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To Infinity & Beyond

SPACEX

The SpaceX logo graphic consists of a white curved line that starts from the right side of the 'X' and extends upwards and to the right. Below this line is a blue chevron shape pointing downwards and to the right.

# Why SpaceX?

SpaceX has proven time and time again that they are one of the most revolutionary companies of all time. They have figured out how to reuse rocket components such as in the Falcon 9 spacecraft that not only cuts back costs but also opens up the gateway for much more. SpaceX is highly focussed on preventing failure and have a design process focused on this. Our VEX VRC team shares this vision.

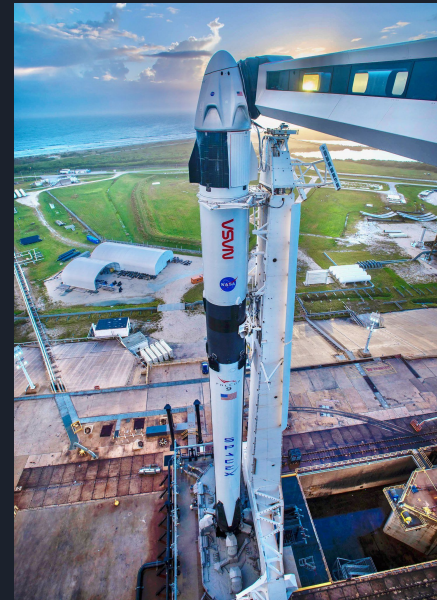


Figure 1: SpaceX's Falcon 9 spacecraft

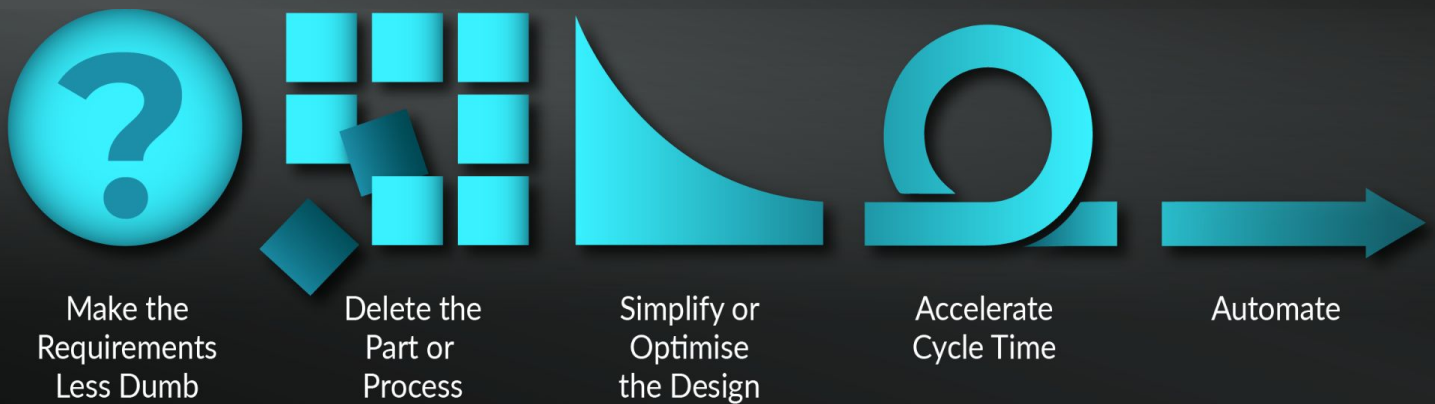


Figure 2: Elon Musk and an interview sharing his and SpaceX's design process.

Learning how SpaceX solves problems has inspired us to be a VEX VRC team; we are a team with many different skill sets and targeted goals similar to SpaceX. In addition, we have learnt to think like engineers when we try to problem solve.

# The Design Process

“Possibly the most common error of a smart engineer is to optimise a thing that should not exist.” - Elon Musk



MUSK'S 5 STEP DESIGN PROCESS | *Elon Musk*

 **MODELTHINKERS.com**

Figure 3 : Elon Musk's and SpaceX's 5 step design process

## Step 1: Make the requirements less dumb

Elon Musk states that no matter who gave you requirements for a task you must take that guidance with a grain of salt even if they are a “smart person”. He says we need to **question the question**.

This is similar to our design process because we “question the question” by seeking inspiration but instead of copying them part for part we question what steps we can eliminate and what can we do to improve on this design and implement it.

## Step 2: Delete The Part Or Process

Secondly Musk tells us **every component must have a purpose** and if you don't know that purpose you probably shouldn't have that component. He also says that instead of a group knowing one particular component to have one person focus on a specific part.

Using this advice we have adapted our team to get rid of unuseful components. We have also had our team be split up in ways where we focus on our own part of the robot.



Figure 4: SpaceX employees with their own distinct jobs

## Step 3: Simplify Or Optimize The Design

Thirdly Elon Musk says that the biggest mistake that engineers make is optimising something that shouldn't exist. He refers to when addressing a problem can have multiple solutions like for SpaceX they tried to reduce the weight of the engine but thought about a simpler solution which was just to lighten the payload.

We take this step seriously so that we can set deadlines for ourselves and not spend too much time on solutions with no problem. When we build our robot we simplify our design as much as possible and if it needs to be optimized we optimize it when needed.

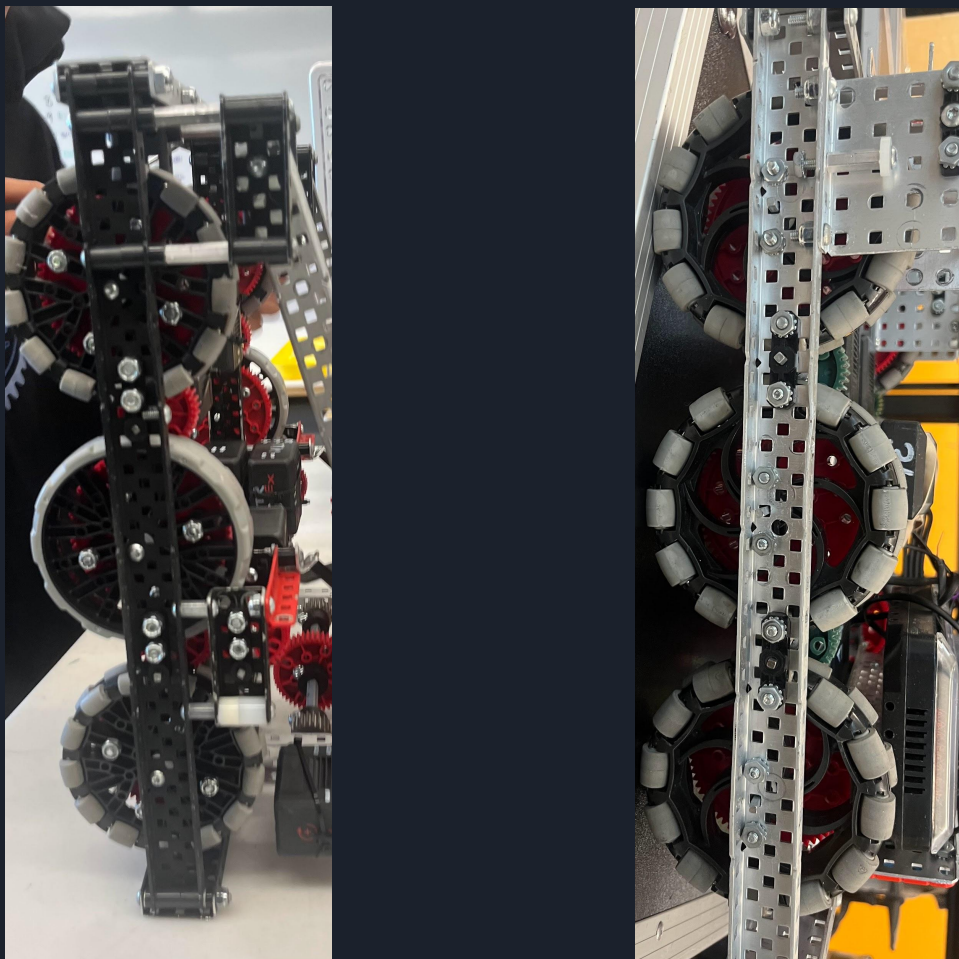


Figure 5: Our inspiration - competitors Drivetrain (Left) our Drivetrain (Right); We optimized our design by observing our competitors robots

## Step 4: Accelerate Cycle Time

Fourthly Musk warns us not to move too quickly in order to make sure you're not moving in the wrong direction. He recommends an agile approach but only after the previous 3 steps have been completed.

In order for our team to progress quickly we divide and conquer with our goal being to build a great working robot. By having one of us build ,another work on our engineering notebook, and the last teammate do the programming we are able to reach our goal much faster and with higher quality.

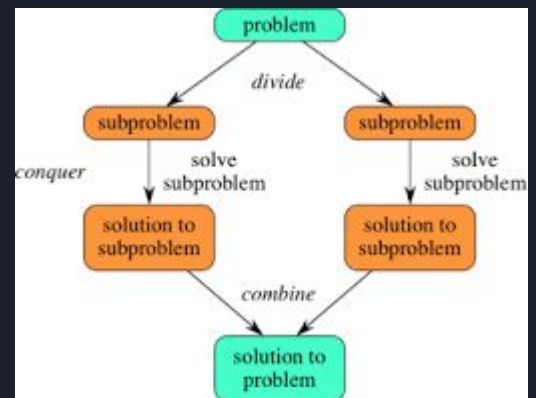


Figure 6 :Divide and conquer

## Step 5: Automate

Finally Musks final step is to automate. He warns us that before automating we must make sure everything that needs to be there is there and everything that doesn't need to be there isn't there. In the automated process all that must be done is have a machine build for you.

For our team we automate by making and testing a particular component until it works, and if there is need for more of the same component we mirror it.



Figure 7: SpaceX software automation

# How has participation in VEX Robotics prepared you for a future career?

VEX has prepared us by giving us hands on experience with multiple aspects of engineering (e.g., building, programming, documenting, etc.). With this experience we are confronting a difficulties and achieving breakthroughs just like people with careers in engineering at SpaceX. Through VEX we have learned skills including teamwork, networking, solving, time management and so much more. There is so much in VEX that helps prepare for our futures.

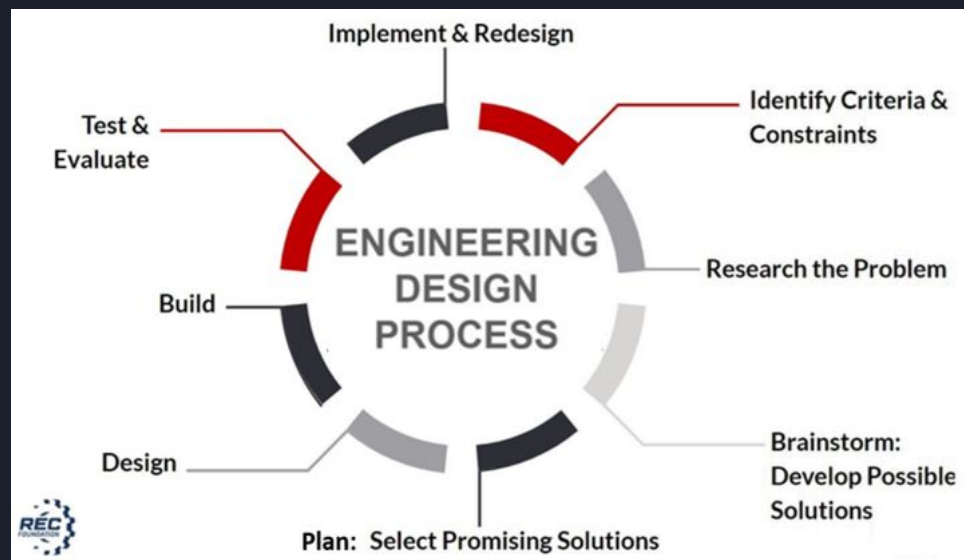


Figure 8: VEX teaches us valuable lessons and career readiness

## Sources

1. Musk's 5 Step Design Process  
<https://modelthinkers.com/mental-model/musks-5-step-design-process>
2. Elon Musk's 'Algorithm,' a 5-Step Process to Dramatically Improve Nearly Anything, Is Both Simple and Brilliant Just make sure you follow the steps in order.  
<https://www.inc.com/jeff-haden/elon-musks-algorithm-a-5-step-process-to-dramatically-improve-nearly-everything-is-both-simple-brilliant.html>