



Mission Planning Systems and Aeronautical Data

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SQNLDR Patrick Redmond
OIC SCI1
DGTA-ADF





Overview

- Background:
 - What is a Mission Planning System?
 - What is Aeronautical Data?
 - Recent Regulatory Progress
- Mission Planning Systems
 - Overview of Certification Requirements
 - Summary of a Recent Significant Issue
- Aeronautical Data
 - Progress Towards Accreditation
 - Accreditation Issues





Background

- The airworthiness of modern ADF aircraft depends heavily on accurate mission planning and aeronautical databases.
 - Simple comparison: CFIT warnings.
 - F-111: Ground Collision Avoidance System based on radar altimeter.
 - Super Hornet: Terrain Awareness and Warning System based on navigation system and digital terrain database.
- Two emerging airworthiness issues:
 - certification of Mission Planning Systems (MPS)
 - accreditation of aeronautical data suppliers





Mission Planning Systems

- A suite of software applications and associated hardware that allow maps, charts, weather, intelligence and aircraft performance data to be used in developing navigation solutions, communication settings, flight/mission calculations, etc.
- **Examples:**
 - Portable Flight Planning System
 - Joint Mission Planning System
 - Ground Mission Management System
- **Functions performed (generally):**
 - Aircrew enter flight details (waypoints, aircraft loading, etc).
 - MPS performs calculations to validate mission plan.
 - e.g. Is weight and balance within limits?
 - MPS produces data to be loaded to the aircraft.
 - e.g. sequence of waypoints, TOLD, digital maps





Common MPS Hazards

- Erroneous Weight and Balance Calculations
- Erroneous Take Off and Landing Data Calculations
- Erroneous Fuel Usage Calculations
- Incorrect Translation of Waypoint Map Coordinates
- Erroneous Data Packages for Guided Weapons
- Introduction of Errors into Aeronautical Data
 - Transfer, Formatting or Translation
 - Digital Maps
 - Navigation Databases
 - Airfield Databases
 - Digital Terrain Elevation Data





Aeronautical Data

- Data that contributes to aircraft functions.
 - May be loaded to the aircraft, or may be used by the MPS.
 - May also be paper products (not considered further by this brief).
- Relevant functions:
 - Required Navigation Performance
 - Departure/Approach Procedures (e.g. GNSS NPA)
 - TAWS
- Types of databases:
 - Navigation
 - Airfield
 - Terrain
- Example Products:
 - Australian Digital Aeronautical Flight Information File (AusDAFIF)
 - Digital Terrain Elevation Data (DTED)





Recent Regulatory Progress

- MILAVREG 6 *Aviation Support Systems* is being rewritten.
- Mission Planning Systems
 - Published AAP 7001.054 Section 2 Chapter 24 'Mission Planning Systems'
 - Describes requirements and process for certification of Mission Planning Systems
- Aeronautical Data
 - No formal progress
 - Concept of future regulatory state is maturing
 - AIS-AF (produce AusDAFIF) progressing towards accreditation
 - or at least what we anticipate accreditation will look like





Certification of Mission Planning Systems





High-Level Changes: MILAVREG 6

- MILAVREG 6 Aviation Support Systems (ASS)
 - Currently requires issue of Installation Operating Permits for ASS
 - Questionable whether MPS are ASS or not
 - ACPA-ADF conducted a survey to determine whether MILAVREG 6 should cover MPS (among others).
 - Probable Outcome (results in, but not confirmed):
 - MPS may be ASS BUT as most are aircraft specific, won't be regulated under MILAVREG 6.
 - Continue to manage aircraft specific MPS as part of aircraft design (i.e. use the Design Acceptance and Service Release processes).
 - Not yet sure how joint MPS will be managed.
 - Issue: MPS may be the same, but criticality might be different.





MPS Certification Requirements

- Key Issue: Assure the correctness of MPS outputs through either:
 - establishing the integrity of MPS functions
 - implementing error detection mechanisms
- In practice, this means:
 - MPS must satisfy DO-178B at a level commensurate with the severity of failure conditions, or
 - MPS must include error detection mechanisms.
 - Mechanism must be able to catch the errors.
 - Mechanism must be assured to an appropriate level.
 - If both above points are true, underlying functionality need not be assured.





Treatment Options

Function	Data Assurance Level	Detection and Handling	OR	Absence
Transfer	Critical	Digital Error Detection	OR	Level A or B
	Essential	Feedback / Read Back Verify	OR	Level C or D
	Routine	No requirements.		
Format	Critical	Feedback / Reversibility Check	OR	Level A or B
	Essential	Independent Redundancy	OR	Level C or D
	Routine	No requirements.		
Manipulate/ Generate	Critical	Feedback / Reversibility Check	OR	Level A or B
	Essential	Independent Redundancy	OR	Level C or D
		AND Logical Consistency Checks OR Semantic Consistency Checks		
	Routine	No requirements.		





What does DGTA expect to see?

- A List of Functions
 - What is the MPS used for?
- Assignment of Severity
 - How critical is the data?
- Allocation of Treatment
 - Assurance of absence
 - Detection and Handling
- Evidence of Implementation
 - Standard software assurance artefacts





A good format...

Data Element	Criticality	MPS Components and Functions		Treatment
		Component	Function	
A	Critical	X	Transfer	CRC Check assured to Level A
		Y	Format	Reversibility Check
		Z	Manipulation	Assured to Level B and Semantic Consistency
B	Essential	P	Transfer	None = Risk
		Q	Manipulation	Independent Redundancy with Component R and Logical Consistency
etc...				





Recent MPS Issues

- In applying the analysis methodology described by .054 S2C24, 'Catastrophic' MPS failure modes have been discovered.
- Key Hazard: calculation of Maximum Take Off Weight
 - Aircraft performance, environmental conditions, vertical obstacles, etc are used to calculate the MTOW.
 - Possible that MPS may calculate an MTOW that is both:
 - within a believable range (i.e. aircrew will not immediately detect that it is erroneous), and
 - high enough that an aircraft taking off at that weight will be physically unable to avoid airfield obstacles (i.e. no aircrew action could prevent impact).
- Analysis of the chain of events concluded that an MPS failure is the only failure required for an aircraft loss to occur.
- Therefore:
 - Failure conditions of the MPS are Catastrophic.
 - MPS must be assured to DO-178B Level A.
 - But, would still be a single point of failure.





Recent MPS Issues (cont'd)

- Fact: No MPS is assured to Level A.
 - Most are roughly Level D.
- How to resolve?
 - We don't yet know.
 - Qantas and Virgin face the same issue and use MPS that are probably assured no higher than Level D.
 - But, there is some concern within the civil aviation community that this is not sufficient.
 - The hazard exists whether an MPS is used or not.
 - Would manual calculations be a better treatment?





Accreditation of Aeronautical Data Providers

Based on 'anticipated' future
regulations





Current State of Play

- Accreditation of aeronautical data providers is the responsibility of the OAA.
 - MILAVREG 6.10 sets out the requirements.
- This approach was designed for more traditional aeronautical data production.
 - e.g. charts, situational awareness info
- Modern aircraft use aeronautical data differently
 - e.g. as an input to RNP, within a TAWS, etc
- Change in scope of use drives increased requirements for assurance of aeronautical data
 - Note especially that RNP certification has implications for civil aircraft (shared airspace). The ADF has an obligation to meet the required performance standards to enter that airspace. Retained risks for RNP are not just an issue for ADF personnel.





High-Level Changes: MILAVREG 6

- DGTA-ADF expects that MILAVREG 6 will be rewritten to provide a more robust framework for accreditation of aeronautical data providers.
 - OAA accreditation based on recommendation from OAARs and TAA.
 - Aligned with FAA/CASA framework.
 - Use RTCA DO-200A/DO-201A.
- MILAVREG 6 is currently being rewritten, but future state is uncertain.





Progress Towards Accreditation

- AIS-AF production of AusDAFIF is the first aeronautical data product to be considered for accreditation.
 - Issue was triggered by C-17 use of this product.
- SCI-DGTA conducted an audit of AIS-AF in 2009
 - Found a number of issues that would prevent accreditation for production of safety related aeronautical data.
- AIS-AF are working towards resolution of these issues.
- DIGO are aware of accreditation issues, but no progress to date.





Accreditation Issues

- Resources/Money
 - Accreditation isn't free, AIS-AF aren't funded or resourced to provide high integrity data.
- Responsibility
 - Central provision of data affects a number of airframes, no clear responsibility for resolution.
- Regulation
 - Bottom up approach to accreditation: being driven by users, providers.
 - A top down regulation approach is also required.
- Operational
 - No clear picture of what the operators require, no strong operational organisation to take carriage of the issue from an operational perspective.





Accreditation Issues (cont'd)

- Specification of Data Quality Requirements
 - No clear definition of what data quality attributes are required.
 - Linked to lack of defined user requirements.
 - Without this, how can the suitability of data be assessed?
- Incoming Data Quality
 - ADF data providers have limited control over incoming data.
 - Can't meet the user need if incoming data doesn't meet the user need.
 - Result: Data quality across the database is not consistent.
 - How can the operators know which data is accurate and which isn't?
- Tool Qualification
 - Biggest financial issue.
 - Tools that can introduce errors must be assured to Level A if full functionality is required (Level C for most functionality).
 - Current tools aren't assured, future tools have issues as well.
- Organisation, People, Processes and Data
 - Various other issues related to procedural controls (e.g. independent review, competency definitions, etc).





Interim Treatments

- Most new aircraft raise an aeronautical data issue paper.
 - Consider DTED and AusDAFIF concerns
 - No need to raise an Issue Paper if data is sourced from an appropriate, civil data supplier (e.g. Wedgetail and MRTT navigation databases)
 - Each aircraft type uses the data differently, so each will have different hazards and different risks
- Propose treatment options:
 - e.g. Use DAFIF (Level 2 data) or AusDAFIF (not accredited)
 - Trade off between known errors and unknown errors
 - Most simply agree to retain risk while accreditation is progressed
 - Accreditation has been “progressing” since 2007, probably a number of years before resolved





Summary

- Modern aircraft use of MPS and aeronautical data presents hazards that weren't seen in older aircraft.
 - MPS and aeronautical data can have direct and serious effects on airworthiness.
- Need to be confident in the correctness aeronautical data and the outputs of MPS.
 - Required degree of confidence varies with criticality
 - Basically requires:
 - Integrity of MPS to be assured.
 - Aeronautical data providers to be accredited.
- Guidance on the certification of MPS has been issued (AAP 7001.054 Sect 2 Chap 24)
- Regulations for accreditation of aeronautical data providers are in development.
 - For now, we are working towards what we expect the regulations to be.





Questions

