# IFEES: ENHANCING ENGINEERING EDUCATION AT A GLOBAL SCALE

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## ABSTRACT

Engineering and technology play a key role in globalization as developed and developing countries develop and implement effective and efficient strategies that advance their economies and social development. Engineering has played a critical role in economic development in the history of civilization, because engineers are important not only in solving local problems but also in knowledge creation and knowledge transfer. Thus, science and technology education need to be in continuous evolvement in order to keep assisting countries reduce poverty, boost socio-economic development and make the right decisions for sustainable and environmentally compatible development. In a flat world, a global approach is needed to effectively innovate engineering education. The world needs to establish effective engineering education processes of high quality around to assure a global supply of well-prepared engineering graduates, engineers who can act locally but think globally. This paper describes the history behind the creation in October 2006 of the International Federation of Engineering Education Societies (IFEES), its strategic intent as well as some of the initiatives currently underway. It will also share some of the needs and views of IFEES various stakeholders worldwide (engineering education associations, students, industry, and other organizations).

*Key words:* Engineering education. Globalization.

## INTRODUCTION

### THE BEST WAY TO PREDICT THE FUTURE IS TO INVENT IT. ALAN KAY

Throughout the history of civilization, engineering has played a critical role in economic development. Engineers are key not only in solving local problems but also in knowledge creation and knowledge transfer. But in a globalized world, engineering and engineers face challenges that go beyond science and technology themselves. Countries around the world are moving fast in developing knowledge based economies. The basic premise is that knowledge is becoming a primary factor of production, in addition to capital, labor and land. In fact, many economists now argue that knowledge has become the most important component of production. The belief is that a knowledge economy will lead to improved quality, reduced costs, better response to consumer needs, and innovative products. Thus, knowledge, knowledge creation and knowledge management will become critical for countries and regions to survive and excel in a globalized world [2].

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It is therefore imperative that technical know-how be supplemented with professional skills to develop an 'adaptive engineering leader' who is capable of addressing the multiple challenges of an ever-changing world. Engineering education should respond to these challenges with effectiveness and efficiency and develop the engineering professional a globalized economies need.

## THE ROLE OF ENGINEERING EDUCATION IN DEVELOPING KNOWLEDGE BASED ECONOMIES

Knowledge and innovation have always played a key role in development. Fifty years ago competitiveness and growth were driven by access to natural resources and labor. With globalization and the technological revolution of the last decades, knowledge has clearly become the key driver of competitiveness. Innovation in technology, as well as products and business processes, boosts productivity. Today, the prosperity of nations depends on how effectively they use their human resources to raise productivity and nurture innovation.

A knowledge economy is one that utilizes knowledge as the key engine of competitive growth. It is an economy where knowledge is acquired, created, disseminated and used effectively to enhance economic development. Transitioning from a traditional economy to a knowledge economy requires long term investments in education, innovation, and ICT, and an appropriate economic and institutional regime that allows efficient mobilization and allocation of resources.

A recent book published by the World Bank Institute [3] argues that whatever their level of development, countries should consider embarking on a knowledge- and innovation-based development process. In these times of accelerated globalization, "grey matter" is a country's main durable resource. Its utilization for economic and social well-being is increasingly at the center of development strategies. The analysis and information on which this book is based are largely drawn from work by the World Bank Institute's Knowledge for Development program, launched in 1999, which has carried out a number of knowledge economy diagnostics and case studies, using the Knowledge Assessment Methodology (KAM).[1]

These diagnostics have confirmed the critical role of education. Many of the growth stars owe their success to solid gains in human capital. While education has always been a key component of innovation and technological advance, the complexity and speed of the interplay between education, knowledge, technology and skills require far reaching adjustments of education systems. Knowledge-enabled economies are able to constantly modernize their education systems in line with changes in economic policies. These changes have been both systemic and deep, affecting the nature of teaching and learning. Most OECD countries have increased their public expenditures on education over the last few decades. Developing countries also have made significant investments in education. However, talent and skills have become the world's most sought-after commodity. As economies increasingly shift towards knowledge-intensive directions, the demand for skills and competencies increases significantly.

More importantly, performance in the marketplace is driven by the quality, skills, and flexibility of labor and management. In addition to traditional "hard" skills and ICT competencies, the knowledge economies require a new set of "soft" skills, such as spirit of enquiry, adaptability, problem solving, communications skills, self-learning and knowledge discovery, cultural sensitivity, social empathy, and motivation for work. Countries need to develop teaching and learning environments that nurture inquiry, adaptability, problem-solving and communication skills. But mastery of these skills is quite low in many countries.

## IFEES HISTORY, VISION, AND MISSION

Recognizing that the 21st century global economy requires well-trained and culturally-sensitive engineers, representatives of 31 organizations from 10 countries, gathered in Rio de Janeiro, Brazil, on October 9, 2006 to launch the International Federation of Engineering Education Societies (IFEES). In addition to electing its leadership team and approving governing documents, the organization's members discussed their overarching goal of building a vibrant, virtual global community to foster collaboration

and learning among the world's engineering-education societies. The key-question posed by the 21st century global economy to engineering educators and engineering education stake-holders was: "How can education in science and technology help reduce poverty, boost socio-economic development and take the right decisions for a sustainable and environmentally compatible development?"

A global approach was needed. The desire was to create a world-wide network of engineering educators and engineering education stakeholders that could attempt to answer such formidable basic questions and drastically raise the horizon of target and ambitions: i.e., to pass from the day-by-day engineering education issues and problems[2] to the "actual impact" on the world-wide development and socio-economic growth.

IFEES was born with the vision to contribute significantly to changing the world (within the context of its mission and competences), i.e. to the extent that engineering education can contribute to these changes. Through the collaboration of its member societies, IFEES' mission is to establish effective and high quality engineering education processes to assure a global supply of well-prepared engineering graduates. IFEES strives to strengthen member organizations and their capacity to support faculty and students. It will attract corporate participation, helping to connect engineering graduates with international corporations that have a pressing need for well-trained engineers who can work in a global environment. IFEES will also aim to enhance the ability of engineering faculty, students and practitioners to understand the varied cultures of the world and to work effectively in them.

"IFEES will become the largest world-wide forum of discussion on engineering education, it will increase the awareness of policy makers on engineering education priorities, and it will boost innovation in science and technology,"[3] were the words of Claudio Borri, the founding president of IFEES. "The formation of IFEES underscores the importance of high-quality engineering education to national economies and the global economy", said Wayne Johnson, previous Vice President, University Relations Worldwide at Hewlett-Packard. "It also spotlights the great significance of technology in today's society. Engineers have played a key role in developing new information technologies, and those innovations can now be used to advance global engineering education."


With this in mind, IFEES is developing partnerships with major organisations worldwide dealing with social development and education.

## MOBILIZING THE BEST HUMAN RESOURCES: CORPORATIONS, PROFESSIONALS, AND STUDENTS

All IFEES officers and members are committed to promoting, developing and putting in place initiatives to mobilize the best human resources and contributing to the common vision of IFEES. Only through the "top people" worldwide will IFEES become influential and have an impact on major changes. Participation must include corporations, as well as professionals from industry, governmental and non-governmental agencies. In this context, IFEES' goal is to build a network of high value partnerships with key leaders around the world, in organizations as well as the engineering education sector. From the economic sector to social sciences, from political sciences to peace-keeping, from banking to financial investors, IFEES shall carry out its mission hand-in-hand with all of them.

One way to reach this goal is to involve students and student organizations in IFEES' strategic planning, initiatives and events. The archaic vision of students as "customers" or (even worse) "end products" of engineering education process needs to be abandoned. IFEES wants and needs to have students on board because they are key stakeholders and their vision, needs, and ideas are important. They are also important in matchmaking opportunities with and obtaining support from the corporate world.

One thing is clear for IFEES. It shouldn't become: An "empty" container of "wishful thinking" and only an organizer of new conferences and summits, increasing the tremendous number of events in the sector. IFEES is and will be focused on actions and projects. It should also not become a simple network of engineering education allowing the members to travel worldwide or an organization from which one can expect revenues in terms of personal career and/or visibility and success. Members will never ask themselves what will IFEES do for them, but rather what can they do for IFEES. IFEES is about catalyzing ideas into real projects that enhance engineering education. It is about thought leadership put into action.

## IFEES ACTION PLAN AND KEY STRATEGIES

In order to achieve its mission and vision, IFEES decided to focus on four strategic areas, namely: Engineering Education Infrastructure, Research & Development and Entrepreneurship, Student Attraction and Success and Lifelong Learning.

IFEES will promote and support activities and initiatives that promote engineering education globally and the access to engineering education for everybody in world, enhance quality of engineering education responding to actual needs of the society, share teaching methods and curriculum plans, increase transparency and recognition of titles, also through the accreditation systems and international accords, foster and favor mobility of students and professionals, promote ethics and gender issues in engineering education, increase awareness towards environmental issues and sustainable development, improve humanistic skills and cultural attitudes of engineers to work in different cultural settings of the world, and foster imagination and innovative thinking in the new generations of engineers, among others.

To fully implement its action plan, IFEES needs the support of all engineering education societies, stake-holders, corporations, and, last but not least, student associations. The structure of the leadership of IFEES also supports the four action areas described above. The Executive Committee consists of the President, President-Elect or Immediate Past President, a Secretary General, four Vice Presidents and 6 other members. Each IFEES Vice President has principal responsibility for leadership for one of the areas and one or more initiatives.

Initiatives undergo a review process and are placed under one of the four areas to make sure they align with the mission, vision and strategic plan. The following sections describe IFEES members' first year global initiatives.

## GLOBAL ENGINEERING DEANS COUNCIL

The Global Engineering Deans Council (GEDC) is one of the key initiatives of IFEES, which approved its creation at the first IFEES Global Engineering Summit on September 30th 2007 held in Istanbul, Turkey.

The reason behind the establishment of GEDC is simple: there are currently big and small institutions with different missions and visions for various engineering programs, and emphasis on research, etc., to meet the diverse engineering manpower and innovation needs of national economies. As the global pressure for engineering solutions to growing problems and issues continue to increase, engineering educators intrinsically feel the need to better prepare engineers to meet new challenges. Stakeholders are increasingly expecting engineering colleges to act as leaders in innovation and to provide solutions to society's challenges. In a global, knowledge-driven economy, technology innovation is critical to competitiveness, long term productivity growth, and the generation of wealth. Therefore, major changes will be necessary in engineering education, research and practice to prepare engineers for a rapidly changing world.

There are many challenges faced by engineering deans, rectors and directors of internationally recognized engineering schools today. Deans need to ensure their schools deliver locally-pertinent and globally-relevant engineering education, they have to develop plans to make engineering more attractive to top students, who are being drawn away from science and technology disciplines, and make engineering more attractive to our future generations of students. They lead programs focused at improving the quality of teaching and learning, and increase the output of engineers, recruit and retain quality faculty members and strengthen "capacity building" such as staffing, funding and infrastructure in engineering schools. They have to improve the quality of governance practices in engineering schools and develop adequate models for facilitating partnerships between engineering schools and industry as well as develop adequate funding models for engineering schools.


The GEDC initiative is timely as it is a great way for engineering deans to learn about engineering education on a global scale by providing a world-wide forum for exchange of information, discussion of experiences, challenges and best practices in leading an engineering school. Through such exchanges, the GEDC will provide a means for engineering deans to partner with one another in innovation, collaborate with industry and other stakeholders, and build a network that would support engineering deans to play a leadership role in developing regional and national policies to advance economies.

The GEDC has the potential to become a serious global effort with meaningful impact for engineering education. Its Executive Committee (made up of deans, rectors and directors of internationally recognized engineering schools) held its first meeting on May 8 and 9, 2008 in Paris, France and will convene its first general assembly of deans in the spring of 2010.

## THE IFEES GLOBAL ENGINEERING EDUCATION SUMMIT

IFEES held its First Global Engineering Education Summit and Assembly at Bo□aziçi University in Istanbul, Turkey on September 30, 2007, co-located with the ASEE Global Colloquium and the Turkish Engineering Deans Council Conference. The theme was Moving from Concept to Action and approximately 150 leaders of engineering education societies, industry, government agencies, the private sector, and engineering student leaders participated in the Summit.

The 2nd IFEES Summit will be held in Cape Town, South Africa from October 19-20, 2008, hosted by the University of Cape Town and the African Engineering Education Association (AEEA). The theme will be "Excellence and Growth in Engineering Education in Resource Constrained Environments – Learning From One Another and Working Together to Produce Quality Engineers to Address Challenges Facing Every Part of the World in the 21st Century". The CapeTown Summit's agenda is action oriented, in other words, IFEES current and future members will hear from IFEES initiatives and will be invited to join, adopt or adapt similar initiatives in their countries/regions. It will also include a Knowledge for Development workshop offered by the World Bank Institute as well as provide a mechanism for policy makers and funding organizations to share programs and resources to support engineering education.

## THE INDO-US COLLABORATIVE FOR ENGINEERING EDUCATION (IUCEE)

One of IFEES' key members, the American Society for Engineering Education (ASEE), along with academic and business leaders from leading US and Indian universities have launched an initiative to build Indo-US collaborations in order to make engineering education and research more relevant to the needs of the global society and to the aptitudes and aspirations of the new generation. This initiative is called the Indo-US Collaborative for Engineering Education (IUCEE). IUCEE focuses on the preparation of the next generation of engineering faculty in the US and India, who can educate their youth with strong technical skills as well as relevant soft skills while motivating them with a powerful vision of engineering for the well-being of the global community.


Engineering educators from the US and India are in a unique position to address these challenges by working together. Strong bonds have already been developed between US and India, because of the large number of Indian engineering graduates who immigrate to the US and make valuable contributions to the US research enterprise and to the US economy. Several of these engineers have become entrepreneurs and have played a major role in the information technology revolution and in a variety of non-technology oriented industries such as hospitality. Many of them are also leaders in engineering education in the US. This synergy between US and India provides the opportunity for the two countries to collaborate on building the next generation technical workforce using new paradigms.

After two planning workshops held in 2007 (one in India, one in the US) involving academic, industry, professional associations and government leaders, IUCEE established its strategic plan for dramatically increasing the number of engineering faculty in the US and in India who collaborate on research and teaching and who will be able to better prepare engineers for the global economy. The roadmap, based on successful best practices, is focused on:

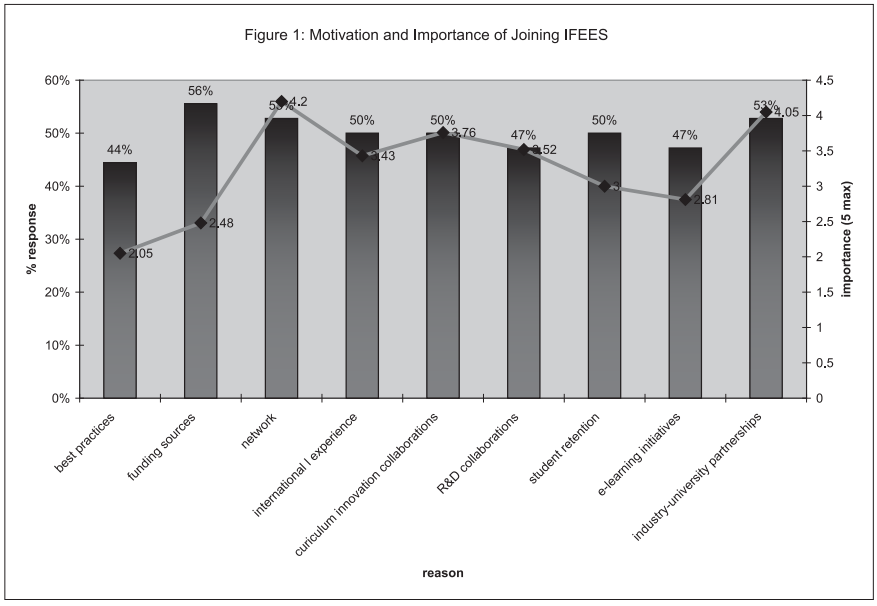
- Increasing research collaborations among faculty in emerging technolo-gies, thereby producing more PhDs.
- Stimulating academic institutions to pursue more research on how students learn engineering.
- Developing and offering new certificates/ degree programs based on this research for current and future engineering faculty.
- Facilitating faculty exchanges between academic institutions and businesses of both countries as a cornerstone for these collaborations.
- Assisting faculty in reforming engineering curriculum with emphasis on hands-on project-based learning, innovation and entrepreneurial skills, soft skills, lifelong learning skills, as well as relevance to industry.
- Supporting widespread use of communication and digital technologies for effective delivery of curriculum.
- Creating a faculty culture of continuous quality improvement based on data and outcomes.
- Increasing participation by women and underrepresented minorities in engineering.
- Generating funding and build partnerships with the private sector for these activities.

IUCEE has gathered significant support and contributions from the private, professional and public sectors in the US and India. The First Faculty Leadership Institute will be offered in 2008, at the Infosys campus, Mysore, India between late May and mid-July. The one-week workshops on specific topics will explore new teaching pedagogies and will include an overview of latest research in the field, and opportunities for collaboration. A total of 500 faculty in India have registered to attend more than 20 workshops scheduled. Each topical workshop will have ~30 carefully invited and selected faculty participants; ~5 of these will be potential trainers/faculty in Regional IUCEE Engineering Faculty Institutes.

## IFEES MEMBERS SURVEY TO DETERMINE THE NEEDS OF ENGINEERING EDUCATION AND ITS STAKEHOLDERS

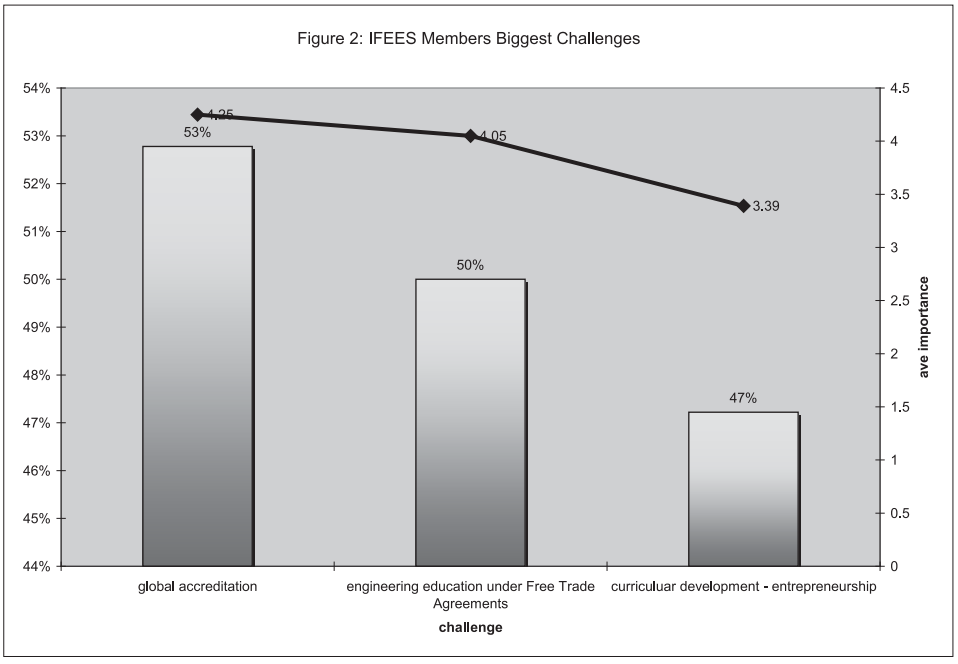
No organization can be effective if it does not understand its members' and stakeholders' needs. Therefore, in order to validate the ideas and strategies IFEES founders had, in the Spring of 2008, IFEES carried out a member survey to understand its member's needs and priorities and value propositions for the organization. The survey explored items like members' motivation to join, perception of engineering education biggest challenges, best practices, as well as members' wishes for IFEES to accomplish. 58% of the current IFEES members at the time (36) responded.

Figure 1 shows members' motivation to join IFEES. Networking with other organizations, faculty and deans from around the world and 'Advancement in bridging and establishing industry-university partnerships seem to be the primary reasons to be a member of IFEES. Members mentioned that they would like to develop industry-university relationships as a primary goal for IFEES policy in the future.




Most of the IFEES members see the "Global Accreditation Issues" as the biggest challenge, with 15 out of 21 members stating they strongly agreed that 'Global Accreditation Issue' is the main challenge. Most of the IFEES members agree on the three major challenges engineering education faces today: global accreditation, engineering education under free trade agreements (FTA) and curriculum development (including entrepreneurship) (Figure 2).

ES members shared their organizations' engineering education best practices. Engineering Education associations' principal activities and best practices focus on annual conferences and meetings and publications. Industry members provide opportunities for research and programs for curriculum innovation. The table below summarize their responses.



| Member | Website | Best Practice |
|---|---|---|
| American Society for Engineering Education (ASEE) | www.asee.org | • Engineering Deans Council (EDI)<br>• Industry-Academic Partnership<br>• Publications |
| Ibero-American Association of Institutes of Engineering Education (ASIBEI) | www.asibei.org | • Association of associations<br>• High component academic and research<br>• Bi annual Iberoamerican meetings |
| Autodesk | www.autodesk.com/ edcommunity | • Autodesk provides powerful 2D and 3D design software, innovative programs and resources to help schools and institutions of higher learning prepare their students for academic and career success. Over 500,000copies of our software have been downloaded. |
| Board of European Students of Technology (BEST) | www.best.eu.org | • Bringing students together from different countries<br>• Being a bridge between students and academics<br>• Promoting Europe among Europeans |
| Cartagena Network of Engineering Education | www.cartagena-engineering-network.org | • Research areas in engineering education<br>• Piloting the education institutions and their logistics<br>• Participate in the new modernization, renewal and planning of the training programs |
| Council of Deans Engineering Faculty of Chile (CONDEFI) | www.condefi.cl | • Many conferences around the year for curricular innovation<br>• Working together with industry in order to find collaboration in all the areas of knowledge |
| Chinese Society for Engineering Education (CSEE) | | • Annual conference<br>• Bimonthly journal<br>• Monthly bulletin |
| Dassault Systèmes | www.campus.3ds.com | • Establish productive academic and industry relationships<br>• Provide industry relevant curricula innovation and educational material<br>• Innovate blended learning practices inspired by professional education |
| Hewlett Packard (HP) | www.hpl.hp.com<br>www.hp.com | • Research partnerships, student programs<br>• Philanthropy programs<br>• Engineering education innovation programs |
| International Society for Engineering Education (IGIP) | www.igip.org | • IGIP curriculum for engineering educators<br>• IGIP conferences in different countries and regional conferences<br>• Workshops for engineering educators |
| Instituto Superior de Engenharia de Lisboa – Portugal (ISEL) | www.isel.ipl.pt | • Create professionals that have high level qualification well recognized by the market.<br>• The ability to cover the entire country's requests on engineering education.<br>• The ability to respond to multiple (and variant) industrial requests for productive partnerships |
| Ibero American Science and Technology Education Consortium (ISTEC) | www.istec.org | • Promote integration between local and international accreditation and certification initiatives in academia and industry<br>• Forum to encourage joint international research and development<br>• Entrepreneurship development: alliances, partnerships, and funding |
| Kazakhstan Society of Engineering Education (KazSEE) | | • Organization of Central Asian engineering universities' instructors involved in international training.<br>• Universities consortium forming for Tempus program in preparation for innovation education.<br>• Preliminary work for creation of Kyrgyzstan society of international pedagogy (Mutanov's and Antonov's, representatives of KazSEE, visit of Bishkek city to take part in information seminar about societies for Engineering education and IFEES). |

Cont.

| | | |
|---|---|---|
| Korean Society of Engineering Education (KSEE) | | • Organizing conferences<br>• Publication<br>• The journals |
| Latin American and Caribbean Consortium of Engineering Institutions (LACCEI) | www.laccei.org | • Annual Conference<br>• Journal<br>• LACCEI was the catalyst behind the Engineering Education Collaboration Agreement for the Americas. ASEE, IFEES, ASIBEI, ISTEC, LACCEI, EftA agreed to exchange free registrations and participate in each others conferences and board meetings. |
| Russian Association for Engineering Education (RAEE) | www.aeer.ru | • Building up international recognition of national engineering programs accreditation system<br>• Organizing of international conferences on engineering education<br>• Publishing annual magazine “Engineering Education” |
| European Society for Engineering Education (SEFI) | www.sefi.be | • Working Groups activity<br>• Annual Conference<br>• Deans Convention |
| Siemens | www.siemens.com | • Support regional engineering initiatives<br>• PLM software grants |
| Turkish Engineering Deans Council (Turkish EDC) | mdk.anadolu.edu.tr | • Engineering Education Forum<br>• Establish the National Accreditation System for Engineering Education |
| Upsilon Pi Epsilon International Honor Society for the Computing and Information Disciples (UPE) | upe.acm.org | • Offering Scholarships<br>• Founder and Co-sponsor of the International Programming Contest<br>• Recognition of Scholar Excellence |

Finally, IFEES members look forward to what the future beholds in this win-win-win federation. Below some comments members shared about their wishes for IFEES to accomplish in the future:

> […] a project with the World Bank Institute and some other organizations… to allow scholarships for smart young pupils to start studying engineering and technology. SEFI.
>
> Establish a common Engineering Curriculum Bank to share with disparate countries. Serve as a catalyst for diversity awareness in engineering education. Siemens.
>
> Support engineering education accreditation initiatives and provide universities with the voice of the employer, important in crafting curricula and student activities… IUCEE (Indo-US.
>
> Collaborative for Engineering Education) program model adopted/adapted in various regions of the world, and developing faculty institutes for the betterment of engineering education, pedagogy and learning. Hewlett Packard.
>
> Pursuit of economic resources for joint projects. ASIBEI.
>
> Work towards creating a synergy between institutions and industry worldwide. ISTE.
>
> Building up of (a) global system and recognition of engineering education and engineering professions. RAEE.
>
> Networking with other honor societies and student organizations to share and develop leadership training material and opportunities for engineering & computer science students. IFEES could help bring together the student chapters of various societies to leverage and share their resources. UPE.
>
> Provide capacity building for the leadership of their member organizations on becoming “global” and “collaborating”. LACCEI.
>
> Develop and present an assessment of the skills and experiences required by engineering graduates to work effectively in a global environment with the goal of enhancing the employability of engineering graduates and increasing the international competitiveness of IFEE’s academic members. Autodesk.
>
> Promote greater open dialog among engineering educators. ASEE.
>
> Become a recognized platform for bridging education and industry/business, achieve undisputable successes in improving employability of students, inspire visible improvements in the overall statistics of engineers “production”, and be recognized as the enabling body for meaningful improvements in engineering education in developing countries. Dassault Systèmes.

IFEES leadership will be using the results of this survey to continue influencing its strate-

gic and operations plans, as well as motivating members to submit specific joint proposals for IFEES endorsement and support.

## WHY IS IFEES UNIQUE? MEMBER'S PERSPECTIVES

> Collaboration between societies from around the world can improve engineering education and help meet growing demands for "a global supply of well – prepared engineering graduates… There are pragmatic things that IFEES can do, including ensuring best practices go from country to country. This is especially important for societies from developed countries to help those in developing nations". Frank Huband, ASEE Executive Director.

IFEES presents a venue, a mechanism to catalyze members' needs into action [27, 28]. This section describes IFEES value proposition and thought leadership from some of its members: engineering education associations, student organizations and industry.

For engineering education associations, the formation of IFEES comes at an opportune time for US engineering education and for ASEE, for example. Engineering education is facing a need for fundamental changes. With the rapid change in technology, decreasing supply of engineers, the impact of globalization, and the complexity of problems to be solved, the US must find ways to better educate the engineers of the future. As Dr. James L. Melsa, ASEE President, states in the September 2007 issue of Prism, "we are currently preparing students for jobs that don't yet exist, using technologies that haven't yet been invented in order to solve problems we don't even know we have".

ASEE's mission is to further education in engineering and engineering technology by promoting excellence in instruction, research, public service, and practice; exercising worldwide leadership; fostering the technological education of society; and providing quality products and services to its members. ASEE seeks to encourage local, national, and international communication and collaboration to achieve its mission. As an international organization, IFEES provides a forum for ASEE to collaborate with its world-wide partners on critical issues in engineering education. ASEE has an interest in and commitment to each of the key strategies IFEES has defined to achieve its overall vision. Although ASEE has much to offer to IFEES, there is also much that ASEE can learn from its worldwide partners. IFEES will provide opportunities to collaborate on solutions to societal problems, access to new teaching methods, opportunities for students and faculty to learn in a global environment, and to explore new strategies for educating tomorrow's engineers. Other IFEES members like LACCEI agree:

> The biggest benefit for regional engineering education societies, such as LACCEI, in joining IFEES is finding innovative and effective strategies being tried in other regions facing similar challenges, and being able to collaborate to leverage existing resources and form new partnerships for seeking funding. The Flat World requires new models of leadership in engineering education societies. Maria Larrondo Petrie, Florida Atlantic University and Executive Director, LACCEI.

One of the most important stakeholders of engineering education is engineering students, tomorrow's engineers. IFEES aims to shape the future of engineering education so that it ensures the sustainable development of mankind which cannot happen without involving those who will be the active players in tomorrow's society. Student involvement embraces the advantages of a fresh and diverse pool of ideas being the key factor for the improvement and evolution of the educational systems worldwide. Furthermore, in order to ensure the continuity, applicability and functionality of the reforms and operation frameworks within engineering education set by global entities such as IFEES, student motivation and empowerment is crucial.

In addressing engineering education on a global scale, students should be involved and their input considered. One way is through worldwide student associations that take the responsibility and have an active role in shaping and improving the process of engineering education. In Europe, student involvement in decision-making processes has increased over the last years starting with the university level (input of student unions), continuing with the national level (national student unions), and ending with the cross-national level (representative European Students' Union [21] and non representative student associations, such as the Board of European Students of Technology (BEST).

BEST has been providing a solid and coherent input to engineering education policies at the European level and beyond, since 1995. With the mission to provide services to students,

BEST focuses in providing complementary education, educational involvement and career support to the European students. BEST is active in 30 countries with 2,000 members and reaching 900,000 students [22]. BEST impacts the development of engineering education by concurrently embodying a live link between students and their education, and a platform where European stakeholders of engineering education meet and improve engineering education, all these according to the BEST Educational Program, run by BEST Educational Committee [24].

During the 5th ASEE Global Colloquium on Engineering Education in Rio de Janeiro, Brazil, BEST joined forces in the creation of IFEES aiming to provide a beneficial input for the worldwide engineering education. Identifying this need, a new worldwide student initiative has been starting to take shape, under the acronym of SPEED (Student Platform for Engineering Education Development) [26]. The challenges and the opportunities of such initiative are being handled by an increasingly numerous group of internationally diverse students, a new breed of global engineers, who look beyond the borders of their education and cultures and connect in spite of the variety of beliefs and backgrounds.


SPEED aspires to connect different stakeholders of education, provide input and create a change in the field of engineering education, and link "local-regional-international" across all stakeholders of engineering education into a "global" entity. The three strategic directions, identified for the further actions of SPEED, are achieved initially by promoting the need for change in the development of engineering education among local student leaders and secondly, by interconnecting them and transforming them in regional student leaders (using student unions or other local student committees). SPEED strives to create a platform for student leaders, to facilitate their engagement into cooperation and research on engineering education matters and finally to connect them with representatives from other NGOs, businesses and the industry sector, academia, civil society, and political leadership.

Companies also see great benefit of student engagement in IFEES, as M P Ravindra, former Senior Vice President for Infosys states:

> It makes eminent sense especially for companies who have transnational presence and aspirations to be part of IFEES. It will help them win their talent wars more successfully… IFEES forum provides a great opportunity for everyone concerned with quality and quality of engineering education happening in the world and is a great way to learn the steps to finding the answers to creating global perspective in every student who pursues engineering education across the world. I liked the SPEED initiative the most as it helps create student leaders that will go a long way in dispelling opportunities for misinformation each other's country and build trust in future generations of world citizens" Dr. M P Ravindra, Advisor, Education and Research Infosys Technologies limited; Former SVP and Head E & R of Infosys Technologies limited.

Even though industry and academia represent different institutional cultures and dynamics, both seek the same goals: knowledge and human development. Yet the fact is that around the world, oftentimes and due to many factors, both sectors engage in these important goals independently and in parallel. Much is lost by this situation. So, why not partner and collaborate to achieve these goals more effectively and efficiently? Industry particularly is interested in an engineer/technology professional that will effectively integrate and contribute to corporate goals. Industry is also interested in research and technology partnerships that advance the state of knowledge faster, bringing together top minds in technology areas. Industry is also looking forward to contributing to communities' needs and supporting philanthropic initiatives.

Companies that have realized the potential of industry-university collaboration – seeking the same goals, best practices, resources and talent to enhance the capacity of each other – have discovered that they can achieve their goals easier while at the same time, contributing to a greater good, that is, enhancing engineering/science

education. Industry-university collaborations take many dimensions, from research and development to technology adoption, account management, internship opportunities for faculty and students, and talent recruiting.

> An increasingly competitive world demands the talents of the world's best and brightest and Autodesk is more dedicated than ever to inspiring and preparing the next generation of designers. In order to compete in tomorrow's global workplace, today's students must be fluent in the technologies used by professionals in the real world, and be able to collaborate effectively across disciplines, time zones, and cultures. Autodesk provides powerful 2D and 3D design software, innovative programs and resources to help schools and institutions of higher learning prepare their students for academic and career success. We're a proud sponsor of IFEES programs and events… (Alan Jacobs, Senior Manager, University Programs, Autodesk).

Inspired by a successful practice of ASEE, founders of IFEES included and are seeking participation of businesses interested in engineering education. Only such collaboration can foster, encourage, and cultivate the dialogue between industry and engineering educators to assure a global supply of well-prepared engineering graduates. Motivation for such an association to include commercial companies can easily be seen as one of the natural mechanisms to collect financial support from future employers or technology providers.

Early activities of IFEES have shown, however, that the mutual value of collaboration essentially emerges through other forms of joint work and outcomes that could be classified in three categories: 1) capacity creation (improve attractiveness of engineering disciplines by defining, testing, sharing and enabling best practices and collaborative initiatives to attract under-represented segments of populations, and to reach families with low or no awareness about engineering or engineering education; jointly invent and deploy ways of sustaining student enthusiasm and tenacity to improve retention in engineering learning disciplines, and, share visibility, ideas and efforts in defining locations at global scale, and disciplines where capacity increase is justified by employment opportunities; 2) curricula update (help faculty understand emerging skills and practices that become standard in engineering jobs, including skills resulting from globalization and virtualization of the engineering profession. Instruments to that end include fellowships, sabbaticals, and academia attendance in industry conferences; establish transfer mechanisms of new engineering methods as practiced in innovative businesses to curricula. Typical actionable means are: faculty training by industry, educational content distribution, and student internships with educational scopes of work, and working together between industry and academia to define faculty education programs in new engineering practices), and finally, 3) educational innovation for competitive education practices (businesses have been exposed very early to acute transformation forces resulting from globalization, to increase their competitiveness – or simply survive – in this context. The recognition that learning is a key response to these challenges drove significant innovation in distant/blended learning, high speed knowledge update, knowledge certification within partners and stakeholders networks and affordability of large scale education programs, to name a few. Sharing understanding, co-inventing new techniques, transferring know-how about these innovations can greatly benefit from collaborative work between businesses and faculty within IFEES.

Two key characteristics of IFEES create favorable conditions for achieving better results within all these categories: 1) the association is truly international hence reflecting the increasingly global operating field of companies, and 2) the association members are associations with their own larger audiences and therefore with a stronger potential for a broader impact. This is why technology providers such as Hewlett Packard, Autodesk and Dassault Systèmes, service providers such as Infosys, or employers in manufacturing such as Bosch or Boeing, have expressed their interest and started their investment in IFEES.

> For Dassault Systèmes as provider of 3D and product Lyfecycle Management Technology, there has been no hesitation in contributing to the emergence of IFEES, with funding, with manpower and with all the creative energy of a global innovation company. (Xavier Fouger, IFEES Vice-President and Director of the PLM Academy at Dassault Systèmes).

## THE FUTURE

IFEES is currently evolving and increasingly reaching out to engineering education societies throughout the world. Additionally, IFEES is

facilitating a dialog with colleagues in countries (i) lacking an engineering education association, (ii) with a recently established engineering education association (e.g., the African Engineering Education Association and Kazakhstan Engineering Education Association), or (iii) those countries interested in establishing such an organization (e.g., Namibia, where colleagues are taking initial steps to form an engineering education association and are beginning to build connections with AEEA, ASEE, IGIP, and SEFI). IFEES sees a tremendous potential for long-established organizations to play a supportive role in the countries that have only recently established their own organizations or are in the process of doing so. It is this kind of effort and interaction between societies that has the tremendous potential of contributing in a meaningful way to the strategies and capacity building of emerging societies who can benefit from the successes and failures of well-established peer engineering education societies.

As IFEES is increasingly conscious of and sensitive to the need to establish a global forum unique to the profession.

> (IFEES is committed to) is using its connections to initiate collaborations among the membership of its societies to help them achieve their global aspirations. (Jack Lohmann, Vice Provost and Professor of Georgia Institute of Technology and Editor of ASEE Journal of Engineering Education).

## CONCLUSION

Throughout the history of civilization, engineering has played a critical role in economic development. Engineers are key not only in solving local problems but also in knowledge creation and knowledge transfer. Thus, engineering education plays a very important role in developing the engineering professionals that will not only solve local, regional challenges but also succeed in the highly technical and globalized economy of today and tomorrow. Competitiveness will increasingly depend on the capacity to tap into global pools of knowledge and leverage the best human resources available in the world. The explosion of knowledge, coupled with the global movement of ideas, makes it impossible to fully anticipate the nature of future innovations. It remains that countries that will derive the most from globalization will be those in which the systems of education, business, and government can cooperate to educate, train, and put to work their human capital. IFEES brings together engineering education societies and other stakeholders around the world to address the major challenges engineering education faces in both the developed and developing world. By strengthening societies, learning from each other, sharing best practices and jointly addressing challenges, IFEES hopes to enhance quality of engineering education responding to actual needs of the society.

## NOTAS

[1] The KAM consists of 83 structural and qualitative variables for 140 countries to measure their performance on the 4 Knowledge Economy (KE) pillars: Economic Incentive and Institutional Regime, Education, Innovation, and Information and Communications Technologies. Variables are normalized on a scale of 0 to 10 relative to other countries in the comparison group.

[2] E. g., issues like curriculum development, quality assurance and accreditation, mobility and recognition of titles, joined curricula, international dimension, ethics and gender issues in engineering education, employment & attractiveness of engineering education, etc.

[3] ASEE Press Release, November 6th 2006.

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