
DESIGN IT!

Presented by FTC Team 7244 - Out of the Box Robotics



OUR OBJECTIVES

What we want you to come out of this workshop with.

OUR OBJECTIVES

- Learn the basics of the engineering process.
- Come up with a plan that fits your team.
- Understand the basics of Game Manual part 1.
- Overview the 2019 FTC game.

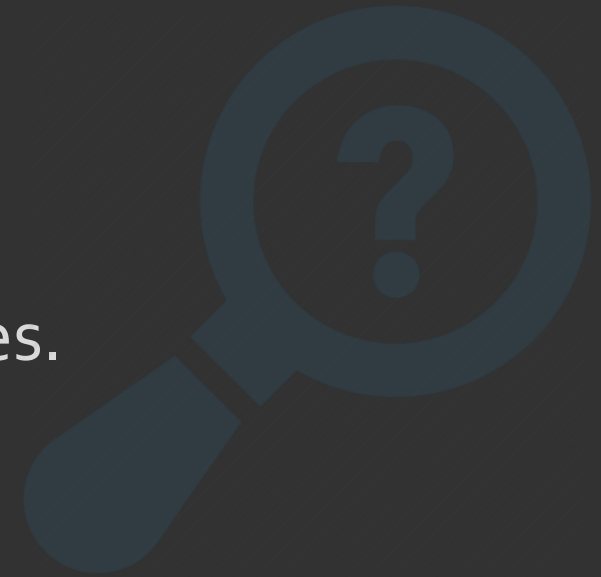


THE ENGINEERING PROCESS

Identify, Think, Design, Build, Test, Repeat!

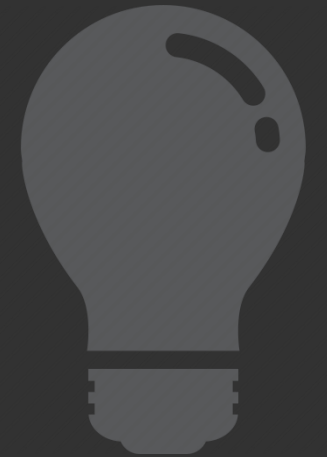
IDENTIFY THE PROBLEMS

- Identify the problem and challenges at hand.
 - What are the tasks of the game?
 - What type of obstacles are there?
 - What can the opposing team do?
- Read Game Manual part 2 to fully understand the challenges.
- What criteria will your robot have to meet?
 - How are the scoring elements scored?
 - What can and can't you do on the field?



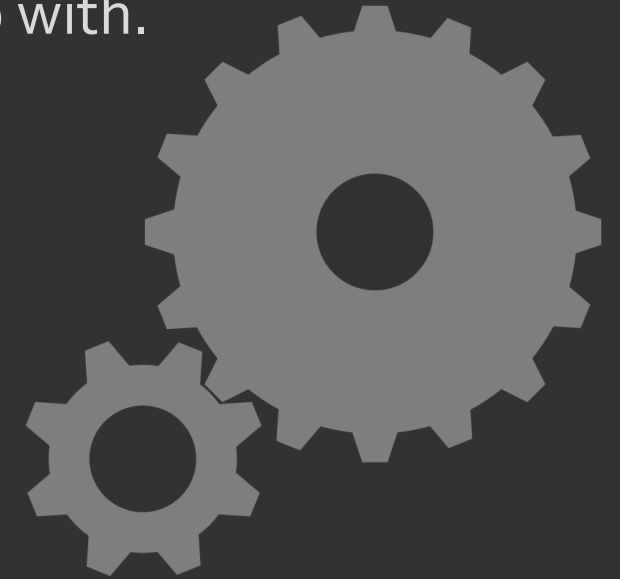
THINK ABOUT SOLUTIONS

- Don't think about how to implement your solutions just yet.
- Always decide what you want to do in the game first.
- Analyze the game and where the points are scored.
 - Is it better to quickly score low points then to score a few high points?
 - What do you feel your team is capable of?
- What is the most effective way to win matches?
- Pick one (or two) objectives in the game that you want to be able to do consistently.
- Plan different strategies for the game.



DESIGN THE SOLUTIONS

- Come up with ideas that fit into the strategy your team came up with.
- Look at what teams did in years past with their robots.
- Draw out all your solutions; even the goofy ones.
- Try to keep all the components apart from one another.
 - What kind of drive train?
 - What kind of scoring mechanism?
- Document ALL your ideas.
- Don't take it personal if someone criticizes your idea, but on the same note don't criticize other ideas simply because they are not your own.
- Be reasonable with your designs.
- Use a decision matrix to decide on your solutions.



DECISION MATRIX

Attribute	Weight	Design 1	Design 2	Design 3			
Speed	3	5	15	2	6	3	9
Power	2	1	2	5	10	3	6
Reliability	5	3	15	4	20	3	15
Defense	2	2	4	5	10	4	8
Scoring	4	5	20	2	8	4	16
		66	54	44			

- Decide on what attributes you think are important.
- Weight them as to how important you think they are for the game
- Decide about these attributes for each of your designs. Not every part can be perfect in any design.
- Multiply the weight and the designs scores.
- Add each column up and look at the totals
- The highest score is (most likely your best choice.)



DECISION MATRIX

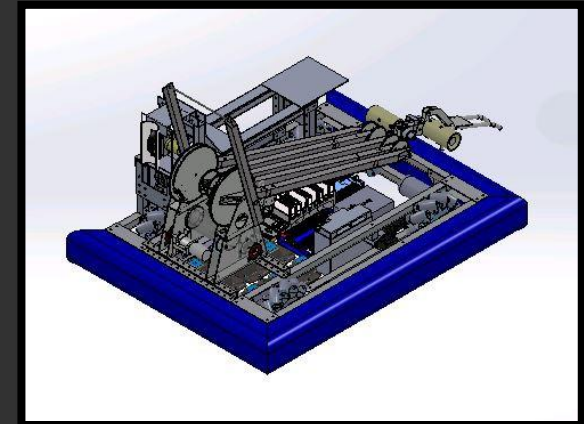
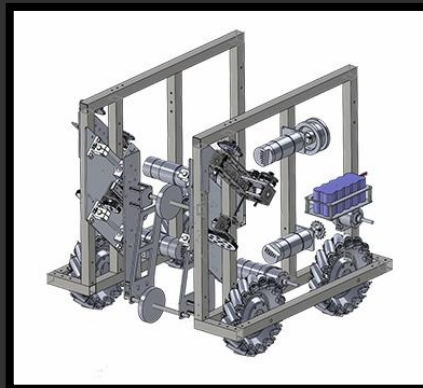
Attribute	Weight	Design 1	Design 2	Design 3			
Speed	1	5	5	2	2	3	3
Power	5	1	5	5	25	3	15
Reliability	3	3	9	4	12	3	9
Defense	1	2	4	5	5	4	4
Scoring	5	5	25	2	10	4	20
		48	54	48			

- Notice how just by changing the weight of the attributes I have changed the result for the best pick.
- Remember you can use this to make all kinds of choices.



FINALIZE YOUR DESIGNS

- After deciding on a design use CAD software to create a 3D model of your robot.
- Programs like SolidWorks, PTC, and Autodesk can be used.
- This step can take awhile since CAD can be difficult to use.
- In addition many teams do not have CAD knowledge. This is O.K!
 - Other ways to finalize the design may be a full scale drawing on paper.
 - Do extra prototyping.
 - Ask other teams for help.
- Use math too!



BUILD IT!

- This is the part where you finally get to see your design come to life!
- Use your plans to manufacture all the parts of your robot.
- Split into different subgroups to make this process go faster.
- Remember you can always tweak your design as you go.
- Use wood, PVC, aluminum stock, plexiglass, parts from your local hardware store, and other building systems to build your robot!
- You aren't just limited to expensive Tetrix parts.



TEST!!!

- Always test as you build and after you build.
- Break things, so you can fix them and make them better.
- Use the same engineering process to figure out the problems your team has and keep improving upon them.
- Always test more than 10 times.
- If something is iffy keep on testing until you know it works or not.
- Not happy with a design? Start over with it!



IMPORTANT TIPS TO KNOW

Take it from us and learn from our experiences.

IMPORTANT THINGS TO KNOW

- Always read Game Manuals 1 and 2. You can't play a game you don't know the rules of.
- Build within your limits
 - What is your experience?
 - How long will it take?
 - Can you afford it?
- Build simple
- Consistently do one or two tasks.
- Document everything!



WHERE TO BUY PARTS

- Finding suppliers for parts may be a daunting task for a new team.
- Here are some great suppliers of parts:
 - AndyMark
 - Rev Robotics
 - McMaster-Carr
 - ServoCity
 - Vex
- Please make sure all your parts are legal according to Game Manual 1



SET A SCHEDULE

And try to stick to it.

WEEKS 1 & 2

- Breakdown the game.
 - Brainstorm all of your ideas.
 - What do you want your robot to do?
 - Decide on a strategy and design for your robot.
-
- IDENTIFY, THINK & DESIGN



WEEKS 3 TO 5

- Split up into groups
 - This is going to help you work in parallel.
 - Keep communication open with all the groups.
 - The sooner you have something built the sooner you can start practicing.
- Build some prototypes
- Start to CAD out your final design
- Find flaws with your prototypes and use the engineering process to fix them.
- Change may be difficult at this point but it is still very possible.
- Start basic code.

- DESIGN & BUILD



WEEKS 5-7

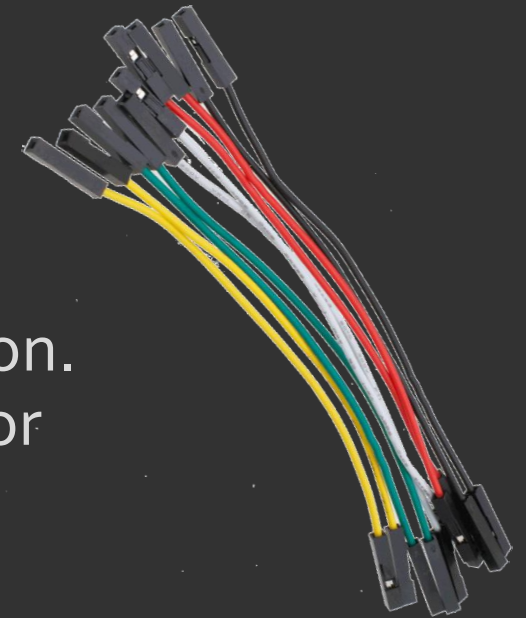
- Try and have a solid design you are happy with.
- Buy and create all the needed parts.
- Start the assembly all of your components.
- BUILD

```
def add5(x):  
    return x+5  
  
def dotwrite(ast):  
    nodename = getNodeName()  
    label=symbol.sym_name.get(int(ast[0]),ast[0])  
    print ' %s [label="%s" % (nodename, label)  
    if isinstance(ast[1], str):  
        if ast[1].strip():  
            print '= %s"' % ast[1]  
        else:  
            print ''  
    else:  
        print ''  
        children = []  
        for n, childrenumerate(ast[1:]):  
            children.append(dotwrite(child))  
    print ' %s -> {' % nodename  
    for n, namechildren  
        print '%s' % name,
```



WEEKS 6-8

- Start to worry about the cosmetics of the robot.
 - Protective shielding
 - Sponsor logos
- Start to wire all of the electronics in.
 - Properly mounting electronics can make or break a season.
 - Only mount what you need at the time but leave room for everything else.
- Keep assembling the robot.
- BUILD & TEST



WEEKS 8-9

- Test your drivetrain as soon as possible.
- You can start to code autonomous and do simple missions.
- Attach all the other components to the robot as they are completed.
- Test your other mechanisms and tweak them to work together.
- Break things
- Yes, break your robot!

- TEST & BUILD



WEEKS 10-12

- DRIVE!!!
- Keep on practicing with all your components.
- Refine your autonomous.
- Break things again
- Keep refining your design and working all the bugs out.
- Make spare parts ready for the first competition.

- If you are driving and everything is working perfectly, keep on building and adding more features.



GAME MANUAL 1

The cliff notes.

GAME MANUAL 1

- READ THE FULL GAME MANUAL
 - However, there are some important things to be careful of when designing.
- Motor limit
- Servo limit
- Size limit
- Weight Limit
- You can use any part as long as it has less than one degree of freedom.
 - What is a degree of freedom?
 - Hinge
 - Linear slide



GAME MANUAL 1

- Here are some banned parts for FTC
 - Premade gripper
 - Anything that is pneumatic.
 - Andymark 4" HiGrip Wheels
 - Lead or any other hazard materials
 - Loose ball bearings
 - IR lights that would mess with other robots.
- Remember to use the forum for any questions



GAME BREAKDOWN

The secret challenge to Rover Ruckus.

GAME BREAKDOWN

- Rover Ruckus is this year's game.
- As all FTC games are, it has been presented as one large challenge to overcome.
- We can however, use our first part of the engineering process to break things down into smaller pieces.



GAME BREAKDOWN

Mechanical

- Start on lander
- Lower off lander
- Place marker
- Remove gold mineral
- Break crater plane
- Pick up minerals
- Drive over the crater
- Store minerals
- Sort minerals
- Score minerals
- Hang back on lander

Control

- Unlatch from lander
- Find home
- Drive to depot, crater, and such
- Identify minerals in auto
- Identify minerals in tele-op
- Driver assistance

QUESTIONS?

Remember you can email us anytime at:

FTC7244@gmail.com