Meeting Challenges of Engineering Education in 21st Century: A case study of Nepal

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Abstract

In the moment the country is entering into the new era of democratic republic and feudal autocratic kingdom was abolished by the people's movement, many horizons of new opportunities are emerging. Waves of joys, courage and enthusiasm are being created. People are sketching their fate of pride and sovereignty. Government in this juncture is planning to sketch prosperous, federal and new democratic republic Nepal, where there will be the end of all discriminations. The thrust of the policy and program of the government is found to be to decide, in the forefront, the process of socio-economic transformation of the country. In the similar way as other countries seeking better quality of life through economic growth, Nepal desperately needs to build internal strength by construction of massive infrastructures. The other infrastructures for local production, distribution and delivery are yet other part to give the attention. As a matter of facts, rapid advancement of technology and emergence of knowledge based economy have called for the quality and competency in the delivery of the services in every sector. The quality of professional sectors fundamentally depends on the competency of entry level professionals. For a developing country like Nepal, there is a need of equipping economically active population with knowledge and skill thus developing human capital. Engineering education that produces professionals is only the means for this. The essence of engineering education has amplified with time. The question is now the quantity and quality of engineering human resources produced in Nepal. The engineering education in Nepal must be capable enough to meet the confronting global and domestic challenges so as to give impetus in the national development process of Nepal. These are the predominants of this article.

Keywords: economic growth, challenges, quality, competency, effectiveness, etc.

Departure point

In the moment the country is entering into the new era of democratic republic and feudal autocratic kingdom was abolished by the people's movement, many horizons of new opportunities are emerging. Waves of joys, courage and enthusiasm are being created. People's are sketching their fate of pride and sovereignty. Government in this juncture is planning to sketch prosperous, federal and new democratic republic Nepal, where there will be the end of all discriminations. The thrust of the policy and program of the government is to decide, in the forefront, the process of socio-economic transformation of the country. The policy paper envisages that the government is determined for high economic growth for the elimination of poverty and unemployment thus establishing social justice. It has also emphasized on the massive development of the infrastructures through public private partnership. Policy paper is also found concern on the development of the skilled human resources by increasing investment in the technical education. Country is leaping forward with the idea of forming new Nepal, prosper Nepal. This has been reflected in the policy paper of the Government of Nepal.

Following the policy and program of the government, national planning commission (NPC) has set new targets for various economic indicators. As indicated in the interim plan of Nepal, the

quantitative targets for various economic indicators are: (1) Economic growth rate has to be increased from 2.5 to 5% per annum. (2) Agriculture growth rate has to increase from 0.7% to 3.6% and non agricultural growth rate from 3.6 to 6.5%. (3) people below poverty line has to be reduced from 31% to 24% (4) Employment has to grow from 3% to 3.5%. (5) Maternal mortality rate has to be reduced from 281 to 250 per one lakh live birth. (6) Infant mortality rate has to be reduced from 34 to 30 per thousand live births. (7) Literacy has to increase from 52% to 60%. (8) Telephone density has to increase 6.5% to 25% of the population. (9) Hectares under irrigation have to be increased from 1.16 million to 1.26 million hectares.

It is considered that the engineering education can definitely play an important role in providing knowledge components in every field towards the development and societal transformation envisaged by the vision document of National Planning Commission. With that perspective, this paper on challenges of engineering education for societal transformation process has been prepared and presented for discussion.

Social Transformation; a Continuous Process

Civilization is ever changing; from hunting age to todays age of modern technology. The change is indeed in the physical condition eventually in the living condition. Over the time, attitudes and values are changing. In most time, the change is taking place in completely new context (or paradigm) based upon different assumptions and beliefs. Social transformation in this context brings shift in collective consciousness of a society - local, state, national or global - so that reality is refined by consensus.

Social transformation is in other hand the development phenomena. The construction and reconstruction of infrastructures, which are necessary to make life safe and comfortable, are the important factors for development. The construction and reconstruction are the instruments for development and this will be achieved through the leading and enabling role of state, a thriving private sector, and the active involvement by all sectors of civil society, which in combination will lead to sustainable economic growth and development. The science and technology contributes substantially in this process of transformation. As the society is more and more dependent on the technology, a public awareness campaign is getting necessity for rising public awareness on the importance of science and technology. Eventually, the importance of higher engineering education system to meet the developmental and growth needs of the country is the today's concern.

Nepal as such underwent through political transformation- from monarchy to federal republic state. The task of societal and economical transformation, which is the essence to achieve the quality of life, is yet to happen. Transformation is needed in the feudalistic culture prevailing in the country and open the horizon of understanding and mutual respect. Unless the culture, norms and the behaviors of the people, deep rooted to the feudal system, are changed the social justice, harmony and economic growth can not be achieved. This is the area that every sector should address and act.

Economic Prosperity and Social Justice: All Time Agendas

Right from the inception of the civilization, human being gave every effort to bring ease and comfort in the general. In the course of time, there happened painful world wars and even today civil wars are happening in different corners of the world. In the other side, technological development is taking momentum in exponential rate. The world is entering into nano-technology and technology has opened the avenues of possibility of generating electricity from the earth's magnetic field.

The global agenda by now is economy. The recent economic recession in united state has compelled to rethink on the total strategy of the government. President elect Mr. Barak Obama has already announced to focus on the domestic economic issues. The European Union is attempting to grow into an economic unit. Neighboring China is fast growing as an economic giant. At present China produces almost 50% of the world's cement and consumes it as well. Similarly China is having highest production of steel and largest heavy equipment production. India in the other hand is also moving ahead with high growth rate. The uni-polar world, after the fall of former Soviet Union, is in the course of time growing to multi-polar economic powers. Extraction of resources from other country is now under question. Human rights, fundamental rights are the concern now.

Economic prosperity is wealth creation of the country and quality of life of the people. Economic indicators as the parameters of wealth are important but they provide only the part of the picture, important is the prosperity of the people. Despite poor level of wealth, many countries have better social indicators, such as; life expectancy, infant mortality, literacy etc. This indicates, to the end, better quality of life in term of security and comfort. Economic prosperity is, therefore, building internal strength in one hand and delivery of goods and services to the other hand.

Economic prosperity is possible only by developing internal strengths of the country, keeping in mind three dynamic dimensions; the people, the overall economy and the strategic interests. In a moment, domestic economy is integrated with world economy and as a result of this, external forces are influencing into the society, developing the core competency areas have comparative advantage. A part of it is the service sector; i.e. production and delivery of the services. Looking to the recent advancement of the technology, mastering of technologies is the key task to which the country and the people have to give importance. This can be considered to be the very essence of development.

The service sector has been considered to be a major part of the economy in recent times. In the course of time production sectors are highly demanding skills and knowledge. Moreover, the information technology revolution has developed the condition that industrial sectors can be sustained through the service sectors alone. This is more pronounced for smaller countries like Nepal. Thus, the service sector if properly developed can be considered a sector in the service of the people.

The human resource development is important requirement for service sector. In a time, the technology has become the part of life style, there is a need of continuous skill upgrading. There is a need of massive investment in the human capital and development of managerial and technological skills to improve people's living standards. Engineering education, as a means of developing skill and knowledge, is the area of concern for all.

Challenges for Economic Growth

Economic growth is the development phenomena. It incorporates all the processes related with the development of the means of productions. As a matter of fact, efficient and effective harnessing of the means of productions results the economic growth of the country eventually following to the prosperity of the people. However, there are different factors responsible to impede the economic activities.

- Catastrophes,
- Human threats
- Infrastructures

- Other challenges

Catastrophes

We were very much worries sometime by the possible outburst of the Chho-rolpa. Very recent outburst of the afflux bund of koshi brought miseries this year in Nepal and India. The earthquake in different part of the world is becoming sorrow every year. Global increase in temperature causing high rate of snowmelt has resulted to the rise of sea level and this has been new threat to some countries. People have not forgotten the devastation of Tsunami few years back. Every year, there are the news of large numbers of villages and towns being washed away by flood. For us in Nepal, erosion and land slides, flooding and earthquake are major natural challenges.

Human threats

Its' not only the natural catastrophe impeding economic growth, but the man-made disasters as well. The wars and insurgencies are destroying important infrastructures in different parts of the world. The international terrorism has grounded the twin towers in USA few years back. Very recently, Mumbai witnessed cold blooded terrorists attack claiming about 200 people. Public infrastructures; railway station, Taj hotel, oberoi hotel etc. were destroyed. The ten years insurgency in Nepal was instrumental for the destruction of important infrastructures. These are all the elements hampering to economic activities.

Infrastructures

Infrastructures are the backbone for economic growth. The production of goods and services or their distributions are possible only with the establishment of related infrastructures. The cardinal infrastructures are means of transportation, energy, information technology & telecommunication system, water supply & sewerage system, urban development etc. Well established form of these infrastructures is the internal strength of the country. Further to this, local infrastructures; such as, local transportation, micro-hydro & alternate energy, housing & urban development, water supply & sewerage system etc. confirms the quality of life. unless massive development of infrastructures economic growth can not be throught.

Other challenges

Further to this, new challenges are emerging in the process. Globalization has been widespread and its effect is emerging in different form and shape in the global arena. This has eventually developed the global economy making countries dependent to each other. The idea of international partnership is taking momentum. Moreover, there has been high mobility of the workforce from one place to other. This has also caused the demographic shifts.

The natural resources as the means of production are declining with their usage. These resources are in the finite limit in one side. In the other side, importance of creative thinking is emerging as new resources. Every moment new ideas are emerging and the process of continuous innovation is taking place. The new competition has compelled everyone for continuous life long learning.

In the short span of time, new technology is emerging making production, distribution and delivery of goods and services more and more efficient and effective. as a result of this, the quality of life is changing. Technology advancement has resulted to information explosion. This has compelled to the infrastructure renewals as well. The question of environmental sustainability, as the every day concern, has become even more important agenda now. Technology has influence on all social institutions changing values norms and attitudes. Change in technology has tremendous impact in the society. The pace of transformation of society is

taking momentum and every sector of the society is fast changing. The technology is the instrument for this creative transformation.

Engineering Education and Present Challenges

Globalization is in effect since the period of colonization. It has been more pronounced in the 20th century due to the fast pace of development. This has globalized the economy, society, industry and education.

Globalization has made the economy much more fragile and almost all financial institutions are investing to the areas of better deal. Investments are canalizing to the areas with better return. Since 2000 money has been exceptionally tight for higher education around the world. As the world economy has faltered, colleges and universities have been forced to adopt strategies for increasing revenues and decreasing costs. Among those strategies are instituting or raising tuition, changing research funding, finding efficiencies in traditional operations, and developing new, for-profit business ventures. The current environment has also been hospitable to the growth and expansion of new educational organizations around the world, both for-profit and not-for-profit. Different articles in national and international journals capture the changing scene of higher education, where, in the face of decreased funding, universities are making more aggressive and complex business deals in hopes of shoring up resources. The famous university in question, Oxford in the UK, has been strapped for funds as are sister institutions in the US, Ghana , Vietnam , Venezuela and Australia . Discussions are underway in a country like Nepal on the resource management. Despite resistance by the students, attempts have been successfully made to raise the tuition fee from its modest rate. Different alternatives are in the wider discussion as the solution to the budget shortfall in the higher education. There are also the arguments on whether higher education is at all the responsibility of the state. Advances in communication and transportation technology, combined with free-market ideology, have given goods, services, and capital unprecedented mobility. Northern countries want to open world markets to their goods and take advantage of abundant, cheap labor in the South. This economic globalization is a challenge for service sector. This, in turn, resulted to high degree of student and professional mobility. Students and engineering faculty have proven to be particularly skillful at following the best the world has to offer, regardless of national borders. Professional mobility for engineers has everything to do with accreditation and licensure issues around the world. Efforts continue to create some consistent standards as a part of searching common global grounds for quality standards, fair employment practices, and useful application of human resources.

Entrepreneurship education programs for engineering students are under discussion after the globalization. It is already becoming familiar in the country like US and accordingly the academic content are periodically refined. Now the movement has spread internationally, with programs being initiated in most parts of the world. Teaching students to consider alternatives to traditional employment is also now seen as an important part of economic recovery programs in less affluent countries. Many of these programs rely heavily on the use of mentors, and include the skills of entrepreneurship – using entrepreneurial skills within a company – creating early bonds between the practice of engineering and the industries that employ engineers.

In many countries where the demand for higher education has outpaced the ability of public institutions to meet it, private higher education institutions are springing up and growing to meet market demands. In many cases these private higher education operations are meeting needs in market niches not well served by traditional public education – such as retraining needed by working professionals, or focused training in hot fields such as computer applications.

In the wake of general economic downturns in countries around the world, higher education has suffered significant losses in financial support. These cuts in external support have generally led to universities passing more of the costs of education on to their students, through tuition and fee increases. In countries where higher education has been essentially free to students or minimal, costs are being passed on to student for the first time. Increased tuition and fees in countries where such student charges have been in place for some time have led to student and faculty protests – and such protests have been even more pronounced in countries where costs are being passed on to students for the first time.

Outsourcing of job that is frequent recent times is under threat. Off-shoring of technical jobs, while still retaining its ability to provoke outrage, is now just as often seen as a permanent characteristic of the employment landscape in developed countries. With the expansion of the European Union in May 2004 to include ten lower-cost countries from the east, and Brussels promoting worker mobility, European engineers and technical people have more reason to be suspicious of threats to their employment coming from within. A part of it, there is the indication that Nepal fears a threat to technical jobs that it might be losing its own competitive edge. Other external developments which are impacting engineering education include arguments about the volatility in computer science employment, continued stagnation in math skills, the promises of nanotechnology etc.

The complexity and interconnectedness of the challenges facing engineering education are nowhere better seen than by looking at instructional and communications technologies. Certainly technology has been viewed, as outlined above, as an opportunity for earning money for institutions and individuals, thus relieving some budget problems. Technology also offers cost-cutting solutions by creating operational efficiencies. Communications and instructional technologies are a means of increasing access to higher education, and thus are related to the social imperatives facing higher education. It is a way of increasing student and professional mobility, through virtual visits, courses, recruiting and communication. Technology has been offered as a means of increasing the effectiveness of both teaching and learning. In fact, technology has been such a driving issue in engineering education that it has merited its own category

More studies have been issued demonstrating the serious issues of equity and access in engineering in almost all countries, and there are no promising solutions being publicly discussed that would lead to a more rapid solution to this problem. In places where women have access to higher education, but face severe restrictions in employment, barriers to diversification in engineering are formidable. Around the world, racial, religious and ethnic conflicts continue to arise, disrupting education, diverting resources, and impeding the course of development. Universities are frequently drawn into the center of these conflicts, especially when they are considered a legitimate stage for future national political activists.

The social side of engineering has been more prominent in recent years. Engineers are being portrayed, appropriately, as more responsive to basic human needs such as poverty reduction and hunger. They are seen as more responsive to environmental concerns, and sustainable development is a popular phrase in describing how current engineers approach the development of new projects to serve mankind. In addition, engineers in developed countries are assisting those in developing countries to build their indigenous technical capabilities in order to attract direct foreign investment, utilize foreign aid funds more effectively, and develop entrepreneurial small businesses – all with the aim of promoting economic development and eventual self-sufficiency for developing countries. Engineers are also heavily involved in converting the results of basic research and development into useful products and services to address the needs of society. Such international organizations, as UNESCO and the World Federation of

Engineering Organizations, are pursuing technical capacity building in developing countries as a major approach to addressing their needs.

As globalization sweeps around the world, stimulating the flow of engineers and their services across national borders, accreditation and other forms of quality assurance have grown in importance. Some form of credentialing is often demanded before an engineer and is allowed to move from one job market to another, or to offer services in another country from a home base. Formal accreditation is often the preferred form of quality assurance in such cases, and accreditation systems for engineering education are being established or strengthened in many parts of the world. Such high level pronouncements as the Bologna Declaration in Europe, and similar declarations have led to the rapid development of quality assurance mechanism within countries or regions. The process of accreditation is in action since 1998 in Nepal after the formation of Nepal Engineering Council. There is also a strong movement toward mutual recognition agreements between such countries once local accreditation systems are in place – leading, for example, to the expansion of such cross-border educational equivalence pacts, such as; Washington accord, engineers' mobility forum etc.

It is obvious that the agenda of human resource development is in the forefront for every country. The developed nations are working seriously in the formulation of comprehensive engineering education plan. As a matter of fact, engineering education is the basis of manpower development of the country. The paradigm shift in the policy of economic growth and the high thrust in knowledge based economy have compelled almost all countries to focus on technical education. Knowledge based industries are the center of attention at present. Over the last decade, many scholars voiced their concern about the future of engineering education being affected by sweeping changes in the global economy. Taking an example of economic recession in USA affecting worldwide and a part of the effect appearing in Nepal as well, the world economy is becoming more and more fragile and dependent.

These changes require an adjustment in the educational policies of institutions that provide knowledge and learning to new engineering candidates. There is a dire need to develop a framework for the re-design of engineering education in order to fulfill the expectations of employers in the near future. This framework should address the way in which data is acquired and classified, the curriculum is integrated and inverted, information is visualized and presented, research and development conducted, as well as the collaboration of all parties encouraged. The educational contents and techniques that are required to satisfy the needs of society at large must be decided around a table with the parties involved in the learning process.

Conclusion

Quality assurance in engineering is an issue of vital importance to an increasingly developed world. The complexity of the problems, which engineers will have to deal with, argues for large doses of flexibility in the manner in which engineers are educated. The results should be generations of young engineers suited to the entire range of opportunities and problems of the real world. The tools used to assure that the educational experience results in quality will have to be responsive to new conditions and forms of education. This includes quality and competence of teachers, entrepreneurship orientation and use of multimedia and mass media technologies in teaching.

It was a time in the past that education was limited to the local demands and was a means to procure local manpower. This has changed now. An Engineer from Nepal is in a position to work in united state or a tiny country in Africa or Latin America. The important point is that the knowledge and skill achieved in the college must be able to cope the confronting problems in respective areas. For this, it is important to understand the ground reality of the people and

geography of the area. Therefore, comprehensive research is required into the nature, design, development, implementation and effectiveness of a global engineering curriculum eventually developing global model of engineering education. This is of tremendous importance in an era of rapid development, where sustainability, sustainable development and environmental engineering are the key issues to be tackled by modern engineering education, as they will determine the foundation of the knowledge, skills and attitudes essential for the formation of a global engineer for the 21st Century.

Over the last decade, many authors have voiced their concern about the future of engineering education being affected by sweeping changes in the global economy. These changes require an adjustment in the educational policies of institutions that provide knowledge and learning to new engineering candidates. There is a dire need to develop a framework for the re-design of engineering education in order to fulfill the expectations of employers in the near future. This framework should address the way in which data is acquired and classified, the curriculum is integrated and inverted, information is visualized and presented, research and development conducted, as well as the collaboration of all parties encouraged. The educational contents and techniques that are required to satisfy the needs of society at large must be decided around a table with the parties involved in the learning process.

A fundamental prerequisite to optimize the usability of engineering education is a good dialogue between industry and university to improve the university knowledge on what is needed outside the university on one hand and to improve the knowledge of the opportunities present within the professional capacity of the university on other hand. The dialogue must be able to cope with a dynamic industrial and technological change, which is often very difficult for rigid university planning. The implementation of Problem-Based Learning (PBL), with a high degree of focus on the integration of real-life engineering problems in the study program, has proved to be a good way of initiating & maintaining this communication. The potential of private sector may be addressed with PBL process. The cultural conflicts may also be identified and solution of which may be drawn with this process.

The engineering education is virtually ineffective if the social part is removed from this. Therefore, it requires the introduction of interdisciplinary programs. This will provide opportunity for additional skills such as, non-professional skills, science skills, specialized engineering skills, individual personal skills etc. this has to be incorporated in the curriculum. This will ensure the proper development of the engineering manpower for the 21st century. Along with the core courses, the subjects like sociology, economics and management should be incorporated in the curriculum.

Engineering has changed all aspects of our lives, including business, industry, communication and entertainment. Yet despite all the innovations and research showing the beneficial effects of engineering on learning when it is well integrated into the educational process, today's academics are generally reluctant to incorporate digital engineering in their teaching. The roots of this reluctance lie in the low knowledge of educational theories and in the lack of instructional design skills. The voluntary bottom-up faculty initiatives cannot change the prevailing culture of our educational institutions. An institutional top-down approach is the only effective enabler of systemic change that will allow the universities, and particularly their engineering departments, to meet challenges of the future.

We have a saying that 21st century is the age of collective works or organizations. Therefore, the interactions and cooperation between individuals and groups concerned with engineering education plays an important role. There must be the comprehensive policies regarding stakeholders. These policies and their implementation have to be streamlined with the national policy.