

The management of undergraduate engineering programmes: an exploratory study of Indian engineering education

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ABSTRACT: The liberalisation of economic and other policies in India has resulted in the drastic growth of software industries and the need for human resources in these fields. However, due to a lack of funds and policy reasons, the Government was unable to start a sufficient number of engineering colleges in order to meet this increased demand. This has led to the setting up of a large number of engineering colleges in the private sector under a self-financing basis. This unprecedented growth of technical institutions in the last two decades has led to several problems with regard to the quality of technical education in India. A study has been undertaken in this context about the functioning of the management of various categories of engineering programmes in India. The framework of the study has been developed from the accreditation criteria of the National Board of Accreditation, the accreditation agency for technical education programmes in India. In the article, the authors discuss the development of a framework and offer a comparison of the performance of management, which is based on the developed framework.

INTRODUCTION

The globalisation and liberalisation of the Indian economy has opened new avenues to Indian engineers. Many IT-based companies have started functioning in India and abroad. However, the labour requirements in IT-related fields has enormously increased. Due to a lack of funds and policy reasons, the Government has not taken initiatives to start engineering colleges so as to meet this increased demand. Hence, many private agencies came forward to start engineering colleges in different parts of India.

The growth of engineering programmes is shown in Figure 1. Out of the 1,267 approved engineering colleges, 1,047 fall under the self-financing category [1]. Although these institutes require approval from the All India Council of Technical Education (AICTE) – a statutory body of the Government of India – the continuation of quality education offered by these institutes was largely dependent on their management’s missions, motives and working styles. In 1994, the National Board of Accreditation (NBA) was established in order to assist stakeholders in technical education to identify those institutions in India and their specific programmes that meet the standards and criteria prescribed by the AICTE [2].

The NBA is responsible for accrediting engineering programmes, and 1,019 programmes have been accredited until March 2004. A study has been undertaken in this context about the functioning of management of various engineering programmes in India based on the NBA criteria.

OBJECTIVE OF THE STUDY

- To develop a framework for assessing the functioning of the management of undergraduate engineering programmes in India.

- To conduct a study of the performance of management of undergraduate engineering programmes offered by various sectors of engineering colleges based on the newly developed framework.

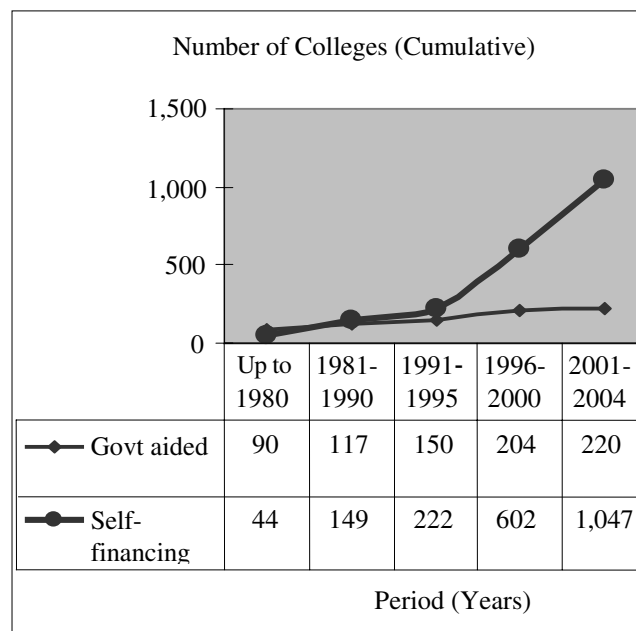


Figure 1: Growth of engineering colleges in India.

DEVELOPMENT OF THE FRAMEWORK

Engineering programmes are assessed based on a set of eight criteria by NBA. These criteria are, namely:

- Mission, goals and organisation;
- Financial and physical resources;
- Human resources: faculty and staff;

- Human resources: students;
- Teaching-learning processes;
- Supplementary processes;
- Industry-institute interaction;
- Research and development.

As part of a previous study, the linear components behind the NBA variables were determined by conducting a set of principal component analyses (PCAs) on the variables coming under these eight criteria [3]. Nineteen components resulted from those analyses. The accreditation parameters for assessing the functioning of management of engineering programmes are given under the first criterion: *Mission, Goals and Organisation*. Moreover, this criterion was found to be the critical one in predicting the accreditation status of an engineering programme [4]. The underlying components of this criterion that emerged from the PCA, and which are also relevant to the present study, are given in Table 1.

Table 1: PCA Results of *Mission, Goals and Organisation*.

Variables	Components			
	1	2	3	4
Decentralisation & delegation	0.988			
Involvement of faculty	0.904			
Transparency	0.764			
Leadership	0.512	0.482		
Efficiency		0.820		
Attitude		0.624	0.369	
Motivation	0.470	0.542		
Mission and goals			0.851	
Commitment			0.830	
Effectiveness		-0.393	0.814	
Incentives				0.900
Planning & monitoring				0.587
Cumulative % of variance	42.300	55.840	56.750	67.010

The first set of variables (decentralisation and delegation; involvement of faculty; and transparency) represents the participative management component of the programme. Hence, the name *participative management* (PM) is given to the first component. *Leadership efficiency* (LE) is the component judged through the variables of attitude, motivation, leadership and efficiency. The component, *commitment to achieve goals* (CA), is identified from the variables of mission and goals, commitment and effectiveness. Planning and monitoring, and incentives for achievements are the indicators of effective *planning and monitoring* (PL).

In order to meet the challenges of competition and to maintain quality, management must use their most valuable assets, their human resources, in the most productive manner. Towards this end, the participative management style is gaining more and more acceptance [5]. But the efforts to gather people together for sharing information like staff meetings alone will not serve the purposes of participative management. Along with up-to-date information on the roles that others play in the organisation, management should promote a sense of employee ownership. If participative management is practiced, employees retain a sense of commitment and are likely to offer ideas to their colleagues to further improve the work that they are involved in [6]. Hence, the knowledge of each employee,

especially faculty, can be utilised to the benefit of the entire institute. In this type of system, faculty should share the decision-making responsibilities, which had previously been the sole province of management. Actual leadership involves empowerment and, as such, necessitates a shared responsibility [7]. To be effective, a shared management organisation requires its members to make decisions that directly impact their work [8]. It is built on an empowerment strategy that provides responsibility and leadership at every level, belief in diversity, innovation, and self-management and support for autonomy and choice. Faculty must have all the information required to make their own course plans, teaching methods and assessment procedures, the autonomy to carry it out, an organisational structure that supports this behaviour, and managers who can operate within this framework. Proper planning and monitoring mechanisms should be followed to support this style of functioning. Actual leaders are interested in direction, vision, goals, objectives, intention, purpose and effectiveness [9]. *Commitment to achieve the goals* is an inherent feature of efficient leadership. Within education, leadership efficiency influences staff cohesiveness, vision, power sharing, reward systems, external networks and institutionalisation. A study of the ethical leadership of Indian private and public sector managers emphasised the two dimensions of *empowerment and motive and character* [10]. The study revealed that the leaders' way of functioning or leading could enhance or diminish the followers' commitment, job performance, satisfaction and ethical behaviour.

The results of the PCA and literature review revealed that efficient leadership, well-structured planning and monitoring mechanisms, total commitment to achieving goals, and a participative style of functioning are the indicators of effective management. Hence, a framework that consists of four components has been selected for the assessment of management functioning of engineering programmes in India (see Figure 1).

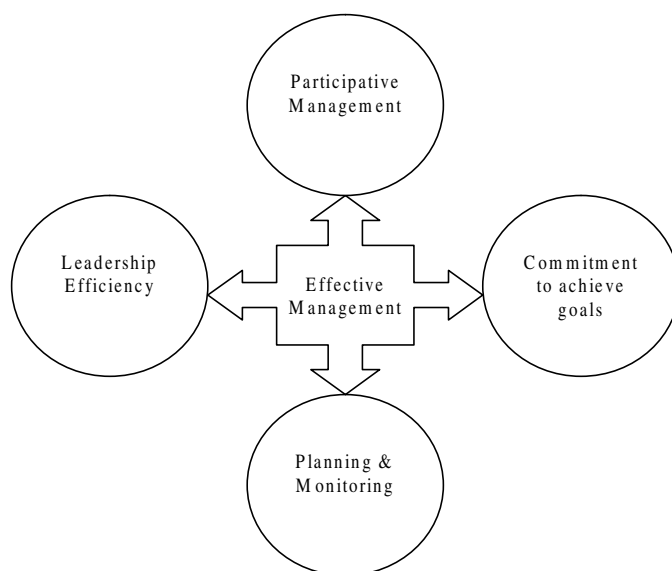


Figure 1: A framework for the assessment of managerial functions.

A STUDY OF MANAGEMENT FUNCTIONING OF UNDERGRADUATE ENGINEERING PROGRAMMES

Undergraduate engineering programmes are offered by four major categories of institutes in India, as follows:

- Indian Institutes of Technology and some other high profile colleges function under an autonomous status, enjoying academic, administrative and financial autonomy.
- Central and state governments administer the second category.
- The third category of colleges comes under the *grant-in-aid* sector. Education societies or private bodies manage these institutes; they take up the responsibility to provide capital assets like land, buildings, etc. The Government provides salary and other working expenses to these colleges. The AICTE, state governments and universities to which these colleges are affiliated fix pay scales and service rules for the staff employed in the second and third categories of these institutes.
- The fourth category of colleges work fully under self-financing schemes. Education societies or private bodies, which take up the responsibility of running these institutes, are mainly responsible for providing the physical facilities, teaching staff, equipments and other support staff, etc.

For the last three categories of colleges, the university is mainly responsible for framing the academic rules. They frame the course duration, subjects to be taught, examination patterns, grading system, etc. Students are admitted to these institutes by government and management on merit, as well as on the basis of reservations.

As the engineering programmes come under four different categories, the study analyses the performance of these four categories of colleges, namely: autonomous colleges (AU), government colleges (G), aided colleges (A) and self-financing colleges (SF). The data of 240 engineering programmes that have undergone accreditation process, and which represent a cross section of Indian engineering colleges, have been collected. This has been split up into the various categories of engineering programmes as listed in Table 2. Data under each category were observed and outliers removed.

Table 2: The number of programmes under the four categories.

Category of Engineering Colleges	No. of Programmes
1. Autonomous colleges	47
2. Government colleges	37
3. Aided colleges	32
4. Self-financing colleges	124
Total	240

TESTING OF HYPOTHESES

Main hypothesis: Functioning of the management of engineering programmes in India is at the same level irrespective of the category of the college.

$$H_0: m_{AUC} = m_{GC} = m_{AC} = m_{SFC}$$

The sub hypotheses are as follows:

1. Equal amount of participatory management exists in all the four categories of engineering programmes.
H0: $m(PM) AU = m(PM) G = m(PM) A = m(PM) SF$
2. There is no difference in leadership efficiency between the four categories of engineering programmes.
H0: $m(LE) AU = m(LE) G = m(LE) A = m(LE) SF$
3. The level of management commitment to achieve goals is the same in all four categories of engineering programmes.
H0: $m(CA) AU = m(CA) G = m(CA) A = m(CA) SF$

4. The planning and monitoring of engineering programmes are at the same level in all four categories.

$$H_0: m(PL) AU = m(PL) G = m(PL) A = m(PL) SF$$

As variances of the four populations are not equal, the non-parametric counterpart of a one-way ANOVA, Kruskal Wallis test was selected for comparison. The null hypothesis of equal median for all the four populations was tested (see Table 4). All components, apart from *commitment to achieve goals* were found to be significantly different for the four categories of programmes. Hypotheses 1, 2 and 4 were rejected, thereby rejecting the main hypothesis also. Hence, the functioning of management is not the same across all categories and the level of participative management, leadership efficiency, and planning and monitoring are different in autonomous, government, aided and self-financing colleges. Multiple comparison tests for the four populations have been conducted to find out the causes of rejection of the hypothesis. Components that are significantly different for different categories of colleges are given in Table 5.

Table 4: The results of the Kruskal Wallis test.

Component	Chi-Square	df	Sig.
Participatory management	12.46	3	0.006
Leadership efficiency	14.36	3	0.002
Commitment to achieve goals	7.18	3	0.066
Planning and monitoring	9.16	3	0.027

Table 5: The results of the multiple comparison tests.

Component	Categories of Colleges		I - J	Sig.
	I	J		
PM	AU	A	11.27	0.003
LE	AU	A	9.23	0.001
	AU	SF	4.68	0.013
PL	AU	G	8.95	0.007

RESULTS AND INTERPRETATIONS

The results indicate the presence of a strong *participatory management* system in autonomous engineering colleges, which might be lacking in the aided colleges. Both government and self-financing colleges have equally good participatory management systems, which is superior to that of the aided colleges. Lack of leadership is clearly visible from the low mean value of the *leadership efficiency* of aided colleges. Self-financing colleges are better in this aspect, but still significantly inferior to autonomous colleges. The mean differences of *commitment to achieve goals* between the various categories of colleges seem to be negligible. Most college management exhibit a high level (more than 70%) of this component. *Planning and monitoring* activities also seem to be poor in government colleges when compared with autonomous colleges. This element is at the same level (65%) in the aided and self-financing colleges. The signatures of the different categories of engineering colleges describing the levels of the four components of their management are given in Figure 3, providing a visual image of the current position of engineering programme management in India.

The study reveals that, in general, the management of engineering programmes is committed to achieving goals and

have good leadership capacities. However, the planning and monitoring mechanisms are not working properly and they are unable to generate a work culture of participatory management. It may be suspected that the involvement of faculty in decision-making is reduced and power is still centralised within the administrators.

Quality control and improvement mechanisms might not be working satisfactorily in the engineering colleges and hence, the intervention from external agencies like the AICTE is essential to ensure the continuous improvement of the quality of education provided by these colleges.

CONCLUSIONS AND SUGGESTIONS

A study has been undertaken about the functioning of the management of various categories of engineering programmes in India. The framework of the study has been developed from the accreditation criteria of the National Board of Accreditation. This framework, which consists of four factors (ie *participatory management; leadership efficiency; commitment to achieve goals; and planning and monitoring*), has been utilised for the assessment of the effectiveness of the management of engineering programmes.

Programme signatures that show these features instead of a single number add value to the assessment process. It has also been revealed from the study that concentrated efforts are needed to promote participatory management and to improve the planning and monitoring of activities for improved service from Indian engineering colleges.

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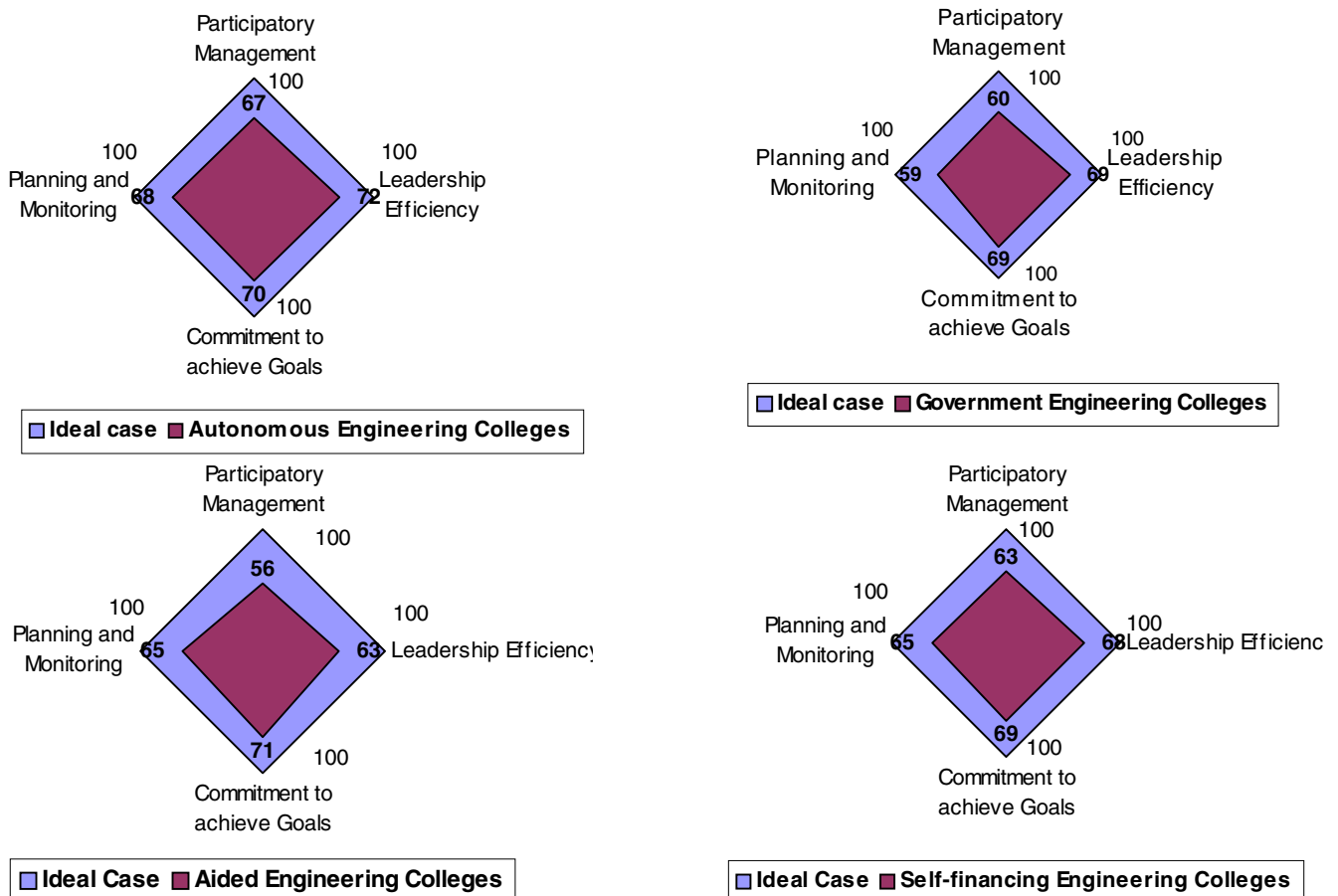


Figure 3: The various management signatures of engineering programmes in India.