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GRT **ANALYTICAL STUDY OF NON-ENGINEERING
GENERAL EDUCATION COMPONENT IN
ENGINEERING EDUCATION CURRICULUM WITH
REFERENCE TO MAHARASHTRA STATE IN INDIA.**

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Abstract:- The design of engineering curriculum is always have been critical in most of countries. Industry always demands skilled human resource i.e. engineers with employability skills which includes technical as well as non-technical skills. There are always much expectations and pressure from industry towards academics. During few decades the expectation from engineering graduates from industry have been changed drastically. It has been resulted into changed engineering education curriculum in most of countries. But in Human Resource Development point of view, the literature and current observations have been shown that India needs drastic improvements in the race of engineering education curriculum design. To gain advantage of changing dynamics, this paper compares the current status of the Non-Engineering General Education Component within Engineering Education curriculum offered by Universities in Maharashtra State (India) with Washington accord signatory countries.

Keywords: Engineering education curriculum, accreditation, employability skills gap.

INTRODUCTION

The Global Competitiveness Report assesses the ability of countries to provide high levels of prosperity to their citizens. This in turn depends on how productively a country uses available resources. There are three main stages of country development. These stages contain 3 sub-indexes and these are grouped into 12 pillars of competitiveness as shown below,



Fig.1: Pillars of Global Competitiveness

Higher education institutions have been both the agent and objects of globalization. So the higher education and training is one of indicator of efficiency driven economy. Engineering education is the heart of the higher and technical education system in an India. The improvement in this sector is definitely going to fetch an added advantage to Indian economy in this competitive world for emerging as developed economy.

INTERNATIONAL ACCORDS

Accreditation ensures the quality of an education by focusing on the excellence in the preparation of graduates. There are six international agreements governing mutual recognition of engineering qualifications and professional competence. There are three agreements covering mutual recognition in respect of tertiary-level qualifications in engineering:

- ❖ **The Washington Accord** signed in 1989 was the first accord. Washington accord recognizes substantial equivalence in the accreditation of qualifications in professional engineering, normally of four years duration. It apply knowledge of basic science component including mathematics, engineering science, engineering fundamentals and an engineering specialization as specified to the solution of complex engineering problems.
- ❖ **The Sydney Accord** commenced in 2001 and recognizes substantial equivalence in the accreditation of qualifications in engineering technology, normally of three years duration. It apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to defined and applied engineering procedures, processes, systems or methodologies.
- ❖ **The Dublin Accord** is an agreement for substantial equivalence in the accreditation of tertiary qualifications in technician engineering, normally of two years duration. It commenced in 2002. It apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to wide practical procedures

and practices.

- ❖ The other three agreements cover recognition of equivalence at the practicing engineer level i.e. APEC Engineer agreement which commenced in 1999, The Engineers Mobility Forum agreement commenced in 2001 and The Engineering Technologist Mobility Forum agreement was signed by participating countries in 2003.
- ❖ This study considers compares the status of non-technical general education components (i.e. soft skills or management education) within engineering education between Washington accord signatory countries and Maharashtra state universities of India.

II.Literature Review:–

Literature have shown that there is need of conducting soft skill based trainings to engineering graduates. Both, Management and Technical education within engineering education in must for overcoming problems like global recession, economic imbalance in industry *1

- ❖ “Association of German Engineers (VDI)” suggests that up to 20% of the engineering curriculum should be in the non-technical field such as language training, self-management, personality development, communication skills, project management, economics and other related topics. To keep pace with changing global dynamics after recession there is need of management education in an engineering. *2
- ❖ Communication Skills Laboratory (GE1352–with fewer credits) a compulsory course for engineering and technology students studying at colleges affiliated to the Anna University, Tamil Nadu. It was introduced in November 2006 and is offered to all 3rd year students. *3
- ❖ And other related literature has been reviewed to carry out further study which has shown that Indian Engineers lags in Employability skills. So it adds additional cost to industry for training them which was highly impossible for industry.

III.Objectives of the study:–

- a.To find the status of the Non-Technical General Education Component in Engineering Education offered by Washington accord signatory countries.
- b.To find the status of the Non-Technical General Education Component in Engineering Education offered by Universities in Maharashtra State.
- c.To find non-engineering general education required for engineering graduates to become skilled graduates by analyzing curriculum gap (if any).
- d.To find weather there is need of the skill based engineering curriculum ?.

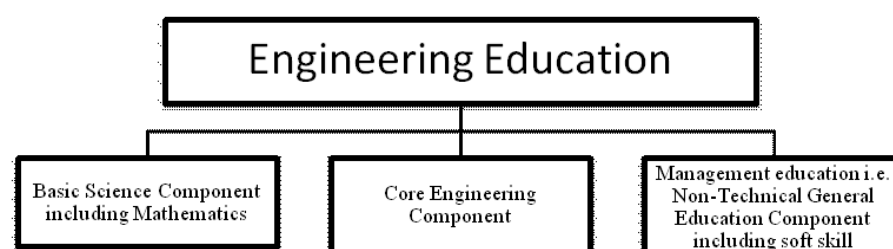
IV.Scope& Limitations of the study: - Only permanent member countries of Washington accord signatory countries are considered for data collection. Countries which are taken for calculation of non technical general education component in the engineering education curriculum are Australia, Canada, Hong Kong, India, Ireland, Japan, Malaysia, New Zealand, Russia, Singapore, South Africa, South Korea, Sri Lanka, Taiwan, Turkey, USA, UK etc. At the present India and Sri Lanka has become permanent member of Washington Accord in 2014.

For second part of the study, on sample basis the engineering education curriculum of state universities of Maharashtra state i.e. S.P. University of Pune, University of Mumbai, North Maharashtra University, Dr.B.A.M.U. University Aurangabad, Solapur University, Shivaji University Kolhapur, S.S.G.B. Amaravati University, S.R.T. Marathwada University, R.T.M. Nagpur University, and Gondwana University are considered for the study (indicated as U1 to U10 in comparison chart). The four year curriculum of major engineering branches like computer, civil, instrumentation, electronics, electrical, I.T., mechanical and chemical engineering are considered for calculating non technical general education component (shown in table 2)

V.Survey Methodology and Statistics:–

This study collects the curriculum related secondary data of countries which are either permanent signatories of Washington accord or who has strong accreditation mechanisms to ensure quality of engineering graduates.

By visiting accreditation board websites of the above countries it has been observed that at present most of accreditation bodies have been changed the engineering education curriculum drastically in the content. This studied curriculum is categorized into mainly three parts shown as below,



General structure of Engineering Education in Washington Accord signatories

First is Basic science part including mathematics. This component is basic building block for studying core engineering educational concepts. Second is Core Engineering education part which includes engineering sciences, professional engineering subject, open electives and projects and Third is the Non-Technical General Education Component which includes subjects from area of Soft Skills, Complementary Skills, Humanities studies, Social science etc. (Management Education Component). To satisfy the requirements of an industry from engineering graduates, some percentage of autonomy is offered to institution for meeting dynamic variables from industry. The proportion of non technical general education components observed is listed below,

No	Country	Nontechnical General Education Component including Soft Skills (%)
1	Australia	±10
2	Canada	11.53+
3	Hong Kong	20.00
4	Japan	13.8+
5	Russia	15.00
6	South Africa	10.00+
7	South Korea	±18.00
8	Taiwan	37.50 (As per industry requirement - Autonomy component included)
9	Turkey	±20.00
10	USA	37.50 (As per industry requirement - Autonomy component included)
11	India	11.95 (Including Mandatory Course)
12	Sri Lanka	16.67
13	Ireland, New Zealand, Malaysia, Singapore, UK	Data with above criteria in these countries could not be found on the website but in the guidelines it is strongly recommended that adequate depth of the knowledge must be given to the engineering graduates which must include Science, Core engineering and management/general education component in the balanced way

Table 1: Engineering Curricula Comparison in Washington accord signatory countries

In second part of the study, on sample basis secondary data is collected for curriculum survey of engineering education. Survey is conducted among the websites of state universities within Maharashtra State (India). The proportion of average non-technical general education component is calculated during all four year of engineering. The branch wise and university wise curriculum has been listed in the table 2 given below,

No.	BRANCH	U ₁	U ₂	U ₃	U ₄	U ₅	U ₆	U ₇	U ₈	U ₉	U ₁₀	Average
1	Computer	2.96	3.29	5.93	1.66	3.12	2.82	5.16	1.66	5.41	2.77	3.48
2	Civil	2.96	2.32	5.08	1.66	11.15	4.43	6.37	5.73	8.29	6.95	5.49
3	Instru.	4.23	5.26	4.23	3.75	–	–	5.26	–	–	4.67	4.57
4	Electronics	4.66	3.29	5.93	1.66	2.75	2.82	5.26	2.5	6.4	6.48	4.18
5	Electrical	3.81	2.9	2.9	1.66	3.17	1.61	0.97	4.09	5.99	2.97	3.01
6	I.T.	3.38	3.2	3.2	1.66	3.12	2.82	4.67	3.19	5.31	4.54	3.51
7	Mechanical	2.96	3.31	3.31	6.25	4.83	6.04	3.19	4.4	5.93	7.14	4.74
8	Chemical	4.66	3.25	3.25	1.69	–	–	4.4	–	3.34	–	3.43
	Average	3.7	3.35	4.23	2.5	4.69	3.42	4.41	3.6	5.81	5.07	4.05

Table 2:– Non technical general education component in Engineering Curriculum of Maharashtra State Universities

VI.Data Analysis

- ❖ From table 1 it has been observed that Engineering Curriculum is not uniform in among all countries. As per industry requirement and other environmental variables, the non-technical general education component enforced by accreditation board varies from 10 % to 20%. (In permanent member countries of Washington accord). Average of the non-technical general education component in these countries is $\pm 15.37\%$. AICTE i.e. Indian accreditation board suggests 11.95 % non-technical general education component to be given to engineering graduates which shall include soft skills, humanities, social science, management and other mandatory courses.
- ❖ From table 2 it has been observed that currently state universities in the Maharashtra state are offering 3 to 5 % non-technical general education component through engineering education curriculum. The average of this factor in major engineering disciplines of different universities is $\pm 4.05\%$.

Sr.	Average percentage of engineering education curriculum	Average percentage of engineering education curriculum of state universities	Industry Academics Gap in engineering education curriculum	Remarks
1	15.37 (Washington accord signatories)	4.05	11.32	Reason for “Engineers with poor employability skills”
2	11.95 (as per AICTE)	4.05	7.9	

Table 3 –Industry Academics Gap in engineering education curriculum.

- ❖ From table 3 it has been observed that, the 11.32 % deviation or industry-academics gap in engineering education curriculum is observed between average percentage of non-technical general education component in Washington accord signatory countries and state universities of Maharashtra state. 7.9 % deviation (industry-academics gap) in engineering education curriculum is observed between average percentage of non-technical general education component in engineering education curriculum proposed by AICTE and state universities of Maharashtra state.

VII.Conclusion

- ❖ Universally world has accepted 3 component model of engineering education curriculum as benchmark for outstanding performance of the engineers i.e. Basic science, core engineering and non-technical education components with provision of little autonomy in every component. In this study, the non-uniformity is seen in percentage of these components can be seen because of dynamic environmental factors and industry.
- ❖ The average non-technical general education component seen across the Washington accord signatory countries is near about 15.37 %.
- ❖ According to recent survey by NASSCOM only 25 percent of engineers in India are qualified to get offshore job

due to underdevelopment of soft or employability skills. We have employment but only few engineers are employable due to lack of the employability skills. The non-technical general education component is mainly responsible for the career, skills and personnel development of the individual.

❖ But from study it has been seen that the lesser percentage of this component is one of the main reason for Industry-Academic gap. The Industry-Academics Gap is main source of underdevelopment of soft or employability skills.

❖ An implementation of common engineering curriculum direction for non technical general education component in all universities will definitely help to bridge the industry-academics gap. AICTE has proposed 11.95 % (22 credits out of 184) curriculum based on non-technical general education component in academics. Thus, improvement in proportion of non-technical general education component in academics will develop the Skilled Human Resource i.e. More Skilled Engineers.

❖ As per other countries at least 15-20 % curriculum designed based on Non Technical General Education Component. There must be recruitments of management expertise to train engineers on Non-Technical General Education Component. This initiatives must be legally recognized by Accreditation Board, Government and Policy Makers.

Suggestion:

❖ To bridge industry – academics gap there is need of skill based curriculum in engineering education.

❖ Engineering curriculum is having management related subjects but suffering from poor assessment, less motivation factor, no legal provision to recruit subject expert faculty for non-technical general education component's subjects. These things are not adding any value to the employability skills. This is resulting into poor quality of higher technical education and widening the gap between industry and academics.

❖ So addition of Non-Technical General Education Component subject's or complete soft skill curriculum with **strong assessment structure** will definitely add an added advantage in improving quality of engineering education and to improve employability skill factor among engineers.

❖ Non-technical general education component subjects should be taught by Expert's from the specialization i.e. management faculties and not by Expert's from any other specialization or Visiting faculties.

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