CHAPTER 1

INTRODUCTION

1.1 GLOBAL SCENARIO

Engineering education throughout the world is facing major challenges, as the pace of technology change shows no signs of slowing down. Though the rate of increase in technological developments has provided an impetus change to engineering education, the social and political factors are increasingly becoming important. Since the society requires more quality Engineers, Engineering Education is to be more responsive to these changes. If engineering education is to be effective in contributing to the prosperity of people, it must increase its quality and range of service (Barbara 2006).

It would be wrong to suggest that any particular system of engineering is necessarily the best, since the needs and cultural differences are the real influencing factors which must be taken into account. Developing countries frequently model their educational systems based on the ones prevailing in developed countries. This may not always be appropriate, because of the rate of change in technology and application in developed countries makes engineering education immensely expensive, particularly where modern, up-to-date laboratory and computing facilities are required and the capital investment is substantial (Blumenthal 2003). Even in developed countries with a strong manufacturing base, it is difficult to provide the resources required, and there is an increasing emphasis on generating income from industry.
Engineering education in Europe and North America can be classified into two categories: one which provides scientific but theoretical knowledge through taught courses and leads to the award of conventional Bachelor or Master of Science degrees and the other emphasizing what is commonly described as more practical and application oriented Engineering (Duggan 1992). Engineering education in United States aims at promoting “the application of science and technology to the purposes of life” (Way kuo 2006). In Germany the Engineering education concentrates more on matters of teaching, research and academic self organization. Australia is focusing at maximizing cost-effective learning opportunities for engineers.

In South America, the nature of engineering education is determined by social, political and economical factors. The main characteristic of their system is strong knowledge about basic science and addresses the social concerns. The engineering education in African countries are suffering because of the traditional approach of teaching, almost no research status, de-motivated staff, and poorly equipped laboratories and low funding levels (Claudio da et al 2002).

World-wide all the engineering education systems consider teaching and research as an integral entity and inseparable activity. Although it is often said that teaching is the primary goal of engineering education, research plays a dominant role in the growth of an Institution. Engineering graduates are frequently considered as indices of industrial development and measures of the responsiveness of the educational system to industrial requirements (Elhami Ibrahim Richard Cockrum 1993).

Regardless of the country there is always an intricate relationship among engineering education, educational hierarchy, economy, development, history, social makeup, and irrational alliances. The globalizations of markets and information explosion in the last decade have been driving engineering
education systems worldwide closer to each other as never before. Thus, all these diversified systems need improvement in one or other factors (Lawrence 1980).

1.2 INDIAN SCENARIO

The origin of engineering education in India evolved from the British period, although educational systems have been in place for centuries. The idea of creating technical training centres came out of the necessity for training the overseers for the construction and maintenance of public buildings, roads, canals and ports. The first engineering college was established in Roorkee, Uttar Pradesh (Uttranchal) in 1847 for the training of Civil Engineers. Then, three more engineering colleges were opened by 1856 in Sibpur, Pune and Chennai. After 1880, the demand for Mechanical and Electrical Engineering was felt, but the above engineering colleges started only apprenticeship classes in these subjects. The Victoria Jubilee Technical Institute, which was started at Bombay in 1887, which produced licentiates in Electrical and Mechanical engineering (Raju et al 2000). The nineteenth century witnessed the birth of other branches of engineering and technology in addition to Civil, Mechanical and Electrical Engineering. The number of engineering colleges and polytechnics in 1947 was only 44 and 43 with an intake of 3200 and 3400 respectively. After independence, Government of India expanded the base for Engineering education extensively through the successive five-year plans and established number of engineering colleges. They are administered by Central or/and State Governments (Felder et al 2000).

The emphasis up to 1960 was towards irrigation, establishment of infrastructure like power lines, rail network and roads. The basic emphasis of technical institutions was to provide knowledge, training and creating technocrats to suit the generic requirement of the governmental projects. The expectation from technical institutions was limited to teaching, conducting examination and
bringing out the trained personnel with the hope that they would be able to play a useful role in creating and maintaining the technical infrastructure of the country. The responsibility of providing technical manpower was mainly with the government through the establishment of technical institutions (www.engc.org.uk).

The increased demand for consumer goods and establishment of communication infrastructure led to the industrial growth in the country from year 1960 to 1990 (ENDREC 1970). Participation by the government increased in the industrial sector by establishing public sector companies to meet the increased demands of the society. The need for qualified technical manpower drastically increased during this period and more emphasis was placed on skill-oriented input. More stress was given to provide knowledge and skills, especially in the emerging disciplines like Electronics and Instrumentation, to cover the technological changes that took place during that period. The link between human resource development and economic development of the country was felt more strongly; especially in the technical education scenario. There was a spurt of demand for technical manpower, which could not be provided by the government institutions. This was the beginning of private sector participation in the development of technical institutions for meeting the increased demand of technical manpower in the country.

The structure, style of functioning and manner of funding of education system in India were developed based on the recommendations of the various committees and commissions appointed for the education reforms in the country during these periods. Major findings and recommendations of those committees, with a special attention to engineering education, are described in the following section.
1.3 EDUCATIONAL REFORMS

India is a federal republic comprises of 28 states and seven union territories. Education is managed through a partnership between the central and state governments. The central government establishes broad education policies and is responsible for regulating and maintaining standards in higher education. Federal policies serve as guidelines to the state governments, which administer most schools and universities within their jurisdictions (Clark 2004).

Education policy is formulated by a number of bodies under the Central Advisory Board of Education (CABE). For engineering and other technical disciplines, it handles the central policymaking All India Council for Technical Education (AICTE) is a regulatory body which determines the requirements for new institutions, programs of study, curriculum standards and norms. It also accredits programs through the National Board of Accreditation (NBA) (TEII 1999).

Immediately after independence, the Ministry of Education appointed a commission on university education under the chairmanship of Dr. S. Radhakrishnan, to submit a Report on Indian University Education (RUEC 1983). According to the commission, institutional forms may vary as time and circumstances require, but there should be a committed loyalty to the abiding elements of respect for human personality, freedom of belief and expression for all citizens, a deep obligation to promote human well-being, faith in reason and humanity.

Another commission to advise the Government on the national pattern of education on the general principles and policies for the development of education at all stages and in all aspects was appointed in 1964. It proposed that
education should address the problems of national development, particularly issues concerning self-reliance, economic growth, employment and social and national integration. The Commission pointed out that the role of education is to improve productivity by emphasizing work-experience, vocationalisation and to develop scientific and technological education. Both Radhakrishnan and Kothari Commissions treated education, especially technical education for the well being of the society and the expenditure made on higher education as an investment of the nation for the future. But during 1980’s, engineering education was driven towards commercialization with the perception that there would be substantial increase in demand for engineers in the technology and knowledge driven society (Windham et al 2001). This led to the privatization, resulting in a considerable increase in the number of engineering colleges as well as the intake, particularly in the southern states like Karnataka, Andhra Pradesh, Tamil Nadu and Maharashtra.

A comprehensive review of the nation’s education policy was made in 1986. The policy statement, reaffirmed that “Education is a unique investment in the present and future; this cardinal principle is the key to the National Policy on Education” (NPE 1986). The NPE 1986 provided a comprehensive policy framework for the development of education and a Plan of Action (POA), assigning specific responsibilities for organizing, implementing and financing its proposals. The policy advocated that in the context of the unprecedented explosion of knowledge, higher education had to become dynamic and constantly enter in to uncharted areas. Further, it proposed that the large number of universities and colleges in the country needed all round improvement and the main emphasis in the future should be on their consolidation and expansion.

A report (2003) of the Board of Planning of Technical Education entitled “Re-engineering of Engineering Education” is set up by the All India Council for Technical Education (AICTE) under the chairmanship of
Dr. V.K. Aatre, provided a roadmap for engineering education in India. It has considered a large number of issues that affect and influence engineering profession. The role that the Indian engineers are expected to play in the new emerging world order. From an analysis of the existing scenario of education in general and engineering education in particular, many recommendations have been put forward under Curriculum development, Teaching and learning, Faculty development, Degree and Diploma programmes, Regional Imbalance and Industry Institute Interaction (Dacin 2002).

The action items identified to revitalize the engineering education system of India are the duration of undergraduate engineering course, Common entrance test, higher qualification to faculty, Flexible promotion scheme for faculty, faculty development, Flexible education system, Common minimum curriculum for science & mathematics education in the country, Higher rebate in tax to industries for funding research in institutions, Higher priority to accreditation of technical education and engineers recognized as registered engineers. It is hoped that the growth and development of engineering education of India will significantly be influenced by the findings and recommendations of these committees and commissions (Awale 1995).

The Indian technical education system has become a formidable reservoir of technical expertise in terms of the magnitude of human resource, expertise available and of physical facilities created over the last three decades. Owing to the pressures from a range of stakeholders for a wider and improved range of services from the higher education sector linked with a simultaneous increase in pressure on resource utilization. Many foreign universities are currently facing the challenges of reorienting their approaches to be more customer-focused. They are conducting their activities in a more business-like manner (Hides et al 2004). The adoption of a market-oriented approach in running
education is said to have the consequences of adoption of the fee-paying principle, popularity of revenue generation activities, market-driven courses and curricula in education (Mok 2000). These changes have made an impact on Indian engineering education system as well.

1.4 CURRENT SCENARIO

In India, Engineering education is developing rapidly due to growing demands for professional engineers and skilled technicians. Being the second largest population in the world, India is characterized as one of the rapidly expanding economies having a stable and democratic political system, (Patil 2000). It has been observed that India has made considerable progress regarding the development of engineering and technology education over the last 50 years.

The rapid progress in the information and communication technologies has led to the increased demand for technical manpower, which in turn has resulted in setting up of a large number of Technical institutions throughout India, offering a variety of programmes to meet this demand. Further, the demand on technical institutions to sustain on their own without support from the government has also increased. The new economic policy regards the expenditure on higher education as less of an investment and more of a subsidy to a relatively affluent section of the society. This has necessitated private sector participation and new specie of ‘businessmen as providers of technical education’ has emerged (Padmanabhan 1999). In response to the growing aspirations of the middle class in 80’s, to the opening up of the Indian economy in early 90’s and exposure to the processes of globalization and liberalization of the market place, private sector has started promoting engineering education on a much larger scale. Various categories of colleges, which provide undergraduate engineering education in India, can be classified as follows.
1.4.1 Indian Institute of Higher Learning - IITs and IISC

Internationally renowned engineering institutions, known as Indian Institutes of Technology (IITs), and Indian Institute of Science (IISc) were created during 1950s and 1960s with the vision of providing excellence in science and engineering education. The IITs & IISc have had an enviable reputation for providing the best undergraduate and postgraduate engineering education in India. At present, there are seven IITs in India located in New Delhi, Mumbai, Kanpur, Kharagpur, Chennai, Guwahati and Roorkee. Student enrolment in these institutes at undergraduate level is limited to 3000.

The IITs and a few other leading engineering institutions formulate their own curriculum with faculty committees and process/have formal consultation with other professional organizations. All other institutions are always trying towards meeting the standards of the IIT’s. Since this involves expertise in many fields, it cannot be achieved very easily. But one can always try to achieve a standard closer to that of the IIT’s. This thesis addresses a novel model to achieve excellence in engineering education so as to move closer to the standards of IITs and IISc.

1.4.2 National Institute of Technology (NIT)

Seventeen NITs (Former Regional Engineering Colleges (REC)) were established in various States as joint enterprises of Central and State Government. Out of seventeen, fifteen RECs have been upgraded to NITs and made deemed universities with direct and enhanced funding from Central Government in order to provide world-class infrastructure and faculty.

1.4.3 Affiliated Colleges in a University System

In addition to the above institutions, a large network of engineering colleges is being established and administered by state government and
universities. Some of them are more than a century old and have been pioneers in engineering education in the country. Government engineering colleges at Roorkee, Pune and Chennai were the earliest started during the British period. Every state of India has Government Engineering Colleges. Another category of colleges come under grant-in-aid sector. Education societies or private bodies manage these institutes. They take up the responsibility of providing capital assets like land, buildings and part of salary. Government provides salary and other working expenses to these colleges. These institutes are affiliated to one of the universities of the state. There are autonomous institutions too. Self Financing Engineering colleges have grown at a very fast pace during the last decade. These institutions are started with the approval of the AICTE and get affiliated to one of the universities of the state.

1.5 CHALLENGES TO INDIAN ENGINEERING EDUCATION SYSTEM

Along with many success stories there is a belief, and there are sufficient evidences that the standard of Science and Technology education in India is deteriorating at a rapid pace, while the intellectual level of the youngsters is rising. As the growth rate of engineering institutions has been phenomenal, many problems associated with such fast growths are present in the Indian engineering education system. Some of these problems are inadequate supply of well qualified and experienced faculty, too many colleges affiliated to a single university, location of many institutions far away from industry centers and lack of understanding between the State Government & Managements of Self-financing institutions on the fee structure and admission processes.

Noted Educationist Gopalan (1994) has identified that the prominent weaknesses of technical education are the imbalance in the distribution
of technical institutions in the country, uneven standards, absence of R&D activity, mismatch between production and demand for engineers, inadequate faculty, meager infrastructure facilities, poor quality of training, archaic curricula, unchecked brain drain, adhoc linkage between technical institutions and user agencies.

The Institution of Applied Manpower Research, India, made a study on the efficiency with which the engineering education system has worked so far. The figures of intake and out turn at the degree level reveal that the wastage at the degree level is of the order of about 30%. From a survey made by the Institute, the reaction of a few students who had undergone these courses, the possible reasons for wastage were stated to be:

- Lack of necessary aptitude for the course among students concerned.
- Inadequacy of infrastructure facilities.
- Ineffective teaching, possibly because of the teachers not being trained.
- A heavy curriculum.
- Non-selective admission of students to the institutions.
- Changing mix of urban and non-urban background of students without corresponding modifications / orientation of educational methods.
- Inadequate utilization of even the existing infrastructure facilities.
- Inadequate departmental operating & training costs.
- Insufficient development of the correct attitudes to the professional education by both the teachers and the students.
- External factor, such as lack of motivation because of inadequate or assured employment opportunities at the end of the course.
Report of a study conducted by the World Bank during the period 1998-2000 observes that “The technical institutions /universities have mostly not been able to maintain high standards of education or to keep pace with the developments in knowledge and technology. They are constrained by the explosion in enrollments, the limited financial support from the Government, and most importantly, by an overall structure built on myriad of controls and supply-driven thinking of the past. The programme offered is unduly rigid (with fixed duration and course structure). Curriculum implementation is also poor. Graduates from many middle and lower level institutions cannot find suitable employment due to the limited job opportunities in the areas for which they are trained and because of a growing mismatch between their knowledge and current practice. Industry often finds that engineering college graduates are weak in professional practice, thus necessitating on-the-job training for making them professionally useful. There is also mismatch between student demand & labour market needs and institutional output & training modalities. Emphasis has shifted from good learning and acquiring skills to passing the examination. This has also resulted in an over-emphasis on theory at the cost of practice. In brief, the importance of making educated technical manpower productive at the earliest after passing out is yet to be realized in many of the institutions”.

The results of a recent survey (Ghani 2002) indicated that the fresh engineers perform only at an average level in the area of ‘knowledge and technology’ and ‘technical skills’, just below the average in ‘behavioral skills’ and just satisfactory in ‘managerial skills’. They do better in IT, computer and software areas. Their skills in idea generation, imagination, inferring the results, interpreting the graphs and diagrams, analyzing the failure, applying the concepts to real life situations and evaluating the material or processes need to be improved. Their performances in maintenance of machines, design of products, solving problems, reasoning, presentation of ideas and communication are found to be below average.
In 2002, a five-member committee headed by U.R. Rao (2002) a prominent scientist and former chairperson of the Indian Space Research Organization, was empowered by the Ministry of Human Resources Development (MHRD) to review the state of professional Education in India. The committee’s report, ‘Revitalizing Technical Education’, submitted to the government in September 2003, described a technical sector that was expanding at an unsustainable level and emphasized on the drastic need of regulation so as to ensure academic standards. The report sparked deep controversy and gained global coverage after one of its minor and tangential recommendations on cutting fees of Indian Institutes of Management was acted upon by the central Government.

The Committee observed that “A serious situation has arisen in recent years because of the mushrooming of a large number of private technical institutions and polytechnics. Barring some exceptions, there is a scant regard for maintenance of standards.”

UR Rao Committee made a strong recommendation enlisting the following challenges facing technical education India:

- Too many institutions due to unregulated growth,
- Institutions are proliferating unevenly in geographical pockets,
- Not enough qualified faculty,
- Weak quality-assurance structures and especially accreditation procedures,
- Lack of co-operation and interaction between industry and Institutions, and
- High levels of unemployment and underemployment among engineering graduates.
Recognizing the high responsibility placed on engineers in the national development, Government of India has realized that improvements are to be made in engineering education sector. The way engineering education is conducted is important to the future of the country in the context of growing gap between the need for well-trained engineers and the ability of colleges to produce such engineers. Effectiveness of existing performance measures and benchmarks are to be analyzed and modifications or new methods, based on quality are to be introduced for the sustained improvement of Indian engineering education system. This thesis is an attempt in that direction.

1.6 INDIAN ENGINEERING EDUCATION

The factors influencing the quality in Indian engineering education are teaching process (Cropley 2003), University- Industry collaboration (Natarajan 2003), role of management (Gopalan 2003), student intelligence and interest (Mouly and Padmaja 2003), excellence of teachers (Shrivastava 2003), accreditation standards (Prem vrat 2003) and proper documentation of activities (Jagdeesh 2001). For some academicians, quality is synonymous with the continuous improvement (Bhat 2000). They advocate implementation of TQM in educational institutions (Tiwari 2000; Sahney et al 2002 and 2003; Gosavi 2001; Rao 1999) for quality improvement.

Joglekar et al (1999) have suggested methods to quantitatively assess the quality of education in technical institutions, which will enhance the accountability of performance indicators. Rao and Singh (2002) have presented a logical procedure to rank the technical institutions using AHP. Institutional performance index is proposed, which evaluates and ranks technical institutions for a given period of time. Suganithi et al (1998) propose a ‘Failure Mode and Effect Analysis’, which has been used extensively in industries, as a proactive
tool for education sector. It is claimed that this method could prevent many of the failures in the educational process and improve the standard of education. Reddy et al (2004) have illustrated the use of analytic hierarchy method for Performance evaluation of technical institutions. All these proposals are at conceptual level without any proven applicability.

There are many reported works that address the ‘Teachers in the development of technical education system’ (Awale 1995), ‘TQM in higher education’ (Sahney 2002), and ’TQM in engineering education’ (Bhushi 2002). Though they provide depth analysis of the respective problems, none of them address the details of performance measurement mechanisms of Indian engineering programmes and the related issues in the Indian engineering education. The three major issues, ‘whose requirements are to be identified’, ‘who specifies the requirements’ and ‘how are requirements specified’ are discussed in this regard. The literature review is extended to familiarize the various quality frameworks prevailing at various parts of the world. The research problem is formulated and the objectives of the research work are fixed.

1.7 QUALITY FRAME WORKS

The concept of quality has undergone significant changes in its definition, approaches, techniques, paradigms and scope of application. Accreditation is a process of quality assurance by which an engineering programme, undergraduate (UG) or postgraduate (PG) in an approved faculty of engineering, is critically appraised at intervals not exceeding five to six years to verify that the programme meets norms and standards prescribed by the accreditation body from time to time.

In the United States, Accreditation Board for Engineering and Technology (ABET 1997) is recognized as the sole agency responsible for
accreditation of educational programmes leading to degrees in engineering. ABET was established in 1932 and is now a federation of 30 professional and technical societies representing the fields of Applied Science, Computing, Engineering and Technology. ABET currently accredits around 2,700 programs at over 550 colleges and universities in USA. ABET also provides leadership internationally through agreements such as the Washington Accord, and offers educational credentials evaluation services to those educated abroad through Engineering Credentials Evaluation International (ECEI).

In United Kingdom, the Quality Assurance Agency for Higher Education (QAA) (http://www.qaa.ac.uk), established in 1997, provides an integrated quality assurance service. Each university and college of higher education is responsible for ensuring that the appropriate standards are being achieved and a good quality education is being offered. It is the responsibility of QAA to safeguard the public interest in respect to standards and higher education qualifications.

Engineering Council United Kingdom, (ECUK) (http://www.engc.org.uk) is concerned with setting and maintaining internationally recognized standards of professional competence, ethics for engineers, technologists and technicians, licensing competent institutions to promote and uphold the standards. Under its Royal Chapter, ECUK regulates the engineering profession in UK and formally represents the interest of UK engineers abroad. The engineering profession in the United Kingdom is regulated by ECUK through 36 engineering institutions (Licensed Members) who are licensed to put suitable qualified members on the ECUK’s Register of Engineers.

Japanese Accreditation Board for Engineering Education of Japan, (JABEE 2003) evaluates a program based on prescribed accreditation criteria.
In New Zealand, the accreditation board has a “Graduate Capability Profile” that defines the skills and attributes. It broadly defines competencies required for a graduate engineer. In addition to this, it evaluates other criteria like admission, program organization, content, curriculum, practical work requirements, program resources and program management before accrediting the engineering programmes. In Australia, Institution of Engineers Australia (IEAUST) is the accreditation agency for engineering programmes (Sitte 2004). Engineering Accreditation Council (EAC) of Malaysia (Chuah 2004) assesses the Engineering programmes in Malaysia.

Russian Accreditation System for Engineering Education (RAEE 2002) is also built around eight criteria such as Curricular Structure with Content, Student Body, Faculty, Professional Component, Facilities, Information Facilities, Financial Resources and Graduates. In Brazil, the evaluation of individual programmes involves two main dimensions viz: Pedagogic Faculty competence, and Infrastructure (Dzieazic and Tozzi 2003). Canada follows three criteria accreditation systems (CEAB 2002) for their engineering colleges where curriculum content, programme environment and general criteria are the components. Accreditation Board of Engineering Education of Korea, analyses the performance in terms of the following seven criteria namely Students, Curricular Objectives, contents, Achievement and Evaluation of the Programmes, Faculty, Facility Funding and Program Accreditation Standards. Council of Engineers (COE), the accreditation agency of Thailand (Hokierti 2004). Requirements for the Board of Engineering Accreditation approval, Thailand are categorized into eight items as Engineering Program, Purpose, Student, Faculty Member and Management, Classroom / Laboratory / Equipment, Management/ Budget and Quality Assurance.
The National Board of Accreditation (NBA), India is assigned with the task of ensuring the quality of technical education offered by various programmes (http://www.nbaaicte.ernet.in). NBA has formulated measures to assess the quality of a programme based on vision, mission, Administration, Teaching and Learning process, Research and development, Industry Institute Interaction and student Activities. NBA operates through All India Council for Technical Education (AICTE) under Ministry of Human Resources Development.

1.8 SCOPE OF THE THESIS

In spite of the economic slowdown across the globe, India is emerging as a strong economic power. Apart from the phenomenal growth in information technology and information technology enabled sectors, the manufacturing and automotive sectors are poised for bigger growth. All these developments mean that there is a tremendous need for trained engineers to meet the challenges. At present, there are about 2500 approved engineering institution in India, out of which about 2% institutions are classified as the institutions of higher learning which have attained excellence and the students coming out of these systems are found excellent. However, colleges which are affiliated to universities are the major component of the total number of engineering institutions in India. If India is to meet the emerging challenges, it has to have quality engineers coming out of these affiliated colleges. Barring few colleges in this sector, majority of these institutions are primarily teaching institutions and do not have any research orientation.

Hence, there is an urgent need in India to evolve mechanism and processes for affiliated colleges so as to elevate their standards and motivate them to attain excellence at the earliest for the benefit of the country. Unfortunately the existing models of the successful institutions of higher learning
cannot be directly used by these institutions. Hence, one has to understand the issues and evolve models that have the unique features.

This thesis is an attempt to evolve a model that is applicable primarily to technical institutions of affiliated category but which could be customized for other types of institutions as well.

1.9 CHAPTER SCHEMATA

The thesis is organized as follows:

Chapter 2 presents various quality excellence models being practiced in industries and other sectors. Based on these models, a novel model is proposed for achieving quality in engineering education. The critical influencing areas and factors identified using quality tools such as literature survey, interviews, questionnaire and analytical hierarchy process are described. The impact of the quality excellence model on the quality of engineering education obtained through a pilot study conducted in the Department of ECE at Thiagarajar College of Engineering, Madurai is also detailed.

Chapter 3 explains the issues in teaching and learning process in engineering colleges affiliated to universities. The critical influencing areas and the critical success factors in respect of teaching and learning identified using quality tools are listed. The impact of the proposed model in respect of Educational System, Curriculum Development, Educational Support and Assessment, Library and Faculty Development reflected through innovative teaching, design oriented approach, product development capability and research orientation are described.
Chapter 4 portrays the global and Indian scenario with respect to research and development in order to address the issues in higher learning institutions adopting research and development approaches to affiliating type of engineering institutions, a novel quality model is proposed. The evolution of the model, the critical influencing factors, the critical success factors and the impact of the model on the research practices in an engineering institution are detailed.

Chapter 5 focuses the critical influencing factors identified using Analytical Hierarchy Process for enhancing Training and Placement and other industry interface activities. The outcome of implementing the proposed model is detailed in terms of enhanced infrastructure, increased student placement, internship for faculty and students and consultancy practice.

Chapter 6 presents the summary and conclusion.