GLOBAL ENGINEERING DEANS COUNCIL (GEDC) CONFERENCE 2015

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Intercontinental Adelaide, South Australia
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GEDC2015
Global Engineering Deans Council · Adelaide · Australia

Conference Report

Prepared by GEDC Secretariat

In December 2015, the GEDC continued in the tradition of meeting to discuss and debate issues in engineering education, research and engagement at universities. John Beynon, Dean of Engineering at The University of Adelaide, hosted the gathering in the city center at the Intercontinental Adelaide. Over the course of just over two days, deans, industry leaders, and government representatives discussed topics varying from economic development to engineering's role in humanitarianism to innovation and much more.

New to this year's program was a session called "Top Tips," which featured five-minute "flash" presentations of best practices from twelve GEDC members. The session was deemed a great success by attendees, covering a breadth of programs and strategies from all over the world.

As in the previous two years, the GEDC honored the accomplishments of GEDC Airbus Diversity Award finalists, Fadi Aloul, Martin Baumann and Renetta Tull. The day before the start of the conference, a jury of GEDC members selected Fadi Aloul as the 2015 award recipient, which was announced at the Awards Dinner sponsored by Airbus at the National Wine Centre.

A combination of workshops, interactive panels, networking, working sessions, the 2015 Conference was a full and productive meeting. Many thanks to all those who made the meeting a great success.

Engineering Education's Contribution to Economic Development

Panelists:
Robin Batterham (Past President, Australian Academy of Technology and Engineering)
Jamal Deen (President, Academy of Science, Royal Society of Canada)
Indranil Manna (Indian National Academy of Engineering)

In this session, Dr. Batterham challenged attendees to consider the role of innovation in economic growth. Professor Deen gave specific examples of how engineering innovations have brought about changes in society over the centuries, citing the economic impact that graduates from the Indian Institutes of Technology (IITs) have had on the Indian and global economies. Professor Manna described an ambitious roadmap of a plan, called IMPRINT, which is currently being implemented in India to further economic development. The goal of IMPRINT is to accelerate the innovation ecosystem and bring the best of engineering and normative science minds to provide solutions to the most pressing problems.

While many studies have shown a positive correlation between spending on engineering education and national GDP - with strong examples of China and India, which have invested in and capitalized on their engineers - the challenge of moving governments to invest more in engineering education remains a big one in many countries. What will prompt governments to invest more in engineering and engineering education?

Dr. Batterham made the argument that a large part of economic growth is the driving down the prices of commodities. Commoditization happens when technological innovations create efficiencies in design and manufacturing processes. This makes it imperative that our future engineers are trained in innovation, since it is not a natural ability that one either has or does not have, rather it is a skill to be learned.

What else can we do to demonstrate to the public and to governments that engineering education is key to economic development? Engineering education leaders must change the narrative, showing that it is not science alone but engineering that solves real-life problems.

International Consortia for Addressing Grand Challenges

Lead Speaker: Yuguo Li (The University of Hong Kong)

Panelists:
Peter Kilpatrick (Notre Dame University, USA)

Christina White (Singapore-MIT Alliance)

Yuguo Li, Head of the Mechanical Engineering Department at the University of Hong Kong, demonstrated the complexities of just one global grand challenge: Densely populated Megacities: air pollution and the threat of outbreak. While the implications were certainly alarming, Li presented them as great opportunities for engineers. Using a couple of smaller scale examples, Dr. Li was able to demonstrate how new scientific tools can be used to address challenges created by the inconsiderate use of technology.

Dean Kirkpatrick and Dr. White then opened up a conversation on different practical approaches to preparing students for global grand challenges. They discussed the importance of creating "pie-shaped"/"I-shaped"/"T-shaped" engineers, who have not only technical skills, but leadership abilities and a global mindset. Young engineers must be able to understand the context of the problems they face, and the broader systems in which they exist. Other questions asked were: How can we educate our students to innovate in under-resourced environments? How can we ensure that our students retain their moral compass as they address challenges?

The US NAE Grand Challenges Scholars Program (GCSP) is one example of how to prepare students to solve the grand challenges of the century. Any university may apply to have GCSP at their institution; the Program rests on five pillars: 1) A Hands-on Project OR Research Experience related to a Grand Challenge, 2) Interdisciplinary Curriculum, 3) Entrepreneurship, 4) Global Dimension, and 5) Service Learning. This type of program can inspire "I-shaped" engineers who are able to innovate for society. [Contact Christina White Christina@smart.mit.edu if you are interested in starting a GCSP at your school.]

Student Centered Learning (SCL) Paradigms

Panelists:
Khairiyah Mohd Yusof (Universiti Teknologi Malaysia)
Les Kirkup (University of Technology Sydney)
Liliana Cuenca Pletsch (Universidad Tecnologica Nacional, Argentina)
Rapporteur: Theo Andrew (Durban University of Technology, South Africa)

There are multiple approaches to SCL: service learning projects, problem- or inquiry-based learning (PBL), and use of appropriate technologies (virtual labs) and more. The key principle in SCL is to encourage students to think about what they're doing rather than passively following instruction. Professor Mohd-Yusof deconstructed the method of scaffolding. Professor Kirkup shared the spectrum of how students can be involved in their own education experience – even the possibility of students being co-deliverers and co-developers of their own learning. Professor Cuenca Pletsch provided SCL experiences in Argentina, where there is a national problem of poor performance of first year engineering students, and how PBL and Virtual Labs helped.

In this session, three issues were raised:

How does an institution go from one or two success stories to actual reformation/transformation at your institution? One of the biggest obstacles is staff who are set in their ways and unwilling to try something new which would cost time and effort. Mohd-Yusof emphasised the importance of deans raising awareness and cultivating an environment supportive of these techniques. Others raised the possibilities of changing the tenure process, incentivizing faculty to use better methodologies, and sharing success stories.

How can we effectively use technology and new tools in SCL? It is easy to be attracted to technology and use it for the sake of technology. It is important to determine whether technology is needed or whether post-its and flip chart will get the job done.

How can we enrich students' lives outside the classroom? Service learning opportunities, cooperative learning with companies, "maker" spaces/labs - there are so many different ways to give students learning opportunities outside the classroom.

Diversity

Panelists:
Monique Simon (Total)
Maureen Dougherty (Boeing)
Shelley Willsmore (BAE Systems)
Roger Thomas (Department of State Development)

While "diversity" or "inclusion" mean different things in different contexts, engineering education leaders generally agree on one thing: diverse workforces produce better results. The panelists spoke about the benefits gained from having a diverse workforce and provided specific examples of initiatives undertaken by their companies. Ms. Simon made the point that proportionality matters in hiring – if a college has 14% women in petrol engineering, then employers aim to hire about 14% women. Ms. Willsmore pointed out the importance of training managers to be aware of unconscious bias. Mr. Thomas painted the backdrop of the indigenous people in the Australian workforce, and how the problem starts as early as primary school. Ms. Dougherty emphasized the importance of inspiration and appealing to young people's natural curiosity and sense of wonder.

So what can be done at different parts of the pipeline in order to increase diversity in engineering education and, ultimately, the engineering field?

1) **Inspiration.** The perception of "What is an engineer?" is important to attracting people of all backgrounds. Engineers should get into media and public policy in order to be in a position to send positive messages about engineering. If we can disseminate the message that engineering is about wonder, curiosity, helping other people, making a difference and more, then engineering may attract those who might have otherwise been uninterested.

Also, there is power in seeing engineers who look like you. People from underrepresented groups benefit from seeing diversity in engineering.

2) **Mentorship.** In industry, it is extremely important for women or minorities to participate in mentorship programs. Every part of the pipeline should also have mentorship-like programs - university students working with high school students, and high school students working with even younger students. All of these groups should be working together to "capture the imagination of future engineers."

Innovation and Entrepreneurship

Speakers:
Charles Champion (Airbus)
Uzi de Haan (Technion, Israel)
Panelist: Ugurhan Akyuz (Middle Eastern Technical University, Turkey)

Mr. Champion opened the session by describing the job environment that engineering students will enter: "Industry is about making the best technical choices within restrictions, and managing risk." Despite this, such companies need to increase innovation and Airbus has created spaces away from the normal routine for groups of engineers to be highly innovative without the restrictions of their normal roles. Professor de Haan talked about entrepreneurial culture and the increasing need for engineers to have a "startup" mentality. Professor Akyuz shared several success stories from METU Technopark – of incorporating entrepreneurial activity into curriculum, leveraging relationships between government, industry and the university.

Innovation is an essential part of today's business landscape. The pace at which technology is changing and implications of those changes make entrepreneurial and innovative thinking absolutely necessary for companies to stay competitive. The questions asked in this session were: How do you inculcate **innovation** or **innovative thinking** in your Engineering School? At what level should it start? How do you reward innovation in your school? What are the challenges involved?

One salient theme that arose from this session was the impact of providing the space/opportunity for innovation. Engineering students are naturally curious and want opportunities to be innovative - they just need the problems, space and tools to realize their ideas, tinker, make and break things. Project-based learning and small, collaborative teams go hand-in-hand with these "maker spaces" to make powerful learning experiences.

Bureaucracy and faculty don't have to be barriers to creating an environment of innovation at your school. Incentivize faculty with IP disclosures and patents. Find relevant roles for faculty - perhaps not as entrepreneurs, but tech advisors. Use innovation in an outcomes-based accreditation approach.

Humanitarian Engineering

Participants:
Lizzie Brown (Engineering Without Borders Australia)
Elizabeth Taylor (RedR, Australia)
Delphine Dean (Clemson University)
Alejandro Jadresic (Universidad Adolfo Ibañez, Chile)
Jose Roberto Cardoso (Universidade De São Paulo, Brazil)

Lizzie Brown opened the session, introducing the spectrum of "humanitarian engineering" – from relief work to rehabilitation to development. Elizabeth Taylor said, "Engineering is very good at showing how they're good at making instruments of war, but not at helping people rebuild lives. Maybe GEDC could do something there." Delphine Dean joined the conference remotely through Skype, emphasizing the importance of the role of industry buy-in in the international co-ops at Clemson University. Professor Cardoso shared about the POLI Citizenship Program at the University of Sao Paolo. Professor Jadresic made the point that "humanitarian engineering" is along the same lines of "social innovation" or "social entrepreneurship."

The UN's Sustainable Development Goals (SDGs) contain the world's most pressing social challenges - from ending poverty, to reducing inequalities, to making peace on earth. What is not so obvious is the need for engineers and engineering solutions in poverty relief and development. Educators should "capitalize" on the SDGs and other humanitarian problems for problem-based learning. So much of engineering contributes to the war economy, but so much more good could come out of solving "humanitarian" problems, such as access to clean water and ending hunger. Technical know-how is needed just as much as goodwill in humanitarian aid & development.

Humanitarian engineering has the added benefit of reducing the gender gap. It has been shown that women are more attracted to engineering when they know that it can help people and benefit society.

Educators were encouraged to go beyond the typical service learning projects, and asked to consider how engineers could raise awareness about humanitarian engineering throughout the pipeline? From elementary school to industry, there are many opportunities to motivate more engineers to work on humanitarian crises and development issues.

Data Driven Education Models

Panelists:
Rich DeMillo (Georgia Institute of Technology, USA)
Bridget Burns (University Innovation Alliance, USA)
Sekhar Chivukula (Michigan State University, USA)

Professor DeMillo opened the session with an overview of "revolution in higher education," which is calling into question the value of the college degree. Ms. Burns presented about an alliance of

universities that is responding precisely to the revolution by using data to rethink the student experience. Professor Chivukula presented an example of a specific data analytics initiative to improve student performance as part of a larger student retention improvement effort.

In the face of a revolution where universities are no longer the gatekeeper to successful careers, and the number of nontraditional suppliers of education is growing, academia must reexamine two things 1) the value of a college degree, and 2) the renewal of the social contract between academic institutions and society. Here, data can be used to keep college education relevant and make continual adjustments and improvements to the ecosystem of higher education.

The University Innovation Alliance is using analytics to reduce repeated failures, and replicate successes, specifically for the purpose of bringing up numbers of degrees awarded to the poorest segment of society. There is power in the combination of predictive analytics and university collaboration - so that education innovations are not kept in the dark, but are disseminated effectively and widely.

Data analytics has the potential to change program and curriculum planning; advising, recruitment, retention, and graduation rates; scholarly research on education, and more. Of course, there are all the usual challenges associated with collecting data: privacy issues, appropriate interpretation and use of data (correlation is not causation), challenges of administering surveys. This underscores the importance that universities learn from each other's experiences.

Top Tips

This year, the GEDC Conference invited twelve presenters to share five-minute presentations on best practices from their institutions. To see all presentations from this session, please visit the GEDC website, www.gedcouncil.org.

New Tools for Engineering Education

Panelists:
Xavier Fouger (Dassault Systèmes)
Ken Dunstan (Mathworks)
Dave Wilson (National Instruments)

Representatives from three GEDC Industry Members came together to give an inspiring session on the role of "tools" in the future of engineering and engineering education. Mr. Wilson drew from the example of Thomas Edison's notebook of "Things doing and to be done" and his "Discovery Laboratory," and today's need "Modern Labs for Discovery." Mr. Dunstan described the "new era of industrial transformation" that is changing the way engineering is done. Mr. Fouger stressed that calling engineering tools "mere tools" completely miscomprehends the modern practice of engineering.

The Internet of Things (IoT), additive manufacturing (3D printing), global supply chains, open-source hardware, “smart” systems - this is the world in which engineers now operate. While engineering principles have not changed, how we *do* engineering (practices) and *what* we are able to engineer (technologies) have evolved quickly. Industry demands that engineers be equipped with the knowledge on how to use new “tools” (software and hardware) for all parts of the engineering process - design, simulation, modeling, manufacturing, etc.

One common challenge from academia: often faculty members don’t know what they need; companies need to work with educators on finding the right tools. Sales people don’t always know how to use the tools, or know what is best for which needs. The emerging role of “tech evangelists” is a way to fill this gap.

Navigating the complexities of the grand challenges will require the right engineering tools - tools that not only provide high-quality engineering experiences, but also enable collaboration and provide top-notch educational experiences.