Iterative Design Process

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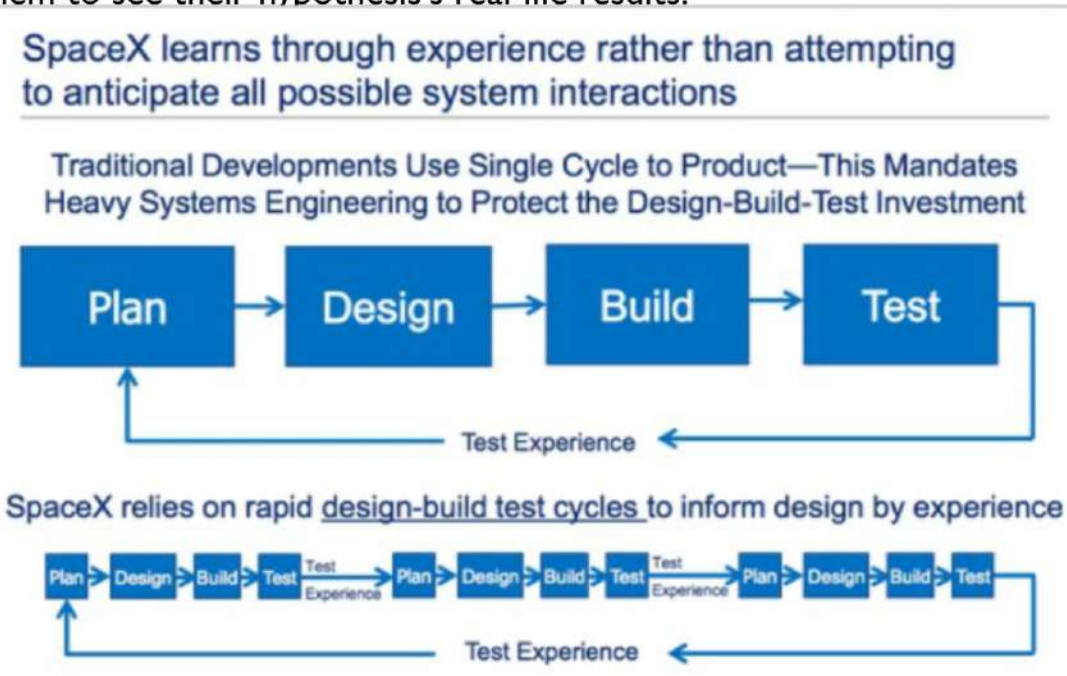
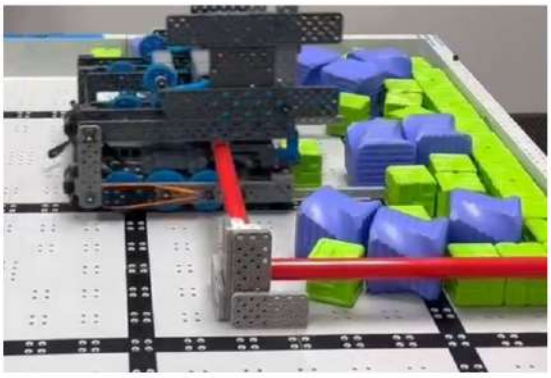
SpaceX is the company we selected to analyze and compare their design process to ours. The company's ambitious goals and achievements stand out to us, as the essential fact is that they are resilient and they never give up. The development of the Starship, intended for interplanetary travel, proves the company's commitment to pushing the boundaries of space exploration beyond Earth.

We went onto SpaceX's website and Elon Musk's biography by Water Isaacson to research about what engineering design process the professionals at SpaceX use. SpaceX's iterative approach to design is "learning by failing". In the traditional aerospace industry, companies spend years designing the rockets before finally building and testing. On the contrary, SpaceX has a different design process. Rockets and engines would be quickly prototyped, tested, revised, and tested again until something managed to work. Their design process allows them to accelerate development quicker than most other companies in the space industry, enabling them to see their hypothesis's real-life results.

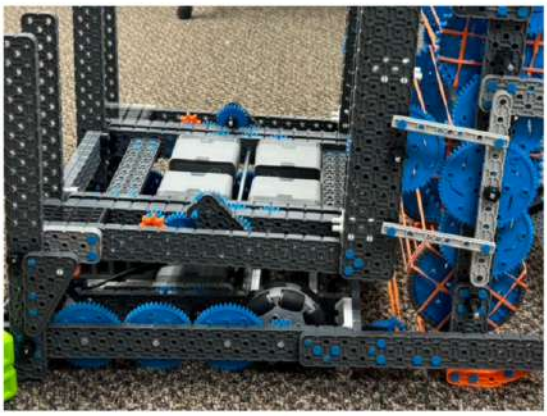


VEX IQ CHALLENGE

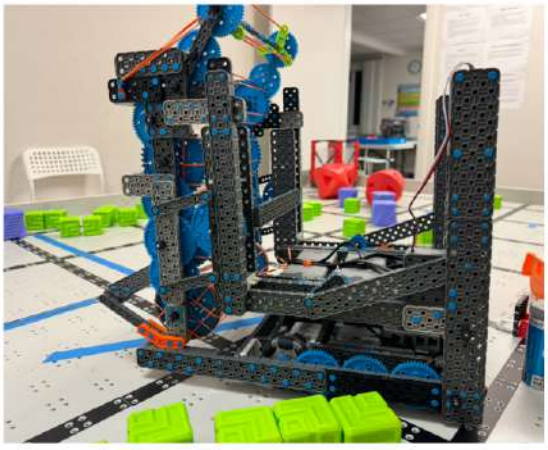
Our Vex IQ team implements the engineering design process by researching the problems we are trying to solve and designing multiple prototypes before we start testing. Like SpaceX, we attempt to test the designs quickly to gain more information. That is how we developed designs like our flip-up roller and cantilever design (see fig. on the right) through multiple iterations and testing. After we tested, we took notes (see pg. on notes) of the things that went well and things that didn't go so well and move on to our next prototype. Ultimately, we chose the best prototype and used that one for our final design. Rapid testing helped us find things we must improve on and saved us a lot of time.



Phasing in the front (Iteration 1)



Added cantilever (iteration 2)



Added structure to the cantilever (iteration 3)

On our first iteration of our robot, we spent a lot of time researching and designing each individual part, and learning about how to build each piece. When we decided to build a second robot, we took the results of the testing we did earlier and created prototypes, and did the engineering design process all over again, but way quicker because we now know how to build those parts, and we had past experiences. We used the same strategy as SpaceX-"informed design by experience". This managed to work out really well in the end.

Career Readiness

Importance of the Engineering Design Process

Vex robotics competitions prepare us for our future careers by teaching us the importance of the engineering design process. We learned that we couldn't just create a design from nowhere and use it, and the only way to improve each design is by research and testing. In our future careers in STEM, we would have the ability to apply the engineering design process to figure out a problem in the real world.

Setting Deadlines

It also helps us with our future careers by setting deadlines for us. Each competition is like a deadline, and our team has a set amount of goals we prepare to finish before the competition. Having a deadline ensures we are always on task and doing everything to the best of our ability. Sometimes, just the right amount of stress drives us to do what we usually couldn't, and most of the time, we are surprised by what we can do.

The importance of teamwork

Another way that Vex robotics competitions prepare us for our future careers is by teaching us the importance of teamwork, not just with our teammates. We learned that the meaning of VIQRC is not solely about winning but also about making friends along your journey. Other teams would help us, and we will help others, as it is all part of growing and improving. VIQRC brought together people who wouldn't meet otherwise, creating many friendships with others. We talked to teams worldwide and forged genuine relationships with other teams that would last forever. We share ideas to move forward together and learn about robotics together. We hope to meet the teams that helped us and those we helped in Dallas.

Thank You, VEX

This is the first year for all of our team members in robotics. We feel very grateful for Vex to provide us with such great opportunities and prepare us to pursue our dreams as aerospace engineers/stem leaders to make the world a better place.

Bibliography:

https://www.spacex.com/

"Elon Musk" by Walter Isaacson

https://www.quora.com/How-does-SpaceX-approach-the-technology-engineering-and-design-of-its-products

Notes we took

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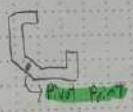
Through The Bar

Idea

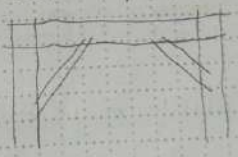
We wanted our robot to go into the supply zone better, and having phasing (see pg. 1) isn't effective because it can get stuck and isn't smooth. We decided to make the bot suspended in the air.

Fig. 1



Design Process

We started off researching into Architectural Designs in order to make sure that our bot stays in the air and doesn't collapse. We found out that bridges has a lot of structure, but it connects on 2 sides, not 1. Then, we found out about cantilevers. We realized that it could work, and we must try.



Prototype

We designed our first prototype using the knowledge we had, but it didn't end up working. More details on the next page →

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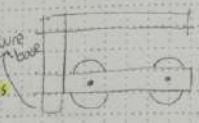
Cantilever

(Iteration 1)

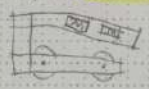
Design

We first made a secure base so that the whole bot can rest on it. We also added a beam sideways so it's harder to bend.



Observations

- We noticed that it bends very towards and can't even handle the weight of 4 motors. This is an issue as we are taking a lot of cubes, and we need to be able to hold a lot of weight.



Things to Improve

1, add more support through the back

2, stick an axle through the holes so even if it leans forwards the axle will hold it up.

3, move the support forwards so it doesn't stretch past the length limit.

Project Cantilever
Name Jason Ma
Date 1/27/24

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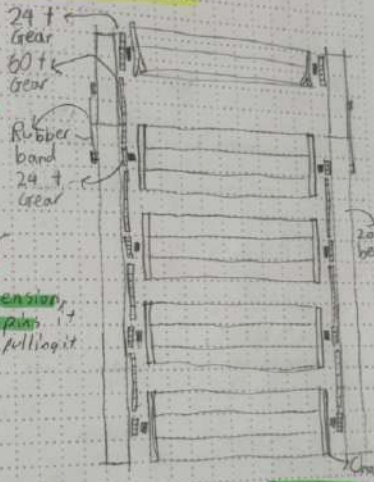
Intake 2.0

Friction Control

- We have a washer, then a gear, then a short collar, the the sprocket for more friction.



Flip Up Roller

- The rubber bands has tension, which when the gear spins, it reaches the tipping point, pulling it up.

Spacing

- Our rollers are 16 holes wide, so it can take 2 purples or one.

Bottom Roller

- We wrap our bottom Roller in chain, then rubber bands to make sure when wont get stuck.

Project Intake 2.0
Name Jason Ma
Date 1/21/24

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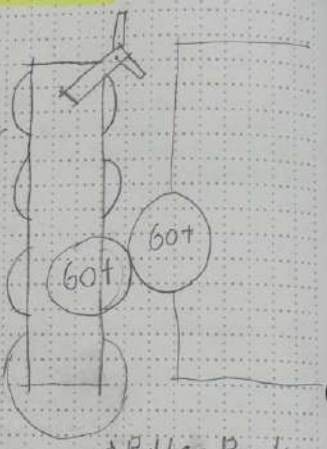
Intake 2.0

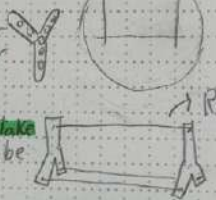
Powering

- We realized that using chain to power the intake can slip, so using 2 60T gears are more effective. (see pg. 125).



Constructing the 5th Roller

- We use Y shaped pieces for our 5th roller, with rubber bands connecting the 2 Ys.



- We originally wanted to use intake flaps for it, but it turned out to be too rigid.

- We didn't want a circular roller either, because it doesn't provide a powerful kick to the cubes.

- We decided, why not combine them? So we thought and realized that Y pieces were perfect, as it combined the pros of each design. It is flexible, and kicks the purple cubes up, making it extremely efficient.

Project Intake 2.0
Name Jason Ma
Date 1/23/24