

UQ Ove Arup Foundation Workshop White Paper

Engineering Education: A Need for Transformation

Universities are complex institutions that have multiple purposes; some clear and some vague. Two clear purposes are to seek truth through knowledge creation and to deliver a learning environment that supports students in engaging in a learning process that enables them to move on from the University and become active contributors to society. The core commonality between these two purposes is that universities should facilitate discovery: be that of knowledge and the unknown, of societal and economic contexts, or of self and others. The period of growth of universities during the 1960s centred around the paradigm of research-led education. Research activities promoted by academics served as a vehicle to educate inside and outside the classroom and thus facilitated discovery. This paradigm expanded from a small group of research-intensive universities to almost the entirety of higher education. Today, there is some recognition that this paradigm seems not to fully deliver contemporary needs of education, nevertheless, no alternative has emerged. Despite the apparent common ground between research and education, universities have chosen to fracture how they deliver to their purposes and maintain their relevance in a globally changing environment.

For engineering, the needs and means by which to adapt to new challenges and realities is particularly complex. Engineers are required to develop and implement new technologies that have the potential to change the world and these technologies inevitably have a significant societal impact. For engineering, these tools are now powerful enough to critically penetrate other, more 'traditional' professions and industries, and so it is crucial that university education encompasses not only technical acumen, but also the ability to consider the social, ethical, and environmental implications of our rapidly-growing knowledge base. Contemporary engineering education principles constantly highlight these abilities as necessary components of university engineering programs. However, curricular space to implement these matters is hard to find. The difficulty comes from the traditional priority that engineers should be technically-capable in the first instance and the additional curricular pressure as the technical knowledge base balloons due to technological advancement. A formula to prioritize all of these essential attributes seems to continue to elude engineering education.

The 2014-2016 Ove Arup Foundation Workshops aimed to facilitate a discussion that could lead to a new paradigm for universities capable of generating both professionals and knowledge deemed of fundamental value to contemporary society.

We have provided a brief synthesis of four of the broad insights discussed during the Workshops below.

Ecosystems of Shared Interest

It is proposed that to achieve an engineering education experience which enables the broad thinking that combines innovation with ethical behaviour and respect for social consequences, universities need to change from their traditional structure to a complex ecosystem that facilitates a series of interactions between stakeholders inside and outside higher education institutions. The ecosystem connects a complex network of internal like-minded actors (i.e. students, academics, campuses, laboratories, etc.) with external actors (i.e. alumni, government, industry, NGOs, the larger community, etc.) that can provide the necessary social connectivity. Facilitating effective internal and external interactions is required to be able to capture the needs of the external environment and to assess the implications of technical knowledge. These interactions become an essential driver for the education of future professionals that can promote innovation and create responsible change.

Adaptable Knowledge Flows

It could be argued that the internal and external interactions presented above have been an important component of engineering education for decades, and what is proposed here is nothing new. However, the key difference in the ecosystem proposed is that the communication and interactions within the ecosystem focus on valuable information, i.e. the ecosystem is able to sieve information and form the relevant knowledge base in a way that adaptively enhances the discovery objectives of the university. The massive flow of information between the university and the world outside the university, can result in information overload and very poor synthesis of what information actually serves to enhance the educational objectives of the university. On the one hand, universities put forward massive amounts of “knowledge” with no purpose other than supporting their role as knowledge creators but with very little external validation of that knowledge. On the other, engineering schools are subject to static accreditation systems driven by a very limited number of external stakeholders. These accreditation systems are currently being questioned, not only for their lack of adaptability but also for their incapacity to truly influence engineering education and the wider engineering profession.

Facilitating Learning vs Facilitating Discovery

Professional identity is developed through interactions between peers, mentors and mentees, and their combined mastery and interpretation of knowledge within the social context that is the university. The university currently uses a model of mentoring whereby students are guided through learning resources. The focus is on the teaching process, the pedagogy, and the qualities the guide or mentor needs to possess to enable the most effective assimilation of knowledge. The amount of human knowledge is increasing exponentially and establishing the relationship between knowledge and societal need is becoming a more complex task. Therefore, the role of the university needs to change from an environment that facilitates the assimilation of knowledge to an ecosystem that enables discovery by all those forming ‘the university’. A university should germinate the capacity to embrace learning processes in all its members (not only the students), to find the learning resources they know they need, and to develop their own adaptable professional identity.

The ecosystem instils this self-directed adaptability through multiple interactions with internal and external stakeholders and not only accepts members that are different and non-traditional, but also rewards them for the contributions their differences can provide.

The Missing Piece: Systems or People?

Developing this modern ecosystem is complex because the university status quo does not possess a system which can track the myriad of internal and external interactions which are happening. Instead, the system is effective at tracking the traditional processes (i.e. learning outcomes, course profiles, research projects, research outputs, professional accolades, etc.) and university actors shape themselves to meet these performance indicators. Diverse interactions that provide an important, and in some cases, a more important, part of the university are not being studied or accounted for, and as such, are close to being completely forgotten as being necessary to the purpose of the university. For this reason, we do not yet know what types and scales of interactions are most effective in helping universities achieve their purpose, or what type of person or institution can grow, track, and attach value to interactions within their own ecosystem.

This final question is therefore perhaps the biggest: who is at the core of this new ecosystem that we want to call the 'New University'? Traditional approaches towards populating universities with students, staff and external partnerships may no longer apply, but the question of the qualities and attributes of those who are part of the New University are still wide open. Reward structures, administrative structures, corporate goals, etc. are all drivers to the nature of those who are successful in today's universities. Are any of these valid within the context of the New University? We are not yet able to talk about this, but even more critically, we are not yet able to talk about *who* is going to change this. Addressing this subject requires a level of introspection and self-criticism that we do not yet seem to be ready to undertake. Nevertheless, it has become clear that the revolution that our centuries' old universities are waiting for will not begin by changes to the system, but by changes to the people who will foster this change.