Team 2056

Orchard Park Robotics

2014 Season Team Manual

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(For Internal Use)

TABLE OF CONENTS

1. INTRODUCTION

Congratulations on the start of a new season with Team 2056. If you are back for another season, we hope you can go above and beyond the level you reached last year. If you are new to the team, welcome! We cannot wait to see what you have to offer and how we can help you grow.

This manual is a short guide to how Team 2056 works. It is not everything that you need to know, but it will teach you the essential concepts. By starting the build season with this knowledge you will be best prepared to contribute to the team. If you have any questions, just ask a senior member or a mentor!

2. DESIGN PHILOSOPHY

Our design philosophy is in the DNA of every robot our team builds. They are the pillars, shown in Figure 1, upon which our team is built. Every time there is a design decision to be made these principles should echo in your head.

SIMPLICITY   **ROBUSTNESS**   **QUALITY**

Figure 1 - Fundamental design principles

The best robots in FIRST follow these basic, yet immensely challenging, rules. Here are examples of how each of them are applied:

SIMPLICITY: Instead of designing a shooter turret, simply rely on turning the robot using the drivetrain. Aim for the most basic, functional design.

ROBUSTNESS: Design the robot to withstand collisions and loads many times larger than what is normal. Aim for no repairs and low maintenance.

QUALITY: Design components thoroughly and build them as planned. Make the robot look and function professionally. Work with a sense of pride!

Each game challenges us to find the best solution that meets these requirements. These three main points will guide you through the remainder of the manual.

2.1. IDEAL ROBOT ATTRIBUTES

While the game changes every year, there are some attributes that are always a design priority for our team. These include:

STABLE: This means having a low center-of-gravity (CoG) so that the robot will not tip in a collision or while climbing over things. Weight should be as centred and close to the ground as possible.

STRONG AND AGILE: The robot should be able to get around the field as quickly as possible while still having the ability to push other robots or field elements. The robot should have the necessary traction and drivetrain gearing.

PRECISE: No matter what the design challenge is, the robot should function in a highly accurate and repeatable way. The robot should perform as designed, with precision.

VISUALLY ATTRACTIVE: A clean, well-finished robot will not only be easy to service but also be excellent to present to judges and function as our team's image on the field.

As with our fundamental principles, these attributes aren't easy to achieve and require discipline in design.

2.2. HOW WE DESIGN

Each design session on Team 2056 has a similar style and follows our team culture. This culture requires intense thinking and dedication from students and mentors alike. Everyone has the responsibility to share his or her ideas and be active participants. Team members should respect all contributions and work to collectively raise our standard of excellence. The team roles in robot design fall into three general groups:

SENIOR STUDENTS: Team members with an exceptional amount of experience and activity on the team are expected bring their knowledge and leadership to the forefront. They should partner with less experienced students and encourage growth amongst the team.

JUNIOR STUDENTS: Team members who are newer to the team are expected to seek out opportunities to observe, learn, and begin to practice the skills of their senior counterparts. They should seek guidance and be unafraid to offer their ideas for consideration.

MENTORS: The mentors serve as teachers and advisors to the students. They share their engineering and operations experience in order to elevate student skills and guide the team in reaching its goals.

In design meetings, we use brainstorming, discussion, and prototyping to help the team arrive at its final robot concept. When brainstorming components, students should offer all ideas and grow them collectively. Discussion and prototyping sessions will allow the

team to narrow its choices and begin to prove the design of a select set of top design candidates.

3. BUILD SEASON ROUTINES

Every build season consists of six weeks from the day that the game is announced until the day that we must stop work and bag and tag the robot. The team will work 20-40 hours a week on the robot – certainly not a light commitment! The members who attend these hours and work intensely will be rewarded with personal growth and additional responsibility. The build season's weekly work breakdown generally follows the schedule in Table 1.

Table 1 – Build season weekly schedule

WEEK	ACTIVITIES
1	- Game is released; study manual and analyze rules - Design sessions and prototyping early in the week - Deliver design choices and start building the field by end of week
2	- Complete mock field - Start parts fabrication and continue any additional prototyping - Initiate programming planning
3	- Examinations week; lighter schedule - Continue parts fabrication and start planning electronics - Begin receiving and processing parts from sponsors
4	- Assembly and wiring of practice robot; final parts fabrication - Base code programming - First test drive of practice robot by end of week
5	- Fully functioning practice robot; begin competition robot assembly - Troubleshooting design and part iteration - Autonomous programming begins - Drive team practice
6	- Competition robot finished; matched to practice bot changes - Autonomous programming continues - Drive team practices; competition robot testing - Bag and tag robot at end of week
7+	- Final programming refinements for autonomous - Drive team practices and robot troubleshooting - Fabrication of spare parts; iteration of designs - Preparation of pit and scouting materials for event

These work plans are variable as the examination schedule, date of final design choices, and sponsor part turnaround can affect timing. In general, however, a successful season follows the basis of this schedule.

3.1. WORK DISTRIBUTION

During the build season, it is important that the sub-teams break down the task of creating the final robot. Members may belong to more than one team, but everyone should understand their role. All teams participate in the initial design phase. This requires good coordination and communication.

3.1.1. MECHANICAL TEAM

The mechanical team focuses on the fabrication, assembly, and iteration of the robot's mechanical systems. This includes shop work, troubleshooting functional design, and maintenance of parts. They must coordinate with the electrical team and programming teams to communicate any changes needed or completed.

3.1.2. ELECTRICAL TEAM

The electrical team implements the electronics, controls, and pneumatics systems for the robot. This includes wiring, troubleshooting communications and power, and maintenance of the robot. They must work closely with the programming team to coordinate system configuration and with the mechanical team to match changes.

3.1.3. PROGRAMMING TEAM

This team designs the software and controls for the robot's teleoperated and autonomous modes. This includes coding, driver interfacing, and troubleshooting – especially for autonomous programs. They must work closely with the electrical team for system configuration, seek feedback from the mechanical team on performance, and design the controls with the drive team.

3.1.4. DRIVE TEAM

The drive team is responsible for learning to operate the robot at a high level and translating that into successful robot performances at events. It is their responsibility to give feedback to the engineering teams about the robot and test changes. They should know the robot inside and out.

3.1.5. STRATEGY TEAM

The strategy team works alongside the engineering teams to ensure the robot design choices meet our game strategy. They also work to prepare scouting resources, study rule changes, and pre-scout the competition. Their communication is periodic with the engineering team.

3.1.6. OPERATIONS TEAM

Operations team members play key roles on the team by taking on tasks such as finance, outreach, website design, awards, and team management. They must communicate with the other teams in a wide variety of ways and prepare the team to be successful on and off the field.

3.2. USE OF SHOPS

Power tools and machines may only be used in the presence of an adult supervisor. Students should not be in the shop rooms with the power enabled unless there is an adult present. For some machines a safety test is required. At the end of work sessions, the shops must be left cleaned and organized so that the next day's classes do not notice our presence. It is recommended that you keep a spare set of clothes in your locker; it gets messy in the shops!

4. MECHANICAL DESIGN

Thoughtful mechanical design of our robot's most critical parts directly affects how we drive and complete the other important tasks of the game. While the other systems of the robot are no less important to being functional, mechanical design helps to distinguish the good robots from the great robots.

4.1. DRIVETRAINS

The purpose of a drivetrain is to give the robot mobility; this is the most basic necessity in FRC. It allows us to move between the different areas of the field and accomplish the game's challenges. Drivetrains define how well we can interact with both objects and other robots. They also define how we climb over things or manoeuvre around obstacles.

The drivetrain must be durable and reliable. If it fails, the rest of robot is essentially useless. We must balance key attributes including speed, pushing force, and agility with our desire to be simple and robust.

4.1.1. TYPES OF DRIVETRAINS

There are three categories of drivetrains that are most commonly found in FRC. These include:

TANK: This drivetrain, also called skid steer, is the most common in FRC; see Figure 2. The right and left sides of the robot are driven independently. By changing the direction of each side you can go in all directions. It is simple, cheap, and easy to program. Tank is also very easy to drive and can generally give the highest speed and/or pushing strength outputs found in FRC. It is slightly less agile than the other options, however this is balanced by its effectiveness in other areas. All Team 2056 robots have been tank drive, giving us considerable experience in working with this design.
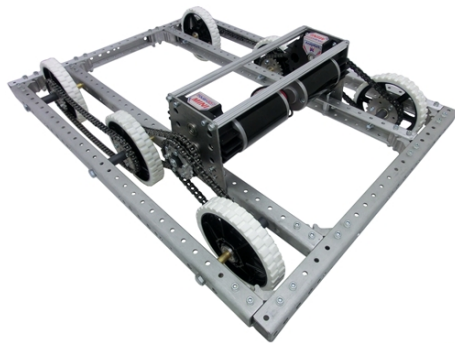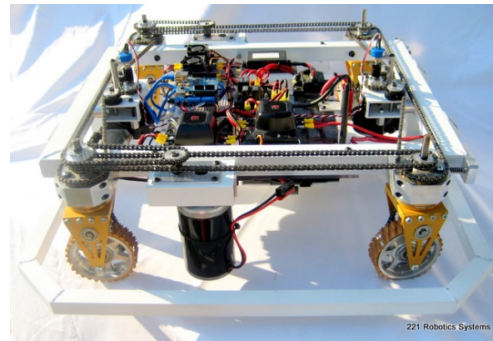

Figure 2 - Tank drivetrain

Figure 3 - Swerve drivetrain

SWERVE: This drivetrain, in Figure 3, uses independently powered wheels that can be rotated. Wheels drive forward and backward in unison and the wheel modules are rotated to move in each direction. It can have the same high speed and/or pushing power of the tank drive, but increases agility substantially. However, it is far more complex and expensive to design and requires much more weight to be dedicated to the drivetrain. Generally, it is also harder to control and maintain than tank drive. We have not previously experimented with this drivetrain.

MECANUM: This is a variation of tank drive that uses special "mecanum" wheels; see Figure 4. These wheels have small, diagonal rollers around the circumference that allow the robot to move in all directions. It does so by powering each wheel independently and in special combinations for each direction. While this improves upon the agility of tank drive, it is both expensive to design and hard to program and drive. There is also has very little pushing force and adds weight to the robot. This drivetrain adds mobility at the cost of power and speed. We have not previously used this drivetrain.
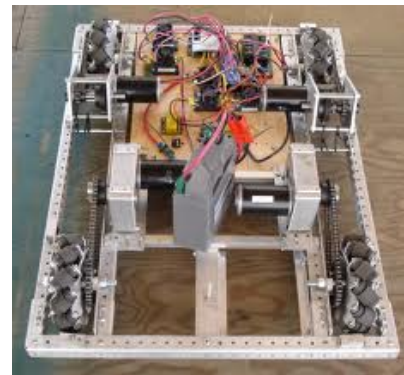

Figure 4 - Mecanum drivetrain

OTHER: There are many custom variations of the drivetrains above and some others that are entirely different. Each added layer of customization adds complexity, but it can potentially give teams the drivetrain attributes they deem most critical to their success in a particular game.

4.1.2. TYPES OF WHEELS

The secondary component that greatly expands the variety of FRC drivetrains is the wheel type. This choice can heavily influence the performance of a drive system. These types are:

STANDARD: These are the most basic wheels and make up the vast majority of those used both in FRC and daily life. They consist of a simple wheel hub surrounded by a traction material. They are simple, reliable, and relatively low cost. The common varieties of standard wheels found in FRC are described in Table 2.

TYPE	TRACTION	STRENGTH	WEIGHT
Kit of Parts (KoP)	Medium	Medium	Low
Traction*	Medium/High	High	Low
Slick (Old KoP)	Medium/Low	Medium	Low
Pneumatic	High	High	High

Traction is generally a slang term used for wheels similar to AndyMark and Vex Pro.

OMNI: These are specialized wheels that have rollers perpendicular to the wheel direction. They allow the wheel to slide sideways without any force. This is used most often for tank drivetrains suffering from turning issues or for specialized designs. They have medium traction forward, medium strength, and medium weight.

MECANUM: Another type of specialized wheel only used in the matching drive system detailed above. They allow travel in all directions when oriented correctly with one another. They have low traction in all directions, medium strength, and high weight.

Images of all of the above wheel types can be found in Appendix A for better reference.

4.2. MECHANISMS AND MANIPULATORS

The mechanisms and manipulators on the robot are what give it the ability to play the game. They are new and unique each year with the changing game challenge. However, there are still a few basic designs that work well in FRC and have appeared in a number of games.

4.2.1. MECHANISMS

We generally classify systems that provide motion outside of the drivetrain under the title of mechanisms. These provide movement and functionality to the robot, but are not directly handling game pieces or interacting with field elements. The most common robot mechanisms are:

ARMS: Arms contain one or more linkages that pivot around a point on the robot's frame or another linkage. The motion is circular around the pivot point. Arms are useful in applications such as lifting objects, reaching outside the frame perimeter, and scoring over opponents. They can be very simple and reliable when designed properly. They can, however, be a bit difficult to program into controls and often raise the center-of-gravity. We have lots of experience with arms, such as on our 2011 robot in Figure 5.

Figure 5 - Example arm

ELEVATOR: Elevators are composed of tubing or sheet metal that slides sections within or beside one another to raise and lower; see Figure 6. The motion is linear and the amount of motion per segment can be varied. They are useful for lifting action. Elevators are generally faster than arms, more compact, and keep the center-of-gravity lower. However, they are much more complex to design and require accurate fabrication. We have no experience with elevators on our past robots.

TELESCOPING ARM: These are a sort of hybrid between arms and elevators. Generally, sections of the arm form an elevator that extends and collapses while pivoting around a point. This allows for potential advantages over standard arms including longer reach, lower center-of-gravity, and compactness. They are even more complex than simple elevators and can be a challenge to program for.

Figure 6 - Example elevator

4.2.2. MANIPULATORS

These are the systems that interact with the game pieces and field elements. Often, they are the end-effectors coupled with one of the mechanisms described above. These are often even more varied than the mechanisms, as they must match a particular object in a game. Still, there are a few common manipulators.

CLAW: Similar to your fingers, these manipulators use two or more surfaces to grab onto a game piece or field element. These are very useful for picking up and placing

objects, such as the tube shown in Figure 7. They are very simple to design and maintain. Claws tend to be harder to operate as they require precision and they generally rely on larger mechanisms to move them and their game piece around the robot. We have used claws on our robots in the past.

ROLLERS: One or more spinning surfaces are used to move a game piece. These are commonly belts or cords spread across rods in a number of sections, as shown in Figure 8. The rods are spun in each direction to track the roller back and forth, just like conveyors in a factory. These are useful for both obtaining game pieces from the floor and moving them within the robot. If sped up, they can also be used to shoot game pieces a short distance. They can be a bit complex to design and require service to make sure alignment and tension is correct. However, they are extremely useful and we have used them on our robots before.

Figure 7 - Example claw

Figure 8 - Example roller

SHOOTER: These manipulators give game pieces high projectile velocity. They come in many different designs but are based upon transferring energy from the shooter to the game piece. This can be done using wheels, punches, or a variety of other devices. Shooters can vary greatly in complexity and maintainability and are a challenge to tune correctly due to the precision of the energy transferred. Sometimes though, they are the key to the game challenge. We have used these before on our robots and are shown in Figures 9 and 10.

5. ELECTRICAL AND PNEUMATIC DESIGN

The control system allows the robot's mechanisms to function at their best. It includes the electrical, pneumatic, programming, and human interface components of the robot. While not the focus of initial design sessions, the control system plays an equally critical role in reaching the simple, robust, and high-quality robot we desire.
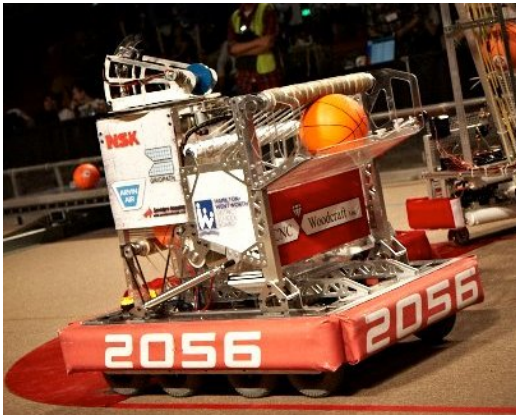
Figure 9 - Our one wheeled shooter used in 2012

Figure 10 - Team 1114 used a punch to launch balls in 2008

The ideal electrical and pneumatic design aims to create a clean, organized, and easy to service product. Teams often overlook the importance of this. Messy wiring and tubing looks unprofessional and can be very hard to troubleshoot. An effective design not only improves the robot's power usage but also results in a reliable, presentable robot.

5.1. POWER

The robot runs on a 12-volt battery from which power is distributed to all sub-systems. This is done through a variety of components that control, limit, and utilize the power in different ways. These include:

MAIN BREAKER: Every robot has an on/off switch. This is perhaps an obvious component, but it is also the main safe guard that prevents the robot from drawing too much current.

POWER DISTRIBUTION BOARD: This is where the main power splitting is done from the battery to the robot systems. In addition to limiting the current and voltage, the board also has many different connections for each section.

SPEED CONTROLLERS: These devices control the amount of current delivered to motors to vary their speed from zero to maximum. They translate a pulsed signal into a range of current throughput.

RELAYS: These are simple on/off controllers for switched components. They also use a pulsed signal to change state.

SOLENOIDS: These are the same as relays, but they control the pneumatic actuators. There are varied types for different actuating actions.

WIRE: Wires are the interconnecting material for the electrical system. Sizes must match the current demands while following colour and labelling convention.

MOTORS: Motors change electricity into mechanical motion. They come in many different sizes, speeds, and power levels, each with a certain application.

A visual guide to these parts is included in Appendix B at the end of the manual.

5.2. PNEUMATICS

Pneumatics use air pressure to provide mechanical energy for robot motion. This is a good system to use when we desire simple two-position control of a mechanism. It greatly simplifies the motion control, can remain in the position without continuous power input, and can provide high strength. There exist two main components in this system:

ACTUATORS: Simple actuators convert air pressure into linear motion by entering compressed air on either side of a piston head. Some more specialized types exist.

COMPRESSOR: Compressors provide the air pressure stored in the system tubing and tanks. It converts electrical power into stored energy in the compressed air.

Images of these two components can also be found in Appendix B.

5.3. CONTROLS

The robot control system is similar to the nervous system in your body, providing controls over each part of the robot. It translates the code we program and the commands we give it into action. The key parts of this system are:

cRIO: The cRIO is the robot controller. We load our code onto it, which is then converted into control signals. The cRIO connects to the Wi-Fi router to receive the driver input and breaks out control to the pneumatics, analog devices, and digital sidecar.

DIGITAL SIDECAR: These components are connected to the cRIO. It breaks out signals for the speed controllers, relays, and other specialized systems into their respective channels.

WIRELESS BRIDGE: This is the device that acts as the connection to the field wireless network.

LAPTOP: The laptop uses a specialized "Driver Station" program to interface the robot and human communication. This program sends and receives data with the robot.

JOYSTICKS/INPUT: The drive input interface usually consists of one or more joysticks and in some cases other customized inputs such as button boxes.

Images of several of these components are found in Appendix B.

5.4. SENSORS

We use a wide variety of sensors to provide information to the robot for use in programming commands in both the teleoperated and autonomous modes. These sensors include the following:

GYROSCOPES: "Gyros" are used to measure changes in the orientation of the robot in three dimensions from its starting position. These are critical for tracking robot movement and giving waypoints in autonomous mode.

ENCODERS: Encoders are used to measure the continuous rotational position of a shaft. These are typically attached to the output of a drive system to measure the rotations of a wheel. They are critical in our autonomous modes as well.

POTENTIOMETERS: "Pots" are also used to measure rotational position. However, they have a limited range of rotation and are therefore used in systems with limited motion such as an arm joint.

LIMIT SWITCHES: These switches are essentially buttons that indicate when something has reached a physical position when they are pressed. This is useful for observing the presence of a game piece or deployment of a robot mechanism.

INFRARED SENSORS: These sensors are used to detect the presence of an object. Typically an infrared beam is reflected off a piece of retro-reflective tape or the beam is broken between the emitter and the receiver. They are useful for detecting the presence of an object.

Of course there are many more sensors available and many versions of the ones above. When solving particularly tough challenges we may need to go beyond these five to get the best result.

6. PROGRAMMING

Programming is an essential part of any robot system. It is the set of instructions that guide the robot to perform as designed. The basic functionality of a mechanism must be proven, but programming can enhance the control of the mechanism. This is achieved through two methods: by making the mechanism more efficient (i.e. faster) and more effective (i.e. accurate) than normal driver control allows. The following includes the general code structure and planning practices.

6.1. CODE STRUCTURE

Our code is generally organized based on the template provided by FIRST and is separated into four main sections: initialization, disabled, teleoperated, and autonomous.

The initialization routines are for declarations and definitions. This is where the electrical input/output (I/O) is mapped to the various motors, sensors and pneumatics. A virtual "object" is created and named to represent each physical component.

The following three modes have two sub-sections: an initialization, which only occurs once when that mode is entered; and a periodic section, which is run and updated every controller clock cycle. They include:

DISABLED: The robot is removed from human control but still powered on. In the initialization all motors are turned off and the pneumatics are reset. The only thing left running during this state is the compressor so that the pneumatic system charges.

AUTONOMOUS: In this state, the robot is controlled by pre-programmed instructions without any human interaction. More information on this is covered below.

TELEOPERATED: One or more human drivers control the robot. The controls should feel natural and flow logically. This design changes depending on the number of robot mechanisms and how common robot actions can be automated together.

6.2. DESIGN PRACTICES

When planning, we write out all the subsystems and how they interact. Then we must figure out what each button and joystick on our controller will do. These mappings must be logical and easy to follow. The selected controller inputs and other sensory inputs are then added as transitions in state diagrams.

Motors and sensors are then added to the subsystems to create a skeleton of how the code will work. Later on, automation will be added to increase efficiency and simplify the driver control.

During this time we also plan the multiple autonomous modes that will be required to for the various situations that will be encountered throughout the season.

6.3. AUTOMATION

In recent years the autonomous period has typically played a large role in the scoring capabilities of our robots. This is because tasks in this period are often worth more points and have no defence to contend with.

In order to best utilize this opportunity, numerous sensors are employed to guide the robot and improve its accuracy. Other tools include timers and loops that are implemented in software to move on to the next task after a certain amount of time has passed. These elements can be combined to have the robot perform a pre-set routine and score points without driver control.

We can also use the methods outlined above to control the robot during teleoperated mode through the automation of processes. These processes range from moving conveyors a certain distance, to holding a shooter wheel at a constant velocity, to completing full scoring actions with the coordination of several subsystems.

However, just because a process can be automated does not mean that it should be! Simplicity is key in the planning of autonomous routines and the level of human control that is automated. For any automated process you must have a way to override it at any time since you never know what might happen at a competition. It's critical to have this option for when a sensor inevitably fails to ensure you don't lose robot functionality (it is also a safety measure).

7. STRATEGY

In order to be successful, we need to have a clear goal from the beginning of the season. A strategic approach to the robotics season will help our team understand where we're going and what we need to get there. This is a fundamental principle of our team culture.

7.1. UNDERSTANDING THE CHALLENGE

In order to build a good robot we need to understand the game it will be playing. There are three key steps to develop that understanding:

READ THE GAME MANUAL: You need to know the game inside-out to be able to helpfully contribute to designing our robot. From scoring to penalties every detail is critical. Never start design without this knowledge.

UNDERSTAND SCORING: Since scoring points wins matches, knowing how to do it (and, equally importantly, how to stop it) will help you to come up with the most effective robot. We need to extract the maximum points in the most efficient way.

KNOW THE TOURNAMENT SYSTEM: The only way to win an event is to understand what you have to do to get there. Our strategy evolves from what we must do to get to the top of the rankings.

7.2. APPLYING YOUR ANALYSIS

With the knowledge of how the game works, we can start evaluating how difficult something is to do versus how rewarding it is to do it. This helps the team to create a prioritised list of desired qualities for our robot. We use this to determine how our resources are allocated throughout the season when making design decisions. Our team has limited time, skills, and finances so we must maximize our use of all three.

7.3. SCOUTING

Even a perfectly built robot is not enough to win on its own. Once the build season is done, there is a limited amount that can be done to make your robot better. However, we can gain a significant advantage by knowing whom we are playing and what ways are best to play with and against them.

Without knowing what other teams are doing, we would be clueless when developing match strategies or figuring out whom to pick in the elimination rounds. Whether it's watching matches on the Blue Alliance, talking to a team in the pits, or taking notes during live matches, being able to accurately collect scouting information is an extremely important task. Our team excels in competition because we take this seriously.

Scouting is a demanding job and takes a lot of focus and concentration. It is also one of the most rewarding jobs on the team when done right because it directly contributes to our successes at competitions.

Scouting can also be lots of fun! Do not just mindlessly record statistics. Talk to each other about interesting designs, strategy, and exciting matches and try to predict outcomes. This is a chance to really understand and enjoy the game, just like a sport!

8. OPERATIONS AND AWARDS

There is more to being a successful and sustainable FRC Team than just designing high-performance robots. Our team aims to be well rounded and support the objective of FIRST in our school and community. This requires team members to take on the roles that bring us to that higher level.

8.1. COMMUNITY OUTREACH

The aim of FIRST is to create heroes in science and technology. We do this in two ways. First, we aim to celebrate science and technology education and careers in our community. We do this through LEGO outreach days, parades, school visits, and presentations. We believe that by sharing FIRST and its ideals with others, we are giving them the opportunity to be champions in this mission as well. Secondly, we want to act like heroes ourselves. We do this through activities such as food and clothing drives, recycling days, and participating in local festivals. We believe that it is important for us to serve those in our community and thank them for all the ways they have helped us.

8.2. WEBSITE

Team 2056's website is a hub for all kinds of activity, information, and resources. We are always looking to expand the content on the website and add functionality. It is designed by students, just like the robot, and is our main interface with external parties.

8.3. FINANCES

Every team requires a commitment to fundraising and sponsorship in order to obtain team resources. It is the responsibility of every student to play a part in this process to support the team and allow us to remain competitive. Without funds, we miss out on the chance to attend events and produce quality robots.

8.4. AWARDS

There are only three trophies at every regional competition for the champions, with the rest awarding technical and non-technical achievements. As a team we commit a great deal of time to applying and competing for several of these awards.

8.4.1. THE CHAIRMAN'S AWARD

The most prestigious award in all of FIRST is the Chairman's Award. This award recognises the efforts of teams on and off the field in serving as a role model for all others. We document all activities and initiatives and their effects on our school community, companies, and other teams. The Chairman's Award requires a creative, professional, and inspired communication of our team's work to engineering leaders through both writing and oral presentations.

8.4.2. WOODIE FLOWERS' AWARD

Every year, students have the opportunity to write a short essay about an exceptional mentor and their contribution to Team 2056. This essay can capture such things as the mentor's teaching strategies, their excitement about FIRST, and their relationship with team members.

8.4.3. DEAN'S LIST AWARD

FIRST teams can nominate two exemplary students to make the FIRST Dean's List. On Team 2056, the mentors pick the nominated students and a group of mentors write the submissions. Nominees are recognised for their exceptional efforts that go above and beyond what is expected of a team member. They are not only exemplary pupils of FIRST but also a mentor to younger students and champion of science and technology in the school community.

8.4.4. OTHER AWARDS

There are a wide variety of other technical and non-technical awards that are presented at regionals and the world championship. While they are too numerous to describe here, we always aspire to be recognized for these award while maintaining our current success. They are all described in the game manual in detail. Any student with initiative

can set out to improve the part of our team that pertains to an award they would like us to strive for!

9. GLOSSARY OF TERMS

Autonomous Mode: The 15 seconds at the start of the match where the robots operate under pre-programmed control via sensors.

Bag and Tag: The stop-work day at the end of build season where the competition robot must be sealed in a bag until the first regional.

Build Season: The six weeks allotted for design, fabrication, and testing of the competition robot before bag and tag.

Competition Season: Generally, the whole timespan from kick-off in January to end of the world championships in April.

FIRST: For Inspiration and Recognition of Science and Technology

FRC: FIRST Robotics Competition

Kick-off: The first day of Build Season where the game is released to all the teams in FIRST.

Regionals: Qualifying competitions for the World Championships held over 7 weekends in March and April.

Teleoperated Mode: The 2 minute period of the match where the drivers control the robot using their input on joysticks, game pads, etc.

World Championships: The final competition held in St. Louis where the world champions are crowned and the top awards are presented - also known as "The Big Show."

10. WEBSITES

Here is a list of websites that you should check out in order to learn more beyond this manual. You can never take in too much information!

Chief Delphi: www.chiefdelphi.com

This is the central forum for FIRST where people post about everything robotics. You are highly encouraged to read what is here though and keep up to date! However, team members **MUST** have posts reviewed by a mentor before posting.

The Blue Alliance: www.thebluealliance.com

This site has profiles for every team containing past event scores and videos, future events registered, and links to team websites. This is an essential scouting resource.

FIRST: www.usfirst.org

This is the main website of FIRST robotics, including FRC. Information on events and the organization is all here.

Team 1114: www.simbotics.org/resources

Check out the "Resources" section on the Simbotics website for more information on the topics we discussed above. We design under similar principles and the information on robot parts here is a great start.

APPENDIX A: MECHANICAL DESIGN IMAGES

The images below show the wheels explained above in Section 4. There are variations of each type, but these images are good representations of their class.

Traction   **Pneumatic**   **Kit of Parts**

Slick   **Omni**   **Mecanum**

APPENDIX B: ELECTRONIC AND PNEUMATIC DESIGN IMAGES

Below is a collection of pictures relating to the parts detailed in Section 5. Some parts have various types but only one has been chosen as a representative for each.

Main Breaker	**12V Battery**	**Motor (CIM)**
Speed Controller (Talon)	**Relay (Spike)**	**Solenoid**

Power Distribution Board

cRIO

Actuator	**Compressor**	**Joystick**

Digital Sidecar

Wireless Bridge
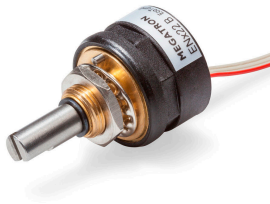
Encoder

Gyroscope

Limit Switch