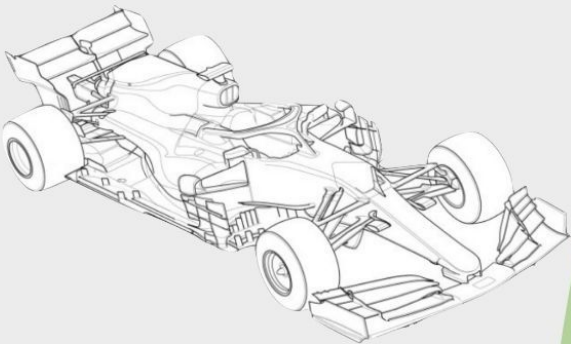


Career Readiness

VEX Robotics Online Challenge
2022-2023

Submitted by:
Madeleine Reynolds



Formula VEX: **Mechanical Engineering** **in Formula 1**

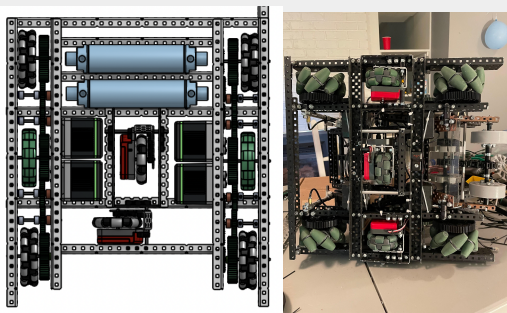
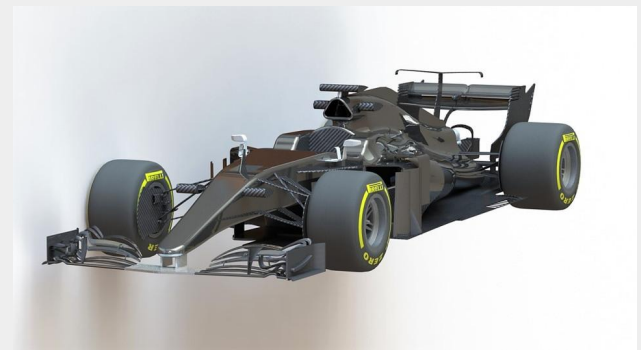
1010X
West Vancouver,
British Columbia, Canada

The high pitched whine of a V6 engine pierces through the air, a knife cutting through the atmospheric mixture of tension and anticipation. The virtually silent whoosh of the practiced path to a high goal. Two sides of the same yellow disk, experience in VEX Robotics enhances the inevitability of a career in Formula 1.

Similar to the chassis of a Formula 1 car, mechanical engineers are the foundation to a team's success. They are not only the most integral occupation in the industry, but a personal dream and a future to work towards. The 2014 season is a vague memory by now, but it initiated a vivid dream. This love of motorsport sparked a passion for engineering which has flourished through VEX Robotics.

Outlined in resources such as the official Formula 1 website, the design process from historically winning F1 teams is remarkably similar to engineering processes in VEX Robotics.

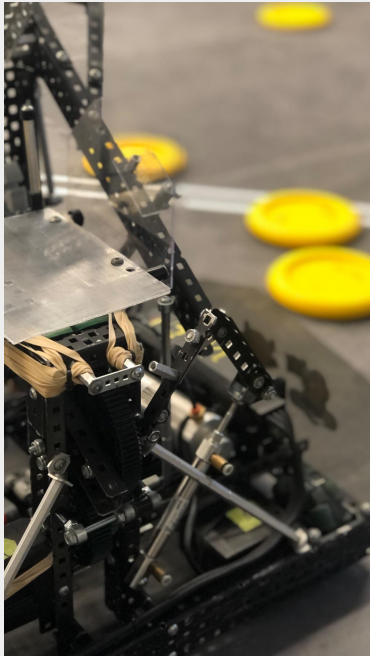
Scuderia Ferrari, Redbull, and Mercedes-AMG Petronas F1 Team have had tremendous success since the inception of the Formula 1 World Driver's Championship in 1950. This is due to their exceptional car design, which in modern days, begins with CAD software. Computer-aided-design is a fundamental framework to expand upon. CAD promotes efficiency in both VEX and F1 teams by preventing the inevitable fix of costly mistakes. Although F1 has higher stakes--millions of dollars and lives on the line--the benefit of CAD to narrow down meticulous designs is evident in VEX. Once designs are finalized, specialized build teams streamline the efficiency of building.



so must failing, testing, analyzing, and discussing. Then finally, improving. Pre-season testing for Formula 1 begins in Barcelona in late February, burdened with the pressure to test the team's tireless work for the first time. Comparably, the team's hard work can either be amplified or diminished regarding driver performance, and driver practice is crucial for success in both. Attending the Mall of America Signature Event before the official season was equivalent to pre-season testing for 1010X. The event allowed the team to gain a greater understanding of emerging build trends and the early season meta for Spin Up. It was an incredibly beneficial experience to see how our robot operates in a



competitive environment, and it aided 1010X in evaluating our robot to improve. In particular, 1010X switched from X-Drive to tank drive as weight inhibited our performance, and speed is critical in Spin Up, alongside Formula 1. This “pre-season testing” was an advantage over regional teams in British Columbia and directly led 1010X to winning both season openers in the province. In both VEX and F1, testing proves crucial to the upcoming races and competition,



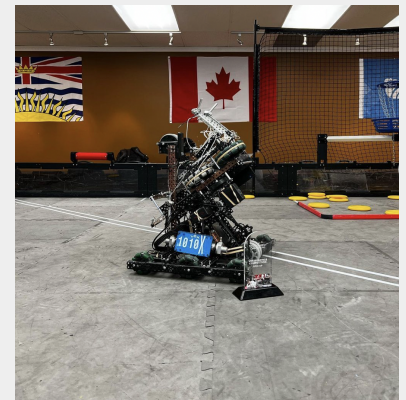
with VRC and motorsport teams making countless changes and analyzing their effects. This aspect of the engineering process is especially pivotal in Spin Up, as potential variables lead to an inconsistency in high goal shots. Adjust the flywheel angle? Add another rubber band to the catapult? 1010X used “pre-season testing” to add a catapult boost, given the importance of long-range disk shots (left).

Tirelessly, testing continues until perfection is reached, yet underneath it all, there is the electric hum of possibility. What if this is the one? Another yellow disk glides up the intake in conjunction with the silent inhale to see if the goal has been reached. When the disk bounces off the high goal, it's another data point to implement an improvement. Instead of frustration, VEX teaches young engineers to be filled with motivation and ingenuity when we strive to be better. These very qualities are how VEX Robotics prepares students for mechanical engineering in Formula 1.



Upgrades continue as the F1 and the VEX seasons progress, when new regulations are introduced. Teams in both interpret the regulations to push their boundaries to capitalize on the wide spectrum of designs and success available. The mechanical engineers at the Alfa Romeo Team were responsible to overcome the early-season problem that plagued teams:

porpoising. Porpoising is an instability in the flow field underneath the car that causes oscillations which fluctuates the ride height and lowers the downforce on the car. Alfa Romeo prematurely improved this to finish 5th at the Imola GP, their best result of 2022. The team achieved this feat by repositioning the venturi section, which limited the conditions where porpoising could occur. A comparative challenge to combat for 1010X was the update of <S2>, stating that endgame expansion outside the field results in a disqualification. To overcome this, the team employed the F1 design process to assess the problem and test potential solutions. For instance, 1010X adapted the endgame design by finding an angle to create more recoil, preventing disqualification.



1010X used CAD software, testing, and adaptation to develop the endgame from a 2 rope expansion, to a 6 way mechanism. Although ambitious, the engineering design process derived from mechanical engineers in Formula 1 made this design successful. The 1010X endgame mechanism consistently covers the full 36 tiles and has been adopted as the basis for all designs within British Columbia. VEX Robotics cultivates a passion for engineering and creates a competitive atmosphere which encourages its members to strive for excellence. Knowledge and implementation of the engineering design process proves invaluable for the future career as a mechanical engineer in Formula 1.

With a sense of undeniable possibility, before “light’s out and away we go”, the pinnacle of modern engineering--Formula 1--rests not just on the black tarmac of a Grand Prix circuit, but on years of the engineering experience that VEX Robotics establishes.



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