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## Plan Overview

*A Data Management Plan created using DMPonline*

**Title:** Mass Estimation for Landing Gear Structural Attachments

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**Template:** DCC Template

### Project abstract:

Weight prediction methods for aircraft typically divide each section of the aircraft into separate entities that will use specific methods and tools to individually generate mass estimations. For the wing, mass estimation includes the wing master geometry and flight loads.

For the landing gear, mass estimations can vary from a simple percentage of the maximum takeoff weight to a more precise calculation based on the master geometries and ground loads.

When all mass estimations of the different parts of the aircraft are combined there is a gap as the structural components linking the landing gears to the wing or fuselage are not accounted for.

This project proposes to examine the implications of modifications to the landing gear attachments on the whole aircraft mass. In order to contain the study to a manageable level the scope will be limited to a wing mounted main landing gear with a rolling and folding single stay.

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**Grant number / URL:** Safran Landing Systems funded PhD

### Copyright information:

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# Mass Estimation for Landing Gear Structural Attachments

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## Data Collection

### What data will you collect or create?

The data will be split into 2 main categories:

1. Literature review data, which will be in the format of pictures and videos on landing gear structural attachment. The information will also be tabulated in .xls or .csv format. Existing data such as coming from books and technical documents will also be used and kept in .pdf format.
2. Analysis data, which will be generated using Abaqus as the FEA software, CATIA as the CAD software, and also Matlab and Python. The .CATPart is predicted to take up the most space as it is big in memory, estimated to be around 1-2 GB.

### How will the data be collected or created?

Due to the rare availability of data, the literature review data can come from primary source, such as direct photograph and video of aircraft landing gear attachments taken from an air museum. Also could come from secondary source such as online books and technical documents. In case online version of such source is not available, scanned document will also be collected. The classification of the landing gear attachment should have been identified prior to taking data. For example for wing-mounted landing gear, there are 2 types: gear rib and gear beam.

The gear rib is then branched into 3 subtypes: with reaction link, with walking beam and with no link. The gear beam is then branched in 2 subtypes: with walking beam and with no link.

The data is then stored within the respective order, following the mentioned classification.

The research/analysis data will be split into 2 main group:

1. A320 base model. This model is based on A320 features that is used to build and validate the methodology.
2. Future single aisle aircraft model with thin composite wing model. This model will be a non-existing aircraft model that serves as a platform to apply the methodology to assess its potential use for futuristic aircraft.

On both group, the built geometry is then parameterized, for example, the side stay attachment lateral position. The folder inside can be broken down into Abaqus data, CATIA data, Matlab data and Python data. Example files for Abaqus data:

A320base\_sidestaystudy\_originalposition.cae

A320base\_sidestaystudy\_0.3m\_outboard.cae (as we move the position 0.3 m outboard)

A320base\_sidestaystudy\_0.2m\_inboard.case (as we move the position 0.3 m inboard)

As we are also playing with material of the wing, we can state V1 for metallic and V2 for composite. Also, as generating one FEM needs some iteration, and indication of version can be shown using the creation date. Here is the example:

A320base\_sidestaystudy\_originalposition\_v1\_07072023.cae

Same principle for the CATIA files.

For the Matlab and Python, the application for it is not yet clearly defined. But it has been identified to be a potential tool to support this research and a file management will be likely to follow similar manner.

The validation process will be achieved through a technical review with Safran experts as well.

## **Documentation and Metadata**

### **What documentation and metadata will accompany the data?**

The documentation which covers methodology, analytical, variable definition and vocabularies will be well presented within the thesis document in .docx and .pdf format. Should an automated design and analysis tool created, a README file will also be created as a user guide.

A metadata will be attached to each of the generated file.

## **Ethics and Legal Compliance**

### **How will you manage any ethical issues?**

Ethical issues is assessed using Cranfield University Research Ethics System (CURES) and approval has been obtained. Document reference is CURES/19799/2023, project ID: 22971.

No personal data will be collected.

### **How will you manage copyright and Intellectual Property Rights (IPR) issues?**

The copyright and IPR will be following the agreement between the University and the funding company as stated within the Safran Research Contract. There, stated that the University and Safran shares ownership of the research data. Should any doubts arises in the process regarding IPR, student will consult to the University and Company research representatives.

## **Storage and Backup**

### **How will the data be stored and backed up during the research?**

The data will be stored within Cranfield University access-restricted OneDrive platform, which is backed by the IT department in daily basis. Copies of the work will also be sent to the supervisor and the funding company via email, which will also serve as back-up measures.

Upload some of the critical document to the student's personal hardisk drive will also be done as an additional measure.

Should any issue emerges, student will consult to the university IT department.

## **How will you manage access and security?**

Work will be strictly shared between the student, academic supervisor and industry supervisor only via official platform (university email). Only people with the link can open the attachment.

## **Selection and Preservation**

### **Which data are of long-term value and should be retained, shared, and/or preserved?**

The final thesis document will be made available on CERES research repository.

The research data will be preserved according to Cranfield Research Data Repository (CORD) policy.

### **What is the long-term preservation plan for the dataset?**

Data will be available on the Cranfield Research Data Repository (CORD) for a minimum of ten years after the end of the research in accordance with university guidelines.

## **Data Sharing**

### **How will you share the data?**

1. The data will be strictly shared between the student, Cranfield and Safran.
2. The data will be available through the link from OneDrive folder organised by Cranfield University which only active during the period of PhD study.
3. Some data will be made public when a research publication is released.

### **Are any restrictions on data sharing required?**

Since this project is commercially sensitive, data sharing will follow clauses stated within the Research Contract Safran document, which basically limits the data to be made into public, especially their competitor. The research contract will also serve as a non-disclosure agreement (NDA). Therefore, publication process is mentioned within the contract where the student should inform Safran regarding any publication draft 30 days prior to submission, for their checking. The exclusivity of data will remain during and after the PhD study.

## **Responsibilities and Resources**

**Who will be responsible for data management?**

Me (Muhammad Haidar Razan Hilmi) will be responsible for every aspect of the data management within the project.

Supervisors (Ioannis Giannopoulos, Jack Stockford and Howard Smith) will be responsible for reviewing and guiding.

Cranfield IT department will be the technical support.

**What resources will you require to deliver your plan?**

Training on DMP online offered by Cranfield University has been attended. Any specific training related to data management for specific software and application (for example, data management for Python) will be attended in the future. Alternatively, online courses will be utilized.