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AGENDA FOR URBAN CONCERN

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Towards preventing unemployment of the educated

DR. NIZAMUDDIN AHMED

IN spite of the welcome channel invasion, the lure of the cable network, the ease of surfing on the net, the charm of international seminars and travel, there are areas where we seem to be have been left stranded on the kerb of information's super highway.

While universities are sprouting as fast as apartment buildings, in many the management are unsure and the students unaware of the relevance of the degree in Bangladesh let alone the international job market the focus of most who are spending a handsome sum for their grooming.

With professionalism depleted by 'trade unionism' due much to self-seeking aspirations of degree-holding dilettantes, the possibility of punitive measures at home have often been drowned by slogans reverberating within the walls of the city. Professionalism has to be established because the possibility of our professionals being barred by overseas as well as home employers is a growing reality.

The role of professional bodies in launching a rescue mission cannot be overemphasised. To say the least, almost all of them have perhaps been caught napping. A longer hibernation could spell disaster and long-term international isolation.

Education in the long run affects urban life. University education has direct relevance to development and physical features that will shape the urban fabric. Sustained good education of professionals can lead to improved living condition perhaps an unsaid yearning in every soul.

Professor Dr. Iqbal Mahmud, now working on PE (professional engineer) certification in Bangladesh, touches today on a topic that should be an eye opener for all professionals (Architects, Engineers, Planners) and the professional associations in Bangladesh.

They say in this country it is easier to get a job than to be fired from one. For a better tomorrow and to ensure employment opportunities, it should be made difficult to keep one. In that effort to acquire competitive quality is ensured the peeping of the sun from behind the dark clouds.

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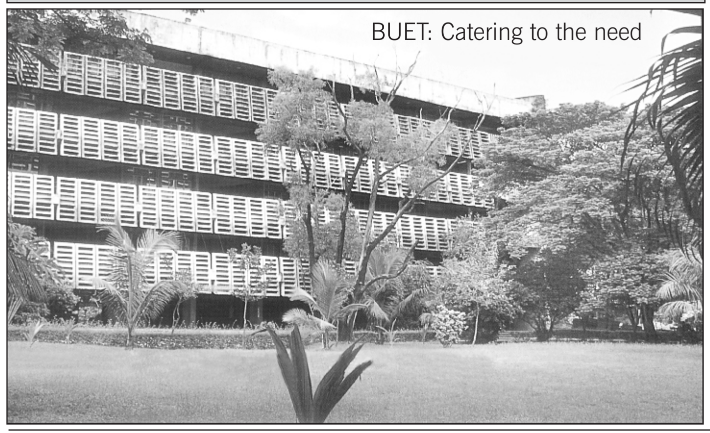


BUET: Catering to the need

Quality assurance in engineering and technological education

DR. IQBAL MAHMUD

DURING the second half of the 20th century rapid development of the newly industrialized economics (NIEs) of East Asia clearly demonstrated the key role of high quality engineering and technical education in narrowing the knowledge gap in science and technology between the developed and developing worlds. There also appears to be an association between per capita income and higher education enrolment (World Bank 1998/99). Probably this trend is a part of a virtuous cycle involving quality education in engineering and technology and income growth.

1.1The National Scene

The demand for engineering or technical degree/diploma being very high, engineering and technical institutions, irrespective of their quality of instruction, have had little difficulty in attracting a large number of qualified applicants. Given the increasing demand for places, the issue of Quality Assurance (QA) in such education has often been pushed to a second place behind the urgency of finding resources for expansion of physical facilities. When it appeared that state funded institutions could not meet the demand, private universities, often with profit motives, have been established to provide engineering education in selected disciplines (selected with an eye on the current market demand). With the private sector beginning to play a significant role, the discerning public have now started to sense the need for a QA mechanism which can help them make the right choice among the different alternatives available.

1.2The International Scene

Significant cross-border movement of engineers and technicians during the later decades of the previous century has become another phenomenon, which is linked to QA mechanism and has drawn the attention of educators as well as policy planners in both developed and developing countries. Referred to as "Brain Drain" in common parlance, movement of engineers and technicians from the country has become a significant issue. However, it has also been observed that "Reverse Brain Drain" of experienced personnel does have a positive impact on the pace of modernization of developing economies; for instance Republic of Korea and India. The current move towards "globalisation" and the initiative of the "World Trade Organization" (WTO) in facilitating implementation of the "General Agreement on Trade and Services" (GATS) will open up some opportunities as well as create a few barriers for cross border mobility of technical personnel. The twin issues of QA and Mutual Recognition (MR) of engineering qualification will soon become critical while promoting the mobility of engineers under the GATS agreement.

2.Current Status of Engineering Education in the Country

Since the departure of the colonial rulers in the middle of 20th century we were left with the formidable task of developing a technological infrastructure sound enough to cope with the explosive increase of initiative throughout the world to innovate new tools and techniques which form an entire gamut of a new language of engineering. Beset with the socio-political and concomitant economic problems that came with the birth pangs of independence, we now face the additional problem of producing engineers and technologists who find themselves obsolete even within the span of time he is graduating.

2.1Curriculum Development

Along with the import of products and manufacturing technologies, a major proportion of expansion in engineering education had been based on the import of institution models and curricula, which were close imitation of similar institutions and course contents of the industrialised West. Thus the transplanted engineering education structure did not have deep organic roots in the country and did not grow naturally out of the needs of the economy. There is of course, no denying the fact that there is considerable merit in adopting the scientific content of the educational material of industrialised countries.

The course content varies primarily with respect to the proportion of physical and engineering sciences and practice-oriented courses. Some of the institutions have a high content of science-oriented subjects, which makes the undergraduate course a better preparatory stage for subsequent postgraduate study and research.

At this stage of our discussion we may pause to enumerate the steps usually followed in curriculum design, viz.,

! Assessment of needs through interaction with concerned external agencies.

! Assessment of capability through evaluation of institutional facilities.

! Formulation and discussion of a draft course in department bodies like boards of studies or courses and curriculum committees.

! Transmittal of a proposed course to the relevant university authority like Faculty and Academic Council for final approval.

Needs and capability analyses are often not carried out objectively or with an agreed set of criteria. Nor are the 'user sectors' seriously involved in curricula design. (Fig 1) Accreditation of professional courses by recognised professional bodies in the country is not yet practised.

2.1.1 Needs Analysis

The need for a specific course actually emerges from a felt need for a coherent pattern, which can lead to development of sequential instructional materials and guidance of teacher's action. Given the rapid expansion of knowledge, together with advances in technology and science and numerous socio-economic forces, continual need analyses for better courses and course revision should be regarded as a primary concern of a university department.

The curriculum handed down from our predecessors call for revisions in some courses in view of the changed needs of society, of industry or business and of the profession. Prior to revision/redesign of a course a survey of the needs referred to above form an important part of the whole process. A curriculum/course designer needs to keep in view both national problems and international trends in the field.

2.1.2Capability analysis

Capability analysis prior to course design may essentially consist of looking into three issues, viz.

! Faculty resources, expertise and interest

! Academic preparation of the student

! Physical facilities including teaching aids, computers etc.

Obviously, the heart of any university programme is the teaching faculty. All other matters are secondary to a competent, qualified, and forward looking faculty that can provide an overall scholarly direction to the process of course design. The relevant competence, experience, research interest, professional involvement of the teacher responsible for a course design is of paramount importance in determining the quality of course content. In countries with advanced university systems, a course designed to be offered by a teacher with specific capability is discontinued after the departure of that person. Such a situation calls for revision of the course to tailor to the competence of the new teacher.

The concept of a course team whereby the responsibility of a cluster of relevant courses devolves on a team of likeminded teachers is worth considering in maintaining continuity in course design and revision efforts.

Assessment of academic background of students is the second factor to be considered in design of a course. In this country the high school education lacks flexibility and the students of comparable academic achievement in public examinations like HSC seldom have much variation with respect to their knowledge in the basic prerequisites for university courses. Similarly, once a student enters the university we allow very few optional courses within a discipline. This makes the job of a course designer much "easier" than that of his peer in developed countries.

2.1.3 Various Components in the Curricula

Table 1 shows the proportion of various subjects or groups of subjects included in the four-year undergraduate curricula in the Bangladesh University of Engineering and Technology. The Bangladesh Institutes of Technology (BITs) and the recently established private universities offering engineering education offer very similar curricula. The humanities and social science courses constitute only 5-10% of the curricula. This is quite low when compared to the requirements in industrialised countries where the percentage is often around 15%. Departmental subjects constitute the major component of the curricula. **This is probably done in the fond belief of the faculty that more engineering courses will make a better engineer**. However, the current trend in the industrialised countries is to provide the engineering students **with more scientific tools of analysis and higher proportion of social sciences** (including management oriented courses) to help him understand the overall setting in which he will have to solve real life engineering problems.

2.2 Accreditation

The University Grants Commission is the national accreditation authority for private universities offering engineering programmes. But this is done at the initial stage only. It is not a time bound periodic event. For the publicly funded universities and institutes accreditation is not carried out.

2.3 Unscheduled Interruptions and Engineering Education

Academic campuses are presumed to be islands of serenity in the sea of noise and bustle of everyday life in a society. However our campuses have become the hot bed of partisan politics and student unrest (often encouraged from outside). With so many interruptions, unscheduled closures and academic discontinuity it is almost impossible to organize teaching in a meaningful manner. Session jam and discontinuous semester not only hampers studies but also greatly reduces our chances to get international recognition.

3. Current World Trends in QA in Engineering Education

Given the period of unprecedented changes that lies ahead in this century, engineering educators around the globe have started recasting their human resource development programme to meet the new challenges such that the engineering graduates of the 21st century will be endowed with:

! Well developed learning skills with ability to deal with technological changes and understanding of the requirement to maintain continued competence and to keep abreast of emerging tools, techniques and practices.

! Basic knowledge of principles of management, economics, finance, business, sustainable development with environmental protection and exposure to issues of social and environmental responsibility as related to the use of new and engineering technologies.

! Ability to deal with open-ended multidisciplinary problems.

Engineering graduates may practise across national borders by

! taking employment in another country

! working for a firm engaged in foreign contracts

! employment with a multinational company

This cross-border mobility of engineering graduates has led to international interest in QA modalities in all countries. Employees, graduate schools and professional licensing boards are now interested in closely examining the quality of education received by engineering graduates who wish to be internationally mobile. QA (QA) system such as accreditation modalities in a given country has to be acceptable to the host country where the graduate aspires to practice. The engineering education, which such engineers have obtained, is subjected to scrutiny by foreign licensure boards.

`developed countries, realizing the need for quality across the board in all major engineering programmes, have put in place formalized QA mechanisms.

QA systems for engineering education vary considerably from country to country, from peer run accreditation programmes to large government bureaucracies. Peer run QA institutions seem to be the preferred option in the country, which follows the US-UK traditions. In case of Japan, there has been a recent reversion to a peer run QA institution from a large government bureaucracy, which continues to be responsible for looking after university education in general.

Table 1: Percentage of Various subjects or Group of subjects Taught in Different Departments of BUET in Undergraduate Courses.

SUBJECT/ GROUP	ENGINEERING DEPARTMENT					
	Chem	Civil	Comp	Elec	Mech	Metal.
Mathematics	9.18%	7.45%	8.07%	7.58%	9.91%	6.27%
Basic Science (Theory)	11.39%	5.59%	4.35%	4.43%	7.43%	8.46%
Basic Science (Sessional)	5.70%	1.86%	1.87%	1.90%	1.86%	1.90%
Engineering Science, Engineering and Technology (Theory)	44.62%	57.76%	55.28%	53.80%	55.10%	55.17%
Engineering Science, Engineering and Technology (Sessional)	12.34%	19.57%	18.64%	23.73%	13.93%	15.98%
Social Science	10.13%	4.97%	8.07%	5.70%	8.05%	8.46%
Project & Thesis	6.64%	2.8%	3.72%	2.87%	3.72%	3.76%

3.1.1 **US Accreditation Board for Engineering and Technology (ABET)**

ABET, a highly respected system for accreditation of engineering education, has over 60 years of experience and has played a significant role in enhancing engineering education in the USA. It is also involved in international matters, viz.,

! Evaluation of programmes in foreign countries against ABET criteria.

! Review of credentials of graduates from foreign programmes for "substantial equivalency" with ABET programmes.

! Addressing issues of "engineering" to facilitate cross-border practice of engineering.

! Assisting other countries in the development of accreditation systems.

It is a federation of 28 professional engineering and technical societies. It has a pool of 1500 volunteers assisting with accreditation. Currently ABET has accredited about 2400 programmes in 350 engineering schools in USA. ABET's international activities include "substantial equivalence" evaluation visits to Turkey, Mexico, Korea, Saudi Arabia, Columbia, Kuwait, the UAE, Iceland, the Netherlands and Singapore.

3.1.2 **The Engineering Council and the Joint Board of Moderators, UK**

The Joint Board of Moderators (JBM), UK undertakes accreditation visits of engineering programmes through active participation of members of the Engineering Council (EC), comprising of professional societies for engineering, to evaluate engineering programmes against the standards laid down in SARTOR (Standards and Routes to Registration).

As a first step towards our own "Accreditation System" for engineering programme, BUET subjected itself to an accreditation exercise by JBM. During 1995 the Institution of Civil Engineers, UK undertook such an exercise on behalf of JBM to accredit the Department of Civil Engineering of BUET. Apparently the report of the assessors was quite positive and they suggested some minor conditionality, which were to be met before "formal accreditation" could take place.

3.1.3 **Japan Accreditation Board of Engineering Education (JABEE)**

The Japan Accreditation Board for Engineering Education (JABEE), established in November 1999, is a non-government body with support of government agencies and the private sector. It is composed of academic and/or engineering societies, professional engineers' organizations, etc. JABEE follows the Criteria 2000, set up by ABET. Previously accreditation of engineering programmes in universities was carried out by a government body similar to UGC in Bangladesh. The switch to a peer run non-governmental body is in conformity with the current trend among the industrialised countries.

3.1.4 **National Board of Accreditation (NBA), India**

The All India Council for Technical Education (AICTE) set up the National Board of Accreditation (NBA) in September 1994 in order to "assess qualitative competence of education institutions from Diploma level to the Post-graduate level Engineering and Technology, Architecture, Pharmacy, Town Planning and Management". The AICTE was established by an Act of the Parliament in 1987. As with all the Boards described this far the major policy adopted by NBA is to accord Accreditation not to the Institution as a whole, but at the Programme level.

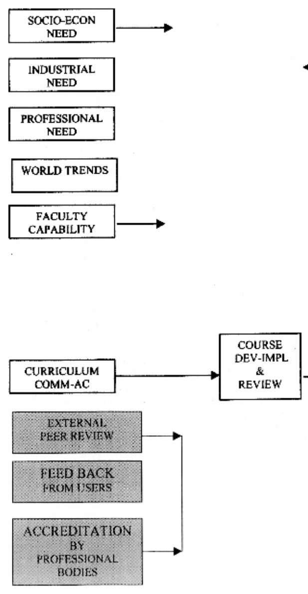
3.2 **QA Agencies and Mutual Recognition for International Quality Assurance**

Current trend is for mutual recognition (MR) by two or more QA agencies to affirm that their aims and procedures are comparable. The Washington Accord (WA), first signed by six countries (Australia, Canada, Ireland, New Zealand, UK and USA), is now recognized as an international mechanism to recognize engineering associations and their Accrediting systems as "substantially equivalent" and comparable. Such MR systems contribute to portability of learning and also establish a global threshold, which is understood by the engineering educators as well as employees in member countries. The Washington Accord (WA) countries (which now include Hong Kong, China, South Africa and Japan as provisional member) have established mutually agreed procedure for MR and approval of accreditation activities for engineering programmes in their respective countries. The members have a common understanding of the relevant parameters and the desired ends. The entry requirements for WA is quite rigorous and once accepted as a "provisional member", the concerned agency will be visited by at least two full signatory countries to establish "substantial equivalence" which is finally endorsed by other members later.

3.2.1**Engineers Mobility Forum (EMF)**

The Washington Accord countries decided to form the "Engineers Mobility Forum" (EMF) in 1996 for MR of experienced "Professional Engineers" and removal of artificial barriers to free movement and practice of engineering (as envisaged in the GATS agreement of WTO). There are now eleven full members (Australia, Canada, Hong Kong, Ireland, Japan, Korea, Malaysia, New Zealand, South Africa, UK and USA). The signatories aim to facilitate cross border practice by experienced engineers by establishing a framework for their recognition based on confidence in the integrity of national assessment systems (for Professional Engineers) secured through continuing visits, inspection and evaluation of those systems.

In Bangladesh the Bangladesh Professional Engineers Registration Board has been established by the Institution of Engineers in order to recognize "Professional Engineers" through an assessment mechanism that has been put in place with support from the Institution of Civil Engineers, UK. Bangladesh will soon make an attempt to become "Provisional" member of EMF.



3.3 **Current QA Mechanisms under Review for Better Criteria to Suit 21st Century**

The Accreditation systems and criteria established during the last century have been under continuous review in order to prepare for future challenges of an engineering graduate. Towards the end of the last century the accrediting process involved rating quality according to resources available. The relationships between resources and goal achievement were neglected. Quality assessments included the number of library books, faculty members with doctorates, and students per classroom. Achievements of alumni and student satisfaction did not form part of the appraisal. In the early years of accrediting only quantitative measures were the basis for determining the quality and hence accreditability of educational institutions. The thrust of many engineering schools (especially in developing countries) has been knowledge acquisition rather than the skill of knowledge acquisition. It is necessary, therefore, to evaluate whether the education provided prepares and enables the student to proceed to higher development in professional life.

Successor to quantitative measurement was "process measurement", viz.

! Careful selection of students

! Careful appointment and promotion of faculty

! Determination of courses, requirements and majors

! Participation of faculty and administrators in policy making

Not satisfied with even "process measurement", engineering educators of the industrialized countries now want to define and measure desirable "outcomes" of their graduates, who will be able to contribute meaningfully to the societal development in the 21st century.

!4 Quality Assurance and New Approaches to Develop Engineering Curricula

External peer review is now considered as an integral component in any curriculum design and assessment process. With the establishment of WTO, implementation of GATS agreement and increasing demands of the process of globalization the designing of an engineering curriculum need to include a built-in mechanism for external peer review as well as periodic accreditation visits for QA.

"Need Analysis" in this country attempts to assess the socio-economic and industrial needs during the initial period of designing a new curricular or degree course, not on a regular or periodic basis. After the initial work the stakeholder is not involved in any significant measure.

In conformity with the new paradigm outlined above, we now have to include, *interalia*,

! Regular external peer review

! Modalities for assessing feed back from the user sector

! Accreditation by Professional Bodies, both national and international

The paradigm is illustrated in the Fig.1

4.1 **Components of a Course and the Intellectual Challenge**

The university level course development processes have gained more from experience of concerned teachers and needs of the practical world than from theories based on accepted principles of teaching and learning. Outside demands, pressure form business and industry, individual preferences and inclinations of professors often result in new courses being added to the existing curricula. Nevertheless, identification of the essential components that a play significant role in course development, and other relevant factors may help in formulating strategies for giving our courses greater degree of continuity, sequence and integration.

Four clusters of essential components are observed in different university courses:

! Descriptive content or relevant information to be included in the course "INFORMATION"

! Analytical tools, concepts, generalized theories to be provided to the student "TOOLS"

! Supervised or structured laboratory or industrial experience to be provided "EXPERIENCE"

! Effort to be expended on research and self study by the student "RESEARCH"

Obviously, the stress to be given on each of the suggested components will vary from course to course. For instance, a course in "Process Industry" will probably have more of "INFORMATION" and "RESEARCH" (e.g. term papers), some "EXPERIENCE" (e.g. field trips) and less of "TOOLS". Whereas, a course in "Heat Transfer" may have more of "TOOLS" and "EXPERIENCE", some "RESEARCH" and "INFORMATION". Any given course is likely to have some features of each of the four components listed above.

The discussion so far has mostly dealt with the "quantitative" aspects of a university course. The "quality" of the contents of a course has to be judged with respect to a further set of criteria. Two major criteria that have been used are "RELEVANCY" and "SIGNIFICANCE". Relevancy refers to the closeness of the course content with the desired objectives it is intended to serve. (e.g. development of analytical skill for a student of engineering management).

Significance refers to the extent of applicability of the course content across narrow subject boundaries. (e.g. field theory may be applied to electromagnetic, fluid flow, aerodynamics, heat transfer and acoustics)

There is also a general belief that undergraduate courses, curricula or disciplines can be classed into "easy" and "difficult". Thus, students of "average" intellectual attainments are found to crowd the corridors of "easy" departments. If we analyse the essential components of a university course we should be able to "measure" the intellectual challenge it offers to a student with respect to:

! the extent of "INFORMATION" it provides to the student

! the number of analytical "TOOLS" a student is trained to use in his work

! the quantum of field/laboratory/real life experience a student can gain from it

! the fraction of study time a student devotes to self study or research in the course

The figure attempts to graphically illustrate the above concept. The essential requirement is that the "area" within each quadrangle drawn for each course should be same to ensure equal intellectual challenge to students. Weightage of each component may vary but the area is a measure of the "challenge".

If by some analytical means it becomes possible to arrive at the "sum total" of all the components for each course, one may find that the total "area" represents the level of intellectual challenge offered to a student by each course. Thus, the "sum total" of the components ought to be nearly same under ideal conditions for all courses, be it Process Industry or Heat Transfer. In other words, the intellectual challenge for the undergraduate in engineering ought to be almost same for every course, not "easy" or "difficult" courses.

4.2 **Outcomes Assessment-Based Improvement of Engineering Education**

ABET's new Engineering Criteria 2000 (EC-2000) is currently undergoing implementation. The key new feature of EC-2000 is its emphasis on outcomes assessments-based improvement of engineering programmes. Similar criteria are also being considered for implementation by the EC-JBM (UK), JABEE and similar organizations in Canada and Australia. It is imperative for developing countries to keep abreast of these new developments.

4.2.1 **Salient Features of EC-2000**

A major change from older criteria is criteria 3 of EC-2000, which requires academic programmes to define and measure desirable outcomes of their graduates.

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