2018

Music City BEST Team Handbook

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The purpose of this Handbook is to provide teachers, coaches, mentors, and student leaders with an overview of how to organize and lead a BEST Robotics team. It covers the technical aspects of designing and building a robot and describes the BEST Award, Practice Day, Competition Day, and advancing to South's BEST.

Some of the material here is taken either directly from existing BEST Robotics, Inc. literature or has been edited or modified for purposes of clarity. There is no intent to claim authorship of all material in this handbook. All material in this handbook, especially material from BEST Robotics, Inc., is to be used solely for the purpose of advancing the mission and purpose of BEST Robotics, Inc. Any other uses of this material are prohibited.

Music City BEST Team Handbook
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BEST Robotics Overview

BEST – Boosting Engineering, Science, and Technology

BEST Mission Statement – BEST Robotics Inc. (BRI) is a non-profit, volunteer-based organization whose mission is to inspire students to pursue careers in engineering, science, and technology through participation in a sports-like, science and engineering-based robotics competition.

BEST Facts

- Started in 1993 with 14 schools and 221 students
- Today BEST has over 850 middle and high schools and over 18,000 students
- No registration fee for schools to participate
- All materials provided to the school at no cost
- Robotics game based on a theme
- BEST Award
    - Project Engineering Notebook
    - Marketing Presentation
    - Team Exhibit and Interviews
    - Spirit and Sportsmanship

Students Learn

- Application of Science and Technology
- Real World Engineering Challenges
- Project Management and Leadership
- Teamwork and Problem Solving
- Marketing and Public Relations
- Technical Writing and Documentation
- Fundraising and Sponsorships

Five Regional Competitions

- South's BEST – Auburn University – Auburn, Alabama
- Texas BEST – University of Texas – Dallas, Texas
- Frontier Trail's BEST – University of Arkansas – Fort Smith, Arkansas
- Wild West BEST – Metropolitan State University of Denver
- Pittsburgh BEST – Carnegie Mellon University – Pittsburg, Pennsylvania

Music City BEST is One of 45 Hubs Across the Nation

- Hosted by Lipscomb University
- Sponsored by Nissan
- Serves Tennessee and surrounding areas
- Sixteen (14) schools competed in 2017

Competition

Each team designs and builds a wireless controlled robot to accomplish defined tasks in a game type format. In 2008, robots assembled airplanes. In 2009, robots accumulated water, carbon dioxide, energy, and catalyst and synthesized isooctane. In 2010, robots sorted parts in a factory. In 2011, robots collected bugs. In 2012, robots delivered supplies to the space station. In 2013, robots manufactured integrated circuits. In 2014, robots assembled energy generating wind turbines. In 2015, robots repaired an abandoned mine and extracted valuable minerals. In 2016, robots cultivated and harvested crops from a farm. In 2017, robots navigated an industrial fire simulator to rescue a trapped person, contain dangerous chemicals, and extinguish the flames. In 2018, robots ride ocean currents to collect recyclable garbage, build artificial reef structures, inspected sea turtle for plastic consumption and analyze current flow data provided by flowing rubber duckies.

Teams receive all materials needed to build their robots, and they receive a detailed set of game rules. Robots cannot weigh more than 24 pounds, must fit within a 24 inch cube, and must be built only from the materials supplied by Music City BEST.

In the robot game, four teams compete at a time in a series of three minute matches. Each team will compete in a minimum of five matches in the seeding rounds. The top eight robots advance to the semi-finals and compete in three matches. The top four robots then advance to the finals for another three matches. In each match, the robots accumulate points by performing the tasks set out in the game rules.

Schedule

Kick-Off Day September 8, 2018

Teams gather at Lipscomb University to see the playing field and receive a detailed set of game rules. Workshops will be offered for students, mentors, coaches, and teachers to learn more about designing and building a robot and competing for the BEST Award.

Practice Day October 13, 2018

Five weeks after Kick-Off Day, teams gather at the Student Activities Center at Lipscomb University for an opportunity to test drive their robots on the competition playing field.

Notebook, Nominations, Web Site & Demographics October 16, 2018

Project Notebook, Best Teacher and Best Mentor nominations, and Demographics Form submissions to the Music City BEST Google shared drive deadline is the Tuesday between Practice Day and Competition Day, by 4 pm. Team Web Site Address are also due by email.

Music City BEST Competition October 20, 2018

Six weeks after Kick-Off Day, teams gather at Lipscomb for the robot competition and to compete for the BEST Award.

South's BEST Regional Competition December 1 & 2, 2018

The winner of the robot competition and the winner of the BEST Award advance to the regional competition at Auburn University.

Awards and Judging

These awards are normally given at Music City BEST. However, the final list of awards is provided at Kick-Off Day. Awards given at South's BEST will vary slightly from this list.

Competition Award: First, second, third, and fourth places to the robots scoring the most points in the game competition

BEST Award: First, second, and third places to the teams that best embody the concept of BEST including: diversity of participation, implementation of the Engineering design process, sportsmanship, teamwork, creativity, positive attitude, enthusiasm, school support, and community involvement. Winning the BEST Award is considered the highest achievement in the competition. The BEST Award is made up of five (5) categories:

- Project Notebook – 30%
- Marketing Presentation – 25%
- Team Exhibit & Interviews – 20%
- Spirit & Sportsmanship – 10%
- Robot Performance – 15%

BEST Category Awards: In addition to being a part of the BEST Award, INDIVIDUAL first place awards will be made for the following four (4) categories:

- Best Project Notebook
- Best Marketing Presentation
- Best Team Exhibit & Interviews
- Best Spirit & Sportsmanship

Founders Award for Creative Design: Awarded to the team that makes best use of the Engineering design process in developing the offensive and defensive capabilities in robot design. This award is in recognition of BEST founders Steve Marum and Ted Mahler.

Most Robust Robot: Awarded to the team whose robot requires the least maintenance during & between matches and is generally the sturdiest machine in the competition.

Other Awards to be Given at the Discretion of Music City BEST

- Most Photogenic Machine
- Best Team Web Page Design
- Best Tee Shirt Design
- Best Team Costume
- Best Team Mascot
- Teacher of the Year
- Mentor of the Year
- Best Middle School Team
- Best Rookie Team
- Best Home School Team
- Exhibit Design & Construction
- Blood, Sweat, & Duct Tape Award
- Lipscomb University Award for Robotic Engineering Excellence
- Rube Goldberg Award for Meritorious Achievement in Design Complexity
- TVA Safety Award
- Additional awards may be added
- The Simulink Design Award will be given at regional competitions only

Team Organization – Student Members

Teams should be organized taking into consideration the number of student members and adult volunteers and the amount of time each is able to commit to the program. This section on team organization is broken into three categories: Enter the Robot, Compete for the BEST Award, and Go for the Gusto. Teams with only a few students and adults may consider limiting participation to only entering a robot into competition. Teams with a good number of students and adults will add competing for the BEST Award. High powered and high achieving teams will go for the gusto.

It is important to note that, at this time, Music City BEST is just now at capacity for the number of teams. However, at such time that Music City BEST exceeds our capacity and is unable to accept all teams interested, teams that are able to fully participate will get priority over teams with limited participation.

The team organization outlined here is simply a recommendation provided by Music City BEST as a starting point. It is expected that each team will alter this organization to fit their needs and circumstances. There are no requirements to follow this pattern.

BEST Robotics teams are to be student run teams. Adult teachers, coaches, and mentors serve in an advisory role only, and more information will be provided on these roles later. The actual titles given to each student leader will vary based on the preferences of the individual teams. Each team will decide if a student can fill more than one position and whether the positions will be filled by election or appointment. Each team will also decide who has the responsibility to make the appointments. In the lists below, titles such as "Coordinator" and "Leader" can easily be replaced by titles such as "Director" or "Manager" or "Chair" or "Committee Chair" or any other title.

Must Have to Enter a Robot for Competition	
Title	Responsibility
President	Overall Leader
	Driver Selection & Strategy
Vice President	Robot Design Leader
	Compliance Verification
Treasurer	Finances
	Fund Raising
Secretary	Team Records
	Photographs
Notebook Editor	Project Notebook

Compete for BEST Award
Marketing Presentation Coordinator
Team Exhibit Coordinator
Public Relations Coordinator
Sponsors Coordinator
Spirit & Sportsmanship Coordinator

Go for the Gusto
Costume Leader
Tee Shirt Leader
Web Page Leader
CAD Leader

Must Have to Enter a Robot for Competition

President – Overall Leader Responsibility

- Overall leadership of the team
- Provide game documents and other information to team members and families
- Plan and moderate team meetings
- Establish and track schedule of activities
- Coordinate activities with other team leaders
- Solve any problems that may arise

President – Driver Selection and Strategy Responsibility

- Develop method for selecting robot drivers
- Conduct trial runs or try outs
- Schedule driving practice
- Work with drivers to decide on driving strategies

Vice President – Robot Design Responsibility

- Leadership of the robot design
- Moderate robot design brainstorming sessions
- Moderate team discussions on design issues
- Moderate team discussions on game strategies
- Coordinate designs among the various design groups

Vice President – Compliance Verification Responsibility

- Responsible for compliance with the robot design rules
- Responsible for compliance with game strategy rules

Treasurer – Finances Responsibility

- Handle all financial matters
- Collect and deposit money
- Make requests for checks to pay expenses or reimbursements
- Keep records or log of money collected and paid out

Treasurer – Fund Raising Responsibility

- Identify fund raising opportunities
- Develop plans for the events
- Schedule people to work
- Make necessary arrangements
- Coordinate getting supplies and materials

Secretary – Photographs

- Ensure adequate photographs and video are being taken for use in the notebook, team exhibit, marketing presentation, and web page
- Scan brainstorming sketches into electronic formats
- Collect, organize, and make available photographs, videos, and sketches for use in the notebook, team exhibit, marketing presentation, and web page
- Provide all team members with a final compilation of all photographs and videos

Secretary – Team Records

- Keep records or log of team activities, decisions, and accomplishments for use in the notebook, the team exhibit, the marketing presentation, and the web page
- Collect information for the project notebook demographics submission

Project Notebook Editor

- Plan the contents of the project notebook
- Assign sections to writers
- Provide guidelines for what is needed in each section
- Edit submissions
- Compile final notebook
- Save finished notebook to PDF file and upload to Google Shared Drive

Compete for the BEST Award

Marketing Presentation Coordinator

- Recruit participants and design outline for the marketing presentation
- Assign sections to speakers
- Assist them with developing those sections
- Assemble the final Power Point presentation
- Schedule and moderate the marketing presentation meetings and practices

Team Exhibit Coordinator

- Develop a theme and design for the team exhibit
- Identify and obtain materials and items needed
- Organize team exhibit construction
- Develop plan for the judge interviews
- Prepare all members on the interview strategy

Public Relations Coordinator

- Identify public relations and promotion of BEST opportunities
- Plan and coordinate activities such as school visits, conferences, presentations, etc.
- Document the events

Sponsors Coordinator

- Develop and maintain relationships with sponsors
- Obtain materials for putting their names and logos on the robot
- Send thank you notes

Spirit and Sportsmanship Coordinator

- Plan, organize, and coordinate spirit and sportsmanship activities
- Invite other students from school to support us at competition
- Solicit ideas for and order give aways
- Create banners and signs
- Develop cheers and chants for the team

Go for the Gusto

Costume Leader

- Identify the person or people who will wear the team costume
- Develop a costume theme and design
- Identify and obtain materials and items needed
- Organize costume construction

Tee Shirt Leader

- Solicit ideas for the team tee shirt and/or other uniform/outer wear
- Lead development of the design
- Determine sizes and quantities needed
- Place order to have them for Practice Day

Web Page Leader

- Develop layout and design for the team web page
- Obtain pictures and information needed
- Lead construction of the web page
- Upload the page

Computer Aided Design (CAD) Leader

- Learn how to use the Computer Aided Design (CAD) program
- Teach others how to use it
- Determine drawings needed
- Coordinate production of the drawings

Team Organization – Adult Volunteers

Although BEST Robotics teams are to be student run teams, adult volunteers are needed to serve in advisory roles. These adult volunteers are teachers, coaches, and mentors. Just as with titles in the student organization, the use of titles such as coach or mentor are not specified or required by BEST. The use of these titles here is simply a recommendation. Each team can choose whatever titles they desire and certainly can combine responsibilities or sub divide them even further. Again, these guidelines are a starting point only. Each team should customize their adult leadership organization to meet the needs of that team.

Adult Volunteer Roles

Teacher – Responsible for overall organization of team
Robot Design Coach – Coordinate the overall robot design and competition strategy
BEST Award Coach – Coordinate the BEST Award
Project Notebook Coach – Coordinate the Notebook
Mentors – Lead the individual small groups

- Robot Design – Base and Locomotion / Movement
- Robot Design – Game Objective Robot Function
- Robot Design – VEX Controls and Software
- Marketing Presentation
- Team Exhibit and Interviews
- Spirit & Sportsmanship and Public Relations

Rules and Compliance Expert

Adult Volunteer Skills

When assembling a group of adult volunteers, the skills needed are fairly self-evident from the descriptions above. However, this list will provide more specific information.

Mechanical Design or Mechanical Engineering – A good understanding of mechanical fundamentals is important in the base, locomotion, manipulation, and handling designs. At this point in the students' education and practical experience, they can develop ideas on how to achieve a particular function and have a good idea of what components can be used. However, they need help in seeing how to apply those components to carry out that function.

Computer and Electrical Engineering – The VEX system offers teams almost unlimited opportunities for operating and controlling the robot. While not overly complicated, the VEX system and programming are not intuitively obvious. A good understanding of these fundamentals is necessary to teach the students how to apply the components and how to set up and program the controls.

Technical Writing – The project notebook is an important part of the program. No one student can put it all together, and technical writing is different from the writing they are learning in school. A good technical writer can teach the students these differences and can coordinate several students writing different sections, so the entire notebook is cohesive.

Public Speaking and Business Presentations – The marketing presentation is a business presentation. As with technical writing, it is different from the public speaking the students may be learning in school. Someone experienced in making business presentations can help the students organize and coordinate a successful presentation.

Public Relations – There are several occasions in which the students need to use public relations skills. They will seek out sponsorships for their team and conduct fund raising activities. They will present themselves at promotional opportunities such as schools, conferences, and other various types of group meetings. They will also be interviewed by judges during the team exhibit competition. In every situation, they are "selling" BEST and their team. While some students may be naturals at these activities, many will need to be taught and coached.

Web Page – Many students will already have this skill, but their activities will need oversight.

Computer Aided Design (CAD) – Some students will already have this skill, but their activities will need oversight.

Creativity and Organization – Do not limit the team to technical people only. Many of the activities will require artistic and creative leadership as well as good organizational skills. Team exhibit, web page, tee shirt, costume, and spirit and sportsmanship activities are just a few of the areas requiring these skills.

Dealing with Conflict

The BEST program is an intense six weeks where emotions run high, and conflict will arise. Most conflict will work itself out, but occasionally it will need to be handled. Left unaddressed, conflict in this kind of situation can escalate and quickly get out of control. Do not ignore conflict that develops between students, between adult volunteers, and between students and adult volunteers. Here is some basic advice:

- Know the students and the adult leaders and their personalities and anticipate where conflict might occur
- Know if cliques exist or develop within the group
- Stay in tune with what is happening, and watch the interactions between the students and the adult leaders
    - Student with student and adult with adult interaction conflicts often work themselves out, but not always
    - Adult with student interaction conflicts are the most difficult to address and usually need to be addressed with the adult because ultimately the adult in the situation needs to resolve the conflict with the student
- Defuse volatile situations before they escalate
- The adult leader's job is to
    - Teach, not criticize – there is a difference
    - Help students develop ideas, not tell them how to design or build the robot

Robot Design

Meeting Schedule

- The meeting site and the work location do not have to be in the same place, but having them together allows more flexibility for the team schedule
- The amount of time a team puts into the program will vary based on the team's experience and the number of students and adult leaders
    - Teams typically will meet from two to four times on weekdays and on Saturdays for a total of five to twenty hours per week
    - Teams typically will schedule times the entire team needs to be together, so there can be team discussions and decisions and small groups can interact
    - Small groups can meet separately as well to focus on their tasks.

Meeting Site

- Plenty of tables and chairs
- Capable of handling separate small group discussions without disturbing each other
- Capable of allowing the entire group to participate in entire team meetings
- Plenty of pads of large poster size paper available for brainstorming
- Each team member should have a bound notebook of blank pages for personal ideas, sketches, notes, and other documentation
- Large white board, chalk board, or the ability to hang the large poster size paper for note taking and sketching during the entire team meetings
- Snacks and drinks are always good to have

Work Location and Tools & Equipment

- A place to display all the parts all the time; this is just like shopping at Home Depot or Lowes and trying to get an idea on how to do something
- Plenty of work tables and chairs for developing small assemblies and prototypes
- Hand Tools: Hammers, Screwdrivers, Pliers, Wrenches, Sockets, Files, Etc.
- Metal Working Tools: Snips, Hammers & Anvils, Bending Tools, and Deburring Tools
- Cutting Tools: Wood Saw, Hack Saw, PVC Pipe Cutter, and box cutters/utility knives
- Hand Power Equipment: Circular Saw, Jig Saw, and Drill with Wood & Metal Cutting Bits , Disc Grinder
- Power Equipment: Table Saw, Band Saw with wood and metal cutting blades, Miter Saw, Grinding Wheel,
- Really Nice to Have but not Necessary: Lathe and Mill

Materials

The students will consume many of the materials provided by Music City BEST as they develop prototypes and try out ideas. Most of these materials can be found at Home Depot and Lowes. Be sure to keep the materials supplies replenished, so the students are not discouraged from trying their ideas. In addition to the allowed materials, keep materials on hand that facilitate trying out ideas and prototyping such as cardboard and coat hangers.

Team Organization for Robot Design

The recommendations here are based on the assumption that future competitions will be similar in complexity and objectives as previous competitions. As described earlier, the team Vice-President (or other designated position) has the responsibility for the overall robot design. However, the most effective approach to designing and constructing the robot is to break the student members into three design groups:

- Robot Design – Base and Locomotion / Movement
- Robot Design – Game Objective Robot Function
- Robot Design – VEX Controls and Software

The team Vice-President (or other designated position) coordinates the activities between the three design groups and works to ensure the designs fit together to make one robot.

Robot Design & Construction Calendar

The recommendations here are based the assumption that most teams rarely go to competition with their first design. Be sure to allow time for testing, failures, and redesigns. When it looks perfect on paper, it stands about a 50% chance of succeeding when built.

- Learn the Parts – First Meeting
- Brainstorming and Design Concept – Week 1
- Build & Test First Prototype – Weeks 2 & 3
    - Establish Design Envelopes
    - Build Prototypes & Assemble First Robot
    - Test Design & Decide on Changes
    - Disassemble to Redesign
- Second Prototype – Week 4
- Strategy, Practice, & Practice Day – Week 5
- Final Design Changes, Strategy, & Practice – Week 6

Safety

Safety is critical to the success of a BEST Robotics team. Most students and some adult volunteers do not understand the inherent dangers and risks associated with the tools and equipment being used to construct a robot. While these guidelines are not comprehensive, they are a good starting point for ensuring safety for your team.

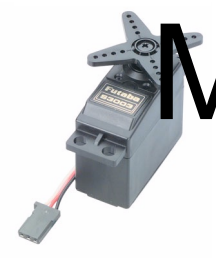
- Verify (DO NOT ASSUME) adult volunteers are qualified and competent to use tools and equipment safely; do not be concerned about offending someone by asking
- Always wear safety glasses – students and adult volunteers
- Students must be properly supervised when using tools & equipment
- Hand tools can be as hazardous as power tools
- Be especially careful with box cutters or utility knives; they are the most dangerous tool of all

VEX Control System

BEST's transition to the VEX control system provides teams almost unlimited opportunities for operating and controlling the robot. The basic components of the system are:

VEX Cortex Microcontroller

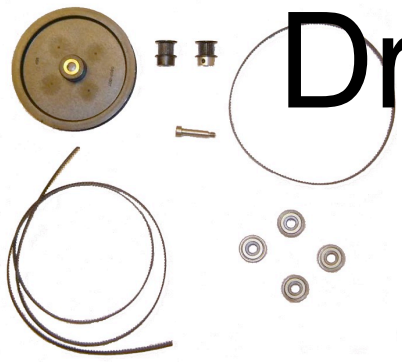
VEX Gaming Style Controller



Motors (4)

Batter

Example System Connections



Dri nts

The VEX control system provides for three different methods for programming. Teams will choose a method based on their skill level, experience, and desire for complexity.

The three different programming environments available are:

- MathWorks Simulink http://www.mathworks.com/best-robotics
- easyCv6 http://www.intelitekdownloads.com/easyCV6
- RobotC http://www.vexrobotics.com/robotc-vexedr-vexiq.html

Simulink is graphical programming/modeling environment with simulation capability (see what your program will do before you download it to the Cortex)

easyC is a block programming environment (drag and drop programming elements)

RobotC programs in C with a text editor, but it has runtime debugging (can step through program line by line and see what the results are)

All details for accessing the software is provided at Kick Off Day.

To learn the details for installing and programming your VEX control system, be sure to see the VEX and Software documents and the VEX Control System Training Power Point presentation that are provided to teams at Kick Off Day.

Project Notebook

The notebook describes how the team designed, built, and tested the robot. It provides evidence of how the Engineering design process was followed, demonstrates that safe practices were followed, and explains the software design and verification process. A research paper is included in the notebook as well.

The Notebook Editor is responsible for coordinating the assembly of the notebook, but it would be impossible for one person to prepare the entire notebook. It is recommended that the notebook responsibilities be divided among several team members. While each student will have a unique style of writing, providing good guidelines will facilitate the Notebook Editor's job in bringing all sections together into a cohesive notebook. Here are some guidelines that may help:

- Specify what word processing program you want each student to use
- Determine whether hand written submissions will be accepted
- Establish a deadline when all submissions must be received by the Editor
- Request that the writers not be concerned about formats, spacing, margins, etc.
- It is easier for the Editor if each writer simply provides text; the Editor can easily take care of the formats, spacing, margins, etc. after all the text is assembled into one file
- Refer to the Awards & Judging Policies for format specifications
- When writing, do not use "I" and "we," always use third person such as:
    - The base design team developed …
    - The arm design team built a prototype of …
    - The BEST Robotics team decided to use a strategy of …

The Secretary is responsible for accumulating, sorting, and filing pictures. In addition, the Secretary is responsible for scanning brainstorming sketches into electronic files. These pictures and sketches are a vital part of the project notebook. Each writer should have access to them and can insert them into the document as needed. Otherwise, the Editor will have to choose and insert the appropriate pictures and sketches.

Typical Notebook Outline

- Executive Summary
- Engineering Design Process
    - Defining the Problem
    - Exploring Offensive & Defensive Game Strategies
    - Brainstorming Design Concepts
    - Prototyping, Testing, & Evaluating Design Alternatives
    - Final Design & Game Strategy
    - Trial Run Performance Results
- Safety
- Software Design
- Research Paper
- Appendix
    - Members and Mentors
    - Team Organization Charts
    - Accomplishments & Decisions Log
    - Electronics and Controls Layout
    - Robot Design Details
    - CAD Drawings
    - Trial Run Results

Special Note and Author Disclaimer

Judging any written document, regardless of how specific the guidelines and score sheets are, is and always will be subjective. There is no universal agreement in the Engineering community as to what makes up a complete and correct project notebook. In addition, throughout BEST, there are many references to the "Engineering Process." A search of Engineering, academic, and other technical literature will reveal variations in the definition or description of this process. The steps described here are simply an example of the "Engineering Process" adapted to the BEST program.

The overall notebook content suggestions and the "Engineering Process" described here are provided by Music City BEST as examples and starting points. There are no requirements to follow these patterns, and there are no guarantees that all judges will find a notebook per these guidelines to be complete or fully correct.

Executive Summary

The executive summary is an overview of the entire notebook and the Engineering design process followed. It needs to be very concise, but it must provide a good summary.

- Introduction giving the team name and school, and a few sentences describing the game and scoring
- Describe the Engineering process
    - Defining the Problem
    - Exploring Offensive & Defensive Game Strategies
    - Brainstorming for Design Concepts
    - Prototyping, Testing, and Evaluating Design Alternatives
    - Final Design and Game Strategy
    - Trial Run Performance Results
- Give an overview of the final robot design and how it performs, one paragraph each
    - Base and locomotion / movement design
    - Game objective robot function design
    - Electronics and controls logic
    - Trial run results

Defining the Problem

This is a very straight forward section. It describes the requirements of the robot.

- Introduction that gives an overview of the game
- Field description
- Scoring summary
- Materials restrictions

Do not just copy from the information that was provided by BEST. The students should use their own words. This section is a summary, but it must include important details such as sizes, dimensions, times, etc.

Exploring Offensive & Defensive Game Strategies

This section describes the various game strategies explored by the team. Some ideas for this section include:

- Identify how many total points are available
- Summarize the discussion over whether to go after only high scoring pieces or go after bonus points instead
- Discuss how the capabilities and limitations of the robot design dictated what strategy was to be used or in what order the game pieces would be retrieved

Do not focus on the final game strategy. Instead, describe the strategies considered including their merits and obstacles. A later section will describe the final game strategies used by the team.

Brainstorming for Design Concepts

This section describes the various brainstorming ideas generated by the team. Some ideas for this section include:

- Identify what themes or similarities continued to show up
- Describe the many variations of a single task that were suggested
- Summarize the evolution of ideas showing how one led into another

Do not focus on the merits of the final design. Instead, describe the brainstorming done to get there. A later section will describe the final overall design of the robot and how it works.

Prototyping, Testing, and Evaluating Design Alternatives

This section describes the various designs the team actually tried to develop. This section should include a lot of pictures and drawings. It usually covers two basic areas, but it could include more:

- Base and locomotion / movement design
- Game objective robot function design

This section should discuss how the prototypes were built and describe the testing done to see if they would work. For example, show how cardboard or popsicle sticks were used to define or explain a concept, or discuss how different size wheels were evaluated to compare speed with power. If there was a design concept that was built and tested but failed to work, discuss what went wrong and how the next design evolved from the failed one. Finally, explain what design decisions were made. Describe the merits of each choice and the compromises that resulted.

Do not focus on the merits of the final design. Instead, describe the prototyping and testing done to get there. A later section will describe the final overall design of the robot, its merits, and how it works.

Final Design and Game Strategy

This section is a detailed description of the final robot design and the final game strategy used. This section should include a lot of pictures and drawings. Do not describe how it was prototyped or tested because this is covered in a previous section.

- Introduction that gives an overview of the robot design including all three areas
- Detailed description of the base and locomotion / movement design
- Detailed description of the game objective robot function design
- Detailed description of the electronics and controls logic
  - Should be coordinated with the detailed drawings and layouts that will be included in the appendix
- Explanation of the scoring rules and our team's game strategy

Trial Run Performance Results

This section is a description of how the robot did in trial runs, not just a listing of the trial run results themselves. The actual results are presented in tables and charts in the appendix. This section refers to those tables and charts, summarizes the information in them, and explains the conclusions drawn from them. Describe how well the robot performed.

Safety

This section demonstrates that safety training occurred and safe practices were followed to prevent students' misuse of tools and other devices or equipment that could result in personal injury or damage to property. A description of the training program and a summary of the teams safety polices should be included. Appropriate photographs could be included.

Software Development Process

This section explains the VEX software design, verification, and release process. It describes the how the robot control requirements were identified and how the code was developed. It further describes how the code was tested and debugged and its release schedule.

Research Paper

This section is a minimum of two pages and a maximum of five pages. It is a research paper discussing how the current year's game theme is related to current technological practices or scientific research. Specifically, look at any correlation between the game and how the technology is being used at a company/industry/research lab in your team's state or region. The paper should also include any related information of the game theme, such as history, famous inventor(s), or major milestones. Credit is given for creativity in linking game theme to appropriately related science/technology content. It is important to remember: proper use of grammar and composition throughout paper, citations of sources used to gather information, and staying within the two to five page limit.

Appendix – Members, Mentors, and Team Organization Charts

There is no specific guideline from BEST as to whether detailed information on the team members and/or the mentors and/or the team organization should be included in the notebook. Few, if any, judges will count off for including it, but not all judges will give credit.

Information about the team members could include:

- Grade in school
- Specific academic interests and/or honors
- Extra-curricular activities
- Number of years participating in BEST
- Areas of the BEST team where contributions were made

Information about the mentors in the appendix could include:

- Company they work for and what they do
- Describe connection to the team – why did they join
- Part of the team they mentored
- Quote on their favorite part of BEST

Appendix – Accomplishments and Decisions Log

This section is not required. However, if this information has been recorded, it may provide support to some of the sections describing the "Engineering Process."

Appendix – Electronics and Controls Layout

This section provides a detailed description of the electronics and controls of the robot. This can include a detailed diagram with some text that explains the various areas of the controls.

Appendix – Software Design

This section includes supporting detail for the software design and development.

Appendix – Robot Design Details and CAD Drawings

This section provides detailed descriptions of the robot design and showcases the team's use of CAD. The choice of what belongs in the main body of the report and what is supporting detail for the appendix is subjective. The main body section should be complete by itself, and information in the appendix should enhance the reader's understanding of the design.

Appendix – Trial Run Results

Each team should conduct trial runs including how it did at Practice Day. Some trial runs should be inclusive of all tasks in the competition and document scores from timed three-minute runs. However, trial runs can be conducted on individual tasks as well, especially if the team finds specific tasks unusually difficult.

Trial run results are best recorded and presented in charts, tables, and graphs. Remember, this section is a record of the test results only. A previous section in the main body of the report will summarize the results and the conclusions drawn from them.

Appendix – National Registry Proof

Teams that supply proof of the team members' registration (e.g. team roster with order numbers per team member) will receive 5 bonus points in the Engineering Notebook "Support Documentation" section. See the section on the National BEST Registry at the end of this document.

Project Notebook Score Sheet

Scoresheets are included in the team notebook and on the team flash drive or can be found at http://best.eng.auburn.edu/download.php?id=3608&folder=1156.

Marketing Presentation

For the marketing presentation, the team should view themselves as employees of a startup company that is marketing their "product" (robot) to a potential buyer (judges). This marketing team works closely with the engineering team that designed their specialized robot, so they can effectively communicate the benefits of its design. The marketing presentation should provide information about their company, the engineering team who designed and manufactured the product, and why it is the best one on the market that can complete the assigned task. The presentation should communicate the company's Brand Promise which establishes a shared understanding of the client's needs and the company's solution. Teams will be judged on how well they close the sale. The potential buyer will be assessing the following:

- The company's structure and quality of the presentation
    - Presenter introductions including name and role in the company
    - Company structure including number of employees and well-defined roles as employees and leaders
    - Organization of company departments
    - Company operations including methods of company decision-making
    - Company demographics and evidence of diversity of employees
    - Evidence of budget that includes sponsorships, expenditures, etc.
    - Professionalism, preparedness, and quality of the visual presentation
- The company's brand promise
    - Define the tangible benefit that makes a product or service desirable.
    - Explain how the design, manufacturing process, and use of technology relate to the brand and the benefit
    - Identify factors that differentiate your brand and product from the competition
- The company's marketing positioning
    - Outreach strategy, publicity efforts, tactics, and materials
    - Audience metrics (how many people you reached, it can include social media views)
    - School and community involvement
    - Other promotional efforts
- Closing the sale
    - Ask for the sale

- Effectively negotiate and confirm next steps
- Have a designated point person and a clear process for follow up
- Be engaged in discussion and be well prepared for questions.

One of the side objectives of the Marketing presentation is for the students to demonstrate they were the primary designers and builders of the robot. This presentation should not include the same level of detail as the notebook contains, but it should include enough information about the design and construction of the robot that the judges can clearly see the students were the primary designers and builders.

Marketing Presentation Score Sheet

Scoresheets are included in the team notebook and on the team flash drive or can be found at http://best.eng.auburn.edu/download.php?id=3610&folder=1156.

Team Exhibit & Interviews

Each team will construct an exhibit to create a brand experience that showcases their company and product and illustrates how their brand engages with the community. The exhibits' visual elements should tell the story about their brand, about their community, and how the BEST program bolsters their interest in STEM majors and careers.

Judges will visit the exhibit and interview the student team members to evaluate how well they:

- Demonstrate outreach efforts including what audiences were reached, how they were engaged, and what resources were used to do so
    - Presentations and robot demonstrations to other schools and community groups
    - Publicity (print materials, media/press) generated within the school and within the community about BEST
    - Use of technology, display models or boards, or multi-media at exhibit in promotion of BEST
- Present data on the frequency and reach of the outreach activities
- Engaged their audiences and what resources they used
- Recognize their sponsors
- Communicate their brand
- Used the national BEST Robotics logo in all media
- Used their exhibit space to balance their display of the team's outreach as BEST Robotics, of the team's brand, and of their product
- Showed creativity in incorporating game theme into design and presentation of this exhibit

During the interviews, students must be able to:

- Effectively communicate the company brand and the benefits of their product.

- Show their enthusiasm, and articulate their learning experience and understanding of the game theme
- Demonstrate evidence that students were the primary designers and builders of the robot
- Show how your team shared information and/or technology with other teams
- Show how your team mentored another BEST team
- Provide information on fund raising and/or sponsorship efforts
    - Strategies used to recruit sponsors
    - Team fund raisers
    - Description of how funds were allocated to support team
    - Team budget information available for review

Team Exhibit & Interview Score Sheet

Scoresheets are included in the team notebook and on the team flash drive or can be found at http://best.eng.auburn.edu/download.php?id=3613&folder=1156.

Spirit and Sportsmanship

The judges will observe the spirit promoted by the team during the competition rounds as well as the team's conduct throughout the day in the seating area, team exhibit area, game floor, and pit area.

Teams will be evaluated on the following:

- Spirit includes the vigor and enthusiasm displayed by team representatives
- Teams can use posters, props, t-shirts, cheerleaders, musicians, mascots, costumes, and lower-frequency noise-makers to increase the level of spirit (check with local hub to determine specific noise-maker restrictions)
- Community involvement: number of team supporters present at competition (other than students)
- Sportsmanship includes outward displays of sportsmanship (e.g., helping other teams in need), grace in winning and losing, and conduct and attitude considered befitting participation in sports
- Overall team sportsmanship is also demonstrated by students (not mentors) making the majority of robot adjustments and repairs during the competition

Spirit and Sportsmanship Score Sheet

Scoresheets are included in the team notebook and on the team flash drive or can be found at http://best.eng.auburn.edu/download.php?id=3612&folder=1156.

Founders Award for Creative Design

Awarded to the team that makes best use of the Engineering design process in developing the offensive and defensive capabilities in robot design. This award is in recognition of BEST founders Steve Marum and Ted Mahler.

The judge's score sheet will have the following categories:

- Unique design – 30 points
- Effective Offensive Strategy – 20 points
- Effective Defensive Strategy – 20 points
- Obvious use of the Engineering design process – 30 points

Founder's Award Score Sheet

Scoresheets are included in the team notebook and on the team flash drive or can be found at http://best.eng.auburn.edu/download.php?id=3609&folder=1156.

Most Robust Robot Award

Awarded to the team whose robot requires the least maintenance during & between matches and is generally the sturdiest machine in the competition.

The judge's score sheet will have the following categories:

- Few breakdowns during games – 25 points
- Few repairs needed during competition – 25 points
- Sturdiness – 25 points
- Robot can extract itself from most situations during play – 25 points

Most Robust Robot Award Score Sheet

Scoresheets are included in the team notebook and on the team flash drive or can be found at http://best.eng.auburn.edu/download.php?id=3611&folder=1156.

Team Demographics Sheet

As a non-profit organization, BEST Robotics relies completely on financial support from industry and academic institutions. Companies and universities who support BEST Robotics are very interested in how many students are impacted by the program, and how they are impacted. In particular, they want to know how many students become interested in STEM programs in college and in STEM careers. In order to provide this information to our sponsors, we collect these data directly from our teams. A copy of the team demographics form can be found in the team handbook and on the team thumb drive. It must be filled out and submitted to the Music City website (https://cps-vo.org/group/MCBEST/demographics) no later than the Tuesday prior to Game Day.

National BEST Registry

New in 2018, BEST, Inc. added the requirement that all team members (students, teachers, mentors) individually register in the BEST National Registry **prior to competing on Game Day** . Registration is at http://bestnationalregistry.eventbrite.com. Team members will need their hub name and assigned team number in order to register. BEST will never sell or share your information with other organizations.