# About Me:

I’m a recent graduate from Queen’s University, with a Bachelor of Applied Science degree in Mechanical Engineering. I completed my degree in 4 years, graduating in the Spring of 2022, and am looking for a full-time permanent position to apply the skills and knowledge that I have picked up and mastered in the recent years.

I am passionate about design engineering, having been a part of the Queen’s Racing Team in my fourth and final year, and enjoy data processing and analysis, an area that I often focused on in group projects. Due to this, I am skilled at and enjoy coding, with advanced MATLAB and Python knowledge, but also proficiency in C++, HTML, and Excel. I am also capable of and often use CAD programs, specifically SolidWorks, to manage complex parts and assemblies.

During my time at Queen’s, I have covered and mastered topics such as thermodynamics, machine design, fluid dynamics, and solid mechanics and learned to apply these skills to real-world design and engineering problems. More importantly, I have adopted many new or improved problem-solving strategies, leadership abilities, and creative-thinking skills to efficiently break down problems and propose a solution with implementation. Having worked in dozens of teams with a variety of people from different programs and years, I thrive in an environment that challenges me and allows me to collaborate with people of different skills and backgrounds, and constantly pushes me to do more.

I have an edge and a unique set of skills, having worked in a mechanics shop and as an assistant HVAC engineer. With experience in both the engineering and the consumer/user side, I believe that I am in an advantageous position when it comes to system and product design in the mechanical engineering field.

My ultimate goal is to practice engineering and continue doing what I enjoy, primarily data analysis and design work, while learning new and improving my skills and constantly expanding my knowledge.

# My Projects:

## Subheading:

Several examples of the work that I have done over the past 4 years at Queen's University. They showcase my capabilities as an engineer and paint a picture of how I apply the skills and knowledge I have gained over the past 4 years to my work.

## Description: My Work

Over the past several years at Queen's University, I have gotten the opportunity to learn and study a variety of subjects and work with dozens of other individuals, all sharing the same passion for engineering. In that time, I have acquired and refined many report writing skills, learned several coding languages, and, most importantly, learned to apply problem-solving skills like an engineer.

Below are a few of my reports, projects, and labs, as a sample of the report skills that I have acquired during my studies and as an introduction to my writing and organizational style.

## Project 1: Gearbox Design Challenge

### Description:

One of my favourites, yet one of the most challenging projects I have done during my studies at Queen's. The team was tasked with designing a gearbox for a miniature electric vehicle to maximize performance in a hill climb and top-speed event. This project is a great example of my passion for design work and engineering.

### Generic Page:

In a team of four, I was tasked with designing a gearbox for a pre-built miniature vehicle. The gearbox was to be designed to maximize the performance of the vehicle in a hill climb event and a top-speed event, between which the team would have a chance to adjust the gearbox but would not be able to remove or add any parts to the assembly. The final design choice had to be fully justified, have a full shaft stress analysis, and satisfy all the design challenge constraints, such as size limit, manufacturing time limit, weight limit, etc.

The project consisted of 4 phases. The first phase was the analysis of possible vehicle configurations and the development of gear ratios for the events. The team first developed a simple single-stage gearbox focused on high torque for the hill climb event, however, for phase 2 this was updated to be an inverted/shifting mechanism needed to reduce torque in favour of higher RPM output. The second phase focused on the fatigue analysis of the shafts and pinion/gear of the proposed design. In the third phase of the design challenge, the team ran an in-depth analysis of stress at critical points along the shaft to identify any possible locations of failure, due to applied stresses and fatigue stress. Phase 4 was the culmination of all 4 phases where the final proposed design was identified, broken down, and justified.

Personally, the open-ended problem, where there was no correct or “best” way to come up with a design proved challenging but also quite satisfying. The balancing of the high-torque to high-RPM gear ratios was quite stimulating and I specifically remember the “A-HA” moment when I realized that by inverting the gear ratios, the team could essentially maximize torque in one event and with a quick adjustment, increase the maximum RPM of the vehicle for the top-speed event. Seeing the gear-ratio numbers get converted into a three-dimensional rendering of a working gearbox was one of the most satisfying feelings, and even though the in-person testing of the gearbox was unfortunately canceled due to COVID-19, the design process and the final report only reinforced my love for design and engineering.

**New Section:**

I believe that this report is a great example of my ability to problem-solve and apply the knowledge I have gained over the past few years to a task. Throughout the project, I had to apply my math and coding skills, and use CAD in SolidWorks, while working in a team of 3 others. Most importantly, while many of the skills I used were learned through courses, the basics of gearbox mechanics and construction were self-taught through research and discussion with my peers, as neither I nor my group members had any experience in gearbox design. I thoroughly enjoyed being able to participate and watch the evolution of an idea turning into a real design.

## Project 2: Noise Control Project

### Description:

The project consisted of a challenge to reduce the sound of a specific instrument in a real machine shop by using experimental data, proposing a design, and then justifying it. I enjoyed this project as it was a very open-ended and problem with very little information given.

### Generic Page:

The goal of this project was to reduce the noise level experienced by an operator caused primarily by the source, which consisted of a pump and motor set and determine an appropriate noise control strategy to limit the noise experienced by the operator and other users of the machine shop where the source is located. The group was provided with 2 sets of data, with the sound pressure level at an array of frequencies and subsequent pressure levels in 1/3 octave bands in the range of 20Hz and 20kHz. The sound pressure level was measured at the location of the operator with the source “off” and at 15 different locations with the source running. The coordinates of these locations were provided, and the dimensions of the enclosed space were also given, however, neither the materials used for the room nor other objects in the shop were described.

The given problem was unusual, as it was found that the sound pressure level at the operator with only the only noise coming from the source was under the threshold of allowed sound. Though with other sources of noise it would likely exceed this threshold, the lack of information/data given, assumptions, and estimations had to be made for the proposed design. Because the sound pressure level from the source was already under the threshold set by Canadian law, it allowed several different approaches to validate the design. My partner and I agreed on using equivalent time sound exposure, a measurement of the time one could spend exposed to the sound level compared to the equivalent time exposed to the maximum sound level according to limits set by OSHA.

The proposed solution consisted of a 2.5-inch thick, 2.5-meter-tall, and 4-meter-wide acrylic barrier being placed between the source and the operator. The location, size, and thickness of the barrier were also experimented with, and the most cost-efficient way was chosen. By putting up the barrier, the surface area/room constant was increased, as well as much of the noise getting absorbed via transmission loss. It was estimated that the equivalent exposure time was nearly tripled due to the proposed design.

**New Section:**

This project was primarily an exercise in data analysis and in making proper assumptions for problem-solving. I was quite happy with the design, it was simple but eliminated much of the unneeded noise to the point that earplugs were not necessary, though still recommended. I very much enjoyed applying knowledge from a topic I’m passionate about to solve a real-world problem, the proposed solution to which could be used in the future.

## Project 3: Internal Combustion Engine Lab

### Description:

A lab to determine the efficiency of a specific internal combustion engine through several experimental data sets. To obtain the variation in the data, the engine was run under several different loads, and the resultant properties at each engine speed were compared and discussed. The breakdown of the data and this report can be used for calibration and tuning of this specific engine.

### Generic Page:

The laboratory was an exercise in data analysis and the application of thermodynamic theory in a real-world scenario. The objective was to compare the resultant properties of the engine at the different engine speeds to theoretical values. The lab group was given 3 different data sets data with pressure vs crank angle in one of the cylinders and a table with the mean torque, power, temperature, and air and fuel flow rates at each of the 3 speeds.

The engine characteristics were found using a dynamometer and a pressure transducer, then analyzed to find properties such as power, heat rate, indicated and brake thermal efficiencies, mechanical and volumetric efficiencies, mean effective pressures, etc. The properties such as indicated vs brake thermal efficiencies were then compared at each engine speed, and the difference in results was broken down and explained. Similarly, properties such as mean effective pressure were found experimentally and theoretically, and the discrepancies in the values were also explained. The discussion of the report also included a detailed section of future recommendations on how to improve the experimental results and further analysis that could be done with more information.

**New Section:**

This report consisted primarily of python and MATLAB data manipulation and required an understanding of several thermodynamical concepts. The lab report reflects my skills in data analysis and report writing, as well as the application of theory to a real problem. Powertrain systems are one of my areas of interest and paired with my passion for data analysis, I very much enjoyed working this lab and adding to my skillset.

# Queen’s Racing Team:

## Generic Page:

In the final year of my studies, I was an active member of the Queen’s Racing Team, formerly known as Queen’s Formula. This is a club consisting of more than a hundred individuals, run entirely by volunteer undergrad students and with the objective of conceiving, designing, and building a small formula-style racing car, capable of racing under the Formula SAE rules and regulations.

I accepted a position as a senior engineer in the powertrain section. I was given a project by the section lead and was responsible for attending a section meeting and a full-team meeting weekly to discuss the status of the car, as well as occasionally give a progress report on my work. My specific project was the adjustment of an existing pneumatic shifting system on the car, which turned into a complete redesign of the system.

The system consists of a pressure tank connected to a 2-way pneumatic cylinder via two solenoid valves controlled by the ECU. With the expansion or compression of the cylinder actuator, a force was exerted on a lever connected to a dogbox gearbox, shifting the gear. The force required to shift the system depends on several factors such as current gear, engine speed, or lever length, and the force that can be exerted by the actuator depends on tank pressure and bore of the cylinder. The project was a balancing act between exerting enough force and minimizing the mass of air required per shift to reduce the shift time as much as possible.

At the end of 2021, it became apparent that the university was once again going to close and move to remote learning, I was put in charge of two lower year students, to introduce them to my research and familiarize them with the system. During the remote part of the school year, a challenge was posed to the entirety of the team as there was no access to the workshop or car. Much of the research and design process was theoretical as no tests or measurements could be done. Despite these difficulties, I was able to find the solution for the current system and laid the groundwork for the future development of the new system in the non-pandemic year.

# Capstone:

## Generic:

The document included here is a 3-page excerpt with a summary of the document. All of the material, designs, and information detailing the UAM design are property of SMSD and will not be disclosed. Due to the agreement signed between the group and the client, and in good faith, the contents be generalized in any discussions. All the images included are courtesy of SMSD Lab group.

A capstone is an independent research project that gave me and four others a chance to demonstrate skills and knowledge of engineering while working on a real-world engineering task contracted out by a client. It is a one-semester-long project, broken down into literature and concept review, proposal, and a final submission, as well as any other relevant material for the client.

The work that my team and I did for SMSD was acknowledged by the Mechanical and Materials faculty and my team and I were presented the <a> href="https://calendar.engineering.queensu.ca/content.php?catoid=7&navoid=193” target="\_blank" George Christie Design Award </a> for my performance in the area of design and product modification. My experience of the fourth-year design project was quite challenging and pushed me beyond the bounds of my comfort zone, but also very fulfilling and rewarding, and I am delighted that this work was recognized by the Department.

I was fortunate to be accepted to my first choice of a project a “UAM Hybrid Power System” for Structural and Multidisciplinary System Design Lab, SMSD Lab for short. Urban Air Mobility is a brand-new type of aviation transportation for operation and transport of cargo and passengers at low altitudes in urban and suburban environments. The objective of the capstone was to specify components and specify a system for an existing UAM vehicle designed by SMSD. SMSD provided the capstone group with characteristics of the existing design and objectives and requirements for the final power system design. The final submission to the client involved a detailed system plan, bill of materials containing all the required major components for the system, the location, and analysis of the center of gravity and aerodynamical center of the design provided by SMSD with the designed power system in place and a mathematical model with a flight simulation of the designed power system.

My primary contributions to the project and material in the final submission were focused on the propulsion system consisting of electrical motors and propellers, aerodynamical analysis of the given design using VSP Aero, power strategy and system proposal/analysis and future recommendations for the project. The final was a 38-page report, with a problem introduction and breakdown, aerodynamical analysis, component selection, simulation, and final proposed design, which consisted of a primary and two supplementary system configurations. The final design was a turbogenerator system with 18% of the power supplied by a battery pack and propelled via 8 axial flux motors. This system would allow for an excess of 150 km range and downtime of 14-41 minutes, depending on the power strategy used. It uses 41.5 kg of kerosene for this kind of flight. The only objective that the project did not achieve was the 50% degree of hybridization, where current technology and limited research into the logistics, it could not be recommended to the client.

Besides the proposed designs, there were several key findings as a result of the design process. The degree of hybridization was found to impact the carbon footprint of design directly and significantly, as much as 41 times more per kWh fuel than per kWh supplied by the Ontario power grid. This could be further decreased with excess turbogenerator power used to charge the batteries in-flight. Additionally, with the current technology and infrastructure, fossil fuel-powered aircraft are still the recommended mode of transportation when compared to UAM vehicles. At the time of writing of this report, in November 2021, the weight and capacity limitations of battery technology are the main hindrance to a 50% hybrid UAM vehicle. However, with the growing awareness and demand for eco-friendly transport alternatives and rapidly evolving technology, the dawn of UAM transportation could be around the corner.

A special thanks to Connor Moffat (M.A.Sc Student) and Owen Pintar (M.A.Sc Student) whom my team and I had a pleasure of working alongside during the three-month-long project, and to Professor Kim (PhD), for his supervision of my team and of <a href="*url*">*SMSD Lab Group*</a>.