The application of Vex Robotics to Automotive Engineering

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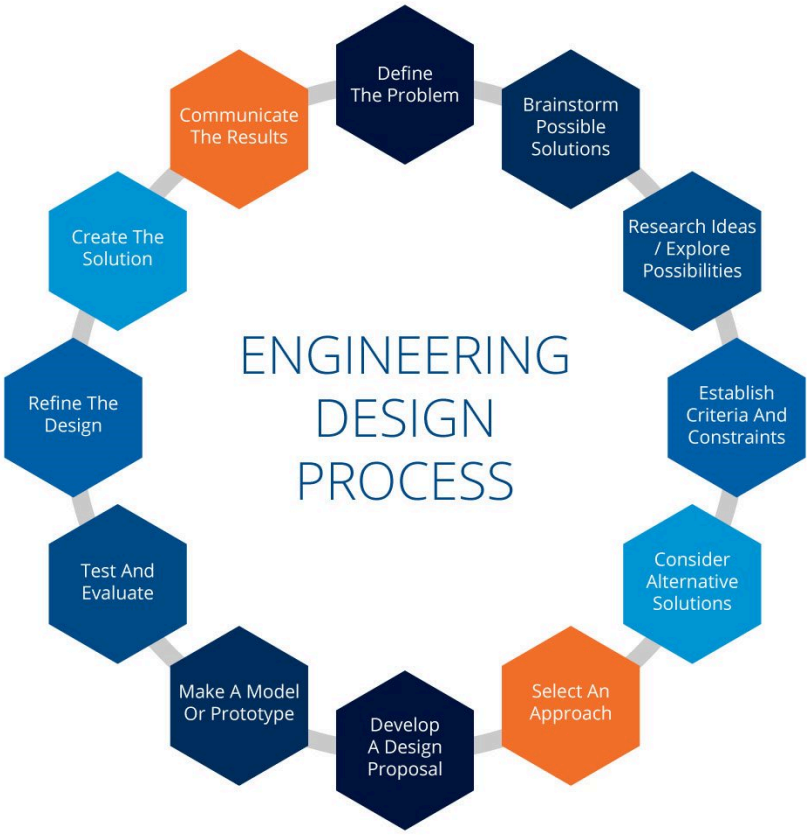
Why choose automotive engineering?

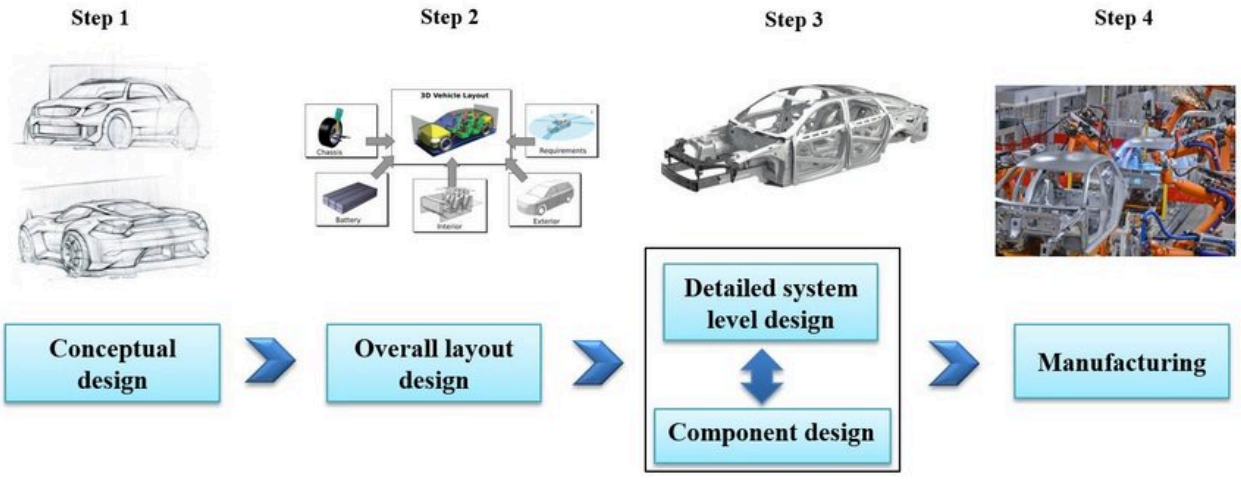
I chose automotive engineering because I see its potential of changing history's transportation methods in the next 10-20 years, for example from burning gas into electric vehicles, and turning them into a cleaner and safer environment. Automotive engineers use the design process to create more efficient and eco-friendly vehicles. The growth of EV vehicles and autopilot technology, shown by Tesla, is a big step toward achieving these goals. Tesla's innovative strategies also inspire other automobile companies to become more "green". Finally, automotive engineering really mixes well with the skills we learn at VEX, such as engineering, being creative, testing and much more. In addition, Tesla is involved in inspiring tennagers and kids into this history-changing field by sponsoring with VEX.

Design process

In the realm of automotive engineering, a basic design process(Image on right) serves as a guideline. It creates a layout for the engineers to follow and helps them design and implement the best model. An image below shows a more specific engineering process for automotive engineering.



In our journey to making an exceptional VRC robot, we use the same design process, specifically going through each of the steps. It has helped us get a good view of what designs and prototypes work best at resolving the tasks at hand.



Define the problem

Defining the problem serves as a crucial first step in designing any model, because it is the step where engineers find a problem to solve and a goal to aim at. An innovative example in automotive engineering is demonstrated by Tesla's approach in solving the **problem** of frequent car accidents on the roads. Tesla focuses on designing an autopilot system that can detect surrounding cars and get to the destination safely. By doing so, a driver can relax during their ride, while decreasing car accidents and reducing traffic.

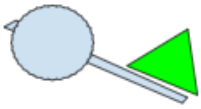
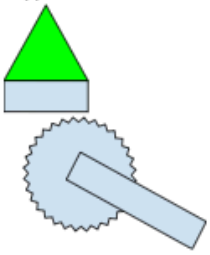
In this example, two cars crashed at an intersection causing traffic from all sides

For this year’s VRC Over Under, we defined the problem as scoring triballs and introducing new triballs in the field. If we match loaded too many at a time, we would not be quick enough to score them all before the opponent pushes them all to their offensive side.

Researching and Brainstorm

In the design process, the role of research and brainstorming is creative ideas coming to life. In this stage, engineers must brainstorm and develop prototypes for the problem defined. Brainstorming with a group of people is also very beneficial because it provides multiple people's views on the problem and has the potential of more ideas. In both the automotive career and in VRC, coming up with ideas and brainstorming is very common. For example, creating a CAD is a good approach because it allows the builder to have a plan of what they are doing and even allows you to picture it in real life.

In VRC, my teammates and I brainstormed a lot of solutions for each possible mechanism and stated the pros and cons for each. Below is a picture of our brainstorm from our team's engineering notebook.

Mechanism	Advantages	Disadvantages
Puncher 	- Can shoot straight into the goal - Fast - Simple to build	- Inconsistent based on the position of the triball - Easy to get blocked
Catapult 	- Shoots from a distance - accurate - Can shoot straight into the goal - Hard to block if it has a high arc. - Can have both high and low arc	- Can be complicated - Very violent. The entire robot might shake when it shoots - Pieces might break from strain - Rubber bands are wear and tear, meaning that you have to change them a lot
Slapper 	- Same advantages as a catapult - Smaller than a catapult - Less violent than a catapult	- Rubber bands wear and tear, so you might have to change them quite often
Roller shooter	- Can shoot the triballs across the field.	- Requires a lot of space - May need two motors to shoot strongly and consistently.

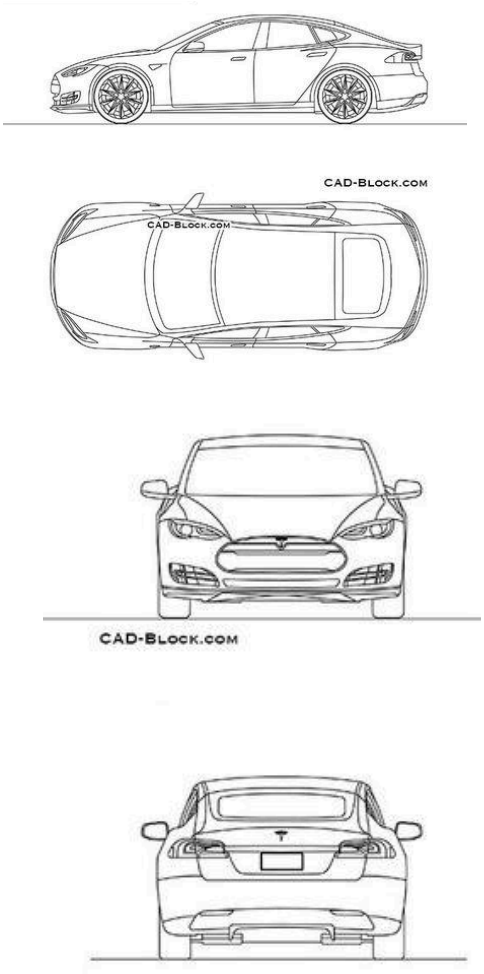
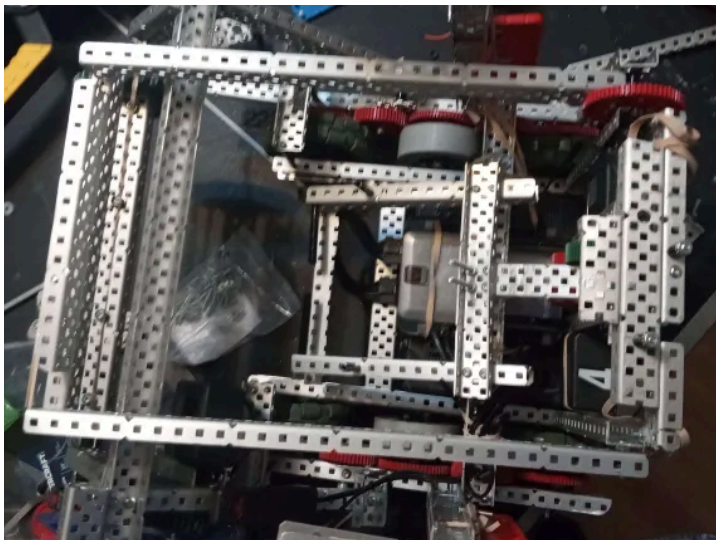
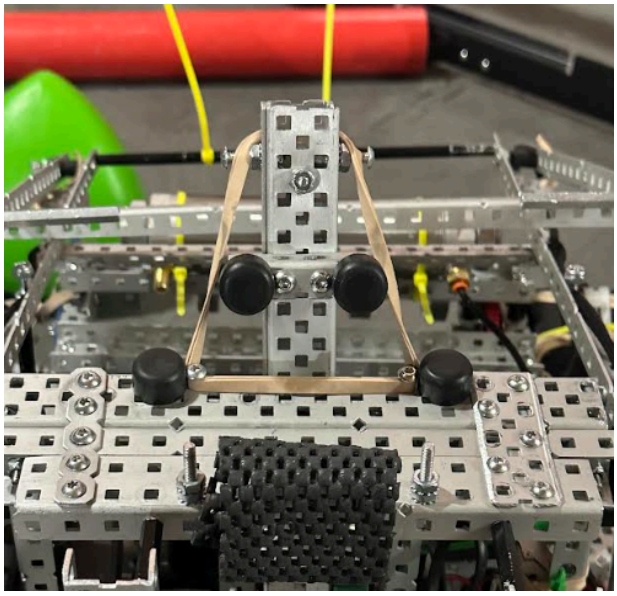


Image of Tesla from CADBlocks

Selecting an approach, testing and refining

After carefully analyzing each solution and prototype, the next step is testing. What Tesla did not excel in testing. As seen in multiple incidents where the autopilot caused crashes, the Autopilot system from Tesla was not flawless. In VRC, my team tried out multiple solutions, especially for the shooting mechanism. First, we listed out each possible prototype and analyzed whether or not it would work well on the field. We even imagined the mechanisms on a possible opponent's robot, such as a blocker. We tested our prototypes on a field at my house. Most times, the prototype would have some flaws and we tried to fix it as best as we could. At the end of the process, we selected the most effective and efficient prototype to use during our next competition. Below is 2 prototypes of our catapult.





Catapult vs Slapper

Communicate results

The next and final step of the design process engineers need to take to complete a design is communicating results. Professionals generally report this back in a formal fashion, in reports or presentations. For us, we noted down everything in our engineering notebook. We started with the goals and general key competition terms. Next is our important design process and how we selected the solutions we are currently using. After this we wrote about our finished robots, programming code and skills and autonomous strategy. Finally, we often updated our log where we noted down changes and improvements to the robot.

Image on left is Discobots demonstrating Vex to a School fair. Bottom is communicating to teams at Vex worlds.

Works cited for images used:

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"Waterloo Research Driving Automotive Innovation." Waterloo News, 12 Apr. 2020, uwaterloo.ca/news/waterloo-research-driving-automotive-innovation.