Mechanical design, as classically taught in engineering has centered around the application of stress analysis theory. While this theory is important, actual industrial design is generally dependent upon manufacturability, time constraints, and cost constraints as well as stress analysis. With this in mind, the SAE Mini Baja® competition was originated at the University of South Carolina in 1976, under the supervision of Dr. John F. Stephens. Since that time, the competition has grown to become a premier engineering design series. Three Mini Baja® competitions are held annually under the sponsorship of SAE.

A precursor to the SAE Mini Baja® was the Recreational-Ecological-Vehicle (REV) contest conceived by Dr. William R. Shapton in 1973. The object of this competition was to design and fabricate a two-man amphibious all-terrain vehicle (ATV) capable of negotiating 25 miles of virgin Michigan forest and several hundred yards of deep water. The six entries in 1973 primarily altered and rebuilt existing commercially available ATVs. During REV 1974, the eight vehicles entered included several built from "scratch." The range of cost of the ATVs in the REV series ranged from $1600 to approximately $5000. They were indeed one-of-a-kind race vehicles and not indicative of a project that would simulate the design of a mass-produced product. The REV series was quite important in that it established the value of such competitions and demonstrated the interest in vehicle oriented themes (SAE Technical Paper 780241).

1976

Based upon the learning experiences of the REV series, Dr. Stephens initiated the concept of Mini Baja®. In 1976, there were several companies producing a one-man all terrain vehicle retailing for approximately $800. Each of these vehicles was reportedly capable of negotiating very rough terrain with a great deal of reliability and speed. The object of the Mini Baja® competition was to design and fabricate a one-man all terrain vehicle having more than two wheels that will be completely competitive with the manufactured versions from the standpoint of safety, appearance, design, performance, and cost. In simplest terms, “design the most competitive vehicle for the least cost.”

1976 cont’d

The 1976 competition required each team to use the same Briggs & Stratton 8 hp, 4-cycle horizontal shaft air cooled engine (Model No. 190432-0535). Twenty-five years later, Briggs & Stratton still remains committed to this worthwhile engineering education competition. The engine had to remain completely stock, and the vehicle must be produced with approximately 300 man-hours. Rules from the first competition required that the vehicles be capable of carrying a 6’3” adult weighing 250 pounds. The vehicle must be capable of operation in loose sand, mud, rough terrain, and occasional water up to 12” deep. Top speed for the vehicle is approximately 40 mph and the vehicle must be capable of climbing a 30 degree incline. Vehicles are to weigh less than 400 pounds and the total vehicle must have a manufactured cost of $450 or less.

Held at the University of South Carolina and Fort Jackson, the first Mini Baja® competition in 1976 included 10 participating universities from: Worcester Polytechnic Institute University of Cincinnati (multiple vehicles) University of Southwestern Louisiana Queen’s University Rose-Hulman Institute of Technology North Carolina State University (multiple vehicles) West Virginia Institute of Technology Southern University University of South Carolina (multiple vehicles) Arizona State University

Judges for the first competition included Vernon A. Johnson of Eaton Corporation, H. A. Weaver of Western Electric Company, Inc., Dale E. Johnson

The competition progressed smoothly with a minimum of difficulties. Two problem areas did exist that warranted some recommendations: (1) cost should be coupled with the vehicle weight to average out any costing errors and (2) competition should be held regionally with a maximum of 16 participants in each region.

Industrial simulation projects involving design and fabrication do increase the “industrial awareness” of engineering students. The competitive environment created by Mini Baja 1977 generated the student and faculty interest necessary to insure complete, quality projects. While requiring more student and faculty time than normal, the benefits seemed to far outweigh the disadvantages. The concept of the 1977 Mini Baja was furthered greatly through the generosity of the Briggs & Stratton Corporation. They provided engines at no cost to the participating universities in addition to covering all expenses of the awards banquet (SAE Technical Paper 780241).

The 1977 winning entry from Auburn University was designed by six senior Mechanical Engineering students in their terminal design course. The use of a group term project as a learning vehicle in design courses was gaining popularity with engineering educators and students. The six man student design team tackled the project by selecting a “chief engineer” to coordinate their activities. Each person was assigned various specialties, and the first three to four weeks were spent gathering information, surveying the availability of relevant components, and generally becoming acquainted with the competition rules. In the end, Auburn amassed 893 out of 1000 points at the competition. This was no landslide win, since the second place vehicle trailed by 11 points (SAE Technical Paper 780242).
In 1978 the Mini Baja competition was divided into three regional events, all similar, yet distinctly different. The Southwest Baja at Arizona State University featured a cross country race, the Southeast Baja at Florida Technological University (FTU) required an amphibious vehicle and the Midwest Baja, sponsored by the SAE Milwaukee Section had a stringent noise requirement.

When FTU was invited to host the 1978 Mini Baja, they decided to keep the same basic format but to include a deep-water hazard into the endurance race to be traversed each lap. Having competed in 1977, FTU realized that there were several schools who had more experience than they at building this type of vehicle and they wanted to force a complete redesign of all entries.

Nine schools participated in the Southeast Mini Baja. A panel of judges from both industry and academia judges the vehicles in the following categories: consumer appeal, safety, design, post field trial, acceleration, drawbar pull, hill climb, bog run, deep water maneuverability, land maneuverability and endurance.

The pervading philosophy that was used in design at FTU was that the vehicle had to be as simple and lightweight as possible. This influenced all of the design decisions which were made. An innovative propeller concept was used on the 1978 FTU vehicle. It utilized two counter rotating propellers inside of cylinders driven in bevel gear fashion by frictional contact with the rear wheels. In spite of the inherent simplicity of the scheme, FTU discarded it in 1979 in favor of 4WD water propulsion (SAE Technical Paper 800541).

Three regional competitions were held essentially repeating the same format as the 1977 competitions, but held at different locations. Oregon State University sponsored the Southwest Baja, the University of South Florida sponsored the Southeast Baja, and Milwaukee sponsored the Midwest Baja again.

One would have to have seen both the 1978 and 1979 Southeast Mini Baja competitions to appreciate the progress that had been made. The 1978 FTU vehicle, which dominated that competition was entered in 1979 for exhibition purposes. It was not competitive on a course that was much more difficult than the previous year. One reason for this may have been that it had not received the tender loving care and fanatical support from the typical pit crew. The truth was, however, that the course was more difficult than the previous year and the vehicles were sufficiently improved that they could still negotiate the course. The FTU vehicle had a differential (2WD) which provided an obvious advantage in maneuverability on a good surface, but it had rained seventeen inches in Tampa, Florida the week before the 1979 competition and traction was more important under those conditions. One must admit that the condition of the course has a lot to do with the outcome of the competition (SAE Technical Paper 800541).

The overall winner for the second straight year was FTU. It was interesting to note that their vehicle did not place first in any single event. All points were accumulated by placing second, third or fourth. While the majority of vehicles were designed primarily for one or two events, the FTU vehicle seemed to be truly an all-terrain design. As in the past, engines for these events were donated by Briggs & Stratton Corporation.
1980

“We came to learn, not to win.” Thus spoke one competitor in the 1980 Mini Baja East competition at the University of Delaware. In truth, there was plenty of learning and of competing. But it was that friendly competition of engineering students whose joy in the success of a really nice design idea ranks nearly with their own zest for victory.

A very competent and enthusiastic team of judges, headed by Dr. Joseph R. Battenburg of Eaton Corporation, was drawn chiefly from industries in Southeastern Pennsylvania and Delaware. It was their task to judge the performance of 21 entries from Ontario to Puerto Rico and from New Hampshire to Texas.

The five overall winners were Syracuse University, Rochester Institute of Technology, Tennessee Technological University, West Virginia University and George Washington University. The endurance race, won by Rochester Institute of Technology, separated the five winners from the field of 18 starters who had survived to that point from the original group of 21. Syracuse had the lightest vehicle, which although it did poorly in the drag race, performed very well in the drawbar pull. Then on the second day it did exceptionally well in the land maneuverability and endurance events.

The solutions to the design problems were remarkable for diversity and ingenuity. Two vehicles were three-wheelers. Propellers showed up here and there, but as in the past, they were not very effective. Three vehicles were hydraulic drives, alone or in combination with chains. Bodies were generally aluminum or fiberglass with ad hoc modifications by duct tape as time went on.

Running the competition was most rewarding for the University of Delaware. It gave all of the practicing engineers involved the opportunity to see that the current crop of students was carrying forward their ideals. They were simply bursting with ideas, energy, and enthusiasm (SAE Technical Paper 800955).

1981

The 1981 Mini Baja Southeast was sponsored by Tennessee Technological University on May 14 and 15. Rochester Institute of Technology took a commanding lead over the other 27 schools who competed. The competition consisted of many different tests including acceleration, efficiency, drawbar pull, land maneuverability, water maneuverability, endurance, and post-competition inspection.

1982

The 1982 Mini Baja East competition was sponsored by Rochester Institute of Technology and the top three finishers were the University of Maryland, Bucknell University, and University of Arkansas, placing 1st, 2nd, and 3rd respectively.

1983

The SAE Student Branch at the University of Maryland sponsored the 1983 Mini Baja East competition. The event was held at Fort Belvoir in Northern Virginia. Forty-four vehicles from 40 schools in the U.S. and Canada participated. West Virginia University took first place with Bucknell University and Georgia Southern University, Car #1 taking second and third, respectively.

On the first day, the vehicles were judged for creativity, safety, consumer appeal and cost. During the first day’s events, held at the Meradcom test area, the vehicles competed in acceleration, top speed, braking, balance, suspension and maneuverability events.

The second day took the competitors into the “nitty gritty” of the competition. The land maneuverability course ran through dirt, gravel and mud with numerous sharp turns. Then came the hill climb with the initial run being a 45% grade of gravel and dirt. Vehicles reaching the top had a run-off on a 60% grade of gravel and dirt.
housed in the McGill University residence halls. After the arrival of the teams, the vehicles were judged on safety, comfort, consumer appeal and creativity.

The first day of competition was held at the Transport Canada Test Center in Blainville. The Government of Canada granted the students the permission to use this spacious and excellent facility. After the preliminary engine tune-up and inspection by Briggs & Stratton representative Bob Simross and his team, every vehicle was tested for land maneuverability, then on three consecutive slopes for its hill climb ability. The participants then engaged in a timed 3-kilometer flat oval track event. An annular pool marked off with buoys was the test site for water maneuverability, compulsory for eligibility to enter the endurance race on the second day. The final events of the day were the acceleration, top speed and braking tests. All the competitors were treated to a gigantic chicken barbecue at the residence hall that evening.

On the second day, the teams prepared their pit area for the days events. The site for the endurance event was an abandoned quarry just outside of Blainville that provided the rough-terrain and water for the event. The morning was spent largely on fine-tuning the vehicles while all teams lined up for the chain-pulling event. The organizers got a chain long enough to baffle even the strongest entry.

The piece de resistance of the contest was the endurance race. All vehicles were lined-up in the water of the large quarry pond for a most spectacular start. This endurance race was to be the most challenging event, clearly separating the most rugged and efficient designs from the rest. The leaders came in front in the first few laps, showing excellent land maneuverability and climbing power as well as efficient designs for water propulsion. After two and one-half hours, only ten vehicles had completed the ten laps with many others out of the race.
1986
This year marked the 10th anniversary of Briggs & Stratton’s support of the SAE Mini Baja competitions. Their support has contributed greatly to the tremendous growth and popularity of Mini Baja. Through their cooperation, thousands of engineering students have been afforded the opportunity to gain valuable practical experience in the design and fabrication of vehicles.

1987
Hosted by the University of Central Florida, the 1987 competition provided a stiff test for the 35 participating student design teams. Professor Alan Nye’s Rochester Institute of Technology team once again showed why it always finishes at or near the top in this event by running a flawless endurance event. Combined with a very consistent showing in the static judging, they took top honors overall.

Louisiana State finished second, maneuvering through the water and over the course with ease. New Jersey Institute of Technology won a place in the top three and gave notice that they will be a team to be reckoned with in future Bajas.

1988
Louisiana State University (LSU) finally put it all together for the 1988 competition with an entry that earned high scores in all events. LSU ran a flawless endurance race to take top honors in Montreal on May 12-14.

The two runner-ups were Tennessee Technological University and West Virginia University (WVU), 2nd and 3rd respectively. WVU showed super strength and versatility this year, popping up among the “top three” in three student design competitions – Mini Baja East, Mini Baja Midwest and Formula SAE.

1989
The 1989 competition was hosted by West Virginia University on May 11-13 in Morgantown, West Virginia. Tennessee Technological University won the competition with Clarkson University and Ryerson Polytechnic Institute following in 2nd and 3rd, respectively.

1990
The 1990 competition was hosted by the University of Central Florida on May 10-12 in Orlando, Florida. For the second straight year, Tennessee Technological University (TTU) won the competition with West Virginia University (WVU) and Clarkson University following in 2nd and 3rd, respectively.

The best performance in the acceleration event was accomplished by TTU. Lawrence Technological University turned in the best performance in top speed and braking. University of Lowell won the chain pull event, and WVU won the land...
1990 cont’d

The best performance for the water maneuverability and endurance was accomplished by TTU. The University of Florida took top honors in the bog run.

1991

The SAE Montreal Section hosted the 1991 competition. First place went to Trenton State College followed by Virginia Tech and Tennessee Technological University in 2nd and 3rd place, respectively.

1992

The 1992 competition was hosted by Tennessee Technological University on May 14-16 in Cookeville, Tennessee. Winning the competition was the University of Florida followed closely by West Virginia University and Ecole de technologie superieure in 2nd and 3rd place, respectively.

1993

Sun, sand, mud, and lily pads were all part of the 1993 Mini Baja East competition on May 13-15. The University of Central Florida in Orlando hosted the event which took competitors over the water and through the woods as part of an extensive off-road course. Vehicles ran through a series of tests including land and water maneuverability, acceleration, top speed and braking, sled pull, suspension and traction, and of course the endurance event. The 1993 water test was the most unusual in the history of Mini Baja. It was done in the resort’s wave pool. Needless to say, no one was interested in swimming in the chocolate brown water after the endurance event was finished.

Virginia Tech won the 1994 competition with 2nd and 3rd places awarded to the University of Central Florida and Clarkson University, respectively.

Thanks to Dr. Anh Dung Ngo who served as organizer for the competition.

1994

View, view, view! The mountain view that was part of the endurance event at the 1994 Mini Baja East competition was breathtaking. The host, Ecole de technologie superieure, was responsible for selecting the beautiful site at Mont Saint Savoeur Resort in Quebec, Canada. The event was held on May 27-29, which still wasn’t late enough in the spring to eliminate all the snow from the mountains.

Vehicles were tested in a series of events which included acceleration, braking, weight pull, land maneuverability, water maneuverability, suspension and traction, and of course the endurance event. The 1994 water test was the most unusual in the history of Mini Baja. It was done in the resort’s wave pool. Needless to say, no one was interested in swimming in the chocolate brown water after the endurance event was finished.

Virginia Tech won the 1994 competition with 2nd and 3rd places awarded to the University of Central Florida and Clarkson University, respectively.

Thanks to Dr. Charles Nuckolls who served as organizer for the competition.
History of Mini Baja® East

1995

On May 11-13, West Virginia University hosted the 1995 competition that included 36 teams competing in Morgantown, West Virginia. WVU had no problem finding a challenging hill for the hill climb event. After a few cars attempted the ascent, the event became even more challenging as the trail was converted into deep ruts by the nobby Baja tires.

This Baja was more than just a competition; it was a great spectators event. WVU set up the maneuverability event as two symmetrical courses laid-out next to each other. Each driver was under pressure from two angles, racing against the clock and racing against the car on the other course. As a finale, the top ten cars with the fastest times were pitted against each other for a grueling run-off. In the end, Tennessee Technological University held off the other teams and won the elimination.

After the eight dynamic events were over, the top three teams were Clarkson University, Tennessee Technological University, and Lawrence Technological University.

Thanks to Dr. Kenneth Means who served as organizer for the competition.

1996

The University of Central Florida (UCF) and the SAE North Florida Section hosted 34 baja vehicles on May 2-4. UCF could definitely boast about having the most water obstacles during an endurance event. Each competitor had to plow into the water three separate times during one lap of the endurance course.

The suspension event certainly took its toll on many vehicles. Quite a few fell victim to the buried logs that measured almost 2 feet in diameter, and not to mention, the railroad ties that were scattered throughout the course.

1996 cont’d

There was no way of avoiding these obstacles and for the cars that hit them at the right angles, they went on to finish with the least amount of damage.

Tennessee Technological University (TTU) and the University of Central Florida were running very close during the endurance event, and when it was all over, TTU accumulated enough points to finish in first place. The team members of TTU were Devon Parker, Captain; Zachery Kitts, Co-captain; Dave Morrow, Benoit Somard, John Larkin, Robert Reed, Brandon Palmer, Mike Sandt, and Carson Correl.

Thanks to Dr. Charles Nuckolls who served as organizer for the competition.

1997

So when does spring arrive in Montreal? Cold winter weather held on until May 1-3 for the 1997 competition hosted by Ecole de technologie superieure. The endurance race was one that teams will remember forever! It was cold, it was wet, and it was muddy. It was very cold! The East competition is known for the water obstacle and the water temperature in 1997 was approximately 32.001 Fahrenheit. It was freezing, but the drivers were determined to endure. That’s why they call it an endurance race. Weather wise, the race started out fine; although it was cold, it was still bearable. After a little while, it started to rain, then it started to sleet, then it started to snow. By the end of the race, the track was covered with mud about one to two feet deep, and it was described by one student as the color, consistency, and temperature of chocolate soft-serve ice cream.
maneuverability, and suspension and traction events helped position them to win their first Mini Baja title. Finishing in a close 2nd and 3rd was Bucknell University and the University of Central Florida, respectively.


Thanks to Greg Melton who served as organizer for the competition.

2000

The 2000 competition unveiled a brand new 10 horsepower Intek Model 20 engine designed for the Mini Baja® competitions and donated by Briggs & Stratton Corporation.

During three days of vehicle testing, Ecole de technologie superieure (ETS) from Montreal, Quebec, Canada out-performed 29 other collegiate teams during East competition on May 11-13 at Hotel le Chantecler Resort and Convention Centre in Ste-Adele, Quebec. More than 250 engineering students participated in this design competition representing universities from the U.S., Canada, and Mexico.

Winning the engineering design and top speed events helped position ETS to win the overall competition with 1,227.20 points. The 1999 winner, Universite de Sherbrooke from Sherbrooke, Quebec finished in sixth place overall. West Virginia University from Morgantown won the land maneuverability event and finished in second place. Third place went to
2000 cont’d

Auburn University from Auburn, Alabama who also won the cost event. Even though North Carolina A&T State University from Greensboro won the four-hour endurance event, they weren’t able to accumulate enough points in the other events to place higher than fourth overall.

Winners of the Women Engineers Committee (WEC) Mini Baja® Challenge, Auburn Lady Tigers performed well and finished in 18th place overall.


Future

While some of the details and rules for the Mini Baja East competition have changed over the last twenty-five years, the premise is still the same – to provide a hands-on learning experience, promote great academia/industry interaction, all while doing what interests most of those participating – building and playing with cars. With Mini Bajas in Brazil, South Africa, and South Korea, other countries are increasingly interested in organizing their own events. The 2001 competition will mark the first entry from outside North America, Alexandria University of Egypt, to compete in the Mini Baja East competition. The biggest challenge to teams may become the ability to raise enough travel funds to take their vehicle around the world to compete at the other competitions.

Epilogue

The history of Mini Baja East should be considered a living document. If you have stories or photos you’d like to contribute, mail them to SAE Educational Relations, Mini Baja, 400 Commonwealth Drive, Warrendale, PA 15096-0001, or email them to students@sae.org.

SAE Mini Baja Rules Subcommittee

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Jack Auld .........................Rod Millen Group
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The complete rules for Mini Baja® and information on the yearly competitions are available through SAE’s website at www.sae.org/students.