2014 IFEES Summit

as part of WEEF 2014 Dubai

Conference Report

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About IFEES 2014 Summit

In December 2014, IFEES continued its leadership role in holding in its trademark event, the World Engineering Education Forum (WEEF), the fifth in its series. This year, The American University in Dubai hosted the Forum, with much support from local institutions.

Then-IFEES President Jose Carlos Quadrado and IFEES Secretary General Hans J. Hoyer served as Program Chairs of the 2014 IFEES Summit. This year's IFEES Conference Program Committee included Uriel Cukierman (newly-elected IFEES President 2014-2016), Alaa Ashmawy, Michael Auer, Francoise Come, Jennifer DeBoer, David Delaine, Ivan Esparragoza, Khairiyah Mohd Yusof, Susan Oh, and Krishna Vedula.

This year, the IFEES Summit Program Committee aimed to move away from the traditional lecture format typical at conferences, and to create interactive sessions where participants would be able to engage in meaningful dialogue about a given topic. These were called "discussion sessions."

This report contains summaries of only the IFEES-specific sessions held at the WEEF 2014 Dubai. For a summary of keynote speeches or other WEEF sessions, please check the WEEF 2014 Dubai Conference Report.

Intergenerational Panel

The Digital (Re)-evolution in Engineering Education

Over the last few years, a key part of WEEF has been the Intergenerational Panel, spearheaded by the Student Platform for Engineering Education Development (SPEED). The panel is an opportunity for students, faculty, and other engineering thought leaders to share their multiple perspectives about a relevant topic towards improving engineering education. The Intergenerational Panel launches the WEEF with a rigorous conversation between panelists and then engages the audience in small group discussions. This year, the discussion centered on "The Digital (Re)-evolution in Engineering Education." Aswin Karthik, a SPEED executive committee member, moderated the panel that included SPEED members, Alexandra Semaan and Joseph Packhem, industry thought leader, Xavier Fouger from *Dassault Systèmes,* and a diverse group of engineering faculty including Buddi Kanmani, Eesa Bastaki, and Zainab Al Hammadi.

The panelists and small groups were prompted to consider how the role of technology in engineering education has evolved dramatically over the past decade. In this session, educators, practitioners and students spanning a range of generations debated the critical role of technology in today's engineering education, and shared their unique perspectives from different vantage points on the proliferation of technology in today's classroom.
Discussions included the challenges of today's engineering students who learn not only from the professor in the classroom, but also from a variety of digital resources including MOOCs, digital labs, online simulations, wikis, discussion boards, and social media. Due to the global nature of the WEEF, topics of conversation also led to facilities that make it easier and more reliable to hold synchronous classroom sessions across different continents. Indeed, the Intergenerational Panel aimed to foster a sense of the importance of thinking globally about engineering education through the lenses of a wide range of stakeholders.

Global Grand Challenges

The IFEES/GEDC session on Global Grand Challenges brought together diverse thought leaders from around the world to broaden the discourse about engineering education within the context of 21st century Engineering Grand Challenges. Grand Challenges are global initiatives that have beaconed support from around the world, including the Chinese Academy of Engineering, National Academy of Engineering, and Royal Academy of Engineering, multinational corporations, and a wide range of universities.

The panel was moderated by Christina White who is a director of Grand Challenges Scholars & K12 Partners Programs (GCSP) and a member of the NAE GCSP committee. To set the groundwork of the concept of Engineering Grand Challenges, Yannis Yorstos, engineering dean at University of Southern California and one of the founders of the GCSP, shared how engineering has evolved from physics devices to complex societal challenges requiring interdisciplinary connections. Jaimie Bonilla, engineering dean of Tecnológico de Monterrey and Khairiyah Yusof, director of the Centre for Engineering Education at Universiti Teknologi in Malaysia, stressed the importance of service-learning to develop a wider range of skills and motivation to solve human challenges. Jean-Francois Minister, Vice President of Research at *Total*, presented the need for new business models coupled with new technologies as being key to scaling solutions globally. He shared a real world example from *Total* where they reconceptualized their business model to work with their new technology

thus making it feasible to scale a lighting solution to 50 million people. Theo Andrew, executive dean at Durban University of Technology, included ideas about how cross-cultural training and systems thinking are needed in engineering education in an effort to address Grand Challenges. Catherine Didion, senior program officer for the Diversity in the Engineering Workforce at the National Academy of Engineering, discussed how Grand Challenges attract diverse students, including those that are traditionally under-represented, into engineering. She and Jean-Francois Minister agreed that Grand Challenges must include diverse perspectives in their solutions.

Overall, the discussion included themes that resonated across Grand Challenges including sustainability, health, technology and growth, entrepreneurship, education, enriching life, and resilience. With this panel and in the future, the WEEF community will continue to enrich the discourse on Grand Challenges from global perspectives on research, teaching, implementation, and engineering education.

Discussion Sessions

Conceive, Design, Implement, and Operate (CDIO)

Moderator: Gareth Thomas (Mathworks); Panelist: Antonio Costa (ISEP); Mushtak Al-Atabi (Taylor's University)

The CDIO™ INITIATIVE is an innovative educational framework that provides students with an education stressing engineering fundamentals set in the context of Conceiving — Designing — Implementing — Operating (CDIO) real-world systems and products. Moderator Gareth Thomas gave an overview of CDIO indicating the important and transferrable skills that students learn in each phase:

C: define customer needs; consider technology, enterprise strategy, and regulations; develop concepts, techniques and business plans

D: create the design; the plans, drawings, and algorithms that describe what will be implemented

I: transform the design into product, including manufacturing, coding, testing and validation

O: use the implemented product to deliver the intended value, including maintaining, evolving and retiring the system

CDIO activities engage students in design-build-test projects, integrate professional skills such as teamwork and communication, feature active and experiential learning, and are constantly improved through quality assurance process with higher aims than accreditation.

Antonio Costa of ISEP and Mushtak Al-Atabi of Taylor's University, described how this CDIO initiative was developed with input from academics, industry, engineers, and students and was specifically designed as a template that can be adapted and adopted by any university engineering school. In addition to students learning skills that can be adapted into a wide range of career pathways in the global workplace it also is highly relevant for innovation and entrepreneurship. The panelists posit that universities that integrate CDIO help students develop lifelong leadership and learning skills beyond traditional engineering curriculum that include communication, innovation, networking, teamwork, and contextualization in local and global economies.

PBL "Discussion Session"

Alex Stojcevski (Deakin University); Erik de Graaff (Aalborg University)

Problem and/or Project-Based Learning (PBL) involves complex and situated problem analysis, and problem solving strategies. It stresses the importance of learners' motivation and the development of various process skills such as management, communication and collaboration. Implementing PBL and managing the change to PBL from traditionally lecture-based methods is a complex matter. Alex Stojcevski's background in collaborative learning and design-based engineering education help shed light on important topics such as universities considering implementing PBL at a single subject level as a start and also the possibilities to introduce it at the program level. Erik de Graaff, with his extensive work at Aalborg University – world renowned for PBL – enriched the discussion by considering the roles of the teachers in the change process, levels the curricula could be revised and ways to do it, and implications it may have on the existing assessment system. The aim of these two thought leaders was to share their extensive experiences so that other engineering educators could understand ways to potentially implement PBL in daily teaching practice suitable within their local contexts. A wide range of methods were included in the discussions and learning outcomes, including presentations by the facilitator, group based experience sharing discussions, brainstorming for solutions, and peer advice.

The New Face of Technology Assisted Learning

Paul Gilbert and Tom Lee (Quanser)

This session was the result of a collaboration between learning technology company Quanser (Tom Lee and Matthias Krug) and Joe Packhem and Jessica Artiles from SPEED. The goal was to assess the potential of progressive technology initiatives from Quanser with the desires and needs of students. The session was very well received and generated some of the liveliest discussion and debate among the largely faculty audience. The format of the session was also unique. Using a "town hall" style of open questions and answers integrated with overviews and live demonstrations of emerging technologies and pedagogies, the session erupted into vigorous discussions on a variety of topics such as mechatronics and robotics, 3D printing, and the potential of mobile devices. Specific technology projects included the extension of traditional servomotor experiments (e.g. Quanser's QUBE-Servo) with creative design dimensions such as developing smart algorithms to coordinate motion control with music — a sort of "mechatronic dance", or the design of a robotic ping pong ball shooter.

Another example that drew significant interest from the audience was the integration of an iPad with Quanser's new Qbot 2 robot illustrating how a single mobile device can be an effective platform to immerse in information and then interact with the physical world. The pedagogical dimensions included design education, reconciliation of theory and hands-on, and increasing student motivation.

Connected Classroom

Moderator: Stephen Lu (University of Southern California); Panelists: Guenther Schuh (RWTH Aachen Univeristy); Lueny Morell (Lueny Morell & Associates); Mazen Hasna (Qatar University); Suman Kapur (BITS-Pilani)

In order to prepare globally competent and socially responsible engineers, it is imperative to provide high quality education that meets the needs of the modern learners. Moderator Stephen Lu contextualized the discussion with the topic of sweeping changes of campus

education over the past few decades, when remote students are connected to classrooms via distance education. The world is more interconnected now then ever before and because of that, there is the opportunity for remote classrooms around the globe to connect together as one learning place.

The panelists, Guenther Schuh, Lueny Morell, Mazen Hasna, and Suman Kapur, talked about the range of national and regional competencies' needs, which can be challenges in the development of curriculum and assessment in connected classrooms. They pointed out that one major advantage to the connected classroom is *global community development* due to advanced technologies that abolish the interaction distance between learners separated by physical, institutional, and cultural boundaries. This advantage may be a draw for students who are capable and interested in completing engineering degrees, but for a multitude of reasons unrelated to skill and ability, choose other paths – particularly underrepresented minorities and women. The panelists included meaningful examples of how to participate in connected classrooms where there is a blend of learning opportunities to address different learning styles, provide practical real world examples, and are employer-relevant. The panelists' discussion supported the ideas that connected classroom opportunities make students ready to enter a 21st century global workforce and more effective in cross-cultural communication skills.

Quality Assurance

Moderator: Michael Milligan (ABET); Panelists: Axel Zafonschnig (Landesschulrat für Kärnten); Badr Aboul-Ela (MOHEST-UAE and ANQAHE); Hasan Mandal (Sabanci University); Krishna Vedula (University of Massachusetts, Lowell); Ramamurthy Natarajan (IIT Madras); Yuri Pokholkov (Tomsk Polytechnic University)

Moderator Michael Milligan of ABET engaged the panelists in a meaningful dialog that was focused on three areas of Quality Assurance in engineering education: 1) accreditation, 2) mobility of graduates, and 3) quality of faculty. Accreditation was described as an assurance that an engineer would have a solid educational foundation as well as having capabilities to lead emerging technologies and innovation in an effort to meet the needs of the broader public. Quality Assurance of programs through accreditation carry significant benefits to institutions but also poses numerous challenges in terms of fulfilling the needs of both international and regional stakeholders. For example, in many countries where engineering educators do not hold doctoral degrees nor have formal training as educators, the need for a Quality Assurance process is fundamental.

Axel Zafonschnig, Badr Aboul-Ela, Hasan Mandal, Krishna Vedula, Ramamurthy Natarajan, and Yuri Pokholkov enriched the discussion by addressing assessment methodologies, data collection and analysis, and the evolution of accreditation standards to address online and blended learning programs. Current and emerging trends towards certification of engineering educators as part of the Quality Assurance cycle were discussed including the example of ABET evaluations of programs that use a variety of delivery methods such as: on-site instruction, online instruction, and those having components of both methods. The programs are evaluated against the same standards regardless of delivery methods.

They discussed the role of accreditation in facilitating mobility of graduates and the impact of professional licensure and mutual agreements on mobility. The panelists explained that Mutual Recognition Agreements (MRAs), or "accords," are agreements among organizations that accredit academic degree programs. These are non-governmental agreements that recognize the substantial equivalency of the organizations' accreditation processes and the

graduates' preparedness to begin professional practice at the entry level. Substantial equivalency means that the accreditation systems have comparable standards, outcomes, and processes, though they may not be identical. The mutual recognition of accrediting systems is intended to improve technical education worldwide and foster the mobility of students and graduates. This is helpful and necessary for the diverse and unique universities from around the world who are preparing graduates for the global workplace.

Presidential Panel – Input, Output, and Process: Why are these Colleges/Universities Unique?

Moderators: Satish Udpa (Michigan State University); Jose Carlos Quadrado (Instituto Superior de Engenharia de Lisboa) & Panelists: David Garza (Technológico de Monterrey); Marcia Grant (Ashesi University College); Richard Miller (Olin College); Swapan Bhattacharya (National Institute of Technology Karnataka); and Tod Laursen (KUSTAR)

Moderators Satish Udpa and Jose Carlos inspired the audience to understand current and future rationales to have global leaders in engineering. They grounded this panel discussion with the topics of multinational corporate needs and unique ways that high quality institutions are re-conceptualizing engineering education to meet those needs and develop talented engineers. They began the panel by describing how the 21st century marketplace calls for globally competent and dynamic engineers. Traditional engineering programs focus on theory in a single discipline and perpetuate the disconnect between education and industry interests. These programs fail to engage 21st century learners, ignoring the plethora of resources and techniques made available by advanced technology. Consequently, half of all engineering students drop out or change their course of study, and the other half enters the job market without the skills needed to fuel socioeconomic progress.

This is not the case for selected engineering colleges around the world. This panel was comprised of a small number of college presidents who shared ways to address these issues and develop the next generation of engineering innovators, with particular focus on the main aspects distinguishing their college/university. Panelists discussed their student recruitment strategies and admission requirements, factors affecting retention and graduation rates, curriculum development processes, evaluation of faculty performance, and employment and career path of graduates.

Richard Miller shared the multivalent recruitment strategies at Olin that include strategies to connect volunteer Olin parents and alumni to future students at college fairs, on-campus events, and in virtual networking to attract students who are connected to the interdisciplinary approach to engineering at Olin. Marcia Grant of Asheshi highlighted similar strategies to attract students who are interested in being change agents in transforming their community through leadership and entrepreneurship with non-traditional approaches to engineering education. Ashesi and Olin's recruitment has been successful in attracting diverse students including an unusually high number of female students so that their student bodies have a gender balance.

Swapan Bhattacharya highlighted key factors that affected the retention and graduation rates at their institution. Specific strategies included remedial coaching classes, workshops on workplace sensitization, and a professional skill enhancement program. Furthermore, NITK is closely considered the cultural needs of many of the students and designed a bi-

lingual program focused on the Hindi section of the institute to provide a strong support structure to retain and graduate diverse students.

David Garza shared insights about the curriculum development processes at Technológico de Monterrey, which included an emphasis on social engagement through real world design projects, online learning, service-learning, and holistic development. He also described how entrepreneurship education is a fundamental part of the curriculum. Monterrey Tec is world-renowned for entrepreneurship as a learning process, as well as a scalable outcome of the unique and high quality curricular, extra-curricular, and research park experiences that students are able to engage in as undergraduates.

A few of the panelists talked about the importance of internal and external evaluation of faculty performance so that improvement could be an ongoing data driven and cyclical process. Richard Miller provided a novel approach to not include the tenure-track process as part of the faculty evaluation system at Olin. Faculty work with five year contracts and are evaluated qualitatively on their rigor to teaching, service, and research from a comprehensive and holistic approach to their engagement in engineering education as opposed to the more traditional quantitative measures of tenure.

The panelists also discussed successful strategies for employment and career path of graduates. Tod Laursen indicated that at KUSTAR, the interdisciplinary research clusters for MSc and PhD programs helped prepare graduates to work on complex problems and be dynamic to cross different engineering fields in the global marketplace. David Garza described how Monterrey Tec's research, development and consultancy engaged companies and national and international organizations so that students developed relationships with industry and also had practical research and work experiences to prepare them for the marketplace. Marcia Grant was able to highlight a goal that Ashesi has reached that other university presidents aim for which is that Ashesi graduates have 100% job placement.

The panel provided a rationale for re-conceptualizing engineering education, specific examples of ways to attract, retain, and graduate successful engineers for the global marketplace, and also inspired the audience to learn from their unique best practices in leading institutions to successful 21st century engineering education.

The Future of MOOCs – Hope or Hype?

Moderators: Uriel Cukierman (Universidad Tecnológica Nacional); Michael Auer (Carinthia University of Applied Sciences) & Panelists: Mushtak Al-Atabi (Taylor's University); Yacob Astatke (Morgan State University)

Moderators Uriel Cukierman and Michael Auer laid the foundation for this panel discussion by providing an overview of Massive Open Online Courses (MOOC). They described how MOOCs offer a new approach to teaching and learning in many disciplines including engineering education.

The MOOC label was coined in 2008 for online courses that are offered free of charge or for very low fees. MOOCs cross time, financial, and geographical boundaries by bringing education from top universities to scholars across the globe. MOOCs can bring quality instruction to places where university attendance is extremely difficult. In addition to traditional course materials such as lectures, videos, readings, and problem sets, MOOCs provide interactive venues that help build communities of students, professors, and teaching assistants.

The panelists, Mushtak Al-Atabi and Yacob Askatke discussed the role and significance of MOOCs in educating engineers, and identified challenges that needed to addressed and optimized in MOOCs for engineering education. They talked about challenges with MOOCs including reaching learners in areas that lack the computer equipment, internet connections, and the consistent electricity necessary for online courses. Another example of a challenge that the panelists described is that engineering educators are still finding ways to address the issue of rigorous discussions in the MOOC environment. Because of the incredibly large amounts of students in a course, educators are finding electronic alternatives to traditional classroom discussions including: message boards, forums, and chat rooms, but the intimacy of face-to-face communication can be lost, and at times there can be miscommunication. Another challenge of the MOOCs is few are accredited and if they are then it is still not equivalent to an earned degree.

Panelists discussed topics including ways to augment MOOCs with interactivity, project work and online laboratories (MOOLs), ambient learning in engineering education, and suitability of MOOCs to different disciplines. Examples were also provided about the success in using MOOCs in blended and flipped classrooms. They described how professors could make the most of their time with students since students would listen to or watch a recorded lecture, or read it, and return to the classroom for more valuable discussion time or other interactive learning. Due to the panelists sharing a range of challenges and benefits of MOOCs, the audience was able to think critically about the future of MOOCs, their impact engineering education, and their potential sustainability.

Attributes of the Global Engineer: Assessing Global Competence

Workshop Leaders: Stephen Hundley (IUPUI); Jennifer DeBoer (Purdue University)

The American Society for Engineering Education Corporate Member Council's Special Interest Group for International Engineering Education developed, presented, and vetted with its stakeholders a series of attributes representing the desired competencies and characteristics needed by engineers in order to effectively live and work in a global context. One example the workshop leaders, Jennifer DeBoer and Stephen Huntley, shared was the ability to working effectively with people who define problems differently, including both engineers and non-engineers. The often-stated goal of learning to work productively with other cultures involves going beyond recognizing that engineering problems can be solved in different ways, to understanding that engineering problems can be defined in different ways.

The workshop leaders described the stakeholder-driven process to identify and define attributes of a global engineer. They encouraged the workshop participants to see that stakeholders have diverse perspectives and are likely to draw boundaries around problems in different ways; people will consider a wide range of implications for their lives and careers when judging problems. The workshop offered tools to guide students in becoming globally competent by being able to develop the ability to anticipate, understand, and respect perspectives that originate in different cultures and negotiate ways to understand conflicting perspectives.

DeBoer and Hundley presented a summary of the key findings-to-date from a global online survey that was launched to validate the performance and proficiency levels of each attribute, including the stages at which attributes were essential to the preparation, performance, and employability of global engineers. They also discussed a series of global

focus groups in various regions of the world which have been held for the purpose of clarifying and defining the attributes, and for discussing ways in which the attributes can be introduced, reinforced, and assessed in the preparation and development of future engineers. In their workshop, focused considerations were given to introducing, reinforcing, and assessing global competence for engineering students.

IFEES Awards

IFEES President's Award

A highlight of WEEF is to recognize and honor leaders in our global community. The IFEES President's Awards thought leaders who have contributed significantly to the global engineering education community. The sitting IFEES President in consultation with former presidents and the Secretary General determine the recipients each year. The IFEES President's Award for Global Visionary is awarded to individuals who have had a long career in engineering education, with a strong reputation and credibility as global leaders. This year, the President's Award honored Krishna Vedula for his multivalent approaches to revolutionizing engineering education through deep commitment and fostering collaboration amongst many stakeholders.

The IFEES President's Award for Pioneering Regional Leader was awarded to Yury P. Pokholkov who has made stellar contributions to engineering education, including establishing ties with community, corporate, and scientific spheres, throughout Russia and the broader region.

IFEES Duncan Fraser Global Award

Dr. Luiz Scavarda, a Physics professor and Administrative Vice President at the Pontifical Catholic University of Rio de Janeiro, Brazil is the recipient of the IFEES Duncan Fraser Global Award. The IFEES Duncan Fraser Global Award (previously the IFEES Global Award for Excellence in Engineering Education) recognizes individuals who have made outstanding and original contributions to engineering education through exemplary teaching, research, and/or leadership innovations. Dr. Scavarda was honored with the 2014 IFEES Duncan Fraser Global Award for his work on several facets of engineering education making an impact on all key stakeholders – students, faculty, industry and government. He also hosted the 2006 IFEES Summit in Rio de Janeiro, is responsible for international activities of the Brazilian Association of Engineering Education (ABENGE), and acted as its formal representative in IFEES since 2006. Dr. Scavarda's efforts to build the engineering educators community in Brazil and his contributions towards enhancing the number of engineering graduates are laudable. His efforts resulted in an increase of engineering graduates in Brazil from 16,000 in 1996 to 65,000 in 2013. In Brazil, his influence would continue to grow. He was elected as member of the National (Brazilian) Academy of Engineering where he will continue to make a significant impact nationally and globally.

IFEES Awards Sponsors

The IFEES Awards and ceremonies would not be possible without the important sponsorship and support of the global community and industry leaders. Hans J. Hoyer, Secretary General of IFEES and Executive Secretary of the Global Engineering Deans Council joined Jose Carlos Quadrado, then-President of IFEES, in showing great appreciation for IFEES Awards Sponsors: Hewlett Packard, Dassault Systèmes, Granta Design, Quanser Consulting, National Instruments, and Siemens. The support of these stellar multi-national corporate leaders in engineering indicates the relevance and importance of the IFEES Awards recipients' contributions to our global engineering education community.