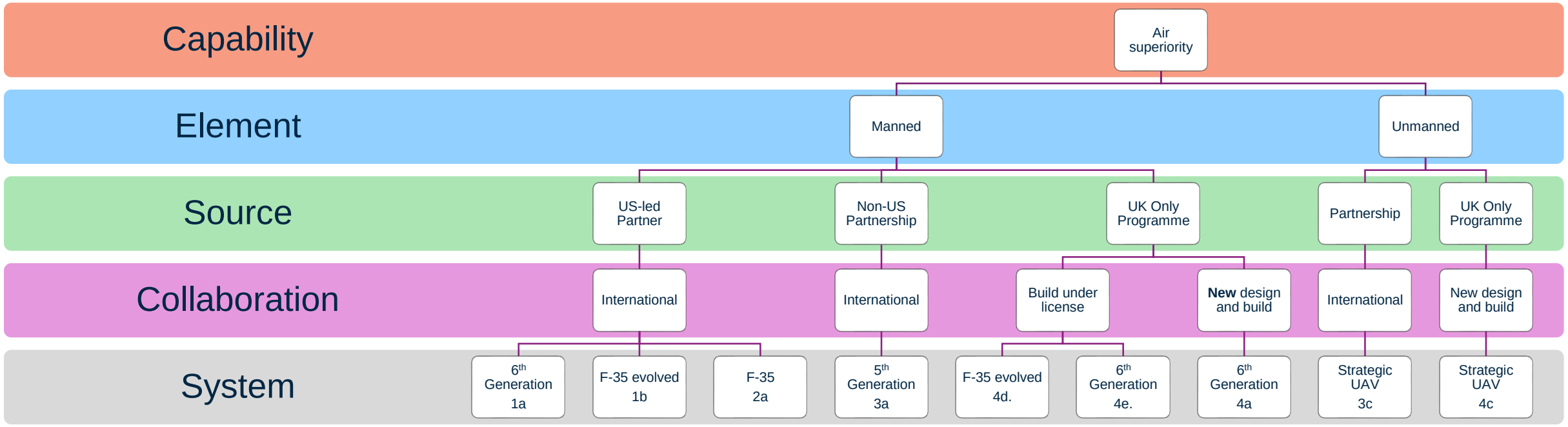
Options analysis



Options analysis - System

- The final option is the solution that will contribute to the Force Element. The platform or system that will satisfy the need expressed in the Capability Statement.
- The Systems can have different performance, design, technology year and so forth.

Options analysis



Options analysis - High level Alternatives

Option ID	Description	Source / Procurement	Example
0.	Current state – Status Quo	Baseline	0. F-35
1.	Do minimum	International	1a. 6th Generation 1b. F-35 evolved
2.	Do same as current	International	2a. F-35 in-service
3.	Do non-sovereign	International	3a. Non-US 5th Generation 3b. Strategic UAV
4.	Do sovereign	UK Design and build	4a. 6th Generation 4b. Strategic UAV
		Build under license	4c. F-35 evolved 4d. 6th Generation

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Case study – 6th Generation air capability

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- Text

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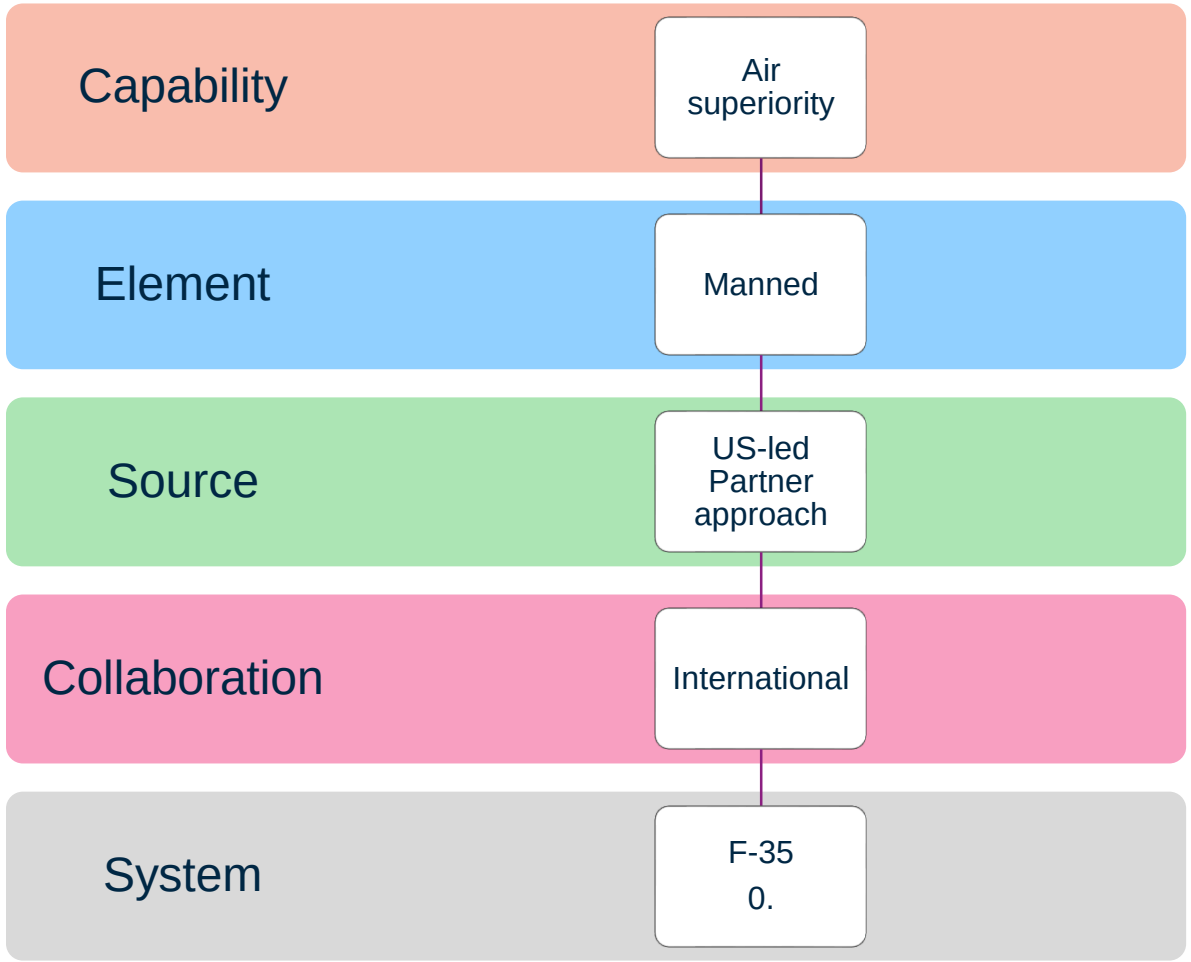
Option 0. F-35 Baseline



- The Joint Combat Aircraft (JCA) is the requirement for a multi-role aircraft to be operated jointly by the Royal Air Force and the Royal Navy from both fixed and deployable land bases and the new Queen Elizabeth Class aircraft carriers.
- In 2001 the F-35 Lightning II design by Lockheed Martin was selected as the aircraft to meet the JCA requirement and provides the UK with a fifth generation air system.
- The UK is the only Level 1 Partner Nation within the System Development and Demonstration (SDD) phase of the Joint Strike Fighter programme, along with the US Services and is able to decide and agree the Requirements.

Source: NAO Major Projects Report 2015 and the Equipment Plan 2015 to 2025, 22 October 2015

Assumptions

- Total production of F-35B will be 508
  - UK will acquire 138 F-35B STOVL variants
- Technology standard
  - 2003 at F-35 Preliminary Design Review (PDR)
- Development Status
  - All new design
- Number of pilots
  - One
- Number of variants (in addition to basis design)
  - Two
- Production rate
  - 145 per year
- Service life
  - 30 years

Technical		
Payload	**15,000 lb**	6,800 kg
Basic mass empty	**32,300 lb**	14,648 kg
Production Manufacture		
Italy	**30 a/c**	
United Kingdom	**138 a/c**	
US Marine Corp	**340 a/c**	
Total Production	**508 a/c**	

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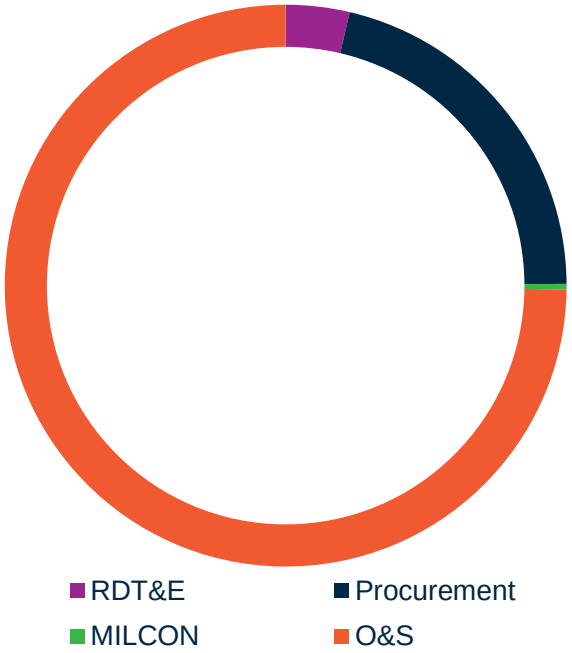
Calibration cost data – F-35

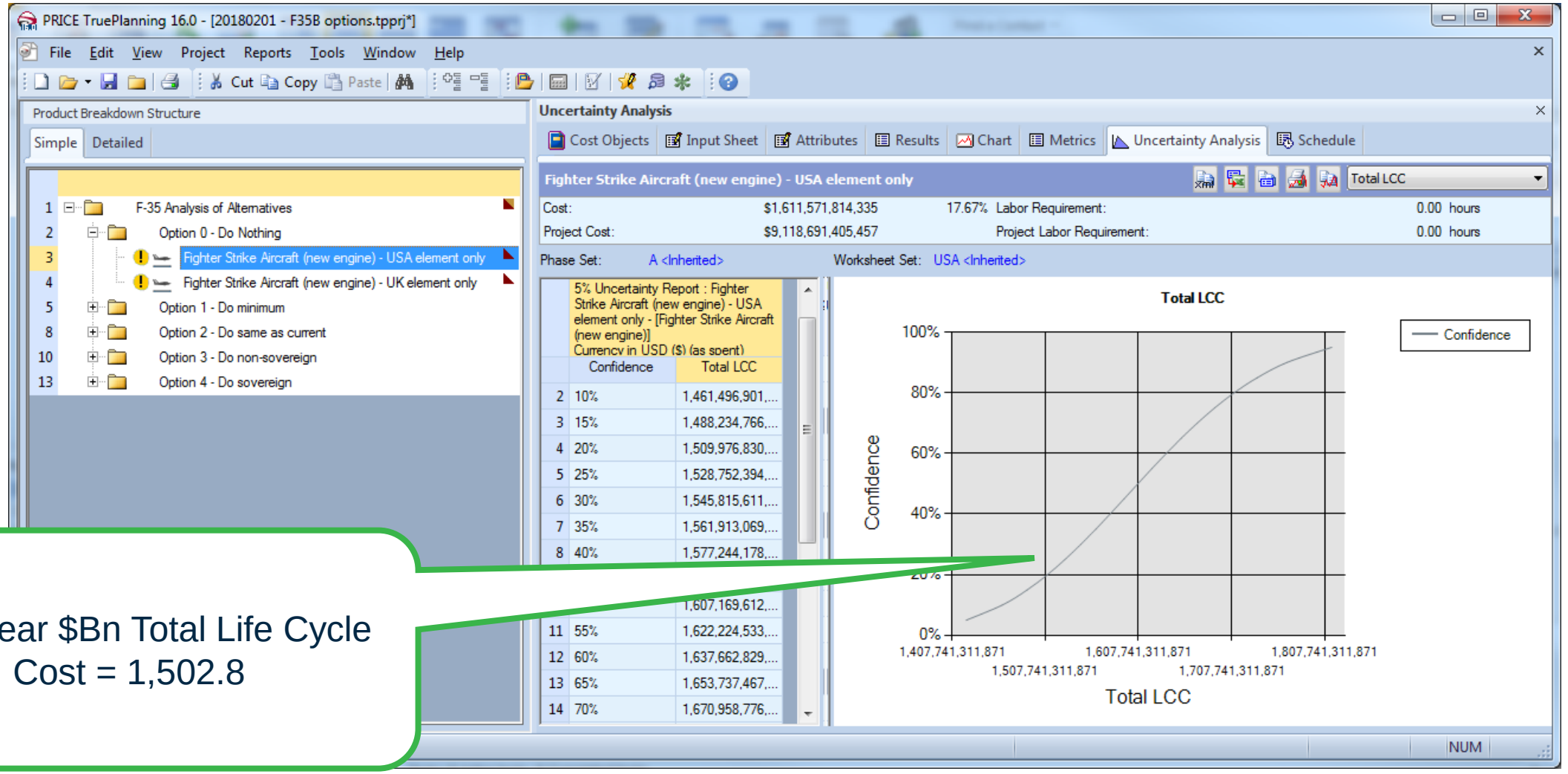
Life Cycle Cost	Then Year $B
Research Development Test and Evaluation	**55.1**
Procurement	**319.1**
Military Construction (MILCON)	**4.8**
Operating and Support Costs	**1,123.8**
Total Life Cycle Costs(LCC)	**1,502.8**

Procurement Cost	Then Year $M
F-35A (1,763)	**100.6**
F-35B (340)	**122.9**
F-35C (340)	**110.7**
Average Procurement Unit Cost (APUC)	**130.6**



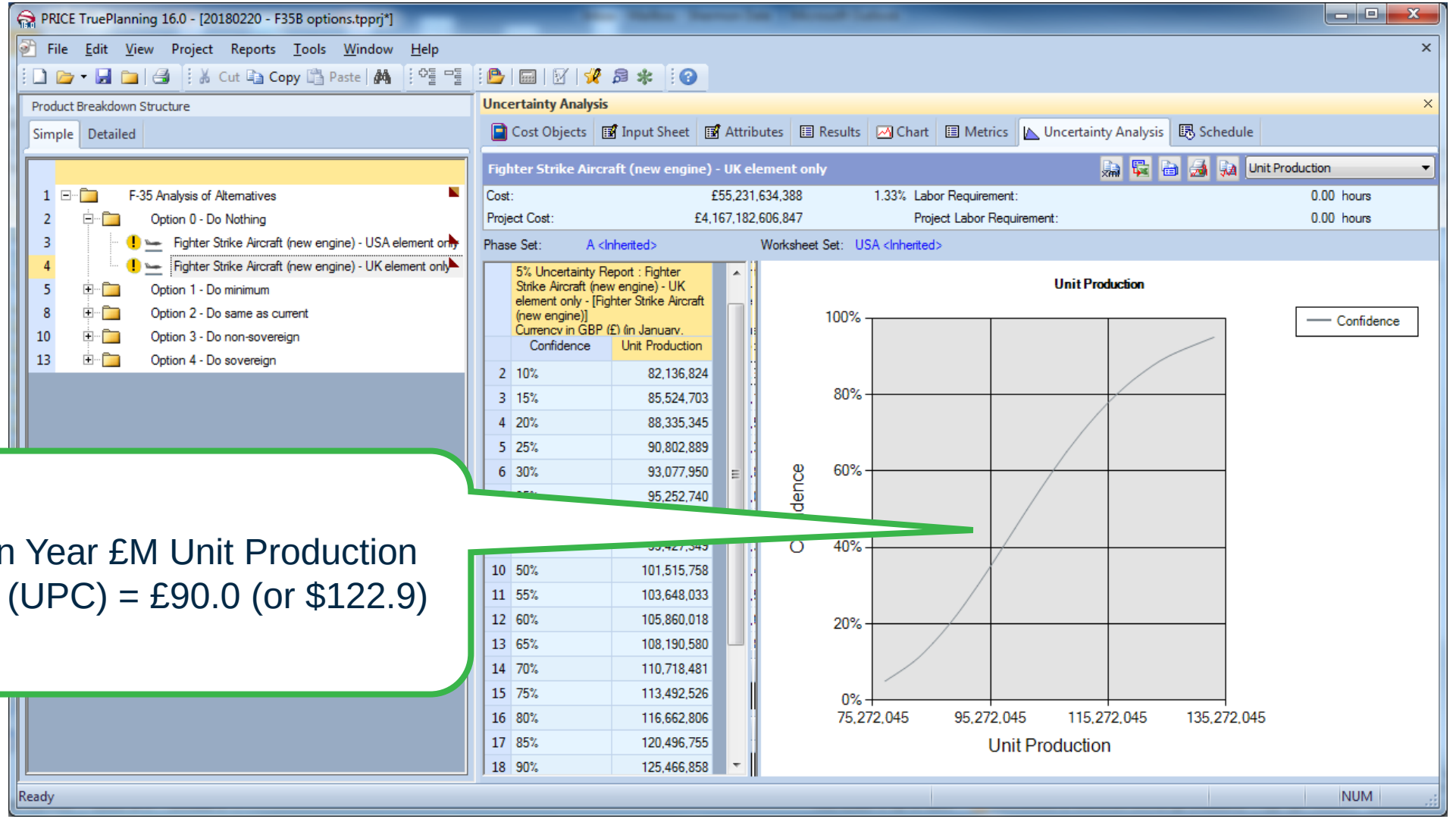
Source: F-35 Lightning II Program Fact Sheet Selected Acquisition Report (SAR) 2015 Cost Data

Calibration cost data – F-35



Then Year $Bn Total Life Cycle Cost = 1,502.8

Calibration cost data – F-35



Then Year £M Unit Production Cost (UPC) = £90.0 (or $122.9)

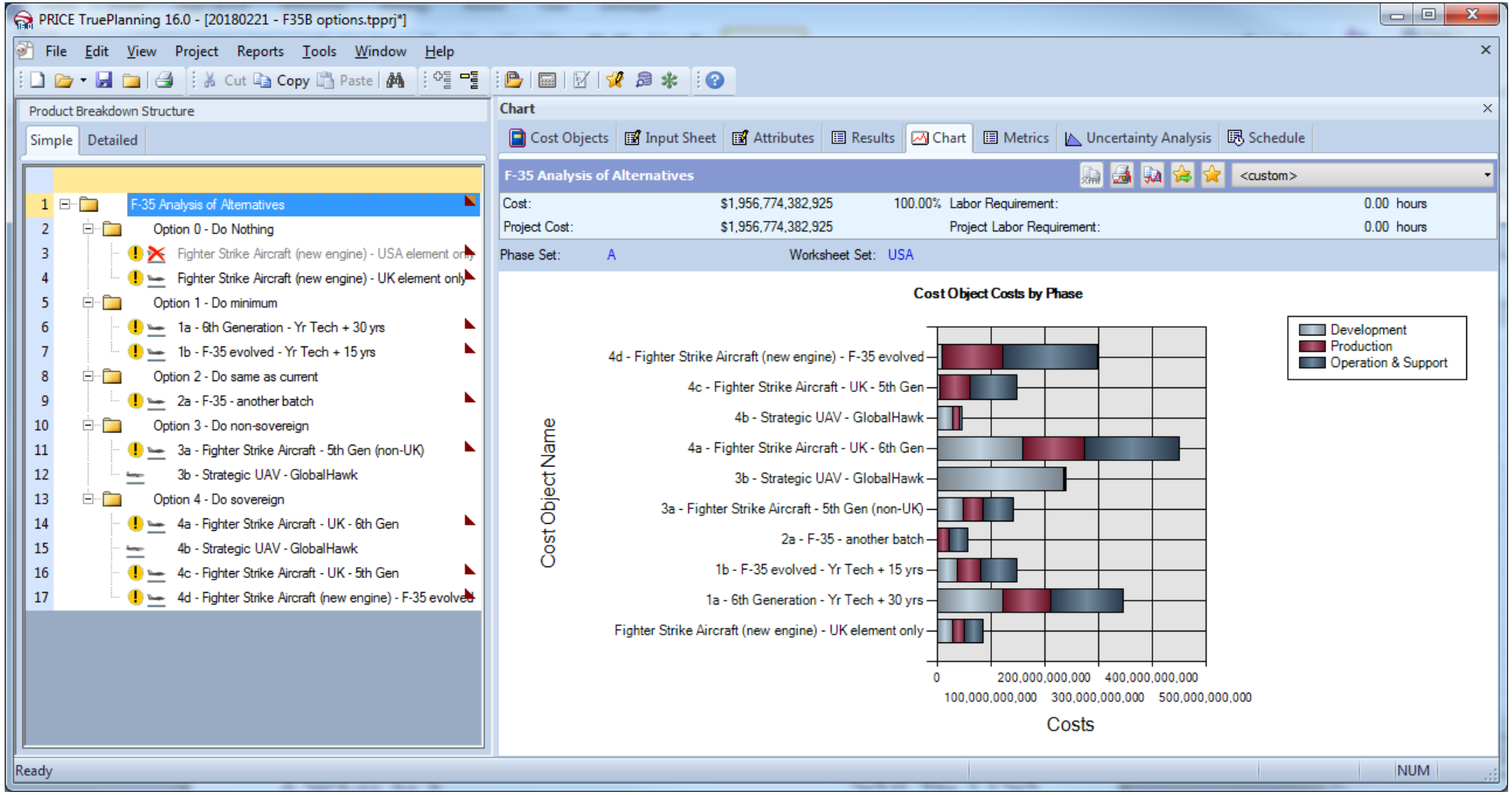
Constant capability

- 5th Generation
  - Payload capability for the F-35 is circa. 6,800 kg
  - Technology standard 1996
- 5th Generation evolved
  - Payload capability for the F-35 is circa. 6,800 kg
  - Technology standard 1996 + 15 years
- 6th Generation
  - Payload capability for the F-35 is circa. 6,800 kg
  - Technology standard 1996 + 30 years
- Strategic UAV
  - Global hawk: Universal Payload Adapter
    - The UPA will support 540kg
- Tactical UAV
  - Mirach 26
    - The payload is 50kg

Description	System	Total Quantity (platforms) all partners
5th Generation		3,109
5th Generation evolved		3,109
6th Generation		3,109
Strategic UAV		39,150

It would require 136 UAV for each aircraft, or over 422,000 tactical UAV to deliver the equivalent payload for all partners.

Macro-parametric cost model



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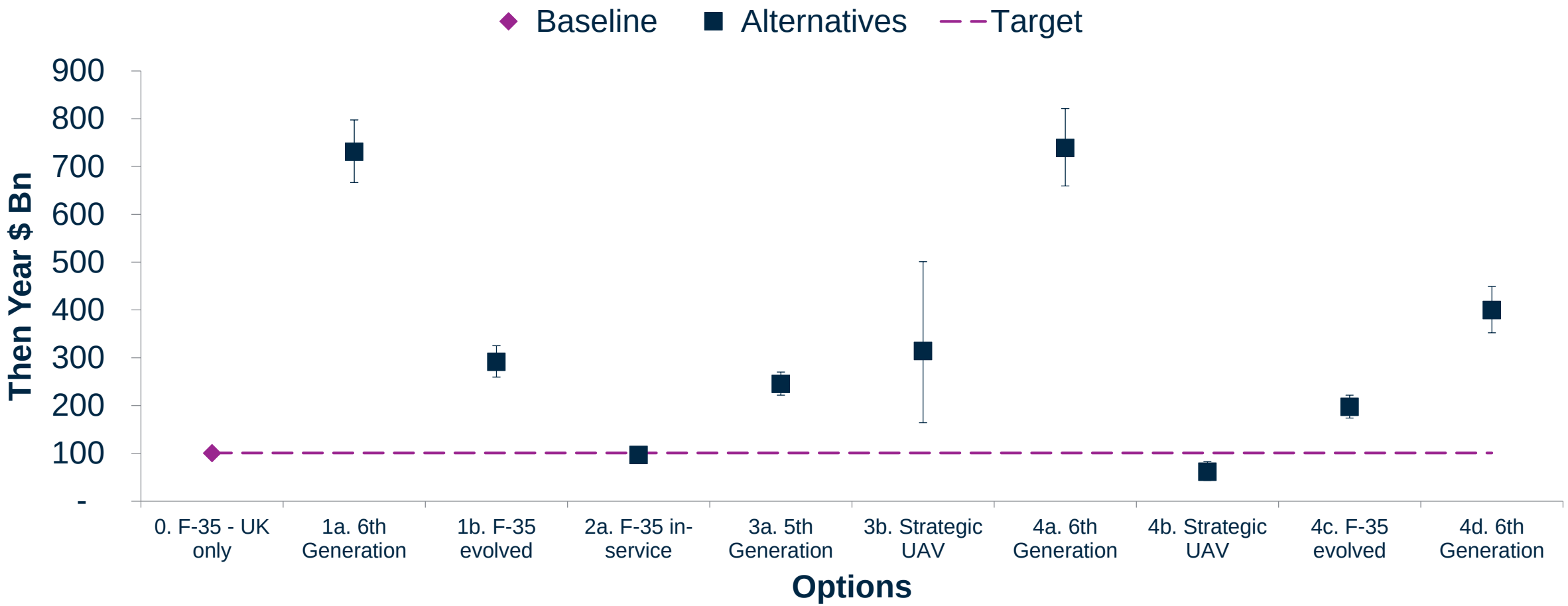
Comparison of Alternatives



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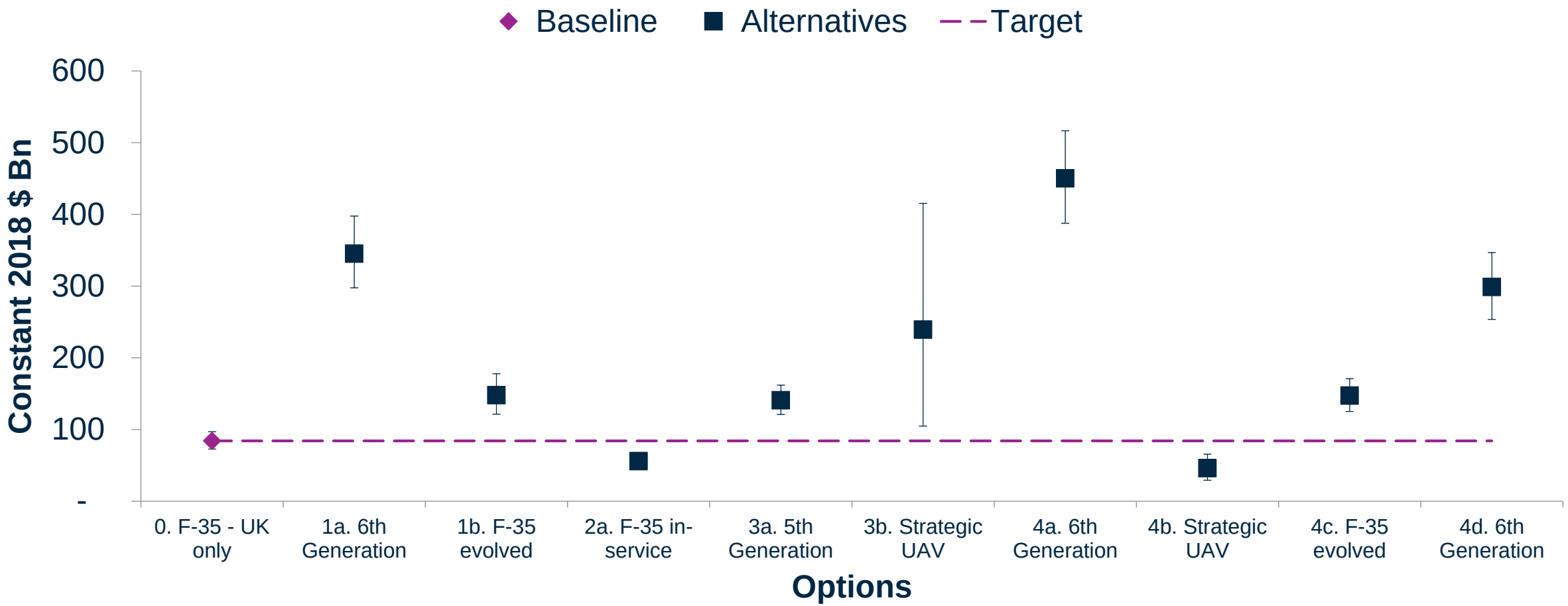

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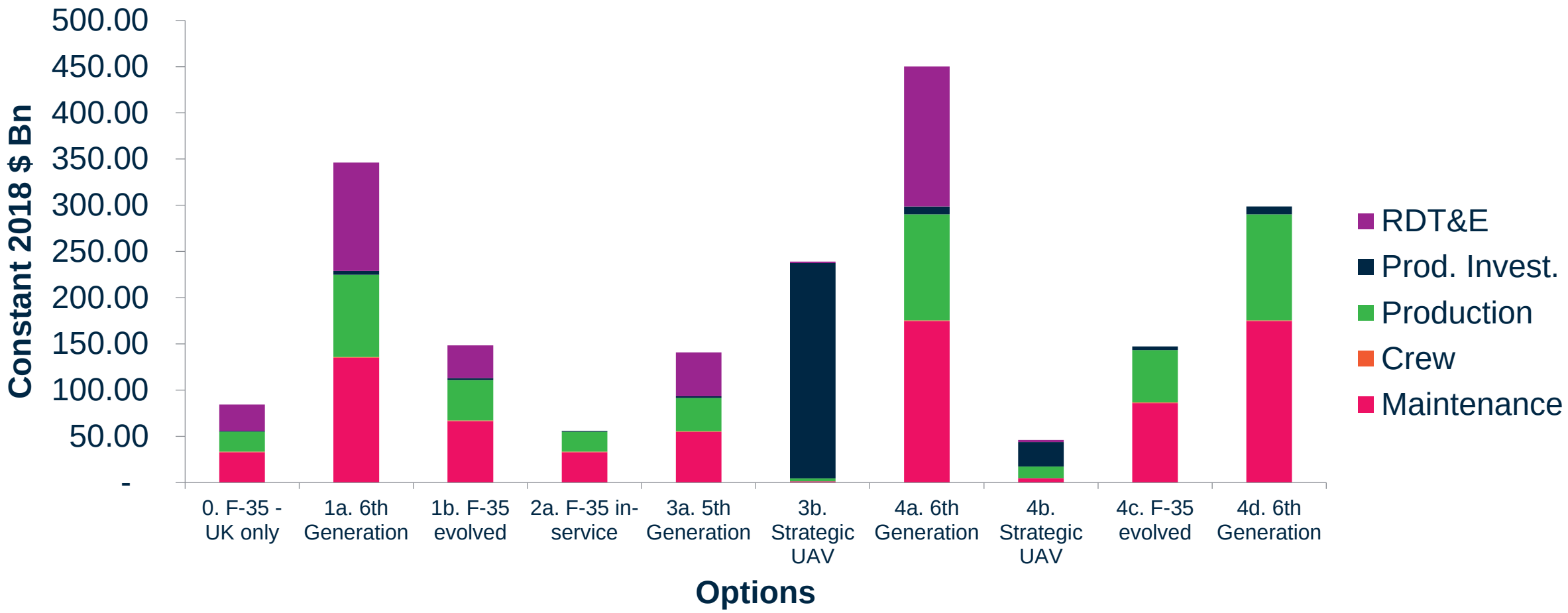

Analysis observations

- ✗ No deviation of the systems capability over time, for example, the same payload is assumed
- ✗ No mixed fleets are considered, for example, manned and unmanned systems in combination
- ✗ No attrition of fleet numbers have been considered
- ✗ No consideration of project specific risks

- ✓ As a first level ROM analysis the exercise can avoid some dead-ends
- ✓ This high level analysis can highlight some problem areas
- ✓ The analysis will provide ROM costs for first level assumptions
- ✓ The analysis assumptions and input parameters are recorded for future scrutiny and debate
- ✓ A cost engineers has prompted a logical discussion regarding future air capability

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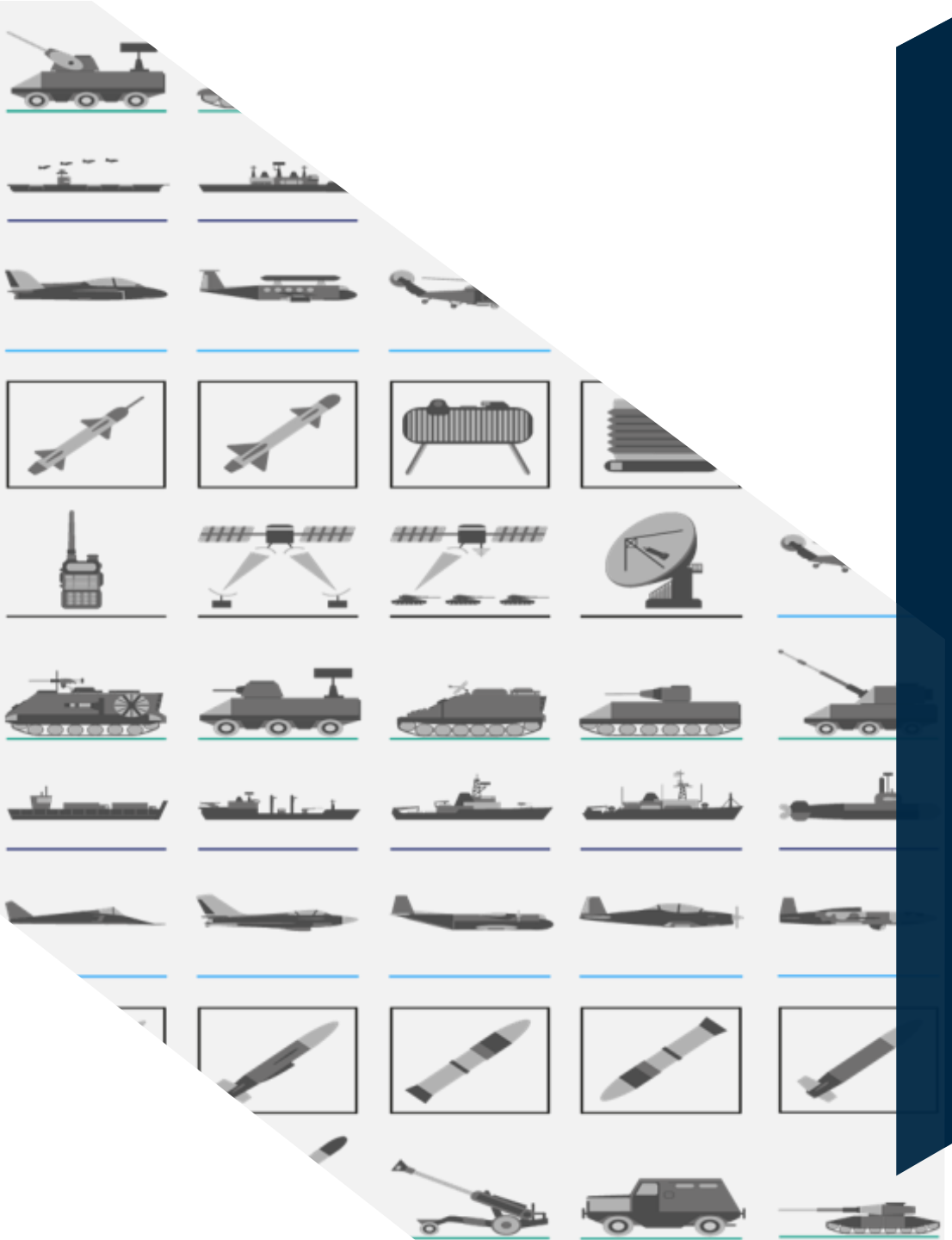

Summary

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Summary

- Cost needs to be heard, Proactive Estimating promotes the generation of options which will stimulate the demand for cost engineering services.
- There is a logical approach to options analysis for cost modelling.
- Macro-parametric cost modelling lends itself to the quick and plentiful generation of costed alternatives.
- The application of a unmanned system fleet would seem expensive due to quantities required to deliver a constant capability.

Any questions?

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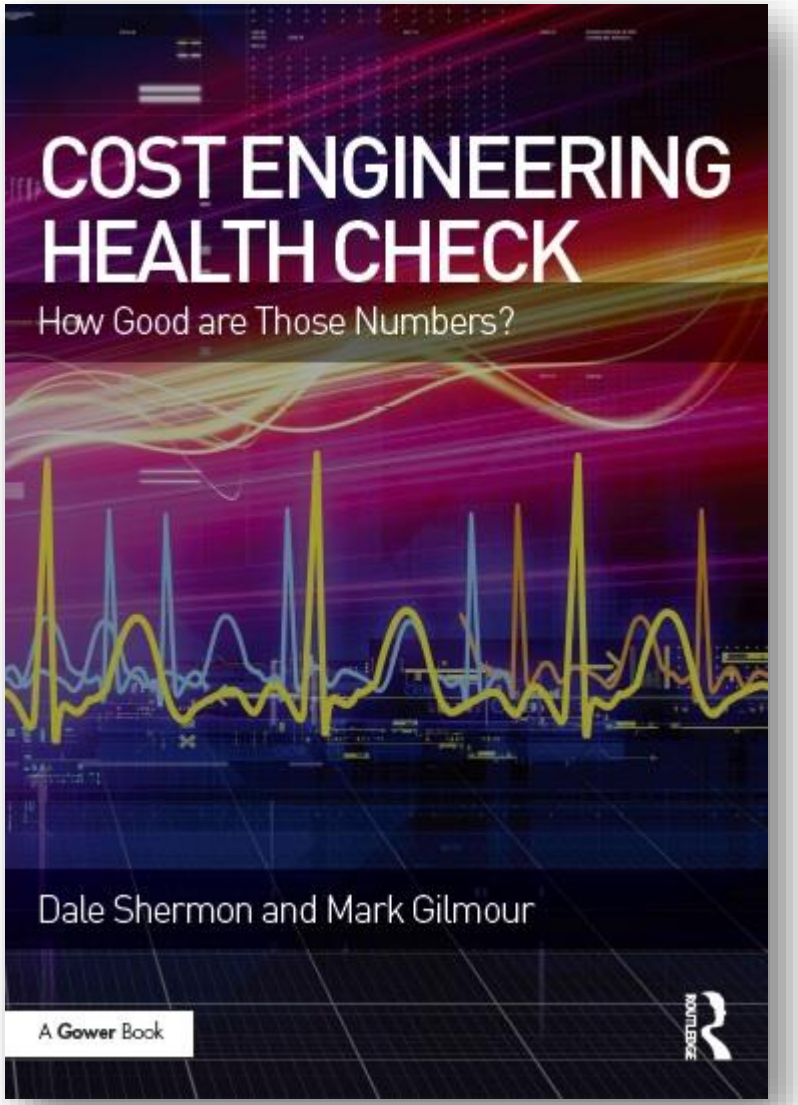

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