2025 NM FTC KICKOFF

FIRST TECH CHALLENGE | FIRST AGE presented by Qualcomm

Design Strategy and Material Sourcing

Presented by FIRST Alumni
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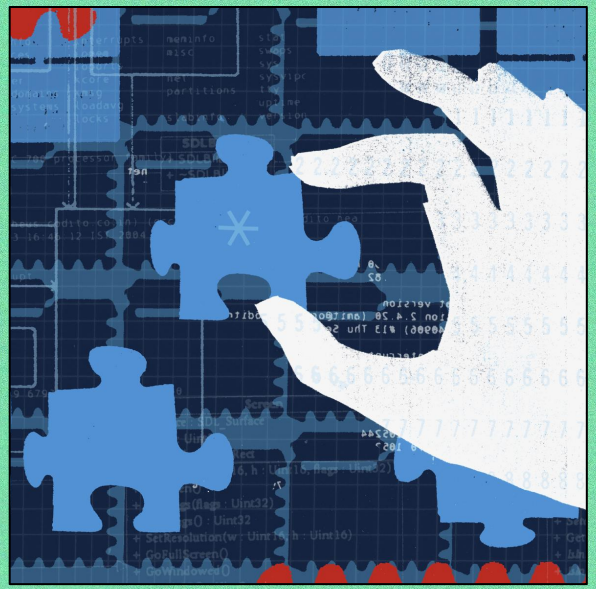
Introduction to Design Strategy

To design an effective robot, you must know the game inside out.

- **Know the Rules:** Reading the competition manual thoroughly, and rewatching the release video are good ways to dissect the game.
- **Know the Ways to Score:** Document ALL scoring, penalties, and ranking rules, and make sure to capture the obvious and obscure scoring opportunities.
- **Cost-Benefit Prioritization:** Weighing the difficulties vs the rewards for each task help narrow down designs.
- **Needs vs Wants:** Needs are must have features to be competitive. Wants are goals to achieve later if you have the time and resources.



Subsystem Roles

Almost all FTC games involve these subsystems in some way.

- **Drivetrain:** The wheels and chassis, also the framework of the robot.
- **Intake:** The subsystem that acquires the game elements.
- **Lift Mechanism:** The subsystem that transfers scoring positions.
- **Scoring Mechanism:** The subsystem that manipulates, and scores game elements.
- **Endgame Mechanism:** The subsystem that helps score endgame points.

More Thoughts from Our Experience as FTC Alumni

- **Practice Makes Perfect:** Practice means:
  - Drivers become familiar with the controls.
  - Programmers can tweak the code.
  - Learn where the robot will break!
- **Consistency is Key:** A simple robot that is fine-tuned to do one thing with hours of practice is better than a complex bot you don't know how to control!
- **Our favorite lift mechanism:** We absolutely love the Misumi drawer slides. They are compact, reliable, and smooth. To the right is a QR code link to buy them!

Introduction to Materials Sourcing

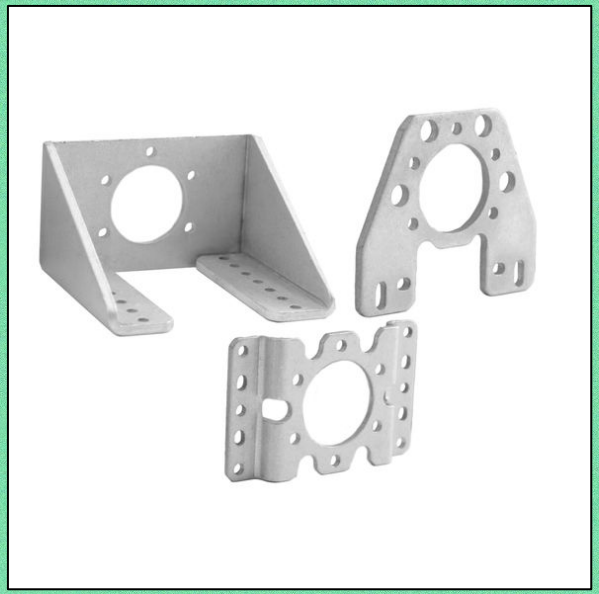
Materials sourcing is a critical aspect of the FIRST Tech Challenge.

- **Impact on Performance:** The quality and availability of materials directly affect robot performance.
- **Budget Considerations:** Effective sourcing helps teams stay within budget.
- **Sourcing Strategies:** Explore various options such as local suppliers, online marketplaces, and donations- Try and get a supplier to be your sponsor!

Understanding Basics of Material Types

Different materials have different properties that make them suitable for specific applications.

- **Metal:** Strong and durable, ideal for structural components. Examples: Aluminum, Steel.
- **Plastic:** Lightweight and versatile, suitable for non-structural parts. Examples: Polycarbonate, Acrylic, PLA, PETG.
- **Wood:** Easy to work with, often used for prototyping and temporary structures. Examples: Plywood, Balsa.
- **Carbon Fiber:** Extremely strong and lightweight, ideal for components that are stressed.

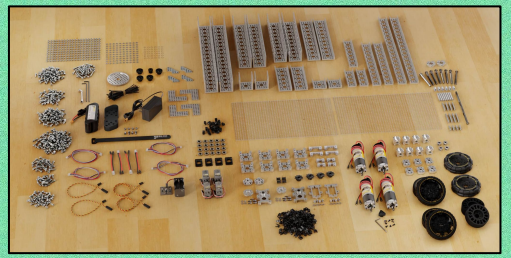


Sourcing Materials: Where to Start

Finding the right materials requires research and planning.

- **Local Suppliers:** Hardware stores, metal suppliers, and electronics shops.
- **Online Marketplaces:** McMaster-Carr, Amazon, and eBay offer a wide range of materials.
- **Recycling Options:** Reuse materials from discarded electronics or other sources.
- **FIRST Partners:** Check for sponsorship or discount opportunities from FIRST partners.
- **Community Vendors:** Axon, Swyft, Optii are all FIRST specific vendors that specialize in certain products.
- **Considerations:** Evaluate material availability, cost, and lead time.

Vendors:



General Parts

- Andymark — Field supplier, also sells drivetrains, wheels, and hardware.
- goBILDA — Modular build system for structure, motion, and drivetrains.
- Grainger — Industrial supplier for tools, fasteners, and components.
- McMaster-Carr — Broad supplier of fasteners, raw materials, and specialty hardware.
- REV Robotics — Provides control system, motors, sensors, and structural parts.
- ServoCity — Actobotics parts, servos, gearboxes, and mechanical hardware.

Specific Parts

- Axon Robotics — High-performance servos with encoders.
- BWTLink — Student-run vendor with competition parts.
- Melonbotics — Electronics, servo accessories, and wiring.
- MiSUMi — Linear slides, extrusion, and precision hardware.
- Monsterbolts — Metric and imperial fasteners.
- Optii — Odometry kits and tracking hardware.
- Swyft — Speciality gearboxes, slides, and servos.

Machining Companies

- CNCMadness — *Custom CNC brackets, plates, and drivetrain parts.*
- Fabworks — *Laser-cut metal and plastic parts.*
- Oshcut — *Sheet metal cutting and bending.*
- SendCutSend — *Fast, affordable laser and waterjet cutting.*
- Xometry — *Large-scale fabrication and raw materials.*

Source: FTC Discord

Resources:

General Resources

Game Manual 0 — *The most comprehensive guide to FTC.*
Official FTC Resources — *Official FTC resources from FIRST*
FTC Discord — *Where the global FTC Community connects*

Design Resources

Fastener Guide — *A simple, detailed guide to fasteners.*
Fusion 360 Parts Library — *An FTC part library for Fusion 360 users.*
FTC Rendering in Fusion 360 — *Guide to rendering FTC robots in Fusion 360.*
Gear Efficiency Comparison — *Compares the efficiency of different gears.*
Mechatronics — *Principles, design, and analysis of complex electro-mechanical systems.*
Onshape Resources For Robotics — *Helpful information for using Onshape.*
Onshape Utilities — *A compilation of utilities for OnShape.*
Rotation and Gear Guide — *Learn about rotation, torque, and gears.*
Vex Motor Testing Data — *Accurate specifications for many different motors.*

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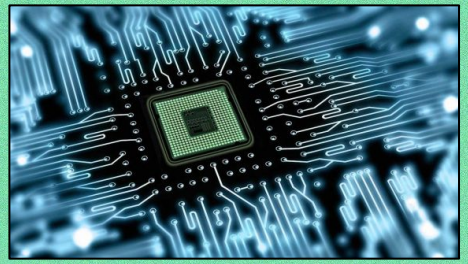
Source: FTC Discord

Resources:

Programming Resources

The Cookbook — *An amazing general programming resource.*
Controls Engineering in FRC — *Graduate-level control theory for high schoolers.*
FTC Dashboard — *A dashboard that allows for live graphing/modifying of variables.*
FTCLib — *A general purpose command-based library for FTC, inspired by WPILib.*
Learn Java For FTC — *An introduction to programming FTC robots in Java.*
Pedro Pathing — *An advanced path following and generation library.*
Road Runner — *A library for planning 2D mobile robot paths/trajectories for FTC.*
Also see here for documentation.



Source: FTC Discord

Engaging with Local Makerspaces

Makerspaces offer valuable resources for FIRST Tech Challenge teams.

- **Access to Tools:** Use advanced equipment that may not be available to the team.
- **Mentorship:** Learn from experienced makers and engineers.
- **Community:** Connect with other robotics enthusiasts.
- **Material Sourcing:** Some makerspaces offer access to materials at discounted prices.
- **Partnerships:** Explore potential collaborations with makerspaces for project support.

Cost-Effective Sourcing Strategies

Budget-conscious teams can find quality materials without breaking the bank.

- **Bulk Purchases:** Buy materials in bulk to save money.
- **Donations:** Seek donations from local businesses or community members.
- **Sponsorships:** Approach companies for financial or in-kind sponsorships.
- **Material Optimization:** Design with readily available and affordable materials in mind.
- **Repurposing:** Use old discarded materials for robot components.

Building a Bill of Materials (BOM)

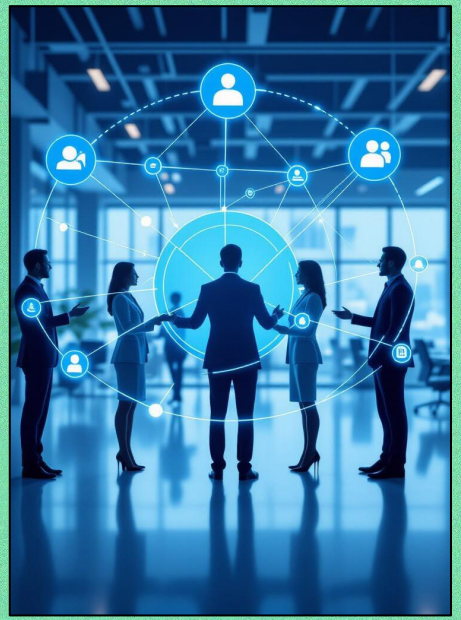
A good BOM helps teams track resources and plan efficiently.

- **Tracking:** Record all materials purchased, donated, or reused.
- **Organization:** Store materials in a systematic way for easy access.
- **Digital Tools:** Use spreadsheets or inventory management software.
- **Benefits:** Reduce waste, and improve project planning.

Team Collaboration in Material Sourcing

Teamwork is essential for effective materials sourcing.

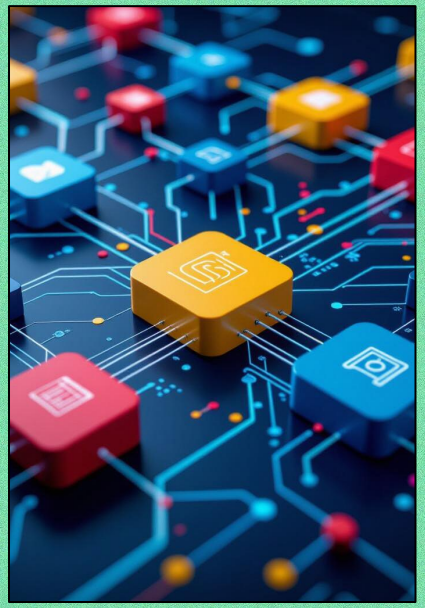
- **Divide and Conquer:** Assign team members to research different suppliers.
- **Leverage Networks:** Tap into team members' contacts for potential donations or sponsorships.
- **Communication:** Share information and updates regularly.
- **Decision-Making:** Collaborate on material selection and sourcing strategies.
- **Documentation:** Keep a record of all sourcing activities and decisions.



Experiential Learning through Sourcing Materials

Materials sourcing is a valuable learning experience. It teaches:

- **Problem-Solving:** Overcome challenges related to material availability and cost.
- **Critical Thinking:** Evaluate different material options and make informed decisions.
- **Engineering Design:** Understand the relationship between materials and robot performance.
- **Financial Literacy:** Manage budgets and track expenses.
- **Real-World Skills:** Develop even more skills that are applicable in various fields.



Tools for Managing Sourcing Efforts

Digital tools can streamline materials sourcing.

- **Spreadsheets:** Examples: Excel, Google Sheets
- **Communication apps:** Examples: Slack, Teams, Discord

Other Examples: Trello, Asana.

Conclusion: The Impact of Effective Sourcing

Effective materials sourcing is critical for success in the FIRST Tech Challenge.

- **Performance:** High-quality materials contribute to a reliable and competitive robot.
- **Budget:** Cost-effective sourcing helps teams stay within budget.
- **Teamwork:** Collaborative sourcing strengthens team bonds.
- **Learning:** The process provides valuable learning opportunities.

Effective sourcing empowers teams to achieve their goals.

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Q&A Session and Discussion

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