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Motorsports Internships at IUPUI

Terri Talbert-Hatch, Joshua Killey, Michael Armbrester, Jr.

Purdue School of Engineering & Technology
Indiana University – Purdue University Indianapolis, IN

Abstract

Internships provide an opportunity for students to apply their classroom studies to real-world experiences. Internships also provide an opportunity for students to get a first-hand experience of what their future career may actually involve.

In motorsports, internships have normally been with race teams, engine and chassis manufacturers, and other suppliers of equipment. In 2006, three IUPUI students studying Motorsports Engineering Technology worked as interns for the Champ Car World Series sanctioning body. These students attended races throughout North America and performed various tasks at each race. The lead student also had the opportunity to attend the race in Surfer's Paradise, Australia. Students learned about the "behind the scences" operation of both the Champ Car and Atlantics series, they had the opportunity to meet engineers, team managers, and mechanics in both series, and they also had cultural experiences while attending races in Canada and Mexico City.

Some of the jobs performed by the interns included:

- Prepared crash data analysis reports for Champ Car
- Verified setup and proper operation of accident data recorders for Champ Car
- Maintained timing and scoring telemetry streams during Champ Car on-track sessions
- Participated in Champ Car and Atlantics technical inspection procedures

Funding from the IUPUI Solution Center provided a 50% match to provide financial assistance for Champ Car to pay for the transportation and hotel accommodations, travel stipend, and food stipend for the students which amounted to approximately $10,000 per student.

The internship program was developed by Champ Car as a way to provide additional insight into the sport for Motorsports Engineering Technology students. This internship also provided the opportunity for students to experience the travel involved with this particular type of career.

Internships at IUPUI

The Purdue School of Engineering and Technology at IUPUI is dedicated to providing experiential learning opportunities for all of its students. Students within the school can participate in the Internship and Cooperative Education Program.

The School adheres to the National Association of Colleges and Employers Guidelines when pursuing internship and co-op opportunities with employers.

- The employer should provide a unique opportunity consisting of career related activities that the student could not obtain outside of the internship.
- The employer should provide a qualified supervisor or "mentor" that is aware of the program's objectives and goals.
- The employer should ensure that the intern has regular contact with this designated supervisor, who will ultimately complete a performance review at the conclusion of the internship
- The employer should provide an orientation for the student in order to familiarize them with company and the work site, clarifying internal rules, operating procedures, and expectations. Key managers should be introduced and the intern should receive an overview of the company's organizational structure.
- The employer should identify selection criteria for students. Students will compete for the internship as they would any full-time position. This should include a proper resume and a formal interview.

For a student to receive credit toward their plan of study for an internship opportunity, they must meet the program requirements. The student must maintain a cumulative GPA of at least 2.3 on a 4.0 scale. They must work at least 200 hours in a position that relates directly to their field of study. Lastly, they must complete a work report that provides them the opportunity to reflect on their education and their work experience. The work report forms are attached in Appendix A.

Internships have proven to be a crucial part of our students' education. Internships assist students in solidifying their choice of major and allow them to apply theory learned in the classroom to hands-on projects. Many of the experiential learning opportunities have led to full-time career opportunities with the internship companies.

Motorsports in Indianapolis

In 2004 the Center for Urban Policy and the Environment, School of Public and Environment Affairs, IUPUI, prepared a report on the Motorsports Industry in the Indianapolis Region. Based on data collected during interviews with 18 motorsports companies in the Indianapolis Region along with additional sources, it was estimated that there are more than 400 motorsports-related firms in the Indianapolis Region. These firms employ 8,800 individuals generating more than $425 million in wages. The average wage for motorsports works is $48,359 compared to Indiana's average wage of

$35,953 (Bureau of Economic Analysis earnings by place of work divided by BEA total employment).

The motorsports industry is also very important to the Indiana economy. Governor Mitch Daniels created a position in the Indiana Economic Development Council to actively pursue motorsports related industries to the state of Indiana. This industry is an asset in Indiana's efforts to retain and attract college students and other creative and skilled individuals. It is a highly technical, high-skill industry with aeronautical engineers, workers with advanced manufacturing skills, and computers in virtually every garage.

The motorsports industry is expected to grow at a rapid pace. The *USA Motorsport Report* estimated that the national value of motorsports in the United States will grow from $16.5 billion in 2002 to $22 billion in 2007, an increase of 33 percent. Indianapolis, Charlotte, NC, and England are the three leading motorsports economies, but many other regions are actively pursuing the industry.

Universities in England have long been the leader in motorsports related education, but several universities in the United States have developed motorsports curriculum and entire degree programs. Preparing future employees of the motorsports industry has also become a competitive endeavor.

The Partners

The partners in this program include The Purdue School of Engineering and Technology, IUPUI, the Champ Car World Series, and the IUPUI Solution Center.

The Purdue School of Engineering and Technology is located in downtown Indianapolis, Indiana on the campus of IUPUI. Graduates of this school receive Purdue University degrees. The school prides itself in its internship and co-op program, small class sizes, undergraduate research opportunities, and the individual attention that it provides students. The IUPUI campus has approximately 29,000 students and 2,500 are enrolled in the School of Engineering and Technology. The Mechanical Engineering Technology Department created a Motorsports Engineering Technology Certificate program under the guidance of Professor Peter Hylton. Professor Hylton has vast knowledge of the industry and a race car driver. The certificate consists of 24 credit hours which are imbedded in the MET Bachelor's degree. The majority of the students enrolled in the certificate program are also pursing the B.S. degree. The school is attracting students from around the country because of this program and the related internships. The certificate program and internships has provided much national and international publicity for the school. The Champ Car World Series is a sanctioning body. Champ Car, a shortened form of "Championship Car", has been the name for a class of cars used in American Racing for many decades. It is also the common name for the Champ Car World Series, an Open Wheel World Championship mainly based in North America that was formerly known as CART, or Championship Auto Racing Teams. The sanctioning body is responsible for determining specifications for the cars, scheduling of races, and promotion of the series.

Champ Car was interested in developing this internship opportunity because it was important for highly technical students to know that motorsports as a career (not just as a hobby) was an option. They were also hopeful that this would be a jumping board for potential employees, both for Champ Car and their affiliate race teams. The motorsports industry is very fast-paced and does not lend itself to a teaching type of environment. Most race teams prefer to hire engineers, mechanics, and technicians with experience in the industry. This internship opportunity exposed students to the industry and exposed race teams to the students and the higher education industry.

The third partner is the IUPUI Solution Center. The Solution Center was established in December 2003 through a $1.7 million Lilly Endowment Initiative to Promote Opportunity grant IUPUI resources. One-quarter of the grant was used for operations and the other three-quarters ($1.2 million) was directed to our Venture Fund grant program. The IUPUI Solution Center opened in May 2004 with a two-fold mission: to serve the state as a key partner in its efforts to increase the numbers of highly trained and degrees professionals living and working in the state of Indiana; and to facilitate meaningful collaboration and talent-driven partnerships with Indiana's business, industry, nonprofit, and government sectors.

The Solution Center serves IUPUI and Central Indiana as a single point of access to campus resources and talent to develop business and research partnerships; create and encourage professional internships; link community and faculty; and customize programs and research for community clients. Solution Center goals for increasing internships and experiential learning, collaborations and research, and the number of graduates living and working in Indiana serve as benchmarks for IUPUI's commitment to the original Lilly Endowment Initiative mission and contribute to the overarching mission to build Indiana's economic vitality through the retention of our greatest asset—our intellectual capital.

As the "front door" to the IUPUI campus, the Solution Center bridges the often complex divide between the campus and the community and assists both by linking community and faculty to develop partnerships, create professional internships, and customize programs and research for community clients.

The Solution Center administers the $1.2 million Community Venture Fund and awards $400,000 per year, on average, to initiate and/or provide short-term support for internships, research, and projects. This fund has proven to be integral to the IUPUI community and our economic development strategy as a tool to with which to build and support new relationships and enhance existing partnerships through talent-driven partnerships.

The presence of the Venture Fund has proven to be an important leveling tool for small businesses, nonprofits, and government agencies. Through the fund, IUPUI has been able to invite new partners to access the University and ensure that internships and research take place in a large number of businesses and organizations that otherwise would not have been able to engage the University and its students.

Since 2004, the Solution Center has coordinated or facilitated over 1,000 internships, research collaborations, and projects. Over 800 of those activities received funding from the IUPUI-Solution Center Community Venture. In the first three years of operation, the Solution Center awarded over 200 grants through the Venture Fund, essentially helping to make many of these partnerships possible by enabling the community to essentially "buy" goods and services from IUPUI.
Internship Activities

Internship Activities

The primary role of the student during the internship was to act as a technical assistant to Champ Car staff during the 2006 season race weekends. This assignment provided the student with the opportunity to employ engineering principles and practice problem solving skills in a number of different environments, while at the same time delivering the unique work experience typical of a career in motorsports. As the sanctioning body of a racing series, Champ Car carries the responsibility to ensure fair enforcement of the sporting rules and to provide the safest possible working environment for its competitors. In addition, Champ Car must work in conjunction with its technical suppliers to allow them to showcase their products on a global stage. Each of these goals influenced the student's work experience in some fashion.

The most prominent duty of the internship was to assist in the process of technical inspection of the cars. During a race weekend, each team must submit their cars to a thorough technical inspection before they are allowed to participate in any track activity. The most important reason for implementing this procedure is to verify that each of the safety devices present on the car is in acceptable condition and functioning properly, but is also provides both Champ Car and the team with a baseline for the setup of the car, which can be useful for comparisons later in the race weekend.

The technical inspection process is a carefully-designed procedure which employs a sophisticated piece of specialized equipment and operates on a very simple principle. Each race car is equipped with three standardized pucks in specified locations. These pucks mate with three housings on the technical inspection pad which are fixed to a floating platform actuated by pressurized nitrogen. This arrangement is chosen because three points completely define a plane. Using this basic principle of mathematics ensures that the plane of the floating platform and the reference plane on the bottom of the car – from which all measurements are defined – will always be parallel, regardless of the orientation of the inspection pad or the car in space. Once that relationship has been established, all measurements of height, body width, and length are made using tools which are rigidly fixed to the floating platform in order to ensure repeatability.

From a competition perspective, the most important measurement is the verification of the height of the undertray of the car as measured from the reference plane. Champ cars have shaped tunnels cut into the bottom of the car to take advantage of the Bernoulli principle. By restricting the flow area under the car, the flow is accelerated and the

pressure is reduced, creating a net downward force – simply termed "downforce" in racing – that increases the lateral force generation of the tires, resulting in increased cornering speeds. A simple fluid mechanics equation, the continuity equation, tells us that the more restricted the flow area becomes – that is, the lower the undertray sits in relation to the race track – the faster the air flows and more downforce is produced. Therefore it is to every team's advantage to run the car as low as possible. However, because of the potential for bottoming out when driving over bumps, which could result in a driver losing control of the vehicle, Champ Car has established a minimum height for the undertray. Precise measurement of this height is critical both for the team's purposes in predicting the aerodynamic performance of their car and for Champ Car's goal of enforcing the rules in a fair and equitable manner. Thanks to the simple-but-ingenious design of the inspection pad, this measurement is repeatable and effective, and the teams depend heavily on the technical inspection crew to help them maximize the performance of the undertray.

After each qualifying session and race, a few cars chosen at random are compelled to undergo an inspection to certify the results of the competition. One of the requirements of this forced inspection is the submission of a full set of data from on-board telemetry. Each car is equipped with a number of sensors and tools to measure accelerations, loads, pressures, and other items. These sensors communicate with a data acquisition system supplied by Pi Research which transmits real-time data to the teams, providing the capability of assessing the car's performance and making quick decisions on setup changes. The student conducted regular inspections of these data sets following a race or qualifying session in order to verify that the teams were not employing any illegal driver aids such as traction control. In a few instances, the data can also provide compelling evidence of guilt or innocence in the event of a multiple-car accident.

Participating both in the physical technical inspection of the cars and regular review of telemetry data provided invaluable experience in the management of vehicle setup. By working closely with the teams to bring their cars into compliance with the regulations, the student learned not only about the individual components of the vehicle, but also how each component depends on the others to create one very complex engineering system. Specific setup parameters are dictated by the track configuration, the weather and the driver's preferences. Learning how to incorporate all of these into a setup that optimizes lap times is the very core of an engineering career in racing, and the time spent in technical inspection was a valuable resource for attaining that knowledge.

Aside from aiding in the various technical inspection procedures, the student also was responsible for the collection and analysis of accident data for the purpose of continuing Champ Car's history of safety improvements. Each car is equipped with an accident data recorder – similar to the familiar "black box" of an aircraft – which records acceleration in three axes, as well as other critical information such as vehicle speed, engine speed, gear position, and the standard driver inputs of throttle, brake, and steering. The drivers are also required to wear specialized earpieces which record three-axis accelerations of the head during an accident.

After any crash, all of this data is retrieved from the accident data recorder and analyzed to determine the cause and nature of the incident. By comparing the driver inputs with previous laps, it can be determined whether the crash was the result of a driver error or of a failure of some component on the car. The peak acceleration of the chassis may be determined to establish the limits of the car, and the peak acceleration of the driver's head is determined and recorded in a database accessible to Champ Car's medical staff for the purpose of evaluation and monitoring of the driver's physical condition. In some cases, the accident may be exacerbated by an unsafe construction of the track – in these cases the data may be used in conjunction with a synchronized video record of the crash to justify changes to the track layout. This particular aspect of the internship provided a great deal of experience in both data acquisition and data analysis, and also helped to illustrate how engineering can relate to other fields in professional practice.

During the 2006 season, Champ Car conducted two independent projects to update their racing car technology for the future. The junior series operated by the company – the Champ Car Atlantic Series – underwent a change of tire suppliers that would be effective at the start of the 2007 season. A series of tests was conducted with the new supplier to establish the compound and construction of the tire. Because the Atlantic Series is a "spec" series, meaning that each competitor uses the same chassis, engine, and tires, only one tire choice was needed rather than the multiple options provided by tire constructors in series where direct competition occurs. As a result, the desired compound could be considered rather hard by racing standards, since sheer speed could be sacrificed for durability.

These tests involved comparison of numerous compounds and constructions, as well as a few direct comparisons of the best candidate with the 2006-spec tire. During the tests, the setup of the car was manipulated to keep the handling as neutral as possible so that differences in the performance of the tire would not be masked by aerodynamic or suspension effects. The student served as the data acquisition specialist during some of the testing, collecting and analyzing the telemetry data to assess the relative performance of each of the tire options, and also had the opportunity to consult on setup changes during the test. For any racing car, tire performance is critical because the tire is the only component of the car which is in contact with the racing surface. The intern's work experiences during the tire test brought many insights into the subtleties of tire construction, demonstrating the effects of changes in tire spring rate, lateral and longitudinal stiffness, and coefficient of friction.

The larger project involved the design of a new chassis which will be used by all competitors in the Champ Car World Series beginning in 2007. Because the supplier of the new car – Elan Motorsports Technologies – will be a single supplier and has no competitors to race against, the car is the first champ car in many years which was designed for the purpose of racing against itself. The previous generation of champ cars, built by multiple constructors, had all emphasized the generation of downforce by aerodynamic devices on the bodywork of the car in addition to the downforce generated by the tunnels in the undertray of the car. The end result was a fairly low ratio of downforce to drag, which created significant wake turbulence behind the cars and made it

difficult for an approaching driver to make a pass. These cars were very much designed to take advantage of laminar airflow, and did not perform well in the turbulent air immediately behind another car. While this does create a challenge for the teams and drivers, it is not necessarily the most exciting way to conduct a race for the fans.

With this in mind and faced with a chance to build a car which would not have to compete against other constructors for sales, Champ Car and Elan worked together using sophisticated CFD techniques to achieve roughly the same level of total downforce generation as the previous cars but with an increased emphasis on the use of the undertray, reducing the total drag generation significantly. The internship provided several opportunities to discuss the design considerations for the new chassis with Champ Car's Director of Technology, Scot Elkins, as well as to see the prototype car in demonstration runs and compare its performance to the 2006-specification vehicles. In any design project, it is critical that the engineer can understand the requirements of various customers and convert those into quantifiable engineering targets to ensure that the design is satisfactory for all parties. For the intern, this was a unique chance to witness the design process in action with engineering targets which are not necessarily typical in motorsports.

Success of the Program

From the student's perspective, the internship program with Champ Car was valuable on many levels, and is a program that would be highly advantageous for any engineering or technology student interested in a career in the auto racing industry.

First and foremost, the internship provided plenty of opportunity to put basic engineering principles into practice. Data acquisition and analysis are a huge component of motorsports, and were heavily highlighted in the work experience. Fluid mechanics, solid mechanics, statics, vehicle dynamics, and basic electrical engineering were emphasized. A firsthand view of the design process and the testing programs associated with reaching and verifying engineering targets enhanced the program significantly.

Aside from the strict academic benefits, the internship program gave the student a chance to work closely with nearly all of the mechanics and engineers who make a living by working in Champ Car. In motorsports, perhaps more than in any other business, success depends on both the depth of academic competency and the credibility that comes with having proven your capabilities. The opportunity to demonstrate engineering skills to prospective employers at racing teams and product suppliers opened the door to a number of potential career-launching relationships, and the familiarity with the teams, cars, circuits, and regulations that resulted from the program cannot be underestimated.

Lastly, as with any internship, the program gave the student a fresh perspective on life as a professional engineer and member of numerous communities. Rather than working exclusively with other engineers, the student worked side-by-side with doctors, attorneys, marketing specialists, computer programmers, and people from many other lines of work, giving a broad view of the role of the engineer in society. The study of various cultures

was a fringe benefit, with the program offering work and travel experiences in numerous regions in the United States, Mexico, Canada, and Australia.

In all, the depth of the Champ Car internship experience was beyond expectations, and was well worth the effort. The present is an exciting time for many people who hold a vested interest in motorsports engineering education, but there is much still to be done. An increasing number of educational institutions are recognizing auto racing as a viable career path and are developing work-study programs which lie beyond the boundaries of a typical co-op or internship experience, broadening their appeal to current and prospective students. Within the motorsports industry at large, the challenge to create these types of experiences for college students still remains, but the reluctance of many racing-centered companies to employ interns is slowly being reduced and the benefits are being realized by an increasing number of employers. It is critical that the academic community continues to educate the racing industry on the gains that can be reaped from programs similar to the one described here while working to reduce the culture gap between the two industries that has provided the barrier to these experiences in the past.

From the IUPUI perspective, this particular internship program was very successful. The three interns involved had the opportunity to travel and experience different cultures in addition to have an "up close" and personal experience in the motorsports industry. One of the interns is currently still working with Champ Car on special projects. The publicity generated by the internships was also responsible for inquiries from many prospective students around the country. The internship program is partly responsible for the growth of the certificate program.

The Champ Car liaison, Scot Elkins, had some disappointments in the internships. His disappointments, however, are not at all related to the students but, to the opportunities available to the students. He was hopeful that he would have more time to dedicate to the students and create a structure and better plan for what they would be doing. But, in addition to the actual races, Scot was also working with the development of new chassis that would be introduced to the series for the 2007 season. He was very pleased with the three interns that he had during the 2006 season. They all had a very broad motorsports experience. He also regrets that the students did not have an experience working with a race team on race day. They are continuing the internships for the 2007 series with continued financial support from the IUPUI Solution Center.

Other Motorsports Opportunities

The School was able to generate additional opportunities for students. One intern was placed as a Support Engineer with Panther Racing. Panther is a team in the IRL series. The highlight of his year was the 2006 Indianapolis 500. This intern will return to Panther in the 2007 season and they are also planning to interview interns for two – three additional opportunities. Panther has also hired an intern from Communication Studies. The School is working closely with Panther in their development of the Panther Education Center which is dedicated to providing education opportunities for K-12 education.

The School has also collaborated with universities in England has created a summer study abroad program. Students will study at four different universities in England, visit race organizations in England, and have the opportunity to go to the Formula One race in England. This opportunity is open to all students.

The School will be hosting its first summer motorsports program for high school students. The summer program will include an introduction to motorsports as well as visits to area race teams.

Each year the school hosts a Motorsports Day. The Champ Car World Series, the Indy Racing League are both represented. In 2006, Champ Car driver Katherine Legge talked with both current IUPUI and prospective IUPUI students. This was just a week after she walked away from a devastating crash in Elkhart Lake, WI where her car flipped at least six times after crashing head-on into a retaining fence. Our interns also talked about their opportunities along with four of our students that are race car drivers in various midget series.

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Biographies

TERRI TALBERT-HATCH is the Assistant Dean for Student Services in the Purdue School of Engineering and Technology, IUPUI. She is responsible for student recruitment, scholarships, marketing, internships and co-ops, and student council advisor. Terri has been involved in motorsports for a number of years as a race team timer/scorer, wife of a mechanic, but mostly as a spectator.

JOSH KILLEY is the Director for the Career Services Office in the Purdue School of Engineering and Technology, IUPUI. His duties include the oversight of the Internship and Cooperative Education program. Josh is currently enrolled in the Higher Education Master's Program at Indiana University.

MICHAEL ARMBRESTER, JR. is a graduate student at IUPUI studying Mechanical Engineering. He is specializing in thermal fluid sciences. He was the lead intern at Champ Car in 2006 and is continuing to work on special projects. He was President and Founding Member of the IUPUI Motorsports Club in 2006.