Design
Where to start?

FRC Team 1640

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Understand the Problem

- Start with articulating the problem that needs to be solved

- Keep potential solutions out of the problem statement

- Quantify (e.g. scoring model)

- Examine scenarios

- Simulate the problem (game)

- Identify issues

- For FRC: understand how the game will be played and important factors for winning – from week 1 to Einstein as the game evolves

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How do you picture the game?
How do you know what will be critical?

- Look at past FRC games for similar situations
  - For example, there were a lot of similarities between the 2017 and 2013 games, especially in terms of traffic flow
  - But the 2006 game (Aim High) provided useful ideas towards managing balls
  - You may use different aspects from several old games
- Set up field and run Student-bot simulations
- Look carefully at scoring modes
  - Are some capped?
  - What's not capped?
  - What can set you apart on a competitive field?

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Brainstorm Solution

- Focus on <u>what</u>, not <u>how</u>
- Phase 1 – Get all ideas out without critique
  - 6-3-5 Brainwriting is a formal method to generate a large number of ideas quickly
  - 6 participants; 3 ideas; 5 minutes
- Phase 2 – Sleep on it
- Phase 3 – Collect any additional ideas
- Phase 4 – Collate and critique – narrow down
- Effective brainstorming requires well-informed participants

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Select and Prioritize Goals

- This effectively sets Strategy

- What goals are necessary?

- What goals are discretionary?

- Are some goals deferable?

- Quantify!

- The things you decide not to pursue are at least as important as the Goals you set

- Be realistic concerning your capabilities

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Set Specifications

- Qualitatively and quantitatively sets the performance targets for each Goal

- Specification need to support the Goals

- Attributes like reliability and serviceability are important and need specifications

- Allocations for mass and cost can be made here

For Each Goal, Brainstorm Approaches

- Smaller teams

- Now the focus is on <u>how</u>

- Like skinning cats, there will generally be more than one way to accomplish a Goal

- Research how other teams have met similar Goals in past seasons

- Research beyond the boundaries of FIRST engineering

- Same brainstorming approach as before: First go wide; break; then narrow

- Should end up with a short list of viable approaches

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Identify Gaps in potential Approaches

- Knowledge gaps
  - Areas in which it is unknown whether the potential approach will meet the required performance; or
  - Areas in which the design cannot proceed without further information
  - Areas in which an approach may be contraindicated by a game or robot rule

- Performance gaps
  - Areas in which the known performance of an approach will not meet the requirements without further development

- Manufacturing gaps
  - Areas where the team does not have the capabilities to either design or manufacture the systems required for an approach

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Close Gaps or Abandon Approaches

- Through modeling or calculation
- Prototype and test – may be iterative
- Further research

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Select approach for each Goal

Design

FIRST constraints

- Robot and Game rules must be followed
- The robot is limited in mass (120 lb_m w/out battery & bumpers)
- The cost of parts and materials are limited ($4,000 total; $400 max per item)
- Perimeter rules apply (and change)
- Bumper rules apply (and change)
- Motors and many Electronic/Control parts are prescribed
- Fabricated parts cannot be reused
- Designs and software cannot be reused unless published

Practical constraints

- Robot on cart should fit through standard doors
- Handholds need to be available for safe lifting
- Robot should fit in trailer without significant disassembly

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