UAS Challenge 2017
Best Practice Guidelines
DESIGN AND OPERATING CONSIDERATIONS

Contained in this guide are some key themes to consider in your planning. It aims to give you pointers to approach the conversion of your design into a viable air vehicle, but without telling you what to do, that is up to you.

Factors to consider are given in more detail below, including:

• Fundamentals – eg Airworthiness and Structural Integrity
• Systems Integration – including avionics and power supplies
• Engineering Management – practical elements, such as maintainability, configuration control and workshop practices
• Operational Support – roles and responsibilities, checks and operating processes

Top tips for fitting flight controls are given in a separate guide
CONTENTS

• **Purpose:**
  - Engineering Best Practice
  - Best Build Practice
  - How does this look in industry
  - Design Considerations
  - Scrutineering Guide

• **Fundamentals:**
  - Structural Integrity
  - Airworthiness
    • Weight and Balance
    • Ergonomics
    • Aerodynamics

• **Other Considerations:**
  - Engineering Management
  - Operational Support processes
PURPOSE
IT'S TIME TO THINK ABOUT...
Best Engineering and Building Practices
The challenge is not just in completing the mission...

It's also about demonstrating that you, as a team, have put careful thought throughout your design process and executed it to a high standard.

This presentation is designed to help you think about your design process you've been following and how you bring this together into your finished Unmanned Air System.

This won't tell you everything that needs to be considered but will get you thinking about your engineering and build quality.

‘As an engineer I'm constantly spotting problems and plotting how to solve them.’
James Dyson
BEST ENGINEERING PRACTICES

What does it mean?

Through solving the engineering problems that present themselves in the process of meeting the specification, there are going to be some great ideas.

One of the keys to best engineering practices, and something you will be judged on, is a well thought-through execution of this idea into a design.
GOOD BUILDING PRACTICES

What are we looking for?

Based on a well-developed design, the next step is to identify the limitations in the manufacturing process and what is achievable. Throughout the design process you will have made assumptions about your design which have to be monitored to ensure that they remain achievable.

A well thought-through design, having followed a thorough design process, can be let down by either unachievable manufacturing processes and/or poor build quality.
These principles are followed through in industry development cycles. If we look at a simple form of the CADMID cycle, we can see how these principles apply in industry.

**Cadmid**

**Concept**
**Assessment**
**Development**
**Manufacture**
**In-service**
**Disposal**
SCRUTINNERING
What do you have to produce?

For the UAS challenge you had to produce an Unmanned Air System against the Specification to deliver two 1kg aid packages and complete a mission.

How are we going to assess this?
The scrutineering staff are going to complete:

• A Safety and Specification Compliance Inspection:
  - To check requirements in the rules are met

• An Airworthiness Inspection:
  - To check for structural integrity and systems integration

• Manufacturing Assessment:
  - To mark for the Award of the Manufacturing Prize

A good performance in these inspections and assessments can be helped with good engineering and building practices.
MANUFACTURING AWARD

How is it scored?

On the day, the scrutineers are going to score you on three key areas:

• design quality (including A1 Manufacturing Poster)
• finished product
• workshop practice

The score will be out of 50

- Design Quality
- Finished Product
- Workshop Practices
FUNDAMENTALS

A Foundation to be built on…

When consider the basics for your design there are fundamentals that you must consider:

• Structural Integrity

• Airworthiness:
  - Weight and Balance
  - Ergonomics
  - Aerodynamics

• Engineering Management

• Operational Support Processes
STRUCTURAL INTEGRITY

Have you considered?

Depending on choices in design, you would have to consider not only the properties of the materials being used, but the integrity of the whole system.

You are going to consider such things as:

What is the material's strength and how will it function in structures?

How is the structure going to be loaded during the stages of the flight?

What if something unexpected happens?

There is more to this, what about the connections between such things as:

Wings to fuselage or motors to airframe?

Payload mechanism to fuselage?

For detailed considerations, see the next slide.
STRUCTURAL INTEGRITY CONSIDERATIONS

• Materials/structures:
  – Strength
  – Torsional stiffness
  – Density

• Payload mechanism:
  – Engagement/Actuation
  – Stowage
  – Dispatch path

• Sub-system fitment:
  – Bolted/bonded/Velcro
  – Batteries

• Load paths:
  – Lift
  – Payload
  – Robustness:
    • Heavy landing
    • Crashworthiness
  – Fixtures/Fasteners

• Interfaces:
  – Wings to Fuselage
  – Undercarriage to fuselage
  – Tail surfaces
  – Propulsion device to airframe
AIRWORTHINESS – DESIGN CONSIDERATIONS

• **Weight and Balance:**
  – Position of CoG – lateral/F&A
  – Stability/Instability
  – Change after payload dispatch

• **Ergonomics:**
  – Relative position of systems and controls
  – Clearance/interference
  – Accessibility

• **Aerodynamics:**
  – Airflow – buffeting, flutter
  – Aesthetics?
  – Finish standards
ENGINEERING MANAGEMENT

• Maintainability is important to enable:
  – Commonality/Standardisation
  – Accessibility: use of panels and fasteners
  – Inspections: Checklists (see FRCs below)

• Modifications: How do you go about changing things?
  – What is your Approvals process:
    • Do you need Validation and Verification?
    • What Testing/Trials must you conduct?
  – Authorisation: What paperwork do you use?

• How do you ensure Configuration Control of your UAS?
  – Roles/Responsibilities – how do you approve changes?
  – Documentation – you need an audit trail to ensure standards
ENGINEERING MANAGEMENT

• What means have you for Transportation?
  – Protection in transit
  – Carriage (fold/stow/remove)
  – Support (work-surface?)

• How do you ensure sound Workshop Practices?
  – Control and Supervision are pre-requisites in aviation
  – Layout and organisation are essential:
    • Engineering hygiene
    • Housekeeping
    • Workbench and flooring
    • Tools and test equipment
    • Spares
OPERATIONAL SUPPORT PROCESSES

Flight Reference Cards (FRCs)

• Consider developing Checklists to ensure Consistency:
  – Start-up
  – Pre-flight/Turn-around
  – Post-flight
  – Maintenance

• Have you developed Processes for:
  – Refuel/defuel?
  – Battery charging?
  – Communications?
  – Flight Controls?
  – Payload dispatch?
ROLES AND RESPONSIBILITIES

• Have you made key appointments?
  – Team lead(s)
  – Pilot (BMFA licenced)
  – Test Engineer?
  – Comms Engineer?
  – Flightline Engineer?
  – Workshop supervisor?
  – Launch/recovery team?

These will be useful leads in the Flight Readiness Review, Scrutineering on the Flightline
The rest is up to you!
See you in the Scrutineering tent.

Good luck ....