Let's Go Racing – Constructing a Collegiate Motorsports Program

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Abstract

A handful of universities have capitalized on the increased visibility of the sport of auto racing and the growth in the motorsports industry. These universities are increasing enrollment by offering courses that prepare students for potential careers in motorsports. Indiana University Purdue University Indianapolis (IUPUI) hired a new professor with experience in the aerospace industry and twenty-five years as both a competitor and event organizer in auto racing. His addition to the faculty afforded the opportunity for the Purdue School of Engineering and Technology at IUPUI to focus on creating a motorsports program.

The steps that were followed in creation of this motorsports program will be covered. This will include a discussion of how new classes were selected, developed, and implemented. The design of applicable student projects will be considered, including how these various projects were utilized in the design and construction of an actual competition vehicle. Fostering of industry involvement and internships will be a topic, as will the building of interdisciplinary cooperation between university departments.

The progress of the new classes and the level of student interest and enrollment will be shared. A critical part of this process is how the new classes fit with the traditional classes and existing curriculum. Additionally, the progress toward the goal of construction of a campus motorsports team will be shown.

Getting Started

In 2004 a new professor joined the Mechanical Engineering Technology (MET) Department at Indiana University Purdue University at Indianapolis (IUPUI) after twenty-five years of spending his days designing and analyzing gas turbines and spending his nights and weekends working on a variety of racecars. The Dean of the School of Engineering and Technology quickly seized upon the background of his newest faculty member, and proposed an opportunity. A number of members of the school believed that as the closest major university to the Indianapolis Motor Speedway and its associated motorsports businesses, IUPUI should have a collegiate motorsports program. A handful of universities have had success in developing such programs. The University of North Carolina at Charlotte[1] in the United States and Oxford Brookes University[2] in the United Kingdom, are two well recognized examples. Out of the IUPUI discussions came a plan to create a series of classes and projects centered around auto racing and the motorsports industry.

The ultimate objective was to develop a race car completely designed and built by IUPUI Engineering Technology students. This was a rather aggressive goal, and the new professor was not completely certain how interested or successful the students would be. As a test case, he offered a team of five students in the MET Capstone Design course the opportunity to go beyond the paper designs which were the normal outcome of the school's student projects. These students took on the task of designing and building a vehicle from the ground up, in a single semester. Specifically, they designed a Basic Utility Vehicle (BUV) to compete in the annual intercollegiate BUV competition sponsored by the Institute for Affordable Transportation (IAT).[3] This competition encourages the design of basic transportation units suitable for underdeveloped third world nations with poor infrastructure and limited financial resources. A $900 price limit is mandated and performance tests ensure durability, reliability, and maneuverability. The students rose to the challenge, creating the impressively quick, lightweight, maneuverable entry shown in Figure 1. The team very nearly won the competition. In fact their second place was remarkable given the fact that a gearbox failed in the middle of the event and had to be removed, rebuilt, and reinstalled in under thirty minutes in order to continue the competition. Clearly, any concern that the students' interest would not be aroused by the possibility of building vehicles for competition had been laid to rest.

Looking for New Challenges

With this initial success achieved, word spread quickly that there were going to be upcoming opportunities to participate in motorsports related design projects, and that there were going to be new motorsports related classes offered. A promotion, entitled "Lets Go Racing" was used to advertise the initiative. Soon, students began inquiring in advance what projects might be offered when they got to the senior design project. A logical first step in creating a race team was to take advantage of IUPUI's status as part of the statewide Purdue University system to enter a team in the annual Purdue Grand Prix go-kart race.[4] This event, conducted every April on the main campus in West Lafayette, Indiana is one of the major events of the Purdue school year. Teams from a variety of groups around Purdue design and build their own karts and students drive them in the event held on a miniature race track in the middle of campus. Almost as soon as the venture was announced, enough MET seniors volunteered to more than fill the team. It was a good start, but more projects were needed.

Having built several racecars for competition in the Sports Car Club of America's (SCCA) amateur Club Racing division, the professor decided that building a complete race car, using various senior projects was a viable possibility. So he went looking for a potential car to build. He came away with a donation of an MGB-GT in somewhat questionable condition. After picking up the car, a thorough survey of the vehicle was conducted and a list was made of all the major items that needed to be addressed in order to turn it into a competition vehicle. The list was fairly extensive and challenging. But, if students wanted to go racing, they needed to be ready for a challenge. This list eventually became the foundation for a series of projects that the instructor began to

outline, to take the car from its initial state of disrepair to one that would impress the campus, and hopefully surprise the SCCA competitors.

During the first semester of new senior projects focused at the race car, one team worked at designing, analyzing, fabricating and installing the roll cage system. Their objective was to meet all SCCA safety standards[5] while constructing a cage that also added structural rigidity to the car, within the published rules for the class in which it would compete. A second team was tasked with the design, analysis, and construction of the fuel system, including competition fuel cell, fuel pump, fuel lines, etc.

Figure 1 – IUPUI's 2005 entry in the inter-collegiate BUV Competition, designed and built by MET Students.

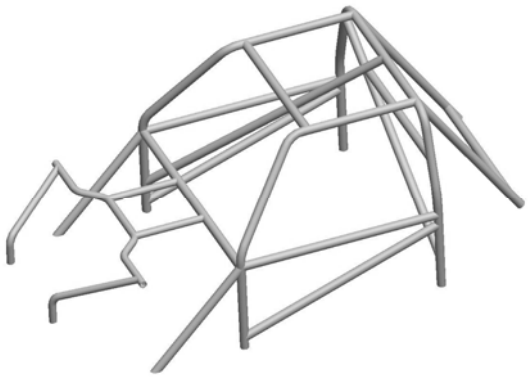

Figure 2 – Roll Cage for the IUPUI Engineering Technology racecar, designed and built by MET Students

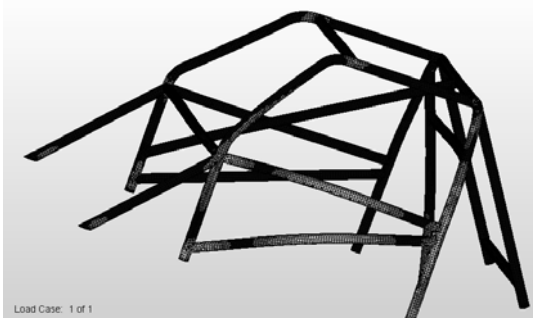

Figure 3 – Finite element stress analysis model of the roll cage, under a 3G side impact crash scenario, with 58 ksi max.

Figure 4 – The student designed roll cage being installed in the IUPUI Engineering Technology racecar.

The roll cage system was designed using the school's CAD system. Several iterations were made as the team worked at incorporating both safety and stiffening features. The final configuration is shown in Figure 2. This cage was analyzed under 3G crash loading and modifications were made to ensure that all components stayed below the tube

material's allowable stress. Stress results from the team's finite element model are shown in Figure 3. Detail drawings were produced for all the cage components which were then fabricated to specifications. The system was installed in the car in an operation which can be seen in Figure 4. The fuel cell system was similarly designed, analyzed, and constructed, and a model representation of it is shown in Figure 5 and the installation in Figure 6.

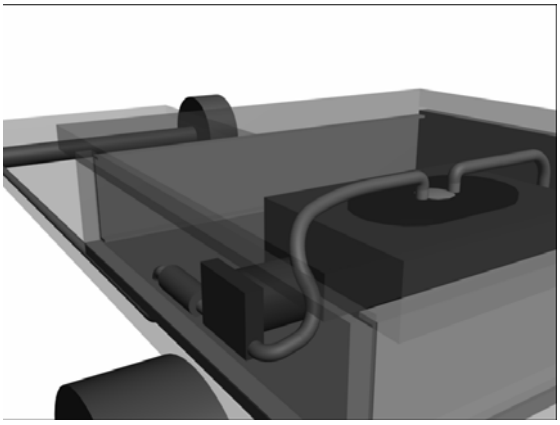

Figure 5 – CAD layout of the fuel cell system for the IUPUI Engineering Technology race car.

Figure 6 – Installation of the fuel system in the IUPUI racecar.

Creating New Classes

When this motorsports initiative began, the IUPUI School of Engineering and Technology had no class offerings which had any direct connection to motorsports. However, the MET Department had an Internal Combustion Engines class on the books as an elective, which had not been offered in a number of years. The logical first step was to reactivate this course and connect it to the other motorsports activities. So it was announced that the students taking the class would not only be studying the fundamentals of IC Engines, but would actually be tearing down and rebuilding a pair of engines for the racecar. The class filled quickly and had students on a waitlist to get in.

Having spent twenty-five years associated with auto racing, as a competitor, organizer, and freelance writer, the motorsports professor rapidly realized that most of the students he was talking with about the program did not have a good idea how the motorsports business worked or what careers were really available. This brought about the idea of a new two hundred level elective course called "Intro to Motorsports" dealing with how the sport is run by the sanctioning bodies and promoters and how a wide variety of people earn their livings in careers associated with the sport. This course was designed to utilize outside speakers with different roles in motorsports, and to involve field trips to competition events to observe behind the scenes activities. Since this is intended to be an introductory course at a sophomore level, it was not highly technical, and did not require a prerequisite beyond the freshman level.

Another class was added to the MET curriculum, this one being a new four hundred level elective course on "Vehicle Dynamics" covering topics ranging from chassis design and suspension set-up to the basics of vehicle aerodynamics. Similar to the IC Engines class, this one was designed to couple a study of fundamental principles with projects aimed at preparing the new racecar for competition in 2007. Although a few vehicle dynamics text books exist, in order to cover all the topics just mentioned, material is being drawn from several sources. Since this was a senior level course, it used prerequisites from the sophomore and junior years, such as dynamics (to support understanding of the dynamic response of the car as a spring/mass system) or strength of materials (to support the design and analysis of structural components).

These three classes, along with the motorsports related projects in the senior design class, formed the basis for the MET Department's plan to go racing. They were promoted both on and off campus with a series of fliers, posters, and press releases along the theme "Lets Go Racing." They also became key elements in a Motorsports Certificate program now being offered by the MET Department, along with several of the basic courses which cover the skills necessary to prepare for those courses. All the classes of the certificate program are shown in Table 1.

Table 1 – Required Courses for the IUPUI Motorsports Technology Certificate Program

MOTORSPORTS CERTIFICATE COURSE	**CREDITS**
MATH 159- ALGEBRA & TRIG or MATH 153/154- ALGEBRA & TRIG I&II	5
MET 111- STATICS	3
MET 211-STRENGTH OF MATERIALS or MET 213-DYNAMICS (MUST TAKE ONE, BUT BOTH ARE RECOMMENDED)	3
MET 220-HEAT AND POWER	3
MET 299-INTRO TO MOTORSPORTS	3
MET 426-IC ENGINES	3
MET 499-VEHICLE DYNAMICS	3
AN MET PROJECT COURSE WITH A MOTORSPORT RELATED PROJECT - MAY BE MET 414, MET 497, OR MET 299 (PROJECT COURSE)	3
TOTAL	26

Certificate programs within the IUPUI School of Engineering and Technology require 20-26 credit hours and combine basic fundamentals courses with courses specific to the certificate topic. The selection of courses was carefully made in an effort to ensure adequate depth of experience yet not exceed the 26 credit hour total.

Widening the Program

Several things have subsequently been done to broaden the appeal and exposure of the program. One of the Computer Graphics Technology (CGT) courses participated in a competition to design a color and graphics scheme for the new racecar. Students were given a list of requirements and objectives for the design, and then they executed independent designs for the car, with one design ultimately selected for the car. The CGT students treated the race team as a client and worked to meet the client's objectives. These objectives included having a car which could be readily identified with both the university and the Engineering Technology program, and of course, meeting the rules of the sanctioning body. Once again the students became excitedly involved in the project and a number of excellent designs were in contention.

A committee was formed with representatives from all Engineering and Technology Departments. The objective was to try to build some synergy between the different programs. This brought the various departments into discussion about how they could cooperate to broaden the appeal of the school's new motorsports activities. This resulted in the Intro to Motorsports class being modified so as to appeal to students, not just from MET and CGT, but from the Electrical and Computer Engineering Technology (ECET), and Organizational Leadership (OLS) departments as well. It even resulted in the ECET Department starting a new course on "Data Acquisition in Motorsports." The MET Department offered to let the developing racecar be used for potential projects in this new class, and the school is promoting it to students in all Departments who are interested in the motorsports program.

The Dean's Office has assisted in building enthusiasm, by staging a Motorsports Day on campus, bringing in members of the local motorsports community with displays and guest speakers. The event was staged in the center of campus and attracted considerable attention. The school's internship office picked up on the new initiative and began making connections with local motorsports groups, all of which showed considerable interest in getting involved, resulting in internships being offered with both race teams and a locally based sanctioning body.

The IUPUI Motorsports Program has drawn so much attention that the School of Engineering and Technology, the School of Business, and the School of Liberal Arts have collaborated to begin development of a dual degree program. It will ultimately result in both a BA and BS degree being offered in Motorsports Studies, such that students receive a fundamental exposure to both the technical and business/public relations side of the motorsports industry before diverging into a specialization in either the technical or management side of the business.

Conclusions

No one has completed the new MET Motorsports Technology Certificate yet, although several are on track to do so in the next semester. Some Engineering program students are adding courses to their plan of study so as to earn the MET Motorsports Certificate in

addition to their BS in Engineering. The project vehicle had a successful debut in competition. All of the new classes have been successfully tested. The students in the IC Engines class completely disassembled two engines, replacing or refurbishing all components, and reassembling them, with performance enhancements permitted under the SCCA rules. Roll cage and fuel cell systems have been designed, fabricated, and installed in the car. The motorsports classes offered to date have been filled. Other departments are seriously looking at either creating their own motorsports oriented classes, or permitting their students to take the existing classes as electives. But most importantly, student enthusiasm for the new program is high, and several students have transferred or enrolled in the university specifically because of their ability to take these classes and work on these projects.

Here are some key steps that helped get this program off the ground and which are recommended for anyone trying to initiate a similar endeavor.

1. Utilize existing inter-collegiate competitions to develop experience at bringing student projects from design to completion to competition.
2. Search for individuals from either the full time or adjunct faculty who have the skills and interests to relate basic motorsports topics to the students. If there are none, then seek them from the local motorsports community, as every major city has some form of motorsports activity nearby.
3. Look for existing courses which either relate to motorsports, or can be redirected slightly to do so.
4. Consider creation of new courses which have applicability to the field and for which viable instructors and/or guest speakers can be located.
5. Investigate local motorsports activities and local teams or individuals involved in the sport as possible sources of both ideas for motorsports projects that the students can become involved in, and for possible internship opportunities for students.
6. Do not underestimate the benefits of good promotion. Create an attention grabbing promotion advertising the new program to students.
7. Make sure there is an individual to serve as the focal point for the new program, to answer questions and talk with both existing and potential students. This should be someone with enthusiasm for the project. In this role, enthusiasm is even more important than knowledge, because enthusiasm is infectious, and will spread to those who talk to the spokesman.
8. Explore interdisciplinary synergy between departments.
9. Enlist support and participation from the Dean's Office.
10. Seek support from, and develop synergies with, external organizations interested in the advancement of motorsports in your area.

References

1. UNC-Charlotte motorsports website: www.mees.uncc.edu/motorsports

2. Oxford Brookes University technology website: www.brookes.ac.uk/schools/technology/News/new_building.htm

3. Institute for Affordable Technology BUV Competition website: www.drivebuv.org

4. Purdue University Grand Prix website: web.ics.purdue.edu/~grand

5. "2005 General Competition Rules and Specifications." Sports Car Club of America, Topeka, 2005.

Author Biography

Pete Hylton is an Assistant Professor of Mechanical Engineering Technology at IUPUI, where he directs the Motorsports Technology Program. He previously spent 25 years in the aerospace industry where he worked on the T406 for the V-22 Osprey, the Comanche Helicopter T800, and the Joint Strike Fighter. He also has 25 years experience in motorsports as a driver, car builder, author and event organizer.

