

Strategic Design

FRC1114 – Simbotics
Karthik Kanagasabapathy
October 8th, 2014



Karthik Kanagasabapathy

- 17 years of *FIRST* experience
- Lead Mentor for Team 1114, 2004-present
 - 23 Regional Championships
 - 2008 World Champions, 2010 & 2014 World Finalists
 - 2012 Championship Chairman's Award
- 2005 Waterloo Regional Woodie Flowers Finalist Award
- TEDx Speaker - <http://youtu.be/MfC3JdkEVgQ>
- Regional Manager, Innovation First International, Canada
- Chairman of the VEX Robotics Game Design Committees



Outline

- Strategic Design
 - Game Analysis
 - Golden Rules
 - Trade Offs



Some Quotes

- *"Enthusiasm is one of the most powerful engines of success. When you do a thing, do it with all your might. Put your whole soul into it. Stamp it with your own personality. Be active, be energetic, be enthusiastic and faithful and you will accomplish your object. Nothing great was ever achieved without enthusiasm" -- R.W. Emerson*
- *"Gentlemen, we are going to relentlessly chase perfection, knowing full well we will not catch it, because nothing is perfect. But we are going to relentlessly chase it, because in the process we will catch excellence. I am not remotely interested in just being good." -- V. Lombardi*
- *"What lies before us and what lies behind us are small matters compared to what lies within us. And when we bring what is within out into the world, miracles happen" -- R.W. Emerson*
- *"Limits, like fears, are often just an illusion" – M. Jordan*



Strategic Design

- Designing and building a cool robot is a lot of fun
 - Designing and building a cool robot that does well in competition is even more fun
- Very hard to go through the build process without a concrete aim
 - The clear choice is success in competition
 - Lots of other (secondary) objectives: aesthetics, design elegance, coolness factor, etc.
- Beware of the “cool factor”
 - It can be fun, but sacrificing effectiveness hurts your partners



Game Analysis

- Read the rules!
- Examine every possible way to score points, no matter how obscure
 - Laps (2008), Hanging off the bridge...? (2012), Full Court Shooting (2013), pass through assists (2014)
- Examine every possible way to prevent your opponents from scoring
 - Capping robots (2004), Giant Walls (2013)
- Understand the ranking system
 - e.g. Win-loss-tie, loser's score, own score plus double the loser's score, Coop bridge...
- Consider possible strategies
 - Leads into overall robot designs



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Chokehold Strategies

- A strategy which, when executed, guarantees victory, independent of any action by your opponents
- Determining if one exists should be the first step in game analysis
- *FIRST* tries to design games with no reasonable chokehold strategy
- If one exists, it will be very difficult to perform
 - Pulling three goals - Team 71, Beatty & Hammond (2002), Deflecting Balls? (2010)
 - 133, 134 (2011) – Why are these numbers relevant?
- Try to find one single, finite task that overwhelms all other possible ways of scoring



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Cost-Benefit Analysis

- For each task you must compare the difficulty of accomplishment to the reward for doing so
 - Balancing easier than scoring (2012)
 - Floor pickup versus Hanging (2013)
 - This is where the strategic value vs. coolness factor decision often pops up
 - Vision tetra vs. hanging tetras...
- The best tasks to perform are those which are relatively easy, yet provide big points
- Remember denying your opponents 10 points is just as good as scoring 10 points (at least in terms of win/loss)
 - Descoring/defending often much easier than scoring (2003, 2013)



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Priority Lists

- Two separate lists
 - Desired robot qualities
 - Things like speed, power, agility, centre of gravity
 - Desired robot functionality
 - The things you want your robot to be able to do
 - Shoot balls, climb bridges, traverse field
- At this point you can merge the two lists, and decide on a drive system and functionalities
- This list determines all direction of design for the season



Simplicity & The Golden Rules

- Golden Rule #1: Always build within your team's limits
 - Evaluate your abilities and resources honestly and realistically
 - Limits are defined by manpower, budget, experience
 - Avoid building unnecessarily complex functions
 - On the other hand, as you get more experienced, start cautiously pushing a few boundaries
- Golden Rule #2: If a team has 30 units of robot and functions have maximum of 10 units, better to have 3 functions at 10/10 instead of 5 at 6/10



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Tradeoffs

- The key to deciding upon a design is to evaluate the tradeoffs
 - e.g. Speed vs. Power, Complexity vs. Durability, Shooting vs. Balancing (High CoG vs. Low CoG), Wide vs. Long
- Making the right choices based on your analysis will determine the fate of your season
 - Make sure tradeoffs are consistent (hard to do when the design is always changing!)
- Remember the Golden Rules – Teams who try to do more than they're capable of tend to fail
 - There's no shame in building a simple robot!



Tradeoffs

- Try to maximize functionality with simple additions or modifications to mechanisms
 - Shoot out of a claw, instead of a claw loading a shooter (Team 1114, 2008)
 - Drivetrain as power for winch (Teams 60 & 254, 2004, 254 & 1114, 2010)
 - Intake used for bridge manipulation
 - Be careful – hard to change one part without affecting the other
- When making tradeoffs, remember your initial priorities!
 - Let your strategic priorities dictate design



Other Strategic Design Tips

- This strategic analysis is a **MUST**
 - There's a tendency to skip this stage, and to head straight into design and implementation
- You must know what you want to do before you can figure out how to do it
- Be realistic when evaluating strategies
 - How many discs were teams scoring in 2013?
 - Did anyone stack and win in 2003?
- Remember, you have partners. It's okay do depend on them for certain tasks. (How much you leave to them should be decided by the Golden Rules)
 - However, be careful not to leave too much in your partners' hands



Other Strategic Design Tips

- Try to identify the different types of robots that will exist
- Go through the different permutations of alliances
 - e.g. How would we do paired with type 'X', against type 'Y' and type 'Z'
 - What would we do if we had to play ourselves?



Final Comments

- Read the rules!
- Come up with a clear, consistent strategy for how your robot will play the game
- Remember the Golden Rules
- Always circle back to your priority list
- Never underestimate the power of simplicity
- Have fun!



Resources

- www.facebook.com/frc1114
- Twitter: @frc1114
- YouTube.com/Simbotics
- www.simbotics.org
- Contact
 - Email: karthik@simbotics.org
 - Twitter: @kkanagas
 - Facebook: /karthik.kanagasabapathy

