CHAPTER 1

INTRODUCTION

1.1. INTRODUCTION

Quality is a concept; it is a philosophy. It helps us in marching towards perfection or excellence. It is a never ending journey, whatever is the superior quality now, and there also exists some chances for improvement. Quality engineering education provides qualified human resources to the nation, training the graduates for a research career for the uplift of society. The successful completion of an engineering graduate depends on the quality of teaching in engineering colleges.

As stated by Mishra (2007) quality in higher education means the education process should ensure that students achieve their goal, satisfy the need of the society and help in national development. Successful engineering education depends on the quality of engineering institution, quality of programmes/branch of specialisation offered by the institution, quality of faculty availability, quality of teaching learning process, quality of management, and quality of students. The successful engineering graduates form a world-class work force that can augment the development of the society or country. Everyone agrees that quality in higher education is important but only a few know how to deliver quality in higher education. Quality is neither optional nor a choice for management but mandatory now for any higher educational institution to survive in this competitive environment. Quality concepts and principles have been taught in engineering
education. Engineering colleges cannot deliver quality education and services unless they have really listened to the students as customers according to Hwarng and Teo (2001). Institutions are needed to practise what they teach as a role model.

The term quality is much used now but less understood. In Engineering Educational Institutions (EEIs), the Principal, Heads of the Departments, Teaching Faculty, Education Planners, Policy Makers, Parents and the entire society want to improve quality with very little understanding of what it is. Quality means

- Conformance to requirements not standards
- Aim at zero defect not acceptable quality level (AQL)
- Approach should be defect prevention not correction or appraisal
- Quality is measured by the price of conformance, or quality cost, not by indexes
- Quality means fitness for use
- Totality of features and characteristics of a product that bears upon its ability to meet stated and / or implied needs
- The (minimal) loss imparted to the society when product is shipped / service rendered

1.1.1 Meaning of “σ”

The symbol “σ” is a Greek alphabet called sigma used to designate the distribution spread (variation) about the mean (average) of any process or procedure or product. The main objective of six sigma concepts is to reduce this variation, “σ” to a great extent.
1.1.2 **Meaning of Six Sigma (6σ)**

Six sigma (6σ) is a metric that indicates how well a process is performing. It is a relentless, ruthless pursuit of the reduction of variation in all critical processes to achieve a continuous and breakthrough improvement through elimination of waste, rework, scrap, non-value added effort, defects and opportunities for defects. The higher the sigma value, the better the process. It measures the capability of the process to perform defect-free-work. Six sigma quality aims at less than 3.4 defects per million opportunities (DPMO) in any process or product characteristics and it is almost nearer to zero defect. Six Sigma quality in engineering education means that engineering graduates are produced with zero defect which means they are satisfying industry and society needs without quality defects.

1.2 **MOTIVATION OF THE RESEARCH WORK**

In developing countries like India any degree in engineering education is a boon to an individual and his family members. It gives them good job opportunities, good salary, and an opening for them to go abroad for lucrative job opportunities. In order to meet this demand of engineering graduates, the Government of India has opened the engineering education to the private trusts /societies to start engineering colleges on self-financing basis. In the academic year 2012-13 as per AICTE (http://www.aicte-india.org), the total number of engineering colleges in India is 3495 including government run, government aided private colleges and self financing engineering colleges. But studies on the employability of engineering graduates in India (http://www.aspiringminds.in) show that only 10 % of the graduates are readily employable in the industry. The low employability demands that the quality of engineering graduates needs to be improved. It is an immediate requirement of regulatory agencies like AICTE and the affiliating University to improve the employability of their graduates. Low
employability, low academic performance but increasing tuition fees and other expenses motivate the research scholars to find a solution for these problems. Many failures in University examinations lead to increase in cost of poor quality (COPQ) to students. This research is aiming at reducing such cost of poor quality in examination process.

1.3 OBJECTIVES OF THE RESEARCH

In order to provide solutions to the problems defined in the previous section, the following were set as the objectives of the research.

a) To investigate the effectiveness of Six Sigma implementations in EEIs especially in private self-financed non-autonomous engineering colleges in India.

b) To create a model that will facilitate the identification of Six Sigma projects in engineering colleges

c) To investigate the practicality of the Six Sigma application in various domains of engineering colleges

d) To investigate the results of tangible and intangible benefits and the method of meeting the requirements of world class standards through the implementation of the Six Sigma in EEIs.

e) To improve the employability of the engineering graduates

f) To improve the academic performance of the students to meet world class standards

g) To improve the quality and competency of the faculty

The above objectives were achieved by doing the doctoral research work reported in the next section as research methodology.
1.4 RESEARCH METHODOLOGY

The methodology followed to carry out this research is presented in Figure 1.1. As shown, the literature review on engineering education in India, quality assurance models followed in EEI, quality improvement methodologies like six sigma, Lean and TQM are studied. In Six sigma methodology DMAIC approach has been studied. Six sigma training, and development programmes have been carried out. The identification of the importance quality attributes and satisfaction quality attributes of customers are essential in six sigma implementation. The importance and satisfaction model has been developed based on Yang (2003) model and studied to apply in engineering colleges in India. Total Failure Mode and effect analysis developed by Devadasan et al (2003) have been studied and applied in engineering colleges for project identification in the define phase. The application of six sigma DMAIC methodology was carried out in an engineering college for the improvement of the employability of the engineering graduates and the improvement of the academic performance. Finally, a model which integrates Six Sigma, ISO 9001, NBA process, Lean and ICT as a University module has been suggested for sustainable control and monitoring of six sigma success.

1.5 SCOPE OF THE RESEARCH WORK

Quality requirement and improvement activities in engineering education took place long ago. In India, the quality assurance models like ISO 9001:2008 QMS, AICTE -NBA process have been practised by many self-financing engineering colleges though it is not mandatory for the improvement of the quality education in their institutions. Despite all these models, the employability of the engineering students graduated from these institutions are very poor as per the report on Employability of engineering graduates in India. So, there is a lot of scope available for this research to find
the reasons for this low employability and take constructive steps to improve it using the model generated for the implementation of six sigma quality management in EEIs.
1.6 LIMITATIONS OF RESEARCH WORK

The results of the efforts carried out in the doctoral work were favorable in terms of the successful practical implementation of Six Sigma in engineering colleges. However, there were a few debacles identified during the pursuance of this doctoral work. First, due to the paucity of time and cost only self financing private non-autonomous engineering colleges have been considered for studying the applicability of six sigma methods. In India, apart from self financing private engineering colleges, there are other categories of engineering college namely IITs, NITs, Government Engineering Colleges, Government Funded Private Engineering Colleges, Universities, Deemed Universities, Autonomous Colleges and so on.

The conduct of student’s feedback survey consumed an ample time for the application of further projects. Second, due to time constraint only a few six sigma projects like employment improvement and academic performance improvement are selected for consideration. The third limitation is that for a sustainable control and monitoring of six sigma success depends on how the engineering colleges and affiliating University uses the suggested University ICT based module. The fourth one is the financial justification of each six sigma project to be evaluated. Despite these debacles, it is envisaged that the findings and contribution of this doctoral work would be helpful in the application of Six Sigma projects in self-financed Private non-autonomous engineering colleges in India.

1.7 ORGANISATION OF THE THESIS

This thesis has been organised into ten chapters. The organisation of this thesis is presented in this section. Following this introductory chapter, the literature review about engineering education in India, employability of engineering graduates in India, studies on six sigma concepts, TQM, Lean
principles and quality tools such as QFD, FMEA are presented in the second chapter. The third chapter portrays the six sigma organisation, roles and responsibilities of various designations with respect to engineering educational institutions. The fourth chapter describes the training and developmental activities conducted for the entire organisation and cultural changes that have been obtained because of the introduction of six sigma organisation structure in the EEI. The fifth chapter presents the development of the Total Failure Mode and Effect Analysis (TFMEA) for EEI and its usage for the project identification and prioritising for quality improvement strategy.

The sixth chapter explains the methodology of assessment of I-S (Importance-Satisfaction) model, the questionnaire design and pilot study. Further this chapter describes the importance-satisfaction survey conducted, and project identified for the implementation of six sigma besides explaining the validation of the survey questionnaire for its content validity, construct validity and reliability. This chapter also demonstrates the hypothesis formulation and the testing of the data by using the statistical techniques namely ANOVA and t-test for a useful statistical inference. In the seventh chapter, the implementation of six sigma in engineering colleges for improving academic performance is explained and in the eighth chapter, improving the employability of the engineering graduates is discussed. The ninth chapter gives results and discussions. Finally in the tenth chapter conclusions are made and the scope for future research has been identified.

1.8 CONCLUSION

The doctoral work reported in this thesis was carried out in the context of applying Six Sigma in non-autonomous self-financing private engineering colleges in India. The results of the literature review conducted in the beginning of this doctoral work indicated that, there were no tools
available for identification of Six Sigma projects in engineering colleges. In order to overcome this deficiency during this doctoral work, the TFMEA model was constructed to identify the improvement areas. The student’s feedback survey conducted also helped to understand their problems. Based on these efforts the vital areas of quality improvement were identified for the Indian engineering colleges. A few vital projects were also chosen and implemented in engineering colleges. These outcomes have revealed the prowess of application of Six Sigma in Indian EEIs. The thesis is concluded by stating that, the Six Sigma programme would enable the contemporary EEIs to improve the educational standards to attain a world class performance level.