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ROBOTS AND COMPETITION: DEVELOPING A NONPROFIT TO SUPPORT AND SUSTAIN FUN STEM EDUCATION

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Abstract

As jobs in science, technology, engineering, and math (STEM) careers increase, our nation is working for ways to motivate and inspire students to become interested in pursuing these careers. For Inspiration and Recognition of Science and Technology (*FIRST*) uses robots participating in sports-related competitions as an exciting way to introduce K-12 students to the skills necessary to be successful in STEM fields. Research has shown that participation in *FIRST* programs increases students' confidence in their ability to work with technology and their likelihood to attend college and major in a STEM field. This paper outlines the processes created for and lessons learned from starting a *FIRST* Robotics Competition (FRC) community-based team. The most important lesson learned is that running an FRC team is equivalent to running a small business. Therefore, this paper also provides the business canvas model for a viable nonprofit that will provide services to support the creation and sustainability of *FIRST* teams.

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1. Introduction

Education in science, technology, engineering, and math (STEM) has gained national attention as the job market for careers in STEM fields grow, but employees to fill the positions are scarce [1, 2, 3, 5, 8, 14]. Public education has an uphill battle to provide the teachers and resources necessary to inspire students to be interested in STEM career paths. Communities that do not have a large number of technology companies or an organized technical community tend to have a more difficult time finding educational resources to augment the school system's ability to provide meaningful STEM-related activities for K-12 students [1]. In these situations, communities can benefit from nationally organized STEM competitions, such as *FIRST* robotics. For Inspiration and Recognition of Science and Technology (*FIRST*) is an established US nonprofit that organizes games and competitions to provide K-12 students with a global opportunity to work alongside engineers and business professionals.

Historically, Wilmington, NC is an arts-based community, with a huge majority of summer camps, after school activities, and enrichment programs focused on music, acting, dancing, and fine arts. With a son who has always been interested in engineering, the engineering summer program offerings in Wilmington were typically too scarce to be able to provide him with hands-on engineering experiences. When I discovered *FIRST* robotics competitions (FRC), I realized that this was a huge opportunity to provide an important need for affordable STEM education to my community and to my son. As a community outreach project through with the UNC Wilmington student chapter of the Association for Computing Machinery (ACM), in 2012, my board and I decided to start Wilmington, North Carolina's first FRC team, team 4535, the Wired Wizards.

Through three years of networking, education, and outreach related to the Wired Wizards, it is evident that the Wilmington community recognizes the need for more STEM activities for school-aged children. There is a general interest in beginning *FIRST* teams on all four levels, and to date, Wilmington has had *FIRST* Lego League (FLL) teams that have not been sustainable when dedicated parents' students age out of the programs. This is because coaching, managing, and maintaining a *FIRST* robotics team is equivalent to operating a small business. There are marketing and legal concerns, budgeting, and fundraising alongside mentoring the students and maintaining a curriculum with activities that allow all students to participate, learn, and attend competitions.

The purpose of this research paper is to determine the best way to address the need to sustain the opportunity for students to participate in *FIRST* robotics. This paper will explore the options of creating an enterprising nonprofit that is set up to coordinate the creation and sustainability of *FIRST* robotics teams. The venture will be set up to develop informal after school activities into prominent programs that are readily available to K-12 students in Wilmington and surrounding counties. Although this paper focuses on the university's local community, the ability to apply this information to any location is discussed. The best possible business plan will be drawn up to reflect the research and the needs identified through personal experience organizing and managing an FRC team for three years.

While many nonprofits are developing around the nation to support robotics teams, many of them do not focus on creating sustainability for multiple teams. This research, and the resulting business plan, focuses on creating a business model that will support the creation and sustainability of fun, enriching, informal after-school

experiences that enable K-12 students to explore computer science and technology through robotics. The business will enable robotics team leaders to focus on the issues specific to organizing and leading students by being the local resource hub for *FIRST* teams. The hope is that this business model will allow the mentors to focus on making STEM fun for students without being hindered by administrative tasks. The model will incorporate the ability for the business to capitalize its resources to provide volunteer training specific for a *FIRST* environment, while providing *FIRST* teams free services. The free services will include student and mentor application processing, team database access for student and mentor information, and a 501(c)3 status for fundraising. The business will also focus on starting one team in each level on *FIRST* per year, networking and building partnerships with schools, local government, and industry to strengthen the resources available to teams.

Chapter 2 of this paper is a review of the literature that highlights the need for informal after school activities to enhance STEM education and why *FIRST* robotics is an inclusive, exciting way to fill this need. Chapter 3 is a description of the steps taken to start an FRC team. Chapter 4 is a discussion of lessons learned. It is modeled after the setup of Chapter 3 in order to sequentially list hints, tips, and tricks that I learned through experience and through interviewing other mentors. Chapter 5 discusses conclusions and future considerations for anyone considering starting an FRC team. The appendix provides example documents for *FIRST* robotics teams, especially FRC teams, that are not readily available through *FIRST*, including a business model canvas for a nonprofit and sample documents that team 4534 used during its first 3 years. Please note that any documents and advice provided are from personal experiences and have not been endorsed by *FIRST*.

2. Review of Literature and Analysis

2.1 The Future of the Technology Job Market

In 2012, the US Science Technology Engineering and Mathematics (STEM) workforce surpassed 7.4 million workers, and it is expected to continue to grow to an estimated 8.65 million workers and 7.03 million self-employed workers in 2018. This growth in demand for scientists and engineers is increasing at four times the rate for all other occupations. The bulk of STEM jobs will be in computing (71%), traditional engineering (16%), physical sciences (7%), life sciences (4%) and mathematics (2%). North Carolina has identified the need to fill 229,000 STEM-related jobs by 2018 [2][3][14].

2.1.1 United States and the global technology job market

As the world's national economies begin to rival the US', the US is looking inward at its ability to be competitive innovation and technology fields. Being competitive is important because if our global STEM competitive edge continues to decline, the US may lose social and political standing in the world economy [13]. According to research done by The Alliance for Science and Technology Research in America (ASTRA), at least 20% of US jobs require high levels of knowledge in at least one STEM field. ASTRA has also reported that the US is ranked 32nd in math and 23rd in science scores in the Programme for International Student Assessment (PISA). ASTRA has also shown that the technology job gap is not just in fields that require college degrees, but the gap is seen in manufacturing fields where workers need STEM skills. In response to these findings, researchers have concluded that in order to increase the US' global STEM standing, the country should focus on increasing STEM engagement at earlier ages, increase engagement with credible mentors, and increasing after school

STEM training. In order to focus on how to begin to fill the technology workforce gaps that the US is beginning to see, ASTRA believes that data needs to be collected at the local level in order to fully address what each community needs to focus on to fulfill their needs for expanding their STEM economy [5][8].

2.1.2 North Carolina's technology education and job market

The North Carolina Board of Education has identified STEM as an important focus area. The goal for the NC Board of Education, as reported on the STEM ScoreCard Report, is to "build STEM knowledge and skills in schools, teachers and communities across North Carolina with unique programs" [2][3][14]. With an estimated 229,000 job openings by the year 2018 in North Carolina, there are many groups who are focusing on increasing STEM education so that we can increase our state's economy [2]. On the state level, organizations such as NC *FIRST* Robotics, North Carolina New Schools, and Project Lead the Way are just a few organizations that are working to increase STEM opportunities and job awareness for students.

2.1.3 Wilmington's technology culture, education, and job market

While North Carolina Board of Education has identified STEM as an important focus area, locally, the Chamber Board of Commerce has also been working to increase initiatives in Wilmington through partnerships that have brought Project Lead the Way to Wilmington and have created a STEM educational listing resource for parents and educators through UNCW's Watson College of Education [6]. Entrepreneurship incubators are growing in Wilmington in order to strengthen STEM jobs in the community, while summer camps such as UNC Wilmington Youth Programs and Cape Fear Academy are beginning to increase their offerings of STEM-related classes.

2.1.4 How Does US FIRST Help Meet These Goals?

For Inspiration and Recognition of Science and Technology (*FIRST*) is a US nonprofit founded by Dean Kamen, an inventor and entrepreneur who focuses his work on medical robotics. A few of his notable inventions include the first wearable drug infusion pump, first portable insulin pump, the first portable kidney dialysis machine, and the Segway. Kamen decided to begin the *FIRST* robotics program 25 years ago as a way "to create a world where science and technology are celebrated" in the same ways that sports are celebrated [16]. *FIRST* has four levels of robotics competitions: Junior *FIRST* LEGO League (JR.FLL) is for students in grades K-3, ages 6-9; *FIRST* LEGO League (FLL) grades 4-8, ages 9-14; *FIRST* Tech Challenge (FTC) grades 6-12, ages 11-18; and *FIRST* Robotics Competition (FRC) grades 9-12, ages 14-18.

The research related to this paper focuses on FRC because this is the type of *FIRST* team that was initiated. FRC is the highest level of competition in *FIRST* and is intended to be the level that incorporates everything students have learned if they have progressed through the programs. *FIRST* develops a challenge for FRC that is kept secret until the build season kickoff. The season's challenge and game manual is released to the 80 countries that have FRC teams on the same day (the first Saturday of the year), and teams get 6 weeks to plan their game strategy; design, build, and program their robot from scratch. Typically, robots cannot weigh more than 120lbs and teams cannot spend more than a specific amount of money on their robot (usually around $3500, depending on the season). Stop build day is usually on a Tuesday. Regional and district events begin the last weekend in February and continue for 6 weeks, and *FIRST* has world championship matches in St. Louis late in April.

FIRST competitions are fun, competitive, sports environments that give students the opportunity to work with engineers and scientists. In an independent longitudinal study by Brandeis University of *FIRST* participants, it is strongly evident that *FIRST* has a positive impact on its participants across all of its programs (Figure 1) [10].

Exhibit 1: Summary of Impacts, for All Participants and by Program

Outcomes	All Participants	FLL	FTC	FRC
Scales				
STEM Interest	✚		✚	✚
STEM Activity	✚	✚	✚	✚
STEM Careers	✚		✚	✚
STEM Identity	✚	✚	✚	✚
STEM Knowledge	✚	✚	✚	✚
Factors				
Technology Factor	✚	✚	✚	✚
Science Factor	✚			✚
Math Factor			✚	
Self-Efficacy Factor			–	
Attribution/Knowledge Factor	✚			
Problem-Solving Factor	✚		✚	

Note: Plus sign (✚) indicates a positive, significant impact at the .05 level or greater. Minus sign (–) indicates a statistically significant negative impact. Empty cells indicate no significant impact for that measure/program. Impacts for FLL based on comparison to comparison group members in grades 5-8 at baseline; FTC and FRC impacts based on comparison to comparison group members in grades 9-12. Results for Academic Self-Concept, College Support, 21st Century Skills, and Self-Efficacy scales and Cooperation and Communications Factors are not significant (not shown in the table).

Figure 1: Summary of Impacts for All FIRST Participants by Program

When FRC 2009-2013 alumni were surveyed on the long-term impacts of *FIRST*, Brandeis University found that when compared to a group of students with similar backgrounds, FRC alumni were found to be:

- Significantly more likely to attend college
- Twice as likely to major in science and engineering

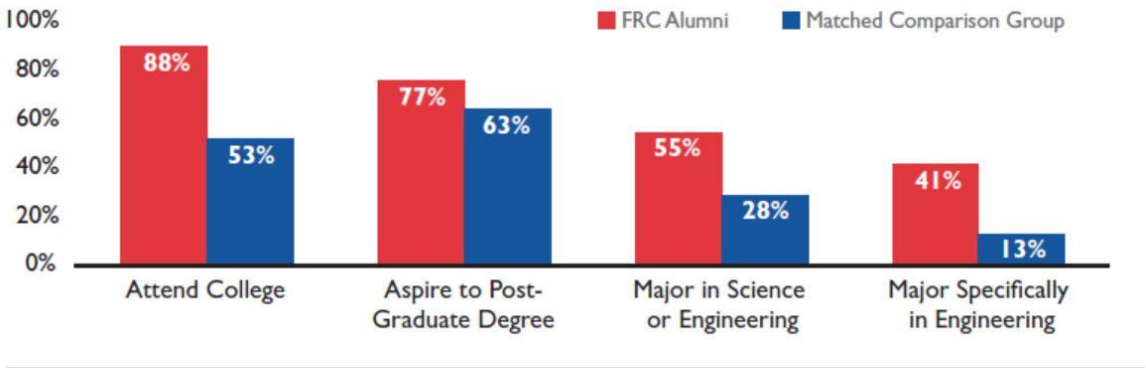

Figure 2: Long-Term Impacts of FIRST

Students also self-reported a higher self-efficacy and positive impact of their experience with *FIRST*:

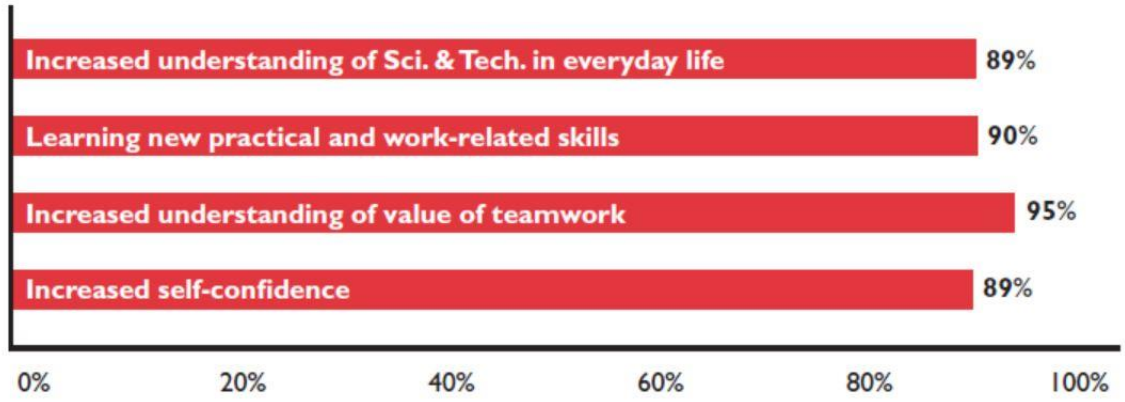

Figure 3: Positive Impacts of FIRST

FIRST is also proven effective by research that is not directly related to the organization. In their research, Barker and Ansorge have repeatedly proven that robots provide a concrete learning tool that allows students to understand abstract concepts while gaining functional understanding. While students see robots as toys, and want to interact with them, they are learning real-world concepts while they participate, such as there is more than one solution to a problem and creative ways to achieve their goals [4]. Another study of students in summer camps that incorporated robotics found that students

who were engaged with robotics were proven to be more excited about the camp and more motivated to learn the material. At the end of the camps, students had increased self-reported confidence in their ability to solve problems and work as a team. The researchers concluded that short-term programs, like those offered in a summer camp, improve students' attitudes towards STEM [12].

2.2 Enterprising Nonprofit

According to the NC Center for Nonprofits' Website, "nonprofits are essential for North Carolina's quality of life and for attracting business and keeping it here." In the case of this nonprofit, hopefully, by inspiring students to be interested in working in STEM fields, Wilmington can attract businesses who want to hire from a diverse technical workforce, provide resources for their employees to be involved in the community, and expand the community where employees will want to raise their children.

In addition to helping to prepare students to work in the growing technical workforce, nonprofits provide one out of every nine jobs in North Carolina and provide $37 billion to North Carolina's economy each year. Also, with the growing interest in building Wilmington technology companies through the UNC Wilmington Center for Innovation and Entrepreneurship (CIE), tekMountain, and other entrepreneurship incubators, it is important to have programs that support STEM education. By supporting STEM education, the community will encourage students to be a part of Wilmington's growing economy with the education and inspiration to have productive careers.

Enterprising nonprofits, also known as social entrepreneurships, are a relatively new business model that have been gaining recognition in the US. Companies that want to provide a social service to improve society are finding that grants and other not-for-

profit fundraising can be highly competitive [8]. For this reason, many nonprofits are branching out to earn income on merchandise and services that will help to fund the service that the company provides. According to research, social entrepreneurships as a legal entity seemed like they were gaining importance to society. In 2010, North Carolina established a new legal business entity call the Low-Profit Limited Liability Company (L3C), but in 2014, North Carolina became the first state to stop recognizing the L3C as a legal structure [11]. It is still accepted that a formal nonprofit company is allowed to sell goods that will allow the business to earn income. For this reason, I decided that the best type of business to begin is a nonprofit entity that has earned-income resources.

3. Methodology: Creating and Leading a *FIRST* Robotics Competition Team

Once UNCW's ACM decided to create a *FIRST* team, we had to determine which type of team to begin. After analyzing programs available to K-12 students in our community, it was decided that the target age range would be high school students because, at the time, there were very few STEM programs in the area that for that age group. There were two options with *FIRST*, FTC and FRC. After consultation and research, it was unanimous that the experience with FRC would better fit the goals and interests of the ACM. The objective of starting this community outreach project was to give UNCW students an opportunity to give back to the community by sharing the skills that we were confident we could help high school students develop while having fun. FRC encompassed these skills in coding, marketing, and problem-solving, and videos of FRC competitions were exciting to watch.

3.1 Establishing the Team

The first phase to establish a team is contacting the *FIRST* regional director and registering with the *FIRST* Team Information Management System (TIMS). For NC, the regional director immediately sent us relevant information, connected us to FRC mentors in NC, and invited us to a mentor training workshop that was available for NC teams. At the workshop, we were shown how to register as a new FRC team in TIMS and given valuable information on team building. There are also many useful links on the NC *FIRST* Robotics Website (www.ncfirstrobotics.org). Also, unlike many large companies, emailing *FIRST* using the frcteams@usfirst.org email yields answers almost always within 24 hours. During the three years that I have run this team, if my regional director could not answer my question, I was able to get an answer quickly through the frcteams@usfirst.org email on everything from who the principal is for a community-

based team (for the NASA grant, discussed below) to how to get extra grant money that was deposited into the team's *FIRST* account (grant money donated through US *FIRST* greater than the cost of registration gets put into a team account with *FIRST* and teams have to officially request a check or they can opt to leave the money in the account until the next season). Anyone interested in starting a *FIRST* team can find who the regional contact is on the *FIRST* Website [15].

3.2 Recruiting Students and Mentors

The regional director and a mentor from team 3459 were instrumental in helping to plan how to recruit students from a community standpoint. Since most FRC teams are affiliated with a school, it is easier to hold a school recruitment event. Since this was a community-based team, we had to focus on building an event that would get the word out to high school students. For this, the regional director helped us to plan a demonstration. For inviting students, we posted flyers in schools that would allow us to post them, sent emails to a local homeschool group, and had interested students invite their friends.

As a student organization at UNCW, we were able to host the event on campus. A team from Pender County (that no longer exists) came to UNCW and demonstrated their robot that could launch basketballs into a goal (for the Rebound Rumble game, 2012). The regional director spoke to the group about *FIRST*, and we handed out student applications. Student applications were adapted from team 3459 and modified each year based on what the team learned we needed (see Appendix C for the new student 2015 version).

Recruiting mentors began with UNCW students and faculty, and the word spread relatively quickly that a team was beginning. Team 4534 was very fortunate to have the

regional director connect us with interested mentors in our area. With direct contact between organizations, our mentor list quickly grew larger than our student numbers.

3.3 Managing Students, Parents, & Mentors

The first season was the easiest year to coordinate and manage the team. The team had fifteen mentors and five parents who were involved in helping with coordinating food for the kids, driving to events, and fundraising. For communication management, we used the website Survey Monkey to coordinate plans for food, driving, and other planning needs. The students created a team website which was utilized to link to a team Google calendar and to post notes from the coach (see www.thewiredwizards.com). We used email lists to contact students, parents, mentors, and sponsors. The email lists were separated because many parents did not want all of the information that was passed on to students. Parents who did want to know were added to the mentor list. The second year, we implemented a Remind101 texting account in order to reach students in real time since many do not check their emails daily.

The second and third competition seasons, we steadily lost many of our original mentors for various reasons before the students were ready to lead on their own. The lessons learned from these circumstances are discussed in Chapter 4.

3.4 Fundraising

Under the guidance of our GE Hitachi mentors and an FRC fundraising workshop that the team attended at a NC FRC workshop event, 4534 created sponsorship levels for eliciting donations. We based the levels on the base-2 number system in order to make the numbers unique and to give the fundraising a computer-based aspect (binary is base-2, and many things computing is based on binary; see Appendix G).

As rookie and second year teams, all FRC teams should plan to apply for the NASA Robotics Alliance Project grant. NASA awards this grant to cover the cost of registration for one event during the season ($6500 for 2013 and $5000 for 2014; rookie registration is always more expensive because the kit of parts includes initial equipment that is needed). Because most teams rely on this grant to begin their team, it was not difficult to ask our mentor teams to share their grant submissions with us to guide our submission. The 2013 season grant application for 4534 is Appendix E of this document. Team 4534 was honored to win this award for two years and to be able to use NASA as a white wizard sponsor (see sponsorship level descriptions in Appendix G).

Team 4534 also created a white paper and a donation letter to elicit donations from companies and government entities, including the local Chamber of Commerce. These types of documents are great to have on hand when someone finds a potential sponsor and needs to present information about the team to the organization (see Appendix F, G).

Teams include sponsor logos on the competition t-shirt, the robot, and the team's website. 4534 asks for the official logo from the sponsor when we receive their donation. We have sponsorship levels that determine how logos are displayed (Appendix G), and we send each sponsor a thank you card with a team picture, team signatures, and a team sticker if we have them available.

3.4 Local Response

The Wilmington, NC community has expressed an interest in starting more robotics teams for students. Through networking, I have identified potential places for teams to be connected to, including the Cape Fear Museum, Rachel Freeman School of Engineering, various community/elementary groups who have contacted me about Jr.

FLL teams, and I believe that with the large number of Laney High School students on the Wired Wizard's team that Laney is the first high school to target for a potential public school-based team in New Hanover County. Topsail High School in Pender County had a team in 2012 that failed due to lack of adult support, but from discussions with the principal, I am positive that with proper support, it would be possible to start a team at Topsail High School as well.

One of Wilmington's private K-12 schools, Cape Fear Academy, is also working to build their STEM offerings through after school activities and summer camps. This is a good opportunity to have a strong private-school based support to help build public school teams. This is possible because an important component of *FIRST* robotics is community outreach, with many FRC teams focusing on ways to support the creation of more *FIRST* teams in their communities at all levels.

3.5 Starting a Nonprofit Organization

Because many community-based FRC teams, and a few school-based teams, create a 501(c)3 in order to augment their fundraising, increase grant opportunities, and have control of funds, there is plenty of information available from other teams on how to start a basic nonprofit. Many of these nonprofits hire a financial advisor to help with applying for 501(c)3 status. With no background in business or public enterprise, I researched nonprofit resources and found the National Council of Nonprofits and a local organization called Quality Enhancement for Nonprofit Organizations (QENO). The National Council of Nonprofits has state associations in almost every state with available resources, including North Carolina. QENO is associated with UNCW and provides local workshops on topics related to improving nonprofits.

Starting a nonprofit organization allowed team 4534 to have its own bank account and will allow the team to obtain its own 501(c)3 status. In North Carolina, the Articles of Incorporation must be completed, signed, and submitted with a fee. Once our Articles of Incorporation were approved, we applied for an Employer Identification Number. Even though forming a nonprofit never fully transferred into having a nonprofit status, it did allow the team to have our own business bank account (BB&T provides free banking to nonprofits), and it allowed our team to be able to receive funds from *FIRST* if grants were submitted directly to them. School-based teams have the benefit of using school information, and many create a booster club in order to augment their ability to raise money.

4. Discussion of Lessons Learned

A very huge lesson that team 4534 has learned through this project is that *FIRST* robotics is more than robots. *FIRST* is entrepreneurship, community outreach, marketing, strategic planning, a major global sporting event, finance, electronics, bumpers, team building, programming, excitement, search engine optimization, conflict management, graphic design, grant writing, leadership, public speaking, writing, building friendships, safety, woodworking, CAD, applied math, common sense, following schematics, metal working, management, planning, website design, learning how to be productive in a team environment while working with professionals of all fields, and making mistakes. This is why it is critical to plan for more than building a robot. I have created a work breakdown structure that models the information to be considered when beginning a new FRC team (Appendix B).

4.1 Establishing the Team

Be prepared and forewarned, starting an FRC team is equivalent to starting a small business. Jr. FLL, FLL, and FTC teams are also significant, but an FRC team is a small business with a substantial budget for a volunteer endeavor. When starting a *FIRST* team, write a business plan that focuses on a goal for the team to accomplish in its first two years. It will be important to revisit this plan again with your team at the end of the two years to determine a 4 to 5 year goal. This is not the same as creating a business plan for a nonprofit that would support the team. This is a business plan that is written exclusively for the team to follow (there is an entrepreneurship award where students can submit their team's business plans, an award 4534 won in 2015). Even though the most obvious focus of any *FIRST* team may be the robot as the product, with awards and recognition during competition, there are many other aspects that the team may focus on

as their product, with the robot as a vehicle to get them to competition and deliver their product. The goal for the team can change, but a new business model should be created to reflect the change in order to guide the team for each season.

Identifying resources is a crucial aspect of beginning a *FIRST* team. Most states (and countries) have at least one regional director, and it is easy to find local contacts via the website's link [15]. The regional director is a major resource for finding teams that want to build their community outreach experiences by mentoring new teams. This is a very huge aspect of the *FIRST* environment. Teams mentor each other across the globe as part of their community service. For example, the NASA Knights (yes, NASA sponsors its own team) used their resources to travel to the Netherlands to start the first team in their country, the Rembrandts. In North Carolina, 4534 was able to find similar mentoring help from multiple teams. An FRC team also hosts a global forum called Chief Delphi. This is a well-known information source for FRC, and most teams use this site for information on everything *FIRST*.

4.2 Recruiting Students and Mentors

The first year, recruiting mentors was easy. The second year, many first-year mentors graduated UNCW and moved. The second and third year, many young corporate mentors were promoted and moved. There were a few who graciously declined mentoring due to opposing viewpoints, mostly related to the issues discussed in the next section. I have learned that in order to recruit mentors in large corporations (such as GE Hitachi and Corning), it is best to know someone who works for the corporation or to find a contact (through the regional director or through personal networking) who is involved with the company's volunteer group. This group is also a huge source of grants through these companies. Many corporations only give grants to an organization if their

employees are volunteering with the organization. One example is Google. There is a NC team who knows a Google employee who mentors them via Skype. Through this mentoring relationship, the employee is able to provide the team a yearly $5000 grant from Google.

Recruiting students the first year was difficult. Flyers cannot be hung in a school unless they are approved by the school board, and it was more difficult than anticipated to get principals to allow us to make announcements to teachers. In short, we learned that if you are not a program that is championed by a teacher within the school, it is very difficult to advertise within the school. Therefore, we mostly had to rely on word of mouth in a community where most people did not know anything about *FIRST* robotics. The second year was just as difficult to recruit students, but by the third year, thanks to press coverage and student momentum, the word got out that team 4534 was fun, and we grew from 13 team members in 2014 to 29 in 2015.

4.3 Managing Students, Parents, & Mentors

This topic is the second biggest motivation for beginning ACR (after wanting to create more teams for more students to experience *FIRST* robotics). This is because I do not believe that starting more teams would be successful if coaches and mentors do not have the proper support. The services that ACR will provide to stakeholders are the things that the mentors for team 4534 did not have time to do in addition to our families, full-time jobs, and full-time class schedules. Also, many mentors were not willing to do administrative tasks because their focus was mentoring the students.

When mentoring students, it is important to make sure that every student has something to do. If every student has a responsibility, then he/she will take leadership of that task and gain the most out of their experiences during meetings. Also, if students do

not feel like they are contributing, then they stop coming to meetings and may drop off the team. While there is only a limited amount that you can do for a student who simply does not show up, students who are willing to come to every meeting should have work to do.

This was not a big issue for the team our first year because we only had nine full-time students, one part-time. With only nine students, we did not have enough students to do all of the work. This was fine for the first year. I learned from Marie Hopper, NC Regional Director, that the normal progression of an FRC team is that in the first year, students tend to rely on the mentors. Mentors end up doing a lot because the teenagers are still unsure of what is expected of them. Without mentors who are teachers by trade or well versed in how to organize and manage an FRC team, the students simply are not sure what to expect of competition or how the build season should go. By the second year, mentors should begin to make sure that students are taking more control. With 4534, students were so excited after experiencing their first competition that many were ready and able to take over the second year but with low confidence in their ability to succeed without mentor intervention. I realize now that I did not properly anticipate this happening. I did realize after having a few issues with mentors during the first season that I should have some type of volunteer training for the mentors. I had little success scheduling meetings with mentors in the same room at the same time, so I opted for asking mentors to read the official *FIRST* Mentoring Guide, and I included expectations in the mentor application (Appendix D). I was not successful in teaching mentors not to work on the robot, and this caused friction between me and the mentors because mentors wanted to work on the robot when the students seemed to lose focus.

I have learned through this experience that if a person realizes that you will do the work if he/she does not do the work, then they do less work. For this reason, a mentor in *FIRST* should never touch anything the students are working on. And, in contrast, I fell into the trap that if someone would not do the work necessary to keep the team running, it was faster and deadlines were more easily met if I completed the task myself. For this reason, a coach has to have mentors who are willing to take on tasks and has to be able to accept with grace when certain things do not get done. These scenarios are detrimental for sustaining an FRC team (and sustaining personal sanity). With too many administrative tasks being put onto a mentor, especially the lead coach, the person will burn out quickly and the team will fail (the only reason 4534 made it to three years is because I cared so much about the students having this experience). If the main focus of *FIRST* is to encourage kids to have fun experiences in STEM, a mentor who is overwhelmed with administrative tasks will not be able to focus on ensuring that the students have fun. It was very evident this season, our third season, that I was too overwhelmed with administrative tasks for 29 students to plan and organize engaging tasks for all 29 students.

From a management standpoint, I have learned that in order to avoid the above scenarios, there are a few things that can be done:

- Organize the team into departments. 4534 has design, build, marketing (also responsible for fundraising and sponsor thank yous), finance, programming, and community outreach.
- Organize student leadership to model business leadership. This year, team coach became the CEO, and the team captain(s) were my chief officer(s) who had authority over the departmental managers. The departmental managers

organized their teams and made sure everyone was working. Everyone should communicate up to make sure that the team's goals are being met.

- Create student, parent, and mentor handbooks and contracts that define exactly what is expected of each stakeholder with their signature. This provides a basis for reprimanding inappropriate behavior by reminding the person that they agreed to the terms laid out in the handbook. I include parents in this list because parents are mentors who help with driving and other supervision roles (be sure to include that a parent cannot pick up hitchhikers with another person's child in the car.)

4.4 Fundraising

Fundraising for an FRC team is a year-round task. Many potential grants have deadlines for submissions all throughout the year. Students should be expected to participate in fundraising events that will increase the team's visibility in the community, but be prepared, community events did not ever raise more than $200 for 4534. These events did give all students a chance to practice planning and marketing, while giving us networking and recruitment opportunities. Students also get team work experience before the build season begins. 4534 created an event that we named the RoboPoWWoW (The WWoW stands for Wired Wizards of Wilmington). We had activities for visitors, sold T-shirts, made personalized buttons, had sponsors set up tables to give information, and the students invited people from their schools who were prospective new team members. The main activity for the event was a rebuilding of our Ultimate Ascent robot. Students rebuilt the robot prior to the RoboPoWWoW, and then unbuilt two hours' worth of work. During the event, visitors were able to watch the students work on rebuilding the robot

and have a first-hand opportunity to see the project and how large the undertaking actually is to build the robot. One of our students came up with the idea for this event.

Plan to thank your sponsors. I learned this year that you should plan seven contacts with each sponsor per year. They should get at least one thank you letter with a team picture and signatures, emails about season progress and competition with pictures (this could be a newsletter or a blog that is emailed to remind sponsors to keep up with what you are doing), and an invitation for a demonstration. There are plenty of stories out there of teams who lose sponsorships because the organization expected a thank you.

4.5 Build Season & Competition

- Tell students and parents up front that an FRC build season is 6 weeks of intense work. 4534 students meet 5-6 days a week, including 8 hours on Saturday and 5 hours on Sunday. While it is not required to be at every meeting, and homework is allowed, students must know ahead of time in case they have other obligations.
- Require dues no less than $75. It is difficult to raise $20,000 +, and all school activities require a substantial monetary requirement for equipment (band, sports). 4534 asks students to pay $100 plus a case of water and a box of snacks. Parents are also asked to contribute to Saturday lunches (that parents organize). 4534 does have scholarships, and we ask one sponsor each year for $500 to fund our scholarship account.
- Use peer pressure/student leadership to stop cell phone/computer games during meetings. Include this in the handbook. Also include rules about dating expectations; if team members date each and whether students are allowed to bring partners to meetings.

- Use the mentor/parent handbook to regulate discussion of alcohol and drug use in front of students. Just do not allow it. Students may use the information to infer that a tired driver was drinking all night and is now driving students in their car because the driver speaks about drinking alcohol in front of that student (this is a legal nightmare waiting to happen, and it happened my first year with the team). 4534 mentors are not allowed to discuss these topics in front of students and are not allowed to drink alcohol during 4534 events.
- Buttons, buttons, buttons. Teams hand out 100s of buttons at competition. If you plan a design early enough, your team can send the artwork in to a company to have them made (this is ideal because making 500+ buttons by hand is a lot of work), but it is also handy to have a button maker to make name buttons and personalized buttons for team building exercises and events. We purchased ours for a decent price from a seller on Etsy.
- The coach and mentors who are working directly with the students during competition should not be expected to chaperone the students in the hotel. Competition is tiring. Plan ahead for enough parents to agree to come (and hopefully to book the hotel and organize emergency phone numbers, room assignment, transportation to and from the hotel to the event site, meals, and drinks in the stands).
- Have a trash bag, 8 oz bottles of water, and snacks for your team in the stands during competition events.
- Find important and exciting things that students need to do during competition so the entire team is engaged and busy. Have a schedule in the pit that lists what each student is supposed to do. This was not an issue for 4534 until we

had 26 students at competition (A team with only 9-13 students means that no one gets a chance to sit down and rest for the entirety of competition).

- Teach safety using ISO standards. This gets student prepared for a real world job. I have heard of organizations who hire students directly out of high school because they have learned these standards while on their FRC team.
- Always have two adults at all meetings and never talk to a student about a sensitive subject with only one adult present.
- Never send only one adult with a team to competition. If there is an emergency, there is not a second adult to stay behind and monitor the rest of the team.

4.5 Personal Lessons Learned

I originally suggested starting a robotics team to the ACM board of directors as a community outreach program for a very personal reason. My son, who was 14 at the time, told me when he was 6-years-old that he wanted to be a robotics engineer after asking me what kind of job got to make his favorite robot toy. Robotics engineer was the first response that occurred to me. That answer stuck, and my son did not change his mind about being a robotics engineer. As a college student, I changed my major decision multiple times, so I was intrigued and proud of my son for being steadfast in his decision. So, naturally, I tried for many years to find engineering camps in Wilmington, NC to give him an opportunity to begin to learn what it meant to be an engineer. This was a fruitless endeavor, and I often considered moving to Raleigh, NC in order to have more options for after school and summer experiences for him. Then I saw a commercial on PBS about *FIRST* robotics. The students were laughing and excited with their colored hair while they drove their robots. I had no idea what I was seeing on the screen, but it looked

amazing, so I researched *FIRST.* I immediately saw this as my solution to allow my son to experience engineering before he went to college.

When I began this project, it had never occurred to me that I could be a leader; I was just giving my son an important opportunity while helping other teenagers. But somehow in the process of starting the team, discussions with my computer science professors resulted in me applying for, and being accepted to, graduate school to get a Master's of Science in Computer Science and Information Systems. Starting the team ended up being the ideal hands-on learning experience as I moved through my classes in this program, and the ideal experience for me to gain the confidence in my skills as a leader, a project manager, a technology professional, and as a person who is dedicated to being a lifelong volunteer.

4.6 Project management/Professional lessons learned

As I worked through my degree program, I have been able to analyze my work with team 4534 and apply the things that I learned to my project. While the programming classes seem to be the most obvious advantage to being a leader of a team that teaches students how to code, instead the team helped me to be more confident in my technological abilities. I have a BA in English and a MAT in English education, so computer science was a relatively new subject for me. The students made sure that I learned how to be a proper nerd by getting me hooked on Dr. Who, and helping them with coding and problem-solving helped to develop my confidence in my career change.

The biggest problem that I had as the coach of team 4534 was managing the students, parents, and mentors. I realized after the first year that this was an issue for me, so I decided to take a class in leading public and nonprofit organizations. I learned that I am a task-oriented leader through this class, which means that I typically focus on the

task at hand above all else. I was able to see that this is true, and that because I tend to focus on the task, many of the people that I lead see me as non-emotional and strict. I have been working on this, but when there is a lot to accomplish, I focus on breaking down the tasks to get the work completed.

My IT project management class was very instrumental in teaching me about how to plan a project, and I was able to use what I learned during the semester to teach my team captain how to plan for the next build season. I learned about risk assessment in multiple classes, and I attribute many of the management issues that I had to not completing full risk and needs assessments before beginning the team. I have also learned in hindsight, that if many of the tools used for planning a project and analyzing a system, such as use cases and other system planning diagrams, were used to develop a team and map out the requirements for beginning a team, then those documents could be shared with teams to help simplify developing new teams. This is a potential activity for ACR to incorporate in their materials that they provide to developing new teams.

5. Conclusions and Future Work

Creating a community-based robotics team to support STEM has been a very rewarding experience. It has been a ton of work for a full-time graduate student who also works a paying job, but the lessons that I have learned and the experiences that I have shared with my team have been invaluable.

The next step for this project would be to continue the planning process for the business. A Board of Directors should be chosen, and the work description for the executive director of the company should be finalized with the Board. Once the selection process is completed for the executive director and a suitable candidate is hired, then the company can begin business as described and planned in the business model.

Once Azalea Coast Robotics has begun a determined number of robotics teams in the area, the next step to create a sustainable model that enables ACR to benefit all *FIRST* teams is to make training videos and materials available to teams for free through the company's website with videos posted to YouTube. If this resource is properly advertised on Chief Delphi and through other *FIRST* resources, then it is possible that ACR can bring in a decent profit through views. It is also possible that ACR can review its business plan to evolve its model to support other STEM after-school activities in the area. ACR employees may also decide to evolve their business model to help other nonprofits that would like to start a similar business model to grow STEM after school opportunities in their communities.

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Appendix A: Azalea Coast Robotics Business Model

Azalea Coast Robotics

April 2015
PO Box 4705, Wilmington, NC 28406
Jazmin Capezza

Azalea Coast Robotics: Executive Summary

"To transform our culture by creating a world where science and technology are celebrated and where young people dream of becoming science and technology leaders."

Dean Kamen, Founder *FIRST*

Science, technology, engineering, and math (STEM) education has become a global center of attention as technology-related job opportunities grow. The school system cannot keep up, with many schools unable to find the resources to provide the education necessary [1][3]. In its 2013 NC STEM Report Card, North Carolina identified informal education and STEM literacy as one of the six domains as imperative to ensuring that preK-16 students are motivated and prepared to pursue STEM careers [2][3].

Value Propositions and Customer Segments

Azalea Coast Robotics (ACR) will support the creation and sustainability of fun, enriching, informal after-school experiences that enable K-12 students to explore computer science and technology through robotics. Through positive experiences with professional mentors, For Inspiration and Recognition of Science and Technology (*FIRST)* gives students experience to know that jobs in technology companies are not as difficult as society perceives. By providing STEM activities for students, local industry is given the chance to educate and train future employees. This will enable our community to compete successfully in a global economy with technology-savvy students and employees.

Key Partners

The key partners for will be utilized to provide information resources, fundraising opportunities, student recruitment, mentor recruitment, and information for parents/families who want their students to join a team.

Key partners that have been identified for ACR's customer segments are:

- Entrepreneurship centers: UNCW's Center for Innovation and Entrepreneurship (CIE) and tekMountain
- Industry: Current: Corning, GE Hitachi, Duke Energy; Future: GE Aviation, PPD, Castle Branch, nCino, Google
- Cape Fear Museum and the Children's Museum of Wilmington
- Cape Fear Community College, UNC Wilmington, and UNC Wilmington youth programs
- Chamber of Commerce in Brunswick, New Hanover, and Pender Counties.
- Cape Fear Boy Scouts and Girl Scouts
- Home School Groups

- Public and Private school systems in Brunswick, New Hanover, and Pender Counties, including home school groups

Key Activities and Resources

It is ACR's vision to fulfill North Carolina's underserved need for informal after school learning experiences for students in New Hanover, Brunswick, and Pender counties by supporting the business functions that may discourage people from beginning programs. These functions include recruiting and training mentors, organizing background checks, providing information for interested parents, students, and volunteers, processing student/mentor application, and providing access to application information through a database.

ACR will focus its beginning programs in competitive robotics through US *FIRST*. Through creation and maintenance of its customer relationships, ACR will focus on beginning robotics teams in all 4 levels of *FIRST* robotics and enable ourselves to provide a resource center for teams and, in the future, other informal STEM activities. By providing the support that teams need with our services, ACR's goal is to enable less complicated management of teams so that volunteers will be more readily available to organize teams without being overwhelmed with paperwork and training.

Through creation and maintenance of its customer relationships with local industry, colleges, public and private school systems, ACR will focus on beginning robotics teams in all 4 levels of *FIRST* robotics (one of each team level per year) and enable ourselves to provide a resource center for teams and, in the future, other informal STEM activities. ACR will use its By providing the support that teams need with our services, ACR's goal is to enable less complicated management of teams so that volunteers will be more readily available to organize teams without being overwhelmed with paperwork and training.

Cost Structure and Revenue Streams

ACR's cost structure will be based on its key activities. Development of training materials and classes will require services from a volunteer training specialist to work with the executive director to develop materials unique to FIRST robotics and/or STEM mentoring situations. This service will be free to teams, and it is expected that a grant or sponsorship will be obtained to pay for the development work.

The database will need to be developed, along with a Web interface, which allows teams to access and query student and mentor information. This service will be free to teams, and it is expected that a grant or sponsorship will be obtained to pay for the development work. Hosting of the database and the Web site will have to be sponsored by other revenue through ACR.

Salaries for employees will be paid through ACR's sponsorships, sells of training materials, YouTube views revenue, and other fundraising activities. An executive director will be needed to work with the Board of Directors to uphold ACR's vision and

mission. This person will focus on networking activities for ACR to build customer relationships. The executive director will be responsible for budgeting, working with a contracted finance person to obtain 501(c)3 status, and insurance. A program coordinator will be needed to work with a volunteer training specialist to create and organize training programs and materials for mentors. This person will also be responsible for planning community outreach events. Since this person will be responsible for events, it will also be his/her job to create and maintain ACR's social media extensions to promote programs and services.

In order to provide information services for teams by processing applications, entering information into a database, and performing background checks, an executive assistant (aka student intern manager) and one or two student interns will be needed. Volunteer trainers to administer training classes will also be needed.

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Azalea Coast Robotics: Business Model Canvas

Key Partners

- Entrepreneurship Centers: CIE, tekMountain
- Industry: Corning, GE Hitachi, Duke Energy
- Cape Fear Museum
- UNCW Youth Programs
- Boy Scouts and Girl Scouts
- Home School Groups
- School Systems: New Hanover, Brunswick, Pender counties
- Cape Fear Academy
- Chamber of Commerce
- University of NC Wilmington

Key Activities

- Process student and mentor applications
- Perform background checks
- Provide database access to application info
- Train mentors
- Connect teams with local resources

Key Resources

- Applications
- Training materials
- Database access through Web
- Training classes
- 501(c)3 status access for grants and charitable donations to teams

Value Propositions

- Create and sustain exciting informal STEM activities for K-12 students
- Enable students to work alongside professionals
- Dispel beliefs that STEM careers are difficult or unattainable
- Streamline administrative tasks
- Train volunteers to work with students

Customer Relationships

- Establish relationships with students/parents/mentors to insure that services are being utilized and teams maintain sustainability

Channels

- Public and private school systems in Brunswick, New Hanover, and Pender Counties
- Businesses
- UNC Wilmington
- Internet; Social Media
- Community outreach

Customer Segments

- K-12 students in public and private schools
- Parents/Grandparents/ Guardians
- STEM Volunteers/Mentors
- Industry and colleges with potential volunteers

Cost Structure

- Development of training materials/classes
- Development of database
- Hosting of database
- Obtaining 501(c)3 status
- Insurance
- Volunteer background checks
- Contract financial services
- Building rent and overhead costs
- Marketing materials
- Salaries:
  Executive Director
  Program Coordinator
  Executive Assistant
  Student interns (2)
  Volunteer trainees (2)

Revenue Streams

- Grants
- Donations/Sponsorships
- Community outreach kits for teams
- YouTube channel (will provide revenue through views)
- Training Materials (potentially sell for revenue)

Azalea Coast Robotics Financials

Start-Up Funds for ACR

Required Start-Up Funds	Amount	Totals
Fixed Assets		
Equipment	1,850	
Total Fixed Assets		
Operating Capital		
Pre-Opening Salaries and Wages	77,857	
Prepaid Insurance Premiums		
Legal and Accounting Fees		
Rent Deposits	1,000	
Supplies	100	
Advertising and Promotions	500	
Licenses	-	
Other Initial Start-Up Costs	500	
Working Capital (Cash On Hand)		
Total Operating Capital		79,957
Total Required Funds		$ 79,957

Sources of Funding	Amount	Totals
Sponsor Donations	75.00%	59,968
Grants	25.00%	19,989
Total Sources of Funding	100.00%	$ 79,957

Figure 4: Startup funds for year 1.

Fixed Operating Expenses

Fixed Operating Expenses	Monthly	Year One	Year Two	Year Three
Percent Change			3.00%	3.00%
Expenses				
Advertising	$ 200	2,400	2,472	2,546
Dues and Subscriptions	20	240	247	255
Insurance (Liability and Property)	30	360	371	382
Postage and Delivery	10	120	124	127
Rent (on business property)	350	4,200	4,326	4,456
Supplies	100	1,200	1,236	1,273
Telephone and Communications	50	600	618	637
Travel	100	1,200	1,236	1,273
Total Fixed Expenses	860	10,320	10,630	10,948

Figure 5: Fixed Operating Expenses for Years 1-3

Figures 6-9 are a financial plan for starting new teams each year. Assumes funding and starting 1 FRC, 1 FTC, and 1 FLL team per year for the first 3 years of operation.

	FRC	FTC	FLL	Total			Number of Groups	
Revenues:							FRC	1
Sponsorships	$7,000	$0	$0	$7,000			FTC	0
Grants	$6,500	$0	$0	$6,500			FLL	0
Fundraising	$0	$0	$0	$0				
Membership Fees	$2,000	$0	$0	$2,000				
Total	$15,500	$0	$0	$15,500				
Expenses:								
Competition*	$9,000	$0	$0	$9,000				
Equipment	$600	$0	$0	$600				
Computer	$500	$0	$0	$500				
Depreciation	$150			$150				
Parts	$3,500	$0	$0	$3,500				
Other	$1,375	$0	$0	$1,375				
Total	$15,125	$0	$0	$15,125				
Net Income	$375	$0	$0	$375				
*See Detail								

Figure 6: Income Statement Year 1

	FRC	FTC	FLL	Total			Number of Groups	
Revenues:							FRC	2
Sponsorships	$14,000	$1,500	$1,000	$16,500			FTC	1
Grants	$13,000	$500	$500	$14,000			FLL	1
Fundraising	$7,000	$1,000	$1,000	$9,000				
Membership Fees	$4,000	$200	$200	$4,400				
Total	$38,000	$3,200	$2,700	$43,900				
Expenses:								
Competition*	$18,000	$1,925	$1,475	$21,400				
Equipment	$600	$0	$0	$600				
Computer	$500	$500	$500	$1,500				
Depreciation	$300	$100	$100	$500				
Parts	$7,000	$0	$0	$7,000				
Other	$2,640	$253	$208	$3,100				
Total	$29,040	$2,778	$2,283	$34,100				
Net Income	$8,960	$423	$418	$9,800				
*See Detail								

Figure 7: Income Statement Year 2

	FRC	FTC	FLL	Total
Revenues:				
Sponsorships	$21,000	$3,000	$2,000	$26,000
Grants	$0	$1,000	$1,000	$2,000
Fundraising	$32,000	$2,000	$2,000	$36,000
Membership Fees	$6,000	$400	$400	$6,800
Total	$59,000	$6,400	$5,400	$70,800
Expenses:				
Competition*	$27,000	$3,850	$2,950	$33,800
Equipment	$600	$0	$0	$600
Computer	$500	$500	$500	$1,500
Depreciation	$450	$200	$200	$850
Parts	$10,500	$0	$0	$10,500
Other	$3,905	$910	$730	$5,545
Total	$42,955	$5,460	$4,380	$52,795
Net Income	$16,045	$940	$1,020	$18,005
*See Detail				

Number of Groups	
FRC	3
FTC	2
FLL	2

Zach:
Grants will be phased out in year 3. Need to generate more fundraising

Figure 8: Income Statement Year 3

	Year 1	Year 2	Year 3
Assets:			
Cash	$5,000	$9,500	$20,000
Accounts Receivable	$100	$570	$1,875
Equipment	$600	$1,200	$1,800
Less: Depreciation	($50)	($100)	($150)
Computer	$500	$2,000	$3,500
Less: Depreciation	($100)	($400)	($700)
Total	$6,050	$12,770	$26,325
Liabilities:			
Accounts Payable	$110	$230	$350
Equity:			
Retained Earnings	$5,940	$12,540	$25,975
Total	$6,050	$12,770	$26,325

Figure 10: Balance Sheet

Competition Expenses:			
	FRC	FTC	FLL
Rookie Registration	$6,500	$275	$275
Travel	$300	$150	$100
Hotel	$1,100	$600	$500
Food	$600	$300	$300
WIFI	$0	$85	$0
KIT	$0	$265	$150
Marketing	$500	$250	$150
Total	$9,000	$1,925	$1,475
Group Detail			
	FRC	FTC	FLL
Members	20	10	10

Figure 9: Competition Expenses

Appendix B: Work Breakdown Structure of Starting an FRC Team

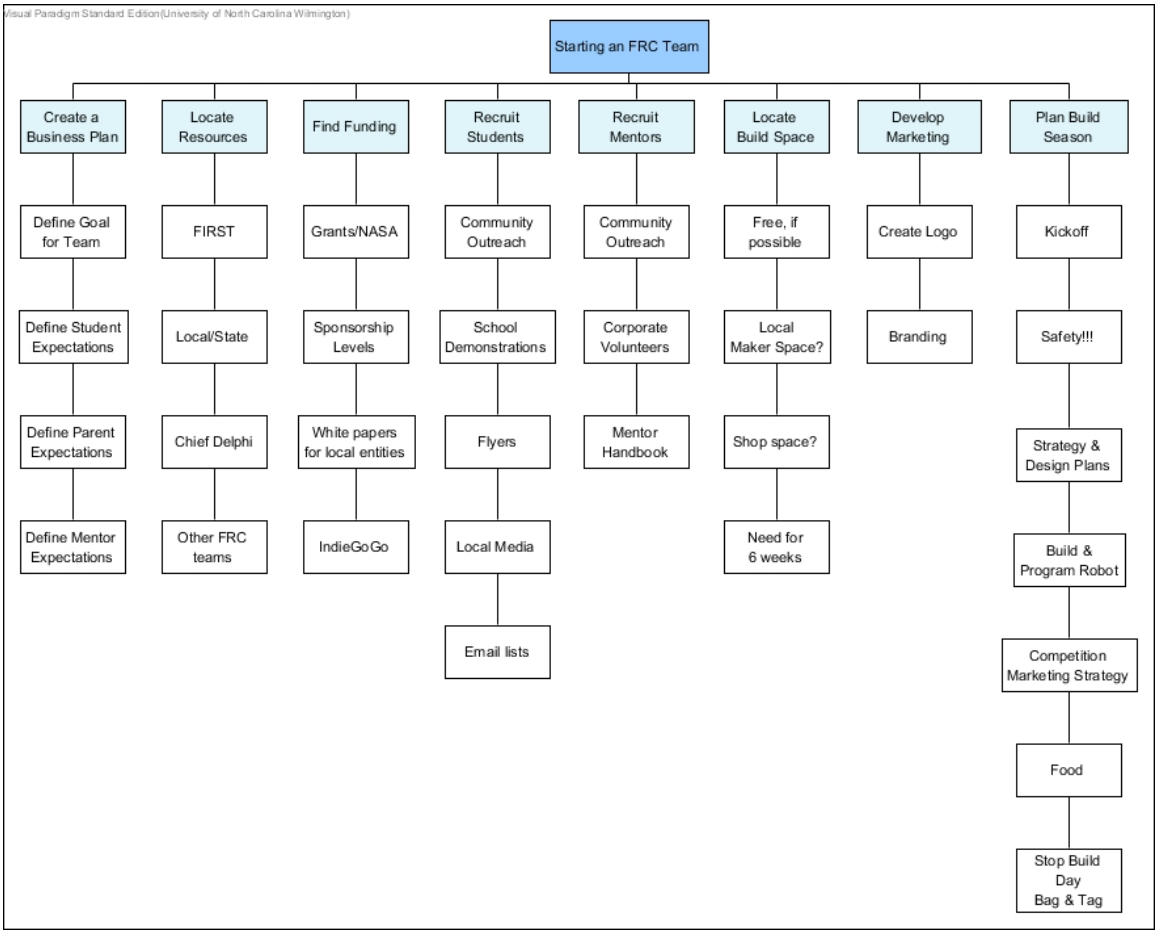

Figure 11: Work Breakdown Structure to Start an FRC Team

Appendix C: New Student Applications

FRC Team #4534: New Member Student Application
2015 Competition Season

Team 4534 was formed as a community-based robotics team by UNCW students for the purpose of STEM (Science, Technology, Engineering and Math) education of high school students. ***The team's success depends on the support and participation of parents and students.***

Signing Up

- ❒ Please read this application. Keep pages 1 to 3.
- ❒ Students: Fill out, sign, and turn in pages 4-6; Parents: Fill out, sign, and turn in pages 7-10.
- ❒ Give your completed membership form, along with a non-refundable registration fee of $100 per student + one case of water to Jazmin. Make your check out to Azalea Coast Robotics. Alternatively, find out from Jazmin the next meeting location (wiredwizards@gmail.com) and you can bring your application to the next meeting. If this fee if a burden or if you receive free or reduced lunch please see Jazmin for scholarship opportunities.

Jazmin Capezza
wiredwizards@gmail.com
910-352-xxxx (cell)
PO Box 4705
Wilmington, NC 28406

Profile of a Team 4534 Student

1. Team player with a positive attitude.
2. Self-motivated.
3. Hard working.
4. Willing to learn and be open to new ideas.
5. Willing to prioritize Team 4534 over other activities.
6. Willing to commit substantial time to the program, including:
    - Meetings, demonstrations and presentations as scheduled.
    - Emergency meetings when needed.
    - Fundraising.
7. Show an appreciation for the time and monetary support provided by mentors, parents and sponsors to make this team possible.
8. Exhibit Gracious Professionalism when working within the team and representing the team, both in person and virtually
9. Willing to help maintain the team's resources (cleaning up the build space, moving/packing team equipment, etc.).
10. Show academic responsibility for school commitments (students who fail their grade cannot return to the Wired Wizards for the next competition season).

General Expectations

- ❒ During all Team 4534 events and activities, students will follow rules of conduct or behavior and all procedures as required by the Student Code of Conduct.
- ❒ All student team members are required to a non-refundable registration fee of $100 per student due November 15. ($25 of this fee is our contribution to Maker Space) If this fee will be a hardship, please see Jazmin as early as possible to apply for a scholarship.
- ❒ All students are expected to follow the requests of the mentors/coaches. In turn, mentors/coaches are expected to listen to students. Students are not allowed to give a task to a mentor/adult to complete. Adults are only present for supervision and advice.
- ❒ Students may be removed from the team by a vote of the mentors/coaches for lack of participation or behavior that is not appropriate if all other means of correcting the problem are ineffective.
- ❒ Elite Innovations Maker Space is providing us with a wonderful place to meet for a very discounted price of $25 per student for the season (this is included in your dues) because of this we would like to stress the importance of giving back to them by assisting them with projects and safety training as available as volunteers.

Specific Situations

Unsafe Behavior: If any dangerous or unsafe behavior is discovered during team events, activities or gatherings, parents will be contacted.

Student Drivers: It is not the mentor or coach's responsibility to monitor student drivers. However, while students are on team time, they may not drive with other students unless specific parent permission has been granted on both sides each time.

Student Relationships: Like supervisors/managers in the workplace, it is not the mentor or coach's responsibility to monitor personal relationships between students. If relationships (good or bad, male or female) impact the team or become a distraction to the rest of the team, means will be taken to minimize that effect, through separation of students and their activities. If it continues to be a distraction, parents will be notified.

Handling Conflicts or Disagreements: If a student, parent, mentor or coach has a disagreement or a problem with a specific decision or in how things are being handled in general, it is up to them to talk directly with the person involved AND the coach simultaneously. If you feel unable to talk with the person involved, please talk with an adult on the team who can mediate. It is inappropriate to talk about personal disagreements with Team 4534 students, mentors, coaches or parents to other FRC teams or other people not involved. It is also inappropriate to discuss personal disagreements about each other without the coach or a mentor involved so a solution can be found.

Being an Integral Part of the Team: More student time involved with the team and placing FRC as a higher priority means:

- Personal ownership of the team.
- Cross functional learning.
- Personal ownership and direction in the team's development/direction.
- More skills learned, used and reinforced.

Team 4534 Code of Conduct: Copy to Keep

Gracious Professionalism

- ❒ I will display "gracious professionalism" – the motto of *FIRST* – at all times and promote the ideals of *FIRST* including:
  - Respect for the feelings, opinions and choices of other team members
  - Respect for tools, equipment and facilities
  - Good sportsmanship during competition-cheering for the other teams
  - A positive attitude with a positive vocabulary
  - A friendly and polite attitude towards all people at all times

Respect

- ❒ I will be respectful of others and behave in a way that protects the health and safety of myself and others:
  - Using only the tools I have been trained to use
  - Using protective gear on eyes, ears, face and hands as necessary
  - Not participating in horseplay in a work area
  - Always wearing closed-toes shoes to all meetings and events.
- ❒ Before using any electronic devices during meetings or events (laptops, cell phones, hand held games and MP3 players), I will consider the appropriateness of this in terms of safety (my own and others) and respect for others in the room (presenters, facilitators, guests, peers). No handheld devices are allowed at meetings unless they are being used for research related to what we are working on or contact with parents about rides, etc.
- ❒ I will refrain from public displays of affection at any FRC meetings or events-I understand that they are a distraction and are not reflective of gracious professionalism or the goals of our team.

Communication

- ❒ I will keep current with team activities and requirements by checking the website, the forum, and email at minimum twice weekly and responding to text message as necessary.
- ❒ I will read and understand all rules of competition, as well as know our team's robot and competition strategy. I will also sign up for Chief Delphi and be aware of this resource.
- ❒ I will ask for help if I don't know what is going on, or am unsure of how to accomplish a task assigned to me.
- ❒ If I am not happy with my job on the team, I will talk to a leader, team captain, mentor or coach about finding another task for the team that I enjoy to do or am motivated to learn.

Checking Out

- ❒ **No student will be allowed to leave for the day unless our work area is cleaned. This is valid for EVERY meeting.**
- ❒ Prior to leaving any work area, I will:
  - Clean my work area and put tools back in their proper location.
  - Report to the mentor in charge what was accomplished and what still remains to be done.
  - Offer to help other team members or the mentors complete clean up and loading of cars or storing of robot and equipment before leaving the facility.

Failure to adhere to these guidelines will result in disciplinary actions determined by the team coaches and mentor(s) and may include a verbal warning, suspension from team activities or removal from the team.

Signature of Student: ***Date:***

Team 4534 New Student Information: Turn in with Signature

General Information

Name

Address

City, State, Zip

Home Phone Number

Cell Phone Number

Preferred Email Address

Birth Date

Emergency Contact

Name

Phone

Relationship

School Information

School Attending Grade

If homeschooling, how long have you been homeschooling?

Physician/Clinic (This is just in case we can't get in touch with a parent in an emergency)

Name / Clinic

Phone

Allergies or any other important medical information

Allergies

Dietary restrictions (please indicate by choice or by medical necessity)

Additional medical information that might be relevant

Team 4534 Code of Conduct: Copy to Sign and Turn In

Gracious Professionalism

- ❒ I will display "gracious professionalism" – the motto of *FIRST* – at all times and promote the ideals of *FIRST* including:
  - Respect for the feelings, opinions and choices of other team members
  - Respect for tools, equipment and facilities
  - Good sportsmanship during competition-cheering for the other teams
  - A positive attitude with a positive vocabulary
  - A friendly and polite attitude towards all people at all times

Respect

- ❒ I will be respectful of others and behave in a way that protects the health and safety of myself and others:
  - Using only the tools I have been trained to use
  - Using protective gear on eyes, ears, face and hands as necessary
  - Not participating in horseplay in a work area
  - Always wearing closed-toes shoes to all meetings and events.
- ❒ Before using any electronic devices during meetings or events (laptops, cell phones, hand held games and MP3 players), I will consider the appropriateness of this in terms of safety (my own and others) and respect for others in the room (presenters, facilitators, guests, peers). No handheld devices are allowed at meetings unless they are being used for research related to what we are working on or contact with parents about rides, etc.
- ❒ I will refrain from public displays of affection at any FRC meetings or events-I understand that they are a distraction and are not reflective of gracious professionalism or the goals of our team.

Communication

- ❒ I will keep current with team activities and requirements by checking the website, the forum, and email at minimum twice weekly and responding to text message as necessary.
- ❒ I will read and understand all rules of competition, as well as know our team's robot and competition strategy. I will also sign up for Chief Delphi and be aware of this resource.
- ❒ I will ask for help if I don't know what is going on, or am unsure of how to accomplish a task assigned to me.
- ❒ If I am not happy with my job on the team, I will talk to a leader, team captain, mentor or coach about finding another task for the team that I enjoy to do or am motivated to learn.

Checking Out

- ❒ **No student will be allowed to leave for the day unless our work area is cleaned. This is valid for EVERY meeting.**
- ❒ Prior to leaving any work area, I will:
  - Clean my work area and put tools back in their proper location.
  - Report to the mentor in charge what was accomplished and what still remains to be done.
  - Offer to help other team members or the mentors complete clean up and loading of cars or storing of robot and equipment before leaving the facility.

Failure to adhere to these guidelines will result in disciplinary actions determined by the team coaches and mentor(s) and may include a verbal warning, suspension from team activities or removal from the team.

Signature of Student: ***Date:***

Parent/Guardian Information for New Members

Student Name:

	Primary Team 4534 Parent/Guardian	Alternative Team 4534 Parent/Guardian
Name		
Address		
City, State, Zip		
Home phone #		
Cell phone		
Email address		
Employer		
Position		

Specific requirements:

By signing below, you agree that:

- ❒ I have read and agree with Member/Parent/Student requirements as laid out.
- ❒ If required in the future, I agree to a background check for each parent/guardian through US *FIRST*.
- ❒ My family will owe a non-refundable registration fee of $100 ($25 of this for the Maker Space fee) and a case of water per student fee due November 15. *I will provide food/snacks/water and supplies during build season a minimum of two times.* IF YOUR COMPANY DOES DONATION MATCHING, PLEASE INQUIRE WITH THEM, THIS TEAM IS A NON-PROFIT. IT MAY BE POSSIBLE TO GET YOUR DUES MATCHED BY YOUR COMPANY.
- ❒ I will assist by attending meetings as necessary for extra supervision.
- ❒ I will abide by the guiding principles as outlined in the *FIRST* Handbook.
- ❒ I will not hold the mentors, families, sponsors or directors of Team 4534 responsible for any injury or accident that may occur during team sponsored events.
- ❒ If you have any concerns, you will contact the team Coach first, so make sure that all problems are handled appropriately, including concerns.
- ❒ I understand that students who fail their grade will not be allowed on the team the next season.

Signature of Parent /Guardian: **Date:**

_____ _____

Appendix D: Mentor Application

FRC Team #4534
Mentor Application for the 2013-2014 Season

Team 4534 Mentor Vision Statement

Team 4534 is excited that you are interested in being a part of our team! As mentors of team 4534, we strive to communicate to the students a sense of the sheer fun of making things. It is fine to talk of secure jobs, high salaries, and national needs with our students, but Team 4534 believes that there are much more gut-level ways in which building and programming a robot are satisfying. The goal of our team is to be sure that the students stop to enjoy the sense of accomplishment along the way to figuring out why the saw will just not cut straight, how to debug an intermittent software problem, or what can be used in place of a $10,000 part they read about on the Internet. We want our team members to enjoy the sense of self-reliance that comes from not giving up, the sense of being part of a team whom you can rely upon, and the sense of self-worth that is developed by being a part of a group that values your ideas and strengths. As mentors, we agree to try to recognize and act on the moments when inspiration and education can be imparted. As long as safety is not an issue, we believe that the best learning experience is to allow students to complete all tasks related to preparing for competition and building the robot. In the experience of teaching robotics, the questions about careers and further education arise organically. We acknowledge that such a moment can arise at any time, while soldering a connection, debugging code, or milling a part from aluminum -- taking the time at that moment to address these opportunities is far more effective in helping our team members grow than most school-based activities.

All mentors are required to read the *FIRST* Mentor Handbook and abide by these guidelines:

- ❒ http://www.usfirst.org/uploadedFiles/Community/FRC/Team_Resources/Mentoring%20Guide.pdf

Thank you for joining us! If you have any questions, please ask

Jazmin Capezza
Coach, Team 4534
910-352-xxxx (cell)
WiredWizards@gmail.com

You may keep this page for your reference, but please return pages 2-4 to Jazmin.

Contact Information:

Name:

Address:

City, State, Zip:

Phone Number:

Cell Phone Number:

Email Address:

Place of work: Position:

About You:

Do you have any skills/experience in the following areas that you might be willing to share?

☑ if Yes	Area	Specific info/languages
❒	Accounting	
❒	Art / Photography / Graphic design	
❒	CAD / drafting	
❒	Mechanical design / building	
❒	Electrical / electronics	
❒	Machining /fabricating	
❒	General construction/tool knowledge	
❒	Fundraising	
❒	Legal / Financial /Non-profit experience	
❒	Media / Public Relations	
❒	Photography	
❒	Programming	
❒	Speaking / Presentation / Sales	
❒	Video / Animation: Programs	
❒	Web Design	
❒	Word Processing/Spreadsheets	
❒	Writing/Editing	
Other?		

Please list two character references with phone number (OK to include current Team 4534 members)

Name	
Phone Number	Email
Relationship	How long have you known this person?

Name	
Phone Number	Email
Relationship	How long have you known this person?

- ❒ I have read and agree in principal to the philosophy laid out for mentors by *FIRST* from the *FIRST* Mentors handbook, and I will do my best to facilitate student growth through the mentor roles and responsibilities laid out in the handbook: (http://www.usfirst.org/uploadedFiles/Community/FRC/Team_Resources/Mentoring%20Guide.pdf).
- ❒ I have read and agree in principal to the Team 4534 Mentor vision statement.
- ❒ I understand that the parents, coaches and current mentors reserve the right to terminate my relationship with Team 4534 without notice, for any purpose if it is deemed beneficial to the team.
- ❒ If I feel I need to leave the team, I will let Jazmin know.
- ❒ I release Team 4534, any team members, their families, or mentors from any responsibility for personal injury that may occur while working or traveling with the team.
- ❒ I agree to submit to a background check as requested by the coach, insurance company, US *FIRST*, or other partners of Team 4534 (please fill out last page of this form).

Signature of mentor (Digital) _____ Date _____

Disclosure/Authorization Form

NOTICE TO APPLICANT REGARDING BACKGROUND CHECK

In order to safeguard the youth in our care, Team 4534 may procure background checks on you in connection with your application to serve as a volunteer and the robotics teams associated with Team 4534. We may procure additional background checks at any time during your service as a volunteer in order to evaluate your continued suitability for volunteer service.

The consumer reports may contain information bearing on your character, general reputation, and personal characteristics. The types of information that may be obtained include but are not limited to Social Security number verification, sex offender registry checks, criminal records checks, inmate records searches, and court records checks. The background checks will not include credit record checks
or motor vehicle record checks.

You are entitled to request a complete and accurate disclosure of the nature and scope of such reports by submitting a written request. Results will be kept confidential and limited to those who need to know for the benefit of the team (typically the lead mentor/s and coaches).

APPLICANT'S ACKNOWLEDGMENT AND AUTHORIZATION
I have carefully read this notice and authorization form and I hereby authorize Team 4534 to procure a background check, which as described above will include information relating to my criminal history as received from reporting agencies. I understand that this information will be used to determine my eligibility for a volunteer position robotics teams. I also understand that as long as I remain a volunteer, additional background checks may be procured at any time. I understand that if Team 4534 chooses not to accept my application or to revoke my membership based on information contained in a consumer report, I will receive a summary of my rights under the Fair Credit Reporting Act and contact information for the reporting agency.

_____ _____

Signature of mentor Date

Information for the background check:

Full Legal Name	
SS#	
Driver's License #	

Appendix E: 2012 NASA Robotics Alliance Grant Submission

Please note: The NASA grant submission form is online. When we submitted this, we wrote down all of the questions, created answers in a Word document, then cut and paste our answers into the text box format that NASA used after we were satisfied with our answers.

1. **Why are you considering entering a team in the 2013 FIRST Robotics Competition? What will define success for your team?**

   Team 4534 is a community-based rookie team established in Wilmington, NC. The team was conceived and organized by the University of North Carolina Wilmington (UNCW) chapter of ACM (Association for Computing Machinery), a student pre-professional society for computer science majors, as a way to further interest, education, and the pursuit of careers in STEM topics among high school students in Wilmington. Conversations with local educators have convinced us that there is demand for such opportunities for Wilmington high school students. There are effective programs for middle school students in robotics, but nothing exists at this point at the high school level. Such opportunity is crucial, as it will affect students' decisions about higher education and career choices in STEM-related fields.

   Specifically, our team was formed with the purposes of: 1) providing a unique and effective learning experience for students to gain experience in planning, designing, engineering, programming, and team building 2) developing leadership skills among students, meanwhile urging them to further pursue STEM activities, degrees, and careers 3) filling a gap to create more STEM opportunities for high school students in our community; and 4) engaging the community in the excitement and mutual benefit of greater STEM advancements.

   Our team is the first *FIRST* Robotics team in New Hanover County, in the southeastern coastal area of North Carolina. Wilmington, the county seat, has a population of 100,000, contributing to a county total of 200,000. Wilmington is located two hours from the high-tech center of the Research Triangle Area (Raleigh, Durham, Chapel Hill), which is a regional hub for *FIRST* Robotics, making travel to competition viable for us. With a number of STEM-based industries, including Corning Optical Fiber manufacturing and General Electric jet engine and nuclear power equipment manufacturing, as well as the local university, we believe we have the community support and expertise for mentoring a *FIRST* Robotics team. The economy of the future in our area depends on the existence of a high-quality local workforce trained and capable of undertaking careers in STEM fields. Given the existence of a local center of the *FIRST* Robotics experience in Raleigh, we believe the opportunity is ripe to found a team here that would help achieve these goals for our community.

   We would define success for our team (in terms of measurable goals) as: 1) recruitment of a viable team from multiple community high schools including Hoggard High School, Wilmington Early College, and Isaac Bear Early College High School, 2) successful preparation for and participation in all aspects the

2013 *FIRST* Robotics Competition, 3) generation of momentum sufficient for the program to continue in 2014 in all area schools who participate in the 2013 competition 4) generation of interest in other schools to participate in 2014 who did not participate in 2013 5) scoring in the competition that reflects the ability, commitment, and level of participation and motivation of all students who are involved in the competition.

2. Please address the following issues:

A. Explain the relationship you envision among your students, faculty, and community partners as part of this year's FIRST Robotics Competition experience, i.e., how your team will be organized to facilitate interaction among these groups.

Initially, the idea for the team came from the group of university students who make up the UNCW chapter of the ACM, primarily spearheaded by President Jazmin Capezza and the other officers of the chapter. We have met with a number of experienced *FIRST* participants, UNCW faculty and administrators, and school officials to build a coalition of supporters in the community. With good support at the administrative levels, we have begun to broaden this relationship into the community with a kickoff meeting on October 22 on UNCW campus. We invited Marie Hopper, *FIRST* Regional Director for Raleigh, NC, to give a FIRST Robotics demonstration, along with five students from an existing FIRST team, the Geek Squad, from Topsail High School in Pender County. At this meeting we had an attendance of 33 people, and we collected interest forms from New Hanover County high school students and parents. Our team has contacted the principals at Hoggard High School and Isaac Bear Early College High School in the New Hanover County School system, and also Cape Fear Academy, a private school in Wilmington that already has a robotics club, and we have received positive encouragement that their students would be interested in participating and that their administration would approve and support the team.

The group described in the previous paragraph gives us all the building blocks in terms of personnel to form a successful team. The one additional community partner we hope to involve is Cape Fear Community College, which possesses significant additional expertise and space related to woodworking, metalworking, welding, and the mechanical arts. There is a high school, Wilmington Early College, associated with Cape Fear Community College whom we hope to involve also.

We envision the ACM chapter providing the primary administrative manpower for the *FIRST* team, with support for design and build coming from ACM members, UNCW computer science faculty such as Dr. Richard Chapman (see below), parents of involved students, faculty at the participating high schools, and perhaps local business such as machine shops. Parents will also provide transportation, food, building assistance, and marketing support.

The ACM chapter will serve as the interface to the *FIRST* organization and will coordinate fundraising efforts.

B. Describe how you envision these groups working together and benefiting from their involvement with FIRST Robotics Competition.

The high school students who participate in the team will benefit most directly and immediately, by learning specific skills such as software development, mechanics, metal and wood working, the use of CAD software, the employment and application of engineering mathematics, and a knowledge of the design/build/test cycle at the heart of engineering through their participation in the design, construction, evaluation, improvement, and competition with their robot. They develop the ability to work as a team to develop and execute a plan. They will benefit indirectly from exposure to university students and professionals in many STEM career fields. This will make the students aware of the possibilities for further STEM education and for STEM careers in their hometown. For many students, this may put a human face on careers such as engineering and science for the first time, if they do not have an engineer or scientist in their family. Through these STEM activities, which are not available through most of the local high school curriculums, students will have an advantage when applying to college, as well as internships and jobs. The community will benefit from our team's activities with *FIRST* by creating brighter, better-equipped future employees.

The student mentors from the ACM Chapter will benefit through this unique experience of advising and guiding students by gaining essential knowledge in leadership, management, and teamwork skills not available through traditional college experiences.

The faculty and community mentors increase the pipeline of interested students who may enter their fields of work upon graduation. The organizations such as UNCW and potentially CFCC benefit by increased student interest in and participation in their STEM educational programs, as the high school students graduate and pursue further STEM education. Also, community awareness in general about the importance of STEM education and careers is raised by the team's existence. We plan a team presence at a number of community events such as the North Carolina Azalea Festival, a local celebration in the spring of 2013, and an opportunity to demonstrate the robot for the public at large.

Finally, the community providers of funding (see below) gain the benefit of the furthering of their organization's philanthropic goals in the local community, by partnering with a proven organization such as *FIRST* Robotics.

3. FIRST Robotics Competitions provide high school students with many unique opportunities, but because of the nature of the competition, as well as the travel that can be involved, participation in FIRST Robotics Competition can require

significant financial resources. In addition to the entrance fees, teams must budget for robot prototyping and construction, travel to one or more events, and miscellaneous items like team t-shirts. Please outline your anticipated budget (expenses) and how you plan to fund your team's participation (income) this year. Please do not use a table format. Instead, use paragraph format.

Team 4534 anticipates needing $12,200 for the 2013 competition season. This amount includes the regional registration fee: $6500; travel expenses to transport the team to Raleigh, NC for both the kickoff event and the competition: $3000; team t-shirts: $200; robot prototyping and building: $2000; and pit set up and marketing materials: $500.

The team is approaching a number of sources for funding in addition to NASA. First, we are approaching Time Warner Cable, whose Connect a Million Minds program funded a robotics camp for low-income, inner-city high school students in Wilmington that was taught by one of our mentors, Dr. Richard Chapman, in summer 2011. We are also approaching the local large industry, Corning Optical Fiber and General Electric, mentioned in response to a previous question. The faculty advisor to the UNCW ACM chapter, Dr. Karl Ricanek, is a former employee of Corning, and has offered to make introductions to relevant people. Dr. Ron Vetter, also a UNCW computer science faculty member, has offered to make contacts among local industry for sponsors on behalf of the ACM chapter and the team. We have also identified our local Best Buy and JC Penney stores as possible sponsors, as they have funded other non-profit educational activities in Wilmington and both corporations nationally support *FIRST* teams. We have received offers of help in securing funding from the director of the Raleigh regional hub, Marie Hopper. The team plans to participate in the *FIRST* light bulb sales to raise funds, to hold a recreational event with a local company that donates 50% of the events' proceeds, and to make items to sell using the tools necessary to build the robot – for example, jewelry made from electronic parts. Finally, we plan to mount a kickstarter.com campaign to raise funds over the Internet. We are pursuing a variety of funding sources, but without funding from NASA, it will be very difficult to achieve the level of funding needed for a successful team the first year.

4. **Please identify the corporate or community partners/mentors who will assist and instruct the students in fabrication, mechanical and electrical concepts, computer programming and control, and computer aided design and animation. How will they enable your students to be successful in this project?**

Team 4534 has approximately 8 UNCW university students who will mentor in computer aided design and animation (including CAD and Maya modeling), computer programming and control, marketing, business, and Web site development. We have a university professor who has experience working with programs similar to FRC: Dr. Richard Chapman is a UNCW adjunct professor of computer science and an associate professor at Auburn University in computer science and software engineering. Dr. Chapman has mentored a rookie robotics competition team for the BEST robotics

competition while at Auburn, has taught summer classes in robotics programming for middle and high school students, and has taught programming to students as young as 5th grade in Alabama public schools. We also will seek out mentors with expertise in mechanical fabrication. Our first attempt in that search will be to contact the faculty at Cape Fear Community College, as well as the parents of our student team members. Our biggest benefit of being associated with the University is that we will have a strong programming, electrical, and design background – the faculty of the UNCW computer science department are an additional resource upon which the team and its ACM university-student mentors can draw. Our team also plans to partner with local teams to share resources and expertise. We have been in contact with team 4339 to create meeting times in which we collaborate for our teams' training sessions so that we can help each other with areas of expertise.

5. **Please describe how participation in the FIRST Robotics Competition will provide an inspirational experience for the participating students, how they will be encouraged to consider science, technology or engineering related careers, and how participation will contribute to your school's overall educational goals.**

If one hopes to provide an inspiring experience for the participating students, it must be the case that the involved adults must also be inspired. One must communicate to the students a sense of the sheer fun of making things. It is fine to talk of secure jobs, high salaries, and national needs, but there are much more gut-level ways in which building and programming a robot are satisfying. The goal of our team is to be sure that the students stop to enjoy the sense of accomplishment along the way from figuring out why the saw will just not cut straight, or how to debug an intermittent software problem, or what can be used in place of a $10,000 part they read about on the Internet. They should stop to enjoy the sense of self-reliance that comes from not giving up, the sense of being part of a team whom you can rely upon. Dr. Chapman has taught small team design to university students for 20 years (in the capstone engineering design project course of an ABET-accredited curriculum) and will work with the ACM students and other mentors to instruct them in recognizing the moments when inspiration can be imparted. In his experience teaching robotics, the questions about careers and further education arise organically in the course of building and provide the mentors, including the ACM students, plenty of opportunities to instruct about their own educational and career paths. Such a moment can arise at any time, while soldering a connection, debugging code, or milling a part from aluminum -- taking the time at that moment is far more effective than in any prepared program. We will consult with administrators and STEM teachers at each of the involved high schools to determine ways in which the FIRST project can mesh with the educational objectives of that school's curriculum.

6. **Access to adequate woodworking, metalworking, welding, and other facilities are important in the robot fabrication process. Some teams have these capabilities available at their school, while others take advantage of tools and machine shops provided by their corporate partners. What facilities are available for your team's use in this year's program?**

Woodworking Dr, Chapman can provide woodworking tools and space to the team, as well as experience and instruction. We also think it is reasonable that parents may assist in this area.

Metalworking We anticipate obtaining assistance and tools for metalworking and welding from either local machine shops or from Cape Fear Community College.

Welding We anticipate obtaining assistance and tools for metalworking and welding from either local machine shops or from Cape Fear Community College.

Software Development Every member of the ACM chapter at UNCW is a computer science major at the university and a capable programmer in C and Java. The level of software support available is one of the great strengths of this team. Additional assistance in software development can be had from the UNCW computer science faculty, including Dr. Chapman, who is experienced with developing software for embedded systems and microcontrollers that operate in real time. Support for website development and animation will also be provided by the UNCW ACM chapter's university students.

Schools participating in FIRST receive the latest version of Autodesk's AutoCAD-based drafting product for computer aided design/ drafting and 3D Studio MAX for 3D simulation and animation.

Do you possess CAD software? Yes No

YES. Our team owns the student version of AutoCAD software and Maya animation software. We also have resources for extra computers that have Maya available through the computer science department at UNCW as it is used in the UNCW Digital Arts Program.

Is CAD software mentorship available? Yes No

YES. Dr Chapman, one of our mentors, a computer science faculty member with 20 years teaching experience, has offered to provide instruction in CAD software usage.

Please describe the facilities that will be used by your team to design, prototype, and build your robot.

Several spaces have been volunteered and additional space is being sought. Dr. Amy Reamer, director of the UNCW/North Carolina State University 2+2 engineering transfer program at UNCW, has offered the use of a classroom space. Computer labs are available in the Computer Information Systems building at UNCW, which houses the UNCW computer science department. Dr. Chapman has volunteered the use of his garage and tools for heavy building, woodwork, and metal work, and additional shop space on campus has been requested from

the Office of the Provost at UNCW. Space will be requested from Cape Fear Community College, which has a number of programs devoted to mechanics, welding, woodwork (wooden boat construction), and other mechanical arts. Space will also be requested from local machine shops for metal fabricating tools and capabilities.

7. **Another critical element for the success of a FIRST Robotics Competition program within a school is the enthusiastic support of the school or group's administration.**

   Do you have support from your senior-level administration, e.g., principal or superintendent? Yes or No

   YES

   If yes, please describe.

   As a community-based team, our program spans several schools. We have support from the principals at Hoggard High School (Principal Eric Furman) and Isaac Bear Early College High School (Principal Philip Sutton), both of whom have met with UNCW ACM President Jazmin Capezza and indicated their support and that their schools are happy to participate. Principal Sutton went on to say that he personally would recommend certain students and encourage them to participate. As well, the administration at Cape Fear Academy, a K-12 private school in Wilmington, has indicated the willingness of the Robotics Club at that school to participate in the team. We believe that with this institutional support from three area high schools, we have the necessary base from which to build a successful team.

8. **Please describe what will set your team apart from other teams competing in this year's FIRST Robotics Competition. What makes you unique? If there are any other considerations that you would like to share with the review panel, you may do so here as well.**

   The distinguishing factor of team 4534 is that the creation of the team is facilitated by the University of NC Wilmington (UNCW) student chapter of the Association for Computing Machinery (ACM). This creates a collaboration of talent between high school students and UNCW students and faculty. UNCW fosters a symbiotic relationship with New Hanover County high schools, including early colleges. Because we are a community-based team, our ability to recruit students from multiple high schools gives us the benefit of having students with advanced interests in robotics, engineering, and college-level course work. Student mentors and distinguished faculty in the fields of engineering and computer science create a strong foundation for high school students to explore and experience real-world engineering.

Appendix F: White Paper

Team 4534: *FIRST* Robotics Competition
(White Paper)

The Wired Wizards is a community-based ***rookie*** team established in Wilmington, NC. The team was conceived and organized by the University of North Carolina Wilmington (UNCW) chapter of ACM (Association for Computing Machinery), a student pre-professional society for computer science majors, as a way to further interest, education, and the pursuit of careers in STEM topics ***among high school students*** in Wilmington. Conversations with local educators have convinced us that there is demand for such opportunities for Wilmington high school students. There are effective programs for middle school students in robotics, but nothing exists at this point at the high school level. Such opportunity is crucial, as it will affect student's decisions about higher education and career choices in STEM-related fields. Specifically, our team was formed with the purposes of:

1) Providing a unique and effective learning experience for students to gain experience in planning, designing, engineering, programming, and team building;
2) Developing leadership skills among students, meanwhile urging them to further pursue STEM activities, degrees, and careers;
3) Filling a gap to create more STEM opportunities for high school students in our community; and
4) Engaging the community in the excitement and mutual benefit of greater STEM advancements.

Our team is the "first" FIRST Robotics team in New Hanover County, in the southeastern coastal area of North Carolina. Wilmington, the county seat, has a population of 100,000, contributing to a county total of 200,000. Wilmington is located two hours from the high-tech center of the Research Triangle Area (Raleigh, Durham, Chapel Hill), which is a regional hub for FIRST Robotics, making travel to competition viable for us. With a number of STEM-based industries, including Corning Optical Fiber manufacturing and General Electric jet engine and nuclear power equipment manufacturing, as well as the local university, we believe we have the community support and expertise for mentoring a FIRST Robotics team. The economy of the future in our area depends on the existence of a high-quality local workforce trained and capable of undertaking careers in STEM fields. Given the existence of a local center of the FIRST Robotics experience in Raleigh, we believe the opportunity is ripe to found a team here that would help achieve these goals for our community.

We would define success for our team (in terms of measurable goals) as:

1) Recruitment of a viable team from multiple community high schools including Hoggard High School, Wilmington Early College, and Isaac Bear Early College High School;
2) Successful preparation for and participation in all aspects the 2013 FIRST Robotics Competition;
3) Generation of momentum sufficient for the program to continue in 2014 in all area schools who participate in the 2013 competition;
4) Generation of interest in other schools to participate in 2014 who did not participate in 2013; and
5) Scoring in the competition that reflects the ability, commitment, and level of participation and motivation of all students who are involved in the competition.

Appendix G: Fundraising Documents

Fundraising Letter with Sponsorship Levels & Donation Flyer

Dear Supporter of Science and Technology,

We invite you to partner with Team 4534, The Wired Wizards, to grow our community's global science, technology, engineering and math (STEM) involvement and workforce. In 2013, we successfully recruited 10 team members from 5 area high schools; secured a build space donation-in-kind with secure robot storage; recruited 15 mentors from five companies; raised $21,000 in donations and grants; and encouraged two of our seniors to pursue engineering degrees. We finished the Raleigh competition 19th out of 55 teams, 2nd out of 8 rookie teams, and totaling more than 2,000 hours of work.

In 2014, our team is determined to increase our community presence and to compete in two regional competitions that will give us a competitive advantage to take our team to national competition. We need your help in order to reach this goal by helping us raise $29,000. To date, we have raised over $6,000 towards this goal.

Team 4534 was formed with three goals. Goal 1: Provide a unique and effective learning experience for students to gain proficiency in planning, designing, engineering, programming, team building, project management, and business and marketing skills. Goal 2: Develop leadership skills among high school students while urging them to further pursue STEM activities, degrees, and careers to give them the opportunity for secure jobs and higher salaries. Goal 3: Engage the community in the excitement and mutual benefit of greater STEM advancements, while building a technologically and scientifically capable workforce in our region.

Our mission for the team is to communicate to our team members a sense of the sheer fun of making things. There are visceral ways in which building and programming a robot are satisfying. The goal of our team is to be sure that the students stop to enjoy a sense of accomplishment along the way to figuring out why the saw will not cut straight, to debugging a software problem, and to figuring out what can be used in place of an expensive part they read about on the Internet. We want our students to enjoy the sense of self-reliance that comes from not giving up, the sense of being part of a team that they can rely on. Our team's motto is '>0'. This motto reflects that we always strive to do our best with an attitude of cooperation in competition and to compete as credible competitors.

We have included our sponsorship levels below as well as a sponsorship form, and we hope that you will consider sponsoring our team. With your support, we hope to build on the momentum from last year and surpass the goals we have set for ourselves for the upcoming 2014 season.

We look forward to working with you this year!

Jazmin Capezza

Sponsorship Levels:	Novice Wizard $$ >= $256	Apprentice Wizard $$ >= $512	Journeyman Wizard $$ >= $1024	Grey Wizard $$ >= $2048	White Wizard $$ >= $4096
Company name on website sponsor page	✓	✓	✓		
Logo displayed on website sponsor page				✓	
Logo on website homepage					✓
Business name on uniform shirt	X	✓	✓		
Logo on uniform shirt				✓	✓
Business name diplayed on robot			✓		
Medium size logo displayed on robot	X	X		✓	
Larger size logo displayed on robot					✓
Business name in pit	✓	✓	✓		
Business name on pit banner				✓	
Logo prominantly displayed on pit banner					✓
Team-led competition tour*	X	X	X	✓	✓
VIP seating at the competition*	X	X	X	X	✓
Business name added to team name*					✓

*optional

Please complete the sponsorship form and send via email to: wiredwizards@gmail.com

Company Name	
Mailing Address	
Contact Name	
Contact Phone Number	
Contact email address	
Sponsor Level	White ☐ Grey ☐ Journeyman ☐ Apprentice ☐ Novice ☐ Committed Sponsorship Donation $_____.
Anticipated Date for Sending Donation	

Please complete the sponsorship form and send via email to: wiredwizards@gmail.com

Donations can be made to our non-profit, **Azalea Coast Robotics.**

Tax deductible donations can be made and handled through **NC FIRST Robotics**, a 501(c) 3 non-profit (Tax ID #46-1301122). Mail donations to: NC Robotics Inc., 1533 Andover Ave, Greensboro, NC 27405 *To ensure that funds are allocated to our team, please indicate **Team 4534** on the check or in an accompanying letter. You may contact Marie Hopper at 1-336-375-3861 or ncfirstrobots@gmail.com with any questions.

The Team

The Wired Wizards is Wilmington's first *FIRST* robotics competition (FRC) team. We are a group of high school students who design, build, and program robots to play sports. So far it has been a learning experience like no other! Our team has students from Hoggard, New Hanover, Laney, and Topsail high schools, along with homeschoolers. Our mentors are from GE Hitachi, Duke Energy, UNCW, Marine Corps, Graybar, Everyone on the our team has worked hard and put a lot of time into making our robot - the students alone have put in over 1,250 hours!

What is *FIRST*?

FRC, *FIRST* Robotics Competition, is a "varsity Sport for the Mind™ that combines the excitement of sport with the rigors of science and technology" (usfirst.org). In an FRC competition, teams are given a kit of parts and a game (a task for the robot to perform) to kick off the season. During the 6 week build season, the team plans, designs, and builds a robot up to 120 lbs. We are FRC team 4534, and we are in our second year.

The Competition

Last season we participated in the regional FRC competition in Raleigh. We placed 19th out of 55 teams, and 2nd out of 8 rookie teams. We were thrilled with that result! We are excited about improving that result for the 2014 season. If you would like to help the Wired Wizards grow and continue to be succesful, you can help us by donating. Join NASA, Duke Energy, and our other sponsors by donating to our team with the information below.

Donations can be made online at *www.thewiredwizards.com* or mailed to:

Tax Deductible Donations
NC Robotics Inc.
1533 Andover Ave
Greensboro, NC 27405
Tax ID #46-1301122

Direct Donations
Azalea Coast Robotics
901-K Litchfield Way
Wilmington, NC 28405

Help support the WIZARDS!

In order to be sure that funds are allocated to our team, please indicate Team 4534 on the check or in an accompanying letter. You may contact Jazmin Capezza at (910) 352-2988 or wiredwizards@gmail.com with any questions.

Appendix H

Project Plan and Work Breakdown Structure for Capstone Completion From Proposal to Defense

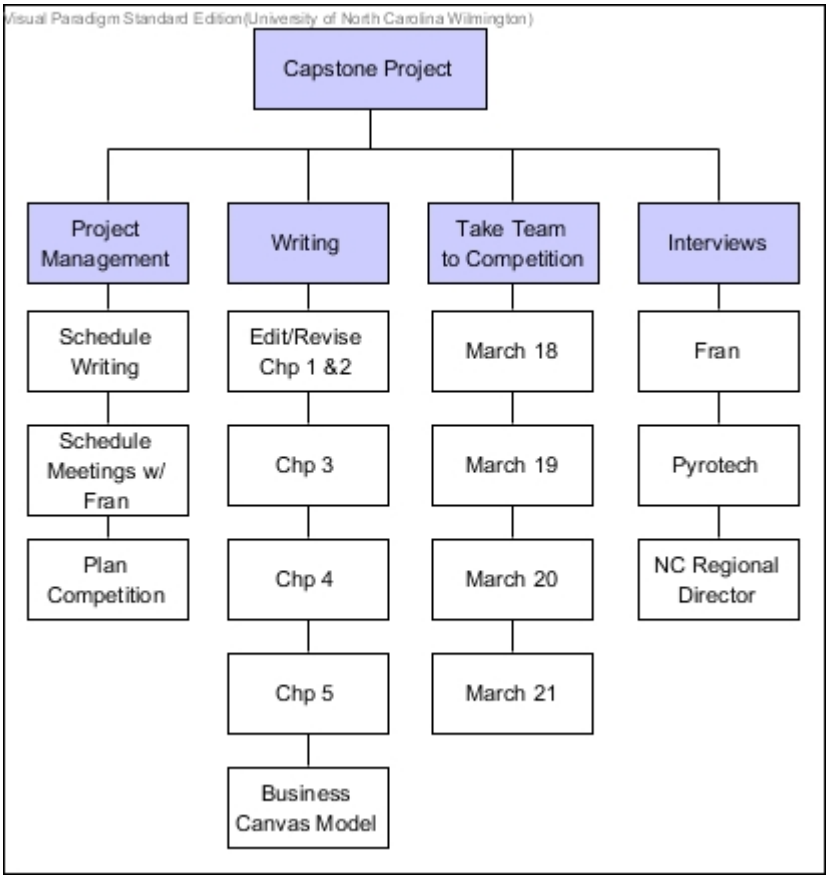

Figure 12 Work Breakdown Structure

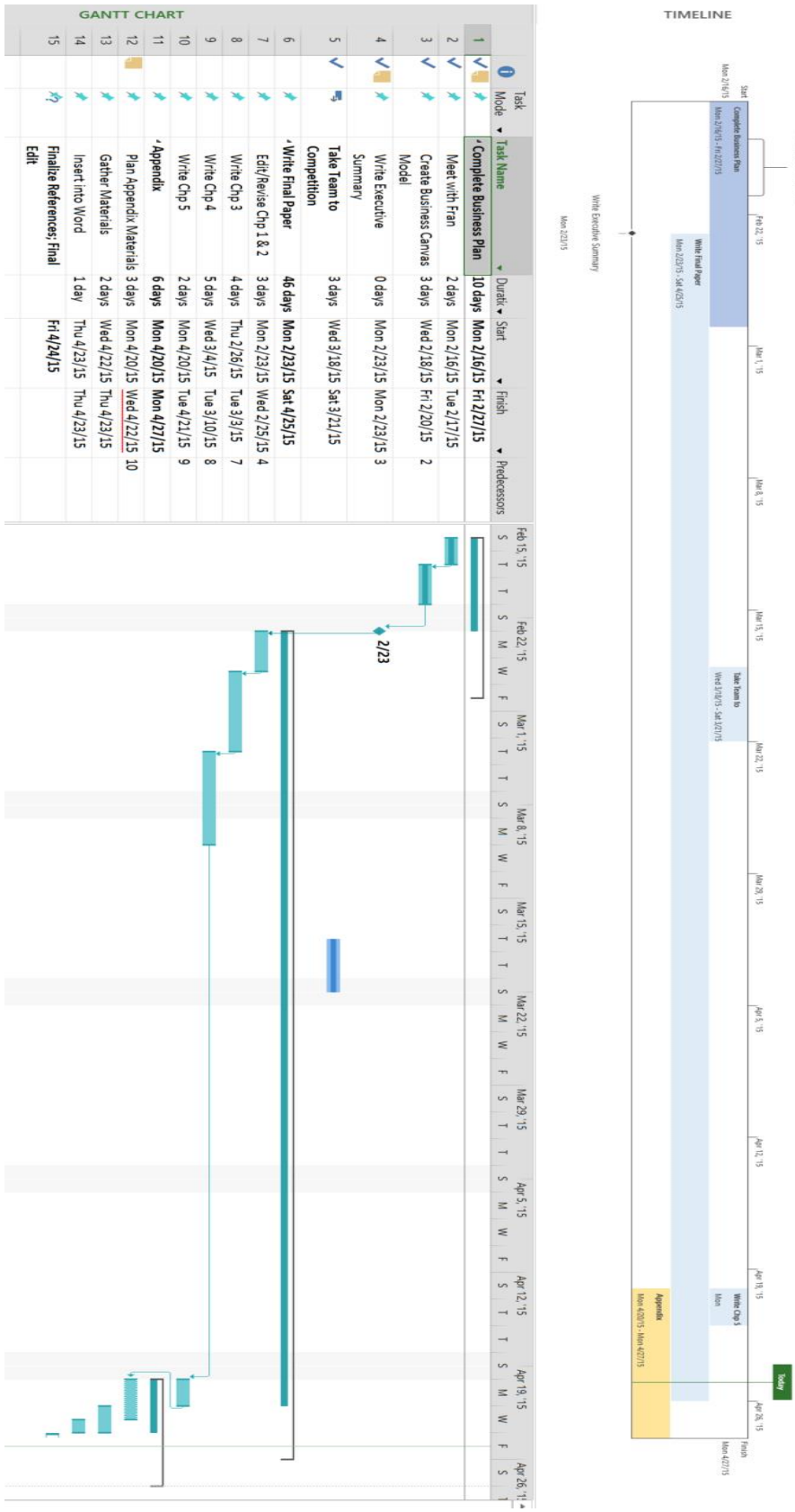

Figure 13: Project Plan