Engineering Education in Korea - Status and Challenges

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Republic of Korea (South Korea)—noted for its remarkable industrial developments over the last 30 years (especially in the engineering industry) and having many readily-recognizable global engineering companies such as Samsung, Hyundai, LG, POS CO and SK—is, owing to its strong historically Confucian cultural roots, also noted for Koreans’ general respect for education as evidenced by the yearly statistics that over 70% of high school graduates enroll in colleges. Although it may seem apparent—with the coupling yearly statistics that about 23% outright majority of the college population major in engineering—that Republic of Korea is on smooth sail with respect to its engineering evolution, there are—due to threats pertaining to changes in industrial structure, culture, economy, politics, education, environment and social structures (and, ultimately, people’s psyche, work-ethics and living styles)—some alarming early signals pertaining to the numbers, quality and sustainability pertaining to its engineering workforce. In this presentation, more introspective examination and analysis beneath the façade is presented which, in turn, points to some challenges that lie ahead for engineering education in Republic of Korea.

In the context of the general engineering education development hierarchy, mirroring the corresponding hierarchies associated with International Federation of Engineering Education Societies (IFESS) and American Society of Engineering Education (ASEE), Korean Society for Engineering Education (KSEE)—under the mission of promoting engineering education in Republic of Korea and with close ties with the Korean Engineering Dean’s Council (KEDC), the Accreditation Board of Engineering Education in Korea (ABEEK) and the National Academy of Engineering of Korea (NAEK)—has been playing a crucial role in disseminating new developments in engineering education since its founding in 1993 and—with 3000 strong membership from academia and industry—engages in numerous publication and academic activities that include: journal of engineering education research, bi-monthly magazine, proceedings, reports, year-round workshops and KSEE Annual Conference in November (with an open invitation to the international community).
Engineering Education in Korea - Status and Challenges

Table of Contents

Status
- Overview (1)
  - Educational Structure (1)
  - Statistics on Education (1, 2)

Challenges
- Challenges for Academia (1, 2)
- Challenges for Students (1, 2)
- Challenges for Industry (1, 2)

What Is Being Done: On-Going Programs
- Accreditation of Engineering Programs (1, 2)
- Government-Sponsored Programs (1, 2, 3)
- Industry-Sponsored Programs (1, 2)
- Korean Society for Engineering Education (1)

Epilogue
- Conclusion (1)
- KSEE Annual Conference (1, 2)
Status of Engineering Education in Korea

Overview (1): South Korea (ROK)

- Population: 48,219,000
- Area: 99,393 km²
- GDP: 12th in the world in 2012
- Global Companies:
  - Samsung, Hyundai, LG/GS, Pohang Steel Co., SK, KT, Doosan, etc.
- Universities such as:
  - Seoul National University, KAIST, POSTECH, Korea University, Yonsei University… (total 325 Universities)
- Web connection:
  - Over 80% of the households
  - Percent of college enrollments: 72.5% in 2011, (33.2% in 1991, peaked in 2008 at 83.8%), female 75%, 4.8% higher than that of male students.
Educational Structure (1)

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- Kindergarten
- Elementary School
- Junior High School
- High School
- University
- Graduate School
- Graduate School
- Master
- Bachelor
- Ph. D.

- College Scholastic Ability Test
- Mandatory
- 21-24 months of military service (mandatory for male)

6-3-3-4 years
<table>
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<th>4-year Universities</th>
<th>Junior Colleges</th>
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<td><strong>Institutions</strong></td>
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<tr>
<td>Total</td>
<td>179</td>
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<td><strong>Students</strong></td>
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<tr>
<td>Total</td>
<td>1,359,000</td>
<td>489,000</td>
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<tr>
<td>Engineering</td>
<td>317,000</td>
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<td><strong>Graduates (per year)</strong></td>
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<tr>
<td>Total</td>
<td>279,000</td>
<td>199,000</td>
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<tr>
<td>Engineering</td>
<td>65,000</td>
<td>40,000</td>
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<tr>
<td><strong>Number of Professors</strong></td>
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<tr>
<td>Total</td>
<td>54,500</td>
<td>12,500</td>
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<tr>
<td>Engineering</td>
<td>11,000</td>
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<td><strong>Employment Ratio</strong></td>
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<td>Total</td>
<td>60.7%</td>
<td>81.5%</td>
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<tr>
<td>Engineering</td>
<td>61.4%</td>
<td>93.2%</td>
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</tbody>
</table>

Source: Statistical Yearbook of Education, 2009
Statistics on Education (2)
Women in Engineering

Female Student Ratio

Female Faculty Ratio

Korea Advanced Institute of Women in Science, Engineering, and Technology
Challenges for Engineering Education in Korea
Challenges for Academia (1)

- Recruiting and retaining top students is problematic
  - Top students prefer medical school, law school, business school, etc, causing engineering “brain-drain”
  - Imminent decrease in population will make the situation tougher
Challenges for Academia (2)

- (Secondary Schools) High school science curriculum and teaching pedagogy
  - Not enough science subjects are offered
  - Chemistry and physics are electives and avoided by majority of students
  - Rote/drilled learning is practiced (in preparing for college entrance exam)

- (Universities) Research-emphasized faculty evaluation system
  - Research is emphasized (regardless of each college’s research infrastructure and capability)
  - The teaching load in most universities is heavy (over 10 lecture hours/week is common and class size is often over 50)
Challenges for Students (1)

- Curriculum is designed to give the basics of each field, but not enough to get in-depth and/or broad knowledge of the field.
  - Not enough electives are offered
  - Lack of motivations for striving for quality
- Fast-paced lectures and heavy assignment load
- Lack of faculty-led guidance for career development
- Lack of opportunities for hands-on experience and research
  - Low quality lectures
  - Lack of equipments for undergraduate laboratory
Challenges for Students (2)

- Despite the difficulties of fulfilling the (accreditation) requirements, there are few short-term benefits such as better employment opportunities.

- Social status of engineers are not on par with other industrialized countries.
  - Scientists/engineers/technicians/manager are not distinguished
  - Lack of professional engineers
  - Much work relates to short-term tasks
  - Engineers are not getting the level of recognition deserved despite their huge contribution to Korean economic growth
Challenges for Industry (1)

- Recruiting top students to industry
  - Top students move on to medical schools, law schools, finance, and other professions after graduating with engineering degree
  - Top students prefer teaching and research organizations (e.g. universities, national labs)
  - These trends worsened after massive lay-off of engineers in 1998 (during the IMF Crisis)
Challenges for Industry (2)

- Training a new engineer to be self-sufficient takes an average of 3 years

- Mismatch of supply and demand in engineering disciplines and levels of skills
  - Lack of IT engineers vs. overflow of engineers in conventional fields

- Engineering curriculum
  - Insufficient up-to-date industrial examples in course materials
What Is Being Done:
On-Going Programs

ABEEK is a full signatory of the Washington Accord and Provisional Member of the Sydney Accord and the Dublin Accord.

ABEEK, a Founding Signatory of the Seoul Accord (for Computing and IT-related education at the tertiary level), serves in its role as Secretariat.

As of March, 2012, 630 programs in 95 universities (EAC : 544, CAC : 51, TAC : 35) have been accredited.
Accreditation of Engineering Program (2)

- **ABEEK’S ENGINEERING ACCREDITATION CRITERIA**

  - **12 required program outcomes**
    - Similar to the 11 Washington Accord outcomes
    - Additional outcome: An understanding of other cultures and an ability to engage in international cooperation

  - **Curriculum**
    - Minimum of 30 credits of college-level mathematics, basic sciences and computing
    - Minimum of 54 credits of engineering topics including 12 credits of engineering design appropriate to student’s field of study
    - Minimum of 18 credits of complementary studies designated for the attainment of the educational objectives of the program

**ABeεK**

KSEE
Innovation Center for Engineering Education

- Launched in 2007 and about 60 centers have completed the first 5-year program
- The second stage of the ICEE project is starting in 2012 with a newly selected 65 centers nationwide.

Main objectives:
- To enhance engineering educational programs to meet the needs of the industries in the region
- To seek a continuing collaboration with the industry on development of relevant educational contents.
Women in Engineering Program

- Launched in 2006, and funded 5 universities across Korea for 6 years
- The second stage of the WIE program was expanded to 16 universities, covering different regions of Korea.
- Main objectives:
  - To promote more inclusive class environment
  - To develop specialized programs for women engineers to be more competitive in the job market (e.g. leadership, machine handling skills etc.)
  - To increase an employment ratio of female students in their engineering disciplines
Government-Sponsored Programs (3)

- **Brain Korea 21 Program**
  - Launched in 1999. Support graduate students and post doctoral researchers
  - Have funded 517 research groups in 69 universities
  - **Partial achievements (2009):**
    - 9% increase in total number of papers published
    - 25% increase in number of Ph. D.
    - Provided more opportunities for global experience

- **Hub University for industrial collaboration**
  - Launched in 2008
  - Main Objective: to develop engineering education programs and strategies to enhance collaboration with regional industries.
Industry-Sponsored Programs (1)

- **Samsung Talent program**
  - Program details vary:
    - An example (EE at Hongik University)
      - Two tracks: Semi-conductors and Communications
      - Students take 10 required subjects and 3 out of 10 electives
      - Students get internship opportunities and preference in employment. Some receive scholarships
Display Track

- Co-sponsored by display industries and government
- Interdisciplinary program (EE, Materials Sciences & Engineering and Chemical Engineering)

- Students take 16 credits (5-6 subjects) of display related subjects
Korean Society for Engineering Education (KSEE) (1)

- Founded: 1993
- Membership: Over 1800

List of Main Activities:
- Publications: Journal of Engineering Education Research, Engineering Education (bi-monthly magazine), Proceedings, research reports...
- Dissemination of Information: Engineering Education Information Center
- Provision of Platform: Engineering Education Workshops
- Globalization: ASEE, JSEE, SEEM, AEESEAP, IFEES and ACEE
- Annual Conference in November

List of Objectives:
- Provision of engineering education-related educational and mutual exchange opportunities to its members (and disbursement of information thereof).
- Promotion of governmental/industrial/educational cooperation.
- Promotion of the value and importance of engineering/engineers to the general public.
- Promotion of internationalization/globalization through international cooperation
Engineering Education in Korea – Status and Challenges: Epilogue
Conclusion (1)

- **Vision: Qualitative**
  - Fostering world-class engineers (WCU)
  - Strengthening National Science and Technology Governance
  - Constructing International Science Business Belt
  - Nurturing National Strategic Technologies
  - Raising the Moral of Scientists and Engineers

- **Vision: Quantitative**
  - R&D Investment Budget per GDP (2010: 3.37% -> 2040: 5.0%)
  - Researcher per 10,000 People (2010: 48.6 -> 2040: 120)
  - Number of World Top-Ranking Universities (2010: 2 -> 2040: More than 10)
  - SCI Papers per Researcher (2010: 0.151 -> 2040: 0.420)
2012 KSEE Annual Conference (1)

- Ambience:
  Beautiful southern island of Jeju where many delegates gather to discuss and collaborate on all issues pertaining to engineering education

- Date:
  2012: 11. 23 (Thursday) – 11. 24 (Friday)

- Place:
  Pheonix Island, Jeju

- Hosted by:
  KSEE (Korean Society for Engineering Education) [www.kseett.or.kr]

- Supported/Co-hosted by:
  DAECK (Deans’ Association for Engineering Colleges of Korea)
  NAEK (The National Academy of Engineering of Korea)
  ABEEK (Accreditation Board for Engineering Education of Korea)

- Note:
  For foreign speakers (up to 20) at these meetings, all registration fees are to be waived and two days’ accommodation is to be provided. KSEE—in pursuit of its renewed and continuing globalization drive—extends its cordial invitations to the international (engineering) community at large.
You are cordially invited!

Date: Nov. 23–24, 2012
Place: Phoenix Island, Jeju