(almost 80%-90%) and are also beset with many rigid constraints. Considering such college, the concept would help other colleges as contingent situations will be identical. Therefore a case study of detailed gap analysis is conducted in RYM Engineering College, Bellary. The relevant data was collected from Students, Teaching faculty, Non teaching & Administrative staff. The sample survey included all the departments in the college. For the student’s survey, only pre final & final year students were considered, as it was felt they had better understanding of the system in comparison to their counter parts. The questionnaire was administered to students taking stratified random sample. The response rate was 63.1% (142 Responses out of 225 distributed). In the faculty category the response rate was 68% (103 out of 152) and 40% (53 out of 132) in the non teaching & administrative category. The methodology used for assessment of the environment in the case study can be generalized for other engineering colleges.

Gap analysis established the scope that was available for improvement, progress that was taking place and gave an indication of culture that prevails. Also, it highlighted, what constitutes excellence in an educational institute, as perceived by the stakeholders and based upon which the Strategic planning is suitably designed and a comprehensive framework with micro level operational constructs for adaptation of TQM in engineering colleges has been developed.

Thus, Total Engineering Education Quality Management (TEEQM), a framework and a methodology to adapt and institutionalize TQM in engineering education is evolved in this thesis. It presents a comprehensive methodology for implementation of TQM. The work is carried out in two stages namely pre-strategic analysis and post-strategic analysis:

- Pre-strategic analysis involved extensive literature survey, questionnaire survey in engineering colleges of Karnataka on relevant issues like ISO study and feasibility study on TQM, gap analysis and ended up in formulating a strategic plan.

- Post-strategic analysis consists of development of operational micro-level frameworks for TMC assessment, implementation and evaluation of Continuous improvement, Customer satisfaction and employee
participation and also includes suggestions on creating quality ambience in the engineering education system.

The unique aspects of this thesis include development of modus operandi for making the institutionalization of the TQM/Continuous Improvement process. The operational framework for the implementation of TQM in the system is arrived at, by the development of constructs at different levels, to set up the TQM/Continuous Improvement process. The constructs are designed to enable the institution to self-assess the status of quality related aspects. These constructs developed, would aid in systematizing and standardizing the framework for TQM implementation. The framework developed is made as generic as possible.

The methods adopted were, extensive literature survey and content analysis, personal interviews, Delphi study on ISO, Feasibility study on assessing the scope of TQM application, Structured questionnaire to perceive the preparedness for TQM implementation, Gap analysis, Ishikawa method to develop cause-effect relations, Developing constructs that facilitate institutionalization of the TQM process through standardized procedures in important areas like Top Management Commitment, Continuous Improvement, Self improvement, Customer focus, etc.

The detailed summary and conclusions of the study are presented herewith.

9.1.1 Literature review conclusions:

In order to identify the key issues related to TQM concept, literature is scanned. The literature review mainly brings to fore the issues related to basic concepts of quality and TQM, approach and need for TQM in education, its application in different parts of the world, and also its application in different facets of the educational system. The success and failure results, along with the difficulties encountered, are discussed. It reveals that, emphasis has mainly been, on the application of TQM in service oriented areas and less in the teaching pedagogy. It is observed that Total Quality Management concept is new to Indian engineering education system, as there are hardly any implementation studies. Also, literature is inadequate in terms of the modus
operandi of implementation of TQM process. There are no established procedures or strategies to implement TQM in engineering colleges. There is a lack of a well-defined focus and an appropriate roadmap for institutionalization of TQM process. Therefore it became necessary to develop a framework for implementation of TQM in engineering education.

9.1.2 Delphi study on ISO 9000

The Delphi study on ISO 9000 in Engineering colleges of Karnataka was carried out through a survey, to understand the situation and scenario of ISO 9000 certifications. It encompassed around 40 different items. The questions were mainly centred on purpose, effect on the working culture, essential requirements needed for the change, hurdles in implementation, after effects, sustainability of the ISO certification etc. Some of the important findings surfaced for quality environment are: necessity of awareness emphasizing the purpose; everyone’s involvement through proper dialogue; systematized education and training; understanding the culture and tailor making it to the organizational purpose; transparency and appropriate empowerment; sustained top management support etc. Also there is a need for constant encouragement and motivation of the people involved and capitalize on the intangible benefits like, changing work culture, self improvement, organized working etc. The study gave preliminary guidelines and cautions. While making a quality initiation in the education services, these are very much useful so that quality movement commences on a firm footing.

9.1.3 Feasibility study of TQM in engineering education:

This study was carried out through a questionnaire survey amongst the Directors, Principals, Professors related to the engineering education in Karnataka. There was a positive response regarding the need for TQM in engineering colleges and they considered TQM as a boon, but there was skepticism in its realization because of inadequate knowledge of realization and lack of awareness in the people about the TQM paradigm. It was observed that, lack of strategic focus; poor investment in the infrastructure and staff training; insufficient co-operation makes the TQM implementation more difficult.
This study also investigated whether the colleges know what skills, the employers and the society demands from students. It was observed that the skills that were emphasized in the college and that expected by the industry vary greatly. In particular, institutions emphasis is more on computational, analytical, application of scientific and quantitative principles; where as, industry emphasis is more on seeking appropriate information needed to make decisions, project management, industrial training, leadership, organizational capabilities working in groups, accept responsibility for the work. The emphasis on these can be formalized through integration of learning organization and knowledge management as a part of the quality culture of the organization.

The study establishes that, human resource development and their continuous improvement plays a vital role in initiating the quality movement. It was observed that, teacher's role as a mentor is very vital, in fact more important than the infrastructural development and the factor that determines the educational effectiveness is the high commitment and motivation of professors, and the other teaching staff. Their intellectual involvement will sustain and guarantee quality. But often there are unstated human needs and expectations such as recognition, reassurance and status. These needs are difficult to quantify, but cannot simply be ignored when setting the standards. Hence a very careful look at these internal customers is important. Though the treatment of teaching and non-teaching faculty as customers were ranked last, nonetheless they are very much essential. Only the satisfied fraternity will be motivated to teaching. This aspect is clearly evident when one considers the premier institutes like Indian Institutes of Technology, where flexibility, freedom and campus life for everyone obviously drive the dedication. Hence, there is an ardent necessity to look at the interests of the internal customers.

The study also reveals that some of the factors essential for making teaching profession attractive were, Standardization of the selection process; Selection of faculty based on merit and professional outlook; Faculty drawn from industry or retrain the faculty in industry on a regular basis; Improve the status and image of faculty in the society; Facilities for employees comparable to that of industry; Indicators for assessment of faculty and so on.
From the remarks of the panelists, it was clear that every institution needs to develop its own indicators of assessment, which should be contingent to the situation in terms of its input quality, its location, its experience, and the internal evaluations that aid in increasing the efficiency of working. The measures set up, should not be used as a tool to punish or relegate someone, but instead should be used for motivation, to find some thing better in the existing, which could be shared, so that the employees have confidence in the indicators and the evaluation. Gradually, institution itself can set up some awards based on the score obtained on peer evaluation of faculty.

The study exemplifies that some of the factors that facilitate an effective implementation of TQM in engineering education are intention to go for ISO certification; Accreditation; Dedication of the Top Management; Training the employees; Employment of staff with higher qualification, Quality and professional attitude; Initiation of strategic planning, and enhancing the Industry institute interaction.

The study brought out that some of the factors that hinder implementation of TQM in education are, Lack of ethics and value; Rigid university system; Lack of awareness of both the management and the employee's; Top management not ready for investment; Lack of Infrastructure; Lack of Commitment and Dedication; Lethargic attitude to change; Emphasis only on teaching and not on skill building; Low morale and Peer jealousy etc.

Based on the above findings and critical analysis of the questionnaire survey, faculty interview, and literature review, a model called “Total Engineering Education Quality Management (TEEQM)”, has been developed which facilitates institutionalization of TQM and setting up of a TQM culture.

9.1.4 Gap analysis and strategic planning - A case study

The TQM framework thus developed was based only on the opinions of the experts, but what problems are actually faced while initiating the quality movement in the college needs to be assessed, based on the factual data and the modus operandi should be tuned to contingent situations existing in the college.
Hence a case of a private self financing engineering college, coming under the purview of a university setting was considered as they form the major chunk of the institutes (almost 80%-90%) and are also beset with many rigid constraints. Considering such college, the concept would help other colleges as contingent situations will be identical.

The chapters V and VI present the effort to demonstrate a case of implementing TEEQM methodology in an engineering college (RYM Engineering College Bellary). It includes identifying the needs of customers and comparing with the present status of the college i.e., gap analysis and developing the strategic plan of the college through SWOT analysis and other strategic tools.

Environmental scanning of the institution is the primary task, before TQM implementation. The scanning was essential from the perspective of using methodologies that suit the conditions. The scanning has to be based on the survey of the stakeholders of the institution. Therefore a feedback survey is conducted in the case study mainly from the students, faculty, non-teaching and administrative staff to assess the conditions that exist. Objective of the survey was to get the actual situation prevailing in the institute, so that the TQM could be tuned based on the culture prevailing. The survey encompassed the areas like Resources and Service at the resource points; Teaching Effectiveness; Interpersonal Relationship; Dedication & Attitude at the different levels in the organization; Positive, Negative Aspects of the college; Role of Management; General Impression, Past, Present and the Future; Immediate requirements needed for the college development. This case study offered some important lessons for TQM initiation as it provides the details of the parameters, thus deduced, that would aid in achieving educational excellence.

Gap analysis established the scope that was available for improvement, progress that was taking place and gave an indication of culture that prevails. Also, it highlighted, what constitutes excellence in an educational institute, as perceived by the stakeholders and based upon which the Strategic planning is suitably designed satisfying as many stakeholders as possible and keeping alive the movement. The strategic plan prepared through a workshop involving top
management, teaching and non-teaching staff is presented. Suitable strategic tools are used to track the need, like SWOT analysis, cause effect relations, vision and mission statements as well as identification of thrust areas for development. The methodology used for assessment of the environment in the institution can be generalized for most of the colleges.

The next phase, post-strategic analysis, concentrates on development of key parameters of TQM like operational methodology, performance measurements and feedback mechanism of top management commitment, continuous improvement and customer focus. This phase, presented in chapter VII, is conceptual in nature and identifies the indicators for measurement as well as systems for implementation.

9.2 Development of TQM Framework

A comprehensive operational framework for adaptation of TQM in engineering institutions has been developed commencing from Strategic planning to the operational constructs. The developed conceptual framework is comprehensive, systematic, flexible and one that gets institutionalized in an educational institute. The Micro level operational constructs are developed for assessment of different aspects of TQM in the institute like, Top management commitment, Continuous improvement, Knowledge sharing groups etc.

The basic points that were considered for construct development are:

i) Constituents of construct  
ii) Construct Assessment  
iii) Who has to administer the questionnaire  
iv) Members of questionnaire design  
v) What is the limiting/ minimum score in each point and what is weightage for each of the item.

The constructs were developed for continuous improvement of teaching pedagogy (through the knowledge sharing groups, laboratory, library and infrastructure quality), customers satisfaction (service quality through quality circles, placement, personality development).

Well defined proforma’s are designed viz. TMC Assessment, operationalization of Knowledge Sharing Teams (KST’s); Sustenance of the
momentum and efficacy of the Quality Circles (used for Service Improvement) and also the roles of the quality steering committee.

These constructs and proforma's helps to formalize all the activities in the educational system that leads to academic excellence and also a means for recording, documenting and controlling. This documentation ensures to understand the quality objectives, smoother interaction and transmission of the knowledge for others to follow and would aid in tailor making the institutionalization of the TQM process in the system.

9.3 Quality ambience in the Engineering Education system

Range of issues that could be taken up to create quality ambience in the Engineering Education System are discussed/suggested in detail in this chapter viz., Strengthening institutions to improve learning outcomes and employability of graduates, Improvements in Teaching, Training and Learning facilities, Enhancement of Research and Consultancy activities, Faculty and Staff Development for Improved Competence, Institutional Management Capacity Enhancement, Implementation of Institutional Reforms, Governance system with participation of stake-holders, Industry- Institution-Interaction Cell (I.I.I.C), Keeping pace with the changing needs, Knowledge Engineering methods etc. There is a need for ensuring quality and integrity through these consistent policies. These measures improve the quality of the engineering education and enhance existing capacities of the institutions to become dynamic, demand-driven, quality conscious, efficient and forward looking, responsive to rapid economic and technological developments occurring at the State, National and International levels. These measures have a clear focus on the objectives to improve the overall quality of engineering educational institutions.
9.4 Scope and Limitations of the Study

9.41 Scope

The study is directed towards the quality of engineering education in Karnataka state particularly in purely private engineering colleges and private engineering colleges partially aided by government which are affiliated to a university. Here, government institutions are not considered because their status, situation, and environment are entirely different to that of private engineering colleges. It is difficult to identify common factors among these categories of institutes. The government engineering colleges, though affiliated to university differ with the private and private-aided institutions in the funding, administration, as well as in the working environment.

Therefore, this study is focused on the private and private aided institutions only, as they almost form 80% - 90% of technical institutions. The data was collected from the engineering colleges of Karnataka state and the college chosen for the case study is a private Engineering college. However, the principles and directions of implementation of TQM can be applied to other categories of colleges also by minor modifications to suit their environment.

9.42 Limitations

Study on ISO certification and TQM in engineering colleges through a Delphi study and questionnaire survey is carried out at an aggregate level, to ascertain the status, purpose and difficulties involved, to be used for devising the TQM implementation strategy for a service organization like education. Data gathered from the questionnaire are subjective and due to ambiguity in the voice of respondents data analysis might be affected and hard to interpret.

The scope of the thesis is mainly for colleges under the purview of University setting, belonging to Karnataka state only.

Only one college has been considered to assess the environment prevailing to design the modus operandi for setting up a Continuous Improvement process and there by the setting up of TQM culture in the
institution. This model could be used by suitably changing the questionnaires contingent to college under study.

9.5 Scope for Future Work:

The application of this model could be further extended to other service oriented organization like, Research laboratories, Medical colleges, hospitals, and other educational organizations. Also the work could be continued to find its impact at the school level.

These instruments or constructs have to undergo extensive testing and verification for its actual usage, and ascertain the structural validity thereby substantially enhancing the validity of TQM adoption process in education.

Also the knowledge base of the user could be incorporated, where the construct items could be added or deleted online and the weightages for each of the item could be made dynamic contingent to the additions or deletions, which results in constructs that are relevant in respective cases.