RIVIAN

REINVENTING WITH RIVIAN

Team 2496N

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WHY RIVIAN?

Rivian's Irvine Office

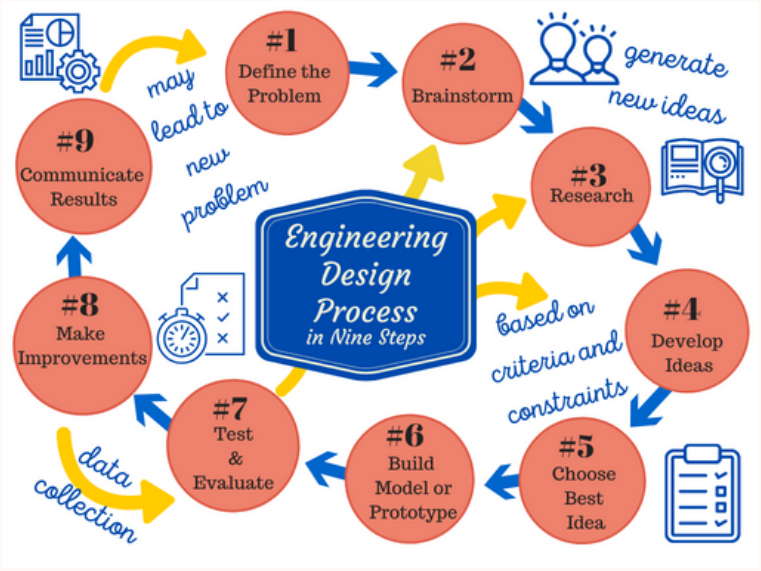
Interview with Mr. Gerard Garcia

Vex Robotics strives to aid students with coming up with new and innovative solutions, as does Rivian. They are an electric vehicle company utilizing many technological advances. Rivian is locally based in Irvine, California. We as a team wanted to interview a local company in hopes of learning more about a professional engineering workplace that is nearby. Mr. Gerard Garcia, a systems integration engineer at Rivian, was able to speak with us on the utilization of the design process at his company.

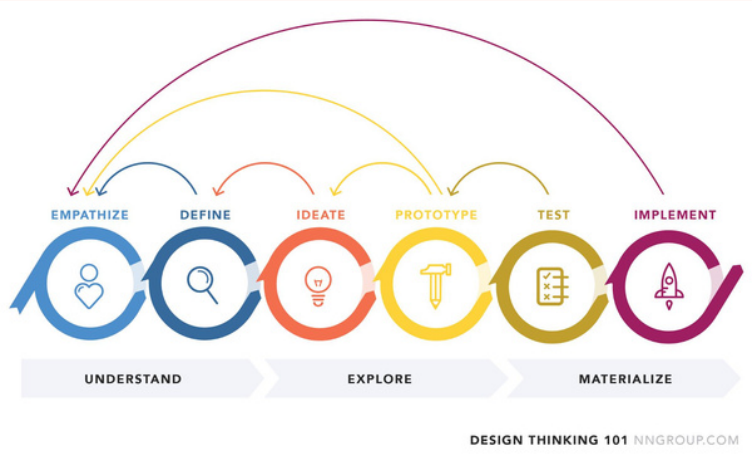
DESIGN PROCESS

Vex Robotics

At Beckman Robotics we utilize a nine step design process. Define the problem leads off the process by stating the problem. Following this is both brainstorm and research. These steps allow us to generate many diverse ideas. Next up is develop and choose the best ideas. Within these steps is when an idea is selected and perfected. Then we begin to build our idea and persevere through any issues. To make sure our build works, we utilize the test & evaluate portion of our process. After testing, we make any improvements Lastly, we must communicate our results, by competing.



Rivian

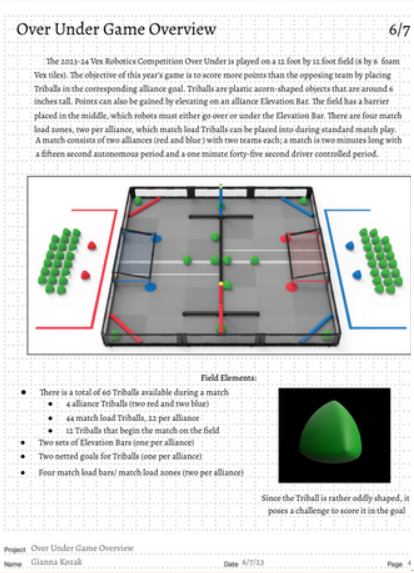


Mr. Garcia was able to illustrate the Rivian design process to us. The company first began by empathizing with their consumers. Next they set their defining problem which they would solve. Following this, Rivian began to produce many ideas while selecting a few to prototype. Within our interview Mr. Garcia stated that, “prototyping is key here; we always protype everything”. After this, Rivian begins to test their vehicles then implement them into the world .

EMPATHIZE/ DEFINE THE PROBLEM

STEP ONE

To begin the design process at Rivian, they start off by empathizing with the consumer. Mr. Garcia detailed that “we realized that there was indeed a sustainability problem within the car industry. Our buyers needed a more sustainable vehicle”. Through empathizing with the buyer, Rivian was able to highlight a prevalent issue within the community.



Over Under Game Overview 6/7

The 2023-24 Vex Robotics Competition Over Under is played on a 12 foot by 12 foot field (6 by 6 foam Vex tiles). The objective of this year's game is to score more points than the opposing team by placing Triballs in the corresponding alliance goal. Triballs are plastic acorn-shaped objects that are around 6 inches tall. Points can also be gained by elevating on an alliance Elevation Bar. The field has a barrier placed in the middle, which robots must either go over or under the Elevation Bar. There are four match load zones, two per alliance, which match load Triballs can be placed into during standard match play. A match consists of two alliances (red and blue) with two teams each; a match is two minutes long with a fifteen second autonomous period and a one minute forty-five second driver controlled period.

Field Elements:

- There is a total of 60 Triballs available during a match
  - 4 alliance Triballs (two red and two blue)
  - 44 match load Triballs, 22 per alliance
  - 12 Triballs that begin the match on the field
- Two sets of Elevation Bars (one per alliance)
- Two netted goals for Triballs (one per alliance)
- Four match load bars/ match load zones (two per alliance)

Since the Triball is rather oddly shaped, it poses a challenge to score it in the goal

Project Over Under Game Overview
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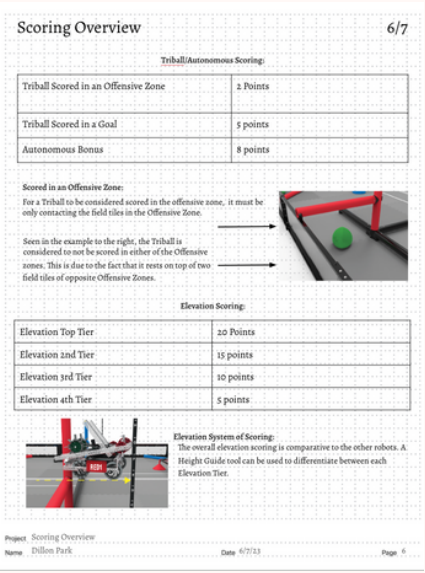

Scoring Overview 6/7

Triball/Autonomous Scoring:

Triball Scored in an Offensive Zone	2 Points
Triball Scored in a Goal	5 points
Autonomous Bonus	8 points

Scored in an Offensive Zone:
For a Triball to be considered scored in the offensive zone, it must be only contacting the field tiles in the Offensive Zone.

Seen in the example to the right, the Triball is considered to not be scored in either of the Offensive zones. This is due to the fact that it rests on top of two field tiles of opposite Offensive Zones.

Elevation Scoring:

Elevation Top Tier	20 Points
Elevation 2nd Tier	15 points
Elevation 3rd Tier	10 points
Elevation 4th Tier	5 points

Elevation System of Scoring:
The overall elevation scoring is comparative to the other robots. A Height Guide tool can be used to differentiate between each Elevation Tier.

Project Scoring Overview
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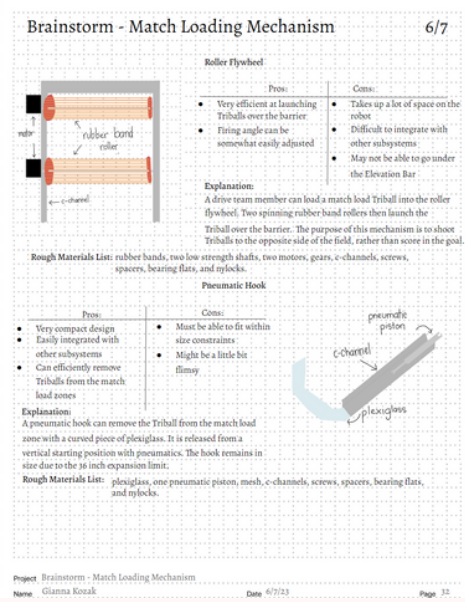
At Beckman Robotics, we incorporate define the problem by stating any constraints and observations for this year’s game. By using our engineering notebook, we can easily document all of our thoughts and ideas.

Although both of these beginning design process phases are similar, there are many differences. It is unnecessary for us to have the step empathize as we are not selling a product. However, it is important to utilize this step at Rivian so that they are aware of what the buyer is seeking.

BRAINSTORM/ IDEATE

STEP TWO

Brainstorming is an important part of 2496N as it allows us to collaborate and share out all ideas. We brainstorm for each subsystem as a team, making sure everyone inputs their ideas.


Brainstorm - Match Loading Mechanism 6/7

Roller Flywheel

Pros:	Cons:
• Very efficient at launching Triballs over the barrier • Firing angle can be somewhat easily adjusted	• Takes up a lot of space on the robot • Difficult to integrate with other subsystems • May not be able to go under the Elevation Bar

Explanation:
A drive team member can load a match load Triball into the roller flywheel. Two spinning rubber-band rollers then launch the Triball over the barrier. The purpose of this mechanism is to shoot Triballs to the opposite side of the field, rather than score in the goal.

Rough Materials List: rubber bands, two low strength shafts, two motors, gears, c-channels, screws, spacers, bearing flats, and nylocks.

Pneumatic Hook

Pros:	Cons:
• Very compact design • Easily integrated with other subsystems • Can efficiently remove Triballs from the match load zones	• Must be able to fit within size constraints • Might be a little bit flimsy

Explanation:
A pneumatic hook can remove the Triball from the match load zone with a curved piece of plexiglass. It is released from a vertical starting position with pneumatics. The hook remains in size due to the 36 inch expansion limit.

Rough Materials List: plexiglass, one pneumatic piston, mesh, c-channels, screws, spacers, bearing flats, and nylocks.

Project Brainstorm - Match Loading Mechanism
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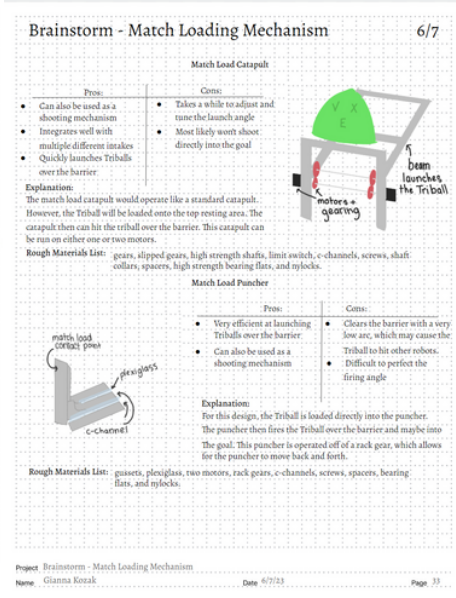
Brainstorm - Match Loading Mechanism 6/7

Match Load Catapult

Pros:	Cons:
• Can also be used as a shooting mechanism • Integrates well with multiple different intakes • Quickly launches Triballs over the barrier	• Takes a while to adjust and tune the launch angle • Most likely won't shoot directly into the goal

Explanation:
The match load catapult would operate like a standard catapult. However, the Triball will be loaded onto the top resting area. The catapult then can hit the triball over the barrier. This catapult can be run on either one or two motors.

Rough Materials List: gears, slipped gears, high strength shafts, limit switch, c-channels, screws, shaft collars, spacers, high strength bearing flats, and nylocks.

Match Load Puncher

Pros:	Cons:
• Very efficient at launching Triballs over the barrier • Can also be used as a shooting mechanism	• Clears the barrier with a very low arc, which may cause the Triball to hit other robots. • Difficult to perfect the firing angle

Explanation:
For this design, the Triball is loaded directly into the puncher. The puncher then fires the Triball over the barrier and maybe into the goal. This puncher is operated off of a rack gear, which allows for the puncher to move back and forth.

Rough Materials List: gussets, plexiglass, two motors, rack gears, c-channels, screws, spacers, bearing flats, and nylocks.

Project Brainstorm - Match Loading Mechanism
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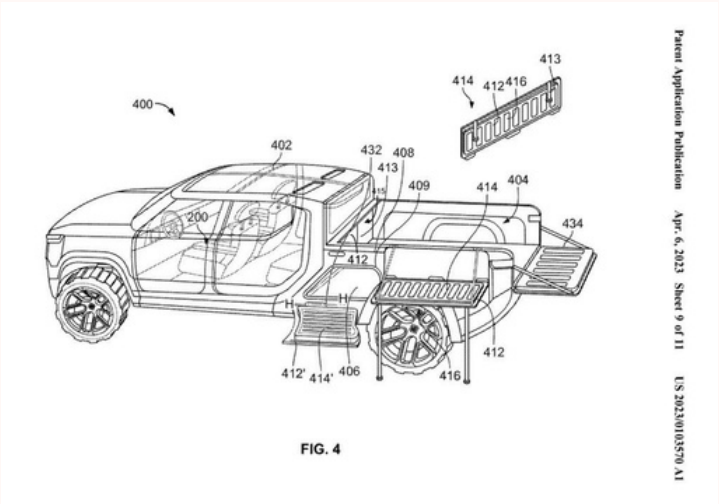


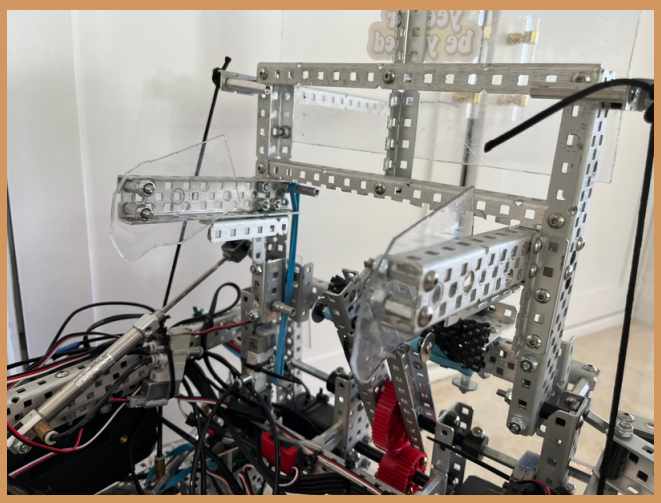
Shown in the photo at left, all brainstorming is done electronically at Rivian. By doing this, sustainability is increased and people can collaborate on the same sketch/concept at once. Mr. Garcia shared a shocking fact, "I have not used a printer in four years. There is no need as we all brainstorm digitally".

One main difference between these steps is sketching only online at Rivian versus us sketching both digitally and physically.

BUILD/ PROTOTYPE

STEP THREE

We begin building the robot after two intermediate steps of the design process. Building each subsystem after the other allows for a more smooth contact and alignment with other parts. Additionally, we build based off of a daily calendar.



Rivian uses machines to help them with assembly. They utilize a similar way of building, which is to start from the base then add other components. Mr. Garcia was able to explain that “this is all the latest technology that we are using; it helps get the job done”.

Although we may not be using state of the art equipment like Rivian, we still both start our assemblies with the chassis.

TEST & IMPLEMENT

STEP FOUR

To test our finished robot, we preform many different tests. All of these test results will then be out into a data table and graphed so that we can analyze the outcome. Once the robot is finished, we use the implement step to showcase it at competitions.

Once the vehicle is fully complete, Rivian is able to test it on their test tracks. One of the main tracks is located in Normal, Illinois. This track is able to put the car through a variety of tests. Out of these tests, the car can either be cleared for market sales or denied. If the car is cleared, it can now be implemented into the fleet of vehicles that will be sold.

These photos of the Normal, Illinois test track were shared with us during the interview.

The main difference between these steps is that Rivian test on a much larger scale and has a fail/pass check. Additionally, Rivian sells the product while we showcase but not sell our robot.

HOW DOES VEX PREPARE US?

Soft Skills

Through participation in Vex Robotics, many key life skills or soft skills are gained. Collaboration plays a major part in a competitive robotics environment. Furthermore, we gain a more diligent mindset as Vex students must compete at the highest levels. Lastly, we learn how to be quick problem solvers. At competitions we must efficiently address the situation while presenting solutions.

Technical Skills

Competitive robotics allows for students to be hands on with building and programming. Students of Vex learn the basics of building. This includes building principals such as triangle bracing or how to properly utilize elastic potential energy. Additionally, a variety of programming languages can be explored by Vex members. All of these languages are universally known, allowing for the knowledge to be utilized outside of VEX.

All of these skills can be effectively used within the workplace. Understanding the principles of building can aid an intern with designing a model or assembling a prototype. These are all major aspects of working at a company such as Rivian. Soft skills or “people skills” such as collaboration can be utilized while working on a large department team or even on a smaller project.

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