



Australian Government
Department of Defence
Science and Technology

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Public Release**

What's Keeping Us Safe?

Aircraft Airworthiness & Sustainment Conference

19-21 July 2017

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DST
GROUP

Science and Technology for Safeguarding Australia

Content

- Introduction / Context
- ADF Aviation Fleet Horizons
- Sustainment Environment
- Science & Technology Focus
- Conclusions

Introduction

- **Airworthiness = Safe Aviation :**

- A fundamental requirement for safe operations of aviation fleets to ensure the risk to personnel is managed at an acceptable level.

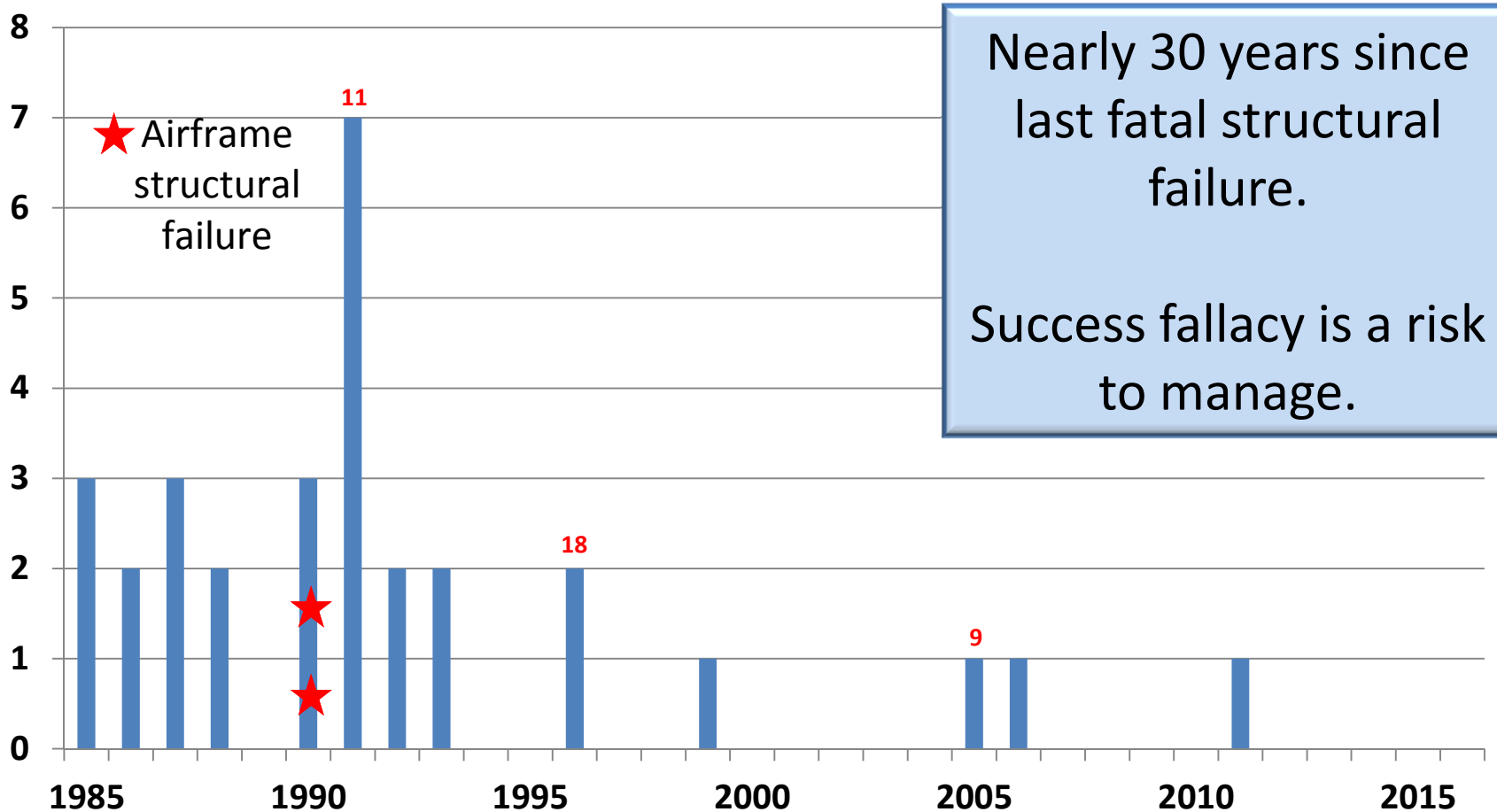
Balance Cost / Capability / Schedule

- An integral part of any fleet acquisition, & actively managed throughout service life.
- ADF: Mission First & Safety Always

ADF = Australian Defence Force



ADF Fatal Accidents (1985 – 2017)



Slide 4

MM1

Nearly 30 year since last fatality due to structural failure.

Success fallacy = new risk to be managed.

McDonald, Marcus, 12/07/2017

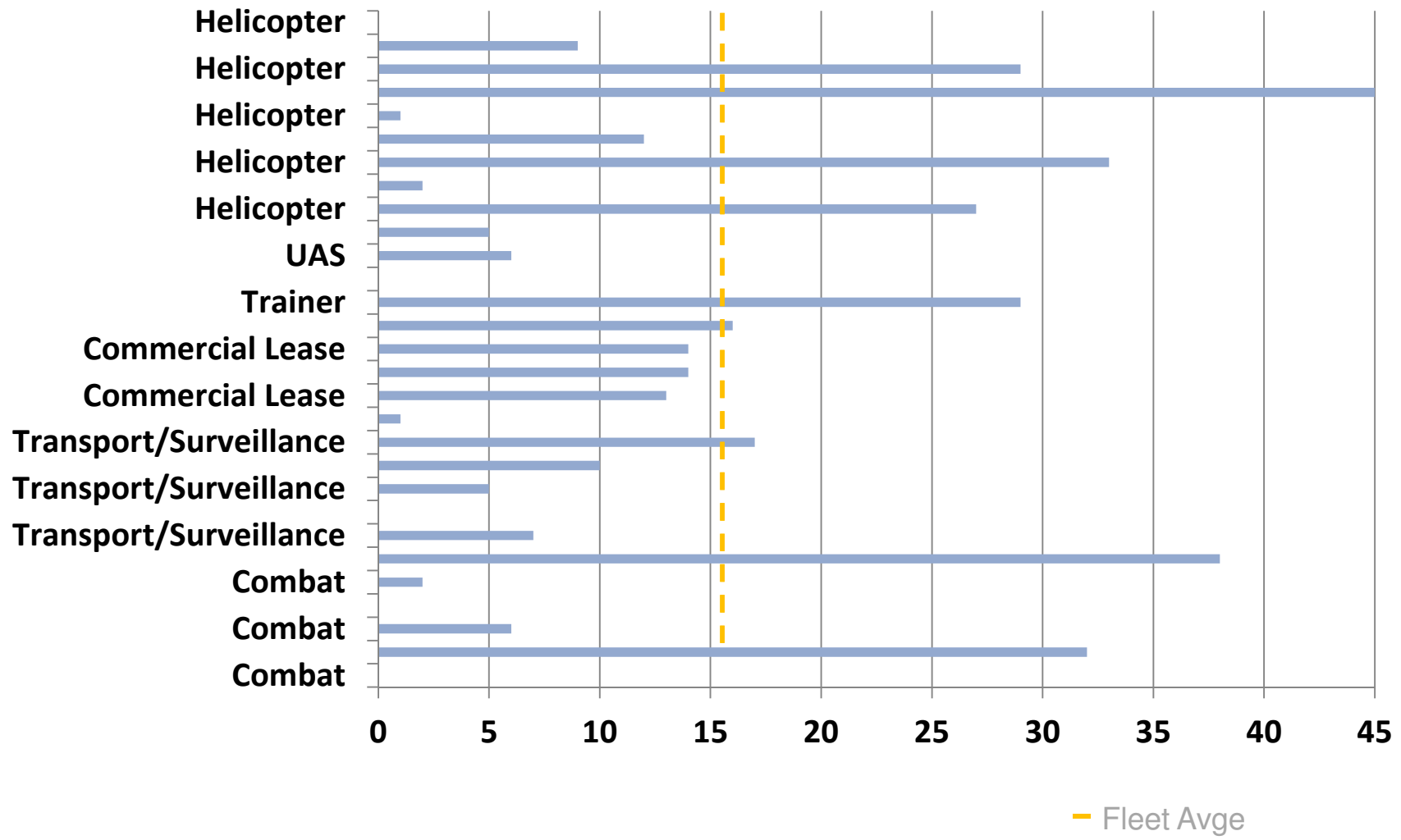
Keeping Us Safe

Philosophy, Policy, People, Processes, Products

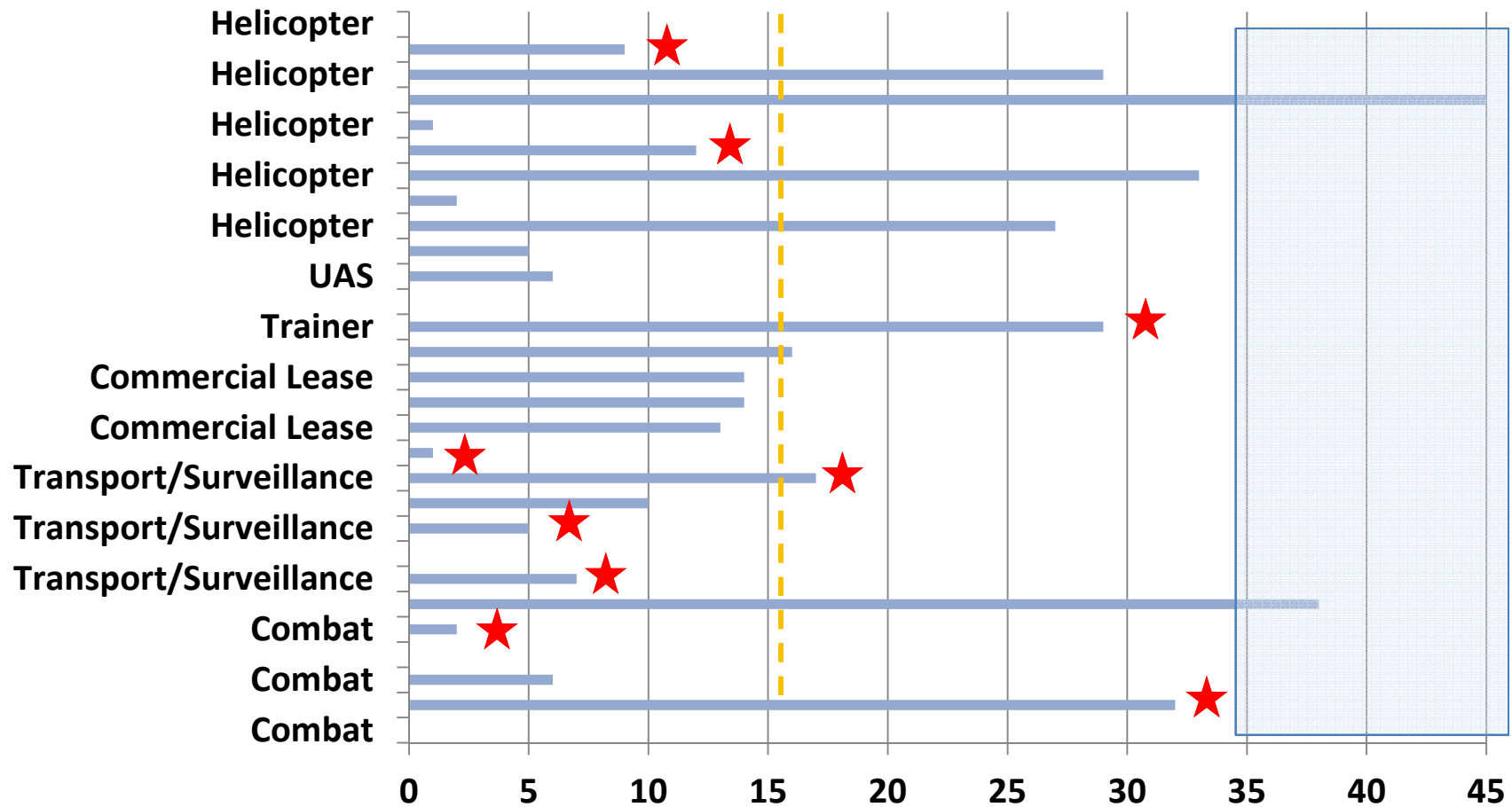
- DDAAFS / DACPA / DG-DASA
- SPO's / Operators / DST / Industry / University
 - Traditional recipe requires regulator workforce
 - Implement European Military Aviation Regulations (EMARs)
 - Trend of delegating/dispersing responsibility
 - Underpinning Expertise & Experience

DAFS = Director Defence Aviation & Air Force Safety
ACPA = Director Airworthiness Coordination & Policy Agency
DASA = Director General - Defence Aviation Safety Authority
SPO = System Program Office

ADF Aviation Fleet Age 2017

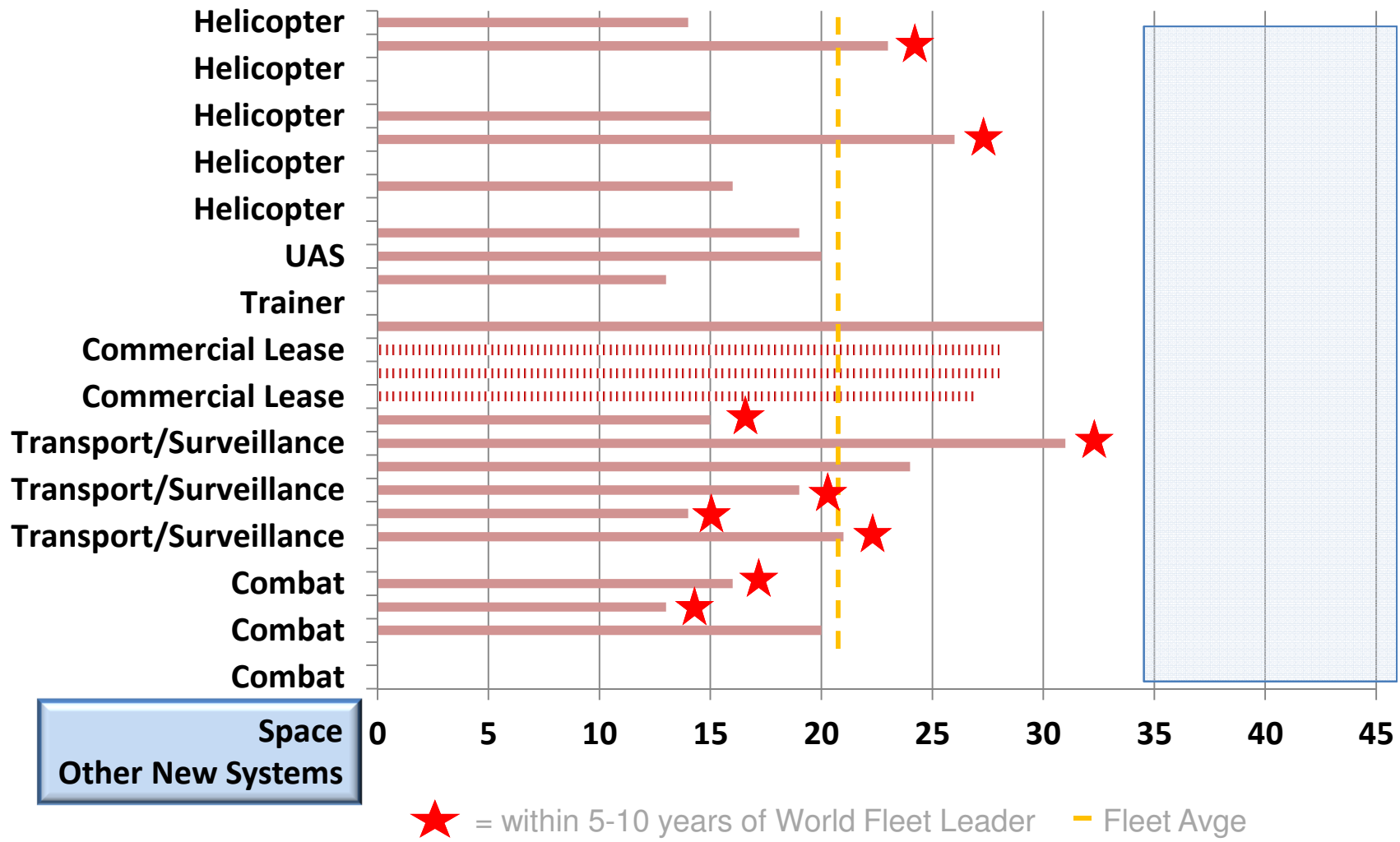


ADF Aviation Fleet Age 2017



★ = within 5-10 years of World Fleet Leader — Fleet Ave


ADF Aviation Fleet Age 2030



(i) ADF Fleet state

- Sustained Fleet Investment
 - Platform vs Systems/Payloads
- Decreasing Fleet Size
 - Improved Capability
 - Better Simulators
- Multi-Role vs Specialist Design
 - Fleet Rationalisation / Specialisation
- Structural Life of Type vs Fleet Viability
 - Aging Aircraft Structural Audits
 - Cost of Ownership
 - Capability Limits

(ii) Fleet Sustainment Environment

- Traditional Support at System Program Offices with industry contractors. 
- Tailored approach using experts:
 - Highly trained ADF personnel
 - Access to full technical details for aircraft
 - Implementation of advanced S&T – “Lead Crack” for Combat designs
 - Def Stan 00-970 Certification benchmark




(ii) Fleet Sustainment Environment

- Traditional Support at System Program Offices with industry contractors.
- Foreign US Military Sales.
 - Alignment with US Capability
 - Rapid Acquisition
 - Improved support via common configuration
 - Unique access to capability
 - Common Role & Environment assumptions
 - Reduced technical data access



(ii) Fleet Sustainment Environment

- Traditional Support at System Program Offices with industry contractors.
- Foreign Military Sales.
- Through Life Support Contracts. 
 - Align ADF and commercial goals for fleet benefits
 - Fleet Usage Data management
 - Individual Aircraft Tracking
 - Commercial System Program Offices



(ii) Fleet Sustainment Environment

- Traditional Support at System Program Offices with industry contractors.
- Foreign Military Sales.
- Through Life Support Contracts.
- European Military Aviation Regulations (EMAR).
 - Integrated Airworthiness & Cost of Ownership
- Rotorcraft Structural Integrity Program (RSIP).
 - Airworthiness for Future Vertical Lift

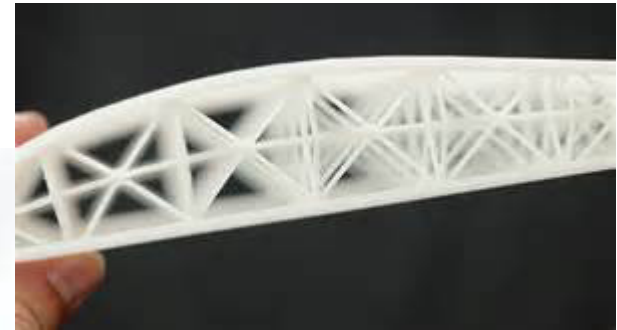
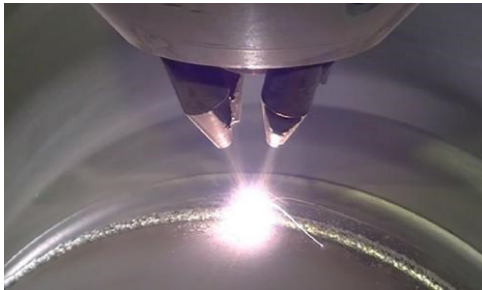
(iii) Technology Landscape

- Aerospace Structural Integrity Research:
 - Legacy Fleets
 - Smarter Maintenance, Repair, Modification via:
 - Usage Data Exploitation & Risk Management
 - » **Digital Thread & Augmented Reality**
 - Better Prediction of Metal and Composite Performance
 - » **Model Validation via Research Test Beds**
 - Non-Destructive Inspection
 - » **New Sensor Suites and Health Prognostics**



(iii) Technology Landscape

- Aerospace Structural Integrity Research:
 - New Materials: Composites & Alloys & Additive Manufacture
 - Building Block Certification and alternatives
 - Validation via repairs, mods, secondary structures
 - New design concepts



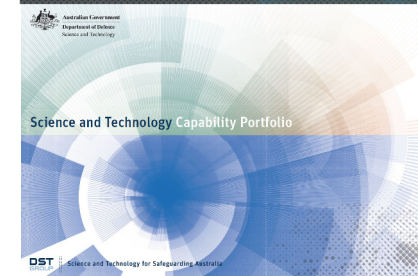
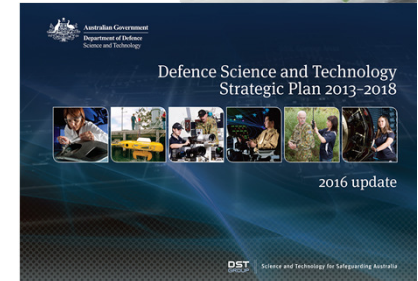
(iii) Technology Landscape

- Aerospace Structural Integrity Research:
 - New Designs – Evolutionary
 - Composites / Fly-by-wire software
 - Optionally manned
 - New Designs – Spacecraft
 - New Designs - Revolutionary
 - Unconventional Layout
 - Unprecedented Performance
 - Hybrid Powerplants

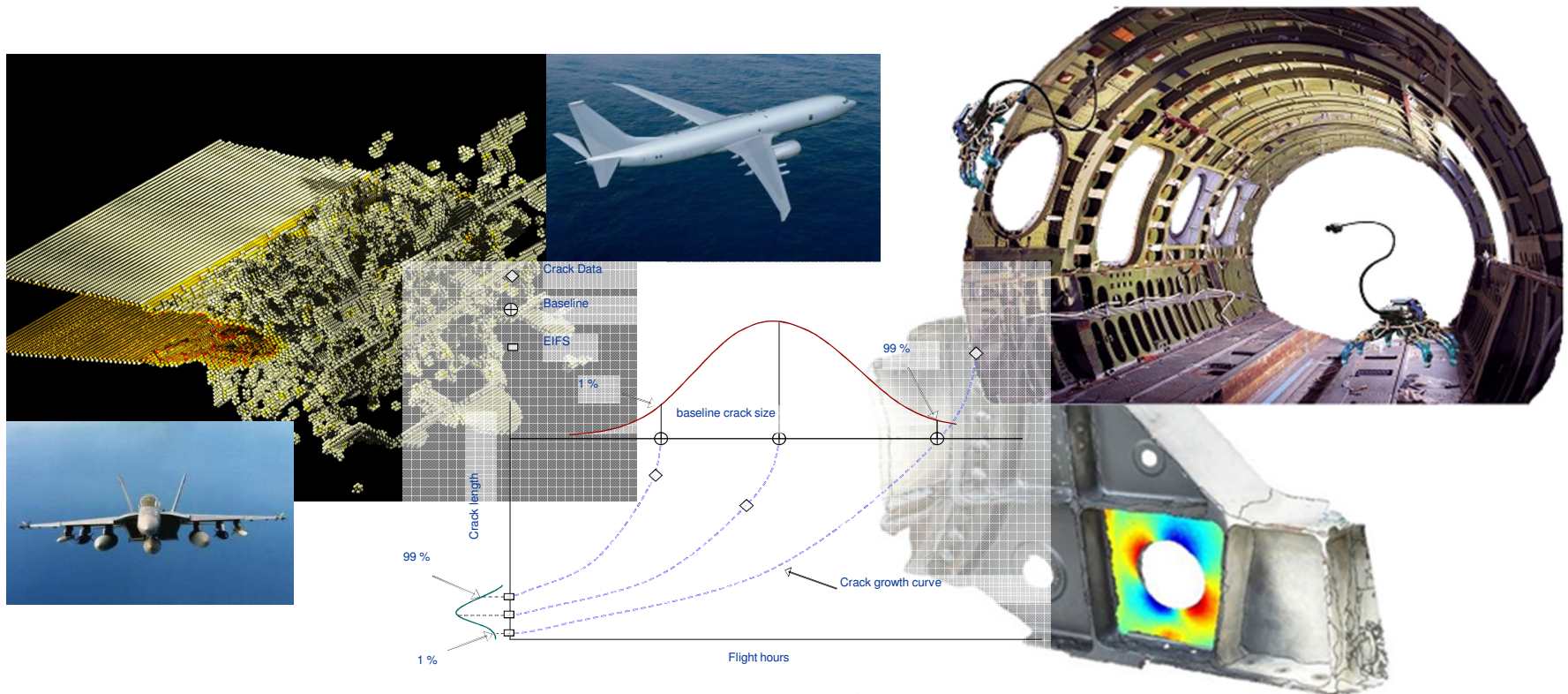


DST Directions:

- 2016 Defence White Paper
 - Innovation in Defence Industry Policy Statement, Next Generation Technology Fund, Defence Innovation Hub
- DST Strategic Plans
 - Aerospace Domain S&T Strategy
- DST Capability Portfolio Document
- DST Investment process:
 - Strategic Research Initiative,
 - S&T Program Reviews & Investment Logic Maps,
 - Major S&T Capability prioritisation



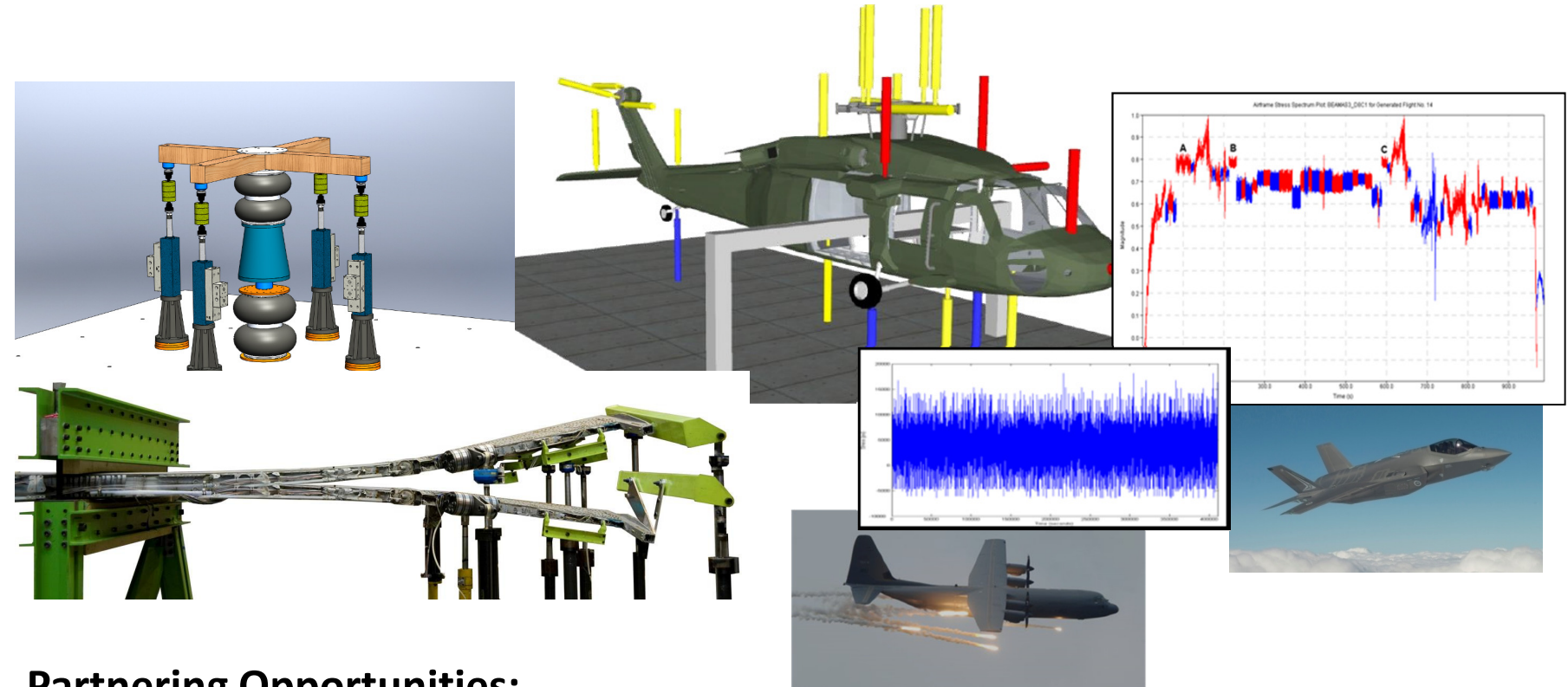
Research - Structural Integrity Prediction



Partnering Opportunities:

- **Development & Validation of Analytic Models** to predict the effects of fatigue cracks and composite delamination from atomic scale through to full-scale aircraft structure.
- **Collaborate on Research, Development and Design** of next generation (autonomous) Thermoelastic Stress Analysis Robots (TSAR) to find & resolve structural problems.

Research Test Beds - Experimental Innovation



Partnering Opportunities:

- **High Speed Testing** – Modelling & Developing of Advanced new Equipment, Instrumentation & Control Systems for faster speeds **x10+**.
- **Load Spectrum Compression/Truncation** – Developing & Validating new analytical methods to replicate the effect **using only 1% of data**.

Keeping Us Safe

Science Focus Areas	Benefits
Rapid agility	Increase ADF capability to rapidly adopt or modify aerospace systems to defeat technology surprise
New concepts	Realise future aerospace capability via new design concepts and materials - while challenging airworthiness paradigms
Capability	Maximise operational capability underpinned by robust airworthiness, optimised sustainment and certainty in platform durability
Freedom of action	ADF retains a technology edge in aerospace through a strong indigenous S&T and Defence Industry network

Keeping Us Safe

- Opportunities
 - Digital connections getting easier via trusted users and secure data storage.
 - High Performance Computing.
 - Continuous Improvement vs Blocks of 15-30 yr.
 - More Australian Start-Ups (eg. commercial space).

**Connections & Capability & Flexibility mean
more **Diverse** flying assets in service **Faster****

Keeping Us Safe

Airworthiness Science Challenges	Current focus	Future focus
Failure modes managed by:	Proving or improving prediction accuracy	Proving or improving prediction accuracy & dealing smartly with prediction uncertainty
Uncertainties managed by:	Converting probabilistics to pragmatic, simple deterministic metrics (e.g. safety factors)	Explicit probabilistics that are easy to relate to and underpinned by trusted sound foundations that capture complexity.
Airworthiness decisional aids driven by context and applications:	Boxed by limited rules	Modelled & coupled
	with affordability and mission capability	

Conclusions

Airworthiness = Safe Aviation :

- **Young ADF fleets**
 - *Mid-life attention & Leading world fleets*
- **Evolving Fleet Capability**
 - *ADF & Defence S&T & University / Industry involvement*
- **Advance Structures Technology**
 - *New Design Concepts & Maintenance, Repair / Modification*
- **More Diverse flying assets in service Faster**
 - *Science & Technology essential*
 - *Start early & lean forward*

Questions

