Title : Wire Health-Monitoring System

Objectives

The number and complexity of electrical devices will increase in future aircraft and more composite materials will be used for structural parts. As a result, the number of electrical links will increase.
Moreover, in future composite aircraft, all functionalities that used to be achieved with metallic structure will be integrated at system level, in that case at electrical harness level.
Thus, the electrical links between equipments will have to be more safe and reliable, and because of the severe installation conditions, their functional status will have to be available in real time or during maintenance operations. The wiring health status would provide Airliner maintenance Centres or military operators a valuable maintenance indicator and it would facilitate the onboard systems reconfiguration to increase safety and efficiency of these new aircrafts.
The wiring health status can be determined with electrical tests such as continuity, isolation, and Dielectric Withstand Voltage (DWV), and even with more advanced tests such as Time Domain Reflectometry (TDR), Standing Wave Ratio (SWR) and Ultrasounds, already used on spacecraft. Those tests could be performed on each wire or on each branch of the harness, in real time or not.

- In case of real-time monitoring, the diagnosis algorithms will be generated by equipments linked to each other, based on calibrated links.
- In case of on-ground monitoring, the diagnosis could be done by ground equipments, plugged if necessary.

The objective of this project is to study wires and shields electrical behaviours in order to establish failures categories and to define equipment algorithms and protocols.

Major Deliverables

Health monitoring test bench, prototypes of harnesses (shielded or not), reports including feasibility and cost / benefit analysis.

Description

The following tasks will be performed:

- Project Management,
- Theoretical studies on material properties, in different configurations,
- Realisation of over-shield and harness prototypes, in flight configuration,
- Research on Diagnosis algorithms,
- Realisation of the test bench,
- Development of a Diagnosis algorithms in aircraft environment and constraints (EMC, EMI),
- Development of a test protocol,
- Tests realisation.

Potential Partners

Project overall Size

Project duration

3 years

CREATe

Crew Reduction for safe and Efficient Air Transport -CREATe

1.0 Objective.

To extend single crew operation to a range of current and new aircraft (greater than 12500lbs) by the identification and evaluation of enhancements to procedures, critical systems and regulations, aimed at reducing crew workload and ensuring survivability in the event of crew incapacitation.

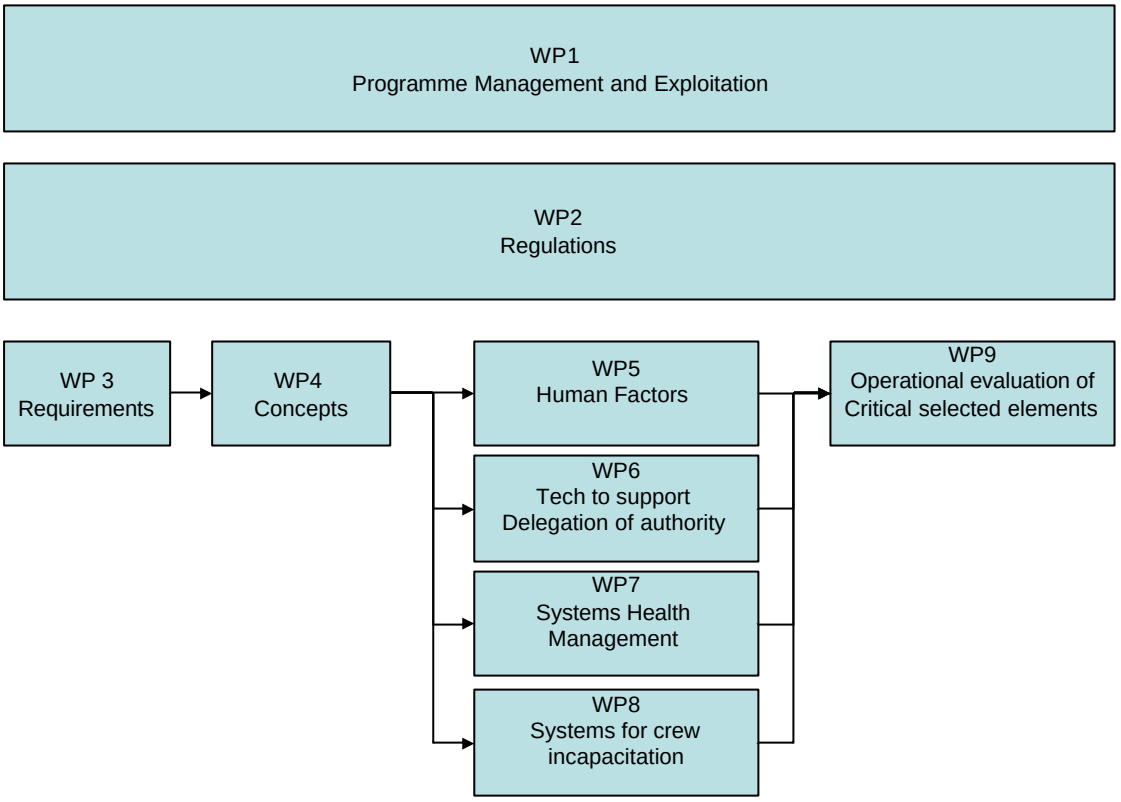
2.0 Scope of Work.

There is a constant drive by airlines towards more efficient and economic operations. A major saving to airlines would be to reduce the number of crew required to fly aircraft over 12500 Ibs which are subject to JAR-OPS and FAR-121. The challenge for the European aerospace companies is to provide systems that will achieve single crew operations whilst maintaining safety. This challenge is made more difficult by the rise in aircraft traffic which is expected to triple over the next 20 years. There is evidence that technology is maturing to the point where there is sufficient confidence that single crew operations can be realised for large aircraft. The new generation of very light jet (VLJ) aircraft now match large jet performance but are being certified for single crew operation. The systems on these aircraft are complex and comparative to larger aircraft. Part of the work proposed in this programme will seek to capture the approach adopted on VLJ.

The work proposed to meet the single crew operational objective will consider a wide range of influences including:

- Current FAA/JAA certification guidance on the subject.
- Workload and human factors and their implication on safety
- System support for the delegation of authority
- Systems Health management
- The management of crew incapacitation

The proposed work will be organised according to the WBS shown below.



WP 1 Project management

Description of project management and exploitation.

There will be a three community workshops to review:

- output of the first draft of WP 4 Concepts. – high level requirements and concepts
- the proposed solutions from WPs 5, 6, 7 and 8
- programme results

WP 2 Regulations

In determining what work needs to be done to achieve single crew operation the first step is understand the current regulations. The two main bodies responsible for aircraft regulation are the Federal Aviation Authority (FAA) based in America and the European Aviation Safety Agency (EASA) based in Europe. The regulations cover both aircraft design requirements and airline operating requirements. The design requirements for large aircraft are covered by CS part 25 and FAR part 25 (for EASA and the FAA respectively). The operating requirements for European airlines are covered by JAR-OPS and JAR 25.1523 is used by the authorities to determine the minimum number of flight crew.
As a minimum the requirements for each the following operational areas need to be addressed: Flight path control, collision avoidance, navigation, communications, operations and monitoring of aircraft engines and systems, command decisions.

Regulations will be reviewed and where possible discussions held with EASA and FAA to fully understand the current requirement, establish possible routes to reduced crew certification and to identify the possible extent (and limitations) of reduced crew concepts of operation.

This work package will assess the need for, and possible scope of, new regulations, conduct a preliminary hazard analysis and develop a certification plan.

WP 3 Requirements

Requirements will be developed for the reduction of crew on aircraft categorised as large aircraft (above 12500 Ibs) which are used on:

- Short / medium haul routes usually consisting of 1 first officer and captain
- Long haul routes consisting of 4 flight deck crew, usually consisting of 2 first officers and 2 captains

New build and upgrade requirements for freight and passenger aircraft will be considered. Discussions will be held with the many stakeholders involved in determining the requirements. These will include flight crew, ground crew, FAA, CAA, EASA, aircraft manufactures and suppliers and airport services. In addition there will be reviews of industry surveys and accident statistics. The deliverable will be a requirements document(s) addressing the main operational areas

WP 4 Concepts

A number of concepts will be developed to meet the requirements set out in WP3.

Scenarios will be generated for each phase of flight including nominal conditions i.e. pre flight, taxi, take-off, cruise including ATC and airline operational control (AOC) communications and landing. From these scenarios high level solutions will be derived taking into account such topics as reduced workload, crew monitoring, crew redundancy and traffic detect and avoid.

WP 5 Human Factors and vehicle management enhancements

This work package will consider crew workload, including situational awareness and emergency handling, collision avoidance and flight deck implications.

The primary impact of reducing crew is a resulting increase in workload. As workload increases, the risk of crew error increases dramatically.

Workload factors to be considered include the following:

- The accessibility, ease and simplicity of all necessary flight, power and equipment controls
- The visual accessibility of all necessary instruments including failure warning devices
- The complexity of emergency and other operating procedures and the extent of required system monitoring
- The flight crew compartment operating environment
- The degree of mental effort required in diagnosing malfunctions and the extent to which this is minimised by redundancies
- The actions requiring a crew member to be unavailable at his assigned duty station (emergencies)
- The communications workload
- The Navigation workload

- Increased workloads associated with emergencies that may lead to other emergencies

The flight deck will have to be modified for single crew operation. Cockpits are designed around two crew members, for a single crew member there is a need to be able to read and reach all necessary indications and controls. In addition there will be implications for the flight deck of including system aids such as HUD, low cost sticks, flyby wire flight controls, HAPTICS and integrated navigation surveillance and communications.

WP 6 Technology to support delegation of authority

Emergency and abnormal situations occur on flights everyday around the world. They range from minor situations readily managed to extremely serious and highly time critical situations that deeply challenge the skills of even the most effective crews. How well crews respond to these situations is a function of the following factors

(1) The design of non-normal procedures and checklists,
(2) Design of aircraft systems and automation,
(3) Specific aspects of the non normal situation, such as time criticality and complexity of the situation,
(4) Human performance capabilities and cognitive limitations under high workload and stress,
(5) Design of training for non normal situations,

The work in this work package will look at the ability of systems to support and enhance single crew operation in high stress situations.

Initially there will be a review of existing Autonomous Systems technologies, to asses s their

- suitability for application to manned systems
- potential for relieving crew workload in high stress situations such as:
    - imminent mid-air collisions
    - emergencies
        - aid in carrying out immediate actions
        - aid in carrying out subsequent actions
        - air in recovering aircraft to safe flight
        - Responding to ATC on behalf of pilot in command
        - Passenger briefings
    - Decision support for re-routing/diverting and replanning
    - Crew Hijack
    - Passenger Disruption

Following on from the review System Design Requirements will be established.

A Systems Design will then be generated, implemented and tested

The System Design Implementation will then be evaluated in a synthetic environment

Following the evaluation system functionality, Safety and Performance Requirements will be generated.

WP 7 Systems Health Management

The main aim of this work package is to develop a health management system architecture that will aid single crew operation by monitoring the integrity of the systems and then clearly presenting their status and necessary emergency actions. The intention would be to generate an architecture that would effectively create a virtual 'flight engineer'. Consideration will also be given to the practicality of down linking status information to a ground Airline Operation control centre for problem resolution

WP 8 Crew incapacitation

The risk of Incapacitation of a single crew member requires aircraft systems to be modified or extended in a way that ensures continued safe flight and landing of the aircraft.

A more detailed Concept of Operation, than undertaken in WP4, will cover:

- identification of scenarios and required functionality
- the requirement for associated ground support facilities and functions
- initiating mechanisms - identification of incapacitation
- immediate required emergency response initiation
- automatic recovery to:
    - safe area
    - S&L flight at minimum safe altitude
    - nearest suitable airfield
- handling of subsequent emergency actions
- handling of, and responding to:
    - ATC authorities
    - Emergency response centre
    - Surrogate ground based captain

Following on from this consideration will be given to the implementation of the required functionality either as an additional high integrity unit or as an embedded function in existing standard systems for at least one of the scenarios.

This functionality will then be evaluated in a synthetic environment.

Following the evaluation system functionality, Safety and Performance Requirements will be generated.

The main deliverable of this package is the development of an approach to dealing with crew Incapacitation that has the potential to meet current safety requirements

WP 9 Operational Evaluation of critical selected elements

The programme will culminate in an evaluation of the key concept elements developed in the previous work packages. In order to provide an assessment of the viability of the single crew concept and recommendations for critical areas of future work. A very preliminary benefits assessment will also be conducted.

Title : Aerodynamic Load and Flow control Equipment (ALFiE)

Objectives

The reduction of aircraft weight and drag to meet ever more stringent environmental regulations will depend on the availability of affordable, integrated and certifiable distributed actuation equipment to manage efficiently the airflow drag and the loads imparted onto the airframe. The forthcoming Clean Sky JTI will demonstrate the potential of such concepts using available technology at TRL 5 to 6. The objective of ALFiE is to develop the next generation distributed sensors and actuators at TRL 3-4 ready for exploitation in the final JTI demonstrations

Major Deliverables

Prototype actuator modules that demonstrate networked MEMS sensors and actuators integrated into an assembly suitable for incorporation into an advanced configuration aircraft.

Reports will detail the achieved performance (aerodynamic, electrical, mass, thermal…) and provide test results to steer the choice of solution for the emerging JTI concepts.

Description

The following tasks will be performed:

- Project Management,
- Requirements analysis to determine the needs and constraints of a distributed actuator assembly
- Assessment of potential technology solutions to meet requirements (covering aspects such as MEMS sensors, MEMS effectors, wireless networking, integration with airframe, integration with flight control)
- Maturation of the selected technologies
- Design and development of the integrated solution including work on :
    - Inter-element packaging and interconnection
    - Interface control
    - Global assembly and the corresponding packaging and connection sub technologies.
- Validation of the assembly to confirm adherence to functional, environmental and certification objectives
- Presentation of the results

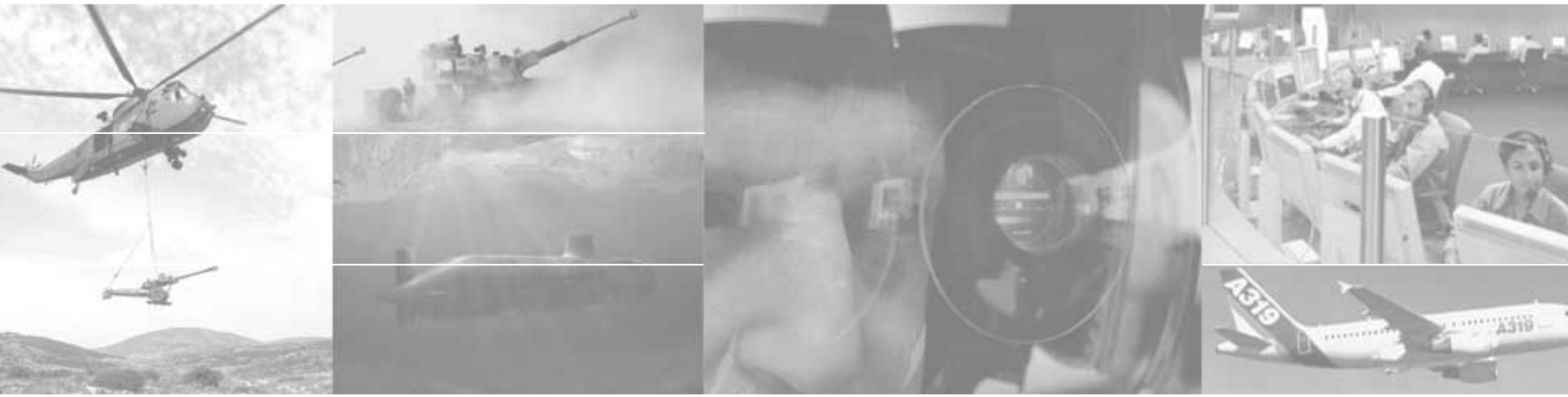
Potential Partners

Project overall Size

Project duration

3 years

- **Framework 7 second Call**
  - Decision Support for Precision Landing



Decision Support for Precision Landing

BAE SYSTEMS

- Need:
  - There is a need for improved situational awareness to provide improved time performance to enable full automatic approach and landing in all weather and advanced guidance and control whilst ensuring that aviation safety remains at current high standards.
- Work Programme Topic
  - AAT.2008.3.3.2. Systems and Equipment
  - AAT.2008.6.2.2. Guidance and Control
  - AAT.2008.3.3.4. Human Factors
- Objectives:
  - This innovative project investigates both the most efficient methodology of presenting the information to the crew and the potential benefit of next generation image processing and information fusion for obstacle detection and representation
    - Development and evaluation of the most efficient visual human interface for enhanced and synthetic vision EVS/SVS common symbology
      - Conformal/non conformal
    - Evaluation of suitability of conformal head up display for advanced guidance and control
    - Development and evaluation of next generation of sensor image processing and display for obstacle detection and presentation in poor visibility environments
- Expected Results/Deliverables
  - EVS/SVS Common symbology set for automatic approach and landing - fixed wing and rotorcraft
  - Suitable of conformal display for advanced aircraft ASAS operations
  - Evaluation of next generation of sensor capture and advanced image processing for obstacle avoidance in all weather conditions

Advanced Composite **I**ntegrated **Ta**il **C**one

Project Acronym: ADVITAC

Summary:
New requirements and ecological policy for greener aircraft lead aeronautic industries to consider new approaches for aircraft development. Tailcone appears to be a strategic part for reducing aircraft noise, consumption and nitrogen oxide emission notably because of its integrated Auxiliary Power Unit (APU). The project central focus is to design and to manufacture lightweight multi-layer/multifunction composite tailcone supplied with embedded sensors for Structural Health Monitoring (SHM). Moreover the latter tailcone will integrate the complete equipments and functions.

In order to ensure a thinner, cheaper and safer system, new architecture, design concepts and manufacturing processes for integrated tailcone should be investigated. **Adv**anced Composite **I**ntegrated **Ta**il **C**one project aims at federating the consortium which has an overview of all the set of problems concerning tailcone and APU integration. Significant weight and cost savings are expected after all partners' issues have been consolidated in a joint definition phase.

The next investigations will be carried out:
- APU efficiency, weight, noise and safety level.
- Lightweight tailcone structure (fibres placement, multilayer/multifunction, electrical continuity, SHM, advanced architecture, manufacturing tools and robots).
- APU integration equipments: Struts, Exhaust, Inlet and cooling ducts, actuators…
- Installation of next generation of APU technologies such as fuel cell (SOFC, PEM…) if Technology Readiness Level appears to be relevant.
- Fire Protection such as Extinguisher, Firewall, Fire detection.
- Maintenance (SHM, accessibility, Line Replaceable Units…).
- Loads during demonstration tests.

Project details (expected):
Start date: October 2008
End date: October 2012
Duration: 48 months
Programme Acronym: FP7-Transport
Programme type: Seventh Framework programme
Subprogramme Area: /
Contract type: /

THALES

RFID for on-board electronics

(Level 1 project for 2nd call of FP7)

Project Name : RFID for on-board electronics

Objective

Demonstration of a Universal Data Format for on-board electronics, eg for large memory Contact Memory Buttons for flight equipment, and e-Log-cards for replacing the Log-Card.

Such Universal Data Format will allow a single middleware for any aeronautics application hosted by on-board electronics.

Project description

- Data analysis with respect to processes of Aerospace Products
- RFID technology implementation analysis
- Technology choice
- Test on mock-up
- Implementation on a pilot equipment
- Benefit analysis for customer support line.

Deliverables

Evaluation report on choice of technology, impact on on-board electronics.

Serviceable solution on a pilot application for customer support line.

Timing and duration : start date on 2009 for 36 months

Expected partners

Electronic components suppliers, universities/SME specialized on RFID, On-board equipment suppliers

THALES

Protection for on-board electronics against SEU / MBU

(Level 1 project for 2nd call of FP7)

SEU : Single Event Upset
MBU : Multiple Burst Upset

Project Name : Protection against SEU / MBU

Objective

To define, to evaluate and to share views on critical components versus SEU/MBU threat for on-board electronics.

Project description

- Definition of a list of targeted components (µP and µC, memories, interfaces, etc) used in on-board electronics
- Evaluation of their SEU / MBU sensitivity (paper analysis, manufacturer audit and cooperation, lab tests, experience feedbacks…)
- Impact analysis on on-board electronics for future aircraft programmes.

Deliverables

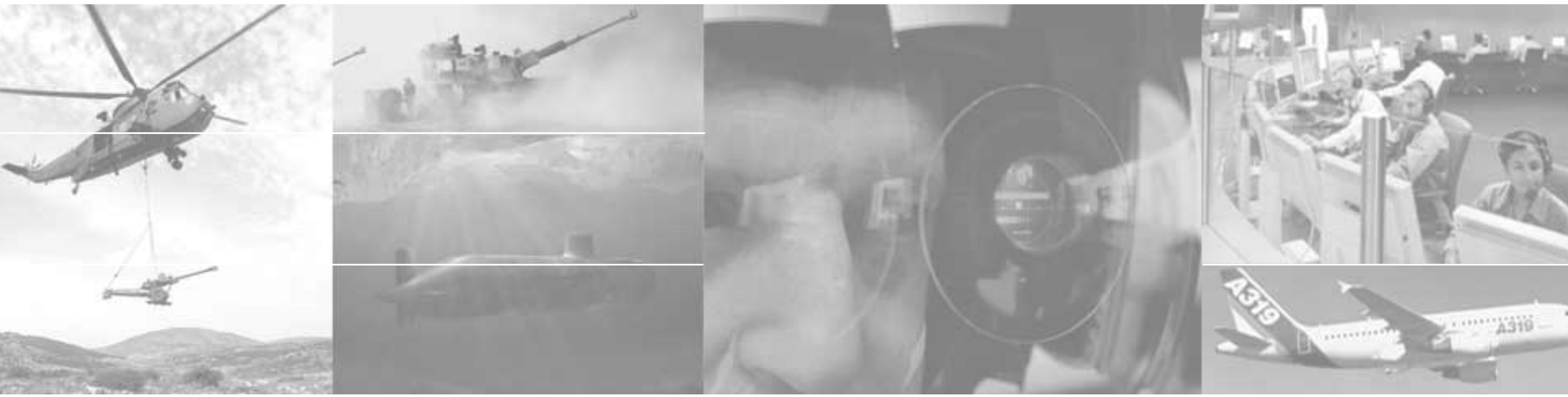
Common avionics database usable by equipment manufacturers to prepare new programs.

Timing and duration : start date on 2009 for 36 months

Expected partners

Electronic components suppliers, universities/SME specialized on SEU / MBU, On-board equipment suppliers

- **Framework 7 second Call**
  - Pilot ‘Assisted’ Visual Acquisition



Pilot Assisted Visual Acquisition and guidance for traffic and conflict avoidance

BAE SYSTEMS

- **Need**
  - **There is a need to investigate of new approaches to guide and control future vehicles to assure both routine traffic avoidance and emergency collision avoidance which could have a high level of automation. For small low cost air vehicles low cost aircraft acquisition techniques are required to allow practical implementation of sense and avoid functionality. This programme investigates the suitability of affordable visual acquisition techniques and next generation computing platform to perform this function especially for non TCAS equipped aircraft**
  - **Work Programme Topic Number**
    - **AAT2008.3.3.2**
- **Objectives:**
  - **Development and evaluation of advanced low cost advanced visual techniques for aircraft visual for next generation more autonomous air vehicles and small air transport vehicles**
  - **Development and evaluation of guidance algorithms for traffic and conflict avoidance in a scalable low cost high integrity computing platform**

TRiFFiD

(ThRough liFe rFiD tracking of structurally significant components)

L1P for FP7 2nd Call

Objective :

- To define, design and validate a system of incorporation of embedded tracking technology; based on RFID principles; into (amongst other things) Ultra High Strength Structural Components.
  The system must be capable of supporting secure data retention and recovery whilst surviving the rigours of processing operations during manufacture, periodic overhaul and repair as well as in-service use.

Technical challenges:

- Attachment or embedding implications.
- Robustness of data transfer (both ways).
- Implications of different base material, component shape and installed location.

Validation :

- Results evaluation and validation of the approach will be performed via practical demonstration.