Developing the Roadmap on Engineering Qualification Standardization

UNESCO, Islamabad
in collaboration with Pakistan Engineering Council, Islamabad
(May 22, 2015)
No. PEC/EQA&QEC/EAB/UNESCO-2015 Date: May 22, 2015

Mr. Raza Shah
National Professional Officer
UNESCO, Islamabad.

Subject: Technical Report and Executive Summary on Development of Roadmap for Engineering Qualification Standardization

Introduction:
With ever evolving science and technology the fields of engineering have gone through great metamorphosis. At the same time the mode of civilization also transformed into modern settlements exploiting natural resources to its benefit using scientific, technological and engineering developments. The evolution of engineering growth during the past half a century has been so enormous that it has influenced all walks of life including education in general and engineering education in particular necessitating the standardization of qualification. It is with this in view that a national dialogue and an international meeting to develop a roadmap on engineering qualification standardization was organized from 9 to 10 January, 2015, in Islamabad, Pakistan by UNESCO, Islamabad, Jakarta in partnership with the Pakistan Engineering Council (PEC), the International Science, Technology and Innovation Center for South–South Cooperation under the auspices of UNESCO (ISTIC), the Federation of Engineering Institutions of Asia and the Pacific (FEIAP) and Economic Cooperation Organization Science Foundation (ECOSF).

During two days’ exhaustive deliberations the forum discussed various aspects of engineering education itemized here under:

1. Needs/situation/opportunity analysis for standardisation at national and sub-regional level
2. Professional Development through Support for Pakistan Academy of Engineers
3. Pedagogy development (e.g. innovative teaching methods), Uniform Entry and Grading System in Academic Institutions
4. Extra-Curricular Learning – Co-learning, Partnership Building (e.g. between educational institutions and industry, NGOs and IGOs)
5. Process of UNESCO Accreditation through Social Integration in and through Engineering, Gender Mainstreaming in all Efforts

Compiled by: Engr. Prof. S.M. Owais
Towards the end of the meeting six groups were formed to premeditate on above mentioned facets to develop a roadmap for standardization of engineering education. The detail of formation of these groups with assigned tasks along with ToR is given in Flag-A. A regular follow up was conducted by PEC to assess the development carried out by the groups.

A detail of group wise cogitation and recommendations are flagged as annexes whereas a resume/summary of each group’s rumination is given here under.

**Group Wise Analysis and Synthesis**

1. Needs/situation/opportunity analysis for standardisation at national and sub-regional level professional development through support for Pakistan Academy of Engineers

To produce innovative design, maintenance and operation engineers requires a realistic assessment of country’s needs, design of curriculum according to the needs and incessant development of experts of engineering. The group members identified the country needs, opportunities and recommendations for standardization.

The country urgently needs to develop power/energy sector, electronic/computer industry, public health engineering, biomedical engineering and at the same time it requires to adopt Out-come Based Education system, constant development of labs, establishment of research/technology incubation centers, capacity building and academia-industry linkage etc.

The group views that catering the above needs will provide job opportunities and open other avenues locally. With the growth of opportunities a systematic capacity building program should be launched through the proposed National Academy of Engineers and simultaneously strengthen the engineering academic programs through joint efforts of PEC and HEC. Flag-B.

2. Professional Development through Establishment of National Academy of Engineers

Pakistan Engineering Council (PEC) being a statutory body has registered 176,000 engineers in twenty five disciplines till 2014. These engineers are working world over. Their knowledge and skills have to be continuously developed professionally through incessant training that improves performance and boosts work place productivity by up-skilling employees, mentoring senior management, thus increasing institutional excellence and productivity in all developmental and social fields.

Further about 107 HIES are offering 300 engineering programs in the country which requires continuous faculty training/development program as per newly introduced Teaching-learning (Pedagogy) concept under OBE approach to adopt internationally accepted good practice in order to produce competent world class engineers. Therefore both academia and industry requires to be trained for all such developmental needs and standards. It is with this in view that the group has strongly recommended the establishment of National Academy of Engineers. A pre-feasibility report is attached here with. Flag-C.
3. Pedagogy development (e.g. innovative teaching methods), Uniform entry and grading system in academic institutions

With the advent of Out-come Based Education system (OBE) the paradigm of learning has shifted from teachers focused to the students or learners focused which is more self-directed and learners must be motivated to commit to study or practice methods of work. This basic theme of modern pedagogy forms the basis to constitute a class of uniform standard from entry to the highest level so that innovative learning methodologies and assessment techniques could be applied. However, the uniform entry test is still a dilemma in Pakistan and even HEC could not develop consensus on this issue as it is revealed in my meeting with the functionaries of HEC. Therefore the group assigned with the task to develop a roadmap for pedagogy has come up with the following suggestion for uniform entry test. Flag-D.

Uniform Entry Test:

a. Develop independent provincial level tests as a short term strategy.

b. On the long term the goal and performance object oriented education system should be introduced in high schools of all the provinces to bring the rural and urban school at the same platform so that a uniform entry test can be conducted at national level

Innovative Techniques

The following innovative teaching methodologies have been deliberated which are in vogue in various international universities. The detail of each method with references is given in the annexed flagged 3.


Grading System and Implementation

PEC should make sure that the students are comprehensively graded using all the under mentioned points and not only through written exams in Engineering Teaching Institutions for which HEC has provided a guideline using relative or absolute grades. A percentage weightage has to be assigned to each of the under mentioned exams:

Regular Quizzes, Midterm exams and Final exam, Skill Test, Analysis and Synthesis of existing problem, ability to design a prototype, report writing skill and group discussion to evolve a solution of a given problem.

4. Extra-curricular learning – co-learning, Partnership building (e.g. between educational institutions and industry, NGOs and IGOs)

Based on deliberations for promoting extracurricular & cooperative learning and partnership building among industry and academia, a Roadmap is outlined in the flow chart (flag-4). The realization and implementation of this Roadmap can prove to be a medium for developing a framework for the captioned
vision and mission. For result oriented implementation the following various separate entities and their collaborative team work is suggested. Flag-E.

Planning Career Advice Services, Cooperative Education program Services, Entrepreneurship Skill Development (ESD) Services, CV Writing Skills, Strategies Management, Extrac urricular Learning, Community Services, Student Sports Activities, Brunch with CEO, Student Support, Student Financial Aid Office, Partnership Building, student & faculty exchange program, Develop Linkage with Industry, Sabbatical (spending of Faculty visits 03-06 months in Industry), Develop Linkages with NGO/INGO (for Poverty, Alleviation, Renewable Energy, Literacy, e-Health), Initiation of Joint Degree Program.

5. Process of UNESCO accreditation through Social Integration in and through Engineering, Gender mainstreaming in all efforts

A detailed verbal presentation was given based on PEC accreditation manual, HEC curriculum addressing social integration and gender mainstreaming, Review and role of Engineering Development Board (EDB) in industry linkages. Flag-F.

6. Lifelong learning through a UNESCO Chair in Co-engineering for sustainable development across ECO countries with HQ in Pakistan

Adopting the principle of lifelong learning does demand a new vision, one that shifts the emphasis from teaching to learning; one that recognizes the diversity of ways in which knowledge and skills can be acquired in the information age outside of the formal system. The lifelong learning also puts the emphasis on Co-engineering methods and principles based on the ACE(Adaptive Complex Enterprise) performance structure to Plan-Execute-Monitor-Analyze Quality Cycle for service planning and service execution. Activities undertaken in the framework of a UNITWIN / UNESCO Chair project may correspond to the goals to be achieved. They may include:

- Program development in non-traditional areas at undergraduate and postgraduate levels
- Research corresponding to the research strategies of UNESCO’s various Sectors
- Conduct research activities fostering partnerships between research and services and industries
- Lifelong learning through a UNESCO Chair in Co-engineering for sustainable development through Professional development through support for Pakistan Academy of Engineers
- Increase the funding and provide other incentives in support of non-formal education and training (i.e. adult and continuing education, NGO and industry-based training.
- UNESCO World Conferences on Higher Education in 1998 and 2009 called for the re-orientation of higher education in the light of the challenges facing us in the 21st century, and at the same time a reaffirmation of its commitment to the core values and functions of higher education, in particular insisting that its mission must be to “contribute to sustainable development and improvement of society as a whole should be preserved, reinforced and further expanded (UNESCO, 1998).
- To achieve the goals of lifelong learning for sustainable development, it is also suggested that the governments of the Member States of the ECO should make policies, strategies and changes that need to be made in order to promote a culture of lifelong learning, to set national targets and to develop and implement integrated action plans and strategies for poverty reduction and sustainable development. Flag-G
7. Recommendations

Based on the analysis and synthesis evolved by all the above mentioned six groups, the following are recommended:

- Develop professionals and experts of engineering through regular training that improves performance, productivity skills of employees and mentoring senior management for increasing institutional excellence and productivity.
- Establish technology incubation centers where engineers could develop the product of market interest and set up his/her own institution or production unit and hence create jobs for others.
- Hire the broad experienced faculty flavored with hands on industrial experience and not only on the basis of higher degrees alone for imparting the skilled knowledge to solve national problems.
- Innovative pedagogical methods have to be adopted to develop the students as learners.
- Plann Career Advice Services, Cooperative Education program Services, Entrepreneurship Skill Development (ESD) Services, CV Writing Skills, Strategies Management, Extracurricular Learning, Community Services, Student Sports Activities, Brunch with CEO, Student Support, Student Financial Aid Office, Partnership Building, student & faculty exchange program, Develop Linkage with Industry.
- Last but not the least Lifelong Learning through a UNESCO Chair in Co-engineering for sustainable development through support for Pakistan’s National Academy of Engineers.

8. List of References is annexed on Flag-H.

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Additional Registrar (Accrd.)

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<thead>
<tr>
<th>A</th>
<th>TERMS OF REFERENCE FOR ENGINEERS WORKING GROUP</th>
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<td>B</td>
<td>NEEDS/SITUATION/OPPORTUNITY ANALYSIS FOR STANDARDISATION AT NATIONAL AND SUB-REGIONAL LEVEL PROFESSIONAL DEVELOPMENT THROUGH SUPPORT FOR PAKISTAN ACADEMY OF ENGINEERS</td>
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<td>C</td>
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<td>PEDAGOGY DEVELOPMENT (E.G. INNOVATIVE TEACHING METHODS), UNIFORM ENTRY AND GRADING SYSTEM IN ACADEMIC INSTITUTIONS</td>
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<td>G</td>
<td>LIFELONG LEARNING THROUGH A UNESCO CHAIR IN CO-ENGINEERING FOR SUSTAINABLE DEVELOPMENT ACROSS ECO COUNTRIES WITH HQ IN PAKISTAN</td>
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<td>H</td>
<td>ITEMIZED LIST OF REFERENCES</td>
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Terms of Reference for Engineers Working Group

Introduction

UNESCO, Islamabad and Jakarta, in partnership with the Pakistan Engineering Council (PEC), the International Science, Technology and Innovation Center for South–South Cooperation under the auspices of UNESCO (ISTIC), the Federation of Engineering Institutions of Asia and the Pacific (FEIAP) and Economic Cooperation Organization Science Foundation (ECOSF) has organized a national dialogue and an international meeting to develop a roadmap on engineering qualification standardization from 9 to 10 January, 2015, in Islamabad, Pakistan.

Some decisions and action points had been finalized in the meeting which will help in developing the road map of engineering qualification standardization for Pakistan and other countries in the Asia Pacific Region.

Participants of the meeting volunteered to work on the action points. This group of participants will be further called engineers working group or working group. The terms of reference of the working group are as follows;

Scope of work

1- The working group will work closely to review, analyze and document the technical reports
2- The working group will correspond on regular basis with each other and have meetings on need basis
3- Working group will respect the given frame and deliver the draft reports as per the decisions made in the meeting
4- The responsible person for each technical paper will initialize the process of the documentation, UNESCO and PEC will facilitate the process
5- Participants of the working group are working on volunteer basis and there is no legal obligation on part of any party
6- All the reports produced under this initiative will be co-branded by UNESCO and ECOSF

Recipients
National Ministries and policy making bodies

Duration
These ToRs are effective till 30 June, 2015

Coordination
The overall coordination is the responsibility of Pakistan Engineering Council and UNESCO
Action Points
As per the agreed action points, following technical studies will be undertaken by the working group:

1- Needs/situation/opportunity analysis for standardisation at national and sub-regional level

Responsible Person/Institution: Prof. Wasi uz Zaman

Group Members:
   i. Dr. Nasir Mehmood
   ii. Engr. Prof. Syed M. Owais
   iii. Engr. Dr. Samreen Amir
   iv. Nominee from FEIAP
   v. Engr. Brig. (Rtd.) Muhammad Amin

Outcome: Technical Report
Deadline: 1st draft by 29th of May 2015 and final report by 30th of June 2015

2- Professional development through support for Pakistan Academy of Engineers

Responsible Person/Institution: Dr. Nasir Mehmood Khan

Group Members:
   i. Engr. Prof. Dr. Qaiser Hameed Malik
   ii. Prof. Dr. Tayyab Hassan

Outcome: Concept Note/Technical Report
Deadline: 28 February, 2015

3- Pedagogy development (e.g. innovative teaching methods), Uniform entry and grading system in academic institutions

Responsible Person/Institution: Dr. Qaiser Hameed Malik

Group Members:
   i. Engr. Prof. Syed M. Owais
   ii. Nominee of HEC
   iii. Engr. Prof. Dr. Saeed ur Rehman
   iv. Mr. Yadullah Babayev
   v. Engr. Naveed Zafar (co-opted member)
Outcome: Technical Report/Paper
Deadline: 29 May, 2015

4- Extra-curricular learning – co-learning, Partnership building (e.g. between educational institutions and industry, NGOs and IGOs)

Responsible Person/Institution: Dr. B.S. Chowdhry

Group Members:
1. Dr. Wasi uz Zaman Khan
2. Engr. Prof. Dr. Muhammad Younus Javed
3. Engr. Prof. Dr. Saeed ur Rehman
4. Engr. Prof. Dr. Waheed ul Haq
5. Engr. Zahid Arif
7. Engr. Sarang Shaykh (co-opted member)

Outcome: Technical Report
Deadline: 29 May, 2015

5- Process of UNESCO accreditation through Social Integration in and through Engineering, Gender mainstreaming in all efforts

Responsible Person/Institution: Engr. Mian Muhammad Ali

Group Members:
1. Engr. Dr. Samreen Amir
2. Dr. CheeFai, Tan (cheefai@utem.edu.my) Nominee of FEIAP/UTM
3. Prof. Chuah Hean Teik (chuahht@gmail.com)

Outcome: Technical Report
Deadline: 29 May, 2015

6- Lifelong learning through a UNESCO Chair in Co-engineering for sustainable development across ECO countries with HQ in Pakistan

Responsible Person/Institution: Dr. Manzoor Hussain Soomro

Group Members:
1. Dr. Nasir Mehmood Khan
2. Engr. Prof. Dr. Bhawani Shanker
3. Nominee from FEIAP
4. Engr. Prof. Dr. Riaz Mughal

Outcome: Technical Report
Deadline: 30 April, 2015
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Islamabad Declaration on Engineering Qualification Standardization

National Dialogue and International Meeting on Engineering Qualification Standardization was held on 9-10 January, 2015 in Islamabad hosted by UNESCO, Islamabad and Jakarta, Pakistan Engineering Council (PEC), the International Science, Technology and Innovation Center for South–South Cooperation under the auspices of UNESCO (ISTIC), the Federation of Engineering Institutions of Asia and the Pacific (FEIAP) and Economic Cooperation Organization Science Foundation (ECOSF). The meeting attracted more than 50 participants.

Under the main theme ‘Developing the road map for engineering qualification standardization’, four sessions devoted to national initiatives and regional perspective of engineering qualification standardization, engendered animated and constructive deliberation, culminating in the recommendations and outcomes in this Islamabad Declaration. The Islamabad Declaration was adopted by the participants of the international meeting on engineering qualification standardization on 10 January, 2015.

This Islamabad Declaration reaffirms that, standardization of engineering qualification is very important for the economies to promote their engineers all over the world. A strong linkage between the stakeholders in this regard is instrumental. That engineers not only assures the human resource pipeline required for the green and clean scientific, engineering and technology devices and systems needed to combat the challenges of global poverty and global climate change, but also provides the world with a rational and discerning citizenry that will help ensure peace and security of the world.

Therefore the Islamabad Declaration now:

- Calls on all engineering councils/associations to redouble their commitment to engineering qualification standardization, including reaching out to their national ministries of education and relevant parent departments.
- Calls on industry to assist engineering councils/association and their national governments to enhance education policies and initiatives to ensure the formation of the creative and innovative human capital that will enable their own enterprises to remain competitive in the increasingly fast-paced science and technology development environment.
- Calls on foundations and donors to sponsor the roll-out of engineering qualification standardization, especially in developing countries.
- Calls on Pakistan, the host nation of the Islamabad meeting, and other nations with rich experience in engineering qualification standardization activities to share their experiences and to assist in capacity building efforts in.
- other pilot countries, especially developing countries, wishing to implement the engineering qualification standards.
- Agreed to the follow up action plan towards formulating the roadmap for engineering qualification standardization for Pakistan as well as other growing economies of the Asia Pacific Region.
- Express thanks to the Government of the Islamic Republic of Pakistan in particular the Pakistan Engineering Council for making excellent arrangements for success of the meeting as well as for extending warm hospitality to the participants.
- Express thanks to the Government of Malaysia for establishing the funds for this particular initiative
- Express thanks to the United Nations Educational, Scientific and Cultural Organization (UNESCO) for the support provided for this important initiative in Pakistan.
Concept Note
National Dialogue and International meeting
“Developing the Roadmap on Engineering Qualification Standardization”-

Preparing Future Engineers for Sustainable Development
Date: 9 - 10 January, 2015
Venue: Pakistan Engineering Council, Islamabad, Pakistan

Introduction

UNESCO, Islamabad and Jakarta, Pakistan Engineering Council (PEC), the International Science, Technology and Innovation Center for South–South Cooperation under the auspices of UNESCO (ISTIC), the Federation of Engineering Institutions of Asia and the Pacific (FEIAP) and Economic Cooperation Organization Science Foundation (ECOSF) are jointly organizing a national dialogue and an international meeting to develop a roadmap on engineering qualification standardization from 9 to 10 January, 2015, in Islamabad, Pakistan.

Objectives

The objectives of the meeting are:

a. Review the existing engineering curricula offered in HEC and PEC recognized universities in the country, with the objective of harmonization and standardization of curricula within Pakistan in particular, and Asia Pacific Region in general

b. Formulate a proposal on strategy for standardization of engineering qualification, with a clear timeframe and goal, while keeping in view the engineering qualification standards in Asia Pacific Region

c. To develop a joint platform to identify job requirements in all engineering sectors, and train the students as per those identified requirements.

Background

Engineers play a key role in the planning, design, construction and maintenance of infrastructure, products, equipment and systems for the benefit and wellbeing of mankind. They Engineers play a lead role in ensuring sustainable development by improving efficiency of energy, transportation systems and natural resources as well as by improving health and use of data.
Engineers can benefit from gaining work experience in different countries; however, the host country often does not recognize their qualification. There is a need for more standardization of engineering qualification.

**Professional organizations and mechanisms for recognition of professional qualification**

The United Nations Educational, Scientific and Cultural Organization (UNESCO), dating back to the 1960s, has supported the founding of professional organizations such as the World Federation of Engineering Organizations. On 6 July 1978, following an exploratory meeting organized by The Engineering Institute of Thailand, with the support of UNESCO, the Federation of Engineering Institutions of South-East Asia and the Pacific was established as an international non-profit professional organization. In 2008, the name was changed to the Federation of Engineering Institutions of Asia and the Pacific (FEIAP) and Pakistan, represented by the Pakistan Engineering Council, became a member in October 2011. The objectives of FEIAP are to encourage the application of technical progress to economic and social advancement throughout the world; to advance engineering as a profession in the interest of all people; and to foster peace throughout the world. It provides its members with a platform for sharing information on issues of concern to engineers in the region.

The existence of many bilateral agreements between countries in different parts of the world prompted six countries in 1988 to draft the original Washington Accord, which was signed in 1989. It is an international agreement among bodies responsible for accrediting engineering degree programs. It recognizes the substantial equivalency of programs accredited by those bodies and recommends that graduates of programmes accredited by any of the signatory bodies be recognized by the other bodies as having met the academic requirements for entry to the practice of engineering. At the meeting of the Washington Accord signatories in October 1997, it was agreed to establish an independent forum to be known as the Engineers Mobility Forum, one of the objectives of which was to facilitate international mobility of professional engineers. Still much effort is required to standardize and harmonize engineering curricula in all countries, which would enable engineers from developing countries to share their knowledge and skills and be employable worldwide.

Along with energy crisis, corruption, bad governance, inflation, and deteriorated security situation; another very significant thing that has choked industrial development in Pakistan is the missing link between academia and industry. Also, there is no coordination among the Ministry of Science and Technology, Ministry of Education, Ministry of Commerce and Industry,

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1 The World Federation of Engineering Organizations (WFEO), is an international, non-governmental organization representing the engineering profession worldwide, founded in Paris in 1968 by a group of regional engineering organizations, under the auspices of UNESCO, which brings together national engineering organizations from over 90 nations and represents some 15 millions engineers from around the world.

Pakistan Engineering Council, Higher Education Commission, and National Commission for Human Development. All of these offices need a strong liaison in order to jointly develop engineering curriculum which fulfills need of industry and trade requirements that is compatible with local and regional trends.

**UNESCO-FEIAP collaboration**

The Federation of Engineering Institutions of Asia and the Pacific (FEIAP) has been collaborating with UNESCO Jakarta to improve the standard of engineering qualification in universities and institutes of higher education, in association with the engineering bodies. UNESCO agreed to assist FEIAP to champion its guidelines. The current FEIAP members are using the Guidelines to help achieve the engineering qualification standards that are required for them to join the Washington Accord.

Pakistan has been selected for the pilot case study in Asia Pacific Region under this collaboration. For the same reason a meeting is organized in Islamabad, where all the key representatives of engineering academia and industry will participate to share their experiences on what they have achieved so far and what is required further for the standardization of engineering qualification in the country and Asia Pacific region. Pakistan Engineering Council is the focal agency for the accreditation of engineers in the country. Higher Education Commission will give inputs on the steps that have been taken in terms of support to the engineering qualification standardization. Three International mentors will attend the meeting as well. They will provide technical backstopping and give their inputs for the development of white papers on achieving the engineering qualification international standards.

**Participants**

The participants of the meeting will be representatives of Universities, Engineering schools and Engineering Industry from all over the country. From each province a presentation will be made on the steps taken to achieve the engineering qualification standardization. The Engineering Industry will present the latest needs and requirements from the engineering institutions. International mentors will provide their feedback on where improvements can be made. At least 2-3 participants from Azerbaijan and Kazakhstan are also expected to join the forum under the aegis of ECO Science Foundation.

**Format**

Présentations, lectures and discussions etc.

**Expected outcome**

The meeting will provide a platform for the stakeholders in the region to share their work and help to formulate a comprehensive plan towards standardization of engineering qualification in Pakistan and Asia Pacific Region.
1. **Needs/situation/opportunity analysis for standardisation at national and sub-regional level professional development through support for Pakistan Academy of Engineers**

To produce innovative design, maintenance and operation engineers requires a realistic assessment of country’s needs, design of curriculum according to the needs and incessant development of experts of engineering. The group members identified the following country needs:

i. Power generation, efficient transmission and distribution to tackle the country’s power problem.

ii. Exploration of alternate power and energy resources such as solar and wind energy along with design and implementation of these resources.

iii. Development of electronic and computer industry from grass root to the highest level (micro to macro level).

iv. Development of biomedical engineers sector.

v. Computer industry including the software and hardware needs to be developed to cater the office and industrial automation needs.

vi. Design of curriculum that helps solving the above mentioned community problems indigenously.

vii. Consistent and related teaching from elementary to the highest level instead of many un-related pieces of information one after the other rather define course goals and performance objectives.

viii. Constant development of labs and libraries (latest books and journals).

ix. Integration of knowledge, skill and attitude.

x. Establish the institutions from elementary to the highest level guaranteeing the development and concept oriented education.

xi. Hire the faculty who can provide guidance in solving the existing problems and foresee the new problems and device the strategy to solve them.

xii. Institutes should be built into learning centers by inculcating the subject interest in the students which in turn puts lot of burden on the instructors at the same time. This implies the solution of daily life problems by the instructors carrying out projects with joint efforts of students and the instructors. Emphasis should be given for developing prototype implementable projects by the faculty that can be presented to the community. Without practical research, publication of papers does not contribute to the development of the country.

xiii. Assurance by the instructor that the students are well initiated into the subject by constant test of their knowledge through application and simulation of real life projects and case studies.

xiv. Arrange work situation experience for the students during semester breaks in the industry of related field of engineering.

xv. Regular seminars and workshops to assist the researchers to update knowledge and gain hands on experience on latest software and hardware tools.

xvi. Establishment of language centers to develop writing and oral communication skills.
xvii. Establish departmental board of studies and collaboration of departmental board with National and International Boards for suggestion in curriculum, assessment methodology and research activities.

xviii. Explore funding sources other than government such as industries or philanthropists or endowments.

xix. Regular feedback from the community and relevant industry.

xx. The Pakistan Engineering Council’s (PEC) should take lead in implementation of suggestions once approved by strictly following the laid down procedures without compromise and expediency.

xxi. PEC’s endeavours should be complemented by the engineering institutions in establishing the laid criteria for faculty, housing, laboratories, library space and books, auditorium and playground etc.

xxii. Capacity building in mineral extraction through scientific knowledge, technology and practice.

xxiii. Establishment of centralized research lab in any metropolitan city of the country.

xxiv. Research groups should be encouraged and open for membership to all interested researchers across Pakistan. The leading research institutes should take the initiative and invite researchers to join their existing active groups.

xxv. Faculty exchange should be emphasized and vigorously implemented to provide better learning opportunities for students and new teaching methodology/techniques for faculty.

xxvi. Final year project/ Research project ideas should be taken from Industry through close liaison with regional Chamber of Commerce & Industries or any other stake holder.

xxvii. Due to the dearth of industry the work situation is limited to the government jobs and that too is inadequate for the number of qualified engineers each year. Consequently most of the engineers look towards Middle East and thereby the country loses qualified manpower. Engineers must be associated with industry like doctors with the hospital.

xxviii. The government should provide incentives to the engineers to enterprise the industry. PEC should take up the role of initiator

xxix. Government should encourage the private sector to develop industry of each field of engineering by funding for certain period and regularly monitor the progress in order to avoid failure. May be we have to start from making needles for sewing machine like china.

xxx. Establish government funded incubation centers where engineers could develop the product of market interest and set up his/her own institution or production unit and hence create jobs for others. It is proposed that bankrupt industries sealed for legal reason may be used as incubators.

xxxi. Last but not the least the above mentioned points require establishment of industry from grass root to the highest level otherwise producing theoretical engineers are of no use.
2. **Professional Development through Establishment of National Academy of Engineers**

During the past two decades globalization has permeated almost all walks of life. It has equally influenced Engineering and Education posing constant challenges to keep up with market requirements. The only way to address and deal with these challenges is to continuously develop engineering community professionally through incessant training that improve performance and boost work place productivity by up-skilling employees, mentoring senior management, thus increasing institutional excellence and productivity. This can only be done through a systematically evolved professional development program entailing the need for establishing National Academy of Engineers (NAE).

**Background Information:**

Pakistan Engineering Council (PEC) being a statutory body has registered 176,000 engineers in twenty five disciplines till 2014. These engineers are working world over. With ever evolving technology their knowledge and skills have to be upgraded to keep pace with technological growth. The Pakistan Engineering Council has already developed a Continued Professional Development (CPD) Program in all engineering disciplines keeping pace with international advancements and national needs. The main objective is to develop competence and ability of engineers for the application of theoretical knowledge to practical situations and to evolve innovative solutions to real life problems while adhering to professional ethics and acquisition of a broader understating of their obligations to society. Detail of CPD activities is given in Annex - B

Besides CPD some of the salient functions of the PEC also include the following activities:

i. Promotion of engineering education and review of courses of studies in consultation with the universities and HEC.

ii. Maintenance of a register of persons qualified to practice as professional engineers and consulting engineers.

iii. Recognition and accreditation of engineering qualifications for registration.

iv. Promotion of reforms in the engineering profession.

v. Management of finances and properties of the Council.

vi. Think tank for federal government on engineering related policies.

vii. Arrange and manage seminars, conference, workshops and short courses.

**Scope of National Academy of Engineers (NAE):**

Pakistan Engineering Council under its Act has mandate for introducing and ensuring continued professional development activities amongst its growing community of engineers and has devised a comprehensive framework titled
Professional Development of Engineers (Bye Laws – 2008) approved by the Government of Pakistan.

Keeping in view the above synopsis, PEC recommends establishment of NAE as a separate entity under PEC. The scope of NAE encompasses the following plausible functions in line with international practice:

i. Provide vibrant intellectual platform to navigate policies.
ii. Act as an instrument of PEC in seamlessly implementing new pedagogical concepts such as Outcome Based Education and Innovative Teaching Methods etc. by training the trainers and develop trainers manual.
iii. Outcome Based Curriculum development.
iv. Capacity building of engineering professionals and institutions for their leading role as competent engineers through CPD in all engineering disciplines keeping pace with international advancements and national needs.
v. Provide a platform for academia, industry and job market linkage
vi. Develop Technology Incubation Centres.
vii. Management of intellectual property.
ix. Development of national vision and approach.
x. Research and policy studies.
xi. Engineering HR development.
xii. Productive collaboration with professional bodies at international, national and regional level.

Territorial Scope:
Pakistan

Monitor & Control Scope:
Management of budget and future expansion etc.

Housing/ Infra structure Requirements:
   a) Land & Edifice
   b) Personnel
   c) Furniture & Fixture
   d) Equipment e.g. computers & networking etc.
   e) Transport

Finance Requirements for:
   a) Development of detailed feasibility report – within 6 months (Cost Rs. 6-9 millions)
   b) Seed money to establish NAE
   c) Capital Expense
   d) Running Expense
   e) Development of curriculum and training manuals
Organizational Structure:

Survey and Analysis:
Existing academies in Europe and USA

Identification Stake Holders:
- All Higher Education Institutions/Universities
- Public Sector Engineering Organizations
- Private Engineering/Consulting & Professional Bodies
- Industry

Monitoring & Evaluation:
Monitoring and evaluation will be carried out in phases from feasibility to the execution of the project.

Review:
By international consultants/UNESCO

Summary:
A digest of the project
Annex – B

Continuing Professional Development (CPD) Activities

A. Overall progress of CPD Activities (Seminar, Training/ Interactive Workshops, Short Courses) conducted by PEC and Registered PEBs as on 31st December 2014

<table>
<thead>
<tr>
<th>Year</th>
<th>CPD activities</th>
<th>No. of Engineers</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>32</td>
<td>755</td>
</tr>
<tr>
<td>2012</td>
<td>100</td>
<td>3,532</td>
</tr>
<tr>
<td>2013</td>
<td>131</td>
<td>6,847</td>
</tr>
<tr>
<td>2014</td>
<td>285</td>
<td>12,658</td>
</tr>
<tr>
<td>Total</td>
<td>548</td>
<td>23,792</td>
</tr>
</tbody>
</table>

CPD Activities conducted

- CPD Activities
- No. of Participants

The chart shows the number of CPD activities and participants from 2011 to 2014.
B. Professional Engineering Bodies (PEBs) registered with PEC up to Dec. 2014

<table>
<thead>
<tr>
<th>Category of PEBs</th>
<th>No. of PEBs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engg Institutions/ Universities</td>
<td>79</td>
</tr>
<tr>
<td>Technical Organization</td>
<td>16</td>
</tr>
<tr>
<td>Professional Institutes</td>
<td>14</td>
</tr>
<tr>
<td><strong>Total Registered</strong></td>
<td><strong>109</strong></td>
</tr>
</tbody>
</table>

C. Details of Engineering Practice Examinations (EPE)

<table>
<thead>
<tr>
<th>S. #</th>
<th>EPE</th>
<th>Applicants</th>
<th>Eligible</th>
<th>Appeared</th>
<th>Qualified/ %age</th>
<th>Disciplines/ Areas of specialization</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1&lt;sup&gt;st&lt;/sup&gt; EPE (Fall-2011)</td>
<td>63</td>
<td>49</td>
<td>48</td>
<td>38 (79 %)</td>
<td>07/16</td>
</tr>
<tr>
<td>2</td>
<td>2&lt;sup&gt;nd&lt;/sup&gt; EPE (Summer-2012)</td>
<td>89</td>
<td>76</td>
<td>71</td>
<td>61 (85 %)</td>
<td>09/22</td>
</tr>
<tr>
<td>3</td>
<td>3&lt;sup&gt;rd&lt;/sup&gt; EPE (Fall-2012)</td>
<td>77</td>
<td>68</td>
<td>61</td>
<td>50 (81 %)</td>
<td>07/15</td>
</tr>
<tr>
<td>4</td>
<td>4&lt;sup&gt;th&lt;/sup&gt; EPE (Summer-2013)</td>
<td>76</td>
<td>63</td>
<td>61</td>
<td>43 (70 %)</td>
<td>11/18</td>
</tr>
<tr>
<td></td>
<td>5th EPE (Fall-2013)</td>
<td>6th EPE (Summer-2014)</td>
<td>7th EPE (Fall-2014)</td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>---</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>74</td>
<td>72</td>
<td>66</td>
<td>49 (75%)</td>
<td>03/15</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>83 (83%)</td>
<td>105</td>
<td>100</td>
<td>06/23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>130</td>
<td>124</td>
<td>114</td>
<td>85 (74.56%)</td>
<td>04/16</td>
<td></td>
</tr>
</tbody>
</table>

### Status of EPE

- **Appeared**
- **Qualified**

![Status of EPE Chart]

- **1st EPE (Fall-2011)**: 48 (Appeared), 38 (Qualified)
- **2nd EPE (Summer-2012)**: 71 ( Appeared), 51 (Qualified)
- **3rd EPE (Fall-2012)**: 61 (Appeared), 10 (Qualified)
- **4th EPE (Summer-2013)**: 61 (Appeared), 43 (Qualified)
- **5th EPE (Fall-2013)**: 66 (Appeared), 19 (Qualified)
- **6th EPE (Summer-2014)**: 100 (Appeared), 83 (Qualified)
- **7th EPE (Fall-2014)**: 114 (Appeared), 85 (Qualified)
3. **Pedagogy development (e.g. innovative teaching methods), Uniform entry and grading system in academic institutions**

The term pedagogy has its genesis in mid 1500 relates to child’s teaching and learning has now generally been adopted for tertiary education in place of andragogy coined in 1800 and popularized in 1960. The present pedagogy has gone through a great metamorphosis since its inception starting with teacher’s perspective to learner’s perspective. The modern pedagogy again transformed from Competency Based Education (CBE) to Outcome Based Education (OBE) particularly in engineering. With the advent of OBE the paradigm of learning has shifted from teachers focused to the students or learners focused which is more self-directed and learners must be motivated to commit to study or practice methods of work. This basic theme of modern pedagogy forms the basis to constitute a class of uniform standard so that innovative learning methodologies and assessment techniques could be applied. Nevertheless with the term pedagogy in vogue and ToR in view a roadmap has to be developed for engineering qualification standardization for Pakistan and other countries in the Asia Pacific Region. This paper deals with uniform entry, innovative teaching methods and grading system in crisp manner without going into unnecessary philosophy and psychology of pedagogy rather concentrates on innovative methods, consensus evolved deliberation entry recommendation and uniform grading system following the guideline of HEC.

**Uniform Entry**

According to Peterson’s university ranking and guide there are five categories of engineering universities. They are:

- **Most Difficult**
- **Very Difficult**
- **Moderately Difficult**
- **Minimally Difficult**
- **None-competitive**

Each of these categories of universities form their own class of uniform standard based on Sat and GRE weighted scores. The point to register is that there is only one entry test either SAT for undergraduate or GRE for graduate which sets the measuring standard. Therefore, there should be one standard test for the whole country so that the real condition of the universities is revealed in the form of above mentioned categories. This is not only true for USA but even in UAE, Saudi Arabia and India there is one standard test for the whole country for admission to engineering colleges and universities. It may not be out of place to mention here that education consultants play great role in establishing the main theme of the institutions’ foundation from the entry to the highest level of learning. Whereas most of the universities and academic institutions in Pakistan have not been established by the consultants or developed from grass root level like international practice. To quote the Example of British Universities – Cambridge, Oxford and London, they all run high school system. And for American Engineering Universities, they were all polytechnic institutes developed into universities or like Stanford or Vanderbilt built by consultants. In our country the only engineering institute established by the consultant is Aeronautical Engineering Colleges by Colonel John H. Blakelock and is the best of all the existing institutions. They are the consultants who lay
down the foundation of uniformity of standards differentiating between universities of various shades of difficulty as mentioned above.

However, the uniform entry test is still a dilemma in Pakistan and even HEC could not develop consensus on this issue as it is revealed in my meeting with the functionaries of HEC. It goes without saying that uniform entry test is imperative for implementing modern innovative methodologies. Therefore the group assigned the task to develop a roadmap for pedagogy has come up with the following suggestion for uniform entry test:

1. It is recommended by the group-3 members to develop independent provincial level tests. During my meeting in HEC I found out that HEC is in the process of developing the tests for engineering discipline.
2. Due to disparity in high school education system of rural and urban schools preparatory classes have be conducted to prepare the candidates for entry test through private academies for the time being. According to HEC and OBE with the shift in paradigm it's the responsibility of learner to prepare himself as per practice all over the world and not that of any authority.
3. On the long term the goal and performance object oriented education system should be introduced in high schools of all the provinces to bring the rural and urban school at the same platform.

Innovative Techniques
The learner-centered pedagogy is “the art and science of helping adults to learn” which lays emphasis on engaging the students in active learning instead of traditional lectures. Active learning means acquiring knowledge and skill to solve complex problems using reason, intuition and perception. For active learning various innovative methods have been introduced in international universities for imparting knowledge in formal teaching. They can also be initiated in our universities. Most of the under mentioned methods are well known to academicians, self explanatory and carry open space roadmap whereas a few need a little elaboration for implementation.

Guideline not specified to Execute the Under Mentioned Techniques:
These techniques are open to institutions to form their own policy for implementation and administration with the condition that the students will produce a written report for evaluation and presentation.

- Live-Demos
- Readings and Discussions of State-of-the-art Literature
- Presentations
- Academic Research
- Guest Lecturers
- Case Studies Seminars
- Intensive Courses
- Discussion Groups
- Field trips
- Lab Lectures
- Expert Interviews
Guideline Specified to Execute the Under Mentioned Techniques.

**Mentoring**
The under mentioned points relate to the student (mentee) and the mentor (teacher) where the mentor regularly discusses these points with the mentee to develop him as positive learner along with his professional development. The mentor is supposed to keep a record of mentee’s development for evaluation for which a weightage of grade has to be announced by the mentor at the beginning of semester.

1. Visited your company
2. Shadowed you at your job
3. Had his/her resume critiqued by you
4. Practiced interviewing
5. Attended a networking event, professional organization meeting, or conference
6. Read & discussed a book, essay, or article
7. Participated in community service
8. Did an informational interview with one of your colleagues
9. Role-played difficult conversations
10. Your individual goals & expectations for the mentoring relationship
11. Your background & career path
12. Your student’s background & career/life goals
13. Potential career tracks for your student
14. Types of businesses/employers
15. Current issues in the profession
16. Job market trends
17. Organizational culture
18. Professional organization membership
19. Quality of life in the profession
20. Work/life balance
21. Management issues
22. Business dress
23. Approaches to ethical/professional dilemmas
24. Study/travel/employment abroad
25. Campus involvement
26. Senior design project ideas
27. Professional dinner etiquette
28. Online/social media etiquette
29. Internship search advice
30. Career fair navigation advice
31. Job search advice
32. Resumes & cover letters
33. Interviewing & networking skills
34. Other

**Tutorial Teaching** (Formally Introduced by Oxford in 1966)

**Objectives:**
- Help students to gain deep understanding of the subject matter so that they can apply what they have learnt.
• Enable students to learn how to think, for instance to synthesize disparate sources, to formulate a thesis and justify it, to anticipate criticisms of their arguments, and to respond to questions and challenges.
• Develop students’ basic academic skills (e.g. identification and evaluation of relevant resources, effective communication both orally and in writing, effective time-management, critical self-assessment).
• Enable students to pursue their individual academic interests within the context of their subject.
• Foster a close relationship between student and tutor

Execution:
• Students generally produce a piece of written work for each tutorial, based on bibliographic guidance provided by the tutor for problem sets with a requirement for the student to write explanatory text as well as the solution
• Data handling exercises (with commentary, deductions and/or diagnosis)
• Summaries of published papers
• Review of a designated topic in note form
• Presentation

World Café (Juanita Brown and David Isaacs in 1995, Berkana Institute, Denver USA)

What is the World Café?
• Method for generation of ideas, share knowledge stimulate innovative thinking explore possibilities through dialogue in groups.

Execution:
• Divide the participants into groups of 4-5
• Each group has a host and a topic
• The hosts don’t change their places, but stay at the table and summarize all the ideas
• The group works together on the topic for a session of 15-20 minutes
• Then all the people except the host from table 1 move to table 2, from table 2 to table 3 and so on and they work again for a session of 15-20 minutes on the next topic
• When the cycle finishes then the groups have 10-20 minutes to summarize all the information that has been gathered on their table
• Finally one representative of each table presents the results

Expectation Queries (Jane Ricken, University of Namur, Belgium)

Students receive a curriculum-based project which could have several solutions. The problem has to be a realistic one so that the students show a certain interest in the topic. Students work in groups to identify what they need to learn in order to solve the problem. It has to be a work-related problem for which they develop a solution path by themselves and which they work on with the option of consultation, but often independently. In limited time they have to develop a result which is then documented and is presented.
Flashlight (CJ Kazilek, Arizona Science Education Collaborative (ASEC))

• Pick up a flashlight and turn it on, but the light does not work. You have observed that the light does not work. You ask the question, Why it doesn't work? With what you already know about flashlights, you might guess (hypothesize) that the batteries are dead. You say to yourself, if I buy new batteries and replace the old ones in the flashlight, the light should work. To test this prediction you replace the old batteries with new ones from the store. You click the switch on. Does the flashlight work? No?

• What else could be the answer? You go back and hypothesize that it might be a broken light bulb. Your new prediction is if you replace the broken light bulb the flashlight will work. It’s time to go back to the store and buy a new light bulb. Now you test this new hypothesis and prediction by replacing the bulb in the flashlight. You flip the switch again. The flashlight lights up. Success!

• If this were a scientific or an engineering project, you would also have written down the results of your tests and a conclusion of your experiments. The results of only the light bulb hypothesis stood up to the test, and we had to reject the battery hypothesis. You would also communicate what you learned to others with a published report, article, or scientific paper.

• Not all questions can be answered with only two experiments. It can often take a lot more work and tests to find an answer. Even when you find an answer it may not always be the only answer to the question. This is one reason that different scientists and engineers will work on the same question and do their own experiments.

The sequence of Learning
• **Observation** – seeing, hearing, touching…
• **Asking a question** – why or how?
• **Hypothesis** – a fancy name for an educated guess about what causes something to happen.
• **Prediction** – what you think will happen if…
• **Testing** – this is where you get to experiment and be creative.
• **Conclusion** – decide how your test results relate to your predictions.
• **Communicate** – share your results so others can learn from your work.

Other parts of the scientific method…
There are a few other things to learn so that you will be able to test out your new skills and test your hypotheses.

• **Control** - A group that is similar to other groups but is left alone so that it can be compared to see what happened to the other groups that are tested.
• **Data** - the numbers and measurements you get from the test in a scientific experiment.
• **Variable** - Something that can cause something you are testing to change. There are several kinds of variables.
- **Independent variable** - a variable that you change as part of your experiment. It is important to only change one independent variable for each experiment.
- **Dependent variable** - a variable that changes when the independent variable is changed.
- **Controlled Variable** - these are variables that you never change in your experiment.

**Partner-Conversation**
To improve listening and conversational speaking skills through regular scheduled interaction with language expert on subject related topics.

**Fishbowl**
The “fishbowl” is a teaching strategy that helps students practice being contributors and listeners in a discussion. Students ask questions, present opinions, and share information when they sit in the “fishbowl” circle, while students on the outside of the circle listen carefully to the ideas presented and pay attention to process. Then the roles reverse. This strategy is especially useful when you want to make sure all students participate in the discussion, when you want to help students reflect on what a “good discussion” looks like, and when you need a structure for discussing controversial or difficult topics. Fishbowls make excellent pre-writing activities, often unearthing questions or ideas that students can explore more deeply in an independent assignment.

**Group Puzzles**
Formulate a realistic problem for a group based on the subject knowledge that the group has acquired and let the group develop the solution. Ask questions.

**Expert Groups**
A group is given a problem to find a solution or alternate solution which is compared with the solution of experts.

**Open-Space**
Open-Space method leads the students to argue different points of view, inspire students to think, mobilize the enthusiasm, develop initiative and creativity and also improve their comprehensive ability.

**Walt-Disney-Method** (Walter Disney)
This method suggests the presentation of an engineering topic with animation to make it interesting like entertainment.

**Six-Thinking-Hats** (Edward de Bono physician and professor)
One of the pioneers of creative, or lateral thinking is Edward de Bono (physician and professor) Of his many techniques that have helped inspire creativity, the most popular is his ‘**six thinking hats**’ theory. Each person, he observed, prefers to think in one of six ways, and he associated each person with a colored hat: thus, **green hat** thinkers tend to be **creative but may not think through the consequences**; **blue hat**
thinkers stand back and look at the bigger picture; yellow hat thinkers tend to be constructive and look for ways of making something work; black hat thinkers tend to play ‘devil’s advocate’ and point out what might go wrong; white hat thinkers tend to focus on facts, figures and logic; and red hat thinkers tend to use hunches, ‘gut feel', intuition and previous experience.

“It is still a huge challenge to realize innovative methods in curricula. Innovative methods in engineering education combine theory, academic methods and professional practice. Using innovative didactic concepts in education is an excellent method to prepare students for the engineering market. Therefore, the re-organization of the curricula and the continuing didactical education of the lecturers are necessary. In addition to research, teaching must take a central focus in tertiary institutions. As a result, more operating funds are needed. Operating funds should be planned according to a structure that actually rewards success in teaching. Furthermore, research projects in engineering education have to be promoted. “

References

Innovative Teaching Methods, HEC Perspective:
• HEC suggests that a regular survey should be conducted to find out as to how many engineering universities are applying some of the innovative techniques. HEC is contemplating to undertake this job for public sector universities.

• If the survey reveals that the universities are not applying or unaware of the techniques the PEC should hold seminars to create awareness and train faculty either directly by itself or through some consultant for engineering universities. HEC’s NAHE old modules are available to train faculty whereas a whole new process of teachers training system is under development.

• PEC should develop regular direct or indirect unbiased monitoring system for the implementation of pedagogy.

Grading System and Implementation:
• PEC should make sure that the students are comprehensively graded using all the under mentioned points and not only through written exams in Engineering Teaching Institutions for which HEC has provided a guideline using relative or absolute grades. A percentage weightage has to be assigned to each of the under mentioned exams.

• Regular Quizzes, Midterm exams and Final exam have to be developed in such a way to test the concepts and clear perception of subject material's depth and breadth. If it is found necessary PEC may conduct seminar on exam developing methodologies.

• Test the skill by giving a practical subject related problem to be solved in defined time
4. **Extra-curricular learning – co-learning, Partnership building (e.g. between educational institutions and industry, NGOs and IGOs)**

1. **Introduction:**

Considering debates and discussions during and after the National Dialogue and International Meeting on Engineering Qualification Standardization held on 9-10 January, 2015 in Islamabad - Pakistan hosted by UNESCO, Islamabad and Jakarta, Pakistan Engineering Council (PEC), the International Science, Technology and Innovation Center for South–South Cooperation under the auspices of UNESCO (ISTIC), the Federation of Engineering Institutions of Asia and the Pacific (FEIAP) and Economic Cooperation Organization Science Foundation (ECOSF).

Islamabad Declaration on Engineering Qualification Standardization was adopted by the participants of the international meeting on engineering qualification standardization on 10 January, 2015[1]. This Islamabad Declaration reaffirms that, standardization of engineering qualification is very important for the economies to promote their engineers all over the world. A strong linkage between the stakeholders in this regard is instrumental. That engineers not only assures the human resource pipeline required for the green and clean scientific, engineering and technology devices and systems needed to combat the challenges of global poverty and global climate change, but also provides the world with a rational and discerning citizenry that will help ensure peace and security of the world.

*This technical report intends to explore the role of extracurricular & self-development learning in meeting the need for cooperative learning and partnership building in current scenario of Higher Engineering Education of Pakistan.*

This document is deliberated to endorse a mutual understanding among all stakeholders of the significant cooperative learning and partnership building Industry and Academia. It mentions concepts and identify good projective activities to promote extracurricular learning. In terms of its hands-on facets, it is meant to aid as a developing reference article identifying a working-flow chart and its details which can bring concrete changes in educational settings (formal and non-formal) and to establish a firm framework for future resolutions and actions in this interest. This Road Map (flow chart) therefore aims to converse a vision and mature an agreement on the reputation of extracurricular learning for building a cooperative environment and partnered projects to ensure the more complete integration of Industry practices into academia for producing tangible results.
2. Methodology/Literature Review/Current scenario:

Extra-curricular Learning, Coop Learning, Partnership Building (e.g. Between Educational Institution and Industry, NGOs and INGOs)

- Directorate of coop Education Program & Career Services
  - Planning Career Advice Services
  - Cooperative Education Program Services
  - Entrepreneurship Skill Development
  - CV Writing Skills
  - Strategies Management

- Extracurricular Learning
  - Student Financial Aid Office
  - Student Counselling Services
  - Initiate Exchange Program

- Student Support
  - Initiate Exchange Program
  - Erasmus Mundus / Fulbright etc.

- Partnership Building
  - Develop Linkage with Industry
    - Sabbatical (spending of Faculty visits 03-06 months in Industry)
  - Develop Linkages with NGO/INGO (for Poverty, Alleviation, Renewable Energy, Literacy, e-Health)

- Initiation of Joint Degree Program
  - Masters Level Exchange within Country and Internationally
Based on deliberations for promoting extracurricular & cooperative learning and partnership building among industry and academia, the above flow chart presents to be a “Road Map” where upon realizing and implementing, can prove to be a medium for developing a framework for the said vision and mission.

For any engineering institute, four departments such as: Directorate of coop Education Program & Career Services, Extracurricular Learning, Student support and partnership building can play a vital role in building up a more engaged student and a more skilled graduate.

Whereas these four can be pillar and underlying components can be separate entities and teams to carry vision more focused.

2.1 Directorate of coop Education Program & Career Services: This directorate encompasses five sub-domains which are:

- **Planning Career Advice Services:** Most often it has been observed a lack of career planning among students. This weakens the chance of a student to join properly intellectual based field of job or study. With proper support of planning career advisory services, the work of appropriate job searching, selecting higher education foreign university and applying at larger companies can be stimulated among students; thus can bring out a more focused graduate. The core activities may include individual and group career guidance, career information, career planning workshops as well as employer permanent payroll cost. Students are enthusiastic, energetic, offer specialist skills from liaison. Every Institute must prepare a notebook or use book such as Career Road Map Guide for Engineers[2].

- **Cooperative Education program Services:** The Cooperative Education program can be responsible for the management and development of the Cooperative Education. Arranging coop education for students means providing them an opportunity to undertake projects or other work by hiring additional temporary resources without adding their academic programmes, and are eager to work on complex or routine tasks. The Coop programme can be a cost effective and flexible solution to recruitment needs of many organizations. Coop also gives targeted industry/ organisation the chance to vet potential graduates’ first-hand over an extended period in a real work environment.

  The Cooperative Education programme (or undergraduate placement) at the University of Limerick is a core element of all undergraduate degrees. As part of the programme, all students, regardless of discipline, undertake relevant work experience normally of eight months duration. About 1,600 students are placed on Coop every year, with about 30% placed internationally. This makes it one of the largest placement programmes in Europe. Some 1,600 employers participate in the programme annually and about 75% of these employers also employ UL graduates [3].

- **Entrepreneurship Skill Development (ESD) Services:** Now a days there is a good trend emerged where increasing numbers of students are setting up their own businesses after leaving university. It’s not a good time to be a student looking for jobs. Competition is stiff for graduate schemes at large companies, and the positions graduates are able to fill seem to decrease by the day. However, a hidden job market has been on the rise in recent years: the jobs you make yourself. “With the rise in graduate unemployment, more and more graduates are reassessing their career options and looking for more entrepreneurial career paths,” says Rajeeb Dey, CEO of Enternships, a company devoted to giving young people...
access to work experience in startup companies. Rajeeb believes that “Gen Y graduates are generally less motivated by money, but more the ability to make an impact and have autonomy in their work, which working in startup environments allow.”[4]

*With a concentration towards job searching after graduation, ESD services shall be responsible to carry out with activities and sessions that can motivate them for pursuing entrepreneurship as their profession.*

- **CV Writing Skills**: Good CV can get students good job, and making good CV is an art that can learned and practiced. Proper guidance on CV making as per market standards can be beneficial in long-run.

- **Strategies Management**: Strategic management is the continuous planning, monitoring, analysis and assessment of all that is necessary for an organization to meet its goals and objectives. Strategic Management is all about identification and description of the strategies that managers can carry so as to achieve better performance and a competitive advantage for their organization

**2.2 Extracurricular Learning**: This encompasses seven sub-domains which are:

- **Community Services**: Community services is a great way to instill a sense of responsibility among students, it’s a medium to give back to society and it should be added in extracurricular learning as it is the direct contribution to society for what we study.

- **Student Sports Activities**: To keep students energetic, sport activities play a vital role and there must be a yearly sports week to promote sport culture. Moreover intra-departmental sports tournaments can be organized.

- **Brunch with CEO**: To get a more detailed and pragmatic approach on how the life would be after graduation, brunch with CEO can bring in a good motivation among students to understand and know the certainties associated with market.

- **Chapters of Professional Bodies (e.g. IEEE, ACM, etc)**: Having chapters of professional societies in a campus can produce leadership learning opportunities for students to participate and organize technical seminars and workshops. Moreover these societies give a ticket to be in-contact with the trend of world.

- **A day with CEO / MD**: A day with CEO can be beneficial both in self-learning and self-development as it creates opportunities for students to showcase their projects or work with industry stake holders which ultimately can bring-in future job or working opportunities for student.

- **Study Visits**: One study visit per semester can give a rational thinking and overview of what the industry is all about and how they have to comply themselves to meet the requirements of market.

- **Guest Speaker Talk**: Alumni talks as guest session can be initiated one/per month which in fact not only can bring in learning to students but can produce meeting and networking opportunities with their peers.
2.3 Student Support: This encompasses two sub-domains which are:

- **Student Financial Aid Office:** Scholarships and Travel grants are most of the times what talented students lack, having a proper student financial aid office can give them a support in aid to their educational finance.

- **Student Counseling Services:** Student life can become difficult, and sometimes, overwhelming. Academic stress, financial stress, social stress can make it difficult for students to perform optimally. In addition, other stresses such as trauma, illness, bereavement, and home sickness can further complicate. Student counseling service needs to provide quality services to students by promoting sound mental health and coping skills necessary for successful pursuit of their educational and life goals.

2.4 Partnership Building:

- It helps the institute in strengthening its “good governance”.
- It can disseminate the public information, education, and consultation.
- It fosters an enabling environment.

**Key elements to be considered**

- It should be collaborative.
- Partners must have a strategic vision, pursue compatible targets, and enjoy equal membership status.
- Both the actions and efforts of partners must be collaborative.
- The strong commitment from each partner to be reflected in the fact that they are equally present and represented by experienced persons.
- The rules of conduct are adhered by partners.
- The equity should be a guiding principle in building a partnership.
- A “bottom-up” structure is needed.
- The political will is needed.
- The human and financial resources are needed.
- In building partnership, the expected outcomes must be determined in advance.
- Roles of each partner must be clarified.
- The strengths & weaknesses of common goals should be assessed/measured in the beginning.
- For implementation of partnership agreement work package is drafted.

**Work package?**

- The work package or work programme outline the work expected from the partner with deadlines.
- The monitoring & evaluation of work package should be an on-going process.
This encompasses four sub-domains which are:

- **Initiate Exchange Program:** Exchange programs are always a good way to give students an exposure to outer world and technology trend. Some of the prominent exchange programs can initiated with the help of: Erasmus Mundus / Fulbright etc. Masters Level Exchange within Country and Internationally.

- **Develop Linkage with Industry:** Academia and industry have to move side by side, thereby developing a linkage with industry to support research projects is important.

- **Sabbatical (spending of Faculty visits 03-06 months in Industry):** Considering the market demands and global trend, faculty members; if spend 3-6 months sabbatical in industry firms and research centres once every 2-3 years can prepare them for transition from a prototype of their project to product of their research.

- **Develop Linkages with NGO/INGO (for Poverty, Alleviation, Renewable Energy, Literacy, e-Health)** - Developing a linkage with NGO’s can fulfill special interest in humanitarian technology. NGOs contribution is important for the reasons of their style or work, innovative &outreach capacity and representation of inaccessible areas/community. NGOs may provide additional resources; they can make the development process more accountable, transparent, and participatory. The planning of projects and policies can be strongly influenced by inviting NGO leaders for consultation. The institution-NGO relationship may not be productive if the relationship is too cozy.

- **Initiation of Joint Degree Program:** Joint Masters program may be launched by two or more collaborative institutions. In this way fewer resources would be needed due to sharing of faculty, resources and facilities.

### 3. Implementation and expected outcome:

Considering the on-going discussions for group-4, the results would be focused on justifying the logics behind every suggested unit in road map to develop an effective framework. It shall be decided what to strongly recommend and what to keep optional, for now the logic table looks as follows:

<table>
<thead>
<tr>
<th>Department</th>
<th>Resources</th>
<th>Activities</th>
<th>Expected Outputs</th>
<th>Expected Impact</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Directorate of Coop Educatio n Program &amp; Career Services</td>
<td>Career Counseling, Future planning, Skill development, Talent acquisition</td>
<td>Student professional awareness conference, Talent Hunt Program, Motivational Sessions</td>
<td>Create focus on proper job searching, More avenue exploration along with job to entrepreneurs</td>
<td>More focused graduate, Self-development, Increase productivity</td>
<td>All activities are strongly recommendeed</td>
</tr>
<tr>
<td>Extracurricular Learning</td>
<td>Student Support</td>
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<tr>
<td>Alumni Engagement</td>
<td>Student counselling</td>
<td></td>
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<tr>
<td>Community development</td>
<td>Financial support program</td>
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<tr>
<td>Industry exposure</td>
<td>Travel Grants Support</td>
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<tr>
<td>Sports Week Guests Talk sessions</td>
<td>Student counselling discussion panels</td>
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<tr>
<td>Field trips Humanitarian workshops</td>
<td>Fund-raisers</td>
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<tr>
<td>Meet up with Industry people</td>
<td>Supporting students on merit-cum-need / need-cum-merit basis</td>
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<tr>
<td></td>
<td>Creating a counselling environment</td>
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<tr>
<td></td>
<td>More less finance worried students</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>More counselled graduates</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Student counselling is strongly recommended, however financial support program is optional and up to engineering school policy makers interest and feasibility.</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

All activities are strongly recommended.

- Industry exposed graduate
- Rational thinking
- Leadership qualified

- Energized and motivated students.
- Create more networking opportunities with industry people.
- Develop more self-responsibility among students.
- Create more networking opportunities with industry people.
- Develop more self-responsibility among students.
- Energized and motivated students.
- Create more networking opportunities with industry people.
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- Energized and motivated students.
- Create more networking opportunities with industry people.
- Develop more self-responsibility among students.
- Energized and motivated students.
4. Discussion:

The need and demand of technical and engineering education programs in Pakistan has considerably increased in last decades. Whereas such economic and industrialization growth in Asian countries like China, India, Singapore, Malaysia etc is faster than elsewhere in the world, however the implementation of quality assurance mechanism in engineering education is slowly picking the pace in these countries. Moreover the policies are underway for the improving overall quality of education. In faster mobilization era engineering education requires global recognition for the survival of engineering profession [5].

There is much discussion concerning the many possible aims of cooperative and productive learning, and ensuring quality of higher education [6]. This assessment leads to questions such as: “Is extracurricular studies taught for self-development alone or should it be seen as a means to enhance learning in productive and supporting environment?”; “Should industry standards be taught as a discipline for its own sake or for the body of knowledge, skills and values to be derived from it (or both)?” These remain central issues in shaping the approach of cooperative learning practitioners, teachers, students and policy makers alike. The Road Map attempts an inclusive retort to these questions and emphasizes that creative, innovative and cultural development should be a basic function of engineering education.

5. Conclusions:

Extra-curricular Learning, Cooperative Learning, Partnership Building may provide opportunities for promotion and adoption of best practices, developing linkages with industry, stimulation of innovation and diversity in engineering education in keeping the pace with changing scenario of world.
6. Recommendations:

Exponential advances in knowledge, instrumentation, communication, and computational capabilities have created mind-boggling possibilities, and students are cutting across traditional disciplinary boundaries in unprecedented ways. Indeed, the distinction between science and engineering in some domains has been blurred to extinction, which raises some serious issues for engineering education. We hope engineering educators accept the challenge and that everyone who serves on these working groups will help stimulate discussion on standardization of engineering education at their campuses. We must call on all engineering councils/associations to redouble their commitment to engineering qualification standardization, including reaching out to their national ministries of education and relevant parent departments for preparing our engineering graduates to compete in the new world economy.

References:

[1] Islamabad Declaration on Engineering Qualification Standardization: adopted by the participants of the international meeting on engineering qualification standardization on 10 January, 2015 (Annexure B).


5. Process of UNESCO accreditation through Social Integration in and through Engineering, Gender mainstreaming in all efforts

1. Brief history of engineering education in global village and Pakistan.

2. Brief history of accreditation of engineering qualification in global village, Asia pacific and Pakistan-mobility.

3. Brief history of social integration and gender mainstreaming in general and in engineering in global village, Asia pacific and Pakistan.


5. FEIAP-Engineering education guidelines addressing social integration and gender mainstreaming.

6. PEC Accreditation manual addressing social integration and gender mainstreaming.

7. PEC bylaws and web site addressing social integration and gender mainstreaming.

8. HEC curriculum addressing social integration and gender mainstreaming.

9. Interviews.

10. Tracing MDGs and SDGs in GOP agencies.


12. Policy and integration matters

13. Policy and integration matters

14. Conclusion and Recommendations.
6. Lifelong learning through a UNESCO Chair in Co-engineering for sustainable development across ECO countries with HQ in Pakistan

Lifelong Learning:

- In the light of the global challenges facing us, lifelong learning has emerged as one of the keys to improving the quality of life in the 21st century.
- It is no longer sufficient to have a sound initial education: one must continue to acquire new knowledge and skills to benefit from the new opportunities that advances in science, engineering and technology bring, and to cope with the difficulties of life in world of change.
- The evidence confirms that investing in learning pays off for both individuals and nations, in terms of income, employment, productivity, health and other benefits. Moreover, providing opportunities to learn throughout life turns out to be a crucial factor in the struggle to eradicate poverty and to educate for sustainable development.
- But adopting the principle of lifelong learning does demand a new vision, one that shifts the emphasis from education to learning; one that moves to a more seamless and user-friendly system; one that recognizes the diversity of ways in which knowledge and skills can be acquired in the information age outside of the formal system. In particular, if progress is to be made in reducing poverty and ensuring development is sustainable, governments and the international community will need to meet their commitments and take the steps needed to make lifelong learning for all a reality.

Co-Engineering:

- As enterprises get complex, adding investment and technology does not automatically guarantee services will improve.
- The performance of such complex systems is best improved by creating and maximizing the value that meets the goals of the stakeholders.
To accomplish this we are interested in services of all the Agents, both humans and non-humans, and their performance contribution to the goals of the stakeholders. Co-engineering represents the simultaneous engineering of such an organization, from the perspective of each BioS (Business tactics, IT, Operations, and Strategy) dimension, to achieve desired results.

Co-engineering methods and principles are based on the ACE(Adaptive Complex Enterprise) performance structure.

The fine-grain monitoring of service Interactions and their simultaneous Δ to BioS provides immediate visibility within service-oriented organizations that must deal with uncertainty, changing requirements, and goals.

This is especially true because within such environments resources are shared and execution status is hard to obtain.

For example, the availability of resources becomes harder to predict as they work on many ad-hoc Requests that result from requirements discovery.

As a result, the ability to meet the customer promised dates becomes harder and satisfaction is negatively impacted.

Plan-Execute-Monitor-Analyze Quality Cycle: RED is a single conceptual structure for service planning and service execution.

As we have shown planning consists of defining the Request type strategy and business value, execution consists of RED Interaction execution with appropriate resources, monitoring consists of metrics collection, and analysis consists of using work products to identify performance-to-goal analysis, prioritization and decision-making.

RED Interactions allow us to relate and ‘trace’ the precise infrastructure service used, to customer benefits, to business and infrastructure capability.

This is in terms of Δ contributions to stakeholder dimensions within the customer and provider organizations.

UNESCO Chair HQ in Pakistan:
Activities undertaken in the framework of a UNITWIN / UNESCO Chair project may correspond to the goals to be achieved. They may include in particular:

1. Programme development in non-traditional areas at undergraduate and postgraduate levels;
2. Exchange of lecturers, students and researchers;
3. Lectures on topics relevant to the field covered by the UNESCO Chair (some of which could be made available online);
4. Research corresponding to the research strategies of UNESCO’s various Sectors;
5. Workshops, seminars, national, regional and international meetings/conferences;
6. Publications;
7. Establishment of or participation in virtual communities of practices.
8. A diploma or certificate associated with a UNESCO Chair may be issued.
9. Activities approved by Member States of the Organization and forms of their implementation that complement the relevant UNESCO programmes and
10. Close cooperation with ongoing UNESCO activities and programmes.
11. From its vantage point of observer, UNESCO will play its role as a catalyst to the full by encouraging
12. UNESCO Chairs and UNITWIN Networks to become poles of excellence and innovation.
13. A pole of excellence is “a combination, in a specific geographical location, of universities, higher education institutions, training centres, foundations, and public or private research units working together on joint projects of an innovative nature.
14. Such a partnership is structured around a specific field or theme (Engineering Education Standardization) that is consonant with UNESCO’s priorities, and must reach a critical mass in order to achieve a certain level of quality and international visibility”.

A pole of excellence and innovation should:
   (i) conduct research activities fostering partnerships between research and services and industries;
   (ii) master the use of technology, in particular distance learning technology, to provide high-level training in its field;
   (iii) integrate public and private sources to ensure successful applications and developments;
   (iv) offer industry the possibility of using research results to implement profitable activities that have an impact on sustainable development;
   (v) innovate today for building tomorrow;
   (vi) provide leadership in technology innovation in education (by creating for example, groundbreaking software);
   (vii) act as a strategic resource pole offering a forum for sharing of knowledge and experience;
   (viii) contribute actively to developing the respective sector of activities at the national and/or regional level;
   (ix) offer research activities at international level that interfaces with the environment, and attract its own resources by having the capacity and the autonomy to bid for projects, which permit its implementation;
   (x) create institutional space, which can be virtual, for research and training (CPD) and documentation, and an Internet site.

UNESCO Chair of the project
“Lifelong learning through a UNESCO Chair in Co-engineering for sustainable development across ECO countries with HQ in Pakistan” will also support all the activities of the following UNESCO initiated projects/studies:
1. Needs/situation/opportunity analysis for standardisation at national and sub-regional level
2. Professional development through support for Pakistan Academy of Engineers
3. Pedagogy development (e.g. innovative teaching methods), Uniform entry and grading system in academic institutions
4. Extra-curricular learning – co-learning, Partnership building (e.g. between educational institutions and industry, NGOs and IGOs)
5. Process of UNESCO accreditation through Social Integration in and through Engineering, Gender mainstreaming in all efforts

Reformation of Engineering Education and Training:
Re-engineering education and training:

1. Ensure that learning as one moves from one level to the next is **seamless**.
2. Improve the **articulation** between levels and types of education and training.
3. Revise their **qualification frameworks, accreditation, quality assurance, indicator and assessment systems, and establish equivalency frameworks** to better recognize TVET, adult and continuing education, within-industry training, apprenticeships and non-formal programmes.
4. Make more **effective use of it** and open learning systems to reach the unreached and to support on-the-job training.
5. Increase the **funding** and provide other incentives in support of non-formal education and training (i.e. Adult and continuing education, ngo and industry-based training) while maintaining (and if necessary also increasing) support for formal education to achieve national and international goals (e.g. Efa, mdgs, esd).
6. Develop an **integrated policy framework** to drive the reform of the entire formal and non-formal education and training system, its component parts and the pathways between them.
7. Such steps are important elements in confronting the challenge posed by lifelong learning so that they are consistent with the principles of lifelong learning.
8. In the end, what is needed is to use the principles of lifelong learning as the framework for re-engineering the entire education-training-adult learning system.
9. Adopting a lifespan perspective takes us back to the issue of the **learning needs** to be met at each **stage of human development**, and the changing priorities of the individual and the communities (local, national and global) in which they live, and in particular those that assume importance in addressing issues of poverty and sustainable development.
10. Similarly, unesco world conferences on higher education in 1998 and 2009 called for the **re-orientation of higher education** in the light of the challenges facing us in the 21st century, and at the same time a reaffirmation of its commitment to the core values and functions of higher education, in particular insisting that its mission must be to "contribute to sustainable development and improvement of society as a whole should be preserved, reinforced and further expanded (unesco, 1998).
11. Through their research and teaching they can help policy makers and those working at the coal face to better understand what needs to be done to alleviate poverty and to promote sustainable development. It is in our higher education institutions that the educators of the future are trained and those already in the workforce need to have their knowledge and skills base constantly upgraded (Karmel and Maclean, 2007).

12. Moreover, they play (or should play) a significant role in the dialogue and action needed to move from the existing fragmented and at times dysfunctional formal system of education to one that takes the principles of lifelong learning seriously, and re-engineers education and training in ways that contribute to the alleviation of poverty and sustainable development.

13. The contribution of non-formal learning and the re-engineering of adult and continuing education is unquestionably one of the greatest challenges in the quest to ensure all have the opportunity to learn throughout life and to ensure that development is sustainable (Maclean and Singh, 2005).

14. In the knowledge society, the increasing involvement of employers and community groups in recurrent and adult learning programmes is opening up new pathways.

Future Directions:
To achieve the goals of lifelong learning for sustainable development, it is suggested that

The governments of the Member States of the ECO:

1. To government on policies, strategies and changes that need to be made in order to promote a culture of lifelong learning, to set national targets and to develop and implement integrated action plans and strategies for poverty reduction and sustainable development.

2. Develop a coherent policy and set of strategies for awareness-raising and to support the re-engineering of existing systems of formal and non-formal education and involve stakeholders and the media in promoting of lifelong learning for poverty alleviation and education for sustainable development.

3. Request all authorities within the public and private sectors of the engineering education and training to undertake a review of the extent to which existing policies and practices is consistent with the principles of lifelong learning.

4. Provide much greater support for non-government and voluntary organizations active in providing non-formal education and training and to enable them to better assess and report on view the contribution that their organization is making to the creation opportunities to continue to learn throughout life for all, and particularly those whose needs have not, or not being adequately met by the formal system,
5. Request employer and community groups and other stakeholder groups to identify skills gaps in the labour market and unmet learning needs of disadvantaged groups in the communities in which they work, giving special attention to the poor and to education for sustainable development for all.

6. Provide the task force with the funds and authority to commission reviews of the research and to undertake additional studies to assess the effectiveness of education and training programmes for children, youth and adults for poverty alleviation and sustainable development, and to examine issues of articulation within and between sectors, recognition of non-formal education and training, and the reorientation of accreditation, qualifications frameworks and quality assurance mechanisms in accordance with the principles of lifelong learning.

7. Support professional development and training programmes for key educational and training personnel to facilitate their efforts to develop strategies within the framework of lifelong learning for poverty reduction and sustainable development.

Request international organizations (inter-governmental, non-government, development Banks and agencies) to

1. Collaborate in the development of a coherent, integrated UN policy and action plan to provide all with opportunities for learning throughout life for poverty reduction and education for sustainable development, reinforcing and extending their collective and individual efforts to support programmes and activities aimed at achieving the MDGs by 2015.

2. Generate a shared international agenda, agreed targets and strategic plan of action, and Joint agreements on roles, responsibilities and funding.

3. Expand international statistics and develop more robust and policy relevant indicator Systems to assess progress in promoting lifelong learning, the effectiveness of international and national policies and strategies aimed at poverty reduction and sustainable development policies and strategies, and the social, economic and environmental benefits from investments made.

4. Build partnerships with and seek the support of international corporations, media, foundations and non-government organizations involving them actively at all stages in the development and implementation of lifelong learning policy and strategies.

5. Support international, comparative and developmental research on the effectiveness of III policy and programmes for poverty alleviation and sustainable development.
Itemized List of References

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