Robot Design Judging Primer

Robot Design judging in FLL can be compared to an engineering design review in the "real world". Design teams present their robots to panels tasked with selecting the robots that best meet the requirements (completion of missions) given constraints like size, parts usage and software. The natural inclination for engineers and technical people is to say, "There is an easy test to see which robots are best – the competition!" However, in FLL, and often in the "real world", decisions are made based on how well a team can explain their design and all the things they considered while developing it. The FLL Robot Design rubric represents a set of criteria that we feel are important "takeaways" from participating in the design of an FLL competition robot. They are analogous to evaluation criteria used when selecting between competing designs. Judges gather information about teams' mechanical design, programming and overall design process to evaluate a team and its robot.

As a judge, here are some overall things to consider:

- The Robot Design judging session is more about the team's ability to present the robot and all the thoughts and considerations that went into their final product than it is about its performance. The performance is covered under the Robot Performance Award. The judging session is the time for the judges to learn from the teams the design processes they used to make decisions and gain understanding; it also allows discussion so that judges can be sure that the teams did the work.
- You may ask teams to perform missions with their robot on the judging table. Give teams the benefit of the doubt should these missions not work successfully all the time. Judging tables and field setup kits are not usually built or maintained to the same standards as competition ones. There is also a tendency for Murphy's Law to rule in these sessions and for teams to be nervous and mistake prone when running missions in a judging setting.
- Teams may bring additional prototypes of their robot or attachments into a judging session. Sometimes these prototypes utilize additional electrical parts beyond those allowable in competition. Remember that electrical parts and software rules apply only to the robot used in the competition itself, and that extra parts or software used by teams to demonstrate designs are perfectly allowable.
- Simpler is usually better. Don't be overly impressed with complicated robots. The complication must be used for a purpose.
- Remember that this is an engineering challenge for autonomous robots. Small imperfections in the field, mission models and environmental variations must be considered by Accomplished and Exemplary teams.

Mechanical Design

Durability – The robot should be able to withstand the rigors of the competition, for example it should be able to contact walls or missions models without pieces falling off or breaking. Attachments should be similarly robust. Long arms that delicately grip a lever aren't very effective if they don't stay attached to the robot.

Mechanical Efficiency – Here the judges are looking for robot structures and attachments which show a judicious use of parts. For example, using six pins to tie two beams together is not as efficient as using one at each end. One note here: don't over penalize the teams for adding small bits of "flair" or pieces that are fun for them to use to express their creativity. Remember the Core Value "We have fun!"

Mechanization – Judges look here for how the robot moves and operates. They look to see whether the robot balances speed and power.

Programming

Just as with Mechanical Design, simplicity is desired when it comes to programs. Teams can develop amazing programs that aren't necessarily better than simple programs that perform the same purpose.

Programming Quality – The robot's programs should work consistently, producing the same results every time. Examples of quality code could include audible checks or a simplified menu system that teams use to make sure they are running the appropriate section of code for a particular mission. Be careful to attempt to assess how the robot's programs would operate independent of mechanical faults.

Programming Efficiency – The goal here is to encourage teams to develop code that is modular, portable and flexible, so that it can be used in multiple situations. This criterion also addresses readability and documentation of code, both of which are good programming practices.

Automation/Navigation – Autonomy in FLL means that the robot operates with minimal driver intervention. Retrieving a robot and taking a touch penalty may be part of an acceptable strategy for a team, but it is still driver intervention. So for this instance, a team might have an Accomplished Mission Strategy, but only score Developing for Automation. This criterion also doesn't distinguish between sensor use/feedback and mechanical feedback. For example, it is valid for a team to use an aligning jig in base followed by a robot using the wall or a mission model to align itself before activating an attachment. It is also just as valid for a team to use a light sensor to follow a line to the same mission model. Teams should try to avoid just using driver aiming, motor rotations and timing to navigate the field, as these methods often become unreliable under variations in field or environmental conditions. Remember that lack of sensors isn't necessarily a bad thing. Lack of Automation, however, should be considered.

Strategy & Innovation

Remember that Strategy and Innovation can be seen in Mechanical Design or Programming, as well as the integration of both.

Design Process – Accomplished teams move beyond a trial and error approach to robot improvements to utilize testing cycles where systematic processes are used. Frequently you will hear teams say, "We tried a lot of different things and this one was the best." You are looking for more details and more organization to their process than that for teams who are Accomplished or Exemplary.

Mission Strategy – This is fairly straightforward. Judges can ask teams, "What is your strategy to complete the missions?" and "How did you make decisions to support that strategy when designing your robot?"

Innovation – This is often a hard area for judges to judge. Things to be on the lookout for here include creativity, uniqueness, a cool attachment or programming trick, or something similar. Most competitions will have one or more robots that will have some feature that captures the judges' attention. Remember that Innovation implies added benefit, so make sure that the team can state the benefits of their cool feature.