CHAPTER-2

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

Literature Search Strategy

The literature review covers a gamut of work undertaken ranging from empirical studies focused on the quality of Engineering Education to theoretical literature that engages with the concept of TQM in education. The literature presents a broad picture of Engineering Education illustrating the quality issues and locating the specific issues pertaining to Punjab and Chandigarh within this overarching framework. In addition, using both international and national experiences, it presents a review of engagements with TQM for Engineering Education assimilating the learning from these programs. In engaging with alternatives, the study has tried to put together published papers and existing evidence based research. The study also presents a literature map that summarizes the different strands of thoughts and engagement with the issue- both empirical and theoretical.

The study uses research by national agencies and committees set up to assess the quality of education such as FICCI and NMIMS report (2013), NAAC report (2006) etc. It also sets the backdrop using vision or agenda documents for education such as at the National Knowledge Commission (NKC) Report (2009). In addition, several studies and papers are sourced from available books and online literature including academic journals, published evaluation reports of multilateral agencies, international nonprofit organizations and policy briefs.

The timeframe for the study is recent, as the burgeoning expansion is a recent issue that has taken place over the last 15-20 years. The paper has tried to exhaustively include most studies on TQM and Engineering Education. The keyword searches included such words as Engineering Education, TQM, Quality of Education.

In the last two decades, India has witnessed an unprecedented increase in the number of Engineering Education Institutions. According to the estimates of the Eleventh five year plan, the country is expected to be home to a skilled workforce of 500 million by 2022 (Planning Commission, 2007). The Plan also focuses on expansion, proposing establishment of 30 new universities. Further, the plan is to have, eight additional Indian Institutes of Technology (IITs) and seven additional Indian Institutes of Management (IIMs). In the field of Information technology, the plan is to have 20 additional Indian Institutes of Information Technology (IIITs). In science research, five additional Indian Institutes of Science are planned. In addition, two Schools of Planning and Architecture are in the plan. At the regional level, 10 National Institutes of Technology (NITs) are planned. Further, for undergraduate education, 373 additional colleges and as many as 1000 additional polytechnic institutions are planned. (National Knowledge Commission, 2009). A good number of these institutes have already been set up and the rest are under establishment. Between 2009 and 2011, the elite technical institutions recorded a 55 percent increase in seats from 90,513 to 140,000 (Loyalka et al, 2014).The growth in number of non- elite institutions and the seats therein has been much more. As on May 28th 2017, there are 23 IITs (Indian Institute of Technology) spread across the country (MHRD, 2017).

However, there are persisting concerns regarding the quality of Engineering Education imparted in the existing colleges and institutions. Existing studies point to

growing skill gaps resulting not just in unemployment but also in employer dissatisfaction (Latitude Group, 2013). The growth in numbers has not been accompanied by improvement in corresponding quality standards. Several studies have observed the inadequacies in both quality and quantity of Engineering Education-while a 2005 NASSCOM-Mckinsey report (2005) indicated a requirement of additional 500,000 professionals to engage in knowledge-based work by 2010. In addition, the U R Rao Committee has indicated the need for more research based work estimating a need for more than 10,000 PhDs and about 20,000 professionals with Masters Degrees in Technology for meeting the Research and Development (R&D) needs (FICCI and NMIMS, 2013). However, commenting on quality, the aforementioned NASSCOM-Mckinsey (2005) report shows that the multinational companies report that only about 25 percent of engineers from India have the skills and competencies to be employable in the IT sector. Other studies have also raised concerns that the quality of IT services in specific and the firms in general may stagnate because of the poor quality of technical skills of the employees. Consequently, the response from the industry regarding the job preparedness of the engineering graduates has been very poor and about three-quarters of India's technical graduates are considered inadequately skilled and, therefore, unemployable by India's high-growth global industries (Anand, 2011). It is on such counts that the quality of technical education in India has often been found to be inadequate especially in comparison with the United States. Making such a comparison, scholars have discussed the poor opinion that employers have of the quality of engineering graduates with regard to the BRIC countries, concluding that the overall levels of skills of the Indian engineers were not competitive in comparison to those from the western countries like the United States (Bloom and Saeki, 2011).

The recent and enormous increase in the number of engineering graduates from India makes it important to assess if the quality of such education and the professionals it produces is globally comparable or competitive. This is of interest as countries like India have been producing graduates in Engineering Education from the high quality elite institutions and the so called non-elite institutions resulting in a range of quality. While some of the institutes are recognized as institutes of excellence with impressive faculty and student profile, there are many that do not meet the requisite quality standards.

However, quality, in itself is a complex term. It has been defined variously and diversely that can be possibly placed in a continuum– from 'perfection' to 'fit for purpose or adequate'. In the context of higher education, NAAC emphasizes that quality "means the educational process is such that it ensures students achieve their goals and thereby satisfy the needs of the society and help in national development" (NAAC, 2006 pp 14).

In this context, a Total Quality Management (TQM) based approach offers interesting possibilities to understand the quality of Engineering Education. TQM is often conceptualized as an approach of holistic management in order to achieve excellence. It is, at the same time, both a guiding philosophy and a set of strategic action points for continuously improving quality. In this way, It is oriented around both application of certain well thought out methods as well as human resources. The broader aim is to improve processes within an organization to enhance the present and future efficiency and productivity. This is an approach that invokes the proactive participation and involvement of all stakeholders in achieving and sustaining high quality standards in Engineering Education (Sapra, 2017). The approach, with a focus on

stakeholder satisfaction, provides an important lens to look at the important aspects of quality such as leadership, management level commitment to quality and continuous improvement, stakeholder engagement and satisfaction**,** process-centeredness with integration of the systems, approaches that are both strategic and systematic**,** informed decision making based on facts and well developed Communication systems. These are the foundation components of TQM and represent its key principles.

Literature Review

Some of the important issues concerning quality with regard to Engineering Education in India pertain to the broader curriculum and the way it is delivered , low financial allocation per student, inadequate infrastructure, poor quality of faculty, inadequate number of faculty members per student, management issues pertaining to institutions, limited research, etc. These result in too few publications, limited development of student perspectives and insignificant industry interaction (Loyalka, et al 2014; MHRD, 2011; National Knowledge Commission, 2009).

It is important to note that these concerns are not new. Close to two decades back, Jain, Puri and Jindal(2000) in their paper discussing the lacunae in the quality of the technical education in India, based on a review of the existing situation, had recommended skill development, better industry-academia interaction, frequent academic audits, improvements in information systems and filling of faculty vacancies. However, given that these and similar issues persist till date and in greater magnitude due to sudden increase in the number of institutes, resorting to new approaches has become necessary.

Tiwari (2000), in his paper on Total Quality Management in Technical Institutions, had enlisted the main messages from the thought leaders of TQM to set the vision for embedding quality assurance initiatives in technical education.

Chantay and Mishra (2000), in their paper titled Quality Assurance in Engineering Education, while mapping the trajectory and evolution of Engineering Education, had also expressed their concerns about the deteriorating quality of such education and stressed attention towards the need to address the same. Bhat (2000), in a perspective paper on quality of education in technical institutions, identified teachers as the driving force of Engineering Education and focused on creating opportunities for their professional growth. The author identified four phases for ensuring quality standards: 1) Visioning phase, 2) Phase for Management Strategy and Action 3) Phase focusing on greater involvement through increasing stakeholder participation and 4) Phase for stronger and strategic business alignment.

Naik (2000), in his paper on internationalization of higher education, also talks about competitiveness of Indian engineers globally. Emphasizing the need to upgrade the quality substantially, he emphasizes on the need for creating research facilities, incubation centers and technology transfer centers. Comparing the educational scenario of India with that of the developed countries, the author argues that investment in Engineering Education with a focus on research and development, while appearing to be expensive, yields significant dividends that can actually propel the growth of the country. He emphasizes that such education should not be starved of funds so that India can be a proactive participant in the global knowledge society.

One of the approaches tried has been the Balanced Score Card (BSC) system. Uma Shankar and Datta (2007), based on their review paper, discuss the BSC concept

and assess the ways in which it should be applied to educational institutions in the Indian context. The BSC approach facilitates a series of measures, often organized in a hierarchy, to enable creation, sharing and use of knowledge. These are evolved into a comprehensive and coherent framework that is communicated to the external stakeholders and within the institutions. However, there is rather limited application of BSC in the domain of education in India and, therefore difficult to comment on its suitability.

While TQM in Engineering Education is not new, many educational institutions in the developed countries follow some or most of the principles without explicitly calling it TQM. Existing studies have indicated the use of TQM perspective for an assessment of the quality of education with specific reference to higher education (Sahney et al, 2004). Research also points to the critical demand for improved quality in Engineering Education and the opportunities offered by TQM in this regard (Mahapatra and Khan, 2006; Sahu, Shrivastava and Shrivastava, 2008). While there have been some attempts to use TQM for education in the West (Winn and Green, 1998), such efforts are at a very preliminary stage in India. Also, the existing studies are yet to consider a stakeholder satisfaction oriented approach to Engineering Education.

Given this context, an extensive literature review was carried out focusing on the following five themes -

- Identification of components of TQM for Engineering Education
- Accreditation for Quality Improvement
- Leadership and Management Commitment to Quality
- Stakeholder focus
- Industry interaction.

Table 1 presents the summary of the key concepts, authors and key ideas around TQM in Higher Education with specific reference to Engineering Education.

Table 1:

TQM in Engineering Education: Key Ideas

Concept	**Authors**	**Key ideas**
Management approach to Higher Education	Winn and Green, (1998); Sahney et al, (2004); Mahapatra and Khan, (2006); Sahu et al (2008);	Total Quality management approach to Higher Education
Components of TQM	Lagrosen, Seyyed-Hashemi & Leitner, (2004) Sakthivel and Rajendran, (2005); Begum, Chandrasekharan and Sai , (2010) Senthilkumar and Arulraj, (2010) Sahu et al, (2008)	5-C TQM Model in engineering institutions of India focused on management commitment, curriculum delivery, campus infrastructure and facilities, customer feedback and continuous improvement. Identification of 27 components reiterating positive relationship between TQM dimensions and institutional performance
Leadership and Management Commitment	Sohani and Sohani (2011); Ola (2013); Sudha(2013)	Top management has to be involved and provide leadership to the process of quality enhancement
Accreditation	Bhat (2000), Natarajan (2004); Sudha (2013); Das et al (2014); Thandapani et al (2010)	Indicators of accreditation around stakeholders self-evaluation mechanisms for the higher educational institutions.

Concept	Authors	Key ideas
Stakeholder Engagement	Alridge and Rowley, (1998); Wills and Taylor(1999); Chua (2004); Khanna(2012); Masood(2007); Gulbarga et al(2012a); Efthimia(2006); Sudha(2013)	Need to identify and engage with different sets of stakeholders including management, faculty, industry and students
Industry Interaction	Chandrakant, Nair and Banerjee(1982); Bansal and Singh(2000); Jain (2000); Murthy(2002); NKC(2009); MHRD(2011); Gulbarga et al (2012a); Gulbarga et al(2012b); FICCI and NMIMS(2013); Loyalka, et al (2014);	Need for greater and regular industry interaction Fellowship and Exchange programmes between industries and technical education institutions Universities as incubators of ideas for the industries with shared research spaces Dynamic curriculum based on changing industry needs
Barriers to TQM Implementation	Widrick et al (2002); Talib et al (2011); Brookers and Becket (2007)	Challenges pertaining to the implementation of quality models especially those concerning performance quality Two levels of problems- at the level of Top management with low levels of commitment to high quality and at the level of Human Resources with high attrition of managers Focus of TQM more towards non-academic and Managerial functions

Identification of components of TQM for Technical Education

One of the early studies that attempted to use quality model for Higher Education was carried out by Lagrosen et al (2004) who used student interviews with Swedish and Austrian students to capture their perspective on quality. The researchers used a questionnaire developed based on in depth interviews with students. This questionnaire was used to elicit response from 448 students on components of quality that they considered important. Against these components, the student perspective on what they considered most important for quality was mapped and differences in responses documented across different groups of students. This led to the inference that Corporate collaboration, information and responsiveness, range of the different courses, internal evaluations, computer infrastructure and facilities and knowledge resources available in the library are important parameters. Though the study was limited in terms of engaging with only students, it elicited important dimensions concerning one of the most important stakeholders.

Sakthivel and Rajendran (2005), in their research on the implementation of TQM and students' satisfaction regarding academic performance, based on a study of students from institutions that include both ISO certified and those without ISO certification across Southern parts of India have looked at developing models of TQM for academic excellence. The study reiterates the 5-C Total Quality Model of academic excellence in engineering institutions of India. Such a model focuses on **c**ommitment (of management), **c**ourse/ curriculum delivery, **c**ampus (on site facilities), **c**ourtesy and behavioral aspects and **c**ustomer engagement, feedback and improvement.

Begum, Chandrasekharan and Sai (2010), in a study of TQM in Engineering Education, describes the existing management practices. Identifying 27 critical factors

of quality, they emphasize the need to steer gaze on the positive relationship between TQM dimensions and institutional performance for quality improvement.

Senthilkumar and Arulraj (2010), in their engagement with quality in higher education with specific reference to placement, have focused on specific areas of quality. These cover pedagogy, the significance of change in environment, disciplinary mechanisms, placement services offered, quality of services and the level of satisfaction of the stakeholders, specifically the students. Based on a study with students in the final year of higher educational institutions across Tamil Nadu. Based on their study, they propose service quality measurement (SQM-HEI) model. Specifically, they emphasize that in most cases, the quality of education, to a large extent, depends on the faculty, physical resources and infrastructure and a range of Disciplines that facilitate the creation of a diverse set of students and also improve placement prospects.

Sahu et al (2013) undertake a review of existing literature to identify critical factors that can facilitate use of TQM and other quality enhancement models in education to enhance the quality of education. Based on an analysis of content, they conclude that adoption of TQM in technical universities needs a dedicated approach that takes into account certain critical factors. These include repositioning of the senior management (with a focus on vision, commitment, resource allocation, etc.), improvement in infrastructure (including appropriate R&D space, good ambience, libraries and classroom environment); curriculum development and Updation (with a focus on teaching methodology, student teacher ratio and R&D), training and placements (with a focus on skills and related competencies of the students and their communication skills).

Leadership and Top Management Commitment:-

Based on their study conducted with the objectives of developing a quality based structural framework of education system in higher education in India, Sohani and Sohani (2011), have engaged in identification, sequencing, categorizing and prioritizing quality characteristics into a systematic model. In doing so, the authors have emphasized on the role of the top management. They have discussed that leadership with vision and effective allocation and financial management plays critical role in setting up management system for higher education, leading to overall improvement in quality.

Ola (2013), in his research focusing on Total Quality Management (TQM) and the related aspect of Continuous Improvement (CI), considers TQM as a philosophy seeking to integrate all organizational functions. Using the TQM principles and Baldridge model (based on European Federation for Quality Management (EQM) model of business excellence framework), he emphasizes that top management should be involved in enhancement of quality and all employees should participate. He also identifies the key principles of TQM as commitment of the top management, empowerment of the employee through engagement, decision making that is based on facts, improvement in an ongoing and continuous manner and a focus on the customer.

Sudha (2013), based on her study with faculty members across Higher Education Institutions (HEIs), has also reinforced the importance of the commitment of the top management emphasizing on their role in reflection and self-evaluation.

Accreditation for Quality Improvement:-

Natarajan (2004), in his research on the role of accreditation of quality, emphasized on the objective parameters of such accreditation processes. He proposes to develop

indicators of accreditation around stakeholders, a key focus on the TQM approach. The paper emphasis the significance of accreditation of institutes for promoting the quality assurance for technical education and for demonstrating impact through indicators around student, faculty and institutional quality.

Bhat (2000) also focuses on the role of accreditation for ensuring quality in technical education. He emphasizes that accreditation helps the stakeholders including parents, students and employers to identify institutions that meet the standard quality indicators. It helps to benchmark institutions for upgradation. Finally, it helps to maintain high standards and encourage institutions to move towards excellence through a process of continuous improvement.

Sudha (2013), based on her study involving faculty members of educational institutions, emphasizes the importance of self-evaluation mechanisms for the higher educational institutions. She emphasizes that such an evaluation should include the top management, faculty and students, taking into account multiple perspectives to arrive at a comprehensive understanding of the performance of the academic institutions with regard to quality.

Das et al (2014), in their study on performance evaluation of technical institutions using multiple criteria, focus on the performance analysis of seven premier technical institutions . They use a multi objective decision making model (MOORA method) to measure against six attributes. The paper evaluates the output delivered by institutions and compares them against the resources used in delivering the same. They emphasize on the use of methods like MOORA for ranking of institutions and making relative comparisons.

Thandapani , Gopalakrishnan, Devadasan, Sreenivasa and Murugesh. (2012), in their work on tracing the quality journey across organizations and engineering educational institutions through a review of existing literature, emphasized on the importance of accreditation for the modern Engineering Educational Institutions from the Accreditation Board for Engineering and Technology (ABET)- meeting the required stipulations. This would lay the foundation for implementation of quality models. The authors emphasize that the industries adopt the ISO 9000 certification for embedding quality in their performance, while the engineering education institutions have focused on accreditation for meeting quality standards. The authors conclude that the Washington accord favors ABET for the standardization of the accreditation process and should be the core function of modern institutions.

NAAC (2006), notes that globally a diverse range of accreditation practices and procedures is followed for maintaining the quality of Engineering Education. In the United States, agencies with specialization in monitoring of quality at various levels- such as the regional and the national are involved. In the UK, specific agencies like the QAA undertakes institutional based and subject based assessments for accreditation. The NAAC accreditation process in India is somewhat similar to this model although there are some differences in criteria.

Stakeholder Focus

Babai and Dharmambal (2000), based on their study on TQM in Stakeholders from Dr Dharmambal Govt Polytechnic, emphasize that students are the prime customers of educational institutions. The way institutions can align their activities to the satisfaction of this customer is by focusing on quality creation, rather than on quality control. They further emphasize that the quality creation consciousness and implementation in

engineering institutions comes through innovation in curriculum development, staff development, facility development and a focus on personality development of students, continuous improvement, industry interaction and consultancy & research and a field work orientation approach to complement library oriented approach. The paper speaks of quality as an organization wide activity which involves all stakeholders.

Chua (2004), in her paper around the notion of perception of Quality in the context of Higher Education, discussed the issues from a marketing perspective. While looking at quality in higher education from multiple perspectives including those of students, parents, faculty members and employers, she focuses on quality from a marketing perspective with a view to understand the needs of the customers of higher education and their perceptions. She uses an Input (student selection process, requirements for admissions) , process (teaching learning process, curriculum content, curriculum delivery, faculty expertise, assessments, etc.) and output (good employment through placement, academic performance) . The study elicited that that the different stakeholders, viz. parents, students, members of the faculty and potential / existing employers perceived quality differently. While the parents view quality as relating to input and output, the students perceived quality in terms of educational process (including courses and teaching) and outputs. The faculty members demonstrated a comprehensive understanding of quality relating the same to the entire education system. The employers perceived quality in terms of skill sets of the students, focusing on the output aspect.

Aldridge and Rowley (1998), based on their study of the student experience at Edge Hill University College, UK, use a questionnaire-based survey. Focused on the experience of the students covering both their personal attributes as well as their feed-

back on the institution, they propose a theoretical model that emphasizes the need to respond to student dissatisfaction- whether it pertains to individual incidents leading to complaints or other longer term issues. Emphasizing on the issue of quality, they argue that continued perception of poor quality leads to disconfirmation. They further discuss that disaffirmation occurs when student withdraws as an effective member of the educational institutional community. This can be through formal withdrawal from the institution or failures. Disaffected students also continue to remain in the institution while performing poorly, perceiving a lack of other options.

Willis and Taylor (1999), in their study to gauge employer's perspective on quality, based on data collected from business organizations, emphasize that the performance of the employees is not used by businesses to arrive at decisions regarding the quality of higher education. Rather, the emphasis in the work setting is on the kind of skills that are required by them. The authors emphasize the need to extend the TQM principles to teaching and learning processes, administrative and operational processes of the colleges.

Khanna (2012), based on his qualitative research on improvement in technical education through a Total Quality Management (TQM) lens, has studied the engineering degree and diplom institutions across the country. Based on the study, he has emphasized the need to focus on the stakeholders like faculty with measures for them to improve motivation levels. He also emphasizes on the need to focus on students with greater industry based exposure and training.

On similar lines, but in our neighboring country, Pakistan, Masood (2007), based on his application and analysis of Total Quality Management in colleges of education in Pakistan, covering colleges, faculty members and students, emphasizes the

need for education to be practical and skill oriented. Gulbarga, Chetty, Ganjigatti and Prakash (2012a), in their review exploring the impact of TQM on higher education, also focus on similar points pertaining to client satisfaction, employee involvement and continuous improvement. In addition, they also lay emphasis on a dynamic curriculum for technical education that is continuously upgraded based on new developments in the field.

Efthimia (2006), also looks at TQM in technical education from a stakeholder perspective. Focusing on process orientation, she cautions against looking at TQM as a quick fix measure. Focusing on the implementation of the TQM approach and the challenges therein, she emphasizes the importance of leadership with a commitment to quality, customer focus, employee empowerment and communication.

Sudha (2013), also focuses on the importance of stakeholder engagement to understand a TQM approach to technical education. Based on a study involving faculty members from Technical, management and Pharmaceutical education, she emphasizes on the need to create synergistic relationship among the stakeholders.

Industry Interaction

Chandrakant et al (1982), based on their interaction with faculty of IITs and captains of the industries, examine factors related to technical institutions (including IITs) not giving the desired and expected outcomes They emphasize that engineering education curriculum, instructions and institutions are not relevant to the Indian industrial situation, in fact, they tend to become theoretical and esoteric. Both students and faculty look at options outside India and in other areas (publications in foreign journals, careers outside India, management courses) instead of relatively limited industry related possibilities in India. Focus on indigenous and high quality research, even in IITs, is

low. To address these issues, the study recommends constant industry interactions to keep curriculum relevant and practical, increased role of academics in industrial establishments, flexibility in engineering programs (by having the first two years common and giving choices to specialize in years 3 and 4 in technology and management courses) . However, the study was largely restricted to IITs, a set of premier institutions, and undertaken in an era when private education in engineering was almost non-existent. Also, it does not capture student perspective, and is largely oriented around the perspective of educational institutions and the industry.

Bansal and Singh (2000), in their paper focusing on Industry- Institute interaction in the context of Curriculum Development, had emphasized on the need to greater engagement with industries to enhance human resource development that is sensitive to the growing and sometimes changing needs of the industries. Indicating some areas that should see greater collaboration, they identify R &D support, knowledge transfer arrangements, shared facilities like computer labs, libraries, scholarship arrangements for students, engagement of industries in curriculum development and course design of the institutions and managing industry- institution collaborative projects. The authors specifically focus on the engagement for curriculum development, given the fast changing nature of industrial development and the need for the educational institutions to keep pace with such changes. The authors suggest greater 'sandwich' programmes for student exposure to industrial settings, industrial visits, industry based teacher training programmes, exchange programmes involving teachers and industry personnel and summer placements of students in industries.

Murthy (2002), in his paper on Industry institute interaction, describes different modes of industry-academia interaction. He presents an overarching view of the Industry-academia interaction based on his experience and examples from IIT Delhi. Looking at the modes for institute to industry, industry to institute and joint activity,

he lists down the support systems required for the same and the benefits of implementing these modes. The paper emphasizes that the subjects of prime importance to industry are in wide variance with what is taught in the classrooms. To address these issues, the following modes of interactions are recommended - students (visits, interactions, internships, projects),teachers (deputation, expert lectures), industry (Depute personnel for higher education, assign consulting jobs, sponsor R&D projects, get industry experts to be the resource persons and adjunct faculty), joint actions (Consortiums in mission mode, Technology transfers, Prototyping, Field trials, International linkages, etc.)

Khanna (2012), based on his qualitative research on the improvement in technical education through Total Quality Management (TQM) lens, has also emphasized on the need to focus on the students with greater industry based exposure and training. Masood (2007), based on his engagements with colleges in Pakistan focuses on the way TQM is applied and emphasizes the need for education to be practical skill oriented.

Gulbarga et al (2012a) also focus on similar points pertaining to continuous improvement, laying emphasis on a dynamic curriculum for technical education that is continuously upgraded based on new developments in the field.

Gulbarga et al (2012b), in their study on the perception of staff and students on three categories of institutions with regard to the quality management practices, also emphasize the need for greater and intense industry-institute interaction.

Barriers to TQM

Despite its many advantages, the TQM approach is not without its set of challenges with regard to implementation. Based on an Interpretive Structural Modeling (ISM)

involving a series of interviews with experts and desk review of literature based approach to understand the barriers and the ways these influence one another, Talib, Rehman & Qureshi, (2011) identify 12 barriers. Classifying these into two broad heads, namely

a) Those that are of high influence and strategic importance (including such factors as inadequate commitment of the top management, lack of inter-departmental co-ordination),and

b) Those pertaining to high levels of attrition at the managerial level, absence of a culture of regular improvement of quality and resistance on the part of the employees to any kind of change.

Based on their engagement with these factors, the authors argue that an attention toward these barriers would considerably address the barriers to implementation.

Much earlier to this, Widrick, Mergen and Grant (2002), based on their review of Higher education institutions in the United States, had attempted to understand and analyze the implementation of quality in US higher education through adherence to the management framework developed by Mergen, Grant and Widrick in 2000, specifically assessing the three interrelated components - design quality, conformance quality and performance quality of the existing institutions . The study elicited that while Quality of design and quality of conformance could be found, quality of performance was one of the most difficult to assess because of lack of data or lack of access to data. An assessment would require an ability to scrutinize the performance of alumni over a period and across organizations that might be difficult to access due to consent as well as confidentiality issues of the organizations.

An important point raised by Brookes and Becket (2007),in their review paper, that looked at the models developed and published in academic journals over 1996 and 2006 across 34 countries, pertains to the approach adopted for different models for quality improvement. Questioning the preference of following a management approach as compared to a teaching and learning approach, they argue that the focus of most models is on industry requirement. While they acknowledge the benefits in terms of improved results in managerial functions, they emphasize that most gains are in the realm of non-academic functions and end up relegating the academics to the second position, thus privileging the managerial functions over the academics functions in Higher Education. They assert that institutions of higher learnings and Universities need to rethink their approach by placing academic activities at the core of their engagement.

Research Gaps

While the texting research is rich in terms of diverse perspectives**,** most of the existing studies have been carried out with certain aspects of Higher Education. Similarly, While TQM as an approach has been suggested in several of these studies, there are very few that actually have de-constructed all the aspects of TQM and tested these against primary data sets pertaining to quality of education. Specifically, multi stakeholder perspective covering the stand points of the students, teaching fraternity, management and industry has not been undertaken in any of the previous studies. There are also very few studies that actually engage with the range of educational institutions- public and private and across three levels- diploma, under graduate and post graduate. This is a major gap given that the quality of education vary significantly across institutions. Similarly, the levels are significant as each level caters to a partic-

ular skill set that needs, to be captured and addressed. It is also pertinent to note that while several studies exist on TQM in Education, the relevance of the same is quite crucial at present as the country is re positioning itself for a manufacturing hub status that needs a skilled workforce. Finally, in a context where engineering educational institutions are experiencing a major increase in number, a primary study capturing existing practices and quality implications thereof is glaringly missing.

Theoretical Foundation

Quality of education from TQM perspective also emphasizes on the quality of education in higher education (Sahney et al 2004). Stressing on the importance of leadership for TQM, commitment of the management leadership has been considered by the author as a key factor that can contribute to the success of TQM in higher education institutions.

In this context, the importance of accreditation of institutes has been emphasized for promoting the Quality Assurance of Technical education and demonstrating the impact through indicators of student, faculty and institutional quality (Natarajan, 2004; NKC, 2009). The guiding philosophy that drives Quality Assurance as well as Quality Management draws from practices that emphasize maximum effort from the human resources and services engaged in the process of strengthening systems pertaining to quality in the institutions.

A model of quality management is also understood to have three components: those pertaining to design, those pertaining to conformance or adherence to set quality norms and those pertaining to expected performance (Mergen et al, 2000). This provides a framework to identify opportunities for improvement in research and development, teaching - learning processes and operations. Using such a classification for

education, evaluation of educational institutions based on these three quality dimensions in higher education has also been proposed.

Conceptualizing TQM variables, a 5-C Total Quality Model of academic excellence in engineering institutions of India has also been developed that includes: **c**ommitment of top management, curriculum delivery, **c**ampus and the facilities, stakeholder feedback and strategies for improvement (Shaktivel and Rajendran, 2005).Similar framework has also been developed for quality values in higher education which include curriculum design and delivery, information dissemination and marketing of the courses offered, process of recruitment of students, set practices for induction and assessment and evaluation systems (Telford and Masson, 2005).

It is possible to envision an educational institution as a coming together of three interrelated systems- management, technology and society (Shahney et al, 2004). Within this, students, teaching and non- teaching staff and infrastructure are the inputs. The teaching learning process and systems of learning including practices such as industrial exposure are the processes. The outputs and their quality is determined in the form of performance in evaluations, placement and employment opportunities and job satisfaction (Shahney et al, 2004).

Thus, Total Quality Management is an approach of managing the whole to achieve excellence. From the standpoint of the present study, the most important factor is ‘Customer Satisfaction’ and it may be mentioned that, in the context of Engineering Education, the word ‘customer’ may be substituted by ‘stake-holder’. Students, parents, faculty, employees, alumni; industry, government and the society at large are all stake holders in Engineering Education system. Therefore, interest of all these stake holders needs to be accorded paramount priority.

In recent times, the approach has also been used in enhancing the quality of education in a way that satisfies all concerned stakeholders.This study looks at Total Quality Management in Engineering Education as an approach to plan, organize and improve all activities involved in the processes of Engineering Education so as to achieve excellence and full satisfaction of the stakeholders.

The following section briefly describes the key components of TQM as an approach and then proceeds to provide a definition of TQM for this particular research project

Components of TQM

As a management approach, TQM has a strong customer-focus organization and involves all stakeholders with a view to achieve continual improvement. In the process, it uses a strategic approach, information, and improved communication and integrates these as a matter of discipline into the culture and activities of the organization. The important component of TQM include: Stakeholder-orientation, complete stakeholder engagement, Process orientation, Well coordinated and Integrated system, systematic approach, strategies for continuous feedback based improvement and a strong decision making process that is driven by facts.

These are the core components of TQM and represent the critical principles that organizations committed to TQM are expected to operate.

TQM, in engaging in the pursuit of quality enhancement, remains process oriented and integrates diverse systems within the Engineering Educational institutions, interconnecting different functional specialties to ensure an institutional focus on implementing quality enhancement measures. It builds on a strategic approach with

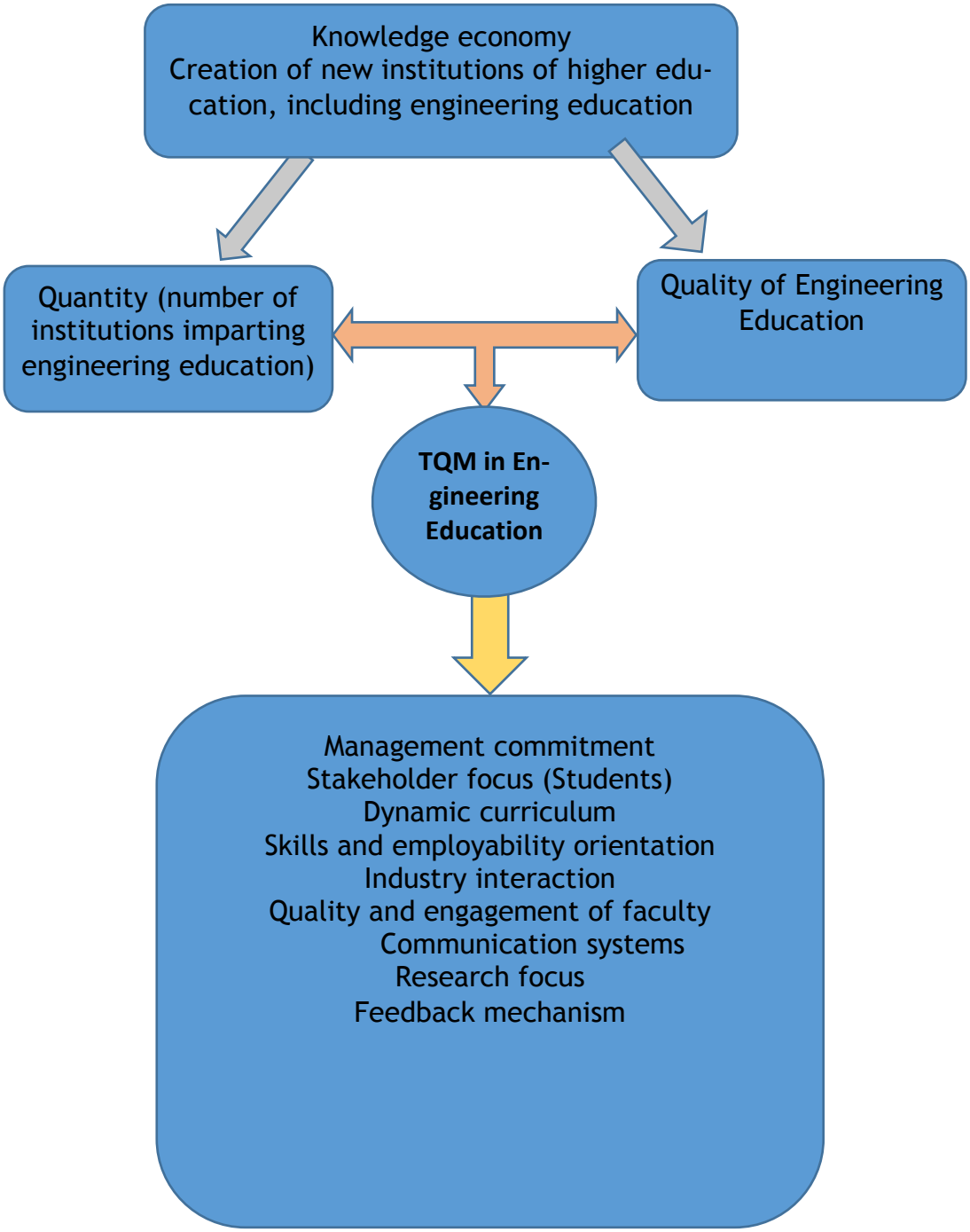
quality not just as a core component but as an area of continual improvement for the institution that can be sustained over time and supported by a robust evidence and fact -based decision making process**.** Finally, given the need for all-stakeholder engagement, TQM would require effective communication to function as a unit committed to enhancing quality of Engineering Education. In addition to this understanding, that captures all the key elements of TQM, given that the project engages with Engineering Education, it would also consider and evaluate the infrastructural aspects (Laboratories, Workshops, Learning Resource Centers , Computer Centers . along with all their machines and equipment, etc.).

Conceptual Framework and Operational Definitions

Figure 1 presents the conceptual framework for the study. The study is located in the broader ecosystem of the vision of the creation of a knowledge economy driven by education and skills. Given this, there is a need to have a large number of engineers, that in turn would require a large number of institutions offering such education. At the same time, enhanced competence is required so that these Engineers are able to deliver what is expected out of them. TQM offers a way in which the balance between quality and quantity can be conceptualized through a comprehensive set of actions. The conceptual model presented in Figure 1 tries to capture this.

Figure 1:

Conceptual Model of TQM in Engineering Education



Operational definitions

Quality: The quality of the education should support students achieve their aspirations and goals. In the process, they address the societal needs and contribute to national development (based on NAAC definition)

Engineering Education: Covers engineering education offered at the Diploma, Graduate, and Post Graduate Levels.

Stakeholders: All those who are concerned with Engineering Education including students, parents, faculty, management and the industry. In TQM, all stakeholders are closely involved to participate in working towards common goals. It believes that such a participation and commitment towards a shared objective can only be achieved by replacing fear by empowerment of the stakeholders through the creation of an appropriate environment by the management. This allows high-performance systems to integrate continuous improvement efforts within normal operations.

Total Quality Management (TQM): an approach that is completely oriented around meeting and exceeding the satisfaction of all its stakeholders, (already defined as above). As such, it is an approach that invokes the proactive participation and involvement of all its stakeholders in achieving and sustaining high quality standards in Engineering Education.

Stakeholder orientation :- In TQM, customer (stakeholder) satisfaction is the ultimate benchmark of success with regard to the level of quality. All actions for quality enhancement—training and capacity building, quality in the design process, updated software and computer applications, or buying state of the art tools for

measurement are intermediate levels geared to the ultimate objective of stakeholder needs and satisfaction.

Process-centered approach :- . Process orientation is at the core of TQM. A process centered approach can be defined as a set of pre-decided steps. Such steps are based on learning, experience and feedback. These help to improve the quality of outputs for the stakeholders, both internal and external. These steps are well defined and documented for monitoring of adherence and performance.

Integrated system: TQM focuses on the horizontal processes interconnecting and integrating different functional specialties. In TQM, all processes aggregate into organizational level system in the process of implementation. Also, all participants understand and are tuned in to the vision, mission, and guiding principles and processes. In such a system, performance is monitored and communicated to all concerned through a well-established feedback mechanism. This is imbibed into the unique work culture that characterizes the organization. Thus, TQM integrates its stakeholders that includes the employees, customers, as a matter of principle, as a part of the organizational quality enhancement endeavor.

- **Strategic Approach**. A strategic approach to work is the hallmark of TQM that drives the entire organization towards its stated vision and mission. Such an approach is characterized by a systematic rather than an ado way of doing things, prior planning, robust implementation and management.
- **Continuous quality improvement**. A core area of TQM is continual (rather than ad hoc or one-time) improvement. this kind of a systemic and process orientated approach to continuous improvement strengthens the analytical and creative capacities of the institutions.

- **Fact-based decision making**. The institution collects and analyzes data continuously and accurately for decision support
- **Communications**. During times of organizational change in favor of TQM, effective communications specifically on aspects of strategies, methods, and timeliness plays a critical role in day-to-day operation, in keeping the organizational morale high and in keeping the human resources and all other stakeholders motivated and involved.

Bibliometric Details:

These are given in Table 2, starting from the next page

Table 2

Bibliometric details

Sl. No	Study	Purpose	Time Frame	Sample Size	Outcome Measures	Relevant Findings	Gaps/Future Scope
1	Planning Commission (2007) Planning Commission (XIth Five Year Plan 2007-2012), Government of India available at http://planningcommission.nic.in/plans/planrel/fiveyr/11th/11_v1/11v1_ch5.pdf accessed on 15th Feb2013	Outline of higher and technical education overview and plan for the XI plan	2007-2012	Educational institutes across the country	Establishment of new institutes for higher educations. Proposal to set up new polytechnics in every district, primarily with central funding.	Over eightfold increase in number of engineering institutions over two decades with a large number of new institutions opening up. Share of private, unaided higher education has risen from 42.6% in 2001 to 63% in 2006. the country has the advantage of having more than 70% of the	With increasing numbers, quality of education is a serious concern

Sl. No	Study	Purpose	Time Frame	Sample Size	Outcome Measures	Relevant Findings	Gaps/Future Scope
						population less than 35 years of age	
2	National Knowledge Commission (2009) Report to the Nation, Government of India available at www.knowledgecommission.gov.in/reports/report09.asp accessed on 10th Jan 2013	Recommendations to transform India into a knowledge society	2006-09	Indian education system	300 recommendations over 27 focus areas, including technical education	Engineering institutions are also affected by lack of high quality teaching -learning at post-graduate and research level. even the workforce which is created is not adequately trained and suited to meet the needs of the industries creating a scenario of incompatibility of curriculum with industry requirements	This report has to be looked at from an implementation standpoint across various categories of institutions

Sl. No	Study	Purpose	Time Frame	Sample Size	Outcome Measures	Relevant Findings	Gaps/Future Scope
3	Latitude Edutech , EEE and TUV Rheinland Registered Education , available at http://www.latitudegroup.in/skill_development.html accessed on 2nd Feb 2013	Evaluating quality with increase in quantity of engineering institutions	2012	Overall	Parameters of quality, employment rate, skill assessment	Unemployment , skill gap are major challenges in spite of the increase in numbers	How do we address these gaps to be detailed
4	Winn R C & Green R S (1998) Applying Total Quality Management to the Educational Process, International Journal of . Engineering Education Vol. 14, No. 1, 24-29 available at http://sinche.uom.gr/sites/default/files/ijee959.pdf accessed on 6th May 2012	Study of Deming's points for implementation of TQM in education through a specific study on the subject of Energy system in the US Air Force	1988-1990	Cadets from all major disciplines	Performance outcomes	TQM success is correlated to the outcome on Deming's 14 points; in the specific course, students liked the course a lot more and they said they learned more; they had better performance in the specific subject where TQM was	Based on one course only; no private institution covered, only Air force academy

Sl. No	Study	Purpose	Time Frame	Sample Size	Outcome Measures	Relevant Findings	Gaps/Future Scope
		Academy for the implementation of TQM				applied	
5	[1] Loyalka, P., Carnoy, M., Froumin, I., Dossani, R., Tilak, J.B., & Yang, P. (2014). Factors Affecting the Quality of Engineering Education in the Four Largest Emerging Economies. Higher Education, 68(6), 977-1004	Comparing engineering education quality in India, Brazil, Russia and China	2008-09	4 countries (Brazil, Russia, India, China)	Dollar per student spent on higher education; ease of getting right faculty members; number of faculty publications; management commitment	Compared to BRIC countries, India has lower levels of salaries paid to faculty and high student faculty ratio, both factors compromising the quality of education. In non-elite institutions, there is a huge challenge in getting faculty with the right skills and proficiency. In terms	Capturing granularity and differences within institutions in India

Sl. No	Study	Purpose	Time Frame	Sample Size	Outcome Measures	Relevant Findings	Gaps/Future Scope
						of publications, a barometer of research, India fares poorly behind China and USA; private colleges in India focus on cutting cost rather than improving quality and their management's commitment to quality is often weak	
6	(FICCI) & NMIMS, Mumbai. (2013). Industry – Academia Convergence "Bridging the Skill Gap", retrieved from http://inskills.co.in/download/General/FICCI-	Gaps in technical education - both qualitative and quantitative	2012-13	Overall systemic study covering industry and academia	Number of engineering graduates required from the Indian economy's standpoint; percent of those who are	In spite of the increase in numbers, there is still a huge gap even from the quantitative standpoint on research,	Measures to address and bridge the skill gap

Sl. No	Study	Purpose	Time Frame	Sample Size	Outcome Measures	Relevant Findings	Gaps/Future Scope
	NMIMS%20report%20on%20Industry-%20Academia%20Convergence%20'Bridging%20the%20Skill%20Gap'.pdf				employable	which especially means Masters and Ph.D. scholars. Plus, the question of Quality remains a question mark as only about 25% are deemed employable in India's high growth industries	
7	Ananad, Geeta. 2011. India Graduates Millions, But Too Few Are Fit to Hire. *Wall Street Journal*, April 8. Available at: http://www.prlog.org/10695114-educated-unemployment-need-for-skillbased-education-system.html	Employability and quality of Engineering graduates in India in the context of ever increasing numbers	2011	NA	Percent of employable engineers	Over 3/4th of India's engineering graduates are unemployable, despite millions of them	Expand to cover all sectors

Sl. No	Study	Purpose	Time Frame	Sample Size	Outcome Measures	Relevant Findings	Gaps/Future Scope
8	[1]Sakthivel, P.B. and Rajendran, G (2005), 'TQM Implementation and Students' Satisfaction of Academic Performance', *The TQM Magazine*, vol. 17, no. 6, pp. 574-589.	Evaluating TQM from the lens of student satisfaction	2005	A sample of students from ISO and non-ISO engineering institutions from South India has been taken for the study	Model of TQM variables for academic excellence	Conceptualizing TQM variables a 5-C Total Quality Model of academic excellence in engineering institutions of India has also been developed that includes: **c**ommitment of top management, **c**ourse delivery, **c**ampus facilities, **c**ourtesy and **c**ustomer feedback and improvement	Study needs to be seen across various categories of institutions
9	Ministry of Human Resource Development (MHRD). 2011. Statistics of higher & technical education, 2009-	Comparing parameters impacting	2009-10	Overall	Student - Faculty Ratio	A much higher number of students in India, reflected	Important to understand the various catego-

Sl. No	Study	Purpose	Time Frame	Sample Size	Outcome Measures	Relevant Findings	Gaps/Future Scope
	10. New Delhi: Bureau of Planning, Monitoring & Statistics	the quality of technical education				through a high student faculty ratio in India, which is much higher than those in developing countries , compromises the quality of engineering education	ries of institutions in India
10	Natarajan R, 2000, "The Role of Accreditation in promoting Quality Assurance of Technical education", International Journal of Engineering Education, vol. 16 No. 2, pp 85-96	Importance of accreditation and objective parameters on accreditation	2000	Overall	Indicators of accreditation around stakeholders	The importance of accreditation of institutes has been emphasized for promoting the Quality Assurance of Technical education and demonstrating the impact through indicators	Applying these indicators in multiple contexts relevant to the study

Sl. No	Study	Purpose	Time Frame	Sample Size	Outcome Measures	Relevant Findings	Gaps/Future Scope
						of student, faculty and institutional quality	
11	Khanna, Pradeep; Qualitative approach for improvement in technical education using Total Quality Management (TQM) concept ; International journal of Scientific Engineering and Technology, Volume No. 1, Issue No. 2 pg: 175-178; ISSN : 2277 - 1581, 1st April 2012	Study of existing technical education system and scope for improving quality using the TQM concept	2012	Degree and Diploma institutions across India	Parameters for improvement related to various stakeholders	Suggestions for improvement include measures for faculty, reward systems, industrial base training , motivation of faculty, innovation and creativity	Quality model as per needs of the institution
12	Ibrahim, Ola; Total Quality Management (TQM) and continuous improvement as addressed by researchers ; International Journal of Scientific and Research Publications, Vol. 3, Issue 10; October 2013; ISSN 2250-3153	TQM as a philosophy seeking to integrate all organization functions has become an	2013		Key principles of TQM are management commitment, employee empowerment, fact based decision making, continuous im-	TQM principles and Baldridge model based on EFQM model. Top management should be involved in the application of qual-	Concrete recommendations for desired levels of quality

Sl. No	Study	Purpose	Time Frame	Sample Size	Outcome Measures	Relevant Findings	Gaps/Future Scope
		important research field			provement and customer focus	ity and all employees should participate	
13	Sayeeda Begum, Rajendran Chandrasekharan, Lokachari Prakash Sai; An empirical study of total quality management in engineering educational institutions of India; Emerald, Benchmarking, an International journal Vol. 17 No. 5, 2010 pp 728-767	Explore adoption of quality management practices in engineering educational institutions in India from a management perspective	2008-10	62	27 critical factors of quality management from the management perspective	Positive relationship between TQM dimensions and institute performance	Only top management covered in this study
14	Akhtar, Masood; Application and analysis of Total Quality Management in colleges of education in Pakistan ; University institute of educa-	Application and analysis of TQM in colleges in	2007	10 colleges, 150 teachers, 600 students	Quality of objectives, systematic examination	Overall quality of education is poor and a lot is left to be done; program	Study done in Punjab (Pakistan), study only on B.Ed

Sl. No	Study	Purpose	Time Frame	Sample Size	Outcome Measures	Relevant Findings	Gaps/Future Scope
	tion and research , University of Arid Agriculture, Rawalpindi, (2007)	Pakistan				needs to be more practical and skill based	
15	Gulbraga Irfan, Chetty Soma V, Ganjigatti JP ; Explicity study on the implication of Total Quality Management on Higher Technical Studies ; International Journal of Mechanical Engineering applications research - IJMEAR, ISSN: 2249-6564; July 2012	Explore the impact of TQM on higher education	2012		Client satisfaction, employee involvement, continuous improvement	There should be a dynamic curriculum that brings data and ability to technical education	No primary data in this case
16	Gulbraga Irfan, Chetty Soma V, Ganjigatti JP ; Prakash Sunil; Assessing technical institutions through the principles of Total Quality Management : the Empirical Study - 2; International Journal of Scientific and research publications , Volume 2, Issue 8, August 2012, ISSN 2250-	Perception of staff and students on three categories of institutions with regards to the quality	2012	162 students, 88 teachers	Client satisfaction, employee involvement, continuous improvement, Industry interface,	More intense industry-institute interaction is called for. Quality in private institutions is of much lower standard.	No concrete recommendations, only self financed institutions considered

Sl. No	Study	Purpose	Time Frame	Sample Size	Outcome Measures	Relevant Findings	Gaps/Future Scope
	3153	management practices and perception difference between staff and students					
17	Staiou Efthimia, Total Quality Management in Engineering Education; 3rd WSEAS / IASME International conference on Engineering Education, Vouliagmeni, Greece, July 11-13, 2006 (pp 125-130)	Main principles of TQM in higher education, role of various stakeholders, dos and don't s in implementation and challenges	2006		Model for implementing TQM	Leadership, commitment, customer focus, quality model, empowerment and communication are important. Do not look at TQM as a quick fix.	Specific examples from engineering colleges
18	Dr Sudha T; Total Quality Management in higher educational institu-	To discus the importance	2013	220 faculty members	Continuous improvement and self	Synergistic relationship amongst	Only faculty members in-

Sl. No	Study	Purpose	Time Frame	Sample Size	Outcome Measures	Relevant Findings	Gaps/Future Scope
	tions ; International journal of social science & interdisciplinary research, 11551R, Vol 2(6), June 2013; ISSN 2277-3630	of quality in higher education institutions; to know the actions required for implementation of TQM principles; to determine the success of TQM actions through various measures		(Business management 58, IT 36, Engineering 84, Pharma 42)	evaluation among stakeholders such as students, top management, faculty is required as an ongoing process	all stakeholders is required to achieve strategic objectives of TQM	cluded in the sample. This can be expanded to include other stakeholders
19	Venkatesh Umashankar & Dutta Kirti: Balanced scorecard in managing higher education institutions- an In-	To look at the Balanced Scorecard	1992-2007	Conceptual paper based on Literature	A model is prepared that can be adapted to the management	BSC approach offers an institution to formulate a cascade	In the absence of evidence of the application

Sl. No	Study	Purpose	Time Frame	Sample Size	Outcome Measures	Relevant Findings	Gaps/Future Scope
	dian perspective. Emerald Insight IJEM 21,1 pp 54-67.	(BSC) concept and discuss in what way it should be applied to higher education programs/ institutions in the Indian context		review and work of other researchers.	of tertiary institutions of education in India.	of measures to translate the mission of knowledge creation, sharing and utilisation into a comprehensive , coherent, communicable and mobilising framework for external stakeholders and for one another.	of BSC to the educational institutional domain in India, this paper can only be a starting-point for a debate and possible strategies to implement BSC methodology in this area. More work is required in the Indian context to fully establish it
20	Jain NK, Puri Manimala, Jindal Manish ; Some suggestions for improvement in present technical education	Discussing the lacunae in the present	2000	Paper based on understanding of	Set of suggestions for addressing the lacunae in the tech-	The following measures need to be put in place to	This paper is largely understanding based

Sl. No	Study	Purpose	Time Frame	Sample Size	Outcome Measures	Relevant Findings	Gaps/Future Scope
	system in India; The Indian Journal of Technical education, Vol. 23, No. 2, April-June 2000, page 70-72	technical education system in India and suggestions to plug the gaps		authors (from AICTE, Delhi College of engineering) about the technical education scenario	nical education system	address the lacunae- Need based expansion of facilities, Industry-Academia interaction, Emphasis on skill development, Academic audits, Information systems , filling of teacher vacancies	and does not have primary data. As a future scope, the suggestions given more than 15 years ago need to be seen in the light of their implementation over the years
21	Natarajan R, 2000, "Managing technical education in the XXI century - challenges and opportunities "; The Indian Journal of Technical education, Vol. 23, No. 3, July-September 2000	Examining the past and the present of technical education and addressing challenges for the	2000	Analysis of universities through the ages and perspective based on the expectations for the new	Recommendations regarding reassessment of the role of universities and embracing innovative opportunities offered by technological develop-	Recommendations cover curriculum, learning experiences, policy issues and delivery mechanisms. At a policy level, engineering education should be	Evaluation of the mechanism of TQM in order to address the recommendations is a gap . This needs to be looked at in the

Sl. No	Study	Purpose	Time Frame	Sample Size	Outcome Measures	Relevant Findings	Gaps/Future Scope
		future		millennium	ments	considered as a partnership between universities and industry, and should go beyond teaching by a professor to a combination of research, consultancy and education administration . Engineering education should be internationalized and curriculum should be modified to facilitate greater integration between disciplines covering	context of total quality management as well.

Sl. No	Study	Purpose	Time Frame	Sample Size	Outcome Measures	Relevant Findings	Gaps/Future Scope
						practical aspects , technical decision making and problem solving	
22	Chandrakant S, Nair MNV, Banerjee MK; "New perspectives for technical education - Industry interaction", Journal of Higher education, Vol. 7 No. 3 Spring 1982	Examining factors related to technical institutions (including IITs) not giving the desired and expected outcomes and offering recommendations	1982	Faculty of IITs, captains of industry	Relevance of the education imparted by the IITs to the reality of the Indian industry	The engineering education curriculum, instructions and institutions are not relevant to the Indian industrial situation, in fact, they tend to become theoretical and esoteric. Both students and faculty look at options outside India and in other areas (publications in foreign	Largely restricted to IITs, in an era when private education in engineering was almost non-existent. Does not capture student perspective, is largely oriented around the perspective of educational institutions and the industry

Sl. No	Study	Purpose	Time Frame	Sample Size	Outcome Measures	Relevant Findings	Gaps/Future Scope
						journals, careers outside India, management courses) as options instead of relatively limited industry related possibilities in India. Focus on indigenous and high quality research, even in IITs, is low. To address these issues, the study recommends constant industry interactions to keep curriculum relevant and practical, increases role of aca-	

Sl. No	Study	Purpose	Time Frame	Sample Size	Outcome Measures	Relevant Findings	Gaps/Future Scope
						demics in industrial establishments, make an engineering program flexible by having the first two years common and giving choices to specialise in years 3 and 4, offer a mix of technology and management courses	
23	Babai KS, Dharmabal; "Total Quality in Engineering Education", The Journal of Indian Technical Education, Vol. 23, No. 3, July-Sep 2000	To demonstrate that students are the first customers of educational institutions	2000	Stakeholders from dr Dharmabal Govt Polytechnic, Chennai and their experi-	Aspects of Quality , illustration of Total Quality to become a centre of excellence	The paper focuses on Quality creation, as against Quality control. The Quality creation consciousness and implementation in	The paper is based on the experiences of one institution in Tamil Nadu. As a future scope, the elements of

Sl. No	Study	Purpose	Time Frame	Sample Size	Outcome Measures	Relevant Findings	Gaps/Future Scope
		and the way institutions can align their activities to the satisfaction of this customer		ences		engineering institutions comes through innovation in curriculum development, staff development, faculty development and a focus on personality development of students, continuous improvement, industry interaction and consultancy & research, field work orientation approach to complement library oriented approach. The paper speaks of	Total Quality can be measured against the As-Is situation , with the gaps leading to specific recommendations

Sl. No	Study	Purpose	Time Frame	Sample Size	Outcome Measures	Relevant Findings	Gaps/Future Scope
						quality as an organization wide activity which involves all stakeholders	
24	Das Manic C., Sarkar Bijan, Ray Siddhartha; "Multicriteria performance evaluation of Indian technical institutions by using MOORA method", The Indian Journal of Technical Education, Vol. 37, No. 3, July-Sep 2014	The paper focusses on the performance analysis of seven premier technical institutions under a multi-criteria environment, for which a multi objective decision making	2007-08	Seven centrally funded technical institutions	Uses quantitative data, institutions are considered as alternatives and measured against six attributes . The normalized performance score of the alternatives is the outcome	The paper evaluates the output produced by institutions and compares them against the resources used in doing the same. The method (MOORA method) can be used for ranking of institutions and making relative comparisons	Focusses on centrally funded institutions, not state funded or privately funded ones. The criteria considered is a six factor criteria, but there is a scope in the future to include attributes from the perspective of the students as this study is

Sl. No	Study	Purpose	Time Frame	Sample Size	Outcome Measures	Relevant Findings	Gaps/Future Scope
		model (MOORA method) is explored					largely from the perspective of the institutions
25	Murthy SS, "Industry Institute Interaction - a vision document prepared for AICTE", The Indian journal for technical education, Vol. 25, No. 2, April-June 2002	Describe different modes of industry-academia interaction. What ways can teachers get more industry savvy. The paper outlines practical aspects and todos for in-	2002	Overall view of the Industry-academia interaction from the author's experience and examples from IIT Delhi	Look at modes for institute to industry, industry to institute and joint activity, list down the support systems required for the same and the beneficiaries of implementing these modes.	Subjects of prime importance to industry are in wide variance with what is taught in the classrooms. To address these, the following modes of interaction are recommended - Student (visits, interactions, internships, projects), Teachers (deputation, expert lectures), Industry	As a future scope, this can be further distilled to the types of courses and institutions to sharpen the modes of interaction. Industries relevant to geographical locations can be brought into the fold more intensely. Role of

Sl. No	Study	Purpose	Time Frame	Sample Size	Outcome Measures	Relevant Findings	Gaps/Future Scope
		dustry-academia interaction by looking at the challenges and suggesting industry to institute actions, institute to industry actions and joint actions				(Depute personnel for higher education, assign consulting jobs, sponsor R&D projects, get industry experts to be resource persons and adjunct faculty), Joint actions (Consortiums in mission mode, Technology transfers, Prototyping, Field trials, International linkages)	alumni in enhancing these interactions can be explored in greater detail
26	Dhond, MH and Biradar SK, "Elements of Quality engineering education", The Indian Journal of Technical Education, Vol. 23, No. 1, Jan-	The paper focusses on the various elements of	2000	Overall perspective on quality of education	Tools and techniques for quality improvement, Elements of a quality	Quality engineering education needs a process of continuous improvement	As a future scope, a road map for implementation needs

Sl. No	Study	Purpose	Time Frame	Sample Size	Outcome Measures	Relevant Findings	Gaps/Future Scope
	uary-March 2000	quality engineering education and also suggests programs, tools and techniques to improve quality			improvement program	and also of innovation through a set of systematic measures. The different factors impacting quality are- Personnel (Management, faculty, Students), Policies, Functions (teaching, research, Admin), Activities (Programs, R&D, industrial planning), Procedures , Systems (evaluation, assessment), Infrastructure , Services , Environment	to be worked out as many things cannot be all implemented at once. This road map, along with a governance mechanism , will ensure that the next step for implementation will be put in place.

Sl. No	Study	Purpose	Time Frame	Sample Size	Outcome Measures	Relevant Findings	Gaps/Future Scope
						and Financials. Updation needs constant quality improvement programs and commitment to continuous improvement	
27	Madan, AK, "Interpretive structural modelling (ISM) - A modern tool for Quality management in technical education", The Indian Journal of technical education, Vol. 37, No. 3, July-Sep 2014	To identify and rank the variables for improvement of quality and to establish the relationship among these identified variables using ISM	2014	-	Ranking of variables	On the basis of the ISM model, the study concludes that the variable- "Design of course structure based on job requirements" is ranked No. 1. The next level variables in the ranking are - comprehensive learning	As a future scope, different categories of educational institutions can be taken up and relative rankings compared. The perspective of different stakeholders can also be built in to

Sl. No	Study	Purpose	Time Frame	Sample Size	Outcome Measures	Relevant Findings	Gaps/Future Scope
						resources, communication skills of academic staff, expertise in lectures, adaptability to modern techniques and well equipped facilities.	make this study multi-dimensional
28	Verma, NK, "Industry-Institute Interaction: Introspection and Involvement", The Indian journal of technical education, Vol. 25, No. 2, April-June 2002	To identify and rank the variables for improvement of quality and to establish the relationship among these identified variables	2002	-	Concrete measures to improve industry-institute interaction	Work on real life projects and problems jointly, have students spend more time in industry and industry captains more time in academic institutions, , more conscious involvement of alumni, create a	Create a priority among the various measures suggested and continuous monitoring to fine tune the measures

Sl. No	Study	Purpose	Time Frame	Sample Size	Outcome Measures	Relevant Findings	Gaps/Future Scope
		using ISM				system of incentives for faculty , more emphasis on consulting projects	
29	Bhattacharya SK, "Enhancing employability of pass outs of technical institutions", The Indian journal technical education, Vol. 24, No, 3, July-Sep 2001	Outline measures to enhance employability and relevance of students graduating from technical institutions	2000-2001	Draws upon a survey of 152 respondents covering Principals of Engineering colleges and Polytechnics, Faculty members and Industry	Competency profile, requirements of employability, Action plan	Skills required are classified into soft skills and hard skills (technical). These are characterized by an interdisciplinary approach to knowledge and their relevance to real life. Focus is on an integrated development covering these attributes. The aspects touched upon in-	The study looks at students as primary customers of educational institutions . While it says the customers are willing to pay for 'value add', a future study could focus on an implementation plan for this value add that is not just a set of

Sl. No	Study	Purpose	Time Frame	Sample Size	Outcome Measures	Relevant Findings	Gaps/Future Scope
						clude competitiveness of technical institutes (relevance of what is taught to reality), design of the curriculum , design of the method of teaching effectiveness interaction with industry, entrepreneurship, a positive work culture and an integration of quality and human values. It also translates the Quality system discourse into what it means for education.	tools but represents a more holistic approach to customer satisfaction. The study looks at the perspective from the point of view of educational institutions and industry, it can further look at the perspective of students and alumni

Sl. No	Study	Purpose	Time Frame	Sample Size	Outcome Measures	Relevant Findings	Gaps/Future Scope
30	Willis, T Hillman and Taylor, Albert J; "Total quality management and higher education: The employers' perspective", Total Quality Management 10(7):997-1007 · September 1999	The paper looks at the issue of quality in technical education from the perspective of the firms that hire students graduating from an educational institution. It also assesses the skills that the business desires and the ability of the educational institu-	1999	100 sample size	Assessment of quality based on survey of employers, attributes that are relevant , are strengths and are weaknesses,	The article explores the question of how business employers perceive the quality of today's college graduate. Sample survey data obtained from business organizations are presented. In general, a significant proportion of businesses do not perceive a difference in the quality of schools based on employee performance. A ranking of required skills is presented and the	This article is done in the US context, it can also be carried out in the Indian context.

Sl. No	Study	Purpose	Time Frame	Sample Size	Outcome Measures	Relevant Findings	Gaps/Future Scope
		tion to fulfil those needs				implications for colleges and universities are discussed. In terms of the way forward, colleges need to continually re-evaluate course offerings, testing and grading procedures, employee skills and personal traits required by hiring firms.	
31	Senthil Kumar N and Arulraj A, "SQM-HEI – determination of service quality measurement of higher education in India", www.emeraldinsight.com/1746-5664.htm, Emerald Insights, JMP 6,1	The purpose of this paper is to develop a new model, service quality measure-	2008-09	1600 usable data points across Tamil Nadu covering all categories of	AS part of the SEM model, the interaction which proved most relevant to determining the quality of education	The mediated SQM-HEI model empirically proved that the placement is the mediated factor for the quality	The study covers students in the final year. A perspective from alumni who have had experi-

Sl. No	Study	Purpose	Time Frame	Sample Size	Outcome Measures	Relevant Findings	Gaps/Future Scope
	; Accepted 20th July 2010	ment in higher education in India (SQM-HEI) for the measurement of service quality in higher educational institutions.		institutions (covering final year students)	was determined.	higher education. The model reveals that the quality of education is based on the best faculty (TM), the excellent physical resources (ECSF), a wide range of disciplines (DA) which paved the diverse student body and to improve the employability of the graduates (placement as mediating factor) coming out of the higher educational institutions in India.	ence in the industry for a few years will ensure that the recency factor will be moderated by a longer term perspective

Sl. No	Study	Purpose	Time Frame	Sample Size	Outcome Measures	Relevant Findings	Gaps/Future Scope
32	Chua Clare, "Perception of Quality in Higher Education", AUQA Occasional Publication, Proceedings of the Australian Universities Quality Forum 2004	The purpose of this research is to assess how quality is perceived by different groups of customers, namely the students, parents, faculty members and employers, regarding the quality of education, and then to	2004	84 responses were obtained covering students, parents, faculty members and industry	Which aspects of quality (Input / Process / Output) are most significant for each category of stakeholder	The study assessed the following perspectives: parents, students, faculty members and employers. These were then classified on quality attributes using the Input–Process–Output framework. The students' perspective of quality falls into mainly the process and output categories; for parents quality is viewed in terms and input and out-	Further investigation into this topic will provide a basis for policy and quality improvement plans undertaken by education institutions. It would also be interesting to look at students, parents, faculty members and employers' perceptions in terms of education quality attributes and how

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		classify these perceived qualities into an Input–Process–Output framework. The information gained from the study will form the basis from which an appropriate quality model can be adopted				put; for faculty it is broad based and for employers in terms of process and output. , thus indicating that different groups of customers have different perspectives of quality. The recommendation is for an integrated approach that will encompass a variety of quality practices.	these differences affect the types of policy and planning choices selected.

Sl. No	Study	Purpose	Time Frame	Sample Size	Outcome Measures	Relevant Findings	Gaps/Future Scope
33	Sohani Neena and Sohani Nagendra, "Developing Interpretive Structural Model for Quality Framework in Higher Education: Indian Context", Journal of Engineering, Science & Management Education, J. Engg. Sc. Mgmt. Ed. Vol-5 Issue-II (495–501), Accepted 07th June 2012	This study has been conducted with the objectives of developing a quality based structural framework of quality education system in higher education in Indian context with identification, sequencing	2011-12		The ISM technique helps prioritize the strategic issues in quality assessment qualitatively, so as to propose a hierarchical structure through prioritizing, sequencing and categorizing of ideas. The elements are classified as drivers, enablers and dependents and the hierarchically structured.	The top management with leadership , vision and effective allocation of funds with proper finance management plays critical role in the success of quality management system for higher education. Satisfied stakeholders come from good quality teachers, teaching learning process, research promotion and extension activities and collaboration.	As a future scope, the study can be taken outside of Indore, where it is currently performed and can cover various categories of educational institutions

Sl. No	Study	Purpose	Time Frame	Sample Size	Outcome Measures	Relevant Findings	Gaps/Future Scope
		categorizing and prioritizing quality characteristics and structuring into a systematic model.					
34	Lagrosen Stefan. Seyyed-Hashemi Roxana and Leitner Markus, "Examination of the dimensions of quality in higher education", Quality Assurance in Education; 2004; 12, 2; Research Library, pg. 61	Examine the dimensions constituting quality in higher education and comparing these with the dimensions of	2003-04	Initially, 29 interviews, followed by 448 responses to questionnaires	Specific quality dimensions	The following dimensions were found to be important - corporate collaboration, information and responsiveness, courses offered, internal evaluation, computer facilities	The study has been done based on the perspective of students. It can be made more broad based by including other stakeholder. Further, the study is

Sl. No	Study	Purpose	Time Frame	Sample Size	Outcome Measures	Relevant Findings	Gaps/Future Scope
		quality in general service quality research				and post study factors	based out of Austria, and can be enriched by adding different countries to it. The study is also business management focussed, and by incorporating other fields of education (e.g. engineering) it can be further enriched

Objectives of the study

High quality Engineering Education corresponds to a set of requirements: not only it is an aspiration of millions of students, it is also the backbone of industrial development in the context of India that needs a driving force led by a skilled workforce. As the country positions itself as a knowledge economy, it has seen a tremendous spurt in the number of educational institutions, especially, engineering institutions. However, there are increasing concerns about the quality that makes it important to reflect on the nature and content of the growth and the direction that it has taken. Engagement with TQM as a conceptual framework for Engineering education, therefore, opens up a new vision for Engineering education indicating concrete pathways to enhance the quality of such education which is of relevance for the entire country. This study will explore this engagement of TQM with the quality of engineering education.