Developing Sovereign Capability in Composites and Adhesively Bonded Joints

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Introduction

• Advances in materials technology and the increased use of those materials in the design of modern aircraft have resulted in a shift in technologies and skills required to safely operate the current fleet of ADF air vehicles.

• DASA has been reviewing the state of composite technology within the ADF; prompted by high-profile fleet issues.

• DASA has recognised gaps in the sovereign capability in composite and bonded structure sustainment.
  – A composites White Paper will document the current state of knowledge and DASA requirements
  – It will also attempt to understand the apparent inadequate uptake of new technology developments

• This presentation provides an overview of the DASA strategy and QinetiQ’s support to DAVENG DASA in their efforts:
  – In management of airworthiness and sustainment of ADF air vehicles
  – In enhancing sovereign capability in composite materials and bonded structures
Day 1 Relevant Messages

• DG DASA:
  – Innovation needs sustainment (time and money)
  – Technology needs time to mature - we need to tolerate some failures along the way
  – The relationship between problem and solution is not linear
  – Collaboration is key - we must leverage industry and academia (and provide stewardship)
  – It takes people with courage, compassion, passion and who are prepared to be daring
  – When it all comes together, we have seen that we ‘punch above our weight!’

• Mr Babish
  – Leveraging the ‘Lincoln 5’ provides the best opportunity for success when introducing new technologies to ASI Programs
  – When introducing new technologies, consider working up the part criticality rating; rather than down
  – Understand the wisdom within MIL-STD-1530

• CAD
  – Sustainment support by DST Group is here to stay (iSustainment)
  – Partnerships are essential
  – DST Group will focus on the innovative and visionary elements of the problem space
Strategy – Concept

- We are learning from the past and trying to understand why good recommendations seem to go unactioned. Some key take-away messages from this process include:
  - A strategic position on composites is necessary to avoid misdirecting research efforts and/or hindering adoption of new technologies.
  - It must transcend the technology/material systems currently employed
  - It should be platform-agnostic; however, case studies are critical to understanding the context and intent of the strategy
  - It must be holistic. If decentralisation is unavoidable, it must be done thoughtfully and still include some engagement.
  - Driving strategic change must be resourced in order to avoid loss of momentum and interest.
  - The strategy must be based on contemporary literature (technical & regulatory)
    - This will make it defensible
    - This takes research, two-way engagement and participation within steering groups, committees, etc. to understand the best practice.
  - To avoid reviews being purely academic, their outcomes must be integrated into live ASIPs
Strategy – Concept (cont.)

- The risk of maintaining the status quo must be assessed and communicated. Some considerations are:
  - Existence/quantifying a capability gap
  - Dependence on vendors/OEM or aircraft suppliers
  - Management of resources and priorities
  - Corporate knowledge of technology in order to aid decision making
  - Availability issues from ADF context – generally, small fleets with different usage

- DASA White Paper and DST Group Roadmap will be complementary, and together define and communicate ADF requirements and priorities
  - N.B. The DASA White Paper will focus on engineering aspects (vs. S&T)
MIL-STD-1530 and the Strategy

• It is important to review the state of the technology against MIL-STD-1530 tasks to leverage the high maturity of the standard.
  – It should look to identify gaps in the context of composite materials.
  – This will allow for a common framework with US DoD as well as a ‘cradle-to-grave’ approach to ASIP management of composite materials.

• The ADF must improve its corporate knowledge of how the MIL-STD-1530 requirements are being satisfied for composite primary structure.

• Deviations from the MIL-STD-1530 must be understood – i.e. when managing aircraft not certified under that standard (i.e. Navy, Army or European Aircraft).

• The connection between the ASIP and the aircraft’s certification basis be clearly articulated.
  – A survey of current ASIMPs has highlighted that explanation of the certification basis of composite structure is vague at best, with detail buried in OEM reports.

• ASIMPs need to outline airworthiness standards in the absence of OEM-specified standards.

• Opportunities to introduce novel technologies exist and we must understand how to maximise their successful uptake:
  – Engage early (Task I and II of ASIP)
  – Know the ‘Lincoln 5’ key indicators
Strategy Implementation

• Opportunity to focus attention on immediate problems
  – Many problems are not fully understood but may have significant impact on cost of asset ownership, like environmental degradation

• Guidelines on capability development in composite and bonded structures

• QinetiQ as an Industry Partner and Subject Matter Expert assists DASA in:
  – Composite Structure Integrity management
  – Composite and bonded technology capability development.

• Overarching goal is integration of improvements into ASI management
QinetiQ Assistance – Development of Sovereign Capability

- QinetiQ is ready to support DASA in development of composite and bonded technology capability
  - We made a good start but they are only first steps on the way to satisfy requirements
  - This is a challenge but we are keen to continue the support

QinetiQ contribution:

- Capitalizing on QinetiQ’s experience in composite and bonded structures DASA sponsored QinetiQ participation in NAVAIR Composites and Adhesive Bonding Workshops
  - USN/Boeing bonded joint analysis methodologies and analysis tools
  - Composite structure damage evaluation in application to F/A-18 aircraft.
  - The awareness is essential in assessment of in-service damages and engineering dispositions by DASA as the airworthiness authority
  - QinetiQ is sharing the knowledge by running training courses for Defence
QinetiQ Assistance – Case Study

- F/A-18 A/B Outer wing skin disbonds – LOTEX
  - Investigation of supporting data and in-service experiences of other Classic Hornet operators to assist in formulation of the life extension strategies for composite components
- HOWSAT Composite Skins
  - Static testing and fatigue life substantiation to support service life extension until PWD
  - Assessment of reported skin disbonds against USN enveloping stress analysis limits
  - Review of Boeing’s disposition on compliance with the enveloping stress analysis document
- HSTAB L/E closure channel inspection
  - Justification to exclude skin bonded joint in the area of corner mass ballast from NDT inspection
- VSTAB/HSTAB buffet loading impact review
  - Investigation of increased buffet loading on integrity of adhesively bonded Ti splice plate and composite skin joints.
QinetiQ Assistance – Case Study

• F/A-18 A/B IWSLJ disbond investigation
  – Review of all OEM documents related to design and certification of the bonded stepped lap joint
  – Review of USN engineering analysis and disposition of reported disbands prepared for RAAF aircraft
  – Panel discussions with DASA and DST on the service life management
• F/A-18F/G investigation of susceptibility of bonded stepped lap joints to disbond
  – No reported defects in RAAF aircraft
  – Precautionary measure to evaluate against F/A-18A/B disbond instances and to plan a management strategy in case of disbands affecting RAAF F/A-18 F/G aircraft
• Review and assessment of DASA-sponsored undergraduate final project reports
• Request from RMIT to join as an industry partner in a DASA instigated research project
Proposed Industry Partner Involvement

• QinetiQ as an independent industry partner is prepared to assume an extensive role in sustainment of composite structures and sovereign capability development
  – Independent practical perspective on aircraft sustainment issues
  – Awareness of the local defence industry and research providers capabilities
  – Attuned to DAVENG’s requirements
  – Good proven experience in project management
  – Significant experience in composite and bonded structures

• QinetiQ’s experience and involvement in on-going support to DASA provide QinetiQ with sufficient attributes to assume that role
  – SME advice in support of F/A-18 A/B and F/G composite structure certification and in-service issues
  – Deep involvement in LOTEX and HOWSAT tasks
  – ASI embedded staff
  – Collaborative research projects with DST within Strategic Alliance framework
    – Internal investment in R&D
Conclusion

• Early days, and this isn’t beyond us
• Strategic direction is being formulated and will learn from false starts of the past
• Lessons are just as applicable to other technology initiatives (probabilistic, AM, etc.)
• DASA White Paper will Dovetail with DSTG strategic roadmap for Composites Lifing
• DASA’s mandate is engineering/regulatory research
• Collaboration is essential within the ‘ASI Ecosystem’
• Case studies hint at a bright future, more investment and leadership is needed to guide efforts
• Overall objective is more efficient, cost effective sustainment of ADF aircraft composite structures
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