

# SEAMLESS ENGINEERING: A FUTURISTIC PERSPECTIVE

Combating Employability and Unemployment Challenges in Engineering Profession by Harnessing Seamless Engineering Curriculum



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"There is no school equal to a decent home and no teacher, is equal to honest virtuous parents. It is gross superstition to suppose, that knowledge can be obtained, only by going to schools and colleges. The world produced brilliant students before schools and colleges came into being. There is nothing so ennobling or lasting, as self study. Schools and colleges, make most of us mere receptacles for holding the superfluities of knowledge, where wheat is left out and mere husk is taken in." **-MAHATMA GANDHI**

Engineering education, through ages has evolved, based on the prevalent socio-economic-cultural conditions. As a system, engineering education was viewed as a course of learning to benefit oneself, the society around and the nation at large. It was also, in this manner, to consolidate the inherited wealth of knowledge and generate further knowledge, that will benefit the mankind.

The basic purpose of engineering education, besides being the storehouse of knowledge, is to cultivate people towards building a better society, establishing an enriched social system through the learned knowledge.

Till about the 18th Century, engineering education was directly or indirectly dependent, more on the religious establishments than on pure scientific pursuit. However, when commercialization of knowledge began, sometime around the 1960s, discoveries grew rapidly, influencing both, the established religious systems and the socio- techno-economic system.

Rapid growth of engineering education resulted in classification of knowledge and specializations. Commercial exploitation of engineering education grew, and as an inevitable result, the link with the religious establishments gradually severed.

Education in engineering became a competitive tool, by which, individuals

could be accepted or rejected, based on the evaluation of their performance. Such an uncontrolled growth of education, threw to the winds, the original intended purpose of 'Creating a Complete Engineer' and resulted in 'Creating a Competitive Society', where engineering education became a tool of 'Earning' rather than 'Learning'.

The paradigm shift, in engineering education is not unexpected altogether. Scientific and technological advancements created schisms in the socio-cultural patterns of every society, upsetting and uprooting many inherited traditional values and economic systems. Transport and digital communication grew, shrinking the world to a global village.

Environment deteriorated, the horrors of modern warfare, worldwide environmental spoliation interference with life supporting ecological systems, progressive resource depletion, wide spread poverty hunger, prevalence of hazardous

substances, stress related deceases, the detrimental climate change all are interconnected components of what we might call, the one world macro problem. They are the consequences of a mind-set and the behaviours and institution associated with it, which brought great benefits in the past, but now, creates problems faster than it solves them.

Today, education has become synonymous with earning qualifications. This perception is not correct and has resulted in people placing a premium on rote-education. Engineering education, is a process of enriching oneself and realizing one's potentials.

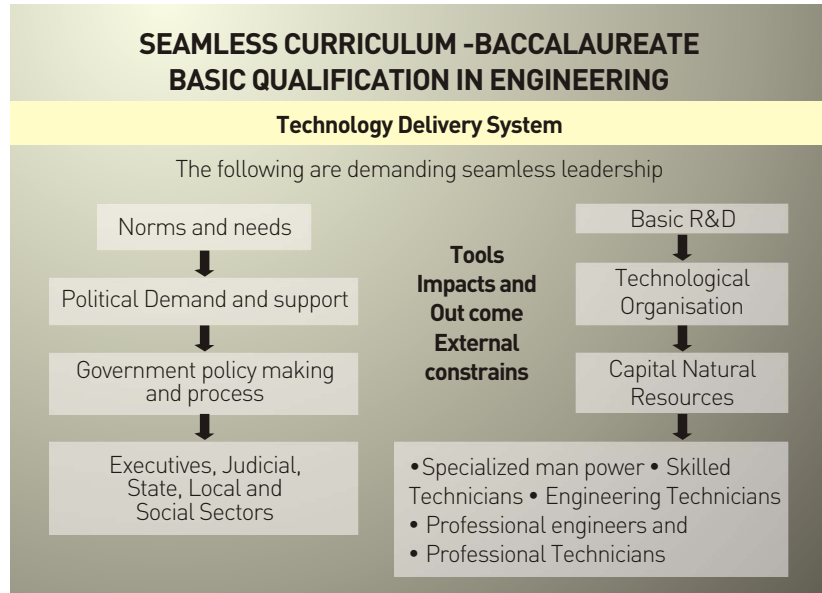
However, the present system has been perpetuating unfair competition among engineering students, through a system of elimination process. All education, whether vocational or professional, must be available to all. It would be gross failure, if the system does not permit interested student to follow a certain course of education, merely because, s/he was not up to an arbitrary standard or was not able to afford an expensive program of study. 'Any Education for Anyone' is not an impractical concept. We must encourage seamless non-conformal education in engineering and technology, to combat the employable syndrome. Anyone can do any course.

**Contextual requirements may amplify how generic standards are applied in context but must not alter the standards**

Engineering education must benefit the society ultimately and must not hamper progress on an account of the examination system. Education, is not the examination system. It has a broader concept. It projects information into the future, applies and experience the knowledge, creates and elaborate concept nest and create specific solution for each problem.

The evolving IT - Information Technology is a seamless engineering discipline. It has brought many changes and universalized education. While, the 'medium may not be a message', it is changing the traditional concepts of classroom technology. Indeed, cellular technology has made it possible for us to communicate over wireless media. Web communication facilities have worked wonders in speeding long distance communication. And with laptops, What's App, Facebook networking and servers has revolutionized, for sending and receiving documents, over satellite mobiles making the digital environment a reality in this modern era.

If we look at how the IT is actually being used in the service of all domains including education, it is not surprising, to find that it turns out to play a traditional role. It is, either viewed as a matter of isolated subject mastery or as a means of augmenting and enhancing the material to be learned. The institutes and parents often consider IT, a waste of time, money and human potential seems to be not healthy, when the student attempts their skills, in playing online games. Like, any acquired knowledge is not exercised, it atrophies. People need freedom and flex-



ibility of study, rather than a fixed system. De-franchising seamless engineering education, is the need of the hour and more relevant in the developing countries.

Now, if we explore the basics of engineering education, how they are being satiated by the present system, what are the reasons for maladies, impact of IT, how IT may be used to solve some of the problems, like what if the teacher had the ability to design seamless course for each individual student in the classroom, based on the industry needs? However, it is a pure fantasy for a 'paperink' teacher and to respond to the changing needs. Skills of students, at professional level, have to be understood for better seamless technical education system.

Learning, is a process of extending the capability of meaning, fully related to what is being experienced. As such, it is a never-ending process, represented by the continuum of living and learning, that develops the individual human potential, from the beginning to the end. The best learning takes place, when a learner is immersed in an environment, which s/he wants to learn. The learning relationship must be organized and made available, according to relationship with meaning-need of the learner, rather than, the structured conveniences of the subject material or mediating technology.

The purpose of education, can only be a vague proposition in the changing context. However, beyond fostering the skills

### RE-ENGINEERING OF TECHNICAL INSTITUTIONS TOWARDS SEAMLESS CURRICULUM

The institute can not produce experts in any domain. The main objectives of institutes are to educate

"How to learn the method of understanding the current world models with the help of the past and must extend to the future."

With the help of Scientists technologist and Humanitarian

### Seamless Curriculum Must Address The Following:

- To understand the contemporary world model with the help of past and future.
- Basic Sciences
- Engineering Sciences
- Engineering Arts
- Technology forecasting
- Technology forecasting
- Technology assessment
- Humanities
- Research Methodology
- Experimental Methods
- System Engineering Concepts
- Impact Assessments
- Environmental Models
- Economy Models
- Legal and Judicial Models
- Technological Interactions (Clouding)
- Political Models
- Importance of Inter Disciplinary and Interactions
- Value System
- Communications.
- Traditional, Conventional and Digital

of learning 'how to learn', it must generate the attributes necessary for personal development. It should engage in activities, that will boost the self-esteem and self-control. Education, makes a person to understand the inter-relations between him and the environment of the technological society. We must see knowledge and skills as the means, through which, we exercise and extend the range of our capacities for learning.

The modern system of classroom teaching, is the best way to ensure the transfer of information from the notes of teacher to the notes of students, without touching the minds of the students. This kind of practice, clearly indicates the inadequacy of our present educational system, for cultivating the human potential. We have to learn to think in a new way, as our fixed-time old syllabus and classroom technology, has not reaped the objectives of the engineering education.

Time has come to revamp the cognitive map of engineering education, so that, it will be compatible with future stage of techno-social evolution. Learning environment comes under many headings. Institute or university environment is the traditional one in all levels, both in technical and non-technical education system, at present. However, future ways of learning are changing into 'virtual learning environment' and 'stay-at-home interactive hypermedia'. It engages the person to learn seamless engineering as a disci-

pline, at any age and any time with attention, imagination, innovation and sensation of being relatively in the context of industry needs, as possible. While, the students involve in developing seamless skills as per the subject matters in ideal environment, will bring the 'real reality'.

Whether you like it or not, the change will penetrate our bedrooms, as the change is permanent. In order to confront the market's demand, from time-to-time, engineers need multiple skills and quick learning and re-learning abilities. All this is happening, because economies are changing dramatically due to technology and job demands, are changing faster than ever before.

Unless, there is a greater measure of flexibility and autonomy in the learning process, the learner-centered learning will be futile. There are many good practices that exists in learning, as advocated by Washington Accord, based on the experiment of ABET Accreditation Board of Engineering and Technology.

Unfortunately, the concept was misunderstood by our institutes and following unwanted attributes, like narrowness subject specific learning tends to be narrow and of restricted utility resulting in aimless, ineffective, inefficient learning. And shallowness with trivial and unacceptable outcomes, in any situation, lack inspiration in the absence of harnessing motivation. An impersonal approach is impossible, without genuinely individual-

ized treatment of learners.

World views are dramatically changing very fast. There are several ideas, which will radically alter the world in the next few years. They are becoming widely accepted, as the basis for the jobs in the cybernetic world. We know, the time is running out and there are cultural lags. The poorly educated engineers are sometimes among the world's largest polluters, what is known as the 'structural discontinuities'. We are already experiencing inflation because of lack of returns on our investment in the name of infrastructures. The future seems to be increasingly complicated, and employees will need to manage, communicate and anticipate this continual sense of change very well.

Employees in the future, will need a strong sense of inquiry and collaboration. As technology plays an increasingly important part of our lives, we have to know how to use this, to stay connected with people and not just data to be successful. What course topics must we add to our curriculum to stay afresh? What courses would the business units/employees need to stay competitive beyond the basics?

Institutes and university education has to move towards more flexible seamless education to satiate the needs of the job market. This means, curricula should be constantly under review as IITs/IIMs. Institute and industry's participation through professional bodies should play an important role in their creation. If a new technology is forecasted in the future, a course should be immediately offered by institutes and universities. When some technology disappears, courses relating to them should be scrapped.

Control and authority (previously, the traditional managerial mindsets) are giving way to a new form of trust. Today, trust is not always built on a face-to-face basis. Possibilities for remote working, virtual and remote communication are blurring the geographical boundaries to give rise to a new form of trust building. This involves integrity, responsibility and respect. Some of the emerging issues that need to be addressed are: values, ethical issues, web security, privacy, cybercrime, addictions, distractions, remote work assessment, e-learning pedagogies, etc.

Understanding these emerging trends, enables policy makers to design

### Masters Program - Specializations

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| <ol style="list-style-type: none"> <li>1. Architecture/Human settlement (Texture, Forms, Aesthetic, Creativity Development)</li> <li>2. Architectural Engineering (Building Systems, Structural Design of Buildings, Plumbing, Heat Ventilations, Plumbing etc.)</li> <li>3. Infrastructural Engineering (Concrete Technology, Design of Roads, Airports, Drainage Systems, Power Generations etc.)</li> <li>4. Infrastructure Maintenance (Retrofitting, Corrosion Sciences, Restoring, Rehabilitation)</li> </ol> | <ol style="list-style-type: none"> <li>5. Structural Engineering (Buildings, Bridges, EQ Engineering, Steel Structures etc.)</li> <li>6. Water Engineering and Environment (Irrigation, Hydrology, Soil Water Interaction etc.)</li> <li>7. Geotechnics and Environment (Investigations, Soil water Contamination, Solid waste disposal etc.)</li> <li>8. Ocean Engineering (Offshore Structures, Tide wave energy, etc.)</li> <li>9. You can Discover or Invent New Domains Based on NEED</li> </ol> |
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With Major Projects related to industry specific, Societal Specific, Technological Specific or inventions etc. (Institute Industry Interactions)

strategies and formulate policies, that will successfully address the changing context, which is brought by the latest innovation, technological changes and the subsequent 'evolution' of mindsets.

The skills required today are no longer those, that most of the people were taught at schools or universities. Education should be regarded, as a lifelong undertaking and employees should provide opportunities for continuous professional development and frequent re-training. This should be geared to provide individuals with the skills, which organisations require and an entrepreneurial mindset, where opportunities are recognised and individuals are prepared to take risks.

Specific domain expertise degrees or 'functional degree courses' brand the engineering graduates as technicians, to trap them into low productivity compartments in routine humdrum job. But, most of the organizations' requirements are creative business and technology management skills.

**The Seamless Engineering Programs are based on four pillars:**

1. Creativity, including idea generation and critical thinking
2. Innovation Management
3. Entrepreneurship, including Intrapreneurship
4. Foresight or Future Studies

Underlying all the four pillars is: Research Methods.

**Four pillars of Seamless Engineering Programs:**

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- Innovation Management
- Entrepreneurship, including Intrapreneurship
- Foresight or Future Studies
- Underlying all the four pillars is: Research Methods.

**Research Methods**

To conduct qualitative and quantitative research (structure of report, data collection, data analysis, sources, interpretation of results), dealing with and critically summarizing masses of information and data from various sources, writing skills, communicating research procedures, data analysis, data interpretation and summarising results of research.

**BE Seamless Engineers (Four Years)**

<ol style="list-style-type: none"> <li>1. How to solve the complex, large-scale problems which must be overcome when dealing with the engineering and management of major engineering projects.</li> <li>2. This course must be integrated and comprehensive to address Basic Sciences, Engineering Sciences, Engineering Arts, Economics, Humanities and Language and Communication,</li> </ol>	<p style="text-align: center;">ALONG WITH Research Methodologies</p> <ol style="list-style-type: none"> <li>3. This course should cover extensive analysis of key subjects relating technology and management: planning, programming and budgeting; finance; organisations; private sector involvement; operations and maintenance; project management; and research needs.</li> </ol>
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**Industries need seamless graduates to put them in the following activities very immediately as Executives**

**Creativity, including idea generation and critical thinking skills**

Using tools and methods to generate novel ideas, consider creativity as a skill, be open-minded and consider a variety of possibilities and solutions, scan for possibilities broadly, switch from one mode of thinking to another, and recognizing opportunities for the application of creative and constructive thinking, adding value to current products, processes and services.

**Critical thinking**

Not to accept at face value, what the media presents to its public, recognizing sweeping statements, generalizations, unfounded assumptions, information provided without sufficient justification or evidence. However, asking pertinent questions, cultivating intellectual curiosity, objectivity, open-mindedness, intellectual skepticism, intellectual honesty, persistence, decisiveness and respect for other viewpoints.

**Innovation Management**

Recognize and apply strategies for innovation management within an organization, harness ideas generated from a variety of sources (employees, customers, suppliers, users, general public), recognize and act to overcome obstacles to innovation in organizations, design and apply creativity and innovation audits.

**Forecasting**

Scanning for trends, awareness

about long range strategic future planning, use and application of simple foresight tools, relevance of foresight for intelligence gathering, corporate strategy and policy making, managing a foresight activity, learning and dissemination in foresight.

The paradigm shifts, which is taking place in every human activity today, are bound to make inedible and irreversible impacts on the engineering educational environment. Sooner or later, this would result in an 'educational and information vacuum' in a growing cross section of society, which would pose serious threats, upsetting social balance in every form.

The right kind of education, is a new kind of security with seamless engineering curriculum to provide more space for employment opportunity. This has been proved in the domains of IT and nanotechnology etc. However, our institutes have yet to accept the fact, that the 'knowledge society' is a society of large organizations-government and business, that necessarily operate on the flow of seamless information systems. At present, none of the educational institutions try to equip students with the elementary skills, that would make them effective as members of organization. The 'Engineering Graduates' ought to be the new archetype of the post business society. It is possible to create borderless engineers with seamless engineering curriculum. It will combat the challenges of employability and employment issues in the near future.♦