

ROBOFEST 2009 Official Report

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Figure 1. World Robofest 2009 Exhibition TARDEC Creativity and Innovation Grant Winners

1. Analysis of Robofest Registration Data

A total of 1,763 students, 563 teams from six countries (Canada, France, Korea, Thailand, Singapore and the USA) participated in the 10th Annual Robofest student robotics competition. Robofest 2009 featured a warm-up competition, 32 qualifying competitions, one World Championship, two afterglow events, and two associate events. Robofest focuses on STEM (Science, Technology Engineering, and Mathematics) education and has grown rapidly since its inception in 2000, as shown in Figure 2.

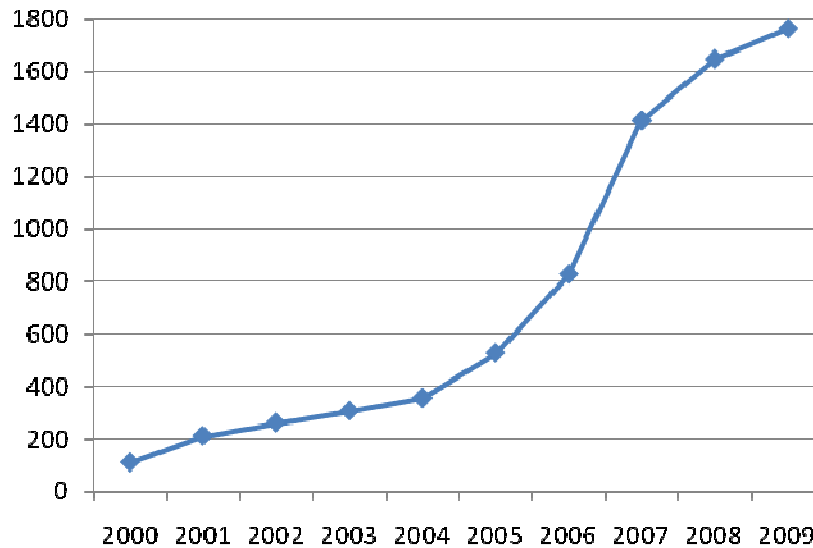


Figure 2. Number of Robofest Student Participants Since 2000 (2009 number does not include associate events)

Robofest would not be possible without the help of many dedicated people. Table 1 shows the total number of officially registered people including students, coaches, team sponsors, team volunteers, site sponsors, and site volunteers for the 2009 Season. Robofest 2009 had its largest number of participants ever, reaching over 3,500 people all together, even if the total number of qualifying sites was decreased. This decrease is due to our management decision that sites with less than 5 teams should be canceled or merged with other sites. (See figure 3). 52% of student participants were from outside of Michigan.

| Site/Event | Teams | Coaches | Players | Sponsors | Team Volunteers | Site Volunteers |
|----------------------|------------|------------|-------------|------------|-----------------|-----------------|
| Emerson_Detroit_MI | 10 | 3 | 46 | 6 | 14 | 8 |
| AnnArbor_MI | 14 | 7 | 52 | 11 | 38 | 27 |
| DSLA_Detroit_MI | 5 | 1 | 15 | 5 | 8 | 7 |
| CIS_Detroit_MI | 27 | 12 | 102 | 18 | 32 | 12 |
| Flint_MI | 11 | 7 | 42 | 6 | 11 | 18 |
| Northville_MI | 14 | 15 | 56 | 11 | 25 | 18 |
| UD_Jesuit_MI | 19 | 8 | 52 | 17 | 20 | 9 |
| Westland_MI | 7 | 4 | 16 | 5 | 12 | 12 |
| Edison_Detroit_MI | 12 | 3 | 35 | 7 | 32 | 3 |
| Cobo_Detroit_MI | 30 | 17 | 94 | 29 | 36 | 13 |
| AAT_Detroit_MI | 14 | 7 | 52 | 14 | 15 | 7 |
| ClintonTwp_MI | 18 | 6 | 43 | 10 | 18 | 9 |
| Southfield_MI | 16 | 10 | 56 | 19 | 23 | 20 |
| Canton_MI | 13 | 12 | 51 | 5 | 18 | 17 |
| Marysville_MI | 13 | 5 | 45 | 10 | 13 | 6 |
| Neinas_Detroit_MI | 3 | 1 | 10 | 3 | 3 | 3 |
| Royal_Oak_MI | 5 | 4 | 25 | 7 | 14 | 10 |
| Cleveland_Detroit_MI | 1 | 2 | 11 | 5 | 4 | |
| LTU_MI (L2Bot) | 9 | 6 | 12 | 10 | 11 | 3 |
| VideoSubmission | 10 | 7 | 26 | 11 | 10 | |
| Aiea_HI | 25 | 14 | 146 | 11 | 51 | 44 |
| Livermore_CA | 12 | 6 | 43 | 7 | 19 | 4 |
| Lone_Tree_CO | 29 | 3 | 79 | 29 | 43 | 30 |
| Monroe_WA | 11 | 4 | 25 | 9 | 19 | |
| Cypress_TX | 11 | 6 | 37 | 10 | 12 | 5 |
| Medina_OH | 18 | 13 | 70 | 17 | 26 | 20 |
| Austin_TX | 10 | 7 | 30 | 4 | 15 | 21 |
| San_Antonio_TX | 6 | 6 | 27 | 6 | 10 | 3 |
| Safety_Harbor_FL | 15 | 14 | 49 | 14 | 20 | 23 |
| Asia-Pacific (*) | 140 | 80 | 300 | | | |
| Aurora_CAN | 22 | 2 | 90 | 0 | 32 | 25 |
| Coaldale_CAN | 13 | 4 | 26 | 1 | 27 | |
| Total | 563 | 296 | 1763 | 317 | 631 | 377 |

(*) the numbers for the Asia-Pacific site are estimates excluding students who participated in non-autonomous events.

Table 1. Total Number of Registered Participants for Each Robofest 2009 Qualifying Competition Location (Numbers for Associate, afterglow, World Robofest events are not included)

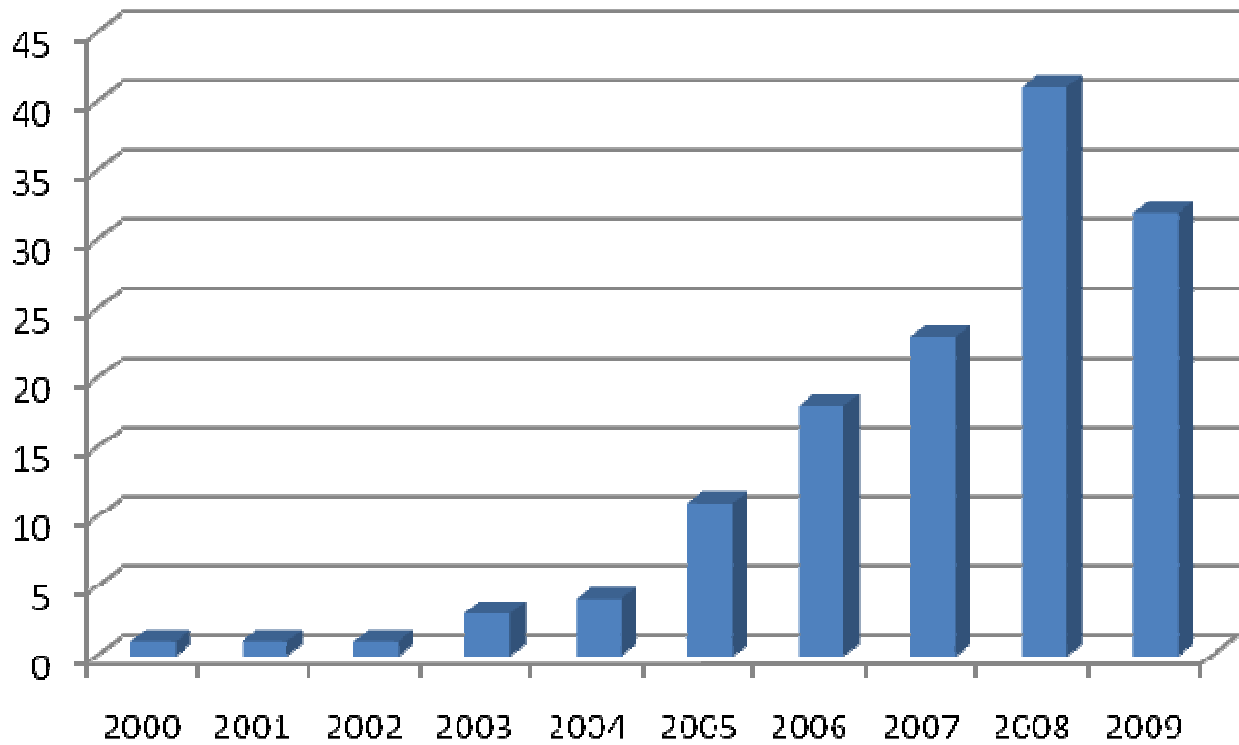


Figure 3. Number of qualifying sites (Average size of a qualifying site became larger in 2009)

65% of teams participated in the RoboZone Game, 24% in Exhibitions, 7% in Fashion Shows, and 4% Mini Urban Challenges using L2Bot. See Figure 4 below.

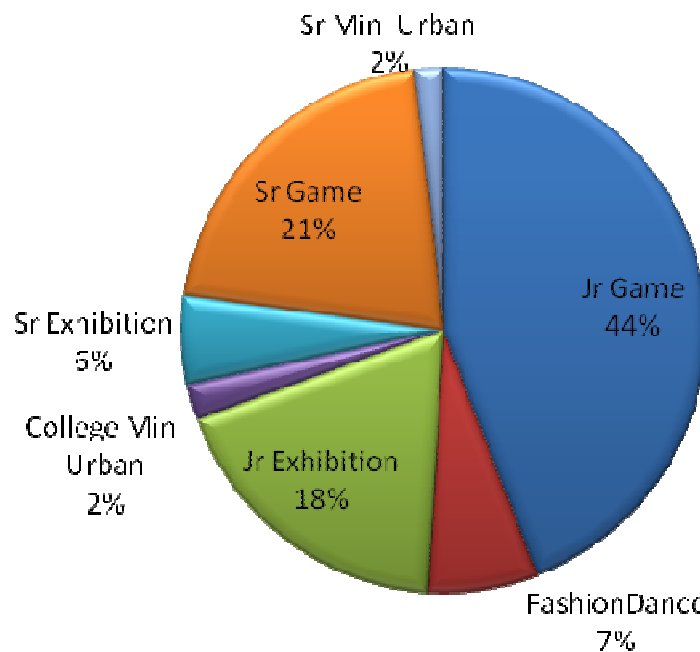


Figure 4. Percentages of Teams by Age Division and Competition Category

Robofest was still popular for 6th through 8th grade students. 47% of the student participants were from middle schools as seen in figure 5. Furthermore, 11% of students were 5th grade level (down from 17% in 2009) while 9% of participants below 5th grade requested an age waiver. The percentage of high school students decreased by 4% this year. Please note that the data does not include students from the Asia Pacific region.

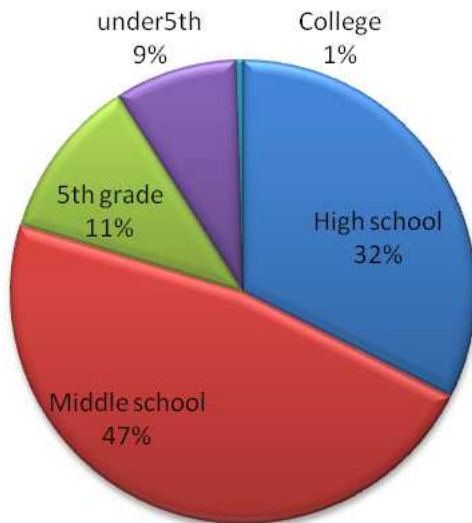


Figure 5. Student Participant School Grade

Figure 6 shows gender ratios of Robofest 2009 students. Robofest has been very successful motivating young female students into robotics which requires them to learn STEM subjects. The data does not include the students participating at the Asia Pacific competition as they were using their own registration system and we were not able to get the data from them.

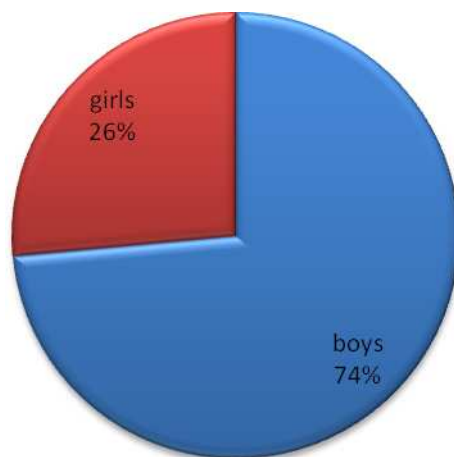


Figure 6. Gender Ratios of Robofest 2009 Students

Ethnic diversity is represented with over one third (34%) of Robofest 2009 participants having minority backgrounds. 20% of Robofest 2009 students were African American, 14% were others as shown in figure 7. The percentage of African Americans decreased from 36% to 20%. This large decrease was due to the discontinuation of the funding from CFSEM (Community Foundation for Southeast Michigan) specifically dedicated to the support of schools in Detroit and Highland Park. Figure 8 shows the changes from 2005. Robofest continues to work hard to encourage students from underserved communities to participate in STEM education through robotics. Figures 7 and 8 data exclude students from the Asia Pacific region.

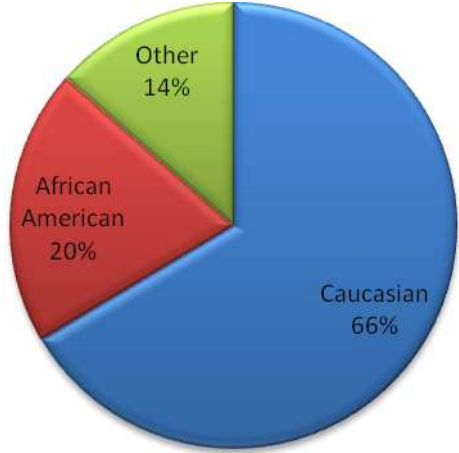


Figure 7. Robofest 2009 Student Participant Ethnicity Data

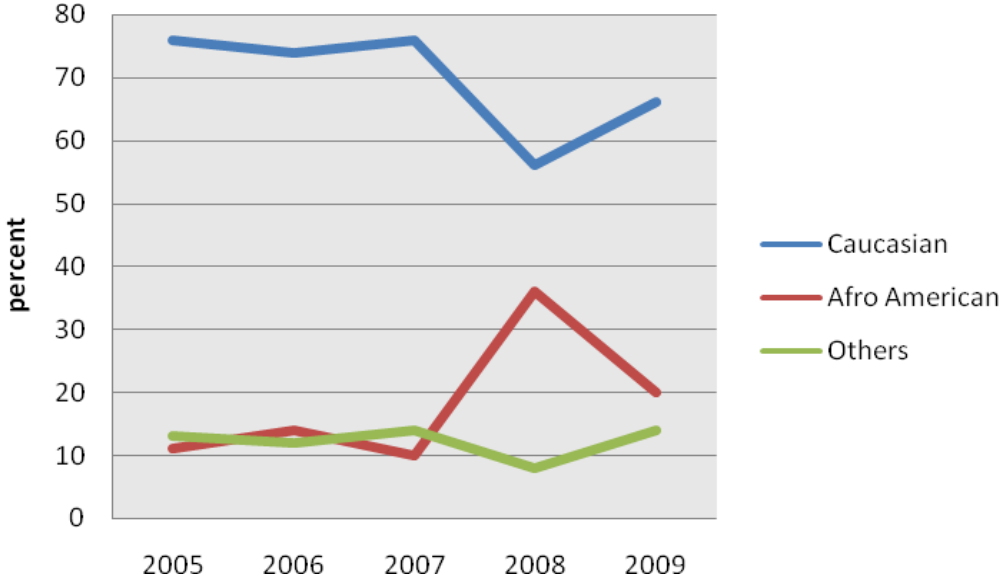


Figure 8. Robofest Ethnicity Data since 2005.

Robofest allows the use of any robotics platform. Figure 9 shows the data on robotics kits used by the teams. We do not have detailed data from the teams in the Asia Pacific region. The majority of the teams were using LEGO NXTs. Data from teams participating in associate events (VEX elevation, FTC, and Flutterbot Firefighting) were not included.

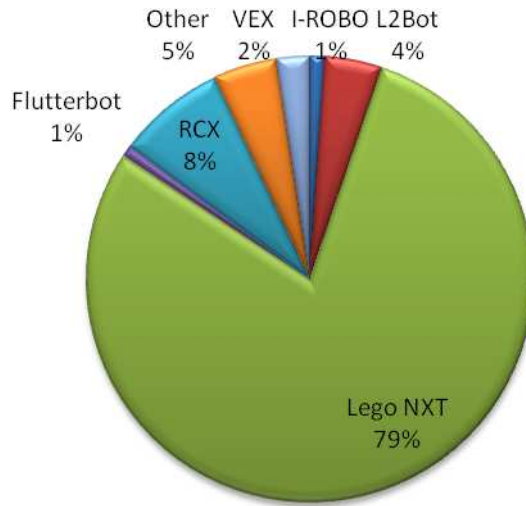


Figure 9. Robot Kits Used by teams

Robofest remains focused on student participants learning computer programming. The programming languages used in Robofest 2009 are graphed in Figure 10. Student teams continue to use advanced and varied forms of programming languages. Allowing students to use whatever programming language they prefer is one of many unique features of Robofest. "other C" in the figure includes Easy C, IC, NQC, NXC, and NBC. RobotC became especially popular for the first time, since Carnegie Mellon provided free licenses for Robofest teams this year. All C-style languages together totaled 15%. Robofest provides opportunities to learn professional programming languages such as C and Java, and helps to prepare our students for future career paths. Robofest students continue to show advanced technical skills and improvements in their abilities. This is possible because of many dedicated coaches and mentors.

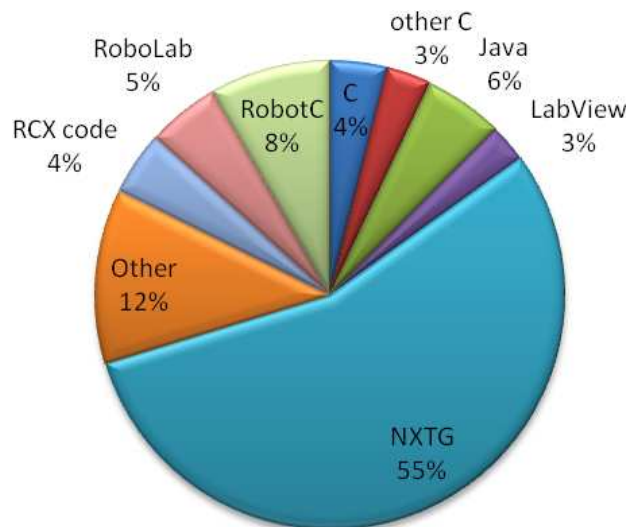


Figure 10. Programming languages used

How are Robofest teams formed? Figure 11 shows that most Robofest teams (52%) were learning and preparing for competition through after school programs. We found that a large portion of teams (15%) were from home schools.

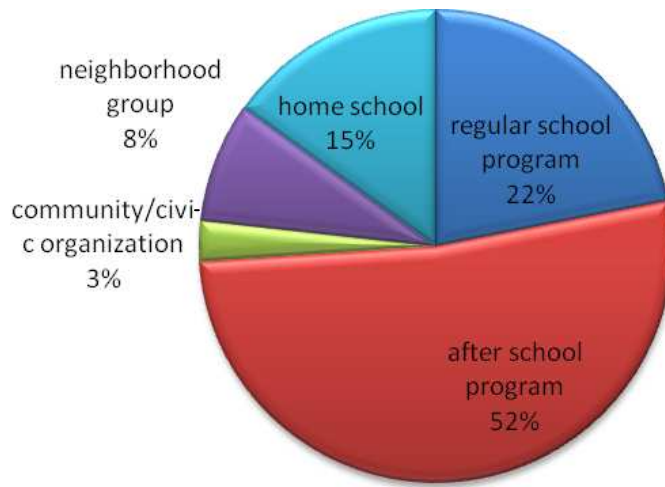


Figure 11. Team organization

2. Robofest 2009 Survey Results

This section shows the results of the anonymous web survey conducted in summer 2009 after the world Robofest. 143 coaches, teachers, parents, team members, or volunteers participated in the survey.

Q: What area do you think is enhanced (or will be enhanced) through Robofest robotics for students?

| | |
|-----------------------|-----|
| science | 15% |
| engineering | 33% |
| computer technologies | 23% |
| math | 4% |
| creativity | 9% |
| team-work | 11% |

Q: For whom do you think the Robofest program is designed?

| | |
|--|-----|
| not sure | 7% |
| students who demonstrate exceptional talent | 2% |
| only for students who are interested in science and eng. | 27% |
| every student | 58% |
| other | 3% |

Q. How likely are you to participate in Robofest next year?

| | |
|------------------|-----|
| extremely likely | 50% |
| very likely | 20% |
| somewhat likely | 16% |
| not likely* | 4% |
| not sure yet | 7% |

(*) Some teams led by just parents are not returning usually when their children go to colleges.

Figure 12 shows funding sources for teams. For the first time, school support is greater than that of parents. (Last year: only 16% were from schools; 41% from parents). Robofest is always helping teams get grants and sponsorships. For example, team 668 got a sponsorship from AREVA NP Inc in WA through Lawrence Tech. Another notable achievement was by Team Justice from Canada who set up an online fundraising tool for their travel to World Robofest. See Figure 13 and check out at <http://pledgie.com/campaigns/3871>

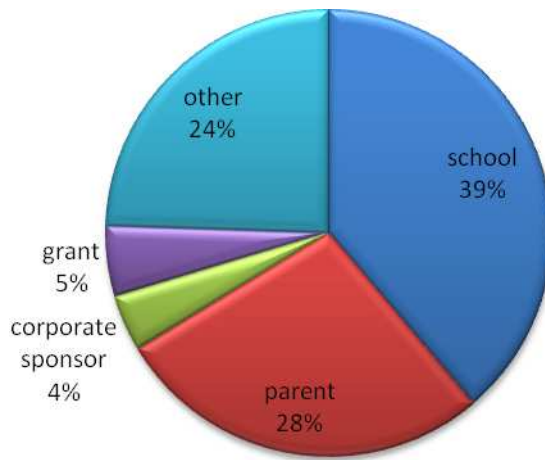


Figure 12. Team Funding Source



Figure 13. Online Fundraising Site for Team Justice

We asked the following question in the survey for the World Robofest Location. In general people supported the idea.

Q. We plan to rotate the location of World Robofest Championship from Michigan to other locations. Do you support this idea?

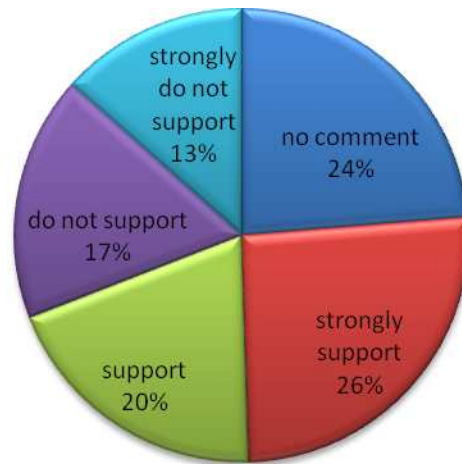


Figure 14. Moving World Championship location to other places

We also asked the following question in the survey for the preferable World Robofest date. In general people supported late April or Early May.

Q. When would be the best time to hold World Robofest?

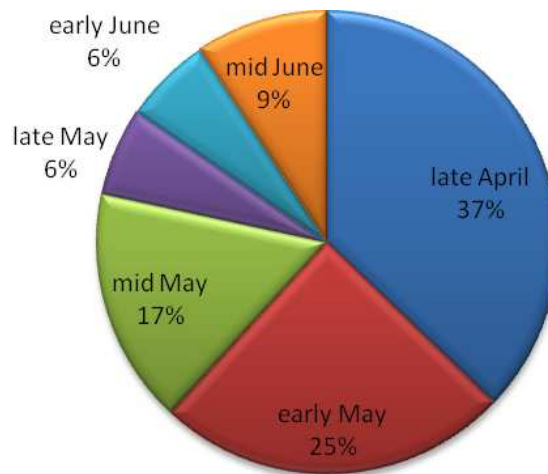


Figure 15. Preferable World Robofest Date

Q. The one aspect of Robofest that I like the best is:

(*) *The number in the parenthesis shows the number of people who wrote the comment*

- Robofest encourages creativity and teamwork. (15)*
- Kids could choose from a variety of different events; there was something for everyone. (12)
- The learning style was fun for kids. (12)

- It was accessible and appealing to any type of student, regardless of their academic ability and family income. Even people from different countries were able to participate. (9)
- Educational: math, computer programming, etc. (7)
- Robofest generated interest from kids in science and engineering. (6)
- Participating was inexpensive. (6)
- Competition gives feedback to students so they can evaluate how well they did. Robofest gave “Feeling of accomplishment” (6)
- Students were encouraged to think on their own without the involvement of parents, at the competition they had to work by themselves and were not allowed the assistance of coaches. (6)
- Robofest is simple – easy to sign up, games aren’t complicated, little equipment is needed, etc. (5)
- Seeing other kids’ ideas for exhibitions and how they chose to solve problems was interesting. (5)
- The workshops and practice rounds were helpful. (4)
- The unknown problem added an interesting element and should be kept. (4)
- Robofest staff did super job (6)
- Students could compete at different levels. (3)
- The setup of the game allowed for many different ways kids could approach the problem. (2)
- Variety of events in one building (1)

Q. If there were one aspect of Robofest that I would change, it would be:

RoboZone Game

() The number in the parenthesis shows the number of people who wrote the comment*

| Summary of Comments and Complaints | Answers and Replies |
|--|---|
| Better explanation and examples of Game (1)* | We admit that our explanation was not the best and we needed more examples. |
| More clarification of the rules is needed (2) | We maintained FAQs on the web, but some coaches / judges did not know about that; there were so many unexpected cases. |
| There should be a rule against selecting different programs after the starting position is given (1) | Our rule permits the use of different programs implicitly by allowing time to adjust. We think it is OK to use different programs for educational purposes, since it helps students develop analytical thinking to solve problems. Also, note that the location of the Zone was placed after the robots were located. |
| The Robo Sumo should be separate from the Game (2) | Problems with RoboSumo were listed in the RoboZone Game rule. We do not plan to have Robo Sumo only games in the near future. |
| The Game should require two robots (1) | We really wish to have Games with two robots as we did before. However, it increases team cost. There are many under privileged schools and teams. We plan to go back to using 2 robots in 2011 or 2012. |
| A team should not be able to win without their robot moving (1) | As far as we know this happened at a qualifying site in Detroit; We admit that this was a problem of the RoboZone game rule. However, robots must be programmed to stay on the table, first. |
| Light sensors could not sense the zone very well (1) | It was not an easy task, but many teams did it successfully and reliably usually by finding correct threshold values as well as the optimum distance between the sensor and the floor. |
| The Game should vary more year to year (1) | Yes, Robofest has been doing that. The 2010 Game will be totally different. |
| Hard to judge when the robot occupied the zone (1) | Yes, it was hard to judge in some cases. We will not do the same RoboZone game again without a reliable mechanism to make a clear decision. |
| Inconsistent judging - judges used different scoring methods, some judges modified rules | We will try our best to set clear rules and train judges based on the consistent rules. However, please understand that |

| | |
|--|--|
| at competition (10) | judges were volunteers. |
| Judges did not always enforce that people or objects (including themselves) must not crowd around the playing area (2) | Since judges need to focus on the judging first, in some cases they forgot to clear the playing area. We will develop better infra structure to control the crowd. |
| Teams caught cheating should automatically be disqualified (1) | We will do our best to enforce the rules. |
| All teams should use the same materials and programs; Robot motors and controllers should be restricted. Same torque and number of batteries, etc. (2) | This is against Robofest philosophy. We encourage diversity of technologies. Actually the teams who won the Sr. Game (994-1) and Jr. Game (993-2) championships were all using Lego NXTs with the same sensors and motors. |
| Require on-site programming and even robot construction during event (1) | A "sort of" onsite programming task will be back in 2010. Robot construction is not practical due to the time limit. |
| Make the Game more challenging! (1) | Thank you! However, it is not possible, since there are many teams struggling to solve the problems; instead we will be considering introducing extra credit challenges in the Games. |
| Do not use the unknown problem as a breaker – does not result in best match for competition (1) | We found a strong correlation between the UP results and Game performance. |

Exhibition

| Summary of Comments and Complaints | Answers and Replies |
|---|---|
| Make Exhibition on a different day than the Game competition (1) | This is something we have been discussing. We could do Exhibition only in the fall. We need more discussions and planning. |
| Combine Jr./Sr. Exhibition (1) | Currently we do not plan to combine them. |
| More exhibits (for spectators) (1) | It was very unfortunate that we did not have enough space to host more exhibits... |
| Make Exhibition non-competitive, coaches and parents took event too seriously (1) | We agree and we will discuss the issue. Our RoboParade event in the fall is non-competitive. |
| More Exhibition judges are needed (1) | Certainly. |
| Have judges with Technical background (1) | We thought all had; However, we admit that many did not have any robotics background. |
| Require Exhibition teams to submit YouTube videos, which the judges can review before judging each team (1) | Currently we recommend uploading videos. We may consider that as a requirement to enter exhibition. |
| The Exhibition judges and teams need more time (3) | If the above video requirements are implemented, then we will require judges to study exhibitions before coming for judging. Then the problem can be solved. |
| Define how Exhibition robots must be autonomous; hand-operated electronic instruments are autonomous? (3) | Autonomous robots must have sensing capabilities to interact with the environment. Therefore, for example, the robotic musical instruments interacting with human players were autonomous and eligible to compete, even if the processing was simple for each input signal. |
| For the Exhibition, the rules and judging should promote engineering, science, & programming rather than business and marketing (1) | Entrepreneurial ideas and mindset made up 5% of the total scores for an exhibition. We regret that we do not have complete written records of the judging. |
| Exhibition judging sheet made it easy to make simple errors when rushed; no back-up system (like spreadsheet check) to confirm score; math errors may have affected overall outcome of the Exhibition judging (5) | We admit the problem and will fix it in the future. |
| More clarification of the rules is needed (2) | We admit that Exhibition Judging rules were not clear |

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|---|---|
| | enough during the World Robofest; in particular, there were no clear roles for the silent Judges. There were no clear guidelines to aggregate all the judges' inputs. Some internal judging materials were not submitted to Robofest admin. |
| Allow each team to present so all other teams could see their presentations (2) | We did it this way for the qualifiers with a few teams; we could not do it in the World Championship, since there were too many teams. See the new plan in Section 3. |

General Team Issues

| Summary of Comments and Complaints | Answers and Replies |
|---|--|
| Allow for bigger teams (1) | Robofest problems are not huge, but require focus. In order to promote in-depth learning for every member, Robofest does not allow more than 7 members and we will not change the rule. |
| Let individual students participate (1) | Robofest rules allow a team with only one student. |
| Improve communication to teams and between teams (4) | Email is the official method for communication. We noticed that some emails we sent were treated as spams. It is the team coach's responsibility to allow emails from robofest.org. For communication between teams, each coach's account can get other coaches' email addresses in a competition site. We could plan to use Facebook for the networking between teams and team members. |
| Set up sensor selling/trading between teams (1) | Nice idea! This could be done on Facebook. |
| Organize a category for kids younger than 5 th grade (1) | We really wish to do that. However, currently we do not have enough staff to expand to that age. Our suggestion is to join RoboParade in the fall. Or check out JFLL (Junior First Lego League) for younger kids into robotics. Also use Robofest's Age Waiver request forms for approval. |
| Using team names instead of numbers would be less confusing (4) | Team names were not unique. For example, there were too many "Eagles"! We will try to use both numbers and names. |

Awards

| Summary of Comments and Complaints | Answers and Replies |
|--|--|
| Give awards to everyone, including all members of winning team (2) | Robofest tries to recognize students' achievement as much as possible. Every participant got a medal and certificate. Each World Robofest participant received a personalized small trophy. At least 25% of the teams received winner trophies. Since team sizes are different, it is not possible to prepare trophies for each member of a winning team. Also, we have budget limitations. This year the revenue decreased more than 30%, mainly due to the economic situation. |
| Provide Judges' Awards for excellent technology and/or programming (1) | Since Robofest allows a variety of programming languages, it is hard to find qualified judges to check programs in detail. Also, it takes a lot of time. Instead, we judge accumulated outcomes of the robotics projects. |
| Maybe have robotic parts or sensors be prizes instead of trophies (1) | This is an excellent idea. We may consider this next year. However, we need more revenue. Sensors are not cheap. |
| Do not allow teams to win more than one award (1) | We would like to do this, but it is technically very challenging. To keep preparations for the award ceremonies, under 30 minutes, it will be difficult to check for double winning teams and find the next team candidate. This process will be error-prone, too. If we had only a few |

| | |
|---|---|
| | trophies, we could do that. But there were 60 trophies to award during the World Robofest... |
| Give trophies out before award ceremony so coaches who did not win can go home. (1) | We need to learn how to recognize and celebrate other teams' achievements too. Anyway, we have a new plan for next year to solve the problem in general. See Section 3. |

World Robofest General Issues

| Summary of Comments and Complaints | Answers and Replies |
|---|--|
| Avoid planning competition at time conflicting with FIRST or VEX (1) | The end of April or early May is the only possible time frame for many teams as well as for Lawrence Tech. To solve this problem we may move the date to another month and/or location outside of Michigan, if Lawrence Tech administrators allow it. |
| Move the World Robofest to mid-June (1) | See the survey result. The majority of the teams did not support the June date. |
| Too many events in one day, projects should be presented individually (1) | This problem was mainly due to the number of teams that we invited. Inviting 145 teams for the World Championship was the problem considering our limited capacity. We plan to reduce the number by introducing new 2 nd level regional competitions. See the new plan below. |
| Schedule was confusing, large time gaps between a team's competitions (2) | |
| Tournaments poorly organized (1) | |
| Provide the coaches with something to do, give them instructions in advance for what to do at the World competition (2) | Some information was posted on the web. Also we did Webinars before the competition. We will promote more coaches to participate in the Webinars. |
| The awards presentation was way too long, especially for teams that did not win (3) | There will be fewer teams and trophies to award from next year, since there will be 2 nd level competitions. See Section 3. |
| The audience could not tell what was going on (2) | The location of the audience seats was not ideal. To make the problem worse, there were many events going on at the same time. We will improve the program and floor layouts. |
| World setup should match qualifiers (1) | World setup was based on the rules. We do not know what happened in each qualifier. Anyway, we will find a way to ensure consistency working together with qualifying hosts. |
| Too much time to wait for the award ceremony to begin (1) | Again, too many teams were invited without considering our capacity. See future plans below. |
| Needed practice mini UC course (1) | We are very sorry. We did not have enough space in the gym... See our future plans. |

World Robofest Equipment/Facility Issues

| Summary of Comments and Complaints | Answers and Replies |
|--|--|
| Electricity was not always accessible (4) | This was the biggest trouble since the gym was not designed to have that many computers, projectors, amplifiers, and speakers. To solve this problem, we decided to invite fewer teams next year by having 2 nd level regional qualifiers. See Section 3 below. |
| Electrical cords in crowded rooms were a hazard; Better air conditioning, room was very hot; Room was too noisy (10) | We apologize for the problems. We will not use the racquet ball courts. |
| Cameras to project Games; More equipment (large screen and LCD projectors for each Game field) (4) | We admit that we did not have enough technological support. Another big problem was, we could not find any video clips of Jr. Games. We will recruit more volunteers and |

| | |
|--|--|
| | provide technical equipment. Robofest needs more revenue to do this. |
| More space would be helpful (5) | Yes. We will try to use other spaces on campus. |
| Unpleasant smells... (1) | We are very sorry for the inconvenience. |
| No place for team parents/visitors to sit (2) | The chairs near the competition tables were not prepared. We are very sorry for the inconvenience. |
| Two RoboZone rings through one sound system was confusing (1) | It was a big mistake. We are very sorry for the inconvenience. See the future plans. |
| Allow access to official scales and competition area (for testing light sensors) (1) | We allowed teams to use the scale and the official table when there was no competition. |

Regional Competitions

| Summary of Comments and Complaints | Answers and Replies |
|--|---|
| Teams should have to qualify at two different levels before moving on to World's (1) | Yes. We are implementing this idea from 2010. See the future plans below. |
| Provide UP score and feedback at regional competition (1) | We will require each site host to post the scores. |
| Train regional judges more thoroughly; they seemed unfamiliar with some of the rules; scoring was inconsistent (1) | We will improve our judge training. |
| Make sure regional judges are not parents or relatives; some of the judging was obviously biased (1) | Yes, we will find a way to prevent this from happening again. |
| Allow teams to handle robots instead of judges (judges have broken robots) (1) | We are very sorry for the incident. |

Promotion

| Summary of Comments and Complaints | Answers and Replies |
|--|--|
| Publicize event more (1) | We have tried hard so far. We will contact Robot Magazine to place an article. Also we may consider placing an ad on robotevent.com. The problem is the cost. It will be better if Robofest and all participating organizations work together. |
| Better promotion to public schools so they can sponsor teams (2) | |
| Make more appealing for kids to sign up (1) | |

Mentoring

| Summary of Comments and Complaints | Answers and Replies |
|---|---|
| Former Robofest participants should have a seminar for new students (2) | We need to find a systemic way to do that. One example would be a new award category for student mentors. |
| High school members could be volunteer coaches for younger teams (1) | |
| Instructors should come to schools (1) | We have tried hard, but Robofest's budget is limited. This year our revenue decreased significantly. |
| More workshops should be created (2) | Practically it is not easy, considering the budget cuts. Instead, we will do more webinars. |

Miscellaneous

| Summary of Comments and Complaints | Answers and Replies |
|------------------------------------|---|
| No change is needed (8) | Thank you. We are striving for improvement for all. |

| | |
|---|--|
| Offer travel scholarships or provide a more convenient location for the World competition (1) | Check out what Team Justice did. Read the report to find more info. Also, we may rotate the location of the World competition. |
| More online submissions (2) | A few teams used our video submission site. Yes, we will promote it more. |
| Online registration needs improvement (1) | We are working on the new improved system. We may be able to use it for 2010. |
| Extend Robofest to a year-long program (1) | We have RoboParade in the fall. We are considering Exhibitions in the fall. |
| Allow for more than one choice on survey | We need to improve our survey system or rewrite survey questions. Currently it allows only one choice. It is not a trivial job to modify the current system, since we need to change the database model. |
| Provide downloadable programming tutorials (1) | We posted zip files; this info was available to coaches. |
| Keep Robofest inexpensive (2) | Sure. |
| Improve the filming of Lego Mindstorms training (1) | Certainly, we are trying. |
| Create a Robofest newsletter (1) | We have published eNewsletters. Please join the list at www.robofest.net |
| Remove check-in fee (1) | Currently it is not possible due to the budget constraints. |
| Better organization (5) | See future plans in Section 3. |
| Create lending book library for coaches and teachers to learn about programming (1) | We will consider it. |

Figure 16 shows the overall satisfaction percentages this year. We realize again that it is not easy to satisfy everyone when organizing a competition. We will, however, try hard to maximize the satisfaction rate for every team every year.

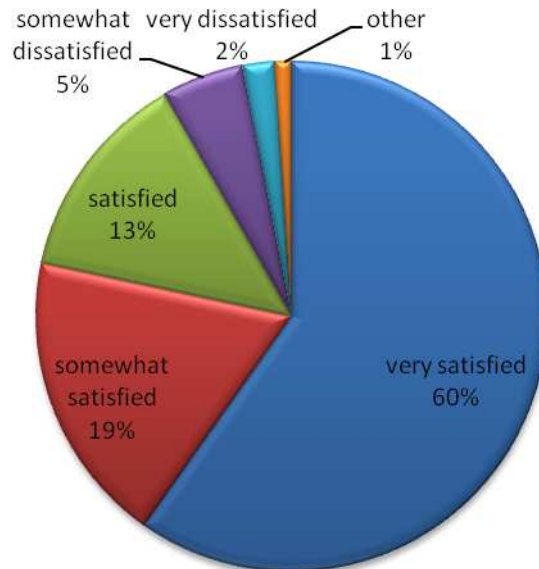


Figure 16. Overall Robofest Satisfaction

3. Future Plans for Improvement

Based on the outcomes, the anonymous on-line survey, private conversations, and emails with coaches/parents, we have identified various facets of Robofest needing enhancement and improvement in the coming years. We apologize that some items summarized below were existing problems from previous years. Please understand that some issues will take time and resources to improve.

General Administration

New Competition Structure

This 2009 season we advanced more teams (145) than ever to the World Robofest competition. 143 teams showed up and this caused big problems such as power outages, crowdedness, noise, confusion, and delays. To solve the problem from the root, we are planning the following new structure.

We have been using a 2-level structure in recent years: local level qualifiers and one World Championship. From the year 2010, we will introduce a 3-level competition structure. In order to compete at the World Championship, a team must pass both a local qualifier and a regional competition as depicted in the following Figure 17. Currently, we are planning the following regional championships: Midwest, West, South, Asia-Pacific, and Online-Video. Due to the introduction of the regional championships, our timeline would change, too. We will start the season slightly earlier. We plan to invite only 80~90 teams to the World Championship considering our capacity. This will solve a lot of problems caused during the World Robofest 2009. The World Championship venue may also be flexible starting in the 2011 or 2012 season to share access and further promote Robofest for future growth.



Figure 17. New Robofest Competition Structure

Site Host Administration

Even though the number of qualifying sites were decreased (see Figure 3), the cost and complexity of supporting site hosts both inside and outside of Michigan remained high in 2009. For example, on the weekend of April 3-4, there were 7 events concurrently. Amazingly, we were able to ship and email supporting items out of state and support local sites with limited staff and volunteers. Efforts will be made to proactively schedule dates next year so that there are not as many events on one day. It is strongly suggested that sites outside of Michigan plan for earlier dates, as time is needed to fund the expenses in traveling to the Regional or World Championship. Some sites were too close to each other. Developing committees for each state to coordinate events is being considered, especially for the regional championships. The hope is to alleviate scheduling conflicts outside of Michigan and to provide geographic distribution as well.

Categories/Age Divisions

During the 2009 season, when there were fewer than five (5) teams registered for a specific category/age division of competition, the division or site was cancelled. The decision was made three weeks before the actual qualifying date. We suggested displaced teams move to another site or use video submissions.

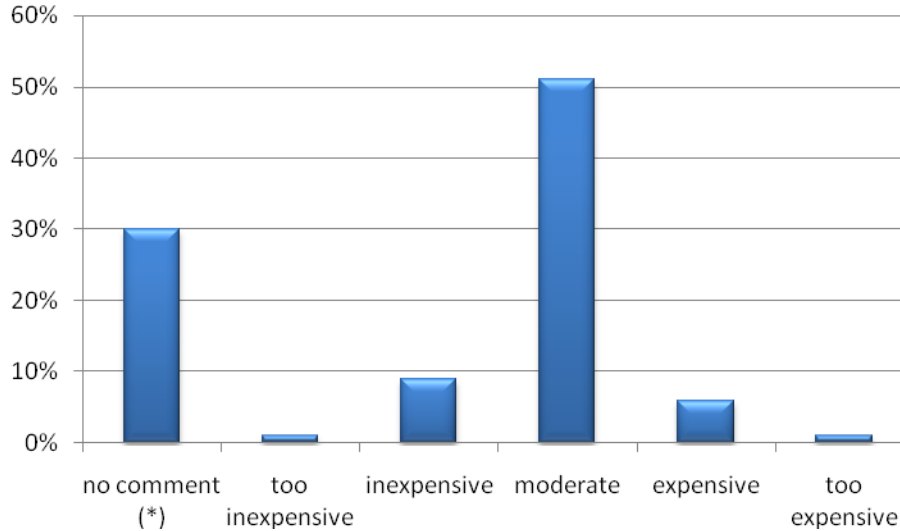
Hotels and Lodging

Due to budgetary and administrative constraints at Lawrence Tech, we were unable to provide hotel compensation for any non-Michigan teams competing in the 2009 World Robofest Championship. Instead, we waived the World Robofest check-in fee (\$40) for the teams from outside Michigan. Some teams, like Team Justice, found very interesting ways to raise funds like setting up an online fundraising site.

Registration Fees and Check-In Fees

According to the anonymous survey, few people said the registration fee (\$50) or check-in fee (\$20) were expensive (See figure 18 and 19). We are proud of our cost-effectiveness and efficient management to minimize the cost for teams to attend.

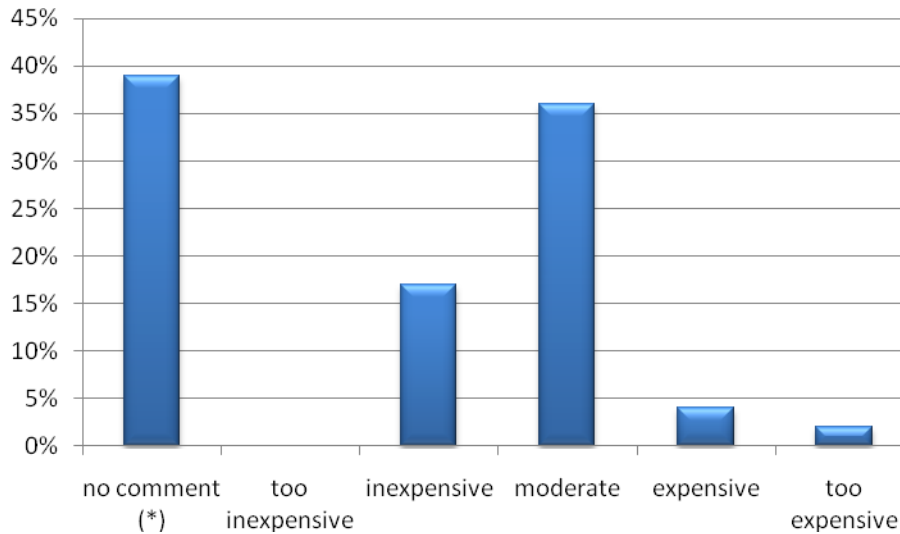
Q. Registration fee (\$50) was:



(*) Among 143 people who participated in the survey, 30% were site volunteers and they chose not to comment.

Figure 18. Registration fee Survey Result

Q. Site check-in fee (usually \$20) collected by the site host was:



(*) More people chose no comment, since some sites did not charge the check-in fee at all.

Figure 19. Site check-in fee Survey Result

Communications

- There is a way for coaches to get information including email addresses of the other team coaches in their qualifying site. However, we found not many coaches were using this function.
- We decided not to develop our own blogging site or bulletin board website. Instead, we will encourage teams to use Facebook for communicating and networking with other teams.

- We will actively use more Webinars.
- Although there were Robofest articles in several publications, Robofest was not well publicized in major media outlets. This is a shame, as students were doing advanced competitions and their achievements should be well publicized. We hope to improve media coverage for 2009. Please send your teams' achievements to your local newspapers and TV stations! We will send articles to newspapers and magazines, too.

Robofest Website

It was still not easy for (new) teams to find all the needed information on the web. We are fully aware that the current website is neither well structured nor well-organized. It is hard to navigate. Web pages are not consistent with design styles and color themes. There are some broken links. Some information is confusing and cluttered. The new system will be introduced hopefully early 2010. We are proud of keeping almost all data/information/pictures from the 10 years of our history. No other competition site provides that kind of information in detail over the years!

Online Registration Systems

- There are still problems operating the online registration system. For example, fewer teams uploaded team pictures this year compared to previous years. (2006: 68%, 2007: 53%, 2008: 55%, 2009: 50%) We need to develop an automatic reminder function or require a team photo to compete.
- There are inefficiencies caused by the team registration system, mailing list system, and volunteer system not being integrated. For example, some coaches receive too many of the same emails generated from the systems, if the coach registered for multiple roles. System integration is not a simple job. We have started the integration of the five independent database web application systems, but the job is not completed yet.
- The connection between our registration system and PayPal was significantly improved this year.
- Some coaches did not like the mandatory volunteer field when a team was registered. Unfortunately, each site host did not use the info effectively either. We need to improve this process.

Technical Support and Free Workshops

In addition to the 8 on-site workshops in Detroit funded by TARDEC and The Herbert and Elsa Ponting Foundation, we provided ten free workshops in January and Feb, 2009 for teams at LTU. Some of the workshops were available on the web through real-time webinars. Most of the workshop files were posted on the web for free. The URL was sent to only registered coaches. However, there were concerns from non-Michigan teams who could not attend workshops in Michigan. We encourage each site host to organize their own workshops using our materials if needed. We learned that teachers needed to learn robotics, too. We are still developing multimedia online class materials. We already introduced ways to borrow robots from LTU Robofest for a minor fee. If you are interested in this program, please email robofest@LTU.edu .

Competition Rules

Rule Documentation and Finalization

The finalization of all the official rules was on time this year. However, both the clarification of the rules and the FAQs were not effectively delivered to the coaches and volunteer judges. We will try for clearer communication and better organization.

Game: RoboZone

Judging whether the robot occupied the zone for 3 seconds was not easy. The unknown drawing problem was done relatively well, though the ranking of the drawings was not easy and simple. Please see the survey result table in section 2 for more details about the game. We will try to develop simple standards for the 2010 Game judging.

Exhibition

There were many interesting exhibition projects. The TARDEC CI grant generated more interest. Always, judging was not easy. See the survey comments and our responses above in Section 2.

RoboFashion Show

This category did not gain as much popularity as expected. Integrations between robots and human players using sensors were not exhibited as much as we had hoped.

Mini Urban Challenge

No other robot competitions in the world are offering something like this for high school students. We plan to promote more participation in this category. There will be free workshops on L2Bots sponsored by DENSO again. Schools of workshop participants will get free L2Bots. The schedule will be announced through Robofest eNews soon. Please join our eNews list at www.robofest.net, if you are interested in this opportunity.

Competition Event Organization

Volunteer Organization

Volunteer recruitment must be started earlier. Some sites did not fully use our online volunteer system. At Worlds, the volunteer check-in line was too long. Some volunteers did not get T-shirts. If you were a site volunteer (not a volunteer for your competition team) and you did not get a T-shirt and a small gift, please let us know (robofest@LTU.edu). We had around 500 people registered on the web and we deeply thank all the site volunteers.

Hours of competitions

- The duration of the larger qualifying sites has always been an issue. We must work harder to fine tune the schedule to ensure finishing on time. We need to simplify competition procedures.
- Due to the large number of prizes, the World championship award ceremony took too long. We may consider reducing the number of trophy winners as some teams suggested.
- For some spectators, it was too boring to stay from the early morning till the evening on a Saturday. We provided informative events for parents and spectators, but the participation was very low.

Playing Fields/Tables

The use of 6ft plastic folding tables will continue next year for Games and FashionShows.

World Venue and Setup

- Robofest is growing and there are growing pains too. There were many complaints due to the three different events in one gym area. The exhibition venue in the racquet ball courts created a lot of problems.
- We know that the spectator viewing was difficult from upstairs in the gym. We needed a lot more chairs. We wish we could have a bigger gym floor area. At least for spectators, it would have been nice to project team numbers and team names currently with the assigned table numbers. In addition we should have a video projection system available to show robots in action on a screen.
- RoboZone events were not well organized mainly due to the large number of teams. Group tournament tables on the screen were not visually shown to the teams or audience; teams were relying on only announcements, but the area was too noisy. Spectators upstairs did not know what was going on. We plan to have only one event at a time in a room next year. It will definitely be possible, since we are inviting fewer teams next year.
- Although Robofest Game does not allow adults in the pit area, there were still complaints that some adults were helping the students. We need more volunteers for proctoring.

Judging

Judging was a big problem we admit. Some judges were not familiar with the Robofest 2009 rules. Head Judges need to be trained properly early on. Please read survey comments and responses in Section 2.

4. Budget Summary

Robofest Budget results for the 2009 season (July 1, 2008 ~ June 30, 2009, Lawrence Tech fiscal year) were as follows: \$43,268.03 in cash revenue, \$33,106.61 in expense which resulted in an overall gain of \$10,162.42. Note that the TARDEC grant was not included, since we did not receive the check by the end of June. This means programs under the TARDEC grant have not been fully paid yet. In-kind donations were not included either in this table. Table 2 shows the summary of cash revenue and expenditure. Some Robofest teams still have not paid registration fees. We decided not to pursue this, since the hourly salary for Robofest staff members is greater than the monies we could collect. However, we realize a more controlled registration process/tools for 2010 is necessary.

| | |
|--|--------------------|
| Cash Revenue | |
| Transfer from 2007-2008 | \$76.22 |
| Individual donors | \$245.81 |
| Corporate/Org Cash Sponsorship | \$17,000.00 |
| Registration fees, sale & others | \$22,946.00 |
| Onsite workshop fee income | \$3,000.00 |
| Total cash revenue | \$43,268.03 |
| Cash Expense | |
| Workshop instructors salary | \$5,170.00 |
| Assistant coordinators salary | \$6,749.75 |
| Supplies, postage, & others | \$21,186.86 |
| Total expense | \$33,106.61 |
| Robofest Account Balance as of Jun 30, 2009 | \$10,161.42 |

Table 2. Cash Revenue and Expense Summary

Table 2 above does not include Lawrence Tech's cash support. Table 3 below summarizes measurable cash contributions from Lawrence Tech. Other LTU contributions include: marketing, fundraising, and special event support by Univ Advancement; help desk laptop support; audio & visual equipment; Dr. Chung's release time; MCS Dept. administrative support; general office supplies (paper); printing; phone and fax; office space; utilities; mailing and postage by admission & MCS; campus facilities; video taping and raw editing - eLearning Services

Three part-time staff funded by LTU Math and Computer Science Department worked 1,854.25 hours from July 2008 ~ June 30, 2009. Total amount of salary for them was \$31,522.25

| | |
|---|--------------------|
| Web Developer & Coordinators' salary by MCS Dept | \$31,522.25 |
| Student Assistants (work study students) salary by MCS* | \$8,000.00 |
| Official poster (first version**) by Admission's office | \$401.00 |
| Table rental by Provost office | \$942.00 |
| Table rental by College of Arts and Sciences | \$761.00 |
| Dinner by Univ. Advancement | \$807.59 |
| Photo copies* | \$1,400.00 |
| Total | \$43,833.84 |

(*) estimates

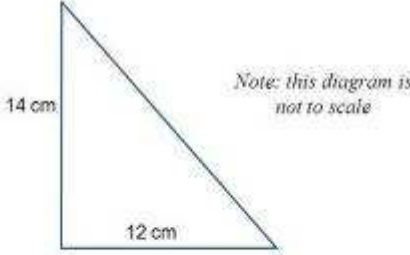
(**) 2nd version was paid by Robofest

Table 3. LTU support summary

5. Student Achievements

We were very happy to see the results of the Unknown Problem challenges that required the use of math. For example, students were asked to make their robots draw a right triangle on a piece of paper. They needed to calculate the number of rotations of their motors to make the robot go straight for a certain distance and spin for a certain angle. In addition, they needed to figure out the spinning angles of the right triangle shown below in Figure 20 using trigonometry. The results were fabulous. Many teams successfully accomplished the mission as shown in Figures 21 and 23.

Sr. Division Unknown Problem Challenge: Right Triangle
(20 minutes given)



Note: this diagram is not to scale

Tabloid 11"x 17" (27.9cm x 43.2cm) paper to be used. One paper to practice will be given to each team.

Figure 20. A sample Unknown Problem (UP) Challenge for Sr. division teams at the World Championship

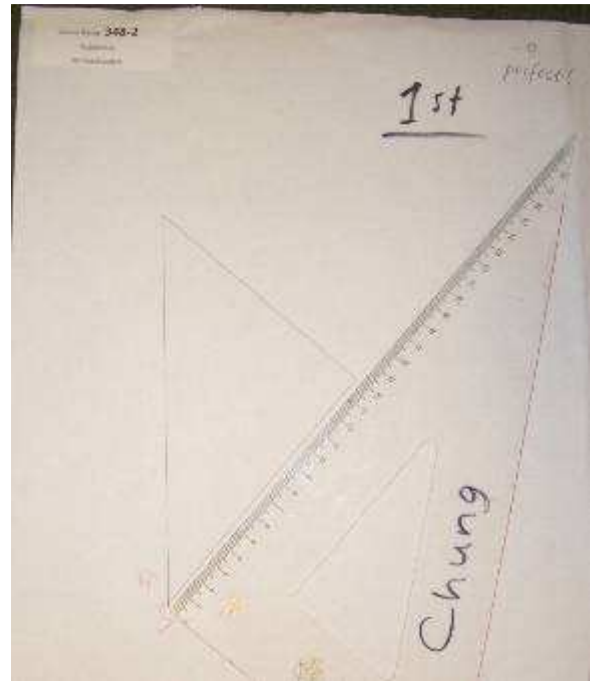
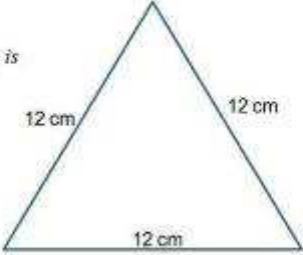


Figure 21 A result of the Sr. UP Challenge by team 348-2 Roboteers

Jr. Division Unknown Problem Challenge: Equilateral Triangle
(20 minutes given)



Note: this diagram is not to scale

Tabloid 11"x 17" (27.9cm x 43.2cm) paper to be used. One paper to practice will be given to each team.

Figure 22. A sample Unknown Problem (UP) Challenge for Jr. division teams at the World Championship

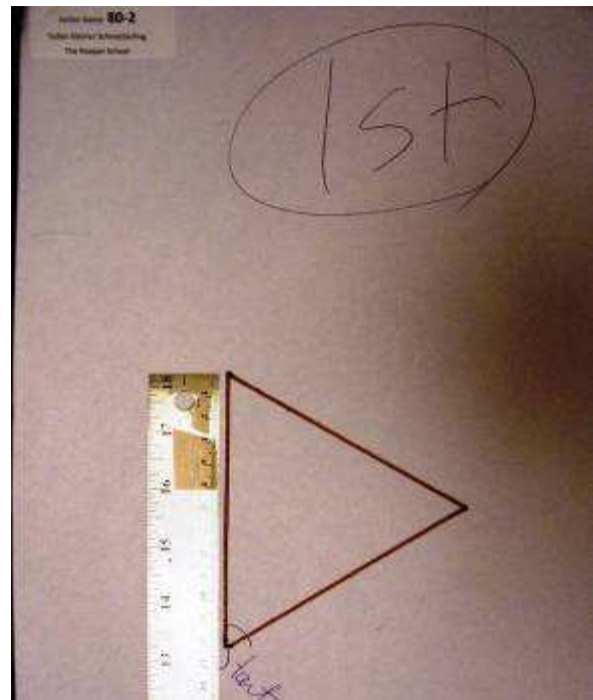


Figure 23. A result of the Jr. UP Challenge by team 80-2 Suber Kleiner Schmetterling

Many high school teams completed the Mini Urban Challenge course that required college level computer science knowledge such as computer vision and image processing and advanced programming skills with Java.

Many superb exhibition projects were entered this year. Team Homemade Titanium, 517-1, made SEEKER, a low cost, lightweight, landmine detection autonomous robot. (See Figure 24) They filed for a patent for SEEKER and formed a company, Homemade Titanium Robotics LLC.

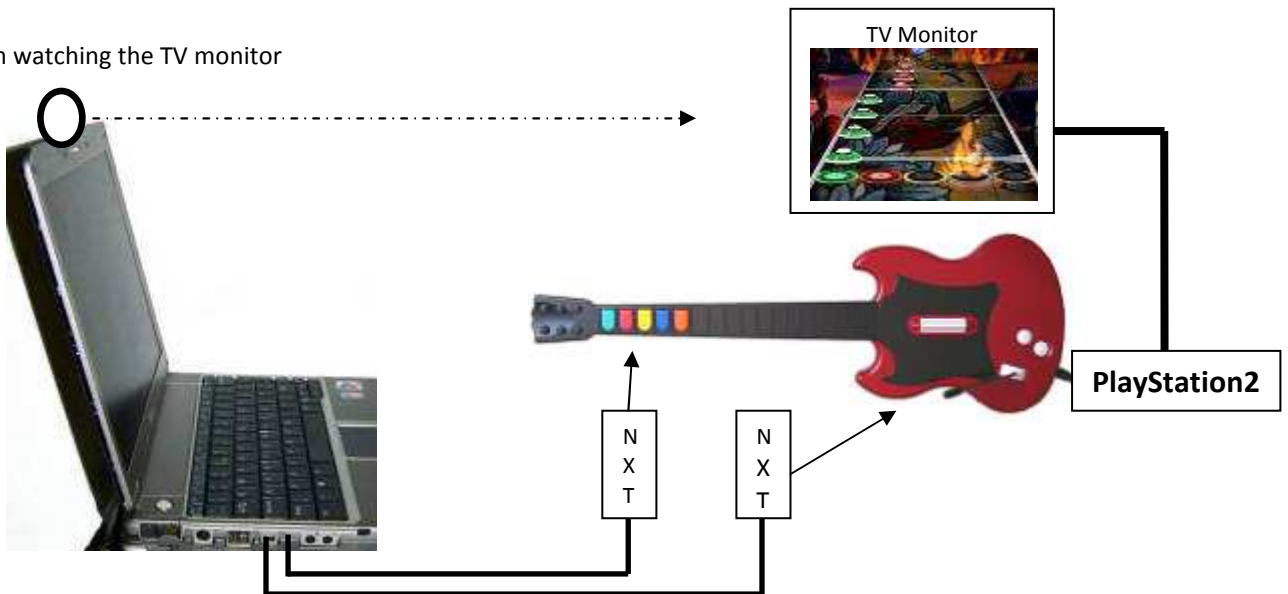
Another notable project was a believed-to-be world's first fully autonomous robot playing the Guitar Hero entered by a Belleville, MI high school team. See Figure 25. All the Exhibition entries can be found at www.robofest.net.



Figure 24. Seeker – landmine detection robot



Webcam watching the TV monitor



PC side: real-time computer vision processing and motor control decisions programmed in Java

NXT side: programmed by LeJos Java

Figure 25. Autonomous Robot that plays the Guitar Hero

6. Assessment

In order to assess the impact of autonomous robotics competitions in STEM education, we asked Robofest students to take online assessments before and after the competition. Another group of students who did not participate in the competition was chosen as a control group, and they took the same pre- and post-assessments. The assessment was 100% anonymous using a web-based system.

Pre-Assessment was conducted over the months of February and March. A total of 158 of both Robofest and Non-Robofest students participated in the junior and senior pre-assessments. However, only 51 students participated in the post-assessment conducted from late April to late May. Overall only 45 of these students took both the pre-assessment and post-assessment. The following table 4 shows the summary of the assessment results using the data only from the 45 students who took both the pre- and post- assessment so that we can better compare the groups.

| Division | Group | Average Pre-Assessment Score | Average Post-assessment Score | % change |
|----------|-------------------------------------|------------------------------|-------------------------------|----------|
| Jr. | Robofest students | 81.25 | 71.67 | -11.4 |
| | non-Robofest control group students | 58.1 | 50.0 | -13.9 |
| Sr. | Robofest students | 66.67 | 62.12 | -6.8 |
| | non-Robofest control group students | n/a | n/a | n/a |

Table 4. Summary of the Robofest 2009 Assessment Results

The questions used for the assessment are math and physics problems. We asked harder questions for the post-assessment. The following summarizes what we found from the 2009 assessment:

- Jr. Division Robofest students were better in the beginning on average. We think this is true, since usually motivated students are signing up the challenge.
- Robofest Jr. group showed improvement in learning compared to the non-Robofest control group. Robofest Jr. group had -11.4% change in the post-assessment, where as non-Robofest group had -13.9% change. However, this statement is not statistically significant, since the data size was too small to analyze. Both sample groups passed the Shapiro-Wilk test for normality. When using a t-test assuming equal variances we found that there was no significance between the differences of the two averages. This means that we cannot attribute the lower average score for the non-Robofest group compared to the Robofest group to anything other than randomness, theoretically.
- Unfortunately, it was not possible for us to gather data from non-Robofest students for the senior assessment.
- For the Robofest Sr. group, the % change became less from the pre-assessment to the post-assessment compared to that of Jr. groups. We cannot make any conclusion based on this data, since we do not have any data from a control group. When testing the two groups for normality the post group was not found to be normal on all levels tested.
- No obvious conclusion came of this analysis other than the need for a larger sample size and the need for a larger control group.

7. Recognition



Figure 26. World Robofest 2009 Championship, May 9, 2009, Sr. Game Final Match

For the fifth time since 2005, personalized individual trophies (see Figure 27) were given to each student participant at the World Robofest Championships. This was possible due to our web-based registration system that included individual student team player names. We thank all the coaches who entered their student names correctly and uploaded team/robot photos. As far as we know, Robofest is the only competition who recognizes each student's efforts by providing personalized certificates (see Figure 28) and World Championship trophies with student names engraved on permanent metal plates. If your team member did not receive a personalized trophy at the World Robofest or a certificate from the qualifying site, please let us know (robofest@LTU.edu).



Figure 27. Personalized individual trophies at the World Robofest Championship



Figure 28. Official Robofest Certificates for all students

Robofest was blessed this year to have 19 corporate/foundation and 2 individual sponsors. Without their support, Robofest 2009 would not have been possible. Figure 29 shows all the logos of the corporate/foundation sponsors which were displayed on a large screen during the World Championship. The logos or names of the sponsor were also printed on all qualifying programs as well as the World Championship programs (see Figure 30). Bronze level or higher sponsor logos were printed on our official posters (see Figure 31). More than 1,000

spectators and 500 students came to the championship event held at Lawrence Tech in Michigan on May 9, 2009. See the crowd in the gym in Figure 26. A list of all the sponsors can be found at www.robofest.net.



Figure 29. Robofest sponsor logos displayed and printed during the World Robofest Championship



Figure 30. Some of Robofest’s qualifying and World Championship programs with all sponsor logos



Figure 31. Robofest 2009 Official Poster

We especially thank TARDEC (Tank Automotive Research, Development and Engineering Center), our Presenting Sponsor, and The Herbert and Elsa Ponting Foundation, our Gold Sponsor.

Their funding enabled us to deliver on-site robotics programming classes to 8 schools (see Figures 32 ~ 39) in the city of Detroit. Here is the summary of the onsite hands-on classes:

- Total number of schools in Detroit that had on-site classes: **8**
- Total number of students served: **109**
- Total number of Robofest teams competing at qualifiers: **32**
- Total number of teams advancing to World's: **10**
- Highest finish at Worlds: 24th place out of 50 in Jr. Division Unknown Problem Challenge by team 998-4
- Total number of teachers directly involved as coaches: **10**

Prof. Keith Bozin, Dr. Chung, Mr. Doug Czinder, Dr. Kurt Meister, Mr. Jeff Sparling, Mr. Joe Long, Ms. Emily Trudell, Mr. Ryan Matthews, and Mr. AJ Ureel delivered the classes on-site in Detroit. We thank the Lawrence Tech help desk for providing laptops for the workshops.



Figure 32. Cleveland High School in Detroit



Figure 33. Detroit Neinas Elementary



Figure 34. Detroit Edison Public School Academy Qualifying Site



Figure 35. Service Learning Academy



Figure 36. A Detroit Merit Academy Team



Figure 37. A Detroit Community High School Team



Figure 38. Mae C. Jemison School Workshop



Figure 39. Detroit Emerson Elementary School Qualifying Site

Based on our 2009 sponsorship rules, we printed the logo of TARDEC on our official Robofest T-shirts as shown in Figure 25. Figure 1 on the first page of this report shows the winners of the first TARDEC CI (Creativity and Innovation) grant. Table 5 shows the list of the grant winner teams (sorted by team ID).

| Division | Team ID | Team Name | Project Title |
|----------|---------|-------------------------------------|---------------------------------------|
| Senior | 336-1 | The Galactic Wailers | Robotic musical instruments |
| | 517-1 | Homemade Titanium | Landmine detecting robot |
| | 928-3 | Newmarket | Blackjack dealing robot |
| Junior | 22-2 | Cranbrook 6, The Bobbers | Water Tester Buoy |
| | 218-1 | Tilt (Technology In Layman's Terms) | Controlling a tilting maze via a ball |
| | 304-2 | Operation Chocolate | Operation Chocolate |
| | 628-1 | Dawg Botz | Carrying Autonomous Robot Tech, CART |
| | 917-1 | Desert Eagles | Robot recycler |

Table 5. Winners of the 2009 TARDEC CI (Creativity and Innovation) grant

We thank IEEE Region 4 PACE and SEM (Southeastern Michigan Section) for their sponsorship for IEEE medals of achievement (see Figure 39) that were awarded all the registered participants of Robofest 2009 during the qualifying competitions.

Dr. Lewis Walker, President of Lawrence Technological University awarded a plaque of appreciation to two dedicated ten-year coaches during the World Robofest. See Figures 41 and 42.



Figure 40. IEEE medal of achievement and Robofest T-shirt



Figure 41. A ten-year coach, Mr. Jay Sinclair, Ida Middle School



Figure 42. A ten-year coach, Ms. Linda Pence, Roeper School

We were also pleased to recognize five-year coaches during the World Robofest. They include the following:

- TJ Murphy 2005 - 2009
- Ronald Fadoir 2005 - 2009
- Robert Globke 2005 - 2009
- Jon Finch 2005 - 2009
- Monti Toly 2005 - 2009
- Steve Dail, 2003, 2004, 2006, 2007, 2009

The following people received the mentor award:

- Barry Brouillette
- Kevin Low

Robofest part-time staff members in the 2008-2009 year were Jerri Ureel, Sara Moss, Jeff Sparling, Susan Latos, Yevgeniya Tarakhovsky, Bashkim Zendeli, Don Dubois, Teri Dubois, and Shari Stout.

Robofest student assistants were Tiffany Platt, Andrew Scala, Joe Long, Ryan Matthews, Emily Trudell, Rich Hellwig, Shahedullah Mohammad, Victor Cabrera De La O, and Namkung Won,

Robofest thanks Cranbrook Schools, Betsy Lamb, Elmer Santos, and others for their dedicated volunteer work in organizing the First Tech Challenge and VEX Elevation events. Dr. George Albercook organized the Flutterbot Firefighting competition. We thank Dr. Albercook for his vision and leadership.

8. Conclusion

Data presented in previous sections show that the Robofest 2009 season accomplished our intended objectives as listed below:

- To spark young students' interest in science, math, engineering and technology
- To promote imaginative, creative and innovative thinking and ideas
- To build a globally competitive engineering work force of the future

We are proud that Robofest is continuously inexpensive since the inception in 2000, while providing a high quality STEM education environment for *all* students. We deeply thank everyone who has hosted, sponsored, supported, volunteered for, and participated in the 10th anniversary Robofest for the 2009 season.

If you find any errors or have comments on this report, please let me know (chung@LTU.edu). We are looking forward to meeting you at the 11th annual Robofest 2010 sites.



Figure 43. Robofest 10th Anniversary Cake for the welcome dinner on May 8, 2009

Respectfully,
August 25, 2009

CJ Chung,

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