



Training and Support



PRESENTING SPONSOR

QUALCOMM

# 2017-2018 *FIRST*<sup>®</sup> Tech Challenge Engineering Notebook Guidelines



## Sponsor Thank You

Thank you to our generous sponsors for your continued support of the *FIRST* Tech Challenge!

***FIRST*® Tech Challenge  
Season Presenting Sponsor**



***FIRST*® Tech Challenge  
Official Program Sponsor**



***FIRST*® Tech Challenge  
Official 3D Augmented Reality/  
Virtual Reality Sponsor**



## Volunteer Thank You

Thank you for taking the time to volunteer for a *FIRST*® Tech Challenge event. *FIRST*® and *FIRST*® Tech Challenge rely heavily on volunteers to ensure events run smoothly and are a fun experience for teams and their families, which could not happen without people like you. With over 4,600 teams competing yearly, your dedication and commitment are essential to the success of each event and the *FIRST* Tech Challenge program. Thank you for your time and effort in supporting the mission of *FIRST*!



Revision History		
Revision	Date	Description
1	09.01.2017	Initial Release

## Contents

What are the *FIRST*® Tech Challenge Engineering Notebook Guidelines? ..... 4

Engineering Notebook Overview ..... 4

    What is an Engineering Notebook? ..... 4

    Engineering Notebook Questions ..... 5

Engineering Notebook Formats ..... 5

    Engineering Notebook Requirements ..... 5

Engineering Notebook Tips to Help your Team Stand Out ..... 6

    Business/Strategic Plan ..... 8

    A Sustainability Plan ..... 9

Notebook Examples ..... 9

Award Categories that Require the Engineering Notebook ..... 10

Additional Engineering Notebook Resources ..... 11

Appendix A – Resources ..... 11

    Game Forum Q&A ..... 11

<i>FIRST</i> Tech Challenge Game Manuals.....	11
<i>FIRST</i> Headquarters Pre-Event Support.....	11
<i>FIRST</i> Tech Challenge Event On-Call Support .....	<b>Error! Bookmark not defined.</b>
<i>FIRST</i> Websites.....	11
<i>FIRST</i> Tech Challenge Social Media .....	11
Feedback.....	12

## What are the *FIRST*® Tech Challenge Engineering Notebook Guidelines?

---

The purpose of the *FIRST* Tech Challenge Engineering Notebook Guidelines is to:

- Provide an additional resource for teams to create successful and effective Engineering Notebooks to be used throughout the *FIRST* Tech Challenge Season.
- Expand on the guidelines provided in [Game Manual Part I](#).
- Providing Award Winning Examples.

The Guide focuses on the skills and concepts needed for the development of the following general goals:

- Creating a successful and effective Engineering Notebook
- Provide tips for Mentors/Coaches to guide students to best utilize the Engineering Notebook.

This Guide would not be possible without the contributions of time, ideas, and resources provided by the following people:

- Jill Wilker, *FIRST* Tech Challenge Judge Advisor
- Dee Tomczak, *FIRST* Tech Challenge 2015 World Championship Think Award Judge
- Gigi Johnson, *FIRST* Tech Challenge 2015 World Championship Think Award Judge
- Marlene Lynn, *FIRST* Tech Challenge 2015 World Championship Think Award Judge
- Team 365, *FIRST* Tech Challenge 2015 World Championship Think Award Finalist
- Team 4250, *FIRST* Tech Challenge 2015 World Championship Think Award Finalist
- Team 5037, *FIRST* Tech Challenge 2015 World Championship Think Award Finalist
- Team 6134, *FIRST* Tech Challenge 2015 World Championship Think Award Finalist

## Engineering Notebook Overview

---

### ***What is an Engineering Notebook?***

One of the goals of *FIRST* and *FIRST* Tech Challenge is to recognize the engineering design process and the journey that a team makes. This journey encompasses the phases of the problem definition, concept design, system-level design, detailed design, test and verification, and production of the robot.

Throughout the process of designing and building a Robot, teams will come across obstacles, lessons learned, and the need to draw things out on paper. This is where teams use an Engineering Notebook. These notebooks track a team from the beginning of the season and throughout the Competition season. Judges review a team's Engineering Notebook to better understand the journey, design, and team as a whole.

The Engineering Notebook is a documentation of the team's Robot design and records the time spent doing research, outreach, team meetings, and plans for growth. This documentation should include:

- Sketches
- Discussions and team meetings
- Design evolution
- Software development
- Processes, obstacles
- Each team member's thoughts throughout the journey for the entire season

**A new notebook should be created for each new season.**

### ***Engineering Notebook Questions***

This journey goes beyond recording the day to day "here's what we did" or just listing "we met today". It explores questions like:

- What is the agenda today and what are our goals?
- Why are you meeting?
- What decisions did your team make in forming the team, creating the robot, writing the program, the outreach projects, etc.?
- Why did you make that choice when building your robot, coded the software that way, chose that group of individuals to outreach to, etc.?
- What was the impact on your team, robot, or community when you made that decision?
- What is the next step?

## **Engineering Notebook Formats**

---

Teams may choose to record their season with either handwritten, electronic, or online documents. There is no distinction made between handwritten and electronic Engineering Notebooks during Judging; each format is equally acceptable. Only one copy is required per team.

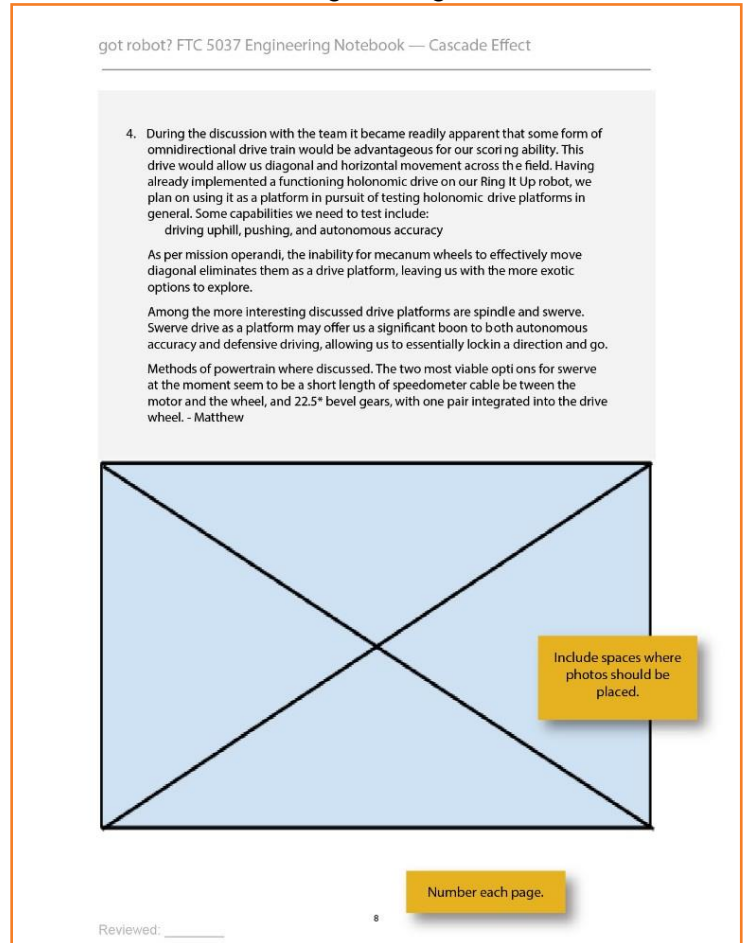
**Electronic/Online:** Teams may choose to use electronic or online programs to create their Engineering Notebook. For the purposes of Judging, teams must print out their Engineering Notebooks and place them in a binder, no larger than 3 in (7.62 cm) and no more than 2 binders.

**Handwritten:** Teams can choose from spiral-bound, laboratory, or documentation notebooks available through their school or local office supply store. Teams can also use loose leaf paper and place them in a three ring binder no larger than 3 in (7.62 cm). No more than 2 binders/notebooks.

### ***Engineering Notebook Requirements***

1. Teams may not submit more than two notebooks at a competition.

2. The Team Number and Team Name must appear on the outside of the Engineering Notebook.  
**Engineering Notebooks will not be considered without this information.**
3. Attach a summary page to the front cover of the Engineering Notebook. The summary should be one page and include a summary narrative about the team, school, or organization with bulleted highlights of the team's season. The team summary page should also include the team number and a list of pages in the Engineering Notebook that the team would most like the Judges to consider.
4. The Engineering Notebook must be divided into multiple sections, including:
  - a. An Engineering Section that includes the Robot design processes (required).
  - b. A Team Section that includes information about the Team and outreach activities (required).
  - c. And include one or more of the following (not required, but check requirements for specific Awards).
    - i. A Business plan
    - ii. A Strategic plan
    - iii. A Sustainability plan



## Engineering Notebook Tips to Help your Team Stand Out

1. Every Notebook is a work in progress, forever changing and developing. Judges do not want to see a “final” copy notebook; they want the real thing complete with misspellings, stains, worn edges and wrinkled pages. Just remember to keep it real!
2. Document EVERYTHING.
  - a. Include the time after you finish your build and all the way up to Competition, as well as between Competitions. If your team plans on competing in multiple events for the season, what are you doing to improve your performance? How are your outreach efforts? How is your team investing its time in between the Competitions? **Do not stop using the Engineering Notebook once the Robot is complete.**
  - b. Ask yourself questions like:
    - i. What worked, what didn't? Do not be afraid to include your failures. This is about your journey toward success. When something didn't work, how did you problem-solve?
    - ii. What modifications are you planning on making?
    - iii. How has your Robot changed over the course of the season?
    - iv. How do you plan to fund your way to each event?
  - c. The documentation should be detailed enough that somebody could look at your notebook and be able to build your Robot from it.
3. Summary Narrative Page should be used as a way to impress the Judges without the team being in the

room.

- a. When crafting your summary narrative, make sure you highlight what makes your team stand out. Remember to keep this short, as you would want Judges to have more time diving into the pages of your notebook that you have tabbed for them.
  - b. Remember, Judges only have a limited amount of time with each notebook. When tagging the pages you would like them to review, keep in mind that more tabs means that they will have less time to spend on each page. Think, **quality over quantity**.
4. Engineering Notebooks should be organized enough that an outsider (e.g. a potential sponsor) can understand the team and their journey.
    - a. Be clear when dividing the notebook into sections.
  5. Start the Team Section of the notebook by introducing each team member and mentor with a brief biography of their name, age (or school year), role on the team, interests, and reasons for joining a FIRST Tech Challenge team.
    - a. The Team Section is also a good place to discuss and show team activities that are done throughout the team's season. These can include what your team outreach efforts include, team building activities, or more.
    - b. Pictures along with the bios would serve as a great visual for the Judges to get to know each member of the team.
  6. Start a fresh page in the Engineering Section at every meeting. The date, and start/stop times should be recorded when starting a new page.
    - a. Include highlights from the meeting. What was talked about? What did you do? What was planned and/or accomplished during your time together?
  7. All designs and changes to the Robot should be recorded directly into the Engineering Section of the Engineering Notebook. The inclusion of all details and sketches are preferable. Notes and calculations should be done in the notebook, NOT on loose paper.
    - a. A Judging panel is always interested to see a unique design or playing strategy. On the other hand, a design without the substance to support its reasoning is not viewed as highly. Remember to explain the *underlying science, math, and strategies your team is using as well as why you are doing what you are doing*.
    - b. Pictures or sketches of the Robot designs, electrical wiring diagrams, or even software development are recommended as part of a thorough documentation.

got robot? FTC 5037 Engineering Notebook — Cascade Effect


---

9.16.14 PROTO-STORM!! Duration 6:00 pm - 8:00 pm

**Attendance:**  
Bo, Chris, Matthew, Aidan, PJ, Kristen, Marcos, Coach, Programming Coach Stephen, Mrs. Laker, Mrs. McKellar, Mr. Solomon

Tasks:	Reflections:
1. Plan ideas for a practice "sparring" robot that we would use as an "opponent" for the rest of the season.	1. Aidan was tasked with developing the sparring bot, a robot which we will use for training during driving practice. (See details.)
2. Brainstorm ideas for ways of picking up and scoring balls	2. Matt, Marcos, Kristen, PJ, Coach, and Mr. Stephen spent time generating ideas for ways that our competition robot could pick up balls and deploy them. (See details.)
3. Put the ideas presented into CAD so they can be tested virtually.	3. Bo and Chris would work on getting the ideas that are presented into CAD. (See details.)
4. Brainstorm new ideas for our robot.	4. The two major discussion points involved the construction and requirements of the drivetrain, and ball transfer devices. Possible drivetrains included the likes of swerve and holonomic, while the ball mechanisms discussion included inertial kickers, slides, and conveyors. (See details.)

Clearly states tasks and team reflections



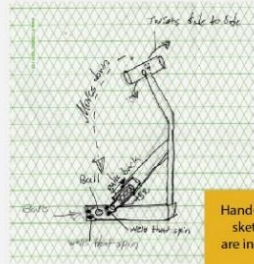
Reviewed: \_\_\_\_\_ 5

8. Think about including your software development. This does not mean including the entire code, rather we encourage you to describe your code.
9. Written entries must be in permanent ink – not pencil.
10. Entries should be made by every team member, initialed, and dated. Judges like to see entries from more than one team member. It is not prohibited for one student to own the Engineering Notebook. However, showing that your team has multiple members sharing the responsibility showcases how your team is thinking about the sustainability of your team.
11. Use both sides of a page. Never leave any white space: “X” out or crosshatch all unused space, and initial and date. For electronic Engineering Notebooks, consider printing on both sides of the paper.
12. To insert pictures or outside information into the notebook, tape the picture into the notebook and outline with permanent ink, to note that it was there in case it falls out. Put the corresponding page number on that inserted page
13. In the case of an error, draw a single line through the incorrect data. Do NOT erase or use correction fluid. All corrections should be initialed and dated.

got robot? FTC 5037 Engineering Notebook — Cascade Effect


Details:

1. My current idea is to make a sparring bot with a telescoping lift that has a scoop/tube attached at the top. This tube will have a pivot in the middle. There will be a scoop with a zip-tie intake in the front and behind the tube will be an opening hatch. In order to pickup balls the lift will lower all the way while the tube moves on its pivot to become parallel with the ground, allowing balls to enter through the zip-tie intake. Once the pipe is full the lift would raise and the pipe would become vertical. To score, the robot would move its lift/tube to roll the balls into a rolling goal we would have attached on the back. This goal would not be released so we could continue scoring easily. --AMP



Hand-drawn sketches are included

2. During our brainstorming section for the robot's intake/delivery multiple ideas were presented.
  - a. I thought of a 2 part delivery mechanism.



Recording ideas for possible design

Delivery Mechanism:

My idea entails a pipe and an arm with 2-3 claws mounted at the end. The illustration to the left shows how these components go together. At the bottom is a square frame/base, which the drawer slide is mounted to, on the front. The top of the slide has two straight bars that make up an arm connecting the slide system to a horizontal 'pipe' at the very top. This 'pipe' will be able to hold 5 balls total. Through the slide changing elevation the arm and thus the pipe will move as desired. This mechanism will have 4 preset movement capabilities:

- Pipe end facing ground at 45° from vertical
- Wrist will rotate left/right
- Arm shoulder rotates up/down so that the arm rises
- Pipe end facing ground at 45° from vertical on either side

Reviewed: \_\_\_\_\_ 6

## Business/Strategic Plan

Identify the Purpose for a Business Plan for your team. This is unique for every team and may touch on one or more of the following needs:

- Direction the team wants to take.
- Outlining team Goals.
- Type of outreach team wants to focus on.
- Creating a team budget.
- Fundraising needs.
- Seeking out Sponsors.

The Business Plan can act as the backbone and guiding force for your team. By mapping out where you plan to go during the season (starting with who and what your team is all about), the goals you want to achieve and what you need to do in order to reach them, your team will be able to stay on track throughout the season. This is a living document and may change based on challenges that may arise through the season, lessons learned, or new opportunities. Plan on revisiting this document a few times throughout the season to see if your team is on track of if a new direction is being taken, and modify your Business Plan accordingly.

Your Strategic Plan may also include milestones. These may they be short term (i.e. competing in at least two events this season) to one-year plan (i.e. making it to a Regional Championship and fundraising the costs) or even further (i.e. plans to create and foster additional FIRST Tech Challenge teams).



Ask yourself:

- What are your team Goals?
- Are you planning to use the Business Plan to plan your funding strategies?
  - How much money does your team need to get started and for what? (ie: a budget)
  - How much money does your team need to sustain it for multiple years?
  - How much money does your team plan to raise through fundraising efforts?
  - How much money does your team anticipate raising through grant opportunities?
  - How much money/in-kind donations do your team plan to raise through sponsorship?
  - How will you promote a business/organization if you receive a sponsorship? (Logo on team t-shirts and flare, etc.)
- Are you planning to use the Business Plan to seek out Sponsors?

A Strategic Plan or Business Plan is documentation of the process through which an organization defines, priorities, and develops the process they will undergo to achieve their goals. It helps the organization (in this case, your team) determine a course of action and a measure by which to decide about how they will gather and use resources. That information can then be shared within the team to keep everyone focused, as well as outside of the team, such as with parents, school administrators, Sponsors, and other groups to articulate the team's purpose and impact.

Make sure to identify what must be purchased, such as tools and major components, not only simple categories like parts, travel lodging, etc. It should include the budget, the fundraising plan, contingencies if the team does not reach their fund-raising plan, and what they will do if they have excess. For multiple team organizations, show who is doing what and how the money raised is divided.

See an example in our Appendix D: [Sample Business/Strategic Plan](#).

### ***A Sustainability Plan***

This plan can be integrated into the Business/Strategic plan. This plan explains how the team plans to grow and stay competitive when students graduate from the program. This may include plans to recruit sponsors, new mentors, or team members.

When considering including a Sustainability Plan, ask yourself:

- How does your team plan on continuing past this season?
- Are you training younger team members in key roles as members graduate out?
- Are there plans for recruiting new members? What are they?
- Does your team have plans on recruiting additional mentors?
- How are you fundraising the costs of next season? Registration? New parts?
- How are you and your team leaving a legacy that will last beyond just this season?

See an example in our Appendix D: [Sample Business/Strategic Plan – Sustainability](#).

## **Notebook Examples**

---

Scanned copies of award-winning Engineering Notebook (both electronic and handwritten) examples are posted on the FIRST Tech Challenge [Team Management Resources](#) website under Engineering Notebook Resources. It is strongly encouraged for teams to look over these great examples of what the Judges will be looking for when reading through the Engineering Notebooks. Please remember, each Engineering Notebook reflects the team creating it. Although these samples are great references, the methodology and format used for these teams may not fit your team. These are examples that may *inspire* your team when starting your Engineering Notebook, but should not be used as the sole template for your Notebook.

## Award Categories that Require the Engineering Notebook

The chart below provides a quick overview of the Engineering Notebook requirements by Award:

Engineering Notebook Requirements by Award	
<b>Inspire Award</b>	<ul style="list-style-type: none"> <li>Team must submit an Engineering Notebook. The Engineering notebook must include an Engineering section, a team section and a Business or Strategic Plan. The entire Engineering Notebook must be high quality, thoughtful, thorough, detailed and well organized.</li> </ul>
<b>Think Award</b>	<ul style="list-style-type: none"> <li>Team must submit an Engineering Notebook. The Engineering Notebook must have an Engineering section that includes entries describing underlying science, mathematics, and game strategies.</li> <li>The Engineering Notebook must show that the team has a clear understanding of the engineering design process, with pictures or drawings and details documenting all stages of Robot design.</li> <li>Notebook must recount the team's journey, experience and lessons learned throughout the season.</li> <li>Engineering Notebook must be organized and follow the formatting guidelines provided by <i>FIRST</i> and include a Summary Page. Note: Teams should review the Engineering Notebook resources published in the Team Management section of the <i>FIRST</i> website.</li> </ul>
<b>Connect Award</b>	<ul style="list-style-type: none"> <li>Team must submit an Engineering Notebook. The Engineering Notebook must include a Business or Strategic plan that identifies their future goals and the steps they will take to reach those goals. The plan could include fund-raising goals, sustainability goals, timelines, outreach, and community service goals.</li> </ul>
<b>Rockwell Collins Innovate Award</b>	<ul style="list-style-type: none"> <li>Team must submit an Engineering Notebook. The Engineering Notebook must include an Engineering section that documents the design process and how the team arrived at their design solution.</li> </ul>
<b>Design Award</b>	<ul style="list-style-type: none"> <li>Team must submit an Engineering Notebook with an Engineering section that includes detailed Robot design drawings.</li> <li>Team demonstrates industrial design principles, striking a balance between form, function, and aesthetics.</li> </ul>
<b>Motivate Award</b>	<ul style="list-style-type: none"> <li>Team must submit an Engineering Notebook. The Engineering Notebook must include a Business or Strategic plan that identifies their future goals and the steps they will take to reach those goals. The plan could include fundraising goals, sustainability goals, timelines, outreach, and community service goals.</li> </ul>
<b>Control Award</b>	<ul style="list-style-type: none"> <li>The Team must submit an Engineering Notebook. The Engineering Notebook must include an Engineering section that documents the control components.</li> </ul>

Read the full Awards Descriptions in [Game Manual Part I](#) here.

## Additional Engineering Notebook Resources

---

For more information and suggestions, check out the following resources:

[Mentor Manual](#) – there is a section on the Engineering Notebook, as well as Appendices that include: Engineering Notebook samples (with tips on why they were successful), information on writing a Business/Strategic Plan, and more.

[FIRST Tech Challenge Example Engineering Notebooks](#) – under the Training Resources section of the *FIRST* Tech Challenge Team Resources webpage there are four full Engineering Notebooks from teams. Check them out for ideas.

[FIRST Tech Challenge Fundraising Resources](#) – Fundraising Guide, Budgets, Sponsor Presentations, etc.

[Fundraising Toolkit](#) – lots of information and example Business, Strategic, and Sustainability plans, including sample budgets.

[Judges Manual](#) – review for information on how Judges will be evaluating the Engineering Notebook.

## Appendix A – Resources

---

### Game Forum Q&A

<http://ftcforum.usfirst.org/forum.php>

Anyone may view questions and answers within the *FIRST*® Tech Challenge Game Q&A forum without a password. In order to submit a new question, you must have a unique Q&A System User Name and Password for your team.

### FIRST Tech Challenge Game Manuals

Part 1 and 2 - <http://www.firstinspires.org/node/4271>

### FIRST Headquarters Pre-Event Support

Phone: 603-666-3906

Mon – Fri

8:30am – 5:00pm

Email: [FTCTeams@firstinspires.org](mailto:FTCTeams@firstinspires.org)

### FIRST Websites

*FIRST* homepage – [www.firstinspires.org](http://www.firstinspires.org)

[FIRST Tech Challenge Page](#) – For everything *FIRST* Tech Challenge.

[FIRST Tech Challenge Volunteer Resources](#) – To access public Volunteer Manuals.

[FIRST Tech Challenge Event Schedule](#) – Find *FIRST* Tech Challenge events in your area.

### FIRST Tech Challenge Social Media

[FIRST Tech Challenge Twitter Feed](#) - If you are on Twitter, follow the *FIRST* Tech Challenge Twitter feed for news updates.

[FIRST Tech Challenge Facebook page](#) - If you are on Facebook, follow the *FIRST* Tech Challenge page for news updates.

[FIRST Tech Challenge YouTube Channel](#) – Contains training videos, Game animations, news clips, and more.

[FIRST Tech Challenge Blog](#) – Weekly articles for the *FIRST* Tech Challenge community, including Outstanding Volunteer Recognition!

[FIRST Tech Challenge Team Email Blasts](#) – contain the most recent *FIRST* Tech Challenge news for Teams.

[FIRST Tech Challenge Google+](#) community - If you are on Google+, follow the *FIRST* Tech Challenge community for news updates.

### **Feedback**

We strive to create support materials that are the best they can be. If you have feedback regarding this manual, please email [ftcteams@firstinspires.org](mailto:ftcteams@firstinspires.org). Thank you!