UMASS University of Massachusetts Lowell

MILL CITY MOTORS

2016 UMass Lowell
Mill City Motors Formula SAE

Mission Statement

Mill City Motors is an organization of motivated engineering students who have a passion for cars and engineering. For many members, it has been a lifelong dream to build and drive racecars, but as undergraduate students they have never had the opportunity. Others may simply want to experience what it is like to work in industry and to further their engineering education outside of the classroom. Our unified goal is to design and build an exhilarating yet user-friendly racecar at reasonable cost. Mill City Motors aims to design a car that meets these criteria while addressing the needs of a serious motorsports hobbyist, and hopes to lay the groundwork for future FSAE teams at UMass Lowell.

What is Formula SAE?

Formula SAE® (FSAE) is an annual automotive design competition sanctioned by the Society of Automotive Engineers (SAE). This all-encompassing competition challenges students to budget, design, build, test, and race a formula-style racecar. Students must organize all of their team's efforts— direct faculty involvement is expressly forbidden. The competition provides students the rare opportunity to learn practical design and gain real-world manufacturing experience. Coming away with a victory at this event carries a considerable amount of prestige due to the blood, sweat, and tears that go into designing a racecar from scratch.

Competition and Events Information

Formula SAE's underlying premise is that there is a strong, unexplored demand in the automotive market for an affordable open-wheel racecar. The typical buyer of this car is a non-professional, weekend autocross racer competing in SCCA-type events. All cars must have excellent acceleration, braking, and handling characteristics while maintaining low cost, reliability, and maintainability. The teams must then align their business strategy to their designs to maximize their car's marketability, which is evaluated by industry experts and given a score. All entrants to the Formula SAE or Formula SAE—Lincoln competitions are further tested in various static and dynamic events, as well as the highly prestigious design competition. Dynamic events include a 13.66 mile endurance race, a technical autocross event, a drag race, and a lateral acceleration skidpad test. Other scored events include fuel efficiency, cost analysis, and a presentation. The final product is ideally a small, affordable F1 car that can easily out-handle and outpace all but the most performance-oriented sports cars on the track.

UMass Lowell's FSAE Design History

Components	2008 Car	2009 Car	2012 Car Proposed	2016 Car
0-60 MPH (est.)	Under 5.9 seconds	Under 5.3 seconds	Under 5.6 seconds	Under 5.2 seconds
Weight (est.)	600 lbs.	450 lbs.	525 lbs.	410 lbs
Horsepower (est.)	65 hp	86 hp	45+30hp (electric motor)	95 hp
Engine	Honda CBR 600 F3	Honda CBR 600 F4i	Honda CR250F + Agni 95 Electric motor	Honda CBR 600RR
Body	Fiberglass	Carbon Fiber Composite	Stressed skin	Ultra lightweight aluminum shell
Suspension	Short-Long Arm (SLA) independent pushrod activated suspension. Fox Racing Shocks/Springs	Short-Long Arm (SLA) independent pullrod activated suspension	Short-Long Arm (SLA) independent pushrod activated suspension	Short-Long Arm (SLA) independent pushrod activated suspension
Drivetrain	Chain driven Zexel-Torsen Differential	Chain driven Zexel-Torsen Differential	Chain driven Zexel-Torsen Differential	Chain driven Zexel-Torsen Differential

After the initial design in 2008, the 2009 UML FSAE Team (then, Riverhawk Racing) reconvened to optimize their design for performance. Massive weight reduction was achieved, and the team committed to using advanced composites since their overall design was largely established. For 2012, several team members organized their Capstone around tailoring the car specifically for simplicity and manufacturability. By entering into the Hybrid competition, the graduating seniors could gently transition into the more complicated competition and simultaneously pass on their own knowledge to future teams.

For 2016, a complete restructuring of the team was accompanied by a thorough reassessment of the existing designs. The entire chronology of UMass Lowell's Formula SAE designs and competition results was examined and then analyzed in a series of research tasks. This helped to establish a final vision for the car and to develop a design methodology.

2016 Design Methodology

Simplicity: the team quickly established that complexity should only be added where absolutely required. This forces the team to seek innovative solutions that will be easy to adjust during the testing phase, and to reduce the amount of time required to transition from 'concept' to 'reality'.

Manufacturability: this idea is born straight from the synthesis of 'simplicity' and an analysis of the design goal specified by FSAE. Any weekend warrior would be more apt to replace a part themselves than to send their car to the factory for three weeks under warranty. The more accessible our design is, the more appealing it will be to the target audience.

Driveability: the performance of a car is limited only by its driver. By appealing directly to the visceral feel of driving a high-performance racing machine, Mill City Motors' car becomes not only more enjoyable to drive but more responsive on the track—allowing the driver to push their limits.

Synergy: the ultimate goal of a track car is how well the subsystems work together as a whole. At Mill City Motors, design choices are made by the team—as a team. By emphasizing intra-team communication during the design process and establishing cross-functional groups within the design teams, the car's flaws will be well-known and minimized before it hits the track.

Using the manufacturing-friendly 2012 car's designs as a base, Mill City Motors sought to again optimize the car's design for performance. This design would be a synthesis of the past three iterations that would utilize specific aspects of each of the cars to generate a balance between raw performance, cost, and simplicity. Previous design work was heavily used for initial research and for general design choices, and then advanced analytical techniques were applied to the designs to yield the most performance possible in a real-world application.

The team further enhanced the effective performance of the car by focusing on the user-experience. In additional to using more robust suspension analysis that accounts for frictional factors, the suspension data was then correlated to driver feedback. Linearity of suspension responses were desirable because this equates to predictability. One key realization was that a more forgiving car can perform better than a much higher performance car in an amateur's hands. The ergonomics were also made to be modular, with a much more highly configurable pedal set-up and custom formed seat inserts for each individual driver. Market research was conducted with several autocross clubs to determine what adjustable settings the target audience desired.

The team decided to utilize the CBR600RR engine because despite the slightly higher initial cost. The rotational mass in the engine was decreased, yielding a more aggressive powerband. The engine could be supplemented with directly compatible and inexpensive CBR600 F4i parts. Numerical modelling was used to develop custom intake and exhaust piping to meet our non-OEM application.

Sponsorship Tiers

Tiers / Rewards	Thank you letter	Framed Photo	Website/Events	Decal	T-shirts	Team Dinner	Competition Invitation	Test Drive
Title ($10,000+)	✓	✓	✓	Primary	7	7 tickets	7 tickets	✓
Platinum ($5,000-$9,000)	✓	✓	✓	Secondary	5	5 tickets		
Gold ($1,500 - $4,999)	✓	✓	✓	Accents	3			
Silver ($1,000 - $1,499)	✓	✓	✓	Quarter Panels				
Contributor ($100 - $999)	✓	✓						

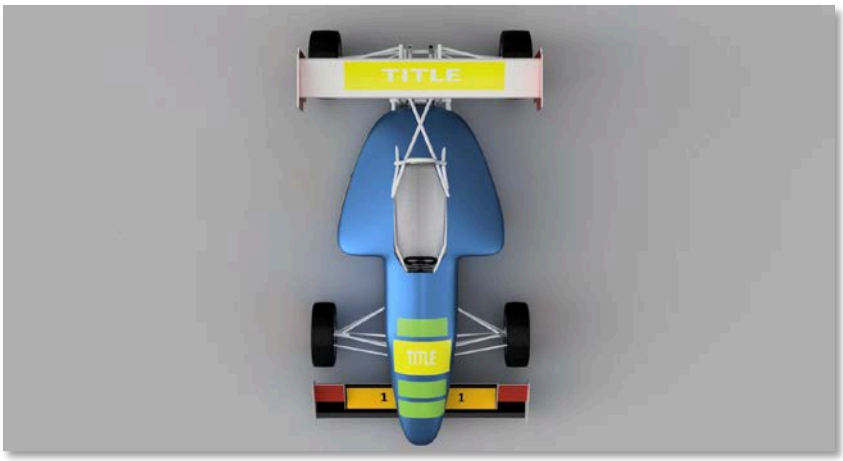
All donors will receive a personalized letter of thanks from the Mill City Motors team. Sponsors at the Bronze level and above will receive recognition on the official team website, on a sponsor board at the event, and a framed photograph of the team with the completed car.

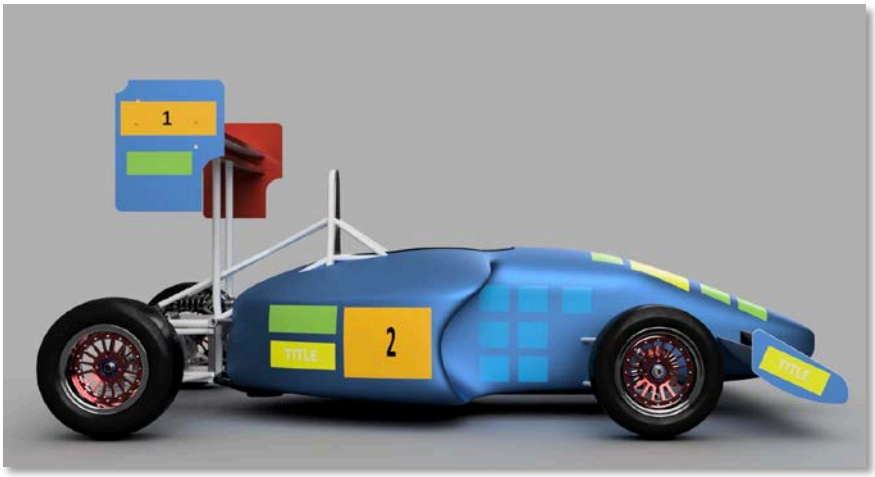
Sponsorship decal slots are ranked by size, relative visibility to spectators, and degree of presentation in the car's race livery. These decal slots are then sorted into 'decal packages' that represent an even distribution of a single company's logo around the car at that corresponding tier. In this way, brand exposure can be maximized while still maintaining a fairly tiered hierarchy.

Donation amounts at or above the Silver tier qualify the sponsor company for logo placement on the car's body, and donations at or above Gold will benefit from multiple decals in prime locations on the car. **Note that donations are not relegated to cash or checks, but can be in the form of equivalent parts or labor.** Sponsors will be given choice of their decal package on a first come, first serve basis as donations are finalized. **Only one "Title" sponsor will be chosen for the year.** All sponsors will receive updates on the progress of the car, as well as an invitation to an open house where team members will be available to talk and the car will be on display.

The mock-up of the final car on the following page demonstrates possible decal allocations, color-coded according to sponsorship tier.

Mock-up Sponsor Decal Placement





Partnership

How we can help you:

Tax Deductions: Any financial contributions (as well as parts supplied to the team of equivalent value) are acknowledged as donations that are **tax deductible** under current federal and state regulations. Mill City Motors will issue the sponsoring company a tax receipt form through the University of Massachusetts Lowell so that they can claim the donation on their taxes. Note that the value of any gifts (t-shirts, dinner tickets, etc.) must be subtracted from the donation under Massachusetts law.

By partnering with Mill City Motors, sponsors are helping young professionals expand their education, gain invaluable practical experience in project management and engineering, and gain a foothold in the field of automotive engineering. Organizations that partner with Mill City Motors seize the unique opportunity to play a role in the history, and future, of the University of Massachusetts Lowell's engineering program. A continued partnership with the team cements a company's reputation in the academic community and paves avenues for future strategic advancement.

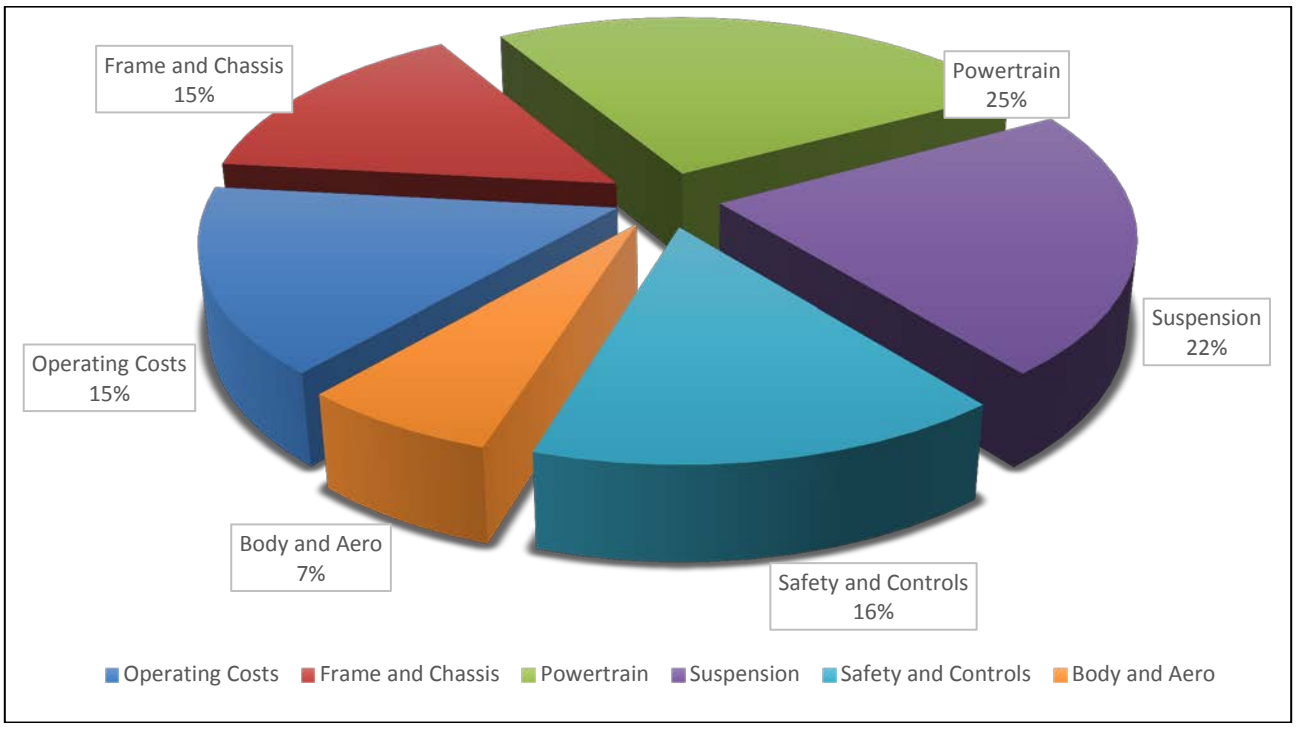
Benefits of Sponsorship Include…

- Recognition for supporting a high-growth, well-respected local university
- Opportunity to present your company and product to future engineers and professionals
- Exposure to the engineering and racing elite at the annual FSAE competition
- Close ties to outgoing FSAE members as they create opportunities in their post-collegiate careers.
- Student-based marketing opportunities that allow for quick growth in name recognition
- Access to the racecar and team members for focused advertising and marketing projects
- For automotive parts suppliers, image boost from product placement in an ultra-high performance racing application—including an endurance event

How We Can Benefit from You:

Any and all contributions to our cause are greatly appreciated, without your continued support we would be unable to pursue this vision that sits at the figurehead of our academic careers.

Mill City Motors FSAE team relies on funding from businesses, private individuals, and the University to complete the task of building a competitive racecar. **Monetary support** is used to purchase the materials and components necessary, as well as to acquire and maintain shop equipment, pay for business expenses, and support competition related travel expenses. In addition to liquid assets, **material, parts, and labor** donations are vital to the completion of the vehicle. Support in these crucial areas will enable Mill City Motors to complete the 2016 racecar at a competitive advantage with a high professional standard of engineering. Finally, **purchasing discounts** enable the team to save money where it counts, and are as equally valuable to the car as cash donations.



Breakdown of Proposed Budget of $35,750

Past Formula SAE Offerings from UMass Lowell

Contact Information

For additional information or sponsorship opportunities, please contact the Mill City Motors team at **millcitymotorsracing@gmail.com**

Dave Birch
UML Mill City Motors President
(508)207-0688
David_Birch@student.uml.edu

Brittney Pogue
UML Mill City Motors Vice President
(954)309-9948
Brittney_Pogue@student.uml.edu

Professor Lawrence Thompson
Faculty Advisor
Lawrence_Thompson@uml.edu

Ahmad Machmouchi
UML Mill City Motors Business Manager
(781)884-8651
Ahmad_Machmouchi@student.uml.edu

Past Sponsors

Below is a list of the sponsors who contributed to the University of Massachusetts Lowell FSAE team for the 2008-2011 seasons. Without them, our past success would not have been possible. We would like build off of this foundation, and ensure that future students at UMass Lowell will have the same wonderful opportunity as us. We truly want to emphasize our gratitude towards all the support from our partners and the community, as well as our desire to foster these relationships in years to come.

We would also like to thank the UMass Lowell Francis College of Engineering for their contributions and perennial support

For more information please contact us!

Email: Millcitymotorsracing@gmail.com

Thank you!

Donation Form

Formula SAE is one of the most rewarding experiences available to undergraduate engineers. Our team is working around the clock to place well at competition, but the opportunity that Mill City Motors provides is only made possible by the corporate sponsors and individual donors. Without your continued support, our organization would not be able to achieve its goals. Please do not hesitate to contact us with any questions. Thank you!

Name / Organization: _____
Mailing Address:_____
City:_____ State: _____
Zip Code:_____
Phone Number: _____ Fax Number:_____
Email: _____
Website: _____

Monetary Donations

What is the amount of your gift? _____
Please attach this form and make checks* payable to:
University of Massachusetts Lowell
Memo: Mill City Motors at UMass Lowell

Parts or Services

What is the nature of the gift in kind? _____
What is the fair market value of the gift in kind? _____
How was the fair market value of the gift of kind determined? _____
_____
_____

University of Massachusetts Lowell is a 501(c)(3) organization, all donations are tax deductible.
Is an income tax receipt required? ____Yes ____No

_____ _____
Signature Date

Please use the provided envelope in order to return this form (including check, if monetary donation) to Mill City Motors.

*if your organization wishes to pay by credit card, please contact the Director of Carolyn Rolfe, Associate Director of Leadership Giving (Carolyn_Rolfe@uml.edu)