Projects

Please follow the specific instructions and criteria for the specific project you select. Proposals must cover one of the following two categories: business opportunities or engineering.

BUSINESS OPPORTUNITIES

1 Urban Air Mobility

BACKGROUND
Given the increasing importance of urban air mobility in the aerospace industry with products such as drones, autonomous flying taxis and unmanned emergency vehicles, the project is to review the potential for a turbine powered drone with a small gas turbine and/or hybrid gas-electric engine and propose potential application scenarios with a thorough deployment assessment.

PROJECT
The proposal will provide:
1) Background on the urban air mobility industry and its forecasted evolution over the next 10 years.
2) Strategic and execution plans (including mission type & market) to achieve strong market penetration to either:
   a. Develop a flying craft powered by a P&WC engine OR
   b. Leverage the applicable technology to support our operations
3) Flying craft capacity and range:
   - Long range delivery (± 200 km radiuses)
   - Can carry a payload of up to 200 kg
   - Flying craft size up to 10 feet long
   - Pre-programmed and/or customized flight corridors
4) Execution plan (including potential partnership, merger and acquisition) on a proof of concept project.
5) Final recommendation.

EXPECTATIONS
During the presentation, students must show that they understand the project, have high-quality research on the air mobility industry and are familiar with Pratt & Whitney Canada's market position.

PRESENTATION STRUCTURE
To complete the project, you must address the following areas:
⇒ Background
⇒ General and environmental strategy
⇒ In-depth case study of the three years prior to entering the market
⇒ Recommendations and conclusion

2 Business Intelligence and Advanced Analytics

BACKGROUND
Airplanes are generating a lot of data. As estimated, by 2026, annual data generation should reach 98 billion gigabytes. By then, the newest generation aircraft will be spewing out between five and eight terabytes per flight, up to 80 times what older planes generate today. This shows how much analytics -related activities can be performed to develop actionable insights from aero data.

On the other hand, service is completely reinventing the aerospace business model. Next-generation aerospace products are becoming more complex, and resulting in increased focus and greater Original Equipment Manufacturers (OEM) ownership of operational reliability. Airline operators are therefore increasingly relying on OEMs and Tier 1 suppliers for service expertise. This is making organizations shift their strategy to a service-based model that generates revenue from serviceable parts. Additionally, it has led to greater OEM penetration in the maintenance, repair, and overhaul (MRO) market while forcing existing MRO companies to leverage digital technologies such as IoT, mobile, and cloud to remain competitive.

YOUR CHALLENGE
An aircraft engine must undergo regular MRO activities based on its usage. Aircraft operators choose to either get MRO activities carried out through OEMs such as Pratt & Whitney Canada, or depend on other third-party companies.

Your challenge is to determine whether the aircraft operator would prefer to service their engines at the OEM facilities or at a third-party service provider.

Can you turn the data into insights?

Project Guidelines
- Download the training and validation datasets from the following link: **datasets.zip**
- The problem is a **binary classification** with the labels as follows:
  - 1, Undesignated shop
  - 0, Others
- The target column is: **A (Shop)**
- The programming language should be **Python**
- Use **Keras** library to train a deep neural network to predict the labels
- You may use any **Deep Learning** model that you think works best for this problem
- You may decide about the number of layers, nodes, activation functions, etc.
- You need to submit three files:
  1. **Python code** - Comment your code in a concise and understandable format
  2. **Predicted output** - The predictions for the validation dataset (one prediction per line)
  3. **Project presentation (ppts)** - Following the Data Science pipeline (Executive Summary, Approach, Tools, Results, Conclusion/Limitations, Recommendation/Next steps)

Evaluation Criteria
Though metrics highlight the quality of the model, we will be equally interested in the approach followed to understand how innovatively the problem was handled.

The following components will be considered when evaluating the project:
⇒ Creativity in the approach
⇒ Data engineering (feature engineering)
⇒ Business acumen (value to the business)
⇒ Overall quality and completeness of the 3 files (Python code, predicted output and project presentation)

ENGINEERING OPPORTUNITIES

3 Zero Oil Consumption

BACKGROUND
Today's gas turbine engines typically use pressurized air to seal bearing compartments and gearboxes to prevent oil leaking into the turbomachinery. The air then mixes with oil to form a two-phase fluid that must then be vented. Oil separators may be used to retain oil and vent the air overboard, but these are not 100% efficient, which results in oil being lost from the system. Lost oil, or "oil consumption", leads to required top-ups or maintenance action, reduced time between maintenance, enlarged oil tanks and emissions of oil vapor into the atmosphere.

PROJECT
Identify a feasible means of eliminating "oil consumption" and assess its practicality in terms of overall gas turbine architecture, weight, cost and operation.

EXPECTATIONS
Solutions may include advanced separators, advanced collectors, eliminating the need for oil, new system architectures avoiding oil and/or air, closed oil systems, modifying oil characteristics to aid separation or other novel approaches and technologies.

The impact of any proposed solution on the overall gas turbine system and its key functional requirements such as durability, heat management, negative G operation and reliability should also be assessed.

PRESENTATION STRUCTURE
To fulfill the project, you must address the following areas:
⇒ Is the solution particularly novel and creative and not just an incremental change to today's methods?
⇒ System impact: Have the impacts/challenges or benefits to the rest of the gas turbine system been considered?
⇒ Technology readiness: Have examples of related applications been found or cited? Low-technology readiness may be appropriate if an understanding of the required technology development steps is shown.
⇒ Is there evidence of technology benchmarking within aerospace but also in other industries?
⇒ Is there evidence of a good understanding of gas turbines and gas turbine lubrication systems?
⇒ Have risks been identified?
⇒ Does the proposed solution appear viable?
⇒ Is the solution a novel application of a known technology or a collection of known technologies?

4 Improve Gas Turbine Performance

BACKGROUND
Today's gas turbine engines provide power or thrust, but this needs to be achieved in the best possible economic and environmental way. Cost, weight and performance are of critical importance, but so are other considerations such as emissions, noise and durability. These are the key performance indicators (KPIs) that are continually driven to be improved. KPIs are often interrelated and difficult to improve without affecting or compromising another KPI. New technologies such as high-temperature materials, improved aerodynamics or advanced combustion methods are always being developed by the aerospace industry to support continual improvement in KPIs.

What technologies have been developed in other industries that have not yet cross-pollinated into aerospace but could help improve gas turbine engines?

PROJECT
Identify ready or nearly ready technologies being used in non-aerospace industries that could be applied in a novel way to benefit gas turbine engines.

EXPECTATIONS
Ideas could benefit the KPIs mentioned above, but they could also improve the customer experience with gas turbine engines or even engine components repair.

The goal is to identify novel applications of new and available technologies not originally anticipated for aerospace or gas turbine end use.

PRESENTATION STRUCTURE
To fulfill the project, you must address the following areas:
⇒ Is the identified technology in use or soon to be in use in a non-aerospace application?
⇒ Is the use of the technology in a gas turbine application clearly defined and thought out?
⇒ Is the use in a gas turbine obvious?
⇒ Does the gas turbine application appear practical and feasible?
⇒ Has consideration been given to the gas turbine operating environment (e.g., pressure, temperature)?
⇒ Has an attempt been made to assess the ownership of the proposed technology? Can it be purchased off the shelf or would it be subject to licensing, etc.?
⇒ Have risks been identified and evaluated?
⇒ Is there any evidence that the technology or its application has not yet been applied in aerospace?