

Performance Excellence Model for Engineering Education: an enabler for sustaining Quality

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Abstract—Achieving Performance Excellence in Engineering Education becomes essential now-a-days so as to focus on the customers and other stakeholders. Some of the challenging tasks like global recognition for the curriculum, performance improvement, research projects and bridging the gap between academia and industry can be addressed effectively, if integrated Quality Model can be adopted and practiced by the Institute. The model proposed in this paper enables the Institute to outperform excellence in education and sustain in the competitive environment.

Keywords— *Quality Model for Engineering Education, Performance Excellence, Quality Award*

I. INTRODUCTION

Engineering Education is the process of training engineers for the purposes of initiating, facilitating and implementing the technological development in the society. Engineers are to solve societal problems in a sustainable way using appropriate engineering tools and techniques to provide the required solutions. The goal of Engineering Education is to build foundation through theory courses, laboratory/workshop practice, tutorials, assignments, project work and industrial training. The technical education has to be framed and designed towards student centric rather than teacher centric in order to synergize the education and research initiatives among students.

But Indian education system faces the following issues like (i) shifted focus from research to manage the affiliation system (2) higher cost of education and lack of financial support (3) no Global Standards (4) no flexibility learning (5) no interactive learning/hands-on learning (6) lack of qualified and experienced faculty (7) role ready engineers for defined job opportunities (8) low or no contributions to the economical growth of industry (9) less industry academia interaction (10) poor infrastructure and ambience. All these issues and challenges can be resolved and customer excellence can be driven by adopting the Performance Excellence Model for Engineering Education as shown in Figure 8.

Every Institute has to have a Quality Management System to deliver successful educational programs and services to their

customers. The perfect alignment of Institute's Vision, Mission and Quality objectives with process specific goals earns credits to the system. Ethics and values are integrated into the system by all means.

II. RELATED WORK

Pankaj Jalote et. al [1] suggested about customizing the Capability Maturity Model for Engineering Education. Maziar et. al [2] discussed the necessity of conducting activities in a more business-like fashion by adapting the quality model based on the European Framework for Quality Management (EFQM) for systematic measurement of quality in higher education sector. Siegfried Rouvrais et. al [3] discussed the necessity of assessment models for higher education using CDIO model. Russel et. al [4] focused on developments and trends that are of particular relevance to engineering education in the Arab States Region and discussed the broader issues such as international exposure for engineering students, education for entrepreneurship and explored the assessment techniques. Olorunfemi et. al [5] discussed the need of changes in Nigerian affiliating bodies and regulations for Engineering Education and suggested improvement measures.

This paper discusses the necessity of Quality Management System and the design of integrated Performance Excellence Model for Engineering Education by focusing on all the stakeholders. This paper is organized as follows: Section III describes the methodology, Section IV discusses the results due to implementation and Section V concludes the proposed model.

III. METHODOLOGY

The Quality Model is designed having focused on the learner centric education rather than teacher centric. The Philosophy of the Institute, as shown in Figure 1, is that the defined targets or goals can be achieved from the core competencies by designing the suitable processes and make everyone to practice them.

From the literature [1], it is understood that the Process Maturity Model of Engineering Education can be as classified

into Levels and the Quality Model is customized as shown in Figure 2 and the key process areas are shown in Figure 4.



Figure 1 Philosophy of the Institute

With the help of management academic professionals, the set of tasks are recognized for each level and each key process. The steps are (i) SWOT analysis for the development of Vision and Mission through strategic objectives and challenges (ii) (re)defining the process model (iii) process monitoring and tracking (iv) feedback analysis and (v) continuous improvement.

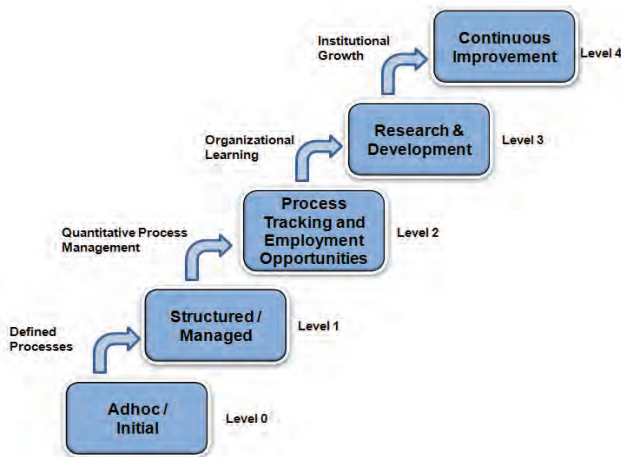


Figure 2 Quality Model for the Institute

A. Formulation of Vision and Mission

The Vision and Mission of the Institute is defined based on the short/long term strategic objectives. The strategic objectives of the Institute are arrived out by doing SWOT analysis at various levels – at the Department level and at the Institute level by getting inputs from internal/external experts for each focused area. SWOT analysis helps in identification of core competencies i.e organization's area of greater expertise. Organization's core competencies are those strategically important capabilities that are central to fulfilling mission or provide an advantage in academic environment or preserve competitive advantage. The process is explained in Figure 3.

B. Process Quality Model

Based on the maturity model defined in the earlier steps, the Key Processes are identified for each Level and

shown in Figure 4. The Institute has to operate at Level 4 so as to sustain in the competitive environment.

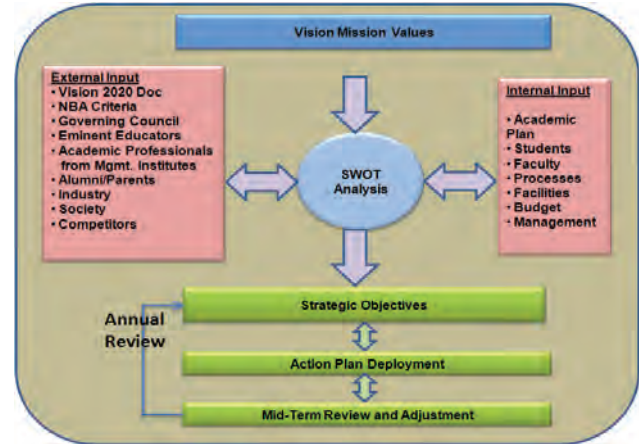


Figure 3 Development of Vision and Mission

C. Work Systems and Work Processes

The process model identifies five major objectives like (i) Institutional Governance (ii) Teaching Learning (iii) Research and Development (iv) Industry Institute Interaction and (v) Societal Services. Work Processes sets the Key Performance Indicators (KPIs) and their target measures for each category, which in turn aligned with Vision and Mission at higher level, shown in Table 1. The overall work system and work processes of Institute are shown in Figure 5.



Figure 4 Key Process Areas for Quality Model

(i) **Institutional Governance** - An organization is sustainable if it addresses all organizational needs and possesses the agility and strategic management to cater to the needs of future expectations. Sustainable environment ensures security and protection to all stakeholders. The process model is designed

such that it satisfies the needs of all stakeholders and ensures the performance of the system in an effective manner. The Governing Bodies reviews and ensures the accountability for management's actions, fiscal accountability and transparency in operations.

(ii) Teaching and Learning- The key process area for academic institute is Curriculum Development in Teaching Learning process. Student centric curriculum is the predominant need for today. The Institute designs the syllabi based on the inputs obtained from academic and industry experts and alumni. The Industry Institute Interaction starts at this point which further strengthens mutual relationship. Special attention is given to academically weak students through peer coaching, buddy mentoring, bridge courses for selective courses like Mathematics and scheme for slow learners as part of Teaching Learning process, improve the overall academic performance of students.

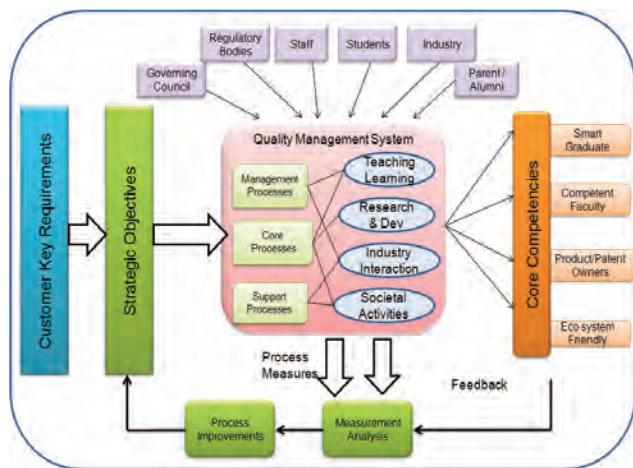


Figure 5 Work System and Work Processes

(iii) Research and Development - Research thirst among students is initiated through asynchronous learning in the form of Special Interest Group (SIG). SIG comprises of faculty, research scholars and UG/PG students for each domain to acquire knowledge in that area. This facilitates the students to get involved in the sponsored research projects which are being carried out by the faculty members. These processes enable the students get engaged in learning beyond curriculum. Innovation Clubs facilitate the students with an objective to participate in the national/international contests now and then. Academic and sponsored research projects enable research activities, which in turn result in journal publications, patents, rewards and contemporary knowledge for the students.

(iv) Industry Institute Interaction - Strong industry institute interaction enables more campus recruitment and industry internships. Industry allied research is implemented by establishing the high end industry supported technological laboratories. These laboratories facilitate the academic and sponsored research being carried out by the faculty members and potential UG/PG students. The relationship can be further strengthened by the institutes by involving industry experts in designing the curriculum to cope up with the latest trends in technologies, joint curriculum, delivering the lectures/hands-on

sessions on tools/techniques and consultancy and testing projects.

(v) Societal Activities - Technology based social work enables the student and faculty team to provide solutions to the problems faced by the society. The adoption of villages or rural areas, the study of problems, domain based solutions and continuous monitoring improves the life style of the people. The key communities identified by the Institute include the neighbouring villages and urban slums in the city. The communities are identified by exploratory visits by few concerned faculty members and students recognized by the Institute. The identified communities are formally visited by the National Service Scheme (NSS) co-coordinators and students. During their subsequent visits, they interact with the Panchayat leaders and elders of those communities to identify their needs. The needs of the community are translated into technology based works.

D. Process Monitoring and Tracking

Metrics on processes have to be measured and analyzed periodically. The Figure 6 shows the processes being followed in the measurement management system. Each Department of the Institute has a Quality Control representative who regularly monitors and tracks all the processes. The revision of targets and process changes are discussed and finalized in this meeting. Lessons learnt and Best practices being adopted are shared across the Departments. Finance and support processes' audits and Management Review Meetings (MRMs) also happen regularly.

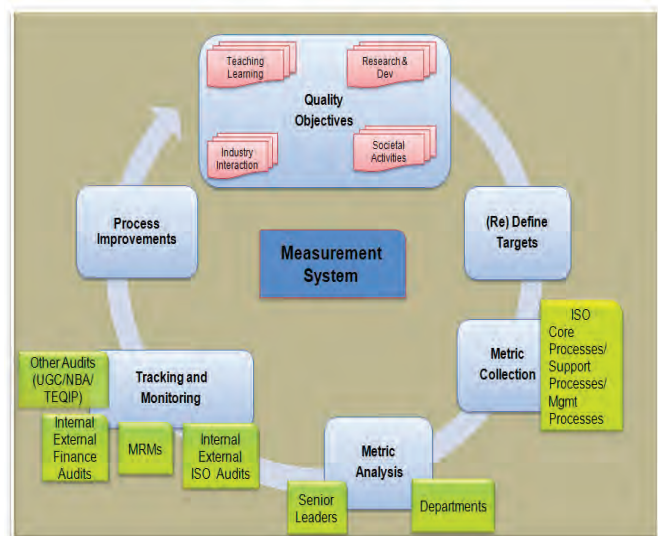


Figure 6 Measurement Management System

E. Customer Feedback

Performance improvement of any Institute depends on the strength of feedback given by the students, alumni, industry and other stakeholders. The Institute should listen to the Voice of Customer at various levels. The Figure 7 explains the feedback collection and analysis mechanism from different segments of stakeholders.

The process of collecting feedback from present students through Class Committee (CC) Meetings, Course feedback at the end of semester and Graduate Exit Survey by the completion of degree programme from the students enable the process improvement in the overall work system. Apart from these meetings, regular Tutor-Student meetings and informal meetings with senior faculty enable the institute to react on the grievances of students.

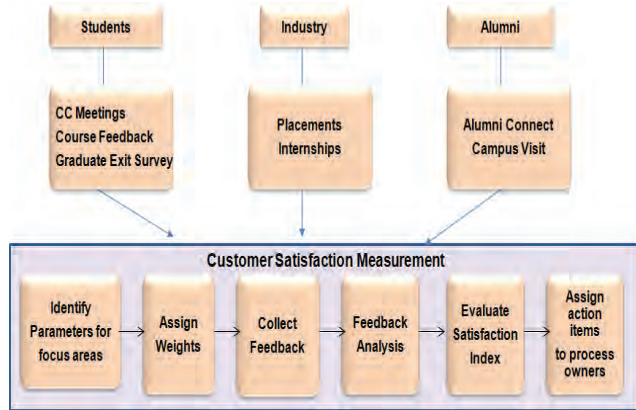


Figure 7 Feedback Mechanism

F. Continuous Improvement

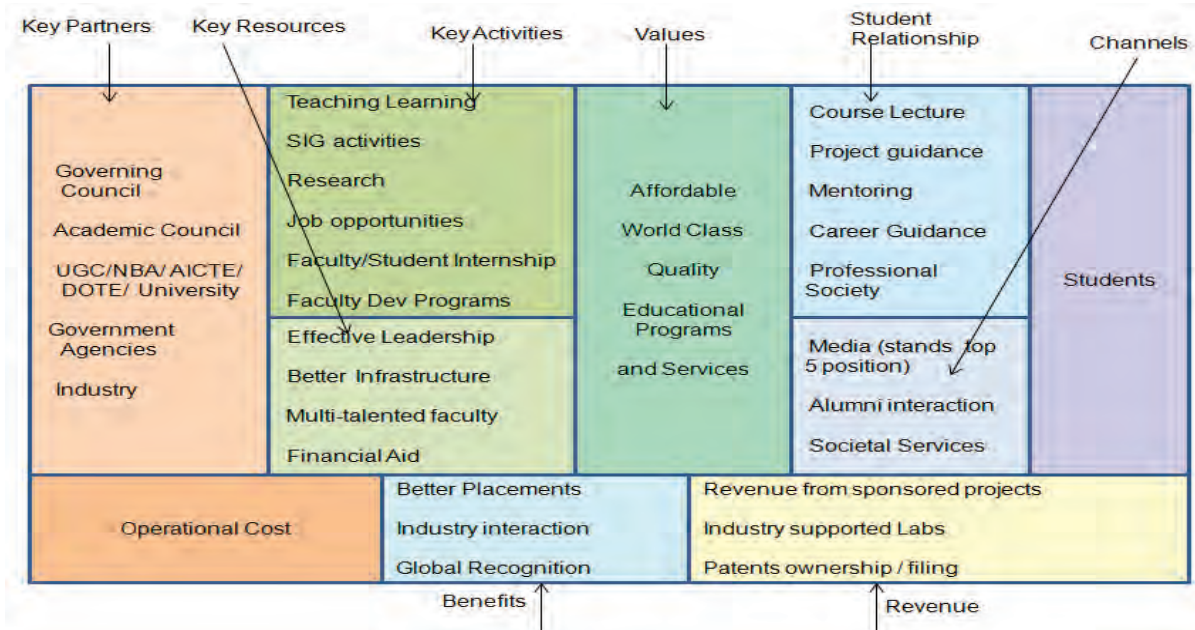


Figure 8 Performance Excellence Quality Model for Engineering Education

B. Key Process Indicators

Table 1 lists the KPIs for each Key process, the target, the tracking mode and the monitoring frequency. The internal audit and MRMs look for the compliances of these measures.

C. Process Improvement and Results

The issues addressed in section I are effectively handled by the integrated model and the results are discussed below:

There exists scope for improvement at every step when processes are monitored and tracked periodically. Teaching Learning processes are improved by introducing new courses in the curriculum to cope up with the latest trends and technologies, facilitating industry internship for students, promoting interdisciplinary projects and innovation clubs, etc. Faculty development is achieved by encouraging them to engage in sponsored projects, consultancy and testing support, filing patents, etc. Continuous alumni support yields motivations to present students, placement training and opportunities, guest lectures and seminars. Industry interaction is strengthened by identifying companies based on SIGs and proposing internships/projects for SIG members.

IV. RESULTS AND DISCUSSIONS

A. Performance Excellence Model

As explained in Section III, SWOT analysis is being done for different areas like enhancing curriculum, teaching learning process, research and development and student related activities at the Department level and at the Institute level. Considering the Philosophy and the Quality Model of the Institute, the Performance Excellence Model is derived as shown in Figure 8 to perform excellence in the competitive environment.

- Academic autonomy has facilitated the Institute to have Board of Studies and Academic Council with members from faculty/students of the College, experts from institutes of higher learning, industry and alumni. These bodies have been given freedom to design and develop innovative curriculum and syllabus.
- Better educational programs and services at nominal cost

- The adoption of Outcome Based Education (OBE) enables the students to get industry internships, to be role ready during their employment, to do life long learning and to become entrepreneurs.
- The concept of introducing 'additional elective' facilitates the students to carry out final semester project internships at industries.
- Promoting inter-disciplinary projects and encouraging students to participate in technical / design contest enables exposure to students.
- Motivating students to actively participate in SIGs brings in innovative ideas and research interest. The faculty members are encouraged to focus in the critical analysis of the course content with the use of real case studies wherever possible.
- The number of Faculty members with eligibility for guiding PhD research scholars is increasing year by year. The number of sponsored/academic research

projects improves the number of journal publications in high impact factor journals, patents and rewards.

- Industry interaction like student project internships during their final semester, delivery of one credit courses and industrial visits gives the enables the students to acquire industrial practices.
- Industry Institute Interaction enables placements, industry allied projects, industry supported labs and placement opportunities by core companies.
- The team from the Institute have identified the issues in the disposal of solid waste and domestic wastewater into the tanks, channels, rivers in the study area and assessed its environmental impact by interacting with various stake holders.
- Recycling of plastics is one of the key factors in protecting the environment. Patent is obtained by the Faculty in plastic bitumen road technology.

TABLE 1 KEY PERFORMANCE INDICATORS AND TARGETS

Focus Areas	Key Performance Indicators	Target	Mode	Monitoring Frequency
Governance	Total Quality Index	> 90%	Governing Council	Twice a year
	Regulations (Accreditation/ Permanent Affiliation)	Nil complaints	NBA, DoTE, Anna Univ, UGC visits	3/5 years; Yearly
	Student Admission	> 99 %	Internal	Yearly
	% of Faculty positions filled	> 90 %	Internal	Every Semester
	Benchmarking	Top 10	Internal	Yearly
	Internal Audits	Zero NCRs	Internal	Yearly
Teaching Learning	Curriculum Renewal	2 changes / Dept.	BoS, Academic Council, MRM	Annually
	Academic Performance in end semester	80% of students	Passing Board Meeting, MRM	Every Semester
	Student Placement	> 80%	Internal Audits, MRM	Annually
	Student Association Activities	10 per Dept.	Departments MRM	Annually
	Student Feedback	> 70%	Departments MRM	Every semester
Research and Development	New Registrations	5 per Dept	MRM	Annually
	Projects and Revenue Earned	3C per year	Research Review	Annually
	High IF Journal publications	10 per Dept.	MRM	Annually
	Patents	1 / yr	MRM	Annually
	Conferences/Workshops organized	1 / Yr / Dept	MRM	Annually
Industry Institute Interaction	Internships	25% of students	Internal Audits, MRM	Annually
	Industry Engagements	5 / semesters / Dept.	III Cell, Internal Audits, MRM	Annually
	Industry Supported Labs	1 / Dept	III Cell	Annually
	Industry Visits	2 / Yr/ Dept	Departments, MRMs	Annually
	Companies Visited	50	III Cell, MRMs	Annually
	New MoUs	5 per year	Departments, MRMs	Annually
	Industry Feedback	> 70%	MRMs	Annually
Societal Activities	Number of activities	1 per Dept.	MRMs	Annually
Staff Development	Staff Training	10 staff per semester	Internal Audits, MRMs	Annually
Library	Collections	1000 books every year	Internal Audits, MRMs	Annually
Hostel	Satisfaction	> 80%	MRMs	Annually
Alumni	Alumni Members	10% increase every year	General Body Meeting	Annually
	Alumni Feedback	>70%	Internal Audits, MRMs	Annually
CoE	Malpractices	0	Internal, A&G	Every semester
	CoE Audit Process	Zero NCRs	ISO Audits, External audit	Every semester
	Timeliness	100 %	Internal Audits, MRMs	Annually

D. Customer Feedback Analysis

The customer feedback is obtained as explained in section III. The satisfaction level of customers, Total Quality Index (TQI), is evaluated using the feedback received from the students, alumni and industry by the appropriate assigned weightages.

$$TQI = \sum w_i c_i = w_1 \times c_1 + w_2 \times c_2 + w_3 \times c_3 + w_4 \times c_4$$

where w_1 , w_2 , w_3 , w_4 are weightages assigned to student (30%), industry (20%), alumni (20%) and graduating student (30%) respectively and c_1 , c_2 , c_3 and c_4 are satisfaction level of student, industry, alumni and graduating students respectively as explained in Figure 9. The overall performance index of the college is 80.56.



Figure 9 Customer Satisfaction Index

E. Continuous Improvement

The adoption of Performance Excellence Quality model for Engineering Education improved the overall improvement as shown in Table 2.

- NBA accreditation for all UG programmes in the years 1998, 2006 and 2012 The College is recognized as NBA nodal centre for creating awareness and training on Outcome Based Education and Accreditation.
- ISO 9001:2008 certified institution for three consecutive years.
- Improving trend in industry institute interactions by having the collaborated curriculum
- Increasing trend in the number of filing of patents and inter-disciplinary projects
- Increase in the number of industry based consultancy and testing projects
- Technology Business Incubation from DST, Govt. of India
- The Institute was ranked in technical school survey by various agencies as given below:

TABLE 2 ACHIEVEMENTS OF THE INSTITUTE

Magazine	National Level Position	Year
Career360	AAAA+	2014
Career360	24 th rank for research	2014
DQIndia	20	2014
	25	2013
Outlook	41	2014
The Week	66	2014
EduWorld	25	2013
Awards	IMC RBNQA Certificate of Merit in the year 2012 IMC RBNQA Performance Excellence award in the year 2013 for Education	
Anna University	Anna University, Chennai permanently affiliated most of the Engineering and Technology programmes, except those PG programmes which have been started very recently.	
NBA	Most of UG/PG programmes get NBA accreditation for five years.	

V. CONCLUSION

The Performance Excellence Quality Model being followed enables the Institute to function effectively in the competitive environment and to sustain the top position among the Institutes. The customer and stakeholder engagement is given priority and by the well defined processes, increases the customer satisfaction, thereby improves the total quality index.

ACKNOWLEDGEMENT

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