The 21st Century Engineering Crisis

Formal engineering education at a university level is a 20th century phenomenon. Till the 19th century, if one wanted to be an engineer, one joined a professional guild by becoming a trainee. This process ensured that a so-called student understood the practice well. Even in the few formal learning environments, training component was a must.

The two World Wars in the first-half of the 20th century fuelled the demand for engineers, which led to the formation of formal, science-based engineering courses that became a norm in the 1950s and 1960s. In such a course a student would not only learn the necessary skills, but would study the most basic science behind the technology. Analytical skills, physics and maths, thereby, became important. Formal and science-based engineering education led to eventual growth in technology, unleashing a volley of innovations. However, even today, a bunch of the former challenges that plagued society and led to the need for professional engineers remain. These problems apparently are not being solved by the current crop of students. To understand why not, a fresh look at the curriculum is needed.

The engineering education sector, particularly in India, has been growing at a fast pace. This change was made possible through standardising education—establishing a set-up in which a single university provided affiliation to hundreds of colleges that would teach a standardised syllabus—leaving little space for innovation. If this lack of innovation was (and is) our primary problem, the secondary one is that we train students to solve problems of the developed world. There is a scarcity of books that talk of problems that are local. (Say for instance there is no literature on the Indian power distribution system—its transmission and distribution losses). While it is good to have an engineer who can solve global problems, it is great to meet one who sees developing and underdeveloped countries as a part of that "world". After all, today's interesting problems often relate to the "bottom of the pyramid".

Engineers should be equipped to deal with real life problems, a trait that's disappearing since computer-simulated problems are all that the youth are encountering nowadays. Several young people don't understand practical considerations. When they become "experts", they often design either inferior products or over-engineered ones. Computers are a great tool—but let them not take students out of labs and workshops.

Curriculum Route

To address this lacuna between necessity and ground reality our country needs a "smart syllabus". The curriculum of the future needs to help students connect to the society, understand practical considerations, encourage creativity and innovation, and hands-on work.

Courses must include extensive laboratory projects and term papers. Ideally, labs train students in skills such as handling equipment and software. Projects require them to develop software, encourage creativity and expose them to development lifecycles. Term papers and presentations expose youth to topics that are not covered in class—inculcating a habit of learning on their own and improve communication skills. Courses, ideally, should have at least one of these components. To enable students to relate to the world around them, universities have always encouraged industry internship—a norm that has become mechanical today. Instead of aiming for a sparkling project report, youth should be encouraged to work towards a positive goal, especially in NGOs or businesses within the local communities to understand society's needs better.

To understand the craft of problem solving, one doesn't need to move too far from the campus. On-campus problems, such as availability of water, power and communication, may be worked upon for a start. For instance, students can develop software programmes to automate administration processes within a campus. Interesting projects, such as rainwater harvesting or establishing wireless links between buildings are educative, challenging and productive at the same time.

Ground Reality

The only motive for learning is not problem solving—sometimes it is about understanding the fact that problems exist. When a student works with a community outside the campus, she realises that an engineer's job does not involve just technology; it involves people. An important part of an engineer's job is to understand trade-offs and choose solutions with the best cost-benefit ratio that benefit the community. If you ask an intelligent student to design a website, she could probably use all the latest technology to design a superb one! In the real world, however, there will be resource constraints and that would be her challenge—to use the resources and create the best product. Her goal would be not to create a cutting-edge site, but one that allows maximum people to access and navigate it without expensive servers and high bandwidth links—considering that both are rare in our country where one percent of the population uses the internet.

Liberal Dose of Arts

Courses on liberal arts should be encouraged, as they prepare students to work with teams consisting of "different sorts of people" in a more globalised industry.

To focus on usability, it is necessary that we introduce a course on "design". Design used to be a part of the curriculum even a few decades ago. But, as there was a scarcity of teachers the course was eventually removed. Now, there is enough material available online and in books. Any interested faculty member can endeavour to teach it. Such a course will enhance the creative and innovative capabilities of students.

A cardinal aspect of understanding the nitty-gritty of a trade-off is economics. Engineers need to understand business. Therefore, a basic course must be offered to them as a mandatory schedule.

Solving layered problems often require understanding of multiple disciplines. While it is not possible to understand several disciplines deeply in a few years, it is important that an engineer understands the language of other disciplines. It should be possible for a team consisting of people from different disciplines to work together to solve problems. To become a "truly global engineer or worker", a student must be encouraged to study a minor stream with her major. (Example: a student of computer science can complete a course in electrical or mechanical engineering).

Society sees its engineers as not just job-seekers, but creators, too. Thus, to be the productive individuals that the nation expects them to be, our engineers need to understand product design, economics and business. A long list of demands perhaps, but all these could make an engineer a global citizen. For those who are not interested in business, a flexible curriculum may pave the path to innovative research. EDU

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Dheeraj Sanghi
Dr Sanghi is the former director of Laxmi Narayan Mittal Institute of Information Technology, Jaipur. He is a professor of computer science at IIT, Kanpur. Dr Sanghi has a BTech in computer science from IIT Kanpur and an MS and a PhD from University of Maryland, USA . He can be reached at *dheeraj.sanghi@edu-leaders.com*