CAREER READINESS

2023-2024

5225A - The PiLon's

Burlington, Ontario

Vera Qian | Avi Jain

WHY TEXAS INSTRUMENTS?

As students, we use calculators every day. While not in school, we are driven around, prepare meals, and listen to music. Everyday technologies such as cars, microwaves, and headphones have a Texas Instrument chip embedded in them.

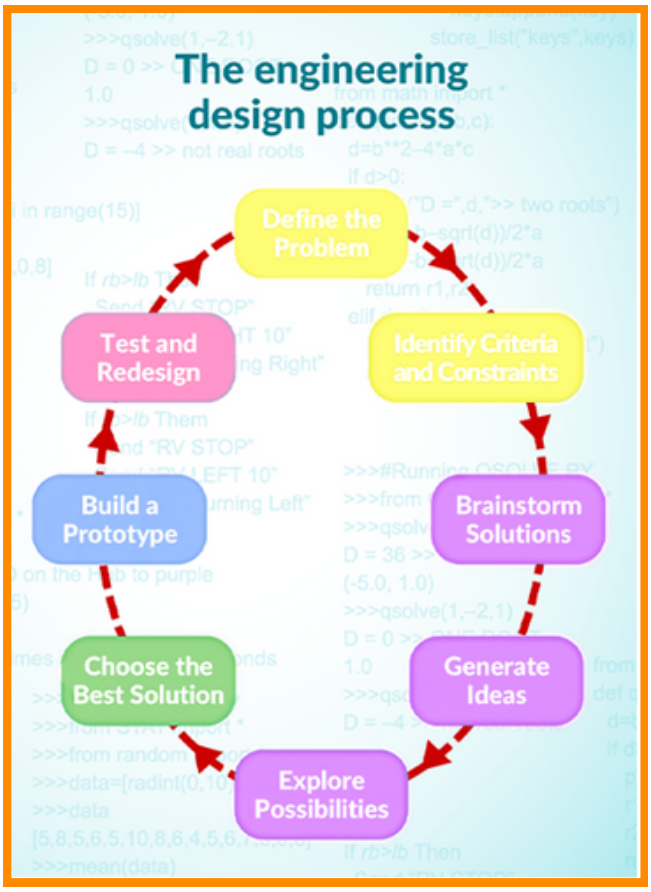
Founded in Dallas, Texas in 1951, the company quickly earned a spot in the IT world. Their famous chips make up 80% of their 20 billion USD revenue, and TI also holds 45,000+ patents globally. After learning all this information, we knew that this powerhouse of a company had to have a well-thought-out engineering design process. We decided to take our shot at contacting TI for insider information. Luckily, our communications with Texas Instruments were successful and we were able to have a meeting with Harshal Chhaya, the lead Systems Engineer and Product Manager for TI's STEM product line. Chhaya was able to shed some light on how TI uses the EDP as well as provide us with an image depicting theirs.

Group Photo!

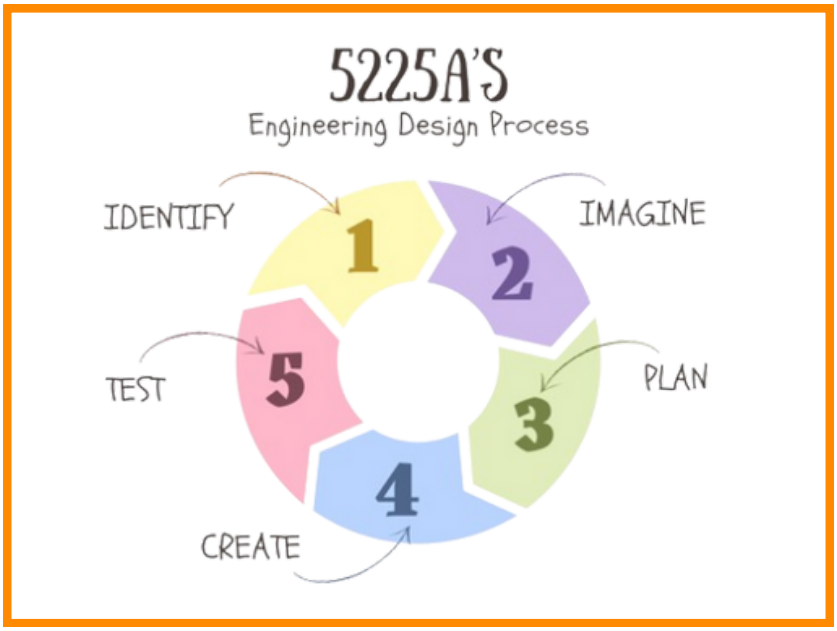
Manufacturing Site in Sherman, Texas.

PROCESSES

The engineering design process provides a roadmap to lead toward a solution for a chosen problem. TI's EDP begins with defining the problem followed by identifying any constraints, brainstorming solutions, generating ideas, exploring possibilities, choosing the best solution, building a prototype, and finally testing and possibly redesigning. This process is then completed repeatedly to achieve the desired solution. Although their process is split into many parts, as stated by Harshal Chhaya, some pieces may merge resulting in 5 segments.



Texas Instruments' Engineering Design Process



Our Engineering Design Process

DEFINE THE PROBLEM, IDENTIFY CONSTRAINTS

The first step of Texas Instruments' EDP is to define the problem and identify constraints. When receiving a project, TI examines its restrictions. According to Chhaya, these can include time, budget, size, and many more depending on the undertaking. Our team undergoes a similar process before ideating. Some factors considered are motors and the time until our competition. This allows us to be prepared when moving on to imagining, and any future steps. Before building any subsystem, we list out their requirements. Our team also uses a spreadsheet to write down deadlines as to when builds need to be done.

The E-Bots' PiLons 2023 - 2024 Team Engineering Notebook

Intake Requirements

October 2, 2023

Note: (Requirements are constantly updated and timestamped.)

- Pick Up from anywhere on the field except the match load zone. 10/2/2023
- Completely Passive when driving up to the bar. 10/2/2023
  - This was added to eliminate the use of a piston.
- When in reverse intake should be able to push triballs over the bar 10/2/2023
- Pick up and be able to stop in intake. 10/2/2023
- Triball should be able to spin out of intake. 10/2/2023
- When going over the bar intake should stay down 10/8/2023
  - This was added because we found it would change the weight distribution of the robot if the intake was tipped back when going over the bar

- Intake should be able to slowly spin when pushing in the triballs into the net 10/8/2023
  - This is to prevent the triball wedging between our robot and the top of the net

Intake Requirements

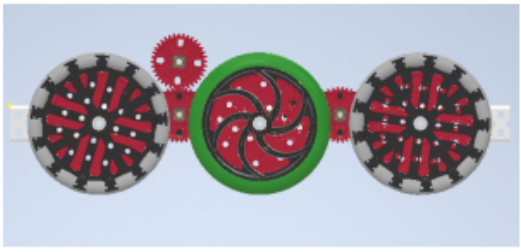
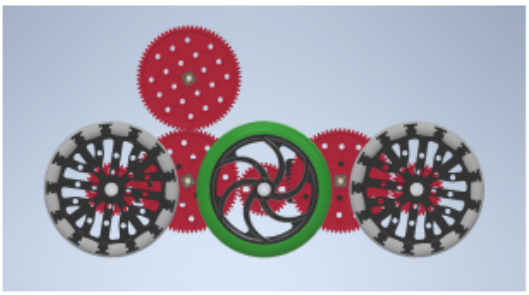
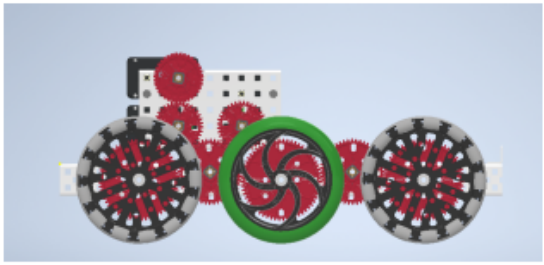
Task	Category	Status	Deadline
Drivebase	Drivebase	Compl...	11/26/2023
Mount Brain down and back	General	Compl...	12/8/2023
Wire Managment	General	Started	12/8/2023
Wheel Drop Down Design	Hang	Compl...	12/16/2023
Wheel Drop Down Built & Tested	Hang	Compl...	12/22/2023
Mount Claw and Brake	Hang	Compl...	1/12/2024
Finalize Wheel Drop Down	Hang	Compl...	1/27/2024
String Managment Prototype	Hang	Started	1/14/2024
Test Hang	Hang	Compl...	1/14/2024
Winch + PTO Design	Hang	Compl...	1/19/2024
Winch + PTO Build	Hang	Compl...	1/19/2024
Winch String Tensioner Design	Hang+Lift	Compl...	1/14/2024
Intake Clean Up	Intake	Compl...	1/13/2024
Lift Mounted and Tested	Lift	Compl...	1/12/2024

Deadlines Document

BRAINSTORM SOLUTIONS, GENERATE IDEAS, EXPLORE POSSIBILITIES

As Chhaya said, the next few steps overlap, as each does not function without involving the others. When executing this segment, TI must consider the constraints set in the previous stage and brainstorm solutions that accommodate them. We carry out a similar process, imagining various potential solutions to the same problem. An example of this is brainstorming for the Reverse Engineering online challenge and our drivebase gearing.

Our Initial Ideas for Reverse Engineering

RPM	Gearing	CAD
300 RPM, 4 Inch Wheels	72:48 - 200 RPM Cartridge	
333 RPM, 4 Inch Wheels	60:36 - 200 RPM Cartridge	
360 RPM, 4 Inch Wheels	36:60 - 600 RPM Cartridge	

Ideas for Drivebase Configuration

CHOOSE THE BEST SOLUTION

When deciding on the best solution, Texas Instruments considers what the project is optimized for. They consider factors such as speed, size, and affordability. A solution is then chosen that best matches the chosen characteristic. Our team implements this approach, deciding on a variety of elements. This helped us decide on which shooting mechanism to implement as well as how best to structure our robot.

Flywheel		Slapper	
Pros	**Cons**	**Pros**	**Cons**
- Very fast	- Difficult to achieve consistent grouping	- Achieves a consistent grouping	- More difficult to build
- Easier to build			

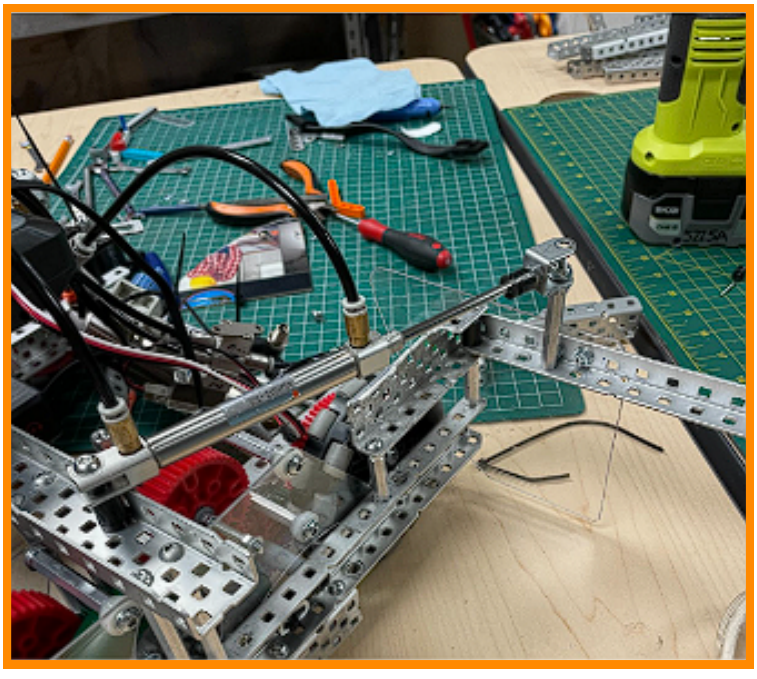
Shooting Mechanism Decision Making Process

Front Shooting Front Intake		Front Shooting Back Intake	
Pros	**Cons**	**Pros**	**Cons**
- Take the ones infront of you and quickly shoot them	- Intake facing outwards during matchload	- Take the ones behind of you and quickly shoot them	- Harder drive backwards (something that a driver can learn)
- Easier to drive and aim			

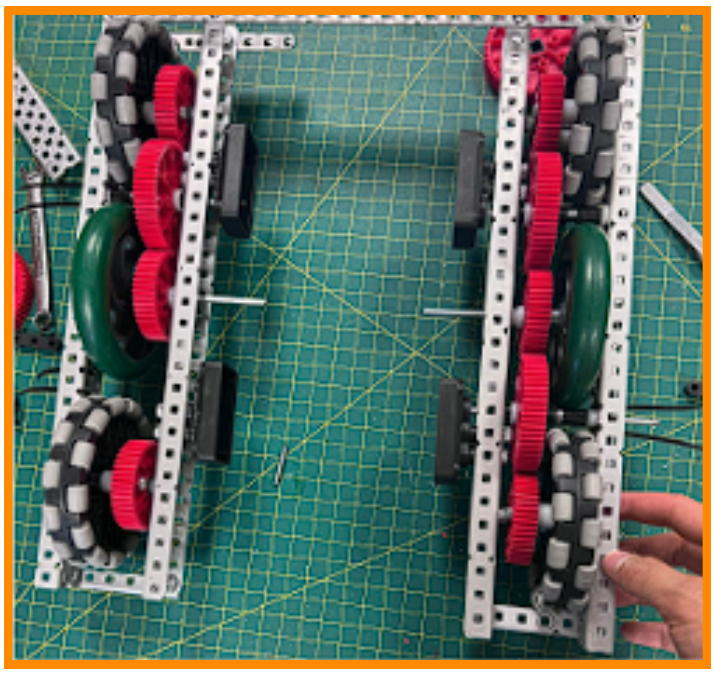
Our Decision Making Process

BUILD A PROTOTYPE

Texas Instruments builds prototypes by taking into account the previous steps and making a physical design. As Chhaya says, the design does not have to be perfect, but just enough to begin testing. Having a prototype helps to determine if the correct design was chosen. After we build a prototype, we go through the same thought process, deciding if the design we chose was the right one. A physical prototype helps to begin testing and improve our robot.



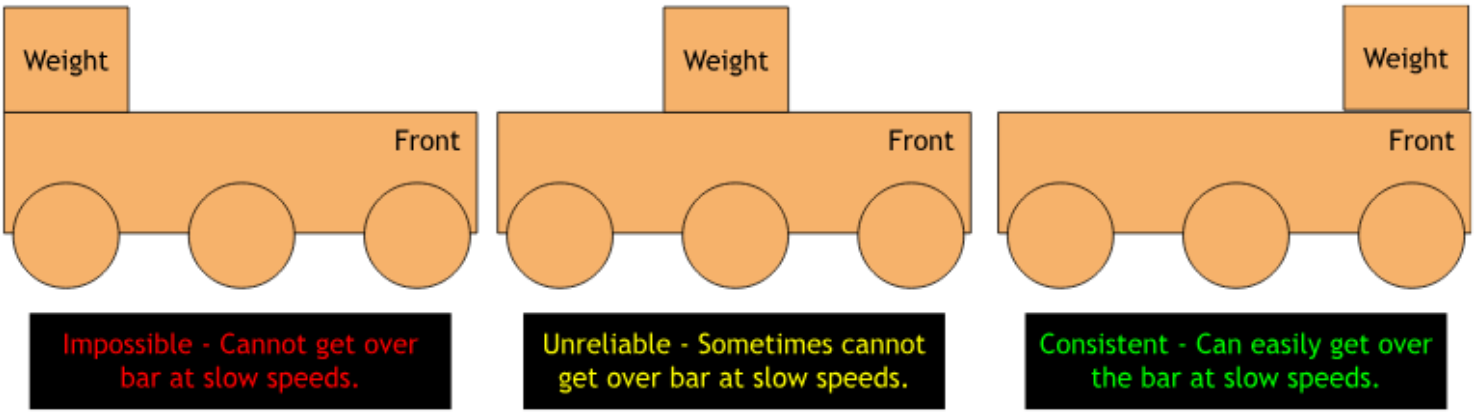
First Wing Design



First Drivebase Design

TEST AND REDESIGN

Testing and redesigning are the most important steps of the EDP. This is the most humbling segment, as you need to be willing to accept any mistakes and admit your faults. Testing can reveal a plethora of issues with the prototype. The problem could range from a building error to a flaw in the design, provoking a complete redesign. For TI, this step is also the time to send out their product for beta testing. This can help find hidden issues not considered before such as temperature's effect on a product. Further testing allows us to figure out any unforeseen problems and prove the validity of our solution. One example is our robot's weight distribution.



Crossing the Center Bar Results

HOW DOES VEX PREPARE?

As shown in this report, the engineering design process of a VEX student and an engineering job like TI, are very similar. However, VEX students are not limited to an engineering pathway, as the skills learned are widely applicable. VEX facilitates a mindset where students approach problems holistically, by first identifying the root of the problem before throwing out solutions. Problem-solving is a key skill in every career, as things are never perfect on the first try. When encountering problems, students are taught to think outside the box without limiting themselves to certain ideas. VEX also develops a multitude of other transferable skills such as time management, team building, and leadership, while impassioning its members. Overall, VEX fosters life-long skills while providing an engaging and fun learning environment.

VEX ROBOTICS COMPETITION

CITATIONS

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