

The background features abstract, overlapping green geometric shapes, primarily triangles and polygons, in various shades of green, creating a modern and dynamic visual effect.

# Mechanical Design Selection Process

FRC Team 503

Frog Force

# Key Ideas

- ▶ Analysis- Analyze the game first
- ▶ Strategy- **What** are we going to do?
- ▶ Design- *Then* design the robot
- ▶ Tactics- *Finally*, specific match strategy- how are we going to do it?

# Strategy

## Understand

- Analyze the Game - know EVERYTHING about it, including every way to score and PENALTIES
- Build within your means



## Identify

- Identify the desired function, everything possible that can be done. Break it up into sections (auton, match, end game)



## Prioritize

- List items by points gained, by time, and/or by difficulty

# Analysis Leads to Strategy

- ◀ Choose a strategy that you can complete reliably.
- ◀ A completed robot with time to practice driving is better than shooting for the moon and not completing the build
- ◀ A task that you can accomplish easily and reliably is better than a task that you may spend an entire match and not accomplish.

# Strategy

- ▶ After understanding the game, you start by seeing what functions you want your robot to do

\*\*\*\*a function is not how you do something, it is what you want to do\*\*\*\*

- ▶ This is called a QFD or Quality Function Deployment renamed for our team as FFFD



## Frog Force Function Deployment

Year: 2017

Game: STEAMWORKS

Group:

Students:

Robot must be able to (verb) the (noun #1) into/over/under the (noun #2) .

### Functions List

Rank	Action (verb)	Target Object (noun #1)	Details (noun #2)	Specifications

## Strategy cont.

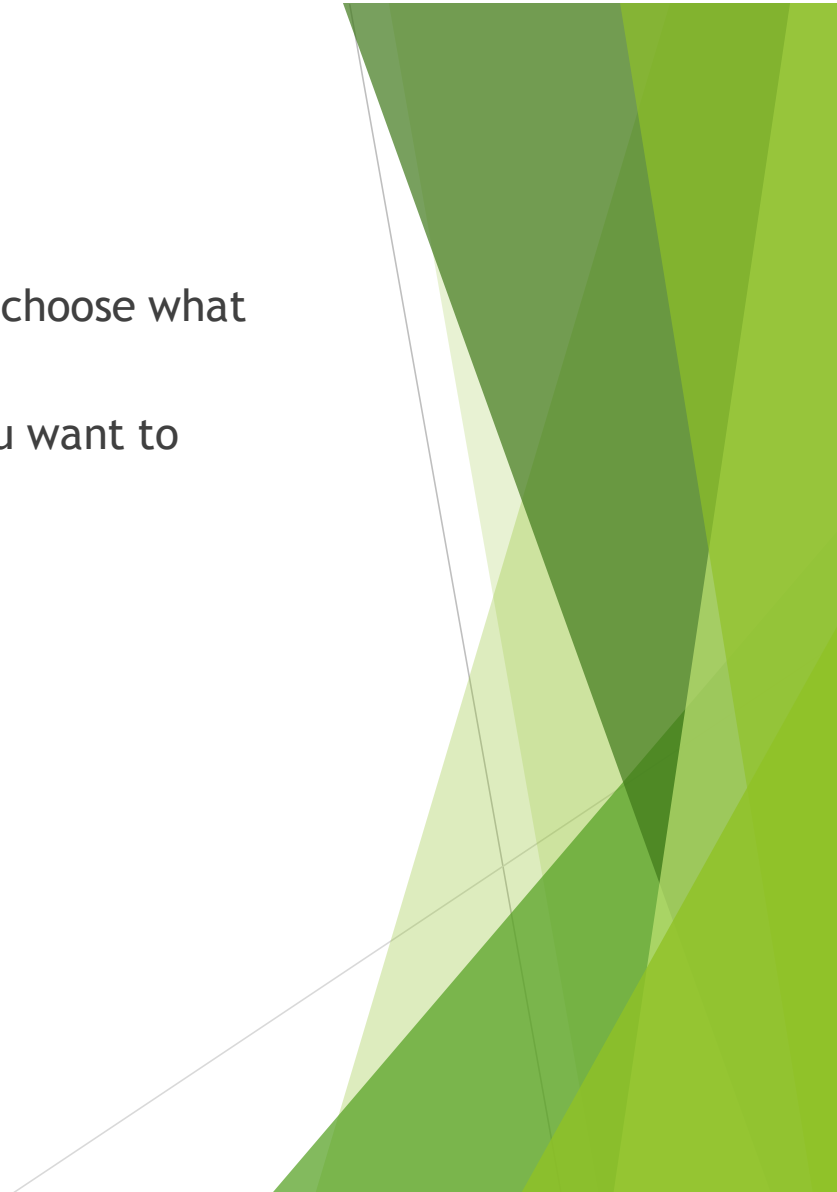
- After finding your functions, you prioritize your functions to see what you need to build to complete these functions
- Based on your rankings, you then start thinking about ideas to build and use a Pugh matrix

EX: 2017 Steamworks

Rank	Action (verb)	Target Object (noun #1)	Details (noun #2)	Specifications
1	Drive	itself	(around) the field	including over auton line
2	Place	Gear	Lift	
3	Store	Fuel	robot	A lot
4	Shoot	Fuel	boiler high goal	
5	Intake	Gear	feeder station	
6	Climb	Rope	top	
7	Intake	Fuel	feeder/hopper	
8	Intake	Fuel	floor	
9	Shoot	Fuel	boiler low goal	
10	Intake	Gear	floor	

# Strategy Leads to Design

- ▶ Only after you've decided on your strategy should you choose what your robot design should be.
- ▶ Don't decide on a build design until you know what you want to accomplish



# What is a Pugh Matrix?

- ▶ A Pugh Matrix is a decision making model to choose between a list of alternatives.
- ▶ It is an engineering tool used across the world to help companies develop the best products





# How do you use a Pugh Matrix?

Criteria: Choose the most important things to consider when assessing your ideas

EX: Robustness, Simplicity, Margin of error

Weight: How much does this criteria mean to your decision, you will give each criteria a weight 1-3 on the importance

EX: You would rather have something that will not break than something that has a small margin of error

Ideas: When scoring your ideas based on the criteria, you will use a 0-3 scale with 3 being the best

Criteria	Weight (1-3)	Idea 1 (0-3)	Idea 2 (0-3)	Idea 3 (0-3)	Idea 4 (0-3)
1					
2					
3					
4					

## What does this tell you?

- ▶ After you put a number for each idea and criteria, you add up all the numbers and find the highest number and pursue that idea
- ▶ Based on your matrix, the highest scoring idea should be the best for your team to build

Pugh Matrix	Weight	spool	spool	single	single	double	double	inchworm	inchworm
Quick	3	3	9	1	3	1	3	0	0
reliable	3	3	9	1	3	2	6	1	3
strength	2	2	4	3	6	2	4	0	0
complexity	1	3	3	2	2	1	1	0	0
			25		14		14		3

# Mechanical Design Selection Steps

Steps:	Key Inputs	Key Outputs
Step 1: Analysis	<ul style="list-style-type: none"><li>• Game manual</li><li>• Knowledge from other teams/discussions</li><li>• Historical</li><li>• Individual experience</li></ul>	<ul style="list-style-type: none"><li>• Scoring worksheet</li><li>• Game strategy</li><li>•</li></ul>
Step 2: Strategy	<ul style="list-style-type: none"><li>• Scoring worksheet</li><li>• Game strategy</li><li>• Running Game Estimates</li></ul>	<ul style="list-style-type: none"><li>• Design functions (move, score high, pull-up)</li><li>•</li></ul>
Step 3: Design	<ul style="list-style-type: none"><li>• Design functions</li></ul>	<ul style="list-style-type: none"><li>• Brainstorm</li><li>• Prototype ideas (multiple)</li></ul>
Step 4: Build	<ul style="list-style-type: none"><li>• Prototype testing data</li><li>• Matrix</li></ul>	<ul style="list-style-type: none"><li>• Mechanical design selection</li></ul>
Step 5: Repeat	<ul style="list-style-type: none"><li>• Mechanical design</li></ul>	<ul style="list-style-type: none"><li>• Back to Step 1</li></ul>

# Pugh Matrix Examples



Criteria	Weight (1-3)	Idea 1 (0-3)	Idea 2 (0-3)	Idea 3 (0-3)	Idea 4 (0-3)
1					
2					
3					
4					

The background features abstract, overlapping green geometric shapes. On the left, a solid green trapezoid points upwards. On the right, a complex arrangement of various shades of green (from light lime to dark forest green) forms a series of overlapping triangles and polygons, creating a dynamic, layered effect. A thin, light gray line extends diagonally from the bottom left towards the right, passing through the green shapes.

Any Questions??