Uniting Formula SAE with FSAE Hybrid

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Introduction

Design. Build. Compete. This motto defines the essence of many Formula SAE (FSAE) teams. One crucial word, however, is often overlooked: Manage. Evolving FSAE into a unified, two-year competition with a focus on project management and hybrid-powered vehicles will equip students with advanced technological skills, deepen their understanding of high-performance production vehicles, and prepare them with organizational skills that allows them to excel in professional motorsports. While FSAE teams are tasked with operating like small businesses, many still approach it solely as an engineering challenge. It is time to emphasize a new order: Manage. Design. Build. Compete.

Background & Qualifications

The Respondents

Alexander Merryman – Team Lead

Alexander, the current Team Lead of GT Motorsports and a double major in Neuroscience and Business Administration, previously served as Finance Lead, where he helped the team secure first place in the 2024 Business Presentation Event. As Team Lead, he has emphasized intentionality, integration, and adaptability, shifting the team's focus toward a project management approach that has ensured timely milestones and the early completion of a fully manufactured car now undergoing rigorous testing. With this momentum, Alexander and the team aim to secure GT Motorsports' first overall victory in over 20 years.

Evan Shaffer – Chief Engineer

Evan is the current chief engineer of GT Motorsports. While pursuing a bachelor's degree in mechanical engineering, Evan led the Suspension subsystem, reforming the previous intuition-based design approach to one based on rigorous simulation, validation through intense testing, and an unswaying focus on competition performance. Bringing this same attention to static events, Evan has introduced targeted lectures and workshops for cost and design, aiming to improve the team's performance in all areas. As a driver, Evan has led GT Motorsports to multiple Top 15 finishes in the Autocross and Endurance disciplines. Evan aims to channel his peers' competitive spirit into a valuable learning experience, while leveraging GT Motorsports' potential to excel in all areas of the competition.

Eli Kuperman – Business Consultant

Eli is the former Team Lead of GT Motorsports. Currently a Master's Student in Economics at Georgia Tech, Eli served as the Sponsorship Lead of GTMS, then the Finance Lead of the Team, before taking the reins. While on the team, Eli was a part of two championship-winning Business Presentation Teams, bringing home first from FSAE Michigan 2022 and 2024. Priding himself on his people-first approach to the competition, Eli is motivated to shift some of the attention of FSAE from the racecars towards the people that build them. SAE's mission is to make great engineers, after all.

The Team

Designing the future of FSAE requires an extensive understanding of the past. Georgia Tech Motorsports first brought a competition vehicle to the FSAE stage at Lawrence Tech, Michigan, in 1988, and has since competed in 30 different competitions all over the world, bringing hardware back to Atlanta from competitions including FSAE Australasia, FSAE UK, and of course, FSAE Michigan. More recently, GTMS brought home seventh place at the highly competitive FSAE Michigan 2023, a return to high form for the team. While engineering great vehicles is a source of pride for the team, we also take enormous pride in the success of our project management and business teams, bringing home first place in the business presentation at FSAE Michigan 2024 and 2022, and fourth in 2023.

The resources at Georgia Institute of Technology greatly benefit our team, but we credit much of our recent success to our project management strategy, particularly the two-year design cycle. While testing and tuning this year's vehicle, the team is also designing and manufacturing next year's vehicle. This massive undertaking in process and system management is what allows us to flesh out each vehicle more thoroughly and take on bigger challenges with each car. We at GTMS believe that FSAE is a management competition just as much as it is an engineering competition, and we want to formalize this notion to both reward teams already taking their management seriously while also incentivizing other teams to improve in this area, thus bettering the operations of all teams in the process.

Competition Format

The transition to a two-year cycle in the FSAE competition offers a valuable opportunity for both teams and organizers to adopt a more deliberate and innovative approach to vehicle design and team management. The first year of this cycle will purely consist of static events with teams defending their project management, business, and design decisions. For the second year, teams will bring their team and vehicle to the site where they will continue to compete in a few static events that ensure the teams retain a strong foundation for their vehicles but will primarily focus on dynamic events that showcase the performance of their vehicle on track. This structure not only provides a balanced focus on both the theoretical and practical aspects of engineering, which is what is expected in industry, but also ensures that teams can fully develop their concepts before bringing them to life on the track.

Benefits of a Two-Year Competition Cycle

1. Enhanced Design and Innovation

- With a two-year timeline, teams can invest more time into researching and developing advanced technologies, particularly the integration of the new hybrid powertrain system.
- This extended period encourages more innovation and validation of designs, resulting in more competitive, professional-level vehicles.

2. Improved Team Structure and Management

- The dedicated first-year static events prioritize the planning and organizational framework of teams. By **tying points to the quality of these processes**, teams are incentivized to focus on smart management practices.
- Long-term planning ensures that teams develop strategies to efficiently allocate resources and train new members over a longer timeframe, **much like in industry**.

3. Increased Testing Time

- By dedicating the second year primarily to dynamic events, **teams gain more time for testing and iteration**.
- This mirrors real-world engineering practices, where rigorous testing is critical to the success and reliability of any design.

4. Benefits for Organizers

- Recently, FSAE has faced challenges **with securing enough volunteers for the competition**. This issue will be partially alleviated by requiring dynamic volunteers only in the second year of the competition cycle.

Under the new two-year competition cycle, a total of 2000 points will be available—850 in Year 1 and 1150 in Year 2. Static events will total 1150 points, highlighting their importance while still distributing enough points to dynamic events to encourage vehicle performance. Annual awards will recognize Year 1, Year 2, and combined overall winners, with individual awards for top three event finishers and top ten overall teams, aligning with the current FSAE framework. Below is a detailed breakdown of events, their descriptions, and point allocations.

Year-1 Events

Event Name	Event Description	Points
Project Management	**Judges evaluate the team’s project management skills, particularly focusing on project initiation.**	**250**
- *Organization*	*Assesses the team’s organization, such as team and leadership structure, timelines, and goal setting.*	*100*
- *Communication*	*Assesses team’s collaboration, such as effective task delegation, documentation, and knowledge transfer.*	*100*
- *Budgeting*	*Assesses team's budgeting plans, documentation, and decision-making abilities.*	*50*
Design	**Judges evaluate the vehicle’s engineering, assessing the team’s understanding of their design and integration of mechanical and electrical systems.**	**250**
- *Mechanical*	*Assesses the design of the mechanical systems, such as the vehicle’s frame, suspension, ICE, drivetrain, ergonomics, and aerodynamic structures.*	*110*
- *Electrical*	*Assesses the design of the electrical systems, such as the LV systems and the HV battery and powertrain.*	*80*
- *Integration*	*Assesses the team’s ability to integrate the mechanical and electrical systems into a cohesive package.*	*60*

Simulation	**Evaluates the team's ability to create and implement simulation tools for optimizing vehicle performance.**	**100**
- *Creation*	*Teams are judged on their self-made simulation tools and their implementation of those tools.*	*75*
- *Implementation*	*Teams are given access to a CEO–provided vehicle simulator and competition prompt. The team must adjust parameters to create a virtual vehicle that will be tested on the specified virtual track. Points are awarded based on the vehicle's performance in accordance with the prompt's criteria.*	*25*
Cost	**Evaluates the team's ability to create a cost-effective prototype while considering manufacturability**	**75**
- *Price*	*Teams are linearly assigned a score based on the budgeted cost of the vehicle.*	*25*
- *Documentation*	*Teams are judged on the thoroughness and professionalism of their documentation, such as their bill of materials and engineering drawings.*	*25*
- *Manufacturing*	*Judges assess the design's manufacturing feasibility and prototype production plan.*	*25*
Business Presentation	**Judges evaluate the team's ability to form a business plan to attract external investment in their concept.**	**75**
Sustainability	**Judges evaluate the team's ability to make sustainable, environmentally mindful decisions.**	**100**
- *Real Case*	*Team's decision-making on their competition prototype is judged in respect to areas such as resource management, material selection, efficiency, and considerations of the long-term impact of the vehicle.*	*50*
- *Hypothetical*	*Teams give a presentation in response to a hypothetical scenario regarding sustainable decisions.*	*50*

Year-2 Events

Event Name	Event Description	Points
Project Management	**Judges evaluate the team's project management skills, focusing on execution, maintaining momentum, and delivering outcomes.**	**150**
- *Execution*	*Assesses the team's preparation for competition and ability to turn their plans into action.*	*50*
- *Risk Management*	*Evaluates the team's ability to identify potential risks, develop mitigation strategies, and respond effectively to unexpected challenges during the project lifecycle.*	*50*
- *Post-competition*	*Assesses the team's ability to ensure long-term success, such as their team structure, knowledge transfer, and usage of tools such as after-action reports.*	*50*
Validation	**Judges evaluate the team's ability to validate designs and design decisions through testing.**	**75**

Cost and Manufacturing Scrutineering	**Judges scrutinize the team's ability to adhere to planned budgeting and manufacturing plans and assess their adaptability to financial changes.**	**75**
- *Scrutineering*	*Points are deducted from maximum point total based on inaccuracies from proposed manufacturing plan.*	*50*
- *Scenario*	*Teams present a financial plan, showcasing their ability to evaluate cost-effective alternatives.*	*25*
Acceleration	**Evaluates the vehicle's straight-line acceleration over a timed 75-meter run.**	**100**
Braking	**Evaluates vehicle's control systems and mechanical ability to brake by measuring the distance to come to a complete stop from 30 mph over a wet track.**	**50**
Skidpad	**Evaluates vehicle's steady state cornering ability through a 9-meter circular track.**	**100**
Autocross	**Evaluates vehicle's single lap performance over a cone-constructed, 1km long autocross track.**	**150**
Endurance	**Evaluates vehicle's consistency of performance, reliability, and serviceability.**	**300**
- *Timing*	*Vehicles are timed around an autocross-style track for a total of 30km with a driver change at half distance.*	*250*
- *Accumulator Replacement*	*During the driver change, teams must swap the accumulator, with faster times earning more points.*	*50*
Efficiency	**Evaluates efficiency of complete vehicle over the endurance event.**	**150**
- *IC Engine*	*Fuel consumption is assessed relative to speed.*	*75*
- *Electric*	*Electricity consumed is assessed relative to speed.*	*75*

Next-Generation Vehicle Vision

To better mirror both the high-performance and motorsport automotive sectors, the next generation of FSAE vehicles will pivot towards a hybrid powertrain system that unites both FSAE IC and EV in a package focused specifically on efficient performance. We plan to provide teams with a subsidized and standardized hybrid system, making the competition more accessible, allowing both novice and established teams to focus their innovative efforts on other aspects of vehicle design. However, the changes we envision for the future of FSAE rely not simply on regulatory measures, but on the creativity an open rulebook inspires in our students. GT Motorsports firmly believes that the greatest aspect of the FSAE competition is not the regulations that are in the rulebook, but the regulations that aren't, giving greater design freedom to students and the creativity it affords them in solving design problems.

As such, the way to change the competition's overarching design approach is not to limit that freedom through additional regulations but change the problems the teams are trying to solve.

Innovations and Regulation Changes	Desired Technical Effect
Autocross and Endurance Track Changes: Increased high-speed zones	Increasing the number of high-speed zones on the endurance track will make teams' aerodynamics

	development more drag-limited and force a greater focus on aerodynamic efficiency.
Vehicle Cost Cap: $35,000 (in cost report)	Penalizing the usage of exotic and expensive materials and parts forces teams to be intentional and efficient with their design choices and levels the playing field for less well-funded teams.
Hybrid Powertrain: Specified IC Engine	A smaller IC engine will be required of teams than currently allowed by FSAE regulations. This will place greater priority on the hybrid system rather than allowing teams to cover up issues with a higher power IC engine. The lower power along with higher speed tracks will also shift the focus of teams to finding creative ways to reduce weight.
Hybrid Powertrain: Specified Electric Motors	Two small spec electric motors will be supplied to the teams. The specifications of these motors will be so that they make a substantial enough amount of power that teams are encouraged to implement them effectively, but not so high power that design of high voltage systems is a dominating concern. The motors will be compact enough to enable simpler in-hub packaging, paving the way for innovations like torque vectoring, advanced control systems, and regenerative braking.
Hybrid Powertrain: Specified Accumulator	The teams will be provided with a relatively low-voltage (<100V) accumulator, including core components like cells, while packaging and other design decisions will be left to the team. This approach will cap power output and encourage teams to innovate in other areas to maximize the potential of the provided package.
Wheelbase: Unrestricted	The wheelbase of the vehicle will now no longer have a minimum distance, potentially rewarding teams with clever packaging to create a nimbler car. This also forces teams to justify their wheelbase decision more thoroughly rather than just choosing the minimum limit.

Strategic Justification

In a time where Motorsports all over the world are being judged not simply based on the performance on track, but on factors such as global impact, environmental effects, and accessibility, a racing series must be designed around more than just the vehicles. In this section, we will discuss the overall strategy behind our proposed shift towards project management and a hybrid powertrain, and how it better aligns with the current and future needs of the high-performance automotive and motorsports industries. We will then discuss the implications for the students involved, highlighting how these changes will positively impact them, as well as the benefits of consolidating FSAE into a single competition.

Environmentally Conscious Motorsport

All around the world, the pinnacles of open wheel racing have been shifting to hybrid powertrains. When F1 transitioned to hybrid vehicles in 2014, they cited environmental concerns as a primary reason. Speaking about the hybrid powertrains in 2019, then-chairman of F1 Chase Carey said, “Few people know that the current F1 hybrid power unit is the most efficient in the world, delivering more power using less fuel, and hence CO2, than any other car.” If F1, the pinnacle of open-wheel racing for almost 75 years, is considering the emissions of their vehicles, it’s time for FSAE to do the same.

Another example of environmentally focused motorsport is Formula E, a rapidly expanding racing series founded in 2012. When GT Motorsports met with Formula E CEO Jeff Dodds, he spoke to the morality of leaving every city Formula E travel to cleaner than they found it. Formula E excels at leaving a positive environmental impact, in addition to the fact that the vehicles themselves produce zero emissions. Speaking with Jeff was illuminating regarding the future of motorsport, and how far behind FSAE truly is on the environmental front. As such, it is critical that we position FSAE as a strategic leader in environmentally conscious racing for years to come.

GTMS with Formula E CEO Jeff Dodds

Personnel Preparation

As students complete their time in FSAE, it becomes a defining element on their resumes and a focal point in interviews. A key objective for the future of FSAE is to structure it in a way that maximizes professional growth and prepares the next generation of students for success beyond college.

The aforementioned changes to a more project management-focused event builds a competition more akin to the real world. While being able to overcome engineering challenges is critical to career success for most of our students, we find that the real distinguishing factors of FSAE for career preparation are organization, participating in a team, and communication skills that the competition builds. We simply are leaning into these existing benefits by adding point values associated with them, aiming to motivate teams to perform better in competition, which will, in turn, help them produce more professional, better prepared engineers.

Uniting FSAE

The current existence of two separate FSAE competitions fosters a culture of exclusion between the two technologies, and the students that are interested in them, which can hinder the overall growth and accessibility of the series. By uniting FSAE into a single, accessible competition with a subsidized powertrain and a cost cap in the rulebook, universities can field just one team, leveling the playing field for all participants. This plan also allows universities to allocate more funding to a single team, potentially even saving some teams from cancelation at schools with less resources. It also gives students interested in all aspects of motorsports and engineering a singular platform to join, rather than separating majors involved in engineering and computing, concentrating talent into one team rather than spreading it thin. Moreover, it ensures that teams focus on a shared vision, fostering collaboration and innovation across the board.

Implementation Plan

Competition Framework

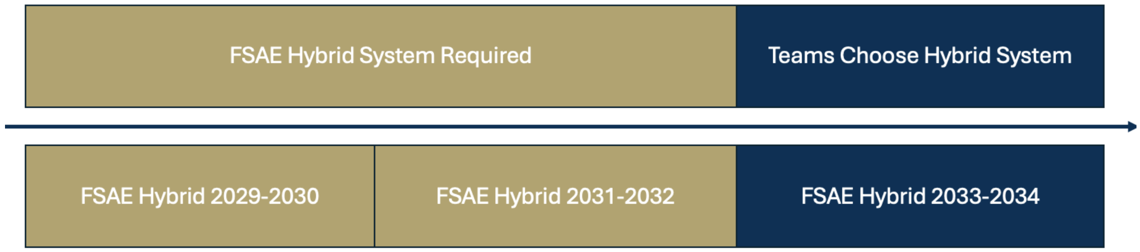
Due to the financial constraints of operating four separate FSAE competitions—FSAE Michigan, FSAE Electric, Formula Hybrid+Electric, and the proposed FSAE Hybrid—the ultimate goal is to consolidate these events under a unified FSAE Hybrid competition. If our proposal is selected, we aim to host the inaugural FSAE Hybrid competition in the summer of 2028.

The official announcement of FSAE Hybrid will occur during the Formula Hybrid+Electric competition in summer 2026, providing a platform to outline the phase-out plan for legacy competitions and gather team feedback. Input collection will continue into fall 2026 alongside the introduction of a new Project Management competition, set to debut at summer 2027 events for testing and refinement. By fall 2027, registration for the first FSAE Hybrid competition will open, marking the start of the phase-out plan for legacy events like Formula Hybrid+Electric. This structured approach ensures a smooth transition to the unified FSAE Hybrid competition in summer 2028. The figure below details these changes:

Due to the two-year cycle of FSAE Hybrid, the competition in Summer 2028 will focus exclusively on the Year-1 Events previously outlined. As a result, the first FSAE Hybrid vehicles will debut on the track in Summer 2029. To ensure all teams have the opportunity to fully participate in the two-year development cycle, Summer 2029 will also mark the final year of both FSAE IC and FSAE EV competitions. Therefore, 2030 will be the first year of FSAE fully united underneath FSAE Hybrid.

Hybrid Powertrain Rollout

To ease the transition to hybrid, FSAE will implement a phased rollout requiring all teams to use a standardized internal combustion engine, electric motor, and accumulator package for the first two FSAE Hybrid competition cycles. This package, subsidized by FSAE with comprehensive documentation, will help teams focus on understanding hybrid systems without being overwhelmed, addressing challenges like the steep learning curve for new powertrain components. After the initial cycles, teams can design or purchase their own systems, with the standardized package remaining available for new or less experienced teams. This approach ensures a level playing field, fosters innovation, and equips teams for long-term success in hybrid vehicle design.



Next Steps

Below is a list of the next steps we plan on taking if our RFP is chosen to move onto the next stage:

- Contacting venues to solidify logistics, availabilities, and finances for each year of the competition
- Consult senior design judges on point distribution and criterion for new series regulations
- Solidifying a list of all innovation changes to include in for the next generation of FSAE vehicles
- Further refine specifications and selecting manufacturers for the subsidized FSAE Hybrid System and secure sponsorship for said subsidies
- Collaborate with professional motorsports series to find placement opportunities for students

Conclusion

In uniting Formula SAE with FSAE Hybrid, this proposal envisions a transformative future where project management and innovation take center stage. The introduction of a two-year competition cycle will provide students with an extended timeline to refine their technical expertise and develop critical leadership skills. By combining advanced engineering practices with real-world project management, the competition will prepare participants to excel in diverse professional environments. This initiative not only elevates the educational value of the program but also strengthens the sense of unity and collaboration across the entire FSAE community for years to come.