Prototyping

Prototyping is the art of rapidly iterating through rough concepts of systems that you may want to put on your robot. You do this so you can see if these systems will work well, figure out how to make them work best, and know what the most fragile elements of your robot are. For a good starting point check out the Prototyping 101 resource.

Use this workbook to work more effectively and efficiently during the build season.

Prototyping

- ❑ Go through this workbook and its questions with your team
- ❑ Includes **following elements:**

01. Selective Prototyping
02. Brainstorming
03. Planning
04. Physical Prototyping
05. Testing
06. Review

01 SELECTIVE PROTOTYPING

DISCUSSION

Choose what systems or mechanisms to prototype.

1. Create a list of the subsystems that you wish to prototype.

   E.g. launcher, intake or climber.

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2. For each of these systems list out what your team needs, wants, and wishes it could do.

02 BRAINSTORMING

ACTIVITY

Before you can start prototyping, you need to know *what* you are prototyping.

For each of the previously listed systems come up with at least four solutions. Do this as a team, and don't forget that there are no bad ideas!

There are many different brainstorm techniques out there, and no single one is better than one other, so go out and try new methods!

A few different techniques are Rapid Ideation, Round-robin Brainstorming, and Reverse Brainstorming. Start off with these and work your way through the internet to find that one technique that works for you.

Make sure that you document all your ideas for later use. Even small parts may lead to a huge breakthrough during this process.

03 PLANNING

DISCUSSION

Define your goals for prototyping, and how you are planning to reach these.

1. For each of the previously listed systems, find the variables you want to understand better to reach your systems goals.

   eg. wheel size, wheel speed, ball placement and ball compression for a launcher.

2. Be prepared to prototype! Plywood, cardboard, tape, and 2x4's are your friends. What other materials might come in handy?

04 PHYSICAL PROTOTYPING

ACTIVITY

Now it is time to get your hands dirty, dig in and let the creativity flow.

Prototyping can be tough as you tend to run into a lot of issues face first, and it may seem that there is no way that your prototype will make the final cut. Don't lose hope, the next breakthrough might be the deciding one!

While prototyping there are a few key points to keep in mind.

1. Just build it, quick and dirty is fine at first! Don't linger too long on decisions, time is key here.

2. Iterate, iterate, iterate. Build your system piece by piece and make sure that everything works before adding more complexity.

3. If something takes too much effort and is too complicated, drop it. Remember KISS (Keep It Simple, Silly).

This is definitely not a full guide on physical prototyping, try it for yourself and improve! For a more in depth look at prototyping, check out: Prototyping 101

05 TESTING

ACTIVITY

Besides the actual prototyping, testing is the most important step in this process, here you will find the weaknesses and strengths of each system.

1. For each of the prototyped systems, tweak the variables previously found. Record videos of all your testing, and take data on what works, and what doesn't.

2. Find the physical limits of your prototype. Have you tested enough times to have found all the failure points?

   When talking about limits think for example of the maximal compression on a launcher before the ball gets stuck, or the minimal feeding speed of an intake.

3. When you are further in the prototyping process you might want to think about how the final robot should look like. What systems do you think need to be tested together, and how could you simulate this?

06 REVIEW

DISCUSSION

Reflect on your team's prototyping and testing process. What still needs to be done?

1. Look back at your videos and data. What do you still need to tune? If you still have the choice between two or more similar subsystems, which one do you want on the robot?

2. Now that you understand the system you have prototyped better, return to step 3: Planning and iterate until you feel the system you are working on is performing how you want it to. What do you think could be done better or more efficiently?