Paper # 15

Karting Engineering Educational Opportunities in Illinois and Indiana

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Abstract

The purpose of this paper is to describe the nature and scope of kart racing activities in Illinois and Indiana and propose related engineering educational opportunities. Karting is generally considered to be the primary entry point for many forms of racing and events are held almost every weekend in Illinois and Indiana from March through October.

While most karters do not become professional racers, many aspire to be engineers and work in related technology fields based upon their karting experiences. Karting can serve as an excellent instructional platform and a valuable recruiting tool for engineering educational programs.

Kart racing has evolved from a "backyard" sport to a sophisticated blend of technology and sport. Karters routinely use innovative technologies such as data acquisition systems, engine dynamometer data analysis, and track mapping resulting in constant race adjustments. Trying to understand the basic physical science-based principles and how these relate to kart and racer performance are challenging for even the most experienced karter.

Karting is a viable motorsports engineering educational opportunity. The use of karts in educational exhibits, websites and demonstrations can provide interest approaches that help young people understand engineering applications and create interest for pursuing engineering studies and careers.

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Introduction

Karting represents the essence of motorsports. On any given weekend from March to October throughout Illinois and Indiana karters will participate in a variety of racing activities. Karting has been active in the United States for over fifty years. Many of the current kart races and activities can trace their roots to the emergence of kart clubs and racetracks established during the nineteen-fifties and sixties. The increased interest in motorsports, dominated by the growth of NASCAR has had a significant impact upon the expansion of karting in Illinois and Indiana over the past five to ten years.

Karting has been and will continue to be a primary starting point for future racers. Almost all of the top level professional racers got their start in racing karts at the local club level. Top level professional racers Michael Schumacher, Frenando Alonso, Aryton Senna, Tony Stewart, Danica Patrick, Scott Speed, A. J. Allmendinger and Graham Rahal not only got started racing in karts but were national and international level champion karters.

Several of the current stars of racing such as Tony Stewart, Danica Patrick and Graham Rahal started in motorsports by racing karts in Indiana and Illinois. Tony Stewart, from Columbus, Indiana, started racing karts at the age of seven, in 1980 at the age of eight won his first championship - a 4-cycle rookie junior class championship, the 1983 International Karting Federation Grand National championship and the 1987 World Karting Association National championship[1]. Danica Patrick, born in Beloit, Wisconsin, hometown Roscoe, Illinois, started racing karts in 1992 at the age of ten, in 1993 finished second in the Midwest Sprint Series, won the World Karting Association Manufacturer's Cup national level championship in 1994 and won the Great Lakes Sprint Series championship in 1995, all in a Yamaha kart class[2]. More recently, Graham Rahal, hometown New Albany, Ohio, started racing karts in Ohio in 2000. In 2001 Rahal, age 12, competed in Yamaha and 80cc shifter classes, winning regional races in Yamaha classes, won his first 80cc shifter pole position at South Bend, Indiana and finished third in the South Bend WKA race[3].

Kart racing has a rich tradition in Illinois and Indiana. Some of the future stars of auto racing are currently racing karts in this area. Supporting karting in Illinois and Indiana is of the mutual benefit not only for motorsports and businesses, but also the engineering education community as well.

Purpose and Objectives

The overall goal of this paper is to describe the nature and scope of kart racing activities in Illinois and Indiana and propose related engineering educational opportunities. The specific questions are:

1. What is the nature and scope of karting in Illinois and Indiana?

2. What are the perceived educational opportunities for karters?

3. What strategies could be utilized to connect engineering education and karting?

Nature and Scope of Karting in Illinois and Indiana

Arguably the Midwest region of the United States is considered one of the primary areas for motorsports including kart racing. California and the Southeast region would lay claim to being more significant areas, however all three areas provide significant opportunities for kart racing. Karting can be divided in to three broad categories; sprint racing, road and endurance racing, and oval track racing. Sprint racing is a series of shorter races, usually about twenty minute sessions, held on road course type asphalt tracks ranging in length from about one half to one full mile. Road racing and endurance races are generally held on larger paved tracks over one mile in length and the race sessions are for a longer period of time. Oval track kart races are held on both paved and dirt tracks. Sprint kart racing is generally considered the most popular with the greatest number of events. While sprint racing may have more total participants, road racing and endurance races often attract the largest fields with several hundred entrants for a single weekend series of races. Sprint racing generally has the largest number of participants and events in Illinois and Indiana and therefore will provide the focus of this paper

Karting can be divided in to three basic levels: club racing, regional racing and national level racing. Local club racing provides the grassroots level for karting. Generally, the local kart club is volunteer based organization. However, some kart clubs are organized and administered by the owners of the local track. The club utilizes a local kart track for a weekly series of about ten to fifteen races. The racing and related activities while based upon racing competition are considered to be recreational activities for the entire family, open to all members who want to participate. Generally, all of the on-track and off-track activities are conducted by volunteer club members. At a club event, a very wide range of race participants are involved, from children starting at age five, to adults, including senior citizens. It not unusual to see three generations of karters participating on track at the same event.

The general classifications of karters starts from ages five to eight years as a non-competition class where all karters are awarded the same trophies for participation, eight to twelve year old classes, the first level of competition karting, followed by the twelve to fifteen year old karters, often considered to be the one of the most competitive classes, the adult classes, from fifteen years and older, and also a series of masters classes for karters starting from either thirty-five or forty-five years old and up. While generally considered to be male dominated sport, the younger levels of karting are often well represented with girls participating. However, it is generally noted, that the level of participation by females does tend to decrease in the more mature classes. One could speculate that over time, more females will participate at all levels.

However, local club kart racing is facing significant challenges for the immediate future. Increasing costs to maintain kart racing facilities and provide activities, insurance and liability, competition from other forms of racing, and the expansion of additional karting

opportunities are considered as possible threats. Local clubs by their very nature as volunteer based organizations are often not in the best position to be able to respond to changing conditions. The family based values structure of club karting may be its most valuable asset.

Regional karting in Illinois and Indiana has seen a significant increase in participation over the past five years. Regional karting is a series of race events, usually a two-day weekend series of races, conducted at several different tracks throughout a region. Within the past three few years, the greater Illinois and Indiana area has seen the expansion from two regional sprints series to five. Road racing which often includes endurance racing also follows a similar regional format, and has seen significant growth as well. A regional series utilizes several tracks in the area and generally hold five or six race weekends during the season. These events have grown significantly. It is common for these types of regional events to have over two-hundred participants for each weekend. For the local tracks and clubs regional races are often a primary revenue generator. The Midwest Sprints Series[4] and the Great Lakes Sprints Series[5] are recognized as premier series and attract racers from all over the United States. The regional road racing and endurance series and oval track racing series also are gaining in popularity and participation.

National level kart racing is also found in Illinois and Indiana. The World Karting Association (WKA) holds two of five of its premier national east coast annual sprint racing events in Indiana[6]. One event is scheduled for the Michiana Raceway Park[7] outside South Bend, Indiana in May and a second event at the New Castle Motorsports Park[8], outside New Castle, Indiana in September. The WKA also holds a national road racing event at the Putnam Park Raceway[9], near Mount Meridian, Indiana. These events will attract the best karters from across the United States and may attract racers from Canada, Mexico, and even South America.

Karts

Just as the nature and scope of kart racing has been growing and expanding, racing karts have been changing as well. It has been our experience that people not familiar with kart racing visualize karts like those you would see at an amusement park or what would be referred to as “yard karts”. However, after they have observed a kart race, they have a different perspective. Karts are surprisingly quick, loud, sophisticated and fun to be around.

Racing karts are very well engineered machines. Each year the major kart manufacturers provide new models for a variety of racing classes and applications. Most of the karts currently raced in the United States are engineered and manufactured outside of the country. The most significant domestic kart is the Margay brand which is headquartered in the St. Louis, Missouri area[10]. Italy provides a significant proportion of the karts raced in the United States.

There are two basic types of engines used for kart racing: two-stroke cycle and four-stroke cycle. The most common two-stroke cycle engine used is a 100 cubic centimeter displacement Yamaha engine[11]. Briggs and Stratton produces the most common four-stroke cycle engines[12]. There are several very successful builders of karting racing engines in Illinois and Indiana. These engines are blueprinted, performance tested and fine-tuned based of upon the rules set by the sanctioning body. It is common for karters participating in the highest levels to use "freshened" engines every weekend.

Kart suppliers not only need to sell karts to perspective buyers but also need to provide information and service to their customers. While not based upon a formal survey, it is possible to hypothesize that much of the information that the suppliers provide to karters is basic information on how to setup, manage and operate the karts. As a general rule, the suppliers are not engineers as the majority of karters are not either. Many of the instructional needs of the kart suppliers are the same as for the karters. Engineering education programs could work through kart suppliers to provide a variety of educational programs. The workshop model setup by MRP Motorsports[7] in South Bend, Indiana would be good starting point. Also, the Kart Expo[13] which is the largest kart show in the United States is held every February in the greater Chicago area. Suppliers could identify instructional topics and strategies, provide facilities and equipment, recruit participants, and manage the instructional delivery.

Tracks and Facilities

If you were to ask kart racers what has changed the most in the Illinois and Indiana karting the past five years? It is fair to say that many would indicate the changes in the kart racing track and facilities. The changes have been dramatic.

A very significant addition has been the building and operation of the New Castle Motorsports Park[8] just off Interstate Highway 70 near New Castle, Indiana. Most everyone would agree that is one of the finest karting facilities in the country, if not the very best. It has a variety of track layouts varying in shape and length up to one mile length configurations. It also has on-site garages, a restaurant, camping facilities and a retail kart supply store. The Dismore family has established this premier karting facility.

Some people would suggest that the South Bend Michiana Motorsports Park[7] is just as noteworthy. This facility was bought and is now managed by MRP Motorsports, headquartered in Thousand Oaks, Michigan. The Lobaughs have greatly improved the track and facilities. This track also has multiple configurations up to about one mile. With the addition of the New Castle and the improvements of the South Bend tracks and facilities, Indiana has become a major center for karting in the United States.

The growth and expansion of karting Illinois is equally as impressive. The Concept Haulers Motor Speedway[14] in Norway, Illinois has been improved under new management. This track and racing facility is located approximately one hour southwest

of downtown Chicago. This track offers multiple configurations up about two-thirds in length.

The Mid-State Kart Club has operated a kart track near Mechanicsburg, Illinois for over fifty years[15]. About five years ago, the club lengthened the sprint road racing course layout to one-half mile and added a paved oval track.

The Autobahn Country Club[16] operates a road racing facility located in a rural area near the Chicagoland Speedway outside of Joliet, Illinois. This past year, they constructed a kart track. The kart track has not been scheduled for nonmember competitive activities. The Kartplex[17] located on the grounds of the Chicagoland Speedway operated some karting activities this past year including Route 66 Series regional sprint races[18]. And, the Chicago Indoor Racing karting facility has open in Buffalo Grove, Illinois in the greater Chicago area and offers year around kart racing and activities[19].

The growth of kart racing track and facilities in Illinois and Indiana over the past five years or so has been impressive. The opportunities for engineering education programs and activities may be just as impressive.

Educational Opportunities

The educational opportunity that may be associated with kart racing and other karting activities is not known. A basic review has not identified any form of instructional needs assessment or inquiry. The rapid growth of kart racing and related facilities seems to indicate that a potential audience is available and expanding. MRP Motorsports[7] operates kart racing school and conduct seminars style workshops for karters. It seems as though engineering education can contribute knowledge and expertise to the karting community to the mutual benefit of both.

Safety

One of the first areas of interest for kart racing is the aspect of safety. All motorsports are inherently dangerous and karting is no exception. Most karts do not provide rollover protective structures and do not use safety seat belts. Safety standards are set by the sanctioning organization. Karters are generally required to wear helmets, neck braces and full abrasive resistance suits or suitable clothing. For sprint and oval track racing the top speeds vary based upon the class, however maximum speeds are from about sixty to seventy miles per hour. It should be noted that the top speeds for road racing and endurance can be faster.

There does not appear to be formal, complete data related to karting accidents and the injuries that occur. It is generally perceived that chest and neck injuries are the most serious. However, the relative number of these occurrences is not readily available. Karters often discuss the need for greater safety measures such as rollbars, seatbelts,

collapsible steering columns, impact absorbing bumpers, and other such devices. The main aspect that karting lack is a systematic, engineering approach to the design of safety measures in karting. For example, the inclusions of rollbars may significantly raise the center of gravity of a kart, and therefore actually increase the likelihood of a rollover. Without sufficient data and information from an engineering perspective, it is difficult for kart racing groups to be able to make changes, as a change may create another unsafe condition. Engineering education could provide a very resource for the karting community by providing simulations of karting safety improvements. Simulating karting accidents would be a major milestone for kart racing.

Data Management

At any given kart race almost every kart will use some form of electronic data collection. Only the kid karts for youth ages five to eight do not readily use this technology. The most common level of data collection system collects engine speed in revolutions per minute, lap times in seconds, and engine cylinder temperatures. A visual live data display is provided to the racer. The data is stored on the kart and after a session can be played back for viewing on the kart or downloaded to a computer.

More sophisticated data collection systems can be used to collect a variety of data inputs such as speed, exhaust gas temperatures, two-axis accelerometers for braking, acceleration, and cornering loads, and segment lap times. These data systems are often used to map track layouts and help the racer determine driving styles and characteristics. These data are often used to improve driver performance as well as kart performance.

The challenge for the karter is to be able to manage data. The more sophisticated data collection systems collect data that is challenging for even the most experienced racer to determine what is manageable. A common phrase from a karter is that the data just confirms that I need to go faster. Engineering education could help the karting community understand how to manage and work with data collection systems using systematic approaches. Also, being able to understand the nature of the data, such as what the units of measure represent and how the data channels are actually collecting the data would be of benefit. The most successful kart racers are probably the ones that are best at being able to understand the data that they have. Such an opportunity exists for engineering education programs.

Racing Physics

How a kart turns is an interesting physics problem. The solid, fixed rear axle does not allow the kart to turn in the same way that most other motor vehicles turn. For the novice as well as veteran karter, understanding the applications of basic physics to an actual race situation is challenging at best. Karters adjust the front steering geometry to allow the desired amount of weight transfer to occur basically in order to allow the kart to "tricycle" around a corner on three wheels, un-weighting the inside rear wheel. Most karters learn this on their own through racing experience, or are provided information from the other racers, track personnel or the kart suppliers.

The MRP Motorsports[7] of South Bend, Indiana operates a series of instructional workshops during the winter months. MRP operates the Michiana Motorsports Park and markets karts and karting supplies. The most popular workshop that they conduct is related to understanding basic kart setup. They provide instruction and demonstrate how to statically set the kart chassis. As one demonstration they use electronic scales for each corner of the kart to simultaneously show how changing the steering setup affects the corner weighting of the kart.

Another aspect of racing physics that has particular application for karting is weight transfer. Kart racers have to meet a minimum racing weight. Karts with the driver on board are weighed after every timed session. Most karters will strive to be above the minimum weight by less than one percent. Therefore, the opportunity exists to move ballast on the kart chassis, move the position of the kart seat, carry varying fuel loads, and otherwise manipulate the center of gravity. For example, lead weights are often moved on the back of the kart seat up or down, and either to the left or right to change the handling and steering input response characteristics of the kart. These changes are based upon a variety of conditions such as track temperature, tire compounds, track surface changes, and even the driving style of the racer. However, understanding the basic aspects of how the kart responses to changing the center of gravity and the relative weight transfer as the kart negotiates a series of corners on the track would be of great interest and benefit to the karting community.

Modern racing karts are designed to have a relative degree of flex in the chassis. The flex contributes to the degree of weight transfer and turning input. As with other aspects of applied physics and engineering, this is a particular challenge for karters at all levels. While the actual composition of the construction materials for a specific brand of kart is proprietary, it is generally perceived that a range of low alloy steels, presumably chrome-molybdenum steels are used for the chassis. The manufacturers use a combination of materials and varying degrees of material thicknesses to achieve the desired amount of chassis flex. The karters have the options of installing and removing selected chassis braces in order to control the relative degree of chassis flex. Also, there are a wide variety of solid rear axles for the karter to choose from. These axles vary based upon the type of materials, heat treating process, dimensions and wall thickness. Understanding how the flex of the axle is a challenge to karters relying upon test data. Manufacturers and suppliers are challenged in that they need to keep technical data secure but be able to work with customers. Any instruction related to the physical properties of kart chassis materials would be of benefit to karters and suppliers.

Another challenge for karters is to understand the basic principles of how tires “generate grip”. Karts do not rely on any significant degree of aerodynamics, as traction for acceleration, braking and cornering is generated from mechanical grip. A practical example is that a common tire used by sanctioning bodies is the Bridgestone kart racing tire, model YHC. At most tracks and based upon the manufacturer’s recommendations, the tire is pressure is operated at approximately 10 to 16 pounds per square inch (psi). However, at the New Castle Motorsports Park, pressures of 22 to 26 psi are commonly

used by some karters. Understanding how tires function would be of benefit to karters in order to try to understand how tires react differently to various track conditions. Also, karts generally race in rain conditions, except for oval racing and under extreme rain conditions. These tire "grip" situations are challenges for karters and there exists a need to better understand the basic principles of how tires operate.

Engine performance is another area of interest. Kart racers spend as much time tuning the engine as they do tuning the chassis. Understanding how to adjust carburetion based upon varying conditions such as air temperature and air density is a constant challenge. Another area of interest is how to determine the optimal gear ratio between the engine and the drive axle. The drive clutch is also adjusted in order to maximize the power and torque output of the engine based upon the speed at which the clutch "locks up". These are but a few of the challenges that karters work with on a constant basis during a race event.

These are but a few examples of opportunities for technology education that engineering education programs could provide. A formal needs assessment might generate a different set of educational opportunities. However, the point that needs to be made is that karting could benefit from what engineering education could provide and it is possible that engineering education students and programs may be able to benefit as well.

Strategies of Engineering Education

The karting community is not only just a bunch of karters out having a good time on weekends racing. There exists a system of kart suppliers, engine builders, tire manufacturers and suppliers, track operators, kart racing schools, recreational kart providers and kart professionals. What may be perceived as an educational need for one group may or not be perceived as a need for another group. However, there probably would be consensus from all the groups involved that the grassroots karter who shows up with his volunteer race team, family and kart each weekend is the key element for the entire industry. The fundamental question then becomes what strategies can engineering educational provide that will benefit not only karting but local businesses, communities and the motorsports industry in general.

Engineering education can have a significant impact for the karting community at the local level. Local kart clubs generally maintain websites, use printed newsletters, and have regularly scheduled meetings for the membership. As with most motor sports organizations, there is a constant need for information. Engineering education programs could provide information to karters using a variety of strategies. For example, undergraduate engineering students could develop web sites that explain and visually demonstrate weight transfer, and to take it one step further, describe how it applies to a kart. For the average karter, the information needs to be basic, clearly presented and provide examples for application.

The other strategy would be to develop basic web sites that present fundamental applications of physical science principles for karting applications. Those involved with

karting recognize success is sometimes achieved by having access to the latest technologies and information. However, having a basic understanding of the technology knowledge base contributes to the eventual applications. Engineering education programs could provide explanations of many of the basic physical sciences principles that apply to karting. Some examples would include the effects of changing the center of gravity, the effects of air density on engine performance, the effect of tire pressures on tire handling characteristics and the relationships of speed and torque as applied to gear ratios.

There are also several kart print publications that are interested in publishing engineering based articles. One such example is the National Karting News which publishes a monthly magazine and maintains a kart sporting news web site[20]. Many of the technical articles present information of the fundamental aspects of karting such as chassis setup and the understanding the principles of weight transfer. It seems as though engineering educators could provide a variety of manuscripts for these types of publications.

While much of the information that engineering education could provide may be best delivered as web sites, the aspect of face to face contact may better serve young people. The interaction between undergraduate engineering students and kart racers of all ages has the potential to provide an excellent learning environment. The students would have opportunities to develop communications and problem-solving skills in practical manner. Karting could provide a good starting point for many engineering students just as it does for many professional auto racers.

Another strategy would be to work towards the recruitment of young people into engineering education programs. It is challenging for youth to make the connection between the karting technologies and engineering education. Most young kart racers realize that they will not have the opportunities to pursue careers as professional racers. What is lacking is recognizing the engineering education that is involved in designing and manufacturing karts, tires, engines and data management systems. The experiences that these young people are getting by working with technologies to achieve goals and be successful are significant learning assets derived from kart racing. While many young karters will not be able to enter four-year undergraduate engineering educational programs, many are able to pursue career paths in automotive related technologies. Engineering education programs should target the youth karting experiences for recruiting perspective students and creating general interest in engineering education.

The final proposed strategy is to link the Society of Automotive Engineering Formula SAE students with the karting community. Formula SAE teams have many of the same challenges that karters have always been working with. The basic concept being how to get a lightweight vehicle, with a relatively low output engine, that utilizes primarily mechanical grip and a spec tire to be able to go fast and handle well. There seems to be natural link between Formula SAE and the karting community.

Summary

The overall goal of this paper was to describe the nature and scope of kart racing activities in Illinois and Indiana and propose related engineering educational opportunities. The specific areas were to address the nature and scope of karting in Illinois and Indiana, present some perceived educational opportunities and suggest strategies that could be utilized to connect engineering education and karting.

The first key points are that karting is experiencing a period of growth and expansion in Illinois and Indiana. Karting is generally considered the primary entry point for other forms of auto racing. However, the foundation of karting is still based upon local level activities and a family level recreational sport. Throughout Illinois and Indiana there are several top level karting facilities and many kart small businesses that provide a variety of services for karters.

The second set of points is that the engineering education needs and interests of the karting community represent a fundamental application of physical science principles to kart racing. Some of the areas of interest include safety, data management, engine performance, chassis setup and handling. The majority of karters have an entry level of knowledge and limited experiences, therefore would benefit significantly from basic engineering education applications.

The third set of points outlines several strategies that engineering education programs, educators and students could use to connect with the karting community. Basic engineering education applications could be provided as web sites, print media, and contacts with local kart clubs, track and suppliers. Karting could provide a means to enhance recruiting and interest in engineering applications through education programs. The synergy from the interactions of engineering students and educators with the karting community could prove beneficial to all.

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