Opportunities and Barriers To Growing

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August 14, 2014

Argosy Foundation

Understanding Opportunities and Barriers to Growing FIRST

Executive Summary

This research project recognizes the useful role that For Inspiration and Recognition of Science and Technology (FIRST) plays in expanding students' engineering and manufacturing training, and asks what opportunities and barriers are present in regards to growing FIRST. In particular, the specific unit of analysis is FIRST Robotics Competition (FRC), which is the foremost competition organized by FIRST. The research agenda was conducted through a mixed methods approach; including statistical, content, and interview analyses.

FINDINGS:

Explaining Variation in the Number of FRC Teams by State

1. The factors that are statistically correlated with the number of FRC teams by state are those internal to FIRST. On average, the addition of two staff members in a state leads to an increase of around 40 teams. Further, states that contain a member of the FIRST National Executive Advisory Board as a resident, witness an average increase of around 40 teams.
2. There is no relationship between the number of FRC teams in 2014 in a state and participation in after school activities, state education spending per pupil, the state budget as a percent of gross domestic product (GDP), a state's political climate, or the proportion of residents employed in manufacturing labor.

Explaining Variation in the Existence of an FRC Team by County (Wisconsin)

3. The unemployment rate of a county is negatively related to the probability that a county contains an FRC team. In addition, the number of county residents engaged in manufacturing work is positively related to the probability of the existence of an FRC team.
4. The presence of a VEX team has no statistical relationship to the existence of an FRC team. There is no statistical evidence that VEX is a competitor of FIRST. County political ideology has no relationship with the existence of an FRC team.

Explaining Team Event Participation and Success (Wisconsin)

5. There is a relationship between the number of sponsors and mentors that are supporting a team and event participation and success. As the number of sponsors and mentors supporting a team increase, there is a significant increase in the probability of participating and succeeding in events.
6. The type of sponsor that is supporting a team could have differing effects on the probability of participation. JC Penney sponsorship is negatively related to participation, while NASA sponsorship is positively related.

Opportunities and Barriers to Growing FIRST

7. The main finding is that the barriers to growing FIRST are not outside of FIRST's control. FIRST has several options for change that could lead to the growth of FRC across the nation.

8. FIRST may be unrecognizable to many prospective sponsors and active steps should be taken to increase their brand recognition. One way to accomplish this goal would be to overhaul the national website and make it more user-friendly for people unfamiliar with FIRST.

9. Additional regional staff, office resources, and the reduction of registration costs through competition venue changes would potentially lead to the creation or participation of more FRC teams.

10. Teams looking for consistent sponsorship should make sure to keep an open line of communication with sponsors, which includes detailing how much the funding helped. In addition, in order to retain mentors, teams should recognize that mentors have different expectations when volunteering. Then, teams should attempt to tailor the volunteering experience to these differing expectations.

Opportunities and Barriers to Growing FIRST

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For Inspiration and Recognition of Science and Technology (FIRST) is an organization that seeks to inspire younger people to become science and technology leaders through engagement in engineering and technological skills. FIRST promotes the creation and participation of teams representing schools in nearly 80 countries in order demonstrate these skills in sanctioned robotics competitions. In 2014, over 350,000 students competed in FIRST competitions.[1]

Programs that FIRST organizes and governs include; FIRST Robotics Competition (FRC), FIRST LEGO League (FLL), Junior FIRST LEGO League (JFLL), and FIRST Tech Challenge (FTC). While FIRST's goals are admirable, questions remain regarding the best strategies for achieving these goals. Further, existing barriers impeding the expansion of this program are unclear. For instance, it is not apparent why Wisconsin is a laggard behind other midwestern states in terms of the number of FRC teams that have emerged and compete regularly? In addition, it is not clear which strategies are optimal for the creation of additional teams in Wisconsin? The unit of analysis in this research project is participation in the FRC; with a substantial focus on Wisconsin.

The FRC represents the foremost competition organized by FIRST. The FRC is the elite competition where rules are strict and engineering skills are most useful. In 2014, there were 2,720 teams, which is comprised of 68,000 high school students (grades 9-12). FRC competitions include 54 regional events, 4 qualifying championship events, and 40 qualifying district competitions. Robots for competitions are built in six weeks from a common kit of parts provided by FIRST, and typically weigh up to 150lbs. The skills obtained by students participating in FRC are useful for future engineering or manufacturing careers. Therefore, the usefulness and desirability of these skills leads to the obvious research question, why do some states have more teams than others? In conjunction, it is important

to attend to additional, supporting questions in order to fully understand the opportunities and barriers to growing FRC.

Research Design

To properly ascertain the opportunities and barriers to growing FIRST, it is necessary to conduct research analyses at different levels. First, the research design is split into two types of analyses: quantitative modeling and qualitative interviews. In order to uncover the opportunities and barriers present, four questions are answered using quantitative data from national-level and Wisconsin state-level teams.[2] Questions include:

- Which variables explain differences in the number of FRC teams by state?
- Why do some counties in Wisconsin have an FRC team while others do not?[3]
- Why do some registered FRC teams participate in competitions while other registered teams do not compete?
- Given that a team participates in competitions, what explains a team's success?

While the results from the statistical analyses lends to the recognition of some opportunities and barriers, a more thorough investigation is needed to fully understand the complete range. This investigation involves the implementation of qualitative interviews with sponsors, mentors, and regional directors affiliated with FIRST. The qualitative interviews were done in order to recognize what types of groups are likely to sponsor teams. In addition, the interviews are useful for determining what factors mentors and regional directors view as barriers to success, as well as what they believe could be done to achieve success and expand FRC. The data from the qualitative interview answers three questions:

- What sponsorship opportunities do volunteers and workers believe are available for teams in Wisconsin?
- Why do volunteers choose to dedicate their time to the FRC program?
- What barriers appear to be most salient when it comes to the expansion of FRC?

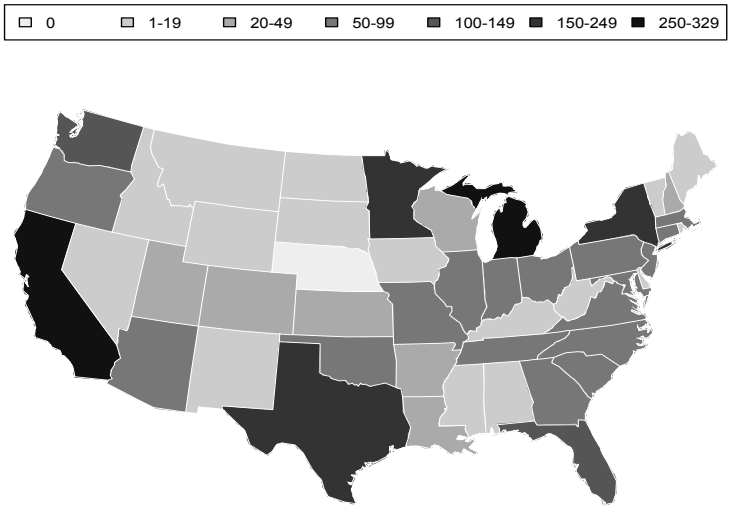
By answering all of the questions presented in this research design, it will be possible to provide insights into the opportunities and barriers that exist for the creation of new teams. In addition, these analyses should provide a roadmap for current team success. Finally, the results from the analyses can provide FIRST with a fully-formed proposal for future success that is based on empirical testing.

Statistical Analysis

United States - National Level Data

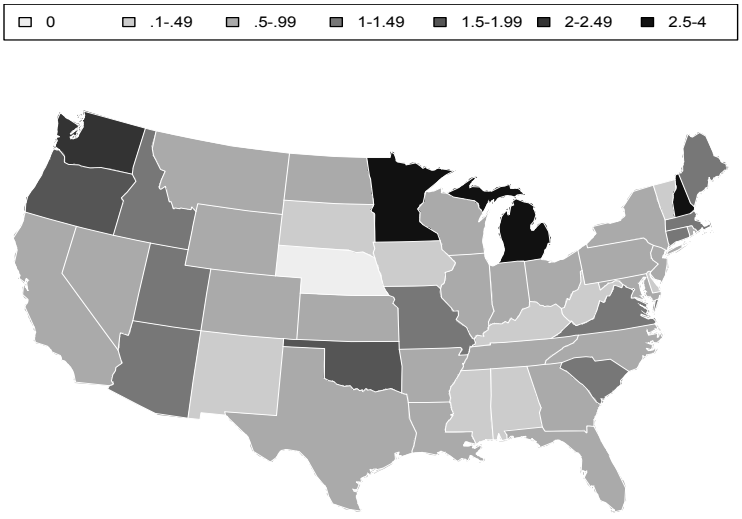
As stated previously, Wisconsin is a laggard behind most midwestern states in terms of the number of FRC teams registered with FIRST. In 2014, Wisconsin had 49 teams registered with FIRST.[4] For comparison, Minnesota had 207 registered FRC teams and Michigan had 329.[5] The following figure provides a graphical display of the disparity in FRC team distribution by state.

Number of First Robotics Competition (FRC) Teams by State



The figure above demonstrates that among states, the number of teams in Wisconsin is comparatively low. However, this figure does not account for the population of a state. Obviously, one would expect that there would be more teams in states that contain a larger number of people. For instance, when looking at the figure it is clear that highly populated states have a greater number of FRC teams (i.e. California, Texas, Florida, and New York). Therefore, the number of teams per 100,000 people is graphically displayed below. This additional figure conveys that Wisconsin is still on the lower end; even when accounting for population, with between .5-.99 teams per 100,000 people.[6]

Number of FRC Teams by State (per 100,000 people)



Explanations by State

What accounts for differences in the number of FRC teams by state? There are a number of possible explanations for differences in the number of teams by state that are empirically tested here. First, students may be participating in other after school activities, which means that there is a lack of students available to participate in FIRST. This hypothesis is tested here using data from the Afterschool Alliance, which provides survey data for each state regarding the availability and participation of students in after school activities.[7] In particular, a variable is included here that represents the percentage of students engaging in after school activities. The expectation is that as the number of students participating in after school activities rises, there will be fewer FRC teams due to a diminished pool of students to draw upon. In addition, another variable is included that represents the gap between the number of students participating in after school activities and the number of students that would be participating in after school activities if available. It may be the case that after school programs are simply not a priority for some states, and this variable will allow for the testing of this notion.[8] The rationale behind accounting for this gap comes from data obtained through interviews suggesting that there is difficulty obtaining participants for FRC. One mentor noted that they have about 20 students that want to participate, but cannot due to extracurricular activities. Mentors have responded to this problem by creating a time during the school day to work on the robot, moving meetings until after 6:30, and having students participate only a few days a week.

Second, the availability of financial support from the state government for school districts might vary by state. Some state governments may be able to provide more funding to school districts to help support extracurricular programs, such as FIRST. Additionally, some (areas, counties, districts) provide stipends for teachers/mentors while others do not. This form of financial incentive may increase participation in and promotion of FRC.[9] These financial factors must also be accounted for in the analysis. There are two variables included in this analysis that attempt to account for differences in spending by state: education spending per pupil and state budget as a percentage of gross domestic product (GDP). For education spending, some states spend a substantially larger sum of money per pupil.[10] The expected relationship is that increased education spending per pupil is associated with a higher number of FRC teams. In addition, the state's budget as a percentage of the state's GDP also contains a large distribution.[11] The expectation is that states with a larger budget are states that support the expansion of government funding for programs that go beyond "necessary" state sponsored activities. Therefore, as the size of the state's budget increases, so should the number of FRC teams.

A third factor related to the state that may explain differences in the number of FRC teams is the political climate that exists in government. One might expect that the political ideology of a state's governing apparatus has an effect on public policy regarding the funding of non-mandatory school programs. Here, two variables are utilized to account for this difference: a governor's political party and the political party that controls the legislature. The governor variable is coded a one if the state's governor is a Democrat and a zero if Republican.[12] For the legislative political control variable, the variable is coded one if both chambers are controlled by Democrats, .5 if one chamber is controlled by each party, and zero for full Republican control.[13]

The final factor internal to the state that

could have an effect on the number of FRC teams is the state's dependence on manufacturing. In states where manufacturing is high, schools may see manufacturing education as an important tool for sustaining the state's labor force. Therefore, one would expect that a state with a large manufacturing labor force would have more programs, such as FIRST, to help train future manufacturers. Here, the share of the labor force participating in manufacturing employment is included as a variable.[14]

In addition, there may be factors internal to FIRST that differ by state, which could explain differences in the number of FRC teams. For instance, it might be the case that some states have more staff from FIRST than others. Obviously, the question here becomes whether adequate staffing or an abundance of teams comes first? Nevertheless, a variable is included here representing the number of contacts in a state (see, Table 1).[15] The other two factors internal to FIRST that may impact the number of teams in a state involve membership on the Board of Directors and Executive Advisory Board. Perhaps, some board members are more active in providing or suggesting the allocation of resources that help to grow FIRST in their home state. Or, it may be the case that a board member provides a substantial amount of funding for their home state through the corporation they lead. Therefore, a variable was created in order to represent whether a state had a member sitting on FIRST's Board of Directors or Executive Advisory Board (see, Table 2).[16]

Finally, there are two control variables included in the statistical analysis. First, population is included in order to account for the fact that there is more demand for FRC teams where there are more people.[17] Second, geographic region is included as a variable in order to account for whether there are regional trends in FIRST's success.

Results - State Data

The dependent variable in the analysis is the number of FIRST Robotics Competition (FRC) teams in a state. The statistical method utilized is OLS linear regression. The model output is presented in Table 4 of the Appendix. For the control variables, the population variable was statistically significant. In particular, the effect of the variable is about an increase of only 20 teams when moving from five million to 35 million people.[18] In comparison, the state's geographical region has no statistically significant effect on the number of FRC teams.

Several additional variables in the model had no statistically significant effect on the number of FRC teams by state. First, the percentage of students participating in after school programs and the percentage available to participate have no effect. Similarly, other factors internal to the state have no significant effect. For instance, education spending per pupil, political partisanship of the state, the state budget as a percentage of GDP, and the percentage employed in manufacturing are not related to the number of FRC teams.[19]

Factors internal to FIRST were the only explanatory variables that were significant in the statistical models. First, a state having a member on FIRST's Executive Advisory Board leads to a statistically significant increase in the number of FRC teams in that state. Specifically, when moving from zero members on the Executive Advisory Board to at least one member, there is an increase of about 40 teams. In addition, the number of contacts (both volunteer and staffed) listed on FIRST's website as contacts in a state is related to the number of teams. For instance, when moving from zero contacts to two con-

tacts, there is an increase of around 40 teams. As the number of contacts increases beyond two, the number of teams in the state increases slightly. These results hold even when accounting for population size. In addition, models were estimated that also explored the number of FIRST Tech Challenge (FTC) teams per state. The same results were found. The results presented here provide a useful template for the types of questions to ask FIRST regional directors in regards to staffing.

Table 1: *Number of FIRST Contacts by State*

0	1	2	3	4	5	6	9	10
AK	CO	AL	FL	IN	MO	NY	TX	CA
KS	IA	AR	KY		PA			
WV	LA	AZ	MD					
	ME	CT	MI					
	MS	DE	MN					
	MT	GA	VA					
	NC	HI	WA					
	ND	ID						
	NE	IL						
	NH	MA						
	NM	NJ						
	OK	NV						
	RI	OH						
	SC	OR						
	SD	WI						
	TN							
	UT							
	VT							
	WY							

Wisconsin - Team Level Data

Explanations by County in Wisconsin

The Wisconsin figure conveys that there is variation in the number of FRC teams present by county. One question that immediately arises when looking at the figure is whether there are county level differences that explain this variation. In the empirical analysis performed here, the dependent variable is whether a county has an FRC team. In 2014, 20 out of 72 counties in Wisconsin had at least one FRC team.

There are four county level variables explored here that may impact whether a county has an FRC team. First, several FIRST regional directors have pointed out that VEX robotics is their number one competitor. Therefore, one would expect that in

Table 2: *Number of FIRST Board Members by State*

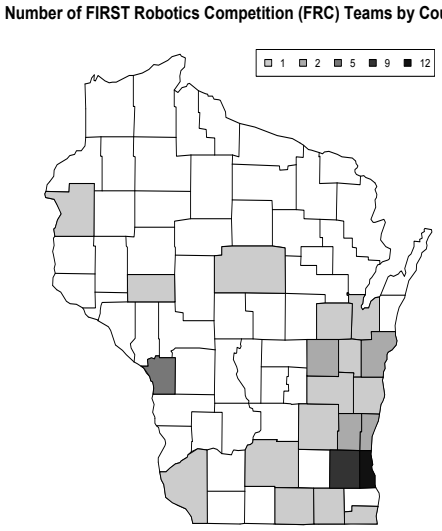
Board of Directors					Executive Advisory Board				
0		1	2	4	0		1	2	4
AK	ND	AZ	IL	NH	AK	ND	CT	MI	CA
AL	NE	CA			AL	NE	FL		MA
AR	NM	GA			AR	NH	ME		NY
CO	NV	IA			AZ	NM	MO		
CT	OH	MA			CO	NV	NJ		
DE	OK	MN			DE	OH	VA		
FL	OR	NJ			GA	OK	WI		
HI	PA	NY			HI	OR			
ID	RI	TX			IA	PA			
IN	SC	VA			ID	RI			
KS	SD				IL	SC			
KY	TN				IN	SD			
LA	UT				KS	TN			
MD	VT				KY	TX			
ME	WA				LA	UT			
MI	WI				MD	VT			
MO	WV				MN	WA			
MS	WY				MS	WV			
MT					MT	WY			
NC					NC				

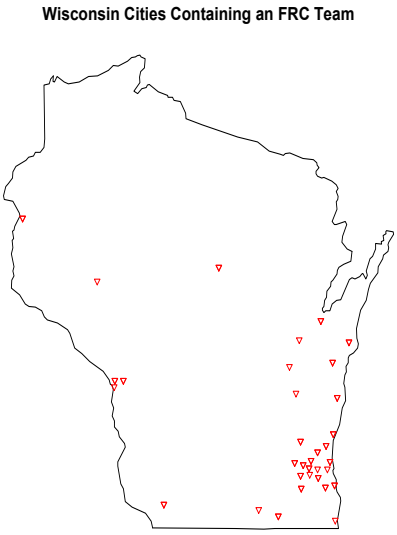
areas where VEX robotics teams exist, one may be less likely to find an FRC team.[20] The reason for this relationship is that VEX is reducing the potential pool of students available to participate in FIRST.

A second county level variable that could explain whether a county has an FRC team is the economic positioning of the county. In particular, the unemployment rate of a county may be a good indicator of the economic potential of an area to sustain a non-essential school activity. Previous non-scholarly research has shown relationships between unemployment rates and school art's programs and after school activities. Therefore, it might be expected that counties struggling economically are less likely to be able to sustain a FIRST team.[21]

A third indicator attempts to account for political differences between counties. As discussed previously, ideological differences regarding the proper role of government may differ by area. In particular, local political ideology has been useful in the past for explaining a number of differences regarding government funding of programs and school board policies. Here, vote share for the Democratic presidential candidate by county is utilized to account for county level political ideology.[22] Although this measure is indirect, this is the best local level ideological measure available since measures for school board ideology do not exist for this time period.

The final variable included in the county level analysis that may explain why some counties have an FRC team and others do not is the





level of manufacturing present in the county. The goal of FIRST is to train students for future careers in manufacturing. In addition, several mentors and regional directors have noted that obtaining sponsors is most successful when you can convince a sponsor that this program is useful for training their future workforce. Therefore, it may be the case that starting an FRC team is easier where a sales pitch regarding training the areas future work force is the most salient; as we would expect that these areas contain a high number of people engaging in this type of work. The variable utilized to represent this concept is the number of people in a county participating in manufacturing labor in 2013.[23]

Results - County Level Data

Models exploring team level data were estimated using probit statistical modeling. Results from the models exploring the factors that impact whether a county has an FRC team are presented in Table 5 of the Appendix. First, it is important to point out that the presence of VEX in a county does not have any effect on FIRST. This finding is important because there is a relatively strong belief among regional directors that VEX is impeding their ability to convince schools to start a FIRST team. However, the evidence here does not support this claim. In fact, the number of VEX teams in the midwest region is well below the number of FRC teams. In addition, many of the teams competing in VEX are also registered and compete in FRC. Therefore, it might be helpful to view VEX as less of a competitor and more of a corroborating partner that is unknowingly doing some of the heavy lifting as far as selling the importance of robotics programs.

The political ideology of a county is another variable with no significant impact on whether a county contains an FRC team. This finding, combined with the state level finding, may indicate that political concerns regarding the acceptance of FIRST transcend ideological lines. If there is a substantial political difference that explains support for FIRST, it goes beyond political party.

There were two variables in the model that are statistically related to the presence of an FRC team in a county. First, unemployment rate is negatively related. As the unemployment rate of a county rises past eight percent,

the probability of a county having an FRC team decreases to zero. This finding lends some support for the idea that the areas that are struggling economically are less likely to have a team. Second, the number of people engaged in manufacturing work is positively related to the existence of an FRC team. In particular, as the number of residents involved in manufacturing moves from zero to 10,000 people, there is an increase of 20% in the probability of having a team. Then, when moving from 10,000 to 20,000 residents engaged in manufacturing there is an increase of 80% in the probability of having a team. This result lends some evidence to the argument that there is a relationship between the existence of manufacturing corporations and people viewing FRC as a worthwhile investment.

Team Participation & Success Explanations

In order to empirically test the factors that effect whether a FRC team participates in a given year, data was collected for all teams in Wisconsin between the years 2003-2014. Additionally, a second Wisconsin team dataset was created for 2014 in order to verify the role that mentorship plays for team success. This second dataset was constructed due to the availability of additional data on the number of mentors per team that does not exist for other years. Along with participation, these two datasets are also utilized for establishing factors that effect whether a FRC team wins a competition in a given year.

The main question that is dissected here is why do some FRC teams participate in competitions, while other teams sit them out? The dependent variable is whether a team participates in at least one competition in a given year.[24] The first explanation for participation is whether the team is a co-op team. In Wisconsin, there are a few co-op teams that represent large geographic areas.[25] Theoretically, one might hypothesize that co-op teams are more likely to participate because these teams have the ability to pool resources together from several areas. In addition, one might think that as a co-op team's success increases, the incentive to disband into several smaller teams decreases. This reluctance may exist because the incentives to disband into competing groups vying for resources is small. Therefore, one might expect that district teams have a greater ability to compete than do individual high school teams.

Additional explanations are related to the number of sponsors a team is able to acquire, along with dissecting whether specific types of sponsors are more important than others. First, one may hypothesize that the teams participating are those teams that have acquired more sponsors. This may occur because a greater number of sponsors means more capital that could be used for registration, travel, and lodging costs for competitions. Therefore, it is expected that a greater number of sponsors is positively related to participation.[26]

Further, one may hypothesize that certain types of sponsors are more important than others. For instance, interviewees have hypothesized that the loss of the JC Penney grant for FRC teams was detrimental to the number of teams in the state.[27] In addition, it may be the case that sponsors from engineering firms provide more guidance than smaller, local businesses. Therefore, a model attempting to test for participation should include some variables that recognize important differences between sponsors.[28]

Finally, a variable should be included in the analysis that looks at previous participation, or the overall number of years a team participates. This would be important because it is not unreasonable to assume that teams

that have previously competed will continue to do so. This assertion could be true because these teams may have successfully learned how to navigate the difficulty of registering, raising money, and participating in an event. Therefore, it is necessary to control for prior participation.

The second question addressed here is, "knowing the factors that effect whether a team participates, what explains a team's success in a competition?" The dependent variable is whether a team was a finalist in a competition, won the competition, or won an award in a given year.[29] The variables discussed above related to participation in a given year are also included in a model looking at this question. These variables include the number of sponsors, whether the team is a co-op, JC Penney sponsorship, and the number of years a team has participated in FRC.

The 2014 Wisconsin FRC team dataset allows for the testing of another important independent variable in regards to its relationship with the dependent variables discussed above. For only the 2014 season, data exists on the number of mentors registered with FIRST for each team. One of the major barriers that may exist regarding participation and success is the number of available mentors for a team. One would expect that as the number of mentors increases, there is a greater chance of success for a FRC team.[30] Therefore, for 2014, an additional model is estimated for both of the questions previously discussed regarding participation and success that includes this variable.

Results - Team Level Data

Models exploring team level data were estimated using probit statistical modeling. Results from the models exploring the factors that lead to FRC team participation in Wisconsin are produced in Table 6 of the Appendix. First, the model estimating FRC participation between 2003-2014 by team conveys some expected results. As expected, the number of sponsors a team has acquired is positively related to participation. For instance, moving from zero to five sponsors leads to an increase of 10% in the probability of participating. In addition, the number of years a team has participated in FIRST is also positively related to participation. A first year team only has a 40% chance of participating. When moving from the first year to the second year, there is an increase of 20% in the probability of participating (60% chance). Finally, a team with 10 years of experience has an 80% chance, and 15 years or more leads to a 100% chance of participating.

On the other hand, this model conveys that co-op teams do not have a higher probability of participating, and JC Penney sponsorship does not have a statistically significant effect on participation. However, it is important to note that in models excluding the number of years participating, JC Penney sponsorship was actually negatively related to participation. In these models, there was a statistically significant relationship between sitting out events and receiving the JC Penney grant. Perhaps, JC Penney sponsorship made first and second year teams too reliant on JC Penney funding, or maybe the grant did not actually provide enough funding for participation.

In the 2014 model on participation, there was an inclusion of a variable representing the number of mentors for each team. Interestingly, in this model the only variable that had a statistically significant effect on event participation was the number of mentors registered with a team through FIRST. In particular, as the number of mentors moves past five, the probability of participating is greater than 50%. At ten mentors, the probability of participating is 80% or higher, and at 30 mentors

the probability is 100%. There is no doubt that mentorship is important to teams. However, it is important to note that the strength of these results are only tentative given the relatively small number of observations and computationally advanced statistical method.

Now that it is clear that sponsorship, prior experience, and mentorship are important for a team's participation in FRC events, what explains success in these events once a team participates? Results from the models that estimate the probability of success are presented in Table 7 of the Appendix. The model estimating the probability of success between 2003-2014 produces results that align with the expectations discussed above. First, the number of sponsors a team has acquired is positively related to the probability of success. When a team has zero partnering sponsors there is less than a 20% chance of winning an award, placing as a finalist, or winning a competition. When there are five sponsors there is a 40% chance of success, and this increase continues slightly until a team reaches 15 sponsors. Second, co-op teams are significantly more likely to be successful. Co-op teams have a 30% greater chance of success than do individual schools. Finally, the number of years registered with FIRST, or experience, is positively related to success. While teams participating for five years or less have less than a 20% chance of success, teams with 12 or more years have over a 50% chance of success. On the other hand, JC Penney sponsorship is not significantly related to success.

The model that looked at success only in 2014 did not come to conclusive results. Unfortunately, a small number of observations made it difficult to determine the precise effects of any of the independent variables. This was due to the fact that while a relatively sizable proportion of teams were registered in 2014 with FIRST, several of these teams did not participate.

As previously discussed, the models have conveyed that sponsorship is important for participation and success. In addition, it was noted that the type of sponsorship might matter for both of these outcomes. However, the results reveal that the type of sponsorship was not significantly related to either of these dependent variables. Additional models were estimated where the type of sponsor was broken down into several categories; whether the type of sponsorship was from a technical college, a university, manufacturing and engineering organization, local business, or corporate enterprising, there was no statistically significant relationship between participation and success. The only aspect of sponsorship that matters for the participation and success of FRC teams is the raw number of sponsors. The more sponsors and money a team is able to obtain, the better positioned the team is to compete and succeed. Therefore, in the final models sponsorship category was excluded.

Qualitative Research

The qualitative portion of this research project includes two different analyses in order to shed some light on the opportunities and barriers to growing FIRST that a statistical analysis is not conducive to uncovering. While the statistical analysis allows for direct testing of straightforward concepts, missing concepts and measurement error are concerns for any quantitative analysis. Therefore, qualitative research is meant to supplement these deficiencies. The qualitative analyses performed include a content analysis of FIRST's website and organization, and structured interviews with people associated with FIRST.

Content Analysis

It is important to point out that I have no relationship with FIRST, and was not aware of the organization prior to this research project. Therefore, I have no preconceived notions regarding FIRST. In addition, any attempt to become familiar with the organization offered a useful opportunity for me to evaluate whether it is easy to find information on FIRST, and whether there brand is distinguishable from other robotics organizations (i.e. VEX). In all, I spent about 35 hours combing through FIRST's national website, team websites, competitor websites, and reading news stories on FIRST.

FIRST's Website

At the start of this research project, I wanted to become familiar with FIRST from the perspective of a prospective mentor or sponsor. The reason for starting the analysis in this way was to determine whether the process of mentoring or sponsoring a team is relatively straightforward. Unfortunately, I found FIRST's national website incredibly difficult/frustrating to navigate. From a sponsor's perspective, there is relatively little information regarding the benefits of sponsoring FIRST. There is a section of the website to donate to FIRST, but this section consists solely of a donate button and almost no information on why it may be important to donate. In addition, regional team statistics and participant statistics are not readily available. Finally, several team websites were not linked from the FIRST website correctly, which would make it difficult for a sponsor to contact a team. This lack of information may create a problem because many sponsors that I interviewed are looking to either sponsor teams in specific areas, or teams with specific participant socio-demographics.

When attempting to sign up as a mentor, a similar experience ensued. First, the website has you watch four or more videos on mentoring before giving contact information. These videos are lacking in specific information and instead give you a vague overview of FIRST. Then, after viewing these videos for several minutes you are given a list of contacts in your area. This could be a frustrating experience because the website's guided videos led me to believe that I would be able to fill out a form and have someone contact me. As several mentors noted in the interviews, it can be difficult to find volunteers. So, it may be beneficial to create a process that puts less burden on the potential mentor. A website contact form where a staff member contacts the prospective mentor may be more useful by placing less of a burden on the mentor. This background information provided me with some useful avenues of inquiry for the interviews.

Interviews

The second portion of the qualitative research involves interviews that are aimed at bringing to light the opportunities and barriers to growing FIRST that a statistical analysis is not conducive to uncovering. For instance, the interviews elucidate the important viewpoints FIRST employees, volunteers, and sponsors have relative to growing FIRST. These people provide valuable experience navigating and participating in FIRST activities, and unique perspectives based on their backgrounds. The impetus for conducting interviews arose after performing the content analysis, and determining that it would be important to get additional viewpoints from people participating in FIRST.

The interviews were conducted between 19 June 2014 and 15 July 2014. Every FIRST employee I had contacted granted me an inter-

view. For mentors, 57.14% of the team lead mentors I contacted granted me an interview. The response rate for mentors is fairly good considering it is summer and many of the team leads are teachers away for the summer. Finally, all of the sponsors that I contacted granted me an interview. The interviews were around 30 minutes in length, and interviewees were assured that their responses would be anonymous. A broad list of questions is provided in the Appendix. Follow up questions were asked in some circumstances and identifying characteristics have been removed from the questions listed in the Appendix.

Table 3: *Interview List*

Contact Type	# Contacted	# Interviewed
FIRST Staff	4	4
Lead Mentor	7	4
Sponsor	5	5

Findings

Attracting Mentors

There exists significant variation in the number of mentors that help a team. In 2014, the number ranged from one to over 30 mentors helping a single team in Wisconsin. One team mentor I interviewed indicated that their team had more than enough team mentors, and that they have never had a problem finding volunteers. However, other mentors, particularly those at schools in less affluent areas, indicated that retaining mentors was a huge problem. In addition, FIRST employees expressed concern over the ability of FIRST to grow due to the difficulty of finding a team lead mentor at schools. Interviews indicated that there are four ways to increase the number of volunteers mentoring teams.

First, both Michigan and Minnesota have been more successful than most states in terms of acquiring stipends for teachers and mentoring teams. For instance, in Michigan, team lead mentors receive a stipend of $1,500. These stipends have helped to supplement some of the time that teachers must invest in FIRST. As one lead mentor noted, volunteering can actually be quite costly in terms of the amount to time spent during the build season. Lead mentors spend an incredible amount of time working with their teams. On average, lead mentors indicated that they have worked over 33 hours a week during the build season with their FRC team. This time was spent performing different types of tasks related to maintaining the team. Given this large time commitment, any monetary compensation or reduction in tasks that lead mentors must perform would be beneficial. School compensation of team lead mentors may not be an unreasonable request considering the compensation that athletic coaches receive. For instance, an inner city high school in Milwaukee pays $3,102 for their only cross country coach, $8,394 for their two swim coaches, $11,992 for three girls basketball coaches, and $22,786 for their football coaching staff of six.

Second, Michigan and Minnesota have also instituted training workshops for mentors in order to offer familiarity with robotics training. In Minnesota, there are between 30-40 workshops at local colleges and universities to help mentors and teams gain experience.

In Michigan, shared build sites allow senior teams to help freshman teams. These workshops are useful for conveying to teachers that they have the ability to mentor a team. The experience gained through these workshops conveys familiarity with a relatively challenging competition, which goes a long way in creating an atmosphere where mentors perceive that they can succeed.

Third, lead mentors noted that volunteers from large companies tend to be the most consistent in terms of helping teams. Mentors noted that consistent sponsorship is usually obtained through the large corporations where parents for FIRST participants, or team mentors work. Almost all of the sponsors that were interviewed were very supportive of their employees mentoring teams. In fact, one sponsor mandates that an employee must be a mentor in order for a team to receive funding. Another sponsor created an internal website for the company that allows employees to view FIRST volunteer opportunities. It would be useful for a team in need of mentors to contact these larger corporations in order to increase the number of mentors helping their team.

Finally, teams that put a large emphasis on conveying their appreciation towards mentors were teams that sustained mentors the longest. The most useful strategy suggested for showing appreciation was to ask mentors upfront what they hoped to achieve or receive from the experience, and then make an attempt to meet those goals. For instance, teams may find that some mentors want to take a more active role in the build process, while others would prefer to direct students towards answers to problems.

Selling FRC

As one mentor put it, obtaining funding through sponsorship is one of the most difficult tasks there is when participating in FIRST. As demonstrated earlier, FRC teams with a greater number of sponsors tend to be more successful. Therefore, much emphasis should be placed on understanding the opportunities and barriers that exist for obtaining funding through sponsorship. While FIRST employees and mentors agree that there is no easy way to acquire sponsors for FRC, interviewees agree that there is one sales pitch that appears to be the most salient.

Mentors and FIRST employees agree that sponsors need to be shown that a potential employment pool is being trained through their participation in FIRST. One mentor said that when talking to sponsors they equate FIRST participation to one year of on the job training. Other mentors state that they convey to sponsors that FIRST inspires capable students that otherwise would not think about manufacturing and engineering to engage in this type of work. One interviewee noted that this sales pitch is especially salient in rural areas. Therefore, there may be areas outside of Milwaukee and other large urban areas where FIRST may be successful encouraging new teams. All of the sponsors agreed that the main reason they provide funding to FIRST is because there is usefulness in training a future workforce. These sponsors believe that FIRST does a good job of conveying useful manufacturing and engineering skills. However, sponsors did note that it would be useful if FIRST provided an alumni list so that sponsors could recruit off of this list and fully benefit from FIRST. In fact, one sponsor noted that FIRST should be taking a more active approach when it comes to providing a list of previous participants. The sponsor stated that, “if the goal of FIRST is to provide training for a future workforce, then they should at least allow us the opportunity to recruit through FIRST.” It is important to point out that this sales pitch comes secondary to the other reasons

sponsors gave for funding FIRST, such as that FIRST raises awareness for their company (i.e. branding) and that giving back to the community is a positive endeavor (either in terms of giving funding or encouraging employees to mentor a team).

A second suggestion for selling FRC was obtaining support from the University of Wisconsin-Madison. The usefulness of this support would transcend a specific monetary gift. In Minnesota, the University of Minnesota is one of the largest sponsors, and this sponsorship helps to give the program recognition and legitimacy in the state (i.e. recognition from the Minnesota High School League). In addition, the University of Michigan provides shared build-sites for FRC in Michigan. It may be useful to tap into the University of Wisconsin in order to see if any opportunities are available. Participation from a university in Wisconsin would not be unprecedented. Currently, the University of Wisconsin-Marinette, Marquette University, Milwaukee Area Technical College, the Milwaukee School of Engineering, and the University of Wisconsin-Platteville sponsor FIRST FRC teams.

Finally, one potential avenue for growth in Wisconsin is achieving some level of administrative support from the state government. In Michigan, the Governor's administrative support has helped to obtain stipends for teacher-mentors. Further, administrative support in Minnesota has been crucial for FIRST receiving official recognition as a high school competitive activity. Administrative support, or support for the educational branch of government in Wisconsin, is an area of potential growth that could be leveraged. However, it is important to note that there may be a certain level of growth that is needed before official administrative recognition. As one interviewee noted, FIRST was not recognized in Minnesota until it reached a certain notoriety. Following an increase in teams that met a certain minimum threshold, FIRST was officially recognized, and then grew substantially larger.

Sponsor Expectations

What do sponsors expect when they sponsor an FRC team? First, sponsors expect to be appreciated. Mentors noted that appreciation of sponsors needs to be a top priority. Sponsors need to be informed of the team's success. Further, sponsors should be informed on how much help their funding was to the team's success. As one mentor noted, there needs to be an open line of communication between sponsors and teams. This open line of communication conveys that the sponsor is appreciated and useful in terms of the team's continued success. All of the sponsors agreed that they expect, and unfortunately sometimes do not receive, feedback from the teams in terms of success and how their funding helped. Several sponsors indicated that "feedback on how their funding was utilized helps to acquire future funding from their bosses." The consensus was that the best feedback a sponsor could receive is one that demonstrates to the sponsor that the team is thankful, the funding is crucial for success, the team is approaching FIRST professionally, and the team is consistently participating in FIRST. In particular, one sponsor sent me a professional letter from a team with team diversity statistics, partnering sponsors, a team mission statement, and the team's impact on the community and students. Most of the sponsors interviewed indicated that there was no set amount that they had allotted to give to FIRST each year. Instead, sponsors either provide funding for teams based on employee request through mentorship, or sponsors provide funding based on need. In fact, all of the sponsors noted that it is important for

them to balance their funding between teams that previously received funding and teams in need of funding. Therefore, it would be wise for teams to indicate to sponsors exactly how much their funding helped each year. This would be especially helpful if the company is not receiving regular updates from an employee that is mentoring the team.

Beyond appreciation, there are several additional expectations that sponsors hold. First, sponsors have an interest in expecting diversity within the teams they sponsor. Sponsors noted that it is easier for them to pitch providing funding for FIRST when they can demonstrate that the organization is diverse. Therefore, it would be useful for teams and FIRST national to provide socio-demographic statistics on their participants. Second, sponsors expect that teams will recognize their sponsorship through displaying their logo or brand. This display helps to show the overall community that the organization is participating in helping to make the community better. Third, sponsors expect that teams will allow employees to mentor a team, and some companies even expect that a team will approach their company regarding employee mentorship. Several sponsors noted the importance of allowing their employees a suitable role in team mentorship. In fact, one sponsor stated that their employees are trained using LEGO robotics. Finally, sponsors expect that teams will help grow FIRST through mentoring junior teams that the company sponsors.

FIRST's Branding

As stated at the beginning of this research project, I spent over 30 hours becoming familiar with FIRST's setup. This process was, at times, a difficult task given the vagueness of the information on the website. More importantly, two sponsors pointed out that FIRST national needs to take a more active role in establishing brand recognition to the average person. For instance, one very prominent national sponsor indicated that they had never heard of FIRST. This interviewee's introduction to FIRST only came about when a board member directed them to look into funding the organization. Further, this sponsor indicated that they did not believe that FIRST does a good job of establishing to school districts and regions its goals and possible benefits to local communities. This problem may be a symptom of an additional observation that sponsors pointed out.

Another sponsor noted a different brand (i.e. rules and processes) of FIRST by region, and they believe that these differences are a hindrance to growth. It was not clear to either of the two sponsors mentioned here whether FIRST was a national organization that directs regions, or a collection of franchised regions that loosely fall under the umbrella of a national organization. Both sponsors noted that there is considerable disconnect between the national headquarters and regions. This confusion, and the regional differences that exist, could make it difficult for a large national sponsor to understand how to direct their funding. The problem regarding funding directly to FIRST national or particular regions was expressed during the interview process. Further, different rules between regions could create confusion regarding how to maximize funding. In Michigan, a team paying registration costs for one competition is eligible to compete in a second competition for free. Does this mean that funding a Michigan team doubles a sponsor's impact? Or, should a sponsor direct funding at a region where a team must raise the full amount to compete in two competitions? The answer is not readily clear.

Regional Staffing

Interviewees noted that FIRST has an opportunity to grow significantly through the expansion of regional staffing. A majority of the mentors that were interviewed recognized that the regional director job in Wisconsin is officially labelled part-time. However, these mentors believe that the amount of time that is needed for growing FIRST in Wisconsin is far and above a part-time job. Further, interviewees noted that the current level of time dedicated to growing FIRST in Wisconsin greatly exceeds the compensatory level. This observation could create a problem in the future where workers do not feel appreciated, or job vacancies become difficult to fill. FIRST employees that were interviewed confirmed that they work considerably more hours than their job title would imply. It may be worth further exploring whether FIRST employees are being set up for success, or whether more staff would help grow FIRST. This finding is something that the statistical analysis already conveyed. As stated, there is a positive relationship between the number of staff in a state and the number of FRC teams.

In addition, throughout the interviews it became clear that employees were fairly reliant on their own resources (i.e. computer, office, phones, etc.). If employees are being underpaid for the level of work they are performing, FIRST may be able to supplement some of this overtime by providing valuable resources. At the very least, providing phones or office supplies may make employees feel more appreciated.

Costs of Participating

Most of the interviewees made it a point to state that the costs of participating in FIRST make growth very difficult. First, several interviewees suggested that registration costs should be lowered if at all possible. It was noted by 46.15% interviewees how FIRST registration costs appear to be too high since regional committees do not obtain any of the registration money to put on the event. Even sponsors noted that they believe registration costs were too high. Interviewees made suggestions for reform that mimic the changes that have already been implemented in Michigan. In Michigan, rookie teams usually have their registration costs covered by a sponsor. In addition, for non-rookie teams, if you pay registration costs once, you get to participate in two competitions. By constructing the registration in this way, FIRST in Michigan has been able to create a point system that ranks teams for their state championship competition. Several sponsors, employees, and mentors also suggested that mentoring and rookie grants could greatly help grow FIRST. In Michigan, $1,000 is paid to every team that helps start a new team, and there are shared build shops available for use. If nothing else, several interviewees believe that registration for a second competition should be lowered.

Second, several sponsors and mentors noted the usefulness of moving competitions out of large arena venues to universities or high schools. A few interviewees claimed that the large venues are incompatible with the type of competition occurring. Other interviewees stated that moving to smaller venues would create much needed savings that could be moved back towards teams. Again, this is a change that Michigan has implemented. Since local committees have to raise money for events, and not FIRST national, Michigan has decided to move away from expensive event venues. One interviewee claimed that this change was made specifically because FIRST collects registration fees, but does not pay for the event. The state has moved away from expensive arena locations to high schools. It was

claimed that this change in venue has saved a large amount of money for FIRST in Michigan, which is the catalyst for the difference in registration fees.

Finally, three mentors noted that enhanced costs have led them to move away from FRC towards FIRST Tech Challenge (FTC), where costs are reduced. If the goal is to grow FRC, the trend towards FTC may pose a problem in the future. FRC is supposed to represent the foremost competition for FIRST. Therefore, it is not desirable to see lead mentors move from FRC to FTC participation. In Michigan, high schools are not allowed to participate in FTC. Perhaps, a sole focus on FRC for high schools in Wisconsin might lead to growth in the long run.

Core Values

As FIRST grows, mentors associated with FIRST for a lengthy period of time are stating that core values are becoming less important. Unfortunately, these people have their eyes out for alternatives to FIRST. From the mentor perspective, there was a suggestion that the program needs to be tailored more towards students again. Three mentors noted negative experiences at competitions where it appeared to them that the overall competition was more important than the students' experiences. One mentor noted that "teams seem like an inconvenience at events." For instance, one mentor argued that the rules for building the field are biased towards the builders. The fact that the field could be built within an inch of the dimensions specified could have negative repercussions on a student's experience if the robot was built for specific dimensions. The same mentor noted that the loss of their wi-fi connection at certain venues had created situations where the students participating completely gave up on a competition. Another mentor indicated that their students were ignored when trying to get an improperly placed receiver moved. The receiver was finally moved midway through a match, which rendered their robot motionless up until that point. Perhaps, small rule changes could make this experience more inline with FIRST's core values.

Additionally, another mentor argued that FIRST has not done a particularly good job recently of recognizing individual achievement. This mentor believes that a mechanism for individual achievement and leadership would help encourage continued individual participation. For instance, the mentor provides patches and symbols of recognition for each year a student has participated in FIRST, as well as recognizing each role a participant had held on a team. Further, the mentor suggested that it might be useful to make awards the most important aspect of FIRST's competition, with winning the game coming of secondary importance. This last suggestion about making awards more important than a game win was held by three out of the four mentors. Importantly, this suggestion was offered without a prompt asking about competitions.

Conclusion

The major takeaway from this study is that expanding the FIRST Robotics Competition (FRC) is not a task that is outside of FIRST's control. It is important to note that the suggestions for growth presented here are not just useful for growing FRC in Wisconsin, but apply to all states. At the state level, the only significant factors that explained variation in the number of FRC teams by state were those factors internal to FIRST. For every National Executive Advisory Board member residing in a state, there is a statistically significant

increase of 40 teams for those states. Interviewees corroborated the idea that there is variation at both the national and state level in terms of individual board member's ability to influence funding and growth. In addition, the number of staff listed on FIRST's website as regional contacts is statistically related to the number of teams in the state. When moving from zero to two contacts there is an increase of around 40 teams. The number of teams in a state increases as the number of staff increases. Again, interviews lend support for the idea that FIRST employees could use more help when it comes to expanding the number of FRC teams in a state. On the other hand, education spending per pupil, state budget size, manufacturing employment, and after school program participation have no effect on the number of teams in a state.

At the county level, results indicate that FIRST should target areas where the number of people engaged in manufacturing work is higher. In addition, the county results indicate that less affluent areas are less likely to have an FRC team. However, the existence of VEX does not have any effect on FIRST. This is important to note because several interviewees indicated that they view VEX as the main competitor of FIRST, and the main barrier to expansion of FIRST. Finally, political ideological orientation of an area has no effect on whether a FRC team exists in an area.

In terms of team participation and success, statistical results and interviews indicated that teams have several strategies available in order to be successful. The statistical results confirm that the number of sponsors and mentors are positively related to participation and success. Through interviews, it became clear that obtaining sponsorship is more successful when pitching FIRST as useful for training the future engineering and manufacturing workforce. Major potential avenues for sponsorship that should be targeted by FIRST in general include the University of Wisconsin-Madison and administrative support from state governments that are currently not providing support. Further, teams need to have an open line of communication with sponsors regarding the usefulness of funding and professionalization of the team if they are going to continue receiving funding.

In regards to attracting mentors, teams should attempt to acquire mentors from larger corporations. Further, teams need to put an emphasis on showing appreciation to volunteers and making sure they get the most out of their experience. Additionally, stipends are a useful tool for encouraging teachers to lead an FRC team. Similarly, workshops can be successful in teaching mentors necessary skills, along with convincing them that they have the ability to lead an FRC team.

Importantly, there are several suggested changes for FIRST that could lead to growth. First, establishing the FIRST brand through unified regional rules and a well-functioning website could help the novice individual become familiar with FIRST. Second, an increase in regional staffing, or an increase in resources for employees, could place staff in a better position to succeed. Lastly, any changes that FIRST could make to reduce the costs of participating should lead to growth. The changes that have been implemented in Michigan regarding registration costs and venue location have lead to a significant increase in the number of teams there. These changes could help to grow FRC throughout the country.

Notes

[1]FIRST. 2014. "Vision and Mission," http://www.usfirst.org/aboutus/vision. accessed, 16 June 2014. FIRST. 2014. "FIRST At A Glance," http://www.usfirst.org/aboutus/first-at-a-glance. accessed, 16 June 2014.

[2]Additional models were estimated using data from Michigan as a control. The results from these models aligned well with the results for Wisconsin. Further, there were also models estimated using data for FTC in order to determine if results differed between FTC and FRC. The results were mostly similar.

[3]Additionally, it would useful to explore why some schools, school districts, or cities in Wisconsin have FRC teams while others do not? Unfortunately, the very small number of FRC teams at these levels in Wisconsin means that the dependent variable would not contain enough variation to do proper binary statistical analysis. The binary dependent variable would contain too many zeros and not enough ones. Therefore, this question was indirectly explored through interviews.

[4]The data related to the number of teams and regional contacts was obtained from FIRST's website through searching teams in states and localities. http://www.usfirst.org/whats-going-on

[5]The mean number of FRC teams by state in 2014 was 62.53, minimum number of teams was 0 (Nebraska), and maximum number of teams was 329 (Michigan).

[6]The number of First Tech Challenge (FTC) teams approximates the distribution of FRC teams. For instance, the mean number of teams by state is 61.82, the minimum number of teams is 3 (Louisiana and Maine), and the maximum number of teams is 317 (Texas).

[7]Afterschool Alliance. 2014. "In Your State," http://www.afterschoolalliance.org/policyStateMap.cfm, accessed 13 June 2014.

[8]It is important to note that during several interviews there was a suggestion that VEX Robotics and FIRST Tech Challenge may also be taking away from the available pool of students for FRC. However, initial data collected for Wisconsin and Michigan revealed that there is no relationship between VEX or FTC participation and FRC. For instance, in Wisconsin over a third of the teams participating in VEX were also FRC participants. In addition, the number of VEX and FTC teams was only a fraction of the number of FRC teams in the two states.

[9]Interviews demonstrated that obtaining stipends for teacher mentors has helped considerably in expanding the number of teams.

[10]The mean amount of money spent per pupil was $10,994 in 2013. The minimum amount of money spent in 2013 per pupil was $6,212 (Utah), and the maximum amount spent was $19,076 (New York).

[11]The mean for this variable is 19.8%. The lowest state budget as a percentage of the state's GDP is 16.06% (Virginia), and the highest 28.89 (Alaska)

[12]In 2014, there are 19 states with Democrat governors and 31 states with Republican governors.

[13]In 2014, there are 19 states where both legislative chambers are controlled by Democrats, 27 states were both are controlled by Republicans, and 4 states where controlled is shared.

[14]National Association of Manufacturers. 2014. "US Manufacturing Statistics - Manufacturing and Trade Data by State," http://www.nam.org/Statistics-And-Data/State-Manufacturing-Data/Manufacturing-by-State.aspx, accessed 10 June 2014.
In 2013, the mean percentage for manufacturing employment by state was 8.7%, the minimum was 2.2% (Hawaii), and the maximum was 16.8% (Indiana).

[15]In 2014, four states had no contacts listed on FIRST's website, 19 had one, 15 had two, seven had three, one had four, two had five, one had six, one had nine, and one state had ten contacts.

[16]Arizona, California, Georgia, Iowa, Massachusetts, Minnesota, New Jersey, New York, Texas, and Virginia each have one member on the Board of Directors. Illinois has two members on the Board of Directors. New Hampshire has four members on the Board of Directors. Connecticut, Florida, Maine, Missouri, New Jersey, Virginia, and Wisconsin each have one member on the Executive Advisory Board. Michigan has two members on the Executive Advisory Board. California, Massachusetts, and New York each have four members on the Executive Advisory Board.

[17]In 2013, the mean population was 6,199,000, the minimum was 582,700 (Wyoming), and the maximum was 38,330,000 (California). Population density was included in an earlier statistical model, but population had more explanatory power when compared to population density.

[18]The substantive effects for all statistically significant variables were determined by calculating and plotting predicted probabilities. The predicted probabilities were calculated by holding continuous variables at their median and dummy variables at zero.

[19]In additional models, support from the state's flagship university had no effect on the number of FRC teams in a state when controlling for other significant variables.

[20]In 2014, 62 Wisconsin counties did not have a single VEX team present. However, ten counties had more than two VEX teams.

[21]In January of 2014, the mean unemployment rate by county in Wisconsin was 6.79%, the lowest rate was 3.8% (Dane County), and the highest rate was 15.7% (Menominee County).

[22]The mean vote share for the Democratic presidential candidate in 2012 was 49.83%, the minimum vote share was 29.5% (Washington County), and the maximum was 86.6% (Menominee County).

[23]The mean number of people engaging in manufacturing labor by county in 2013 was 6,403, the minimum number was 14 (Menominee County), and the maximum number was 49,954 (Milwaukee). Additionally, it is important to note that this variable correlates highly (0.906) with population. Thus, population is not included in the analysis.

[24]Over the 11 years, around 84% of teams registered with first participated in at least one competition. Further, FIRST records indicate that the mean number of years registered with FIRST for teams in Wisconsin was 8.1. The minimum number of registered years was four, and the maximum number of years was 20.

[25]Between 2003-2014, there were an average of 10.25 teams per year that were co-op teams. This corresponds to co-op teams representing around 50.8% of teams in Wisconsin between these years. In 2014, 12 out of 45 teams (or 26.66%) in Wisconsin were co-op teams.

[26]Between 2003-2014, teams averaged around 3.97 sponsors listed in their team info on FIRST's website. The minimum number of sponsors listed were zero, and the maximum number listed was 34.

[27]The JC Penney grant provided first, second, and third year teams with different levels of funding. For first year teams, JC Penney covered the cost of registration. From 2011-2014, 34 teams acquired the JC Penny grant, which is 25.19% of the teams registered in the years the grant was available.

[28]Between 2003-2014, 36.34% of sponsors were local technical colleges and 18.31% were university sponsors. In 2014, 53.57% of sponsors were engineering and manufacturing corporations, 28.81% were local businesses, 17.62% were non-engineering or non-manufacturing corporate sponsors.

[29]Between 2003-2014, 48.71% of teams either won a competition, were a finalist, or won an award. In 2014, 48.72% of teams were successful.

[30]The mean number of mentors registered by team in 2014 was 11.89, the minimum number was zero, and the maximum number was 34 (BadgerBots).

Appendix

Statistical Models

Table 4: *FRC Teams by State Models*

	Full Model		Parsimonious Model	
	Coefficient	Std. Error	Coef	SE
(Intercept)	-56.74	89.25	2.95	9.12
Population	0.00*	0.00	0.00**	0.00
Executive Advisory Board Member	18.31*	10.14	12.89*	7.09
# of Regional Contacts	10.48	8.26	11.77*	6.08
Midwest	43.38	37.70		
New England	-0.50	37.94		
South	18.69	44.57		
Southwest	49.15	49.97		
West	31.64	40.11		
% Students in After School Programs	-0.62	3.14		
% Available for Participation	0.26	1.23		
Education Spending (per pupil)	0.00	0.01		
Democratic Governor	7.77	21.63		
Democratic Assembly	9.68	24.47		
State Budget (% of GDP)	-0.04	3.52		
% Employed in Manufacturing	2.05	3.49		
Board of Directors Member	4.93	11.84		
N		50		50
R^2		0.73		0.68
adj. R^2		0.59		0.66
Resid. sd		47.84		43.66

** indicates significance at $p < 0.05$, * at $p < 0.1$

Table 5: *FRC Teams by County Model*

	Coefficient	Std. Error
(Intercept)	1.05	(2.53)
VEX Team	1.02	(0.85)
Unemployment Rate	-0.93*	(0.37)
Presidential Vote Share (Democratic)	0.04	(0.04)
Manufacturing Employees	0.00*	(0.00)
N		72
AIC		37.77
BIC		83.31
$\log L$		1.11
PRE		0.600
ePRE		0.692

Standard errors in parentheses

* indicates significance at $p < 0.05$

Table 6: *Models Predicting FRC Event Participation in Wisconsin*

	2003-2014 Model		2003-2014 Model		2014 Model	
	Coefficient	Std. Error	Coef	SE	Coef	SE
(Intercept)	-0.29	0.19	-0.44**	0.20	-0.49	0.72
# of Sponsors	0.06*	0.04	0.05	0.04	0.06	0.07
Co-op Team	-0.23	0.21	-0.19	0.22	-0.46	1.26
JC Penney Sponsorship	0.11	0.29	0.24	0.30	-0.44	0.95
# of Years Participated	0.19**	0.03	0.20**	0.03	-0.02	0.09
# of Mentors					0.28**	0.13
NASA Sponsorship			0.68**	0.28		
N		364		364		45
AIC		238.33		234.04		28.28
BIC		316.27		327.57		71.10
$\log L$		-99.17		-93.02		9.86
PRE		0.289		0.203		0.830
ePRE		0.270		0.287		0.522

** indicates significance at $p < 0.05$, * at $p < 0.1$

Table 7: *Models Predicting FRC Success in Wisconsin*

	2003-2014 Model		2014 Model	
	Coefficient	Std. Error	Coef	SE
(Intercept)	-1.08**	0.21	-0.75	0.48
# of Sponsors	0.07**	0.02	0.03	0.03
Co-op Team	0.71**	0.17	0.73	0.54
JC Penney Sponsorship	-0.01	0.27	-4.57	376.75
# of Years Participated	0.06**	0.02	-0.02	0.05
# of Mentors			0.03	0.03
N		309		38
AIC		386.24		57.50
BIC		460.91		96.81
$\log L$		-173.12		-4.75
PRE		0.329		0.352
ePRE		0.159		0.168

** indicates significance at $p < 0.05$, * at $p < 0.1$

Interview Questions

FIRST Staff

1. What tasks do you perform for FIRST, how many hours do you work, and are you a paid staff member (full, part-time, or volunteer)?
2. How has your experience been working for FIRST?
3. Why do you believe that Wisconsin is a laggard in terms of FRC when compared to surrounding states? Do surrounding states have any distinguishing features that make FRC more appealing?
4. What barriers appear to be most salient when it comes to growing FIRST?
5. How has your experience been attracting sponsors? Are there useful strategies for obtaining sponsors?
6. How has your experience been attracting volunteers/mentors? Are there useful strategies for obtaining volunteers/mentors?
7. Is there anything that FIRST could be doing to help expand or grow?

Lead Mentors

1. What is your official title regarding the team and what tasks do you perform? Do you receive a stipend or monetary compensation? How many hours a week during the build season do you spend on team activities?
(1a.) Why not participate in FRC? (If the mentor only participates in FTC.)
2. How has your experience been attracting sponsors? Are there useful strategies for obtaining sponsors?
3. How has your experience been attracting volunteers/mentors? Are there useful strategies for obtaining volunteers/mentors?
4. Why do you dedicate your time to FIRST?
5. What barriers appear to be most salient when it comes to growing FIRST?
6. Is there anything that FIRST could be doing to help expand or grow?

Sponsors

1. Have you been to a competition or event? If yes, what were your impressions of the event?
2. Do you have a family member that participates in FIRST, or have you ever worked with a team?
3. Why does your company fund FIRST?
4. What determines the level of funding that your company provides to FIRST?
5. What does your company expect out of sponsorship?
6. What type of appreciation is expected when sponsoring a team, and is it being met?
7. Are employees encouraged to mentor a team?
8. What barriers appear to be most salient when it comes to growing FIRST?
9. Is there anything that FIRST could be doing to help expand or grow?