WHEN ENGINEERING STUDENTS TURN PRODUCT BUILDERS

Energy-positive homes, robots, drug delivery systems, chips for quick medical diagnosis, special wheelchairs, visual aids, and a whole lot more. That's the handiwork of some students in Indian engineering colleges. As they plug into the domestic and global competition ecosystem, these students are going from books to blueprints, from laboratory projects to real-world products, reports Hari Pulakkat

Two years ago, about 30 students from IIT Madras came together to build an autonomous underwater vehicle, which travel underwater without human control. It was an audacious goal. Autonomous underwater vehicles are not easy to build, as they need good intelligence to navigate currents and take instant decisions. The students' immediate objective was to participate in an international competition, but they had a far more useful long-term agenda on their minds. No one makes commercial autonomous underwater vehicles in India, although there is a demand for such a product. Why not form a company that would sell it at some point?

One potential customer would be the Railways, which often sends people or remotely-piloted vehicles underwater for inspecting bridges. There are other uses for them too, like inspecting submerged pipes and studying lake or ocean floors. These are risky activities for people, and remote control becomes difficult as the distance from the shore increases. The only Indian institution that has developed autonomous vehicles is the Defence Research and Development Organisation (DRDO).

After two years of work, this team of IIT Madras students have built a vehicle that has won the first prize of the Indian leg of the RoboSub competition, and earned a free trip to the international RoboSub competition in San Diego. With some more development, it can become a commercial product in the future. "We are participating in the competition to benchmark ourselves," says Ashish Bajaj, a team member. "We should be able to launch the company in two years."

Other student teams at IIT Madras are similarly busy, building various kinds of gadgets for tech competitions. They are not academic projects but attempts to solve real social and business problems in the country. In recent times, students have had special incentives to do so, including a well-equipped lab that can be used to build anything without prior clearances.

IIT Madras students are not unique in this endeavour either, as building useful products has now become part of a student movement around the country. This movement is strong in the IITs, but students from other engineering colleges are giving IITians tough competition.

The products they build are of a staggering variety: energy-positive homes, robots, drug delivery systems, chips for quick medical diagnosis, special wheelchairs, visual aids, novel combustion engines, and so on. Some of them use sophisticated engineering principles and are yet low-cost devices for rural areas. Some try to tackle uniquely Indian problems not yet solved by anybody, while some others are fresh attempts at solving cutting-edge contemporary engineering problems. "Students these days are less deferential," says Anil Gupta, professor at IIM Ahmedabad, who organises one such technology competition. "And they don't care about getting jobs."

Solving Real-World Problems

Gupta's organisation Sristi gives away, every year, the Gandhian Young Technological Innovation Awards, now becoming extremely popular among engineering students around the country. The award gets over 1,500 entries from students from 100 institutions around the country, but the IITs dominate the winners.

The notable entries this year—in three categories—included a satellite-based white space communication system, a vegetable chiller for rural farmers, a system for detecting contamination in food, an inhalable carrier for TB drug delivery, and a diagnostic biochip. These products are unlike anything we have seen, as the questions asked by the students are quite unique.

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Washing clothes had long bothered Gyanendra Singh, now a PhD student at the department of pharmaceutical engineering at IIT-BHU. He had thought, as would have many of his ilk, about designing clothes that needed washing only once in three or four days. His eyes lit up when he heard about non-compliance in taking anti-TB drugs, common in rural areas. Why not develop a method to let people take the drug once in four days?

Within two years, he had developed a method of delivering TB drugs to the body slowly, after it is taken in one dose. He didn't win the Gandhian innovation prize, but received a certificate of appreciation. Now it has developed into his PhD project. "I cannot develop it into a commercial product," says Singh. "But I hope a pharma company will take it up later."

Making a commercial product is not the aim of most students when they start a technology project. Even if these products do not end up in the market, they will contribute to the development of Indian industry over several years. This is specifically true of technology challenges, which keep raising the bar as the students go along.

Consider the automobile industry as an example. Over 3,000 students in 100 teams have participated in the Baja SAE challenge since it started in 2007. The challenge is to build and race vehicles that can perform well in difficult terrains. Student designs were crude in the first two years, but they gradually learned the ropes. Their work is now very impressive, according to industry experts.

Over the years, the students learned to improve the suspension and steering, get the right height, and get substantial weight reductions in their vehicles. "It required significant effort outside the classes," says Pawan Goenka, president of the Mahindra Group's automotive, two-wheeler and farm equipment businesses, who had been closely involved in the challenge right from the beginning. "When we started, students had no exposure to automobiles. Now, they are better prepared to work in the industry." Mahindra has hired several such students in its labs and factories.

Competing Internationally

From a global perspective, Indian students have still some way to go; they are yet to make a mark in the international leg of the Baja competition, held every year in Mexico. Students from the country now perform well in several other international competitions, and some of them, particularly from the IITs, are becoming increasingly ambitious. The underwater vehicle, for example, is a tough challenge but the IIT Madras students are confident of being in the top 10 in the RoboSub competition in San Diego. They have competition from two other Indian institutions: SRM University and IIT Bombay.

IIT Bombay students are involved in another major international project: to build an energy positive house. Called the Solar Decathlon, this competition requires students to assemble within 10 days a 700-sq ft house from prefabricated materials. The only energy input should be through solar panels, and the house will be judged on multiple parameters like architecture, energy efficiency, sustainability, and so on. The challenge is tough because the energy consumption of the house has to be reduced to the bare minimum, while still providing enough energy for comfortable living.

Students who worked on the project, called team Shunya, had Indian requirements in their minds. They used many contemporary design concepts in their house, which is now on its way to France for the competition. It uses passive solar design, a technique of using solar energy without mechanical devices.

It uses solar tracking, where solar arrays tilt as the sun moves to receive maximum sunlight. It uses a hybrid AC-DC network and DC devices to reduce energy use. Above all, it uses home automation systems to use energy optimally. Says Parth Bhatia, a student in the team: "It was a wholesome experience. We don't get opportunities in the curriculum to do this kind of hands-on work."

Work for competitions is done completely outside academic obligations, and projects such as these abound in engineering colleges around the country. Some colleges give the IITians a run for their money, often coming up with better products repeatedly. Chennai-based SRM University, for example, sent a satellite into low-earth orbit two years ago, using ISRO's launch vehicle, beating at least two IITs in the process. The university spent Rs 2 crore for the satellite project. SRM students are truly ambitious, as their products sometimes require serious technology development.

Unmanned aerial vehicles have caught the fancy of students around the country. SRM built one, and then moved on to a product not so popular: a small copter. Its 2-kg copter—with weather sensors—can now fly up to 2 km with a one kg payload. The India Meteorological Department (IMD) was impressed enough with the copter that it wanted 40 of them.

The Pune-based Indian Institute of Tropical Meteorology wanted a vehicle that can carry a 2-kg payload, and the National Physical Laboratory in Delhi wanted one to survey the Himalayas. Even the DRDO made enquiries: can SRM build a tiny copter weighing only 50 grams? "People would take a 50-gram copter for a bird," says Narayana Rao, head of R&D at SRM. "It would have done its job by the time they realise what it is."

Raising The Creativity Bar

Despite the variety of ideas, most student projects fall into certain popular categories: robots, autonomous vehicles, aids for the physically challenged, and solutions to typical rural problems. Mechanical and electronics engineering—sometimes called mechatronics—dominate among subjects.

Not all student products, spectacular though they seem from outside, are made after understanding the engineering principles well. This is especially true of academic projects. Says Swami Manohar, CEO of LimberLink, which conducts a competition called Jed-i for the best final-year engineering project: "There are exceptions, but in general, there is no depth of understanding in most projects. Computer science is the weakest link."

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Jed-i this year has no computer science prize as the entries were weak. Over the last three years, the winning entries included a visual aid for those with poor eyesight, a prosthetic arm for amputees, a method for producing energy from cellulosic waste, a standing wheelchair, an unmanned aerial vehicle, and so on.

Occasionally, some students try to solve local problems. IIT Mandi students are working on a project to design a sewerage network in the campus. Students from St Joseph's College of Engineering in Palai, a small town near Cochin, have sent a proposal this year that outlines a controlled development for the city of Cochin.

The management in engineering institutions are aware of the large student interest in building things, and are creating conditions and the infrastructure to help them. Some of the best institutions also try to raise standards through courses that deepen the students' understanding.

IIT Madras, for example, now has a course called 'engineering in everyday life', which teaches students to apply principles learned in other courses. "The projects require the students to write down the mathematical models before they do hardware design," says Mahesh Panchagnula, associate professor of applied mechanics at IIT Madras. Panchagnula has overseen many of the student projects outside academics, including the underwater vehicle.

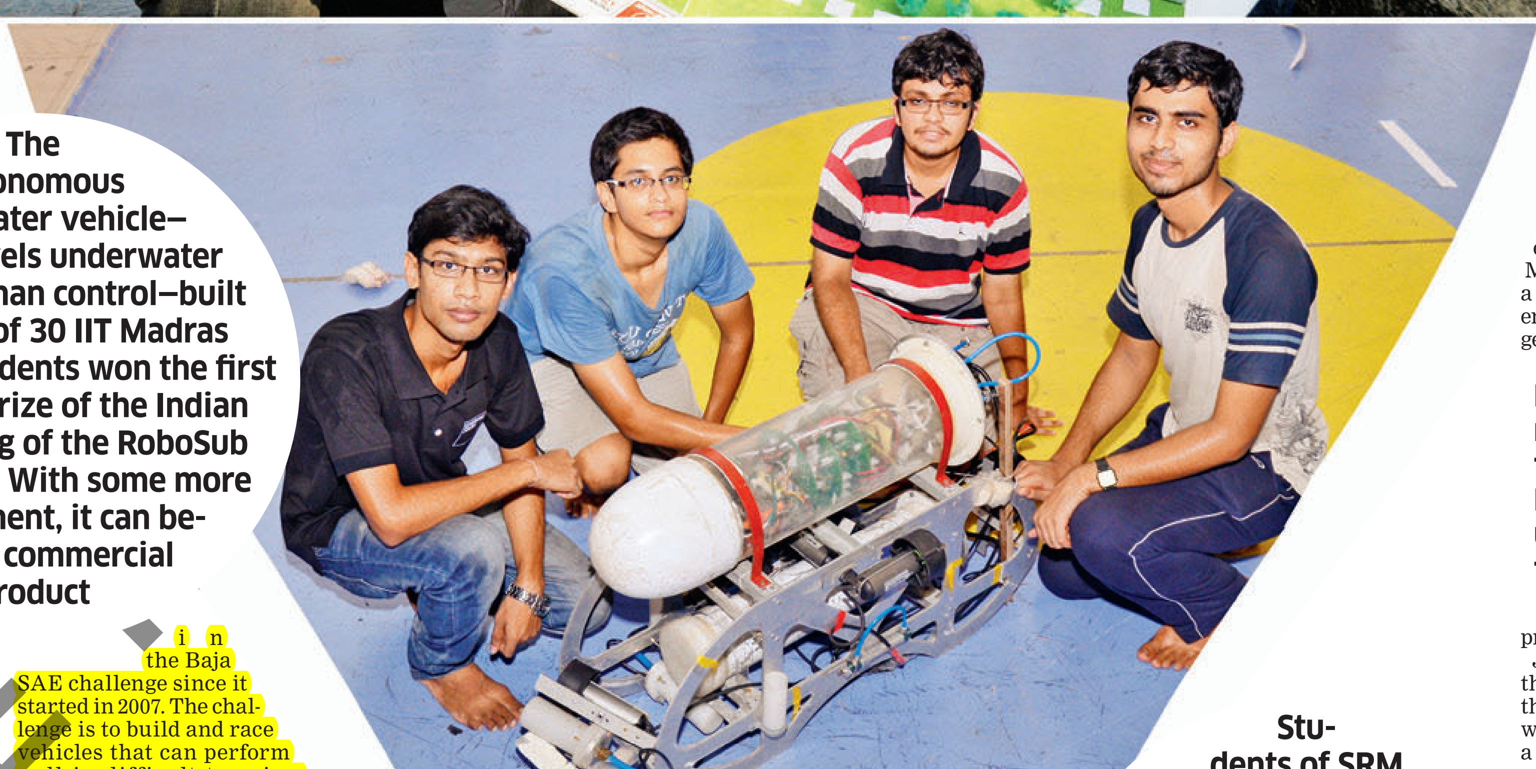
As the movement spreads across the country, product building has seeped into PhD work as well. Earlier the benchmark was research papers, but professors increasingly insist now on building products as part of a PhD programme, and also assign tough challenges involving large teams.

At IIT Kanpur, where students are active with a large number of non-academic projects, chemical engineering professor Sidharth Panda set his students a tough task: develop a low-cost sensor for detecting diseases early. The technology to be used was microfluidics, an emerging and multidisciplinary field that uses small volumes of fluid.

The first disease that they tackled was prostate cancer, by developing a method to detect the amount of prostate specific antigen (PSA) in the blood. The product had to be small, rugged and inexpensive. Existing products were big and expensive, using optical technology. No one used electrochemical technology like Panda wanted to. The product is now at the prototype stage and won the Gandhian Engineering award this year. "There is a buzz among the students after the award," says Panda. "We have now raised the bar for the younger PhD students."

hari.pulakkat@timesgroup.com

IIT BOMBAY The 700 sq ft energy-positive house—which is entirely powered by sunlight—built by Rahul Singh, Sanjana Shettigar and Parth Bhatia (left to right) is on its way to France to participate in the Solar Decathlon. It will be judged on parameters like architecture, energy efficiency...



IIT MADRAS The autonomous underwater vehicle—which travels underwater without human control—built by a team of 30 IIT Madras students won the first prize of the Indian leg of the RoboSub competition. With some more development, it can become a commercial product

SRM University Students of SRM University in Chennai built a small, unmanned copter. This 2-kg copter—with weather sensors—can now fly up to 2 km with a one kg payload. The India Meteorological Department was impressed enough with the copter that it wanted 40 of them

IIT Bombay Piciture: BHARAT CHANDA; IIT Madras Picture: S VARADHARAJAN

Where Engineering Students from India are Competing

Engineering students from India are increasingly plugging into competitions that present the challenge of building real-world products. These are some of those competitions:

COMPETITION	ORGANISATION	CHALLENGE
RoboSub Competition	Association for Unmanned Vehicle Systems International, San Diego	Develop autonomous vehicles that perform missions under water
Solar Decathlon	US department of Energy	Build energy-efficient, solar-powered houses that are attractive
University Rover Challenge	Mars Society, Colorado	Build next generation Mars Rovers that will work alongside humans
Gandhian Technological Innovation Award	Society for Research and Initiatives for Sustainable Technologies and Institutions, Ahmedabad	Cost-effective, socially-relevant and technologically advanced innovations
Baja SAE Challenge	Society of Automobile Engineers, Chennai	Build and race vehicles in challenging terrains