Advice for New FIRST Teams

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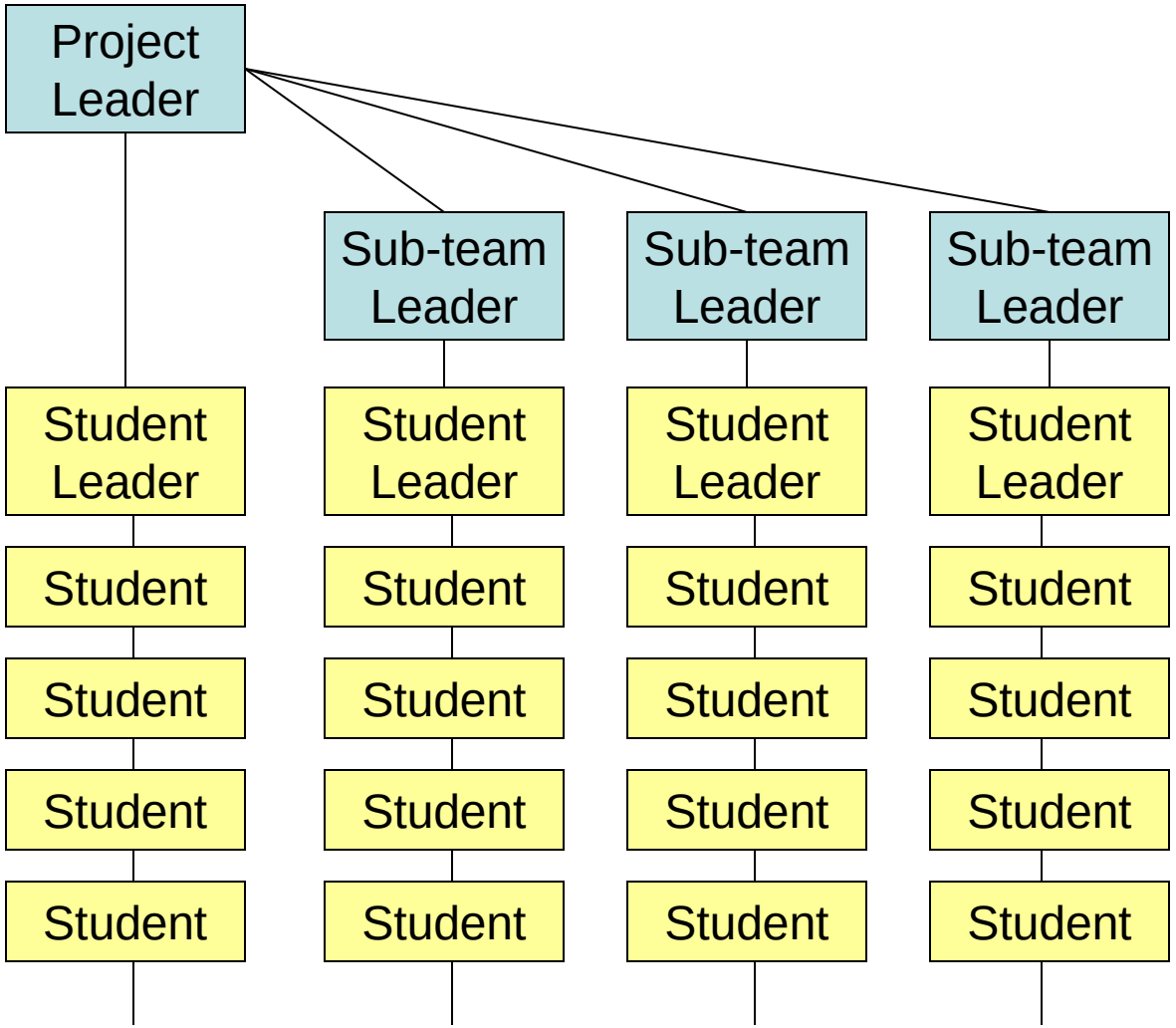
Team #33
Killer Bees

Jim's Disclaimer

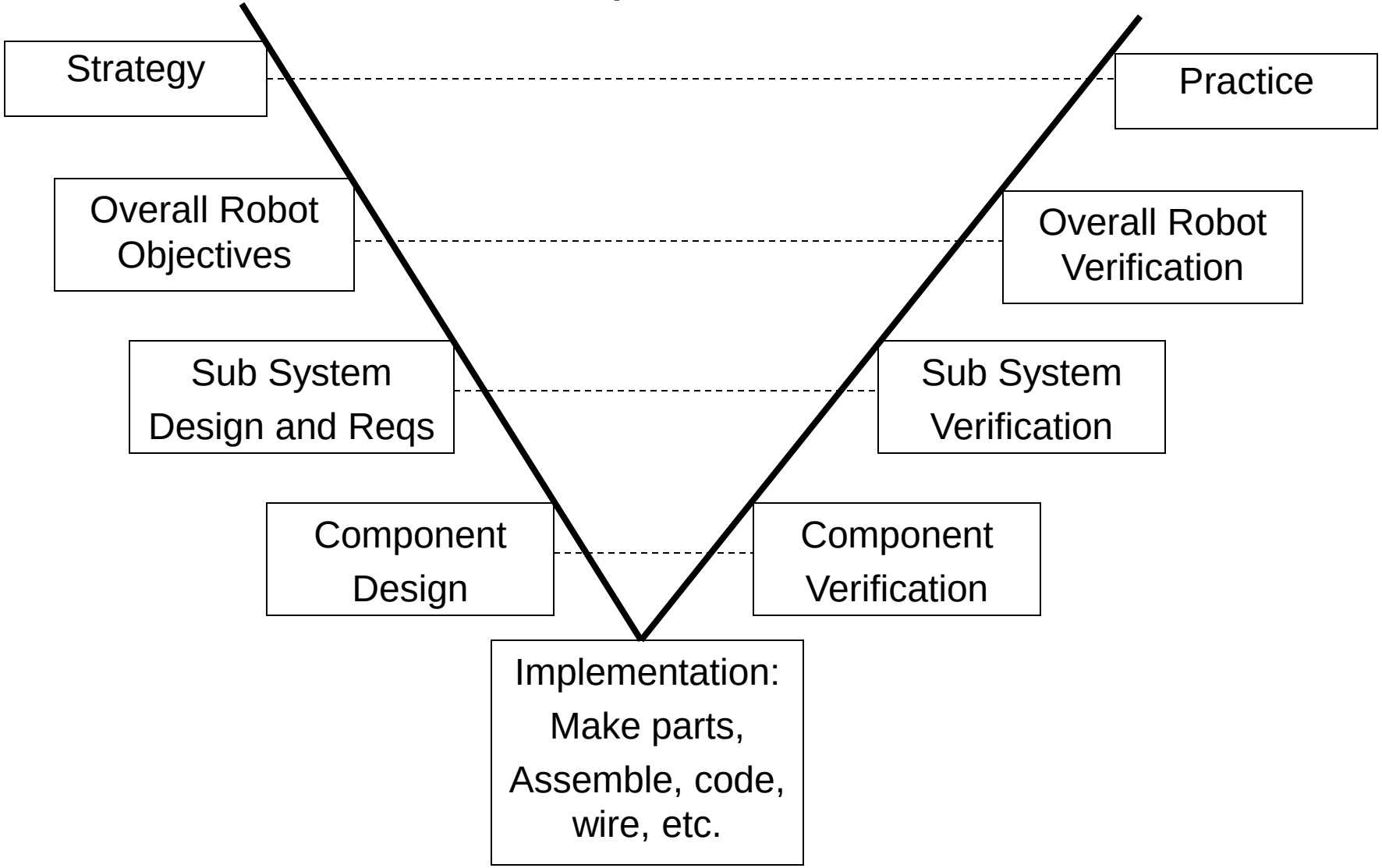
- Every FIRST team is different, and the methods you choose for running your team will be driven by your team's individual situations. The ideas discussed here work well for Team #33 but your team may have different resources and demands.
  - Key factors include:
    - **Money**
    - **Facilities**
    - **Skills**
    - **Experience**
    - **Number of people**
    - **Current game challenge**

- None of this is static: Despite 19 years of experience, we adjust the details of our process somewhat every year.

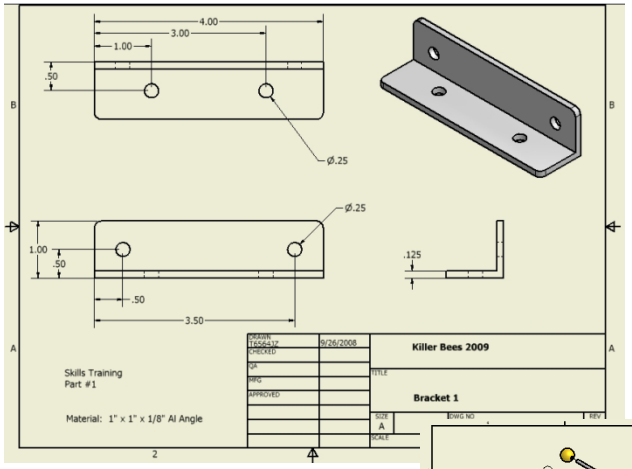
Team Organizational Structure

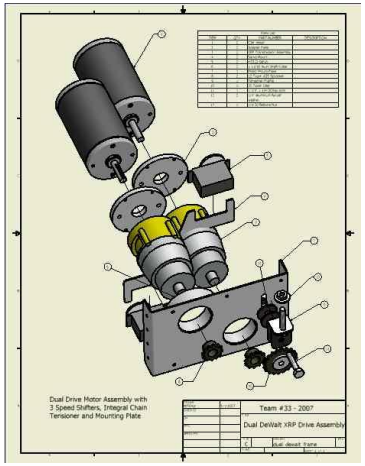


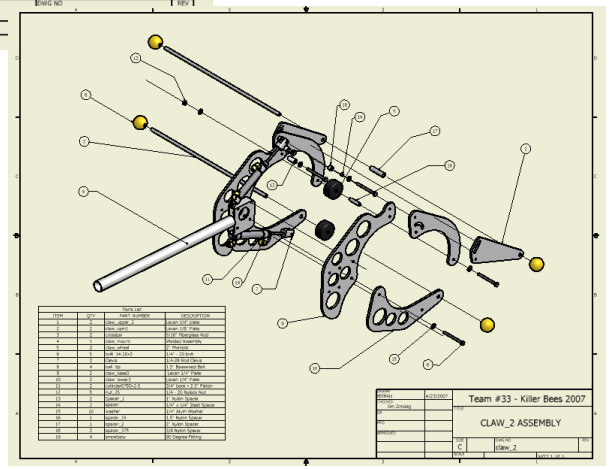
Development V Model

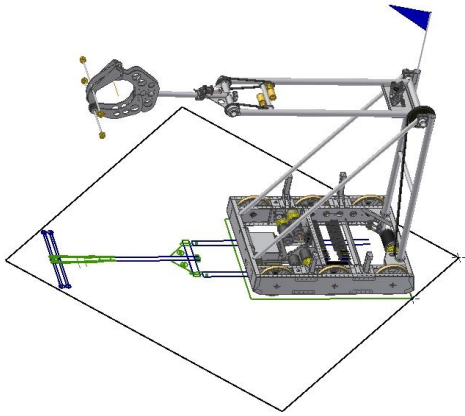


Make CAD drawing of all parts:









Indispensable for:
Design discussions
Part Manufacturing
Component packaging
Award Submissions
Technical Papers

This should be a team effort!

Top 10 Lists

- Pre season:
  1. Make a detailed schedule
  2. Make a budget outline
  3. Define your organization
  4. Pre order material
  5. Predefine standards
  6. Learn to make parts
  7. Learn computer skills.
  8. Benchmark others
  9. Get involved
  10. Order Uniforms

- Build season
  1. Define a strategy and stick to it.
  2. Keep it simple
  3. Do the Math
  4. Build Mockups
  5. Make Drawings of everything
  6. Modularize your design
  7. Make spare parts
  8. Over-Schedule your meetings
  9. Test everything
  10. Practice, Practice, Practice

- Competition
  1. Take only what you need
  2. Organize
  3. Have a pit display
  4. Have a judges book
  5. Have a spirit leader
  6. Assign people you can trust to coordinate scouting
  7. Make a strategy for each match.
  8. ALWAYS make a pick list
  9. Be honest to other teams
  10. Take benchmarking photos

- Post season:
  1. Cover lessons learned, things gone right things gone wrong
  2. Perform exit interviews with students
  3. Implement improvements and Ideas
  4. Continue learning skills
  5. Fundraising can be a year round thing.
  6. Summer is a great time for a team party.
  7. Chairman’s award activities.
  8. Make prototypes of new ideas
  9. Learn new construction methods
  10. Restock shop and replace tools

Students are an Asset - Use Them!

- High School students are capable of doing virtually any task related to your team with a little training and leadership. Never underestimate them.
- If you think something can't be done by students, always ask yourself; "Why not?" and "What can be done to enable them to do it?"
- In the end the students get more out if they put more in. Remember, we are here for their benefit.
- The more they can do, the more they will do (and thus the less adults have to do.)
- In time, you will develop student leaders as capable and dedicated as any adult.

Set Goals as a Team, Pick a Direction and Go!

- Analyze scoring and prioritize all possible robot tasks.
- Make sure everyone knows the rules of the game! Consider having a pop quiz or a trivia contest.
- Spend time strategizing and role playing, avoid jumping straight to machine design.
- Get the whole team to understand and agree on the chosen direction! Later, if someone has a problem with the direction, you can always refer back to the original goals. This will prevent differences from becoming personal.
- IMPORTANT: Picking an imperfect direction and figuring out how to enhance it is usually better than trying to change direction radically and then not getting done.

Mock It Up!

- Mockups bridge the gap between concept and reality. 3-D objects convey ideas more effectively than sketches or CAD drawings. They make ideas flow.
- Often, the requirements of a feature or mechanism must be found experimentally. This is impossible without some quick way to try out your ideas and determine what is important and what is not.
- Wood, foamboard, cardboard, and old robots are great media for experimentation.
- Others can assist more easily than with paper designs.
- Once the design is fine tuned, the real one can be made quickly and with confidence.

Modularize Your Design!

- Break your robot into several main functional sub systems (chassis, arm, claw, etc.) and have a subgroup and leader for each one.
- Try to define the size, weight, resource, and functional requirements of each section as thoroughly as possible.
- Allocate manpower and resources to the subgroups according to the priorities established during goal setting.
- Avoid thinking “ that’s their problem”or “our part is more important” of the other groups, you are all on the same team.
- Have daily summary meetings with each group.
- Someone MUST be an overseer over the whole project.

Know your Limits!

Polycarbonate = .05 lb/in3

6061 Alum = .1 lb/in3

4130 Steel = .3 lb/in3

Wood = .02 lb/in3

- FIRST limits us in five main areas.
  - Materials, Size, Cost, Weight, Time
- **Time and Weight** are the big ones.
  - Time and weight tend to be inversely proportional:
    - Lightweight solutions take longer to design and build.
  - Use steel sparingly, check weight status often.
  - Use tube and sheet instead of solid sections where ever possible.
  - Keep CG as low as possible. Battery = 10%
  - Never make complicated items which can be bought.
- K.I.S.S. - Precision and complexity kill.
  - Avoid needless precision, most robot elements don't need to be very precise. Exacting precision costs time and generally forces students out of the process, wasting manpower.
  - We like to start by asking "Can I do it with a string?" and then work bottom up to a realistic design.
  - Once you have your initial idea for a design, have a brief brainstorming session to discuss ways to make it simpler and lighter before you start cutting metal.

Do the Math!

- A few quick calculations on any design are necessary before beginning to build to insure success. It only takes a few minutes and will save many hours of frustration. Figure out how fast it will move, how much it can lift, etc.
- Always check your numbers on gear/chain ratios against motor speed, torque, and power specs.
- Check shear forces on critical joints, tension on chains, etc. They are often higher than you think.
- Be sure to go over this with the students.
- Avoid pushing your luck, design in some safety margins.

  Robots have a way of degrading.

Get it Moving!

- The sooner your chassis runs the better off you are.
- “Half the game is just getting there!”
- Most major robot failures are chassis related. You need to prove it out and beat it up. Test drive it often, on carpet and with ballast representative of final robot weight.
- Having something moving helps eliminate the “week 4 blues”. Once your robot begins to move it stops being a pile of parts and takes on a life of its own in the minds of the team. Renewed enthusiasm will result.
- Drivers need to train if you expect them to win. There is no substitute for practice.
- If needed, schedule drive practice apart from build meetings.
- Basic Limits: Robots should always be geared to move between 4 ft/s to 16 ft/s. Your exact speed choice will be determined by the game design.

Electrical - Neatness Counts

- Neatness = Reliability and Reparability
- Most sudden unexpected and “ghost” type problems tend to be electrical in nature.
- Many electrical repairs are done under panic conditions. When quick trouble shooting is needed, it must be obvious what is what, what goes where, and what looks out of place.
- Label, Label, Label, Document, Document, Document.
- Strain relieve wire connections, hot glue your PWM connectors.
- Do it right and then leave it alone.
- Students can do any and all your electrical jobs.
- Tip: Robots with messy wiring NEVER win tech awards.

Controls Make the Difference

- Intuitive, easy to use driver controls often make the difference between a good robot and great robot.
- As soon as you decide on a mechanism, immediately ask yourself “ how will the driver control this?”
- Having to look down at the controls can be a game killer.
- Automated and semi-automated features simplify operation and allow drivers to train quickly. Having a robot that is easy to drive can help make up for lack of practice.
- Mechanical design must be sound for good controllability. Controls can only enhance functionality.
- You must build time into your schedule to do iterative tuning of your systems once the robot is built.
- Feedback loops are a beautiful thing.

Questions?

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