Team QinetiQ

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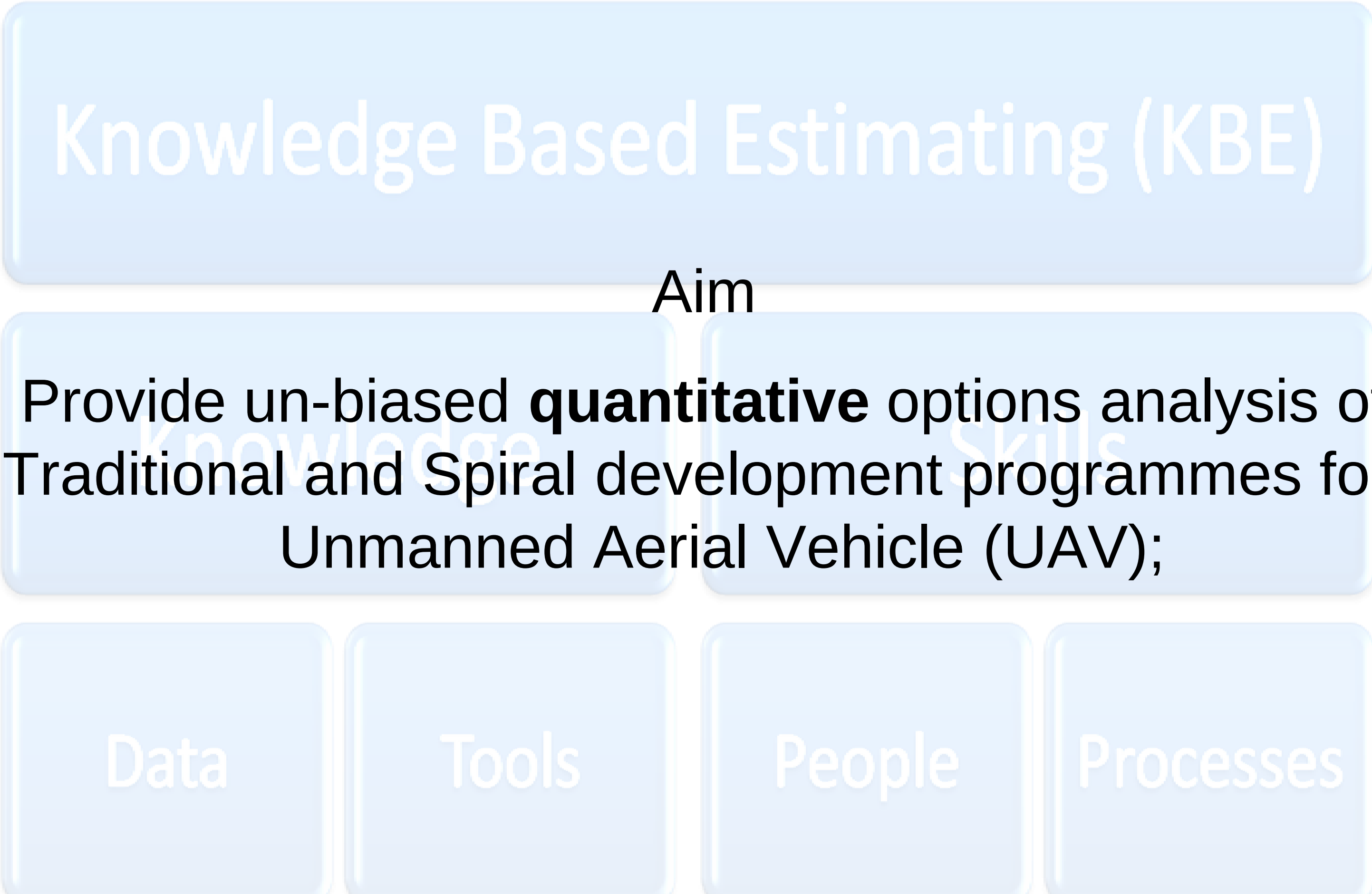
Agenda

1. Defining the Challenge
2. Our Approach
3. Defining Performance
4. Calculating the Cost
5. Delivering Capability
6. Summary

QinetiQ Zephyr High Altitude Long Endurance UAV

1. Defining the Challenge

Challenge



Aim

Provide un-biased **quantitative** options analysis of Traditional and Spiral development programmes for a Unmanned Aerial Vehicle (UAV);

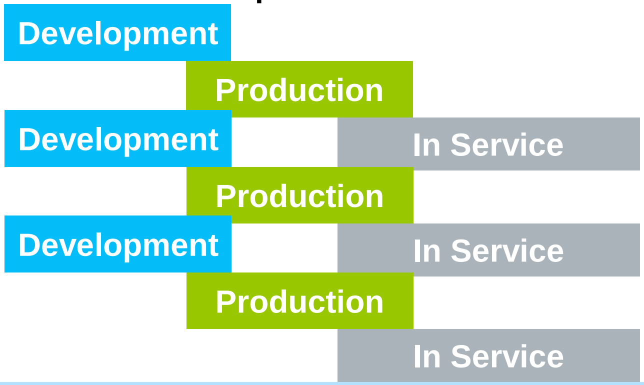
Options Definition

Traditional Development

Acquiring a capability to meet a well defined set of requirements at the beginning and delivering to that set of requirements.

Spiral Development

The capability is added / procured incrementally. Each increment delivers an ever increasing level of capability with a clear defined map of each increment and the end solution.



Technology Solution

Stealth Combatant Aircraft of the **Future** (SCAF) UAV Design Assumptions

- Propeller propulsion
- 17 hours endurance
- Reconnaissance Role
- Empty weight: 400kg

4 Sub-Systems assumed for the purposes of this analysis

- Airframe
- Propulsion
- Synthetic Aperture Radar (SAR)
- Infra Red Sensor (IR)


QinetiQ Zephyr High Altitude Long Endurance UAV

Assumptions

Why a UAV??…

- **Hypothetical** exercise grounded in **realism** as much as possible;
- Utilised QinetiQ's **knowledge** and **experience** of UAV systems.

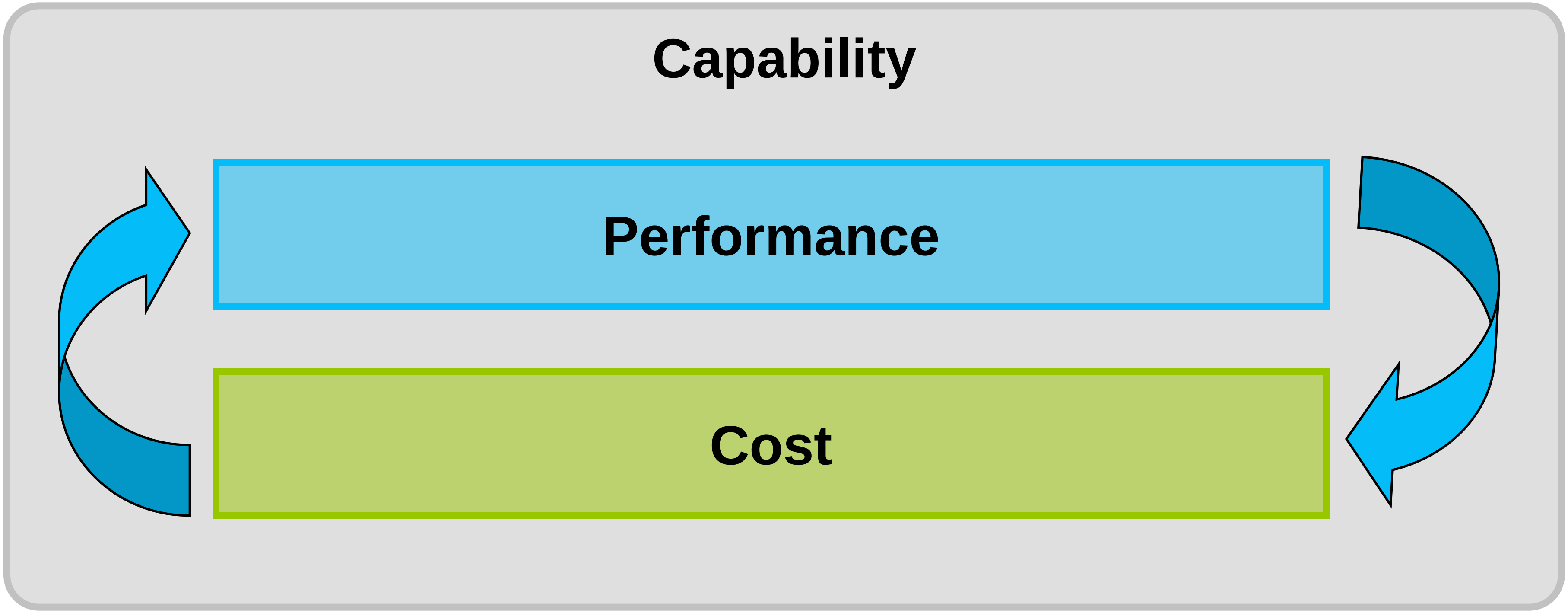
To ensure a fair comparison is made, the following assumptions are also made;

- Defining a set time period: 2010 to 2060
- Setting equal capability targets at points in time (2020 and 2040)
- Assumed a fixed requirement
- Maintaining the same overall number of aircraft (80)
- Simplified life cycle

2. Our Approach

Approach

Integrating **Cost**, **Performance** and **Capability** process streams



Approach

In any trade off, one would look to complete the following at the minimum;

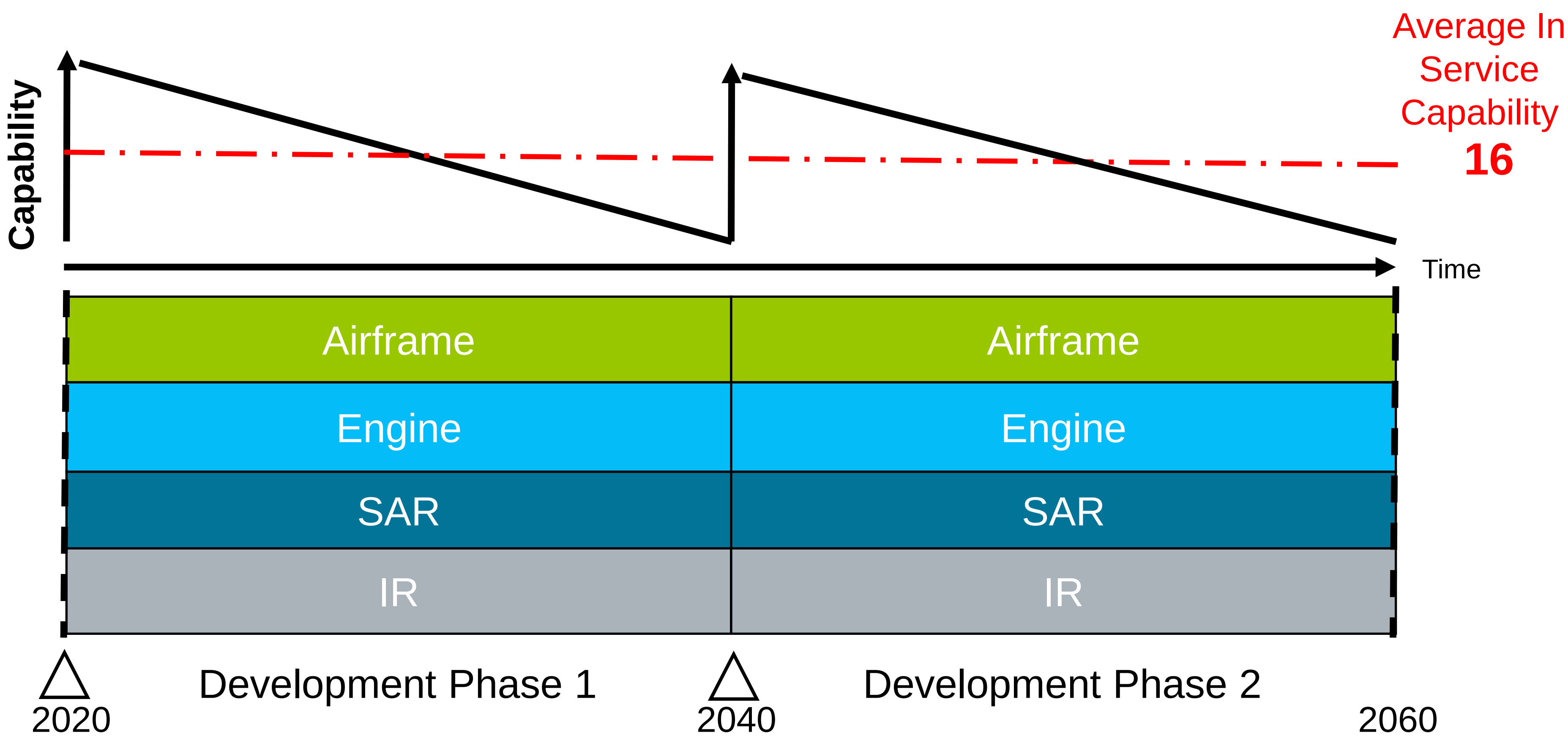
- Whole Life Cost (WLC)
  - Cost Data and Assumptions List (CDAL)
  - Cost and Schedule Uncertainty / Risk analysis
- Operational Analysis (OA)
- Defence Lines of Development (DLoDs) coherence

3. Defining Performance

How is performance measured?

Sub System	Development Phase	Measure of Effectiveness				ISD
		Payload (Kg)	Power (BHP)	Detection Range	Identification Range	
Airframe	1	3				2020
	2	7				2040
Propulsion	1		3			2020
	2		7			2040
SAR	1			3		2020
	2			7		2040
IIR	1				3	2020
	2				7	2040

Traditional Development Resultant Capability

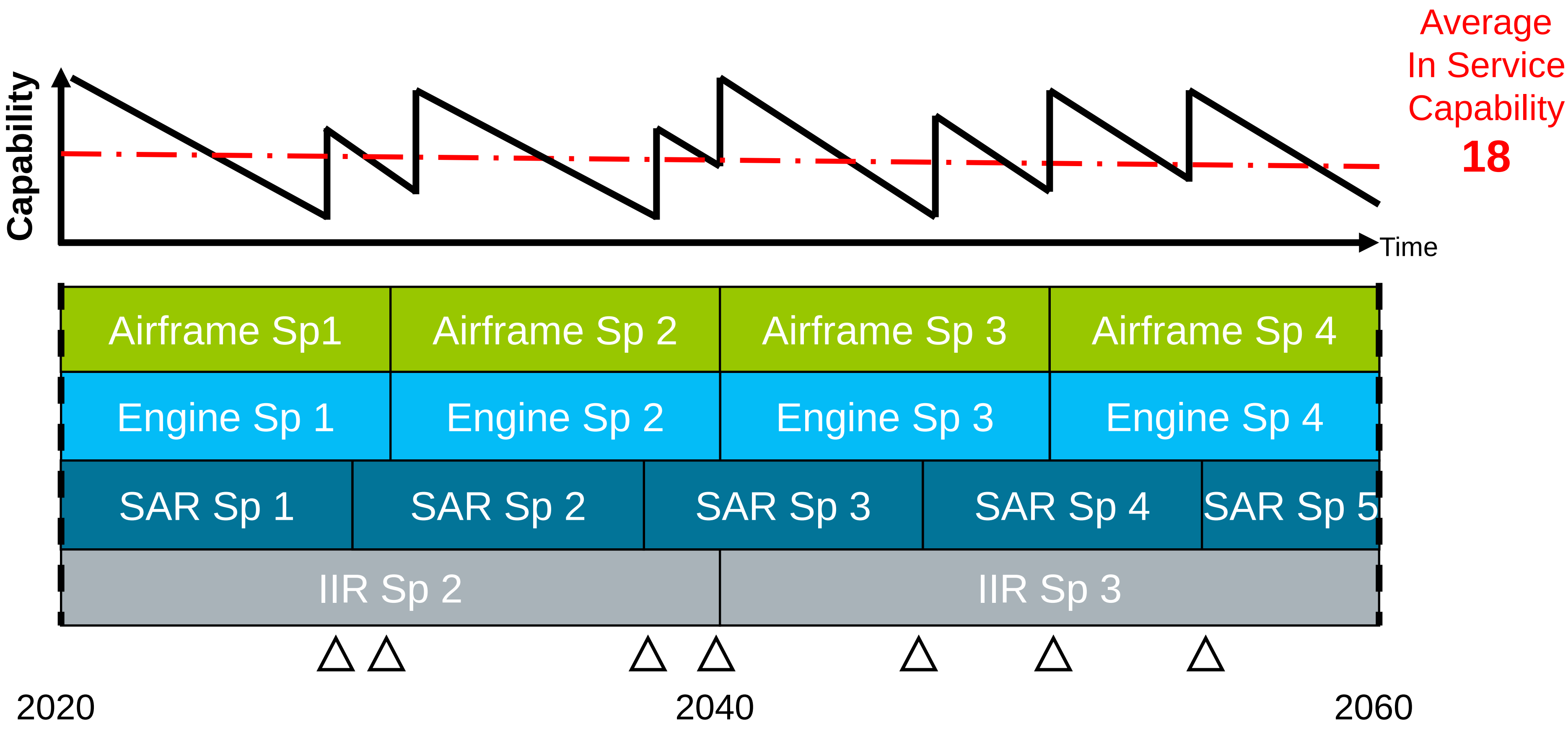


Planned Maintenance & Integration Points In Time

How is performance measured?

Sub System	Spiral	Payload (Kg)	Power (BHP)	Detection Range	Identification Range	Technology Insertion date
Airframe	1	2				2016
	2	3				2020
	3	6				2037
	4	8				2047
Propulsion	1		2			2016
	2		3			2019
	3		6			2036
	4		8			2056
SAR	1			2		2016
	2			3		2026
	3			6		2036
	4			8		2047
	5			10		2056
IIR	1				5	2028
	2				7	2036

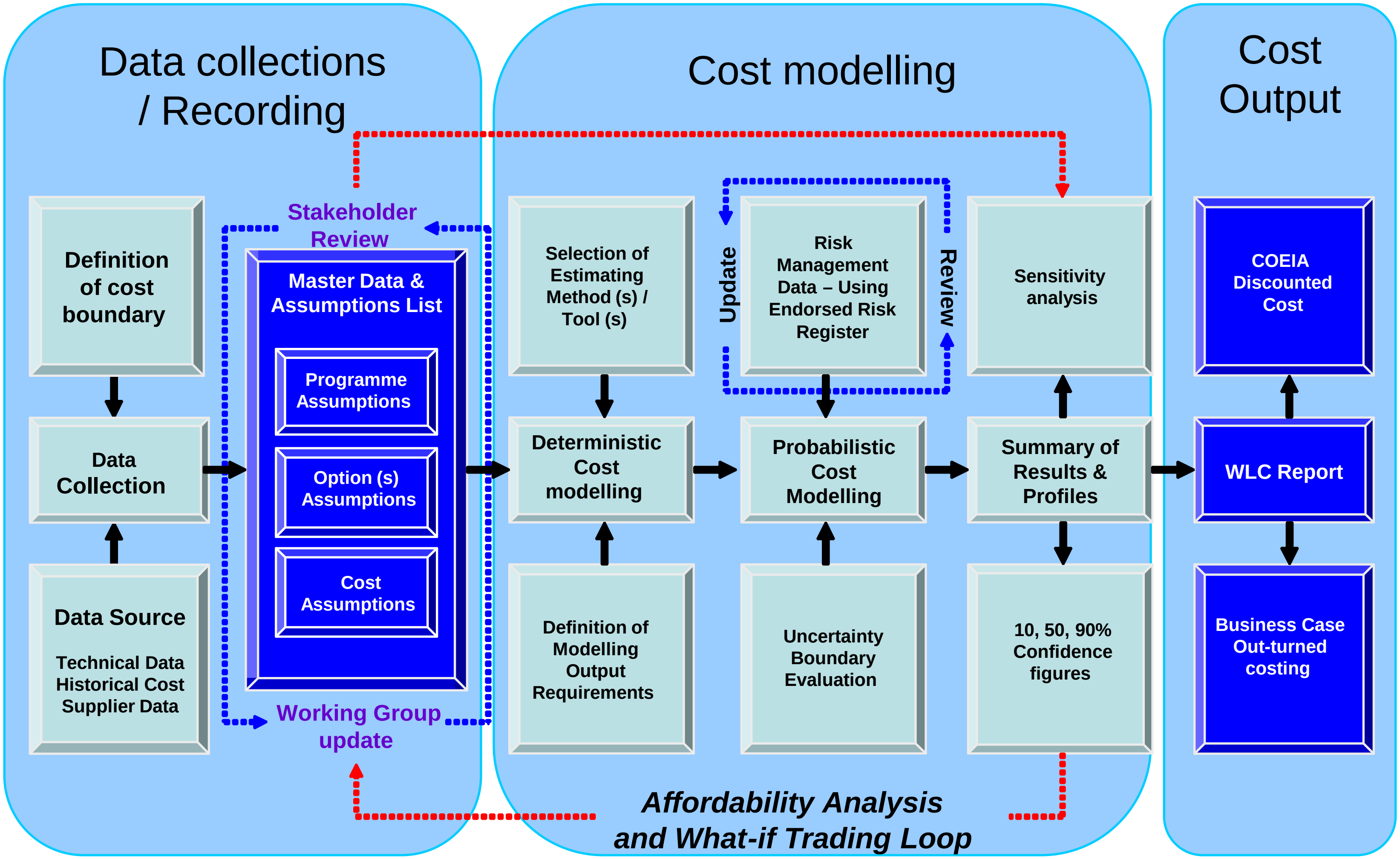
Spiral Development Resultant Capability



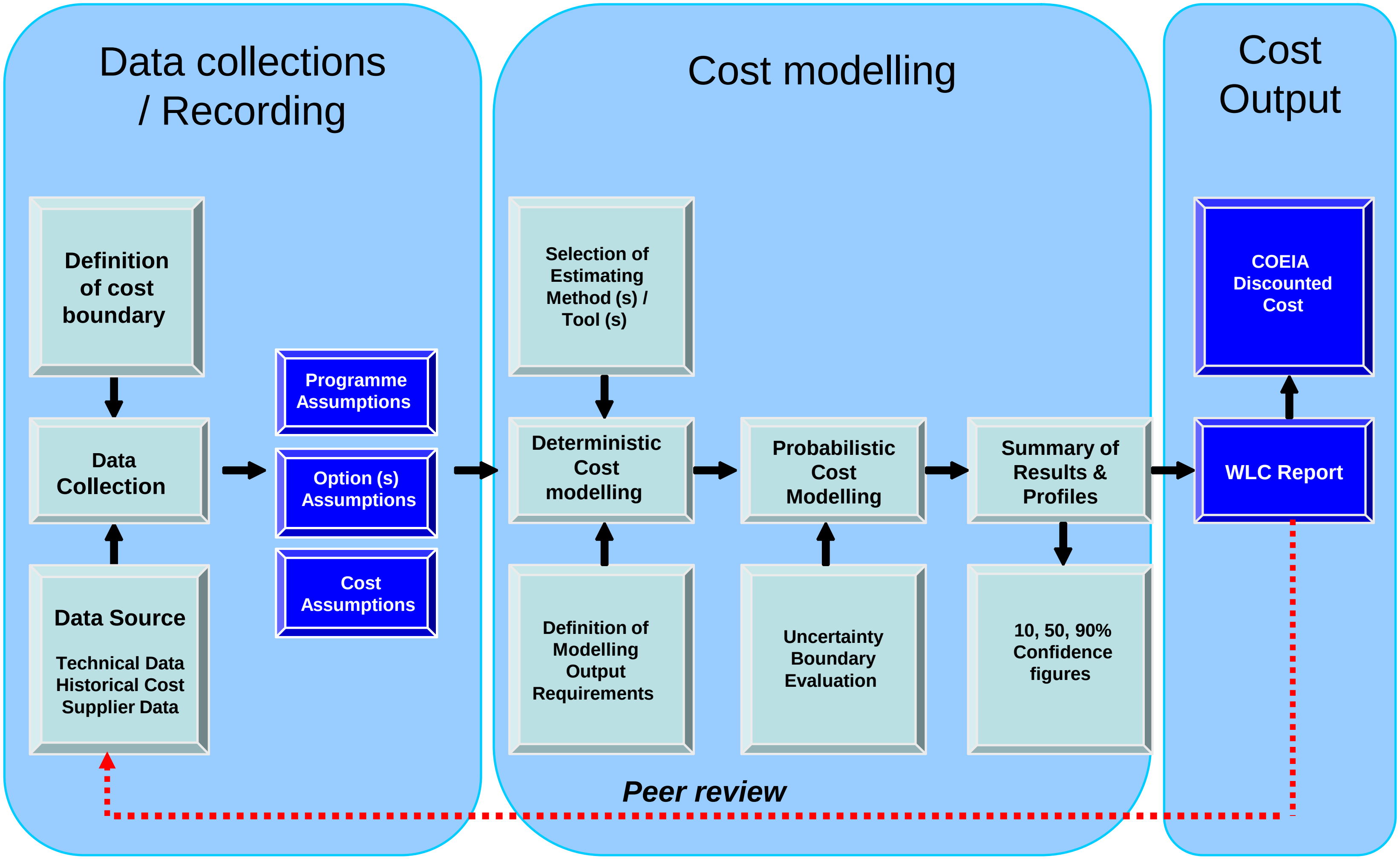
Planned Maintenance & Integration Points In Time

4. Calculating the Cost

Costing Approach



Costing Approach – simplified for this exercise



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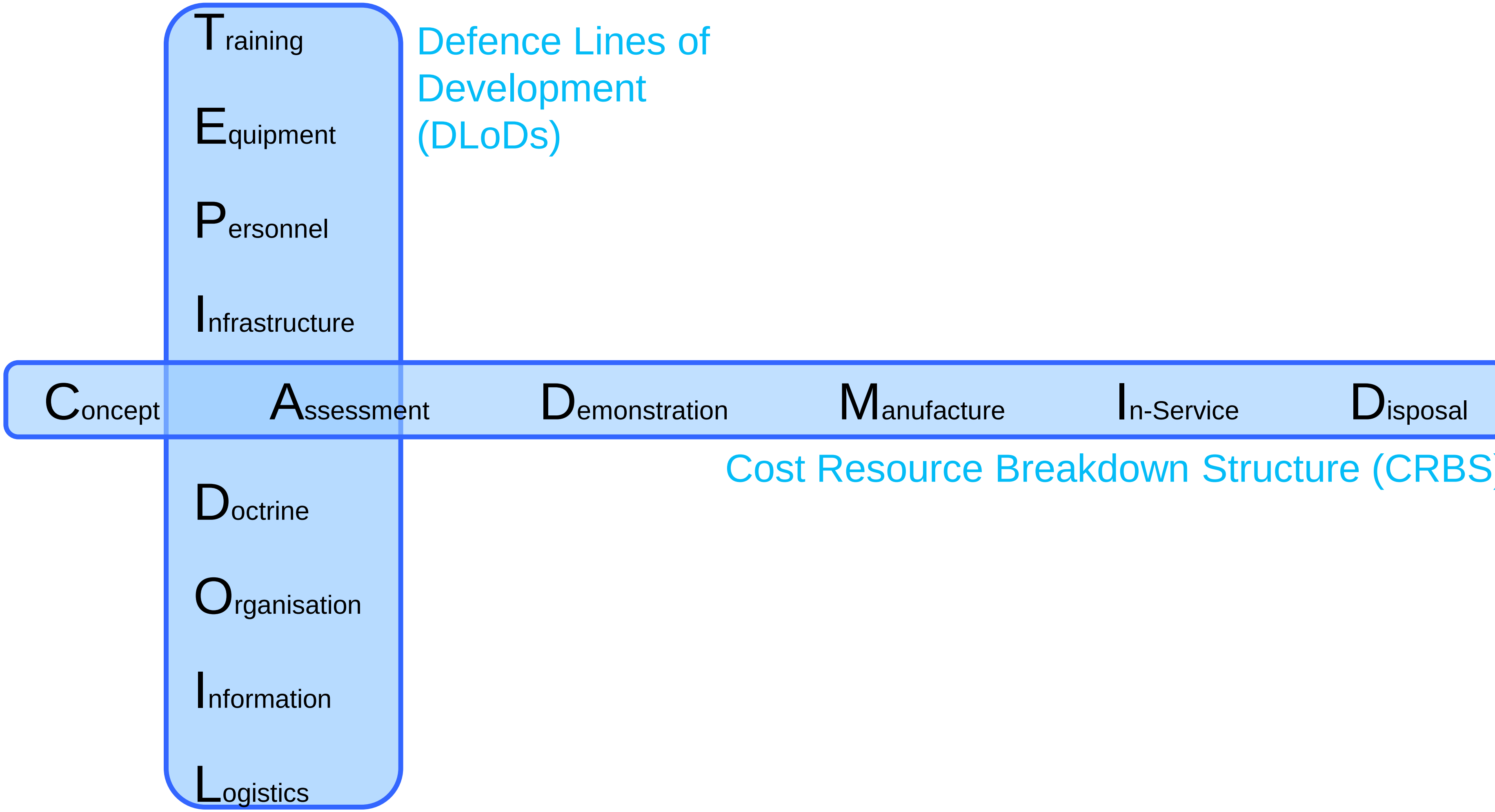
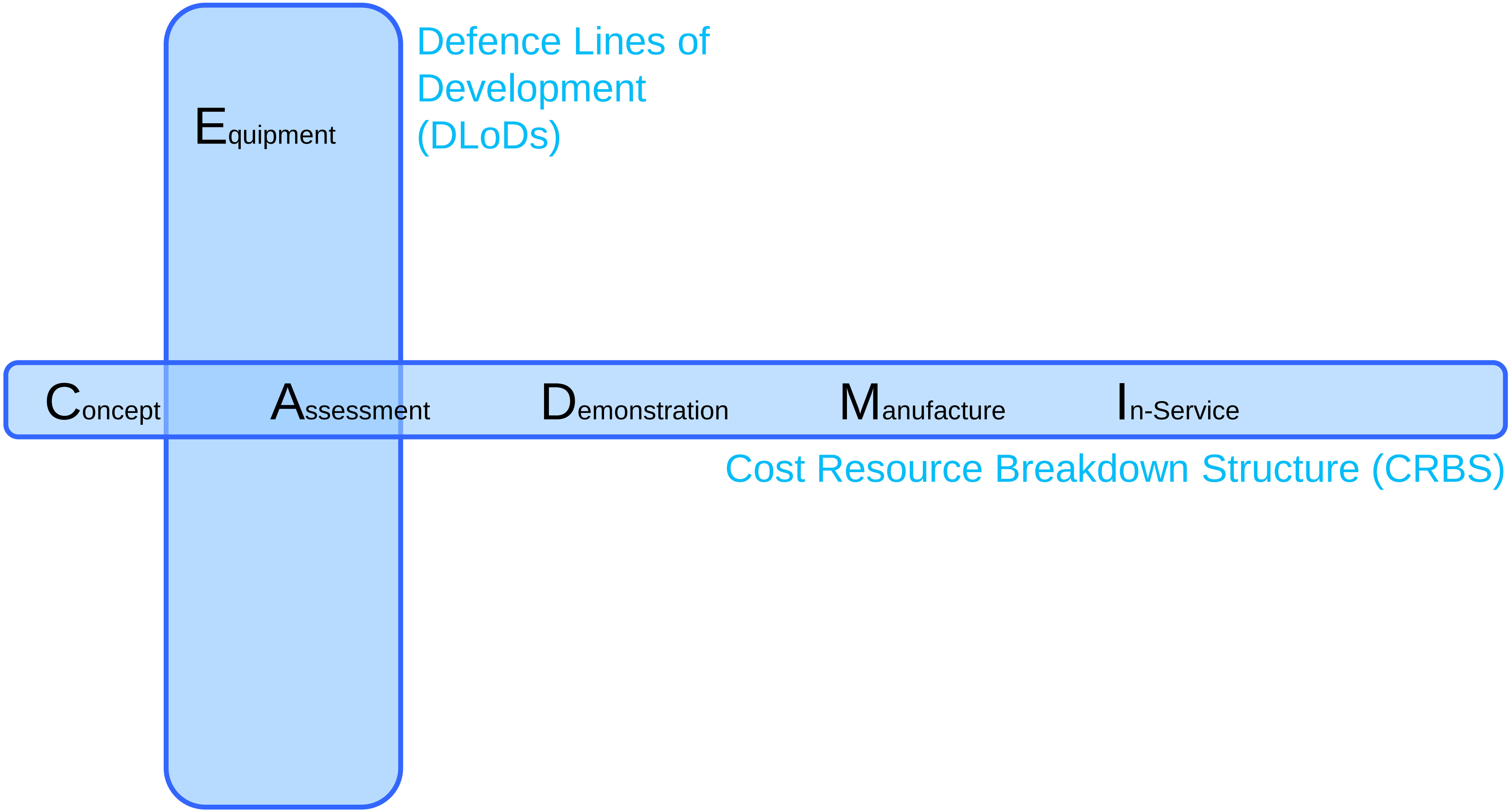
Whole Life Cost (WLC)



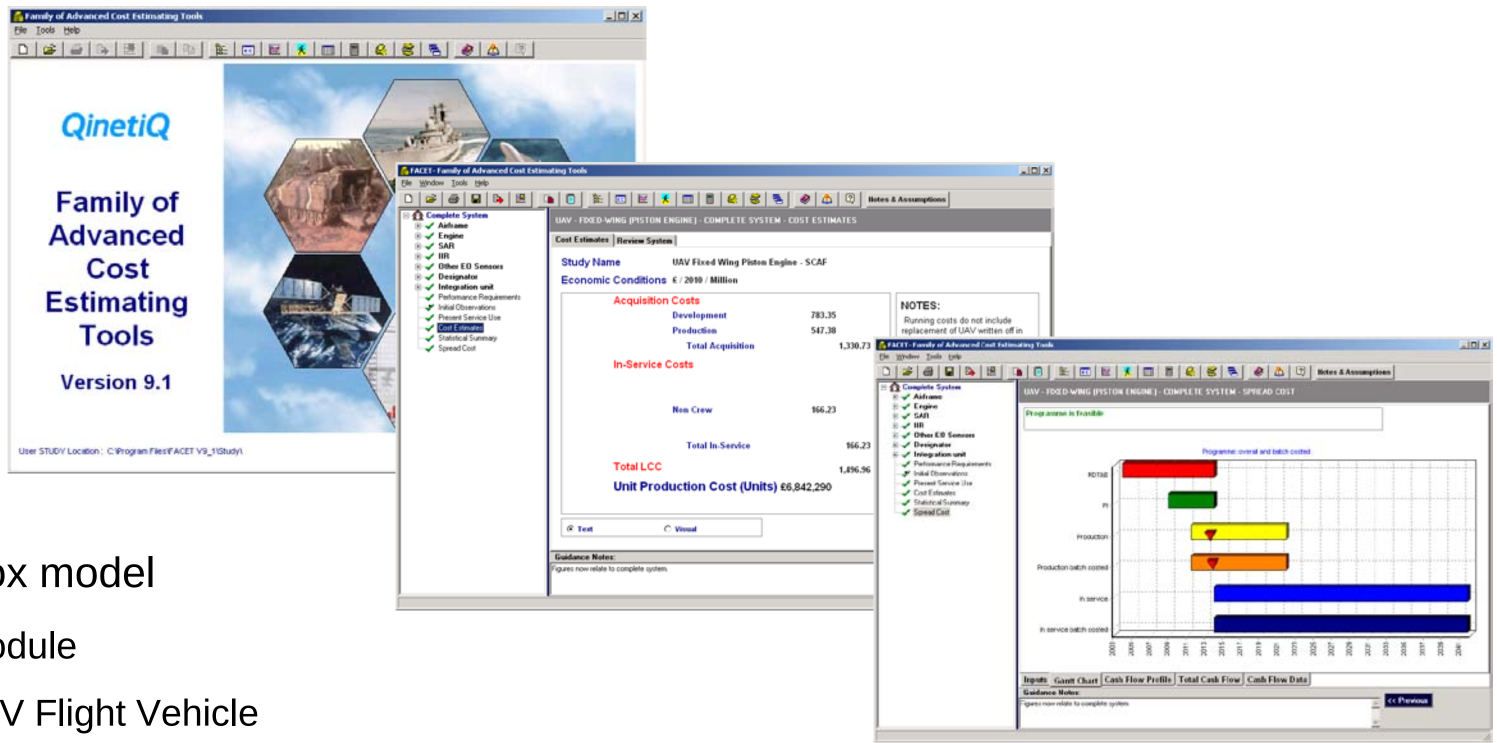
Whole Life Cost (WLC) – Cost Boundary



Cost Estimating

QinetiQ's Family of Advanced Cost Estimating Tool (FACET) was utilised to derive the three point cost estimates based on design parameter uncertainty.

Out of the 80+ modules within FACET, the following was used for this exercise;



- Multi Box model
  - Air Module
    - UAV Flight Vehicle

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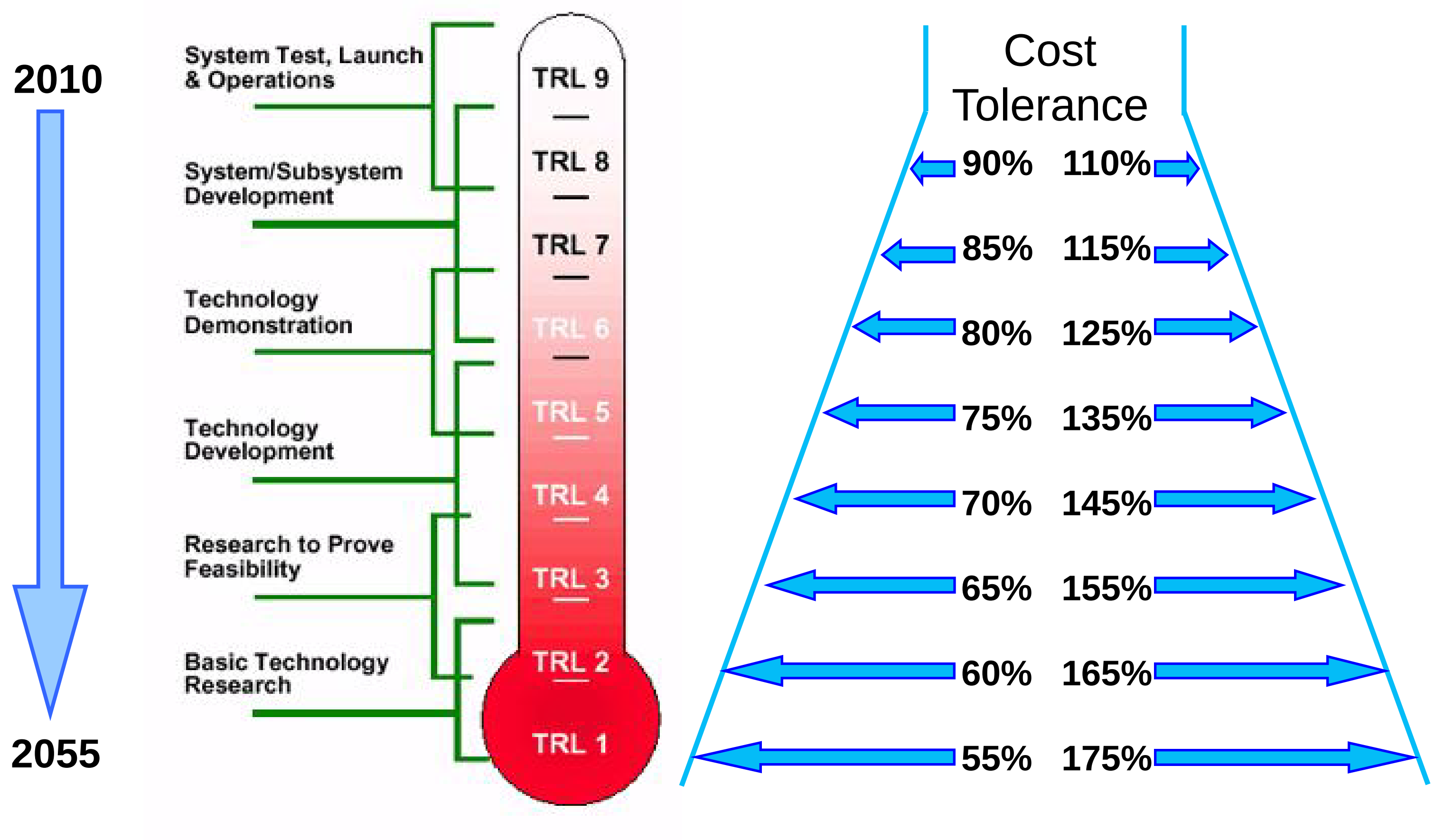
Uncertainty



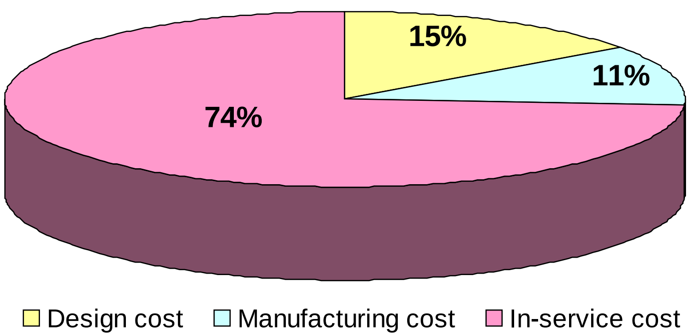
e.g. Spiral 5 SAR – Insertion Date 2056, Cost uncertainty -55% + 175%

Whole Life Cost

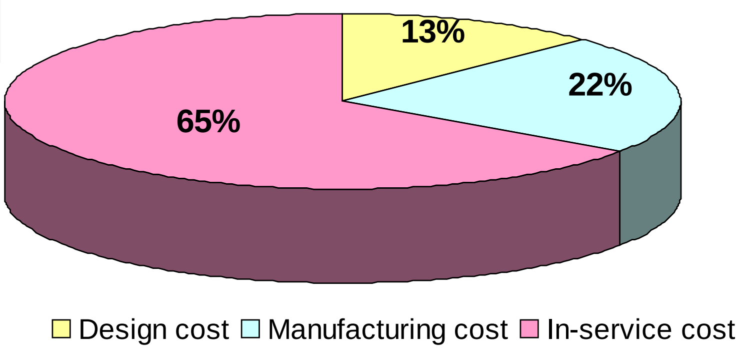
	2010 Constant Cost (£Bn)		
	10%	**50%**	**90%**
Traditional Approach	£10.1	**£11.8**	£12.9
Spiral Development	£11.1	**£13.2**	£15.8

Spiral Development **15%** higher cost

Traditional Approach Cost Apportionment

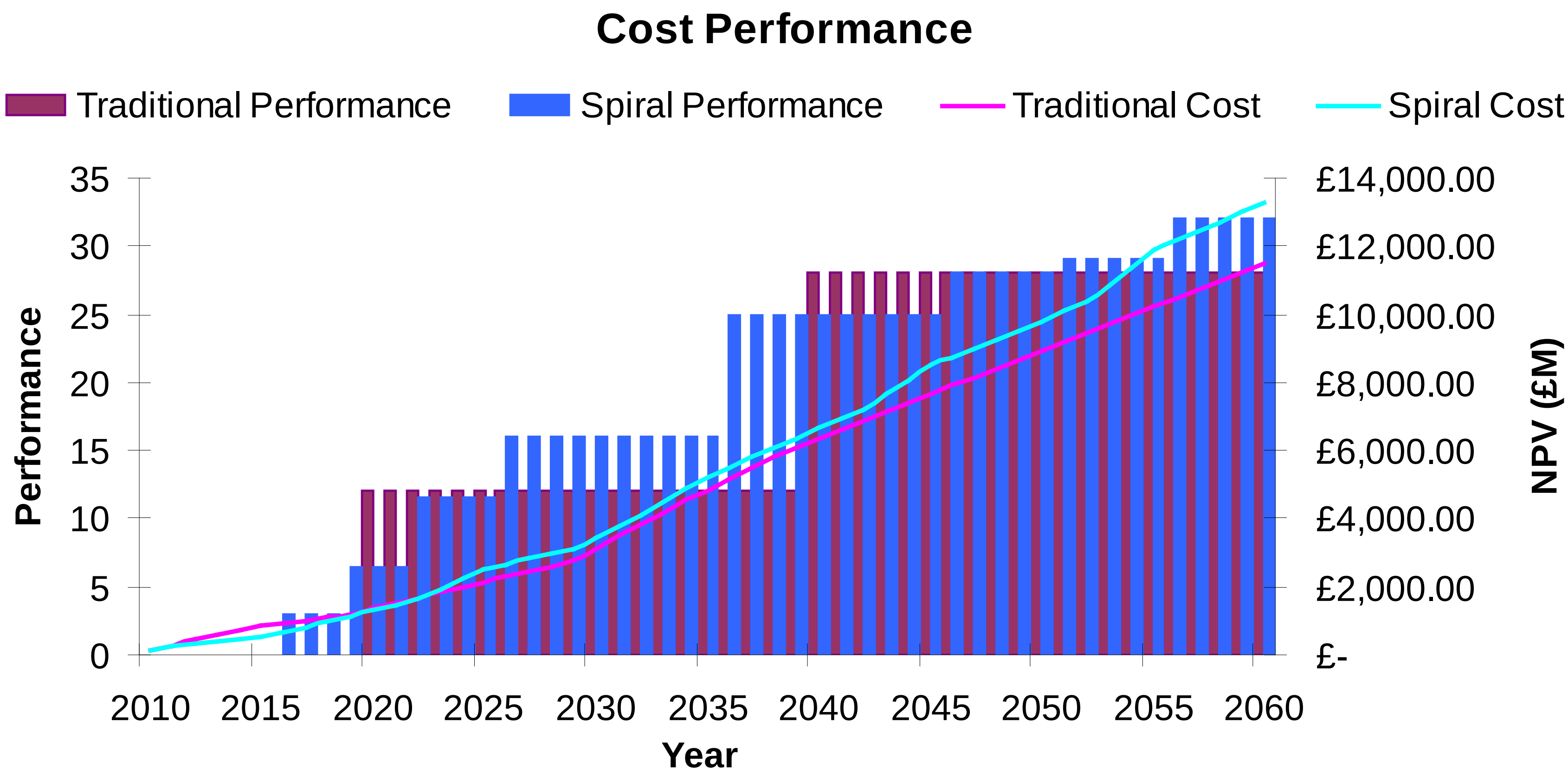


Spiral Development Cost Apportionment

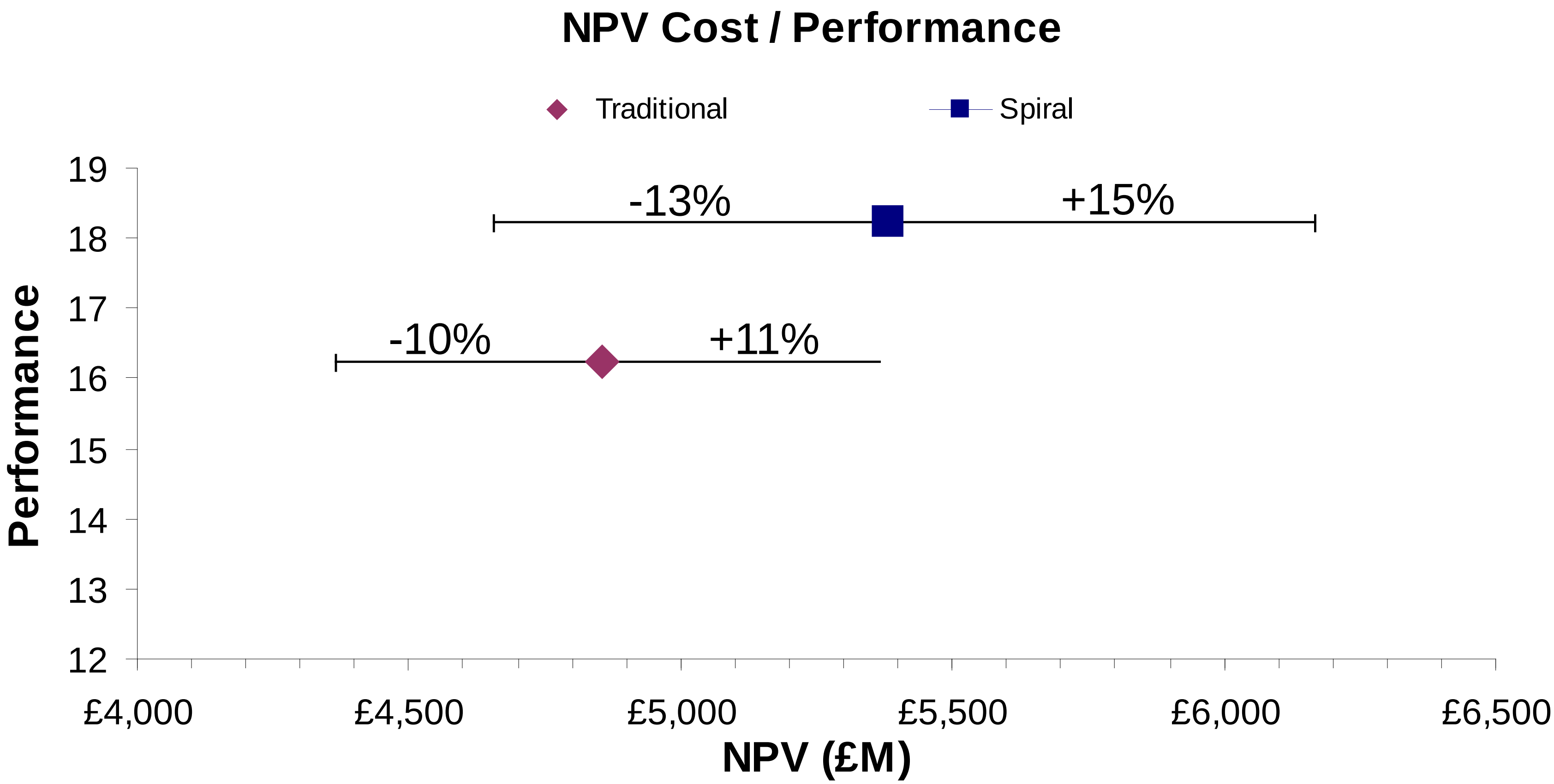


Manufacturing Costs **Double** during Spiral Development

Cost / Performance Results



Cost / Performance Results

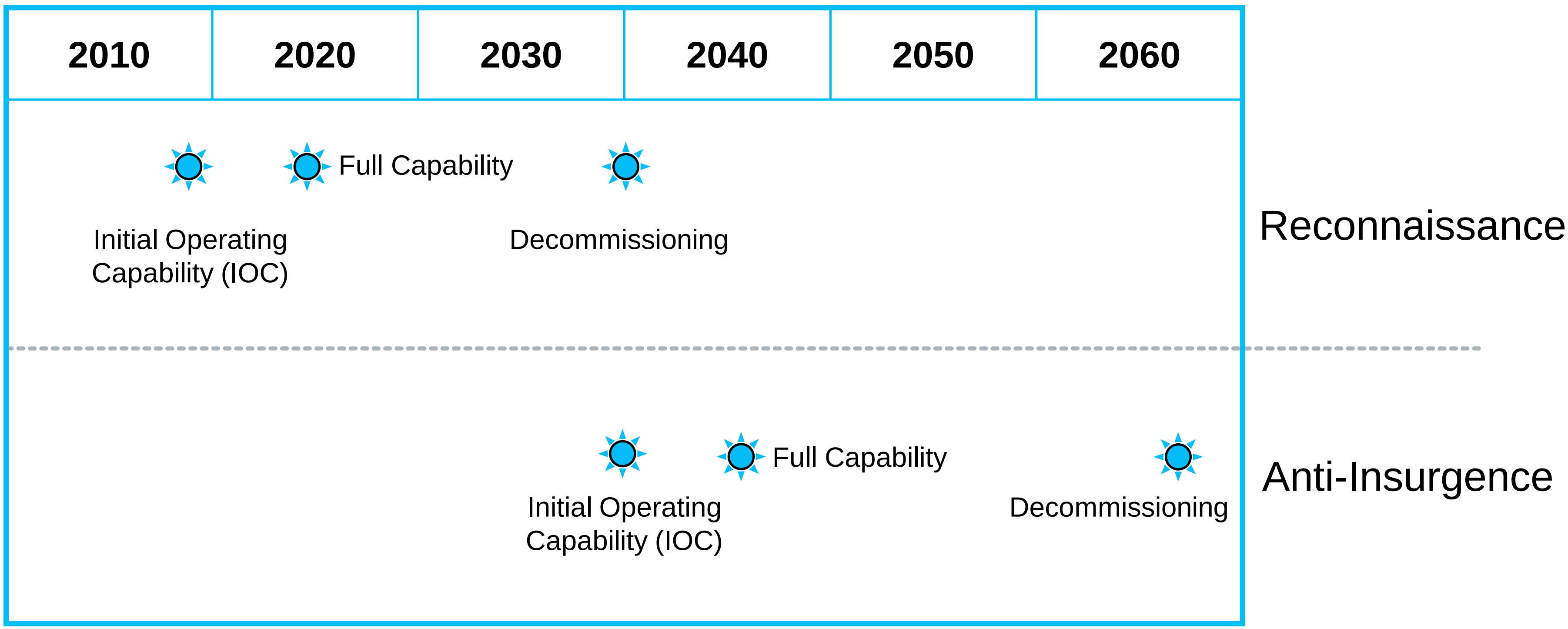


5. Delivering Capability

Capability Planning

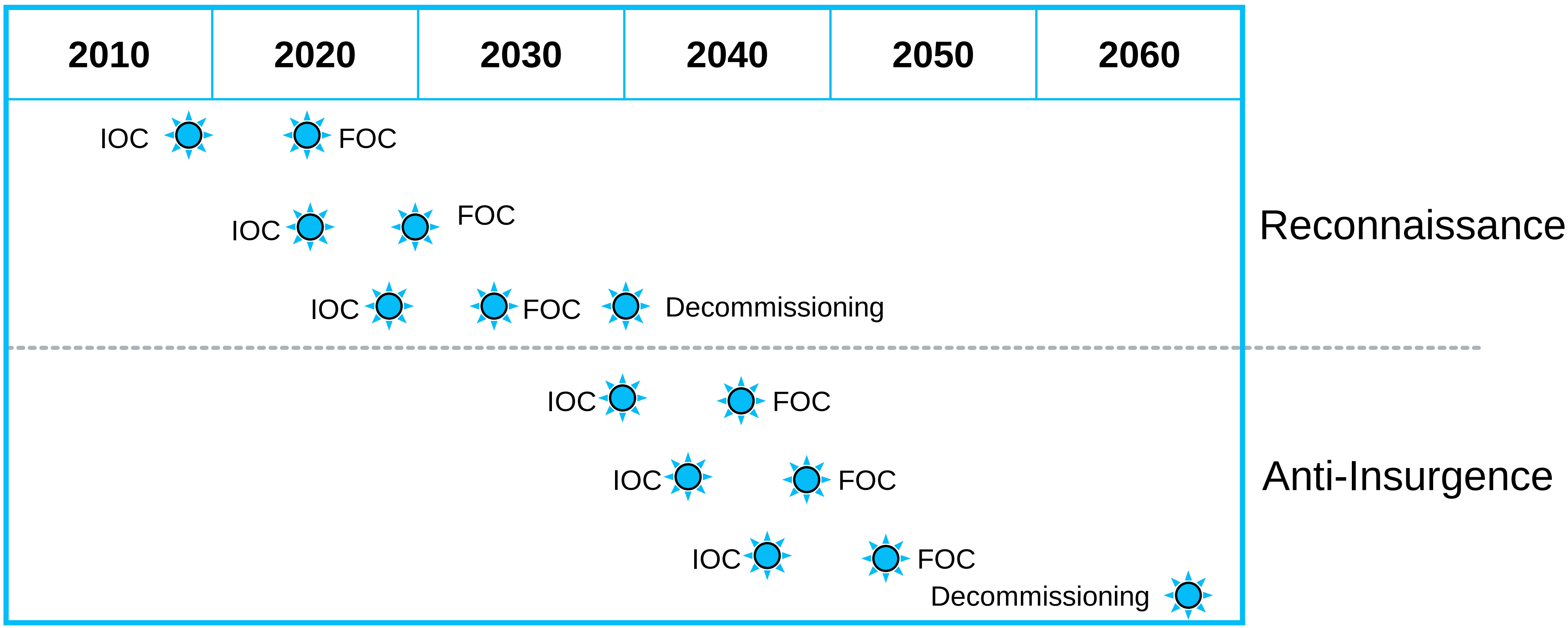
What are the actions required across the DLoDs to delivery Capability?

Traditional Capability Plan



Capability Planning

Spiral Development Capability Plan

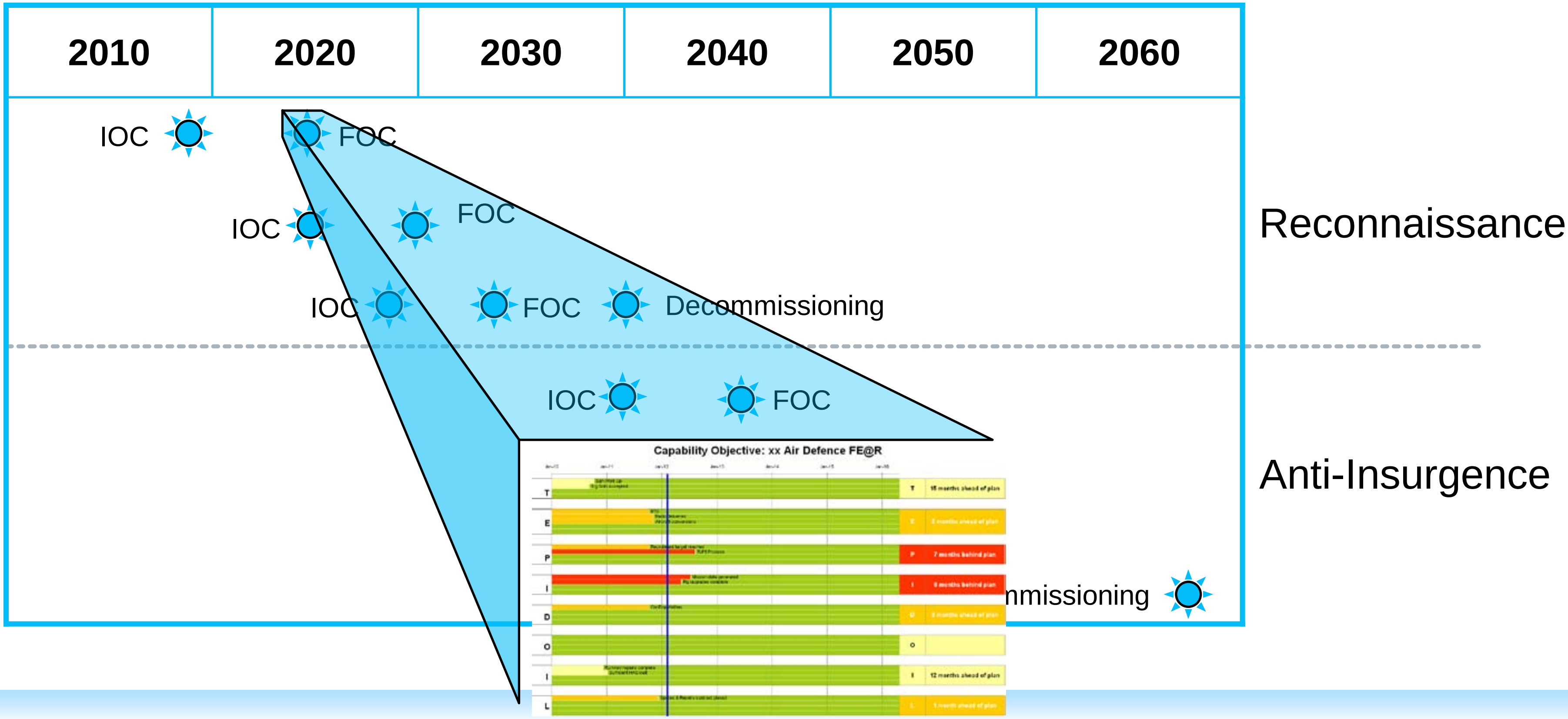


Capability Road Map DLoDs Approach

Capability Planning

What is the actions required across the DLoDs to delivery Capability?

Spiral Development **Capability Plan**



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6. Summary

A touch of realism

- Hypothetical Scenario – Assumed performance road maps
    - Analysis options limited to procurement approach rather then technology solutions
- DLoDs cost not currently taken into account
- Cost tolerance assumed to be correlated to TRL
- Risks not currently considered as they would be dependant upon the specific project circumstances

Development Mode Merits

Traditional Approach

- Cheaper overall
- Reduced number of configurations and equipments
- Reduced integration effort
- Reduced DLoDs impact
- Less uncertainty

Spiral Development

- Greater flexibility to meet changing requirements
- Greater refresh of equipment throughout life cycle allowing
- Obsolescence is managed more effectively
- Development and design team continuity
- Provides greater focus on use of commercially available equipment
- Provides a more consistent and overall higher capability

Questions?

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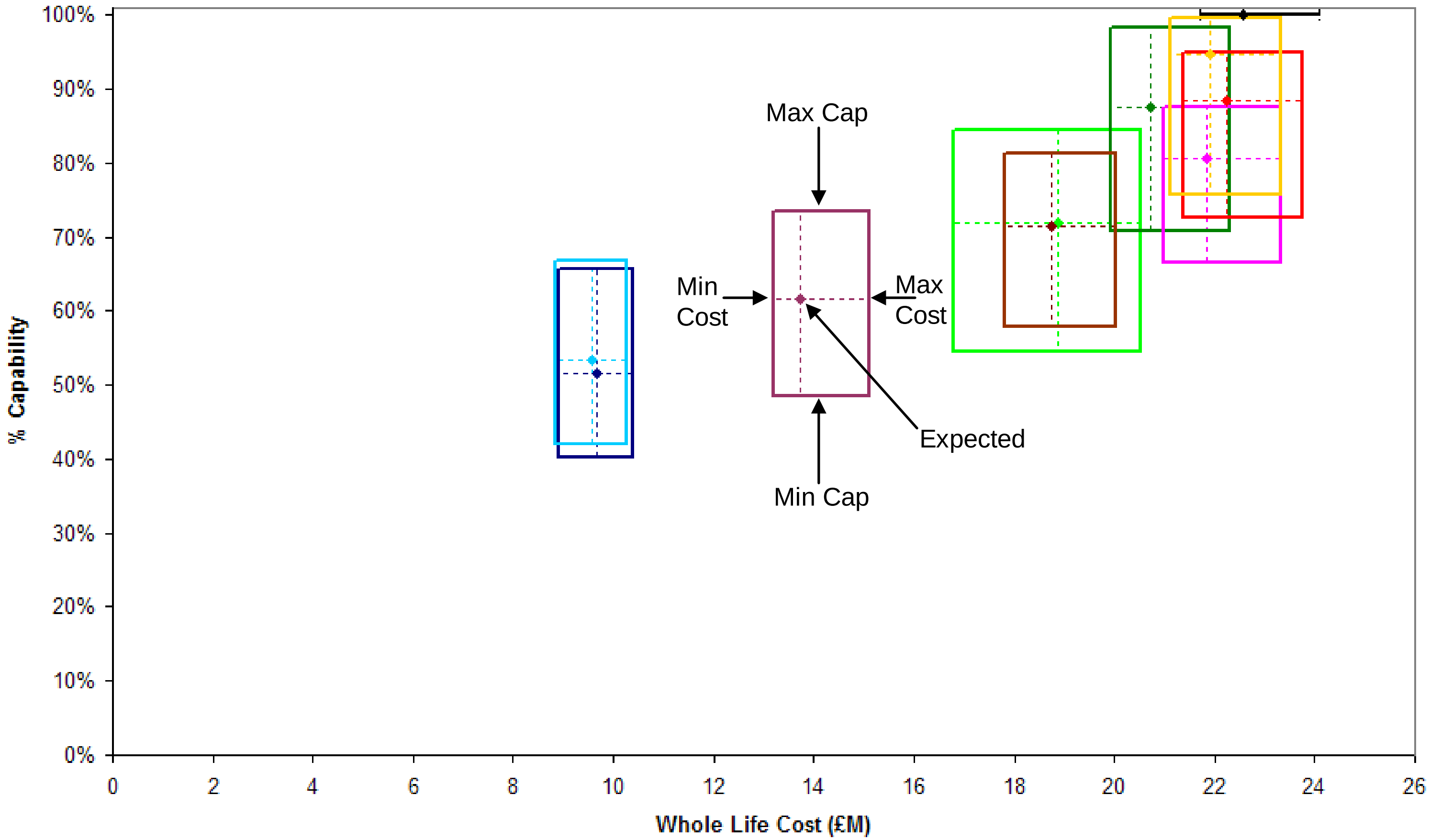
Cost / Performance Trade Off Space



Spiral development has a huge effect across the board. For the purposes of this task, a simplified view has been taken.

A spiral development would potentially mean a larger vehicle being designed from the beginning compared to a traditional development vehicle to ensure there is sufficient space to accommodate future technologies. This would mean a more expensive initial design.

A spiral development enables the capability to remain higher on average.

In service costs are potentially higher due to smaller scale purchase of spares and additional training that may be required on any new systems.

Spiral development may help where it is a new technology and limited budget. A technology demonstrator can be considered the first spiral.

Unless a clear development path is defined from the outset, there is potential for considerable risk and uncertainty.

Spiral capability is already being practised to some extent with Typhoon aircraft.

Spiral development can potentially be a method of maintaining sovereign skills albeit on a small scale over longer periods.

May help with affordability over the longer term.

Does not make sense to have too many spirals on high value items such as engines and airframe.

High degree of re-development can lead to program advancement regressing and potential project failure.

No analysis done but we suspect there is a relationship between TRL and capability.