CHAPTER-5

DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

Discussions and Conclusions

With responses from over 800 stakeholders obtained across the spectrum, this research is very important to adding the multiple stakeholder dimensions to the body of knowledge, and doing so with a specific emphasis on the situation in Punjab and Chandigarh.

Evaluating Total Quality Management as an approach that can create a positive and long lasting, sustainable effect on the quality of engineering education, studying in depth the various elements that constitute TQM and their relevance to the situation in Punjab and Chandigarh has given new insights. Studying the interplay of the TQM dimensions with dependent variable attributes that are likely to get affected because of such an approach has demonstrated linkages that can be joined to create a model for enhancing the quality of Engineering Education. It has also provided a prioritized set of elements that have the most significant effect on the dependent variables. Total Stakeholder Involvement and setting up of a Quality Management system are the top two important elements of the approach. These substantially, and positively affect academics, the teaching and learning process, corporate connect, placements, faculty research and publications and the overall infrastructure.

The study addresses the research questions which lead to the three research objectives as under:

- Objective 1: To what extent do the present institutions located in Punjab and Chandigarh reflect components of TQM?
- Objective2: To evaluate the existing system in terms of skills, employability, industry relevance, specifically in Punjab and Chandigarh.
- Objective 3: To design a model for providing Quality Technical Education in Punjab and Chandigarh.

Objective 1 is addressed through Research question 1, which is about the existing system of Engineering Education (EE) in India with reference to Punjab and Chandigarh.

Objective 2 is addressed by Research Question 2, which covers faring of the existing system fare in terms of skills, employability, industry relevance, specifically in Punjab and Chandigarh.

Similarly, Objective 3 is addressed by Research questions 3 and 4, which cover the manner in which the present institutions could include components of TQM Objectives to improve the quality of education

Indian technical education has come a long way since 1947, when there were approx. 2500 to 3200 engineers graduating annually from a handful of engineering colleges.

India is now producing not only a much higher number of engineering graduates than it did nearly three decades ago, She has also augmented the number of enrolments in its elite institutions such as the Indian Institutes of Technology (IITs) and the National Institutes of Technology

(NITs) through rapid and wide scale expansion. Enormous increase both in number of Institutions and the number of seats took place starting with late 1990s and up to mid-2000s.

In addition to the Indian Institutes of Technology (IITs) and the Indian Institutes of Management (IIMs), Indian Institutes of Information Technology (IIITs) and additional National Institutes of Technology (NITs) were set up. Additional institutes for undergraduate education and additional polytechnic institutions have also come up. The growth in number of non- elite institutions and the seats therein has been much more. These are the other categories of institutions, most notably private engineering institutions all over the country and other government run institutions.

As per the AICTE, there are 6275 institutions in India offering engineering and technology programs in 2018-19, with a total intake of 2,712,311 (website accessed on 10-Feb-2019). Out of these, there are 239 in Punjab and Chandigarh combined, with a total intake of 94,308 students.

This covers degree programs (undergraduate as well as post graduate) and Diploma programs. This also covers all types of institutions, viz. Institutions of National importance, Central universities, Government institutions, Private institutions, Unaided-private institutions, University managed and affiliated – private institutions, University managed and affiliated Government institutions, Government aided institutions, Deemed universities (government) and Deemed universities (private).

However, beyond the numbers, the issue of poor quality and wide variation in outcomes continues to exist even in the engineering discipline. Skill gaps and Employer dissatisfaction are rampant. Many engineers are considered unemployable. Questions are raised on the quality of such education compared to that in other countries, especially in the west.

In addition to varying perceptions on quality, the current model of education is considered to be content heavy, involving a lot of information and testing with inadequate

emphasis on experiential learning, real world exposure, industry needs, problem solving and creative intelligence.

Certain other studies point to growing skill gaps resulting not just in unemployment but also in employer dissatisfaction (Latitude Group, 2013). 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 and other Western countries.

It has been explained in Chapter 3 how the sample design had been formulated for this study carried out in the states of Punjab and Chandigarh, using non probabilistic stratified sampling approach, which is the suitable approach for Explorative research study.

Resolution of the Research problem:-

A wide variation in the quality of education is observed across engineering institutions (as seen in areas such as placements, faculty quality, curriculum, infrastructure, industry exposure and employability).

TQM is a holistic approach that has been able to improve the quality of products and services, leading to total stakeholder satisfaction, as experienced in Japan and other countries.

This research studies the relevance of the TQM approach in the context of quality of engineering education.

After studying the importance and relevance of TQM, and based upon analysis of the data collected, a model for total quality management in engineering education with reference to Punjab and Chandigarh is proposed to be evolved.

Research Questions Contents and their resolution towards meeting the Research Objectives.:-

1) Existing system of Engineering Education (EE) in India with reference to Punjab and Chandigarh? (classified as R1)

f) The scope/ landscape of EE in India today.

g) Evolution of Engineering Education post- independence in this area.

h) Frequency of curriculum updated

i) The present state of industry- EE institution interface.

Whether the existing system is able to deliver 'competencies' with reference to

i) Use of modern training technologies including distance learning, web based learning

ii) Initiatives for faculty skill upgradation

iii) Norms for quality assurance.

2) Faring of the existing system fare in terms of skills, employability, industry relevance, specifically in Punjab and Chandigarh? (classified as R2)

h) Conceptualization of stakeholder satisfaction in the Institutions and the extent to which the systems are oriented to 'customer/stakeholder-satisfaction'.

i) Identification of the processes to mobilize stakeholder participation in the process of quality enhancement.

j) Communication mechanisms at the institutional level.

k) Engagement of the institution(s) in making process-related changes to improve quality. Mechanism of monitoring of the performance of different processes.

l) Initiatives undertaken to integrate different aspects of institutional functioning and specialties.

m) Existence of a planned process of strategic planning in the Institution and whether quality enhancement is a feature of such planning. Existence of evidence based decision making processes?

n) Initiatives for sustained quality improvement.

3): The manner in which the present institutions could include components of TQM Objectives to improve the quality of education? (classified as R3)

b) The extent to which a TQM based approach could be integrated in the present institutions imparting Engineering Education?

Benefits of adopting TQM based approach with regard to such aspects as

i) Employability

v) Appropriate skill development

vi) Industry linkage

vii) Stakeholder satisfaction

c) Key challenges in adopting/implementing a TQM based approach to Engineering Education.

4) Development of a model for providing Quality Technical Education in Punjab and Chandigarh. (classified as R4)

c) Essential components of the model.

d) The manner in which such a model can be put to use and mainstreamed across different types of institutions imparting engineering education.

Meeting the Research Objectives through the Research Questions:-

After study of the landscape of engineering education, one of the most commonly identified challenges, namely the relevance of engineering education to the industry and industry academia interactions, was explored in detail. The observation that the subjects of prime importance to industry are in wide variance with what is taught in the classrooms is also a common one.

In the study, when asked whether their institutions facilitated interaction with various industry bodies such as ISTE, NASSCOM, about 48% students answered in the affirmative while 23% disagreed. About 40% agreed that industry experts were invited to the college. When asked whether they were taken for industrial visits to various establishments, only 26% students agreed. About 28% students said they were taken to industries for interaction with experts and for training and interaction. The response levels were consistently poor across the type of institutions, with top 100 and private institutions faring marginally better than government institutions, which registered the lowest scores.

Another important area covered was a dynamic curriculum based on changing industry needs. Many of these initiatives involve students as well as faculty and enable an upgradation of skills for both categories of stakeholders.

In the study, when asked whether the curriculum and course content has been the same for many years, only 148 out of 589 valid student respondents disagreed. Most agreed. This means that the majority view was in line with the fact that curriculum has been pretty static over the years. The response from faculty respondents is also

pointing to a similar trend, with 72.6% of faculty respondents also agreeing to the fact that the curriculum has been the same for many years.

Summarizing objective 1, while there is a significant increase in the number of institutions offering engineering education in India, there are several challenges around their quality, covering aspects such as curriculum, relevance to the industry and faculty quality ; essential requirements for a TQM approach. These are also true for Chandigarh and Punjab, where the quality of engineering education and adoption of TQM approach have not kept pace with the increase in quantity.

Objective 2: To evaluate the existing system in terms of skills, employability, industry relevance, specifically in Punjab and Chandigarh.

The Objective is addressed through the research question regarding the existing system faring in terms of skills, employability, and industry relevance, specifically in Punjab and Chandigarh.(Research Question R2)

The present education system in India has multiple experiences in terms of skills imparted, skills needed, employability of graduates, relevance of the curriculum to industry and relevance of skillsets of students to industry. Many of these factors are attributable to, and outcomes of, the quality practices being undertaken by respective institutions.

Multiple studies, including this study, have highlighted the need to identify and engage with different sets of stakeholders including management, faculty, industry and students for this purpose. Engaging with multiple stakeholders is also one of the primary principles of Total Quality management (TQM) and its related aspects.

As a management approach, TQM calls for a strong customer-focus organization and involves all stakeholders with a view to achieve continual improvement. The other

important components of TQM include complete stakeholder engagement, process orientation,a well coordinated and integrated system, a systematic approach, strategies for continuous feedback based improvement and a strong decision making process.

In this study, when asked whether their institutions facilitated interaction with various industry bodies such as ISTE, NASSCOM, only 48% students answered in the affirmative.

Of the students surveyed, only 40% agreed that industry experts were invited to the college. About 28% students said they were taken to industries for interaction with experts and for training. The response levels were consistently low across all types of institutions, viz. Top 100 institutions, Private Institutions and Government institutions. Out of these three categories of institutions, the students of top 100 and private institutions gave better scores that students of government institutions, which registered the lowest scores.

In the study, students' overall response on the continued interaction of the college with the industry does not present a very good picture. When specifically asked if the institute keeps in touch with students and gets their feedback after they have joined industrial establishments, only 32.7% of the respondents agreed. Within the responses, students from private colleges believed this was done the most, those of government colleges felt this was done by their faculty members the least. When asked whether the faculty visits and interacts during their industrial training and internship, only about one third of the respondents agreed.

In the study, a different perspective comes in from faculty members. The Faculty members overwhelmingly (92.7%) agreed that they teach with the help of practical

examples. Over 88% also agreed that they cover practical work in various subjects which has a good coverage. In terms of communicating with students, 91.4% of faculty members said they find it easy to communicate and interact with students. These statistics represent a very different picture from the perception of students and the qualitative feedback received from members of the industry, thus pointing to a difference in stakeholder perception on the same issue.

While talking of research and publications, in the study, 71.9% of faculty members agreed with the assessment that they were allowed to do research and publish papers. Further 78.4% said they were also encouraged to present them in conferences and other external forums. Over 75% of faculty members said ‘yes’ when asked whether they underwent refresher courses and development programs. A very high 85% believed that being a faculty member allowed them to learn new things while they taught. More than 88% also admitted to liking teaching and having a good aptitude for teaching. The figures above point to a very high perception on faculty scores. The issue arises when we compare these perceptions with other scores and the perception of other stakeholders, viz. students, which is quite different from that of faculty.

Sustained quality improvement entails quality monitoring mechanisms within the organization. In the study, of the students, when asked if there is a quality monitoring mechanism in their institution, 210 respondents agreed, while 180 did not. The others were neutral. This implies that while some institutions have such a mechanism, several others do not. In some, wherever response is neutral, we would assume that even if such a mechanism exists, students are unaware of itsexistence, and possibly, its impact.

These summarize the Objective No. 2 of the study.

Objective 3: To design a model for providing Quality Technical Education in Punjab and Chandigarh.

This objective is addressed by the study through its research questions on ways the present institutions include components of TQM Objective to improve the quality of education and a model for technical education in Punjab and Chandigarh.(Research Questions R3 and R4)

The study looked at the high number of engineering institutions that have come up in the last few years and the incongruence of quality with quantity.

In the study, Continuous monitoring and evaluation came up as a key element of the quality approach. When students were asked whether their performance was evaluated on a continuous basis, over two-thirds agreed to the same. The faculty perception on this was also similar to students, with over 85% faculty agreeing that student performance was being evaluated on a continuous basis. Ironically, through discussions with stakeholders, the things that they were being evaluated upon continued to be pretty much similar over the years, pointing to gaps in the curriculum being tuned to the needs and expectations of students and the industry.

In the study, while most students said they were being continuously evaluated, their response was not so when asked whether the institute had a regular and well established system of taking feedback from them for continuous improvement. Less than half of the total (44.6%) respondents answered in the affirmative. However, a very wide difference was noticed between respondents from the three type of institutions, viz. government, private and top 100 institutions. Government institutions got the poorest scores from their students, while the other two categories had a relatively

better response. Feedback mechanisms and continuous improvement are key aspects of the TQM process and this response gives the perspective of students on the same. Interestingly, when asked the same question on how they viewed the situation, faculty members had a very different view. Most of them (71%) agreed with the statement that the institute has a well- established system of taking feedback from faculty members for improvement on a regular and continuous basis. The responses were consistently high across the categories of institutions, unlike in the case of students.

In the study, when it was asked whether the institute has an open and transparent system of two way communication between students, faculty and other stakeholders (top management, industry), about 40% of students agreed. Comparatively, about 66% of the faculty respondents agreed, a much higher percentage . Here too, within the student population, students studying in government institutions had lower scores.

The other question related to TQM in the study in Punjab and Chandigarh covered the institute benchmarking its performance and stakeholder satisfaction against other institutes offering engineering education. 44% students agreed, compared to 73% faculty members.

In the study, it was also asked whether the institute has a well-established quality management system that works towards improving the quality of its offerings. In response to this, 42% of students agreed, whereas 73% faculty members were in agreement.

The above four comparisons point to multiple contrasts on stakeholder perception on the TQM dimensions. This is a very important outcome of the study. Reconciling the varying expectations and perceptions to create truly aligned institutions for these two critical categories of stakeholders is of paramount importance.

The study addresses this research objective by outlining the essential components of a model to provide quality technical education in engineering institutions. The study also explores the ways to implement and mainstream such components across institutions imparting engineering education.

The following model is shown for providing quality technical education in Punjab and Chandigarh.

This is depicted from the standpoint of perception of students and also from the perception of faculty.

As per the perception of students, Quality management systems and Continuous improvement are the two most impacting aspects of Total quality management. They impact faculty quality, placements, infrastructure and curriculum and industry connect the highest. This is followed by the total stakeholder involvement and benchmarking elements of TQM.

Quality management systems have the highest impact on faculty quality and placements. This is followed by the TQM element of Continuous improvement impacting infrastructure, followed by Quality management systems.

Model as per perception of students :-

In Tables 18 and 19 and Figure 4 and 5, the inter relationshitp of TQM Independent Varibles and Dependent Varibles has been shown.

The table below shows the relationship between the Independent TQM variables and the Dependent Variables in decreasing order of Impact. The maximum effect is of Quality Management System (QMS) on the Faculty Quality, followed by its effect on Placement and Career Counselling. The next best effect is of Continuous Improvement on Infrastructure followed by the effect of QMS on Infrastructure and on Curriculum and Industry connect.

Table 31

Effect of TQM Element on dependent variables

TQM Element (Independent variable)	**Students (Dependent variable)**	**Students-Original Sample (O)**
Quality Management System	FACQ - Faculty	0.370
Quality Management System	PLCA - Placement	0.360
Continuous Improvement	INFR - Infrastructure	0.330
Quality Management System	INFR - Infrastructure	0.280
Quality Management System	CIND - Curriculum and industry	0.270
Continuous Improvement	PLCA - Placement	0.240
Total Stakeholder Involvement	FACQ - Faculty	0.180
Continuous Improvement	CIND- Curriculum and industry	0.180
Total Stakeholder Involvement	CIND - Curriculum and industry	0.160
Total Stakeholder Involvement	PLCA - Placement	0.160
Continuous Improvement	FACQ - Faculty	0.160
Benchmarking	CIND - Curriculum and industry	0.140
Benchmarking	FACQ - Faculty	0.120
Benchmarking	INFR - Infrastructure	0.100

Model as per perception of faculty:-

The results obtained in the model, organized in descending order of relative importance, are as follows:

The highest effect is of Total Stakeholder Involvement on ACC, i.e. Academics and Curriculum, Corporate connect and the least is of Total Stakeholder Involvement on Infrastructure. Benchmarking, in the case of Faculty, has no effect on any of the Dependent Variables.

Table 32

Effect of TQM Element on dependent variables

TQM Element (Independent Variable)	**Faculty (Dependent Variable)**	**Faculty- Original Sample (O)**
Total stakeholder involvement	ACC - Academic and corporate connect	0.39
Quality Management System	Faculty (TLP - Teaching and learning process)	0.34
Quality Management System	INFR- Infrastructure	0.32
Total Stakeholder Involvement	Faculty (RP - Research and publications)	0.29
Total Stakeholder Involvement	PLC - Placement	0.27
Quality Management System	PLC - Placement	0.26
Continuous Improvement	Faculty (RP - Research and publications)	0.21
Continuous Improvement	INFR- Infrastructure	0.21
Total Stakeholder Involvement	INFR- Infrastructure	0.19

This summarizes the Objective No. 3 of the study.

All the three objectives of the research have thus been addressed as above. In addition, several important recommendations are included in the study. The study also lists possibilities of extending this research from a geographical standpoint, from a larger number of stakeholder standpoint and from a longitudinal time scale standpoint.

Just like the principles of TQM, this research is the beginning of a journey that enables a better understanding of the aspects that impact the quality of engineering education. It is hoped that this improved understanding will lead to management commitment and specific actions that will impact the quality of engineering education in a positive manner for the entire set of stakeholders.

Limitations of the Study:-

Geographical-

The study was undertaken in selected institutes in Punjab and Chandigarh. This is a geographical limitation. . A wider, more geographically broad based study will be more comprehensive.

Sample size-

One of the limitations of the study, is the sample size, especially in the case of stakeholders such as parents, top management and industry.

Industry-

The industry interactions were carried out mostly with representatives of the industry in Punjab and Chandigarh. It is important to note that many students from institutions in these area go and work in other parts of India (and some, outside India) after

completing their studies. Feedback from industry representatives in that area can enrich the quality of such a research.

Recommendations

Total Quality Management as a management approach is likely to enable and positively facilitate the quality journey for engineering institutions. Use of this approach will certainly lead to better outcomes and stakeholder satisfaction, not just from the perspective of the long-term, but also of the near term. .

TQM being a holistic approach necessarily requires all stakeholder perspectives to come together in the spirit of continuous improvement. Therefore, the journey starts with full stakeholder involvement as the first step. It is important to get these key stakeholders, viz. students, faculty, parents, industry representatives and the top management together, in the spirit of open and transparent dialogue. By laying down expectations, each stakeholder benefits from the perspective of the other and looks at his own actions in the right spirit and context.

With the total stakeholder perspective in place as a first step, there needs to be a management commitment to putting in place a quality management system. This system would encompass multiple aspects on the elements of TQM, thereby impacting the multiple variables studied in the research.

Setting up of this system needs management commitment and a long term view. It also needs open dialogue, transparent communication and continued feedback across and amongst the stakeholders. The setting up of this process will enable the journey to remain on track and the system to constantly seek ways of continuous improvement.

It is important to note that TQM is a management system. . As the organization commits to TQM, there are also corresponding actions that will get impacted by having TQM, and by certain additional actions that might be needed.

This study has given some additional areas which are recommended to improve the quality of engineering education –

a. Curriculum – Needs to be dynamic and constantly updated. It needs to reflect the needs of the industry and growing trends in technology. The design needs to be carved out in consultation with stakeholders across the spectrum, including students, faculty and industry representatives. There needs to be a greater element of the 'practical' than the theoretical.

    i. In addition to the technical skills in engineering, the curriculum needs to include communication, soft skills, attributes of collaboration and teamwork. An emphasis on well rounded development of the individual is important, rather than a theoretical emphasis on technical subjects.

    ii. It is important to keep in mind that the person graduating is not just someone who holds an engineering degree or a diploma, but someone who is expected to be a thriving and contributing member of a highly interconnected, and interdependent society. Therefore, an emphasis on a holistic approach to individual development is necessary.

    iii. Integrated and holistic view, covering different and upcoming aspects of technology is very important. For example, programming and coding might not just be a requirement for computer science engineers, but for everyone operating in the engineering domain. Familiarity with machine learning, data analytics, artificial intelligence, integrated approaches such as the 'IOT' (internet

of things) is a basic requirement for operating in the technology domain of tomorrow. The conventional boundaries between branches of engineering are also blurring, hence, the full perspective is all the more important. A car, for example, which would be conventionally falling in the domain of mechanical and automobile engineering, today has a huge amount of programming and electronics built in. Making or designing a car today is as much about familiarity with computers, electronics and programming as it is about automobile engineering.

iv. Global preparedness: As the world becomes more and more interconnected, supply chains become more complex and can span across different parts of the world. Even if one is working in India, the goods or services one is working on could be used in other parts of the world. Likewise, being in India one could be a consumer of goods and services produced in some other parts of the world. Therefore, the ability to work, collaborate and contribute in an increasingly global and interconnected world is a key success factor for the engineers of tomorrow. Inculcating this preparedness, through a combination of classroom learning, face to face interactions and hands-on projects is a key aspect of the curriculum of tomorrow. Tie-ups with institutions outside India, and programs like student exchange would significantly enhance the exposure and perspective of students.

b. Industry interactions- This has come up as one of the big gaps from a multiplicity of stakeholders. Enhancing industry interactions and including the industry perspective in the academic processes is the key to de-compartmentalize the silos between industry and academics. There are several pragmatic and creative ways in which this can be achieved. This is a weak area and there is no end to the possibil-

ities of enhancing the quantity, as well as quality of these interactions. The quality management principles of total stakeholder engagement will need to be ensured so that the industry perspective is provided to students as they journey through the engineering course. An important aspect to note here is that if this is implemented in the right earnest, the industry also has a lot to gain from these collaborations. They can run pilot projects, undertake proof of concept (POC) work on key ideas and solicit inputs for research and development from academia. There are multiple ways to keep these interactions an ongoing affair, and they need to be integrated into the curriculum. It is important for institutions to be constantly strengthening the linkage among students, faculty and the industry. This is very important not just while a student is journeying through a course, but it is important also to keep getting feedback from him after he completes studies and joins the industry.

c. Faculty – The faculty are a key stakeholder in running most processes while students are going through an engineering course. Not only is it important for the faculty to be competent, it is also important for them to be genuinely interested in teaching and academics. Therefore, a career in academics must be seen as a credible and compelling choice, driven by interest and a zest to make a difference to engineers of the future. It is ironical that to teach in a school, a person needs to have some sort of a teaching certification (such as B.Ed., for example) whereas to teach in an engineering college, no such requirement exists. The framework of faculty selections, aptitude determination, needs to be looked at from the context of total quality management, starting with the element of total stakeholder involvement. Commitment to the faculty's growth, learning and aspiration is very important from the top management's standpoint- without it, any intervention is likely to be unsuccessful. The more the faculty is enabled for research, building

new skill sets, learning new things and constantly upgrading their competencies, the more are they likely to facilitate students for the same. The more it is accomplished for students, the more are the industry representatives likely to be accepting such students. Therefore, a positive spiral comes into effect if the faculty's growth, learning and aspirations are taken care of. Structured, long term mechanisms to enable these are imperative for this to happen.

d. Placement and career counselling- Engineering is viewed as a key milestone in a person's career. Therefore, the right kind of enabling environment, counselling and career advice needs to be inculcated as a structured process. Students look at options in industry, research, academics, government and entrepreneurship as possible areas post-engineering. The right kind of aptitude determination, followed by facilitation into the areas of interest is a key aspect of world class institutions. If this is addressed, students themselves will be proactive participants in the process, rather than being a statistic in the figures many institutions come up with at the end of every year of the course. While placements are a key aspect of a student's journey through the engineering course, the starting point is the right kind of career counselling, advice and guidance. The more an institution has industry linkages and connect with it's own alumni, the more likely is it to come up with successful career outcomes for its students. Not just placements, but also summer projects, internships and coursework linked projects are very important foundations in the career journey of students. Strengthening these through a robust and well thought out mechanism will significantly impact the quality of outcomes for all stakeholders. With an increasing number of students looking at entrepreneurship options, such areas will become very important to building the right skillsets and providing the necessary insights into the working of the 'real' world.

e. Depth vs Breadth for academic course– One of the key questions in any academic course is the question of depth vs breadth. Depth refers to deep insights into a few chosen areas, while breadth refers to a broader perspective of many more things. Both are important, and both have their place in the sun. While management notions of growth are often shown as linked to breadth and leverage, innovation is almost certainly related to depth and deep insights. Research leads to depth, and is often the starting point of innovation and discovery. It is very closely linked to academics. World class institutes treat these in an integrated manner. From the standpoint of engineering education, the right balance to recommend would be 25-30% of the time spent on building a perspective through breadth and the balance on getting deep expertise and depth in a chosen area of interest and relevance. This depth can be built by integrating theory with practice and industry with academia.

f. Quality or Quantity: Many researchers have given their thoughts on this which have been captured in the previous chapters. The proper recommendation is not Quality OR Quantity but Quality AND Quantity. Merely increasing the numbers, be they of students, of enrollments, of number of courses offered, is pointless. The difference is created when all of this is done with a high quality. Therefore, the right management approach, deep commitment to quality and a total stakeholder approach become imperative. A long term orientation, and therefore an approach which puts, in the event of a trade-off, Quality as being the most significant attribute, much more than quantity, is recommended. Therefore, having the right approach and orientation, demonstration of long term commitment is absolutely imperative for the success of stakeholders in engineering and technical education in India.

Implications and Further Study

This study has been carried out in engineering institutions in Punjab and Chandigarh. This study is the first of its kind for the region in that it incorporates the perspective of all stakeholders, viz students, faculty, parents, top management and industry representatives. This has given very valuable insights into the total stakeholder involvement element, and from it, other aspects that determine the quality of technical and engineering education.

The implication of this study is that anyone prospecting an institution, be it a potential student, a potential faculty member, or a potential recruiter of a student who has studied in that institution, will be able to get a good sense of the key aspects of the quality management and their relevance in shaping his choice. The implication for the top management who run these institutions, is to become aware and cognizant of the wide variety of stakeholder expectations and, therefore, build systems and processes that can enable total stakeholder satisfaction. Governance mechanisms can also be embedded in the management processes so that the quality of education imparted can be improved.

Further studies can incorporate more of these stakeholders as data points, and cover a larger part of India. Potentially, a more detailed linkage of student performance in academics with their performance in the industry can be worked out. This can also be measured on a time scale. The time taken for a student to get ‘up-to-speed’ in a work setup after graduation can also be an important aspect to consider.

The financial dimension of going through the engineering course can also be studied further. For example, comparing the return on investment (ROI) of the cost of

education across institutions in a given set of years after graduation can be an interesting point of comparison.

Therefore, the scope for further study presents several interesting possibilities from the dimension of breadth, depth and also on a longitudinal time scale.