ASERF Policy Paper - I

AN ISSUE OF QUALITY:
THE INDIAN HIGHER EDUCATION SYSTEM AND INFORMATION TECHNOLOGY

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Abstract

India has been gaining international reputation for its Information Technology Industry. A good part of the success of this industry has been linked to its ability to its ability to produce a large number of software engineers. This paper examines the Indian higher education policy and practice, specifically looking at Indian Software engineering education with a view to determine the extent to which it effectively prepares its students to hold jobs in the new economy. It argues that the higher education system in India is not providing its students with the skill that are needed in the market economy. It gives a background of the current Indian higher education system, uses data gained from the field to illustrate its substantial shortcomings, and provides suggestions to improve the system.

Contents

Introduction

India with its population above 1billion is rich in potential human capital. The word "potential" is key to this statement, as an unskilled, uneducated and illiterate population may be considered a liability rather than an asset. India's population has been considered by its government in the past an issue of national importance. In the past (1977), the Congress(I) government with Indira Gandhi at its helm even went forward with forced sterilization programs for males to prevent the population from growing[1]. However, more recently the government and the media are starting to look at the large number of people in India as India's biggest resource. This to some extent has been proven correct with India's recent successes as an outsourcing hub, or as a source of intellectual labor for importation.

This is substantiated with articles in the media, especially in the United States, call for comparison between the numbers of engineering graduates that their colleges produce. Some policy makers in the United States have even used these numbers which show India far ahead of the United States as a warning that United States is losing its competitiveness, and its lead in the technological world. There has been a hue and cry over the issues of outsourcing work to outside the United States, and some protectionist backlashes. In 2004 thirty-one states[2] considered measures to impose a ban on outsourcing of any of their government contracts to locations outside of the United States specifically citing India. However, there is not only an issue of quantity of graduates, but also an issue of quality. A hint of this is given in the joint McKinsey and Nasscom report of 2005. McKinsey is well known and regarded management consulting company, and Nasscom is the apex chamber of commerce for the software and service industry in India. According to the report only 25% of all technical and only 15% of all general college graduates produced by Indian colleges are actually employable by the information technology, and BPO (Business Process Outsourcing) industry. Thus, **the objective of this paper is to study the Indian higher education policy and practice, specifically looking at software engineering in its ability to prepare its wards for jobs in the new economy.**

Software engineering for the purposes of this thesis is defined as the creation, development, and maintenance of non-trivial computer based programs/applications in accordance with established quality and engineering processes.

The following questions have been discussed in this paper:

1) Is the formal education system for software engineering failing to prepare its graduates for real jobs?

2) If so, why is it failing?

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[1] Do Population Policies Matter? Fertility and Politics in Egypt, India, Kenya, and Mexico. 1998. by Anrudh Jain, Population Studies, Vol. 53, No. 3 (Nov., 1999) , pp. 390-391
[2] http://www.post-gazette.com/pg/04095/295972.stm

3) What are some of the pragmatic solutions that can address the problems and issues raised in question two?

In chapter one of this paper, the Indian education system is described with appropriate background. This includes information on key players, organizations and terms. The concentration is on creating an accurate portrayal of the current education system, and describing in practical detail its workings. Information for this has been gained through books, organizational histories, primary sources, and interviews.

In chapter two, a discussion on relevant literature written on this specific issue is presented. Unfortunately, there is not a large volume available that specifically addresses these particular questions, however, there is sufficient to describe the problems and issues faced in a more general context of the Indian higher education system.

Chapter three focuses on the field research that was conducted for this thesis. The chapter includes methodologies for the research conducted, the evidence gained from the field, its representation in charts and graphs, and the tracking of trends and results.

Chapter four takes these results and analyzes the data, bringing it into categories of problems and issues, which are then explored with the help of interviews and secondary sources. It then presents plausible theories and explanations for these issues and problems, with connections to the educational structure and policy.

Chapter five concentrates on developing pragmatic suggestions and recommendations to solve some of these problems and issues.

1. Background

The Indian higher education system is a complicated partnership between the public and the private sectors. The system can be divided into two clear subsets, the formal education system, and the informal education system. The formal education system, which is the primary focus of this paper, gives degrees, while the informal education system grants diplomas and certificates. In the last decade many institutions have come to blur the lines in quality and acceptability between the two systems. The difference between the two primarily arises out of accreditation and government mandates.

There are currently 348 University level institutions and 17,625 colleges, which educate a combined total of about 10.5 million students. However, despite the apparent enormity of this infrastructure, it is not adequate to cover even 7% of the population between the ages of eighteen and twenty three. There is a societal impetus towards getting a college degree, and these figures highlight the huge gap between access and demand for higher education in India. The quick rise of the informal education system is primarily due to this disparity in supply and demand.

1.1 Formal Education System

The formal higher education system is built around Universities and their affiliated colleges. According to the central (federal) law, a University can be created only by an act of legislature at the central or state level. The former are termed as Central Universities and the latter State Universities. Universities are the only entities allowed to grant degrees. Colleges, both public and private, affiliate themselves to a particular University for a single course / subject or multiple courses and subjects. However, not all Universities are allowed to affiliate colleges, the ability to do so is dependant on the language in the legislation passed. At the end of the study period the student receives a degree from the University, along with a label designating in which college they studied. Often, the reputation of a college will surpass that of a University and students on their resume will prefer to put only the College's name.

Table I: Growth of Higher Education Institutions and Enrolment

Year	Universities	Colleges	Total HEIs	Enrolment (in million)
1947-48	20	496	516	0.2
1950-51	28	578	606	0.2
1960-61	45	1,819	1,864	0.6
1970-71	93	3,277	3,370	2.0
1980-81	123	4,738	4,861	2.8
1990-91	184	5,748	5,932	4.4
2000-01	266	11,146	11,412	8.8
2005-06	348	17,625	17,973	10.5

Source: University Grants Commission. (Universities include central, state, private and deemed-to-be universities as also institutions of national importance established both by the central and the state legislatures.)

Figure I
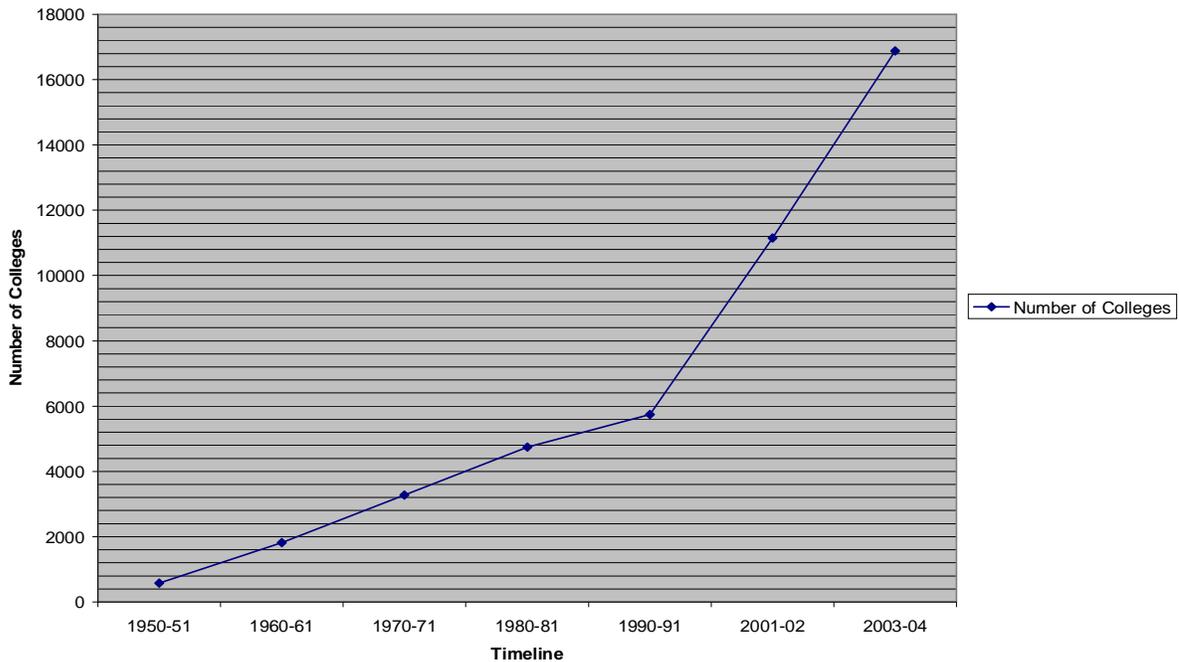
1.2 Higher Education Institutions

Universities in India can be broadly described in five categories:

- Universities
- Deemed Universities
- Private Universities
- Institutions of National Importance
- Premier Institutions of Management

1.2.1 Deemed Universities:

Institutions of excellence (usually colleges) are given deemed university status by the Central Government on the recommendation of the UGC (University Grants Commission) as per Section 3 of the UGC Act (1956). These institutions need to meet minimum eligibility criteria, and usually offer advanced courses in a particular field of specialization, though it is common to also offer general degrees. There has been a sudden spurt in the number of deemed universities since 2000, when the provisions were slightly changed to accommodate newer institutions with private sector participation. There are currently ninety-three deemed universities in the country, forty-eight of which were declared deemed universities between the years 2000 and 2005, and more than half of which are privately sponsored institutions. Usually, as a condition of being a deemed university, the central government gains certain controls over the institution, including several seats on

the institution's board. This is especially evident in institutions which were majority private owned.

1.2.2 Private Universities:

These Universities are formed by the various State governments through acts of the State's legislature. Some of them seek recognition, and have been recognized by the UGC. Currently, there are seven private universities across four states: Gujarat, Himachal Pradesh, UttarPradesh and Uttranchal. Each act of parliament which creates a private university establishes a unique and specific framework for the university, including specific requirements in terms of accreditation, constitution, financial and legal construction.

1.2.3 Institutions of National Importance

Institutions recognized by the Government of India as institutions of national importance, are declared as such by an act of Parliament, and are empowered to award degrees. In a few cases, such institutions are also set up by the government through an Act of State Legislation.

1.2.4 Premier institutions of Management

The government has granted special recognition to institutes which are focused on Management. Currently, this includes the IIMs (Indian Institutes of Management). They are empowered to give diplomas in management, and are supported by government finances.

1.2.5 Colleges

Colleges are operated by the government or by private entities. Colleges must affiliate themselves with a University to be able to grant degrees. The college can not grant degrees in its own name, and must follow all the guidelines setup by the University, and by the regulatory bodies. In the case of software engineering, the AICTE (All India Council for Technical Education) governs and certifies all aspects of colleges regardless of their public or private status.

1.3 Regulatory Framework

The Ministry of Human Resource and Development is directly responsible for all education in India. In terms of higher education several bodies have been set up by either acts of parliament, or appointments to regulate and ensure quality standards.

Regulatory and Statutory Bodies in Higher Education

Sl. No	Name of Body	Mandate	Websites
1	University Grants Commission	• Co-ordination, determination and maintenance of standards in higher education • Release of grants to individual institutions	**www.ugc.ac.in**
2	All India Council for Technical Education	• Proper planning & coordinated development of technical education system throughout the country	**www. aicte.ernet.in**
3	Distance Education Council	Promotion of Open University in and Distance Education systems in the educational pattern of the country	**www.education.nic**
4	Indian Council of Agricultural Research	Co-ordination of agricultural research and development programmes and develop linkages at national and international levels	**www.icar.org.in**
5	Bar Council of India	Co-ordination, determination and maintenance of standards in legal education and profession	**www.lawmin.nic.in**
6	National Council for Teachers Education	Achieving planned and coordinated development of the teacher education system throughout the country	**www.ncte-in org**
7	Rehabilitation Council of India	Standardization and regulation of training of personnel and professionals in the field of rehabilitation and special education	**www.rehabcouncil.nic.in**
8	Medical Council of India	Establishment of standards in medical education and to define medical qualifications in India and abroad.	**www. icmr.nic.in**
9	Pharmacy Council of India	Prescription, regulation and maintenance of minimum educational standards for the training of pharmacists	**www,pci.nic.in**
10	Indian Nursing Council	Regulation and maintenance of uniform standards of training	**http.//mohfw.nic.in/kk/95/ib/95ib0301.htm**
11	Dental Council of India	Regulation of the Dental Education and ethics in the country	**www.dmer.org/pgd.htm**
12	Central Council of Homeopathy	Maintenance of the central Register org of Homoeopathy	**www.ccrhindia**
13	Central Council of Indian Medicine	Maintenance of the central Register of Indian Medicine	**www.indianmedicine.nic.in**

In terms of software engineering there are two main bodies that apply; the first is the University Grants Commission and the second is the All Indian Council for Technical Education, or the AICTE.

1.3.1 AICTE

In technical education the primary body is the All Indian Council for Technical Education. The AICTE was set up by an act of parliament in 1945 as national body

to conduct surveys on technical education facilities and to promote education in a coordinated and integrated manner. Later, the National Policy of Education (1986) vested the AICTE with the statutory authority for planning, formulating, maintaining norms and standards, assuring quality through accreditation, deciding funding for priority areas, monitoring and evaluation, and maintaining the parity of certification and awards. Thus, it was given broad regulatory control over technical education in India, and the AICTE Act was amended accordingly in 1987. Currently, the purview of AICTE covers programs of technical education including training and research in Engineering, Technology, Architecture, Town Planning, Management, Pharmacy, Applied Arts and Crafts, Hotel Management and Catering Technology.

Practically the AICTE has become the governing body for every technical course that is taught in institutions. The AICTE sets the norms that colleges need to follow to teach a particular course, down to the exact infrastructure, and qualification of teachers. The body has come under criticism for being inflexible and being unable to adapt to changing technologies and requirements. This is true particularly in the case of the curriculum, which the AICTE mandates and sets, along with the types of degrees that can be offered. This directly interferes with the freedom of teachers in the classroom as well as academics in the University and college, to adapt the course and syllabus to the changing needs of students and the market.

Recently, private colleges have tried to go around the AICTE, but have faced problems. The major issue is the inability of graduates to apply for further degrees and programs at accredited colleges if their undergraduate degree is not recognized by the AICTE. The AICTE is mandated by its Act (1987) to "take all steps necessary to avoid the commercialisation (sic) of technical education," and following this philosophy, has laid down its underlining principles in its fees regulation guide (1997), which states that…. "prevention of profit making and ensuring, as far as possible, the principle of no-profit -no-loss" [3] The Judicial pronouncement in J. P. Unni Krishnan Judgment, 1993 upheld that "commercialization of education cannot and should not be permitted" Further TMA Pai judgment, 2002 though opposed 'profiteering' but permitted a 'reasonable revenue surplus….. for the purpose of development of education and expansion of the institution' favouring autonomy in granting admissions and determining fees.

1.3.2 UGC

University Grants Commission was established in Nov. 1956 as a statutory body of the Government of India through an Act of Parliament. It has the unique distinction of being the only grant-giving agency in the country which has been vested with two responsibilities: that of providing funds and that of coordination, determination and maintenance of standards in institutions of higher education in India. Its mandate is to promote and coordinate university education; determine and maintain standards of teaching, examination and research in universities; Frame regulations on minimum standards of education; Monitor developments in the field

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[3] Govt. of India Resolutions for Fee Structure, 1997, http://www.aicte.ernet.in/regulation_1997.htm

of collegiate and university education; disburse grants to the universities and colleges. It serves as a vital link between the Union and state governments and institutions of higher learning. One of the most important function is to advise the Central and State governments on the measures necessary for improvement of university education.

Its enforcement powers over the years have been deteriorating, due to lot of external interferences which is taking the toll of its Autonomy It exercises considerable power over the institutions which it gives funding to. The UGC also has the powers and the responsibility to recommend the granting of Deemed University Status to institutes of excellence to the HRD Ministry.

1.4 Informal Education System

The informal education system has grown exponentially in the last decade, primarily due to the disparity in supply and demand in the formal education system. The informal education system primarily comprises of corporate entities, granting certificates and diplomas of varying quality and relevance. In the software engineering field, they have become cornerstones in India's rise as an outsourcing power. It is quite common for high school graduates and even college graduates to turn to these companies to allow them quick access to the information technology industry. These courses do not have any entrance requirements, and generally operate on the franchise model. The certificates and diplomas from these institutes are usually directly applicable to the current needs and demands of the industry. Often, middle school and high school students will sign up for these courses to give them an edge over their peers and to compound their resumes and skill sets. The shorter versions of these courses are specific to the point of a single programming language or methodology, and the longer ones mirror the style of education given at a standard four year college course. The shorter coursers are also taken by those pursuing a four year college degree to fill in the gaps in their own course curriculum, and to make themselves more attractive to potential employers. These institutes will partner with companies such as Microsoft, and IBM to offer certification in their specific product lines. The government treats these institutes as private entities, and brings them under the standard service tax system. The certificates and diplomas granted by these institutions are not recognized for future studies by the formal education system.

1.5 The evaluation system

The Indian education system bases its evaluation on an external examination system with an objective outlook. Practically, this means that the University sets a central examination for all its affiliated colleges. The exams are usually given once a year, and a student has no recourse if he misses them even for a valid reason. The exams themselves are in a multiple number of formats which range from essay type questions, to multiple choice questions. However, the University provides stringent objective criteria for giving grades by creating a marking scheme which assigns points to the mention of specifics words/sentences even in

the essay questions. Colleges usually teach for the examination, and students refer to external coaching centers which train them on the specific types of questions that could come up in the examination. The principles behind the examination are to promote constancy and provide an accurate means of assessment across a large number of students. Though the examination systems accomplish these principals well, they often unable to provide a complete evaluation of the learning that has occurred.

1.6 The coaching centers

Due to the consistency and objectivity of the exam, students direct their energies in finding the best ways to clear them. Since the exam follows a very predictable pattern, external coaching centers have cropped up which prepare students exclusively on how to do well or "game" the examination system. These coaching centers charge hefty fees, and are able to employ faculty from the colleges directly who are attracted due to the monetary incentives. Often, students will stop attending classes, or concentrating in classes, opting to go directly through the coaching center route. Since, the assessment is based primarily on the external examination; the student has no need or incentive to sit through the classroom process which concentrates on the broader syllabus rather than the specific examination questions and answers. Colleges have implemented minimum attendance criteria to qualify for the examination, but these can be easily worked around.

The coaching business is getting bigger than the education business, entrance examination for the IIT's, IIM's and a few prestigious management school attract about 600,000 applicants (who spend nearly Rs. 1.50 lac each for pre-coaching, amounting to Rs 9000 crores per year, for 6000 seats. These institutions spend hardly Rs. 800 to 1000 crores per year, as their teaching budget[4]

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[4] www.wakeupcall.org

2. Literature Review

Software Engineering as a field in itself is quite new. With computers becoming mainstream only in the last decade or so, software engineering has sometimes been combined with Computer Science. However, software engineering in recent times has become a field of study in its own right. In India, this is particularly so due to the focus on applied technology. While computer science is founded more on algorithmic, mathematical and research principles, software engineer concentrates on the creation, development, and maintenance of non-trivial computer based programs and applications. Unfortunately, due to the specific nature of this paper, software engineering and then in India, there is a lack of prior literature. However, there is a great amount of literature available on the higher education system in India in general, and technology and engineering (of which software education is considered a part) in specific. This chapter will briefly review and discuss aspects that are relevant to the study questions.

The current literature all suggests there are major problems with the current higher education system. Elizebeth P. Lam visiting from the United States government wrote in 1962, "In retrospect and in comparison with higher education in all other countries visited, India stands out as the most mature in its self-appraisal, administrative organization, and breadth of educational aim." This indicated that India got off to a good start in comparison with the rest of Asia. However, even then she observed indicators that there were problems with the system. Since then many books and papers have been written trying to explain the state of higher education in India, especially regarding its problems. Authors have tried to give a complete overview or target specific sub-systems and institutions. However, due to the constant flux and changing laws, most of the books, articles and papers are frequently invalidated or are no longer applicable. There are some problems with the Indian education system that have remained despite being recognized by the academic community.

2.1 Supply and Demand

After India gained independence it took the stance of a socialist country with a planned economy. The planning commission decided the number of graduates the country needed in every field. Early academics described the supply and demand problems of education from the perspective of the planning commission rather than the individualistic interests of the consumers. Gosh (1983) wrote about the problem that students wanted to take up engineering jobs with the hope of employment, this caused problems because it was much greater than the figures of the Government's planning commission.

A decade later the planning commission still existed, but started to lose relevance in the country and with the market reforms in the early 90s has almost become irrelevant. In India there has always been a continued increase in demand for technology and professional education, especially among the middle class. Altbach (1993) writes about the determination of the Indian student to get a

professional degree with aim of social and economic mobility. He explains that the high demand is against the desire of every major policy recommendation which suggest that higher education enrollment in engineering is a misallocation of resources. He further suggests that, "the availability of places in colleges and universities is a top priority of the aspiring middle class and to the growing segments of the upwardly mobile rural and urban poor." Altbach comments about the inability of the higher education system to keep up with the demand of this emerging middle class.

In a Article in The Indian National Daily "Times of India" dated June 22, 2006 it was mentioned Number of Unemployed up 3-Fold in 10 Years and 17% of India's Graduate Jobless ...." the number of jobless in India grew by more than three times in 10 years - from 13.8 million in 1991 to 44.5 million in 2001, according to recently released census figures. What is worse, education does not seem to improve your chances of getting a job. The unemployment rate of graduates (17.2%) is significantly higher than the overall unemployment rate of 10.1%. Nearly 40% of the graduates are not productively employed. Even among technical graduates, as many as 32% are "non-workers", only lower than 39% figure for technical graduates. The Census also found over 4200 graduates had been reduced to begging or vagrancy, including 419 technical graduates. To a large extent, these statistics are a result of the fact that a majority of female graduates-74% among the non-technical ones and 49% among those technically qualified - are not working. Among males 22.6% of all graduates are not working which includes more than 25% of male technical graduates"

Several years later the problem has still been the same. However, there is an increasing view that the government no longer is able to supply education to the extend that is needed and demanded by the masses. Jayaraman(2004) comments on the focus of students on practical and applicative courses rather than academic ones. He contends that the top choices for students and technology and engineering courses, and failing that directly applicable technical courses such as "packaging, plastic technology, fabric designing, air conditioning and refrigeration, among others." (pg. 94) The demand according to him still exists despite rising unemployment, even among professional degree holders. In regards to the upsurge in supply, he describes many of the new colleges are substandard; "many of these institutions are inadequately equipped to offer any education, let alone professional education." (pg 95). He looks to the newly developing informal education system sector as being the future of higher education in India.

All scholars content that the demand has far out stripped the supply in technology and professional education. They go insofar as to worry and comment about the lack of interest from students in the other fields including basic science and humanities.

2.2 Bureaucratic and Regulatory Problems

Much of the literature points to bureaucratic and regulatory problems in abstract, but does not go far enough to pin point the problems. Partially, this is due to the fact that the same regulatory bodies provide research funds for these studies and academics. Most of the studies stop quite short of giving specific examples of problems and corruption. For example Altbach (1993) simply states that a major problem with structure of education is, "a highly bureaucratized system that does not stress a high level of innovation." Without going into the specific details of these hurdles, and the organizations / people responsible for them.

In his paper titled *The Enterprise of Education,* James Tooley an English professor gives a remarkably frank criticism of the AICTE. He lists the requirements set by the body and deconstructs the guidelines for a specific course "Masters in Computer Application," finding major problems and faults while comparing it to the superior methodology used by NIIT, the most successful company in the informal education system.

2.3 Finances and Resources

The Indian education system is responsible for educating the second largest population in the world. Phillip Altbach (1993) declares that the, "Indian higher education is chronically short of money. Even when compared to the resources provided to higher education in many other Third World countries, India seems, when measured on a per capita basis to be relatively poorly endowed."

This view of finances is shared by many scholars who point to the government's insistence on the extensive subsidization of education.

Tilak (1993) points to the fact that fees only account for 10% of the total costs of higher education. Also, that in real terms the average tuition fees paid have been cut by 50% since 1950. He analyses the financing of education from an economic perspective, declaring it as a unique combination of public and private good. He remarks that the private households are willing to pay a greater price for education than is being currently charged. Tilak also shows the declining contribution of the government budget to higher education. Jayaraman (1997) criticizes the government's contribution of 85% of education system and comments about the "ludicrously low" (pg. 82) tuition fees in the country, and claims, "the greatest lapse in the education policy has been the failure to evolve a rational fee structure."

Recently scholars have growing consensus that the government is no longer able to satisfactory able to finance, or even suggest it finance higher education.

Jayaraman (2004) builds on the figures of Tilak(1993) and adds, "The gradual decline in state support of higher education has made it impossible to address the needed reforms within the conventional higher education system." He claims that the government run colleges are strapped for funding, and that the private sector

will have to take over the responsibility of education from the government. Tilak further (EPW, Feb 18, 2006) states on the allocation of 6% of GDP to education which long ago in 1966, the education commission (1964-66) (Chaired by D. S. Kothari) had recommended that we should allocate 6% of national income to education. But the goal remained unfulfilled. "If there is a political will, the goal of allocating resources equivalent to 6 percent of the gross domestic product for education is realizable. Allocation to education can be increased by reallocating resources from other sectors or by raising more resources for the common pool of government funds or by both. However, a generous approach needs to be adopted in allocation to and reallocation of resources in favour of education (Tilak, 2006). Lacking in most of the studies is a view into the financing of education, and the controls that government places which causes formal education to be left out of the market economy boom that India is going through.

2.4 Quality of Education

Establishing and maintaining high-quality education systems is a challenge faced by all countries around the world. In India most academicians are in agreement, and have been in agreement for decades, that quality is deteriorating, but have been unable to do anything significant about it. Chitnis (1993) comments about the complete deterioration of the University system, she point blank declares that , "employers complain that university graduates fail to measure up to their jobs. Initially, this complaint was only made about traditional arts, commerce and science graduates. Now it is extensively heard about graduates in the professional fields as well."

Before 2000, scholars still seemed to think that the government will be able to get its act together and reform itself. However, literature after that is pessimistic about the government reforms and instead looks to the private sector. Jayaraman (2004) commends the entrepreneurs who have established education institutions outside the formal system as describes these institutions as "extraordinarily sensitive to the range of knowledge and skills demanded by the changing market economy. They are also extremely flexible, both in the courses they offer and how they offer them." He contends that the established University system due to its stranglehold does not face any competition, and has no reason to change. He points to the decay of the established University system in the light of the market economy. He makes a good case for privatization of higher education and says, "It is now conceded that the future of higher education in India will be determined by the market economy and the private sector."

2.5 Examination System

As far back as 1962, Elizebeth P. Lam described the external examination system as significant problem in higher education in India. The external examination is the process in which learning is evaluated through a standardized test administered by a central authority, for example, a central university exam for all affiliated colleges.

Altbach (1993) describes the examination problem as being a dominant problem for the Indian education system for more than a century. He describes efforts by commissions and regulatory bodies to change the system for the prior forty years, all of which have failed spectacularly. Some of these solutions include using suggested question banks instead of exams, as well as a gradual movement towards internal assessment. Altbach claims the reason for the failure is a broad resistance from students and faculty. The students know what to expect on the exam, and a vast informal system of coaching has come up to aid them. The faculty earns money from moonlighting at the coaching centers as well as is freed from the task of actually having to properly grade the examinations.

Zachariah's (1993) views are in agreement with Altbach, and he provides further information on the resistance of students and faculty to the change in the system. He accuses the informal coaching system which he claims wields considerable influence, of trying to stall the education reforms as it would be detrimental to their business model. He explains some of the problems with the system including that fact that the student has no recourse if he misses the exam even for a valid reason such as sickness.

The examination system has been declared as a chronic problem by many scholars who have commented on the subject. However, they have been unable to find a pragmatic reformation solution that would be able to satisfy the opposing desires of the interested parties.

2.6 Quality of Teachers

The quality of teachers is another chronic problem well documented. Much of this has to do with the nature of the profession in India. Jayaraman (2004) agrees with the views of prior authors that the teaching profession is held in low esteem by society, including the students and parents. He remarks that the teaching profession holds itself in low esteem. He echoes the concerns of several academics, that teachers are merely making a living rather than following a vocation. He describes the failure of a UGC effort to conduct biannual tests for teachers in order to make sure they are up to quality standards. He describes an earlier scenario when the academic profession was considered with a view towards job security, especially in the government run institutions. But, due to lack of funds, and politics, this is no longer the case. He writes that the teachers do not avail themselves of professional development opportunities, or are interested in peer review or self assessment. He disregards the view that teacher's are paid less, and states they have got the best deal through their unionization and political efforts in the prior decade.

2.7 Problems with Existing Literature

The existing literature on this subject suffers a few fatal problems, first, the majority of it is not based on data collection, interviews or field observations, and second, since the scholars developing the literature are inside the system and

depend on the good will of the regulatory bodies, they do not present a completely accurate view of these bodies. There is absence of on the ground knowledge in most of the literature with the author speaking from the perspective of overview and generics, with few real examples. Very rarely do these authors venture out to give proper solutions. They only state what needs to be done which is usually very obvious. As academicians they are also reluctant to comment, and usually are unable to provide problems and issues with operations and management, and usually concern themselves with indicators and the results of macro plans, versus the pragmatic problems faced by the institutions.

Another type of available literature which has not been discussed by this paper is the type that has been generated from the perspective of politicians and philosophers, who concentrate more on the morality and ethics of education rather than its practical problems and implication. The authors of these are usually ex-politicians, or politically motivated individuals, who have a flare for the rhetoric rather than for concrete empirical data.

The third type literature is from the perspective of macro level economists, who do an excellent job in explaining the relations between education and the economy. They even come up with solution for financing education, expansions, and industry-education linkages. However these are economic and numerical models and they tend to miss the academic end of the problem, as well as the ground realities which are faced everyday by those working in the field of education.

Further, in the software engineering field there is an absolute gap in literature. Most of the literature concentrates on higher education in general, and sometimes goes into the details of technology and engineering education. However, due to the novel nature of the field, traditional academics have not approached it in specific and tried to analyze or look at the unique problems it faces.

3. Methodology and Research

The Indian higher education system is complex, and has always been in flux. Several far reaching laws and decisions are made by the central government. To give an accurate representation of the system, a multi prong approach has been used. First, a series of informal interviews were conducted with education professionals, students, corporate professionals, and politicians. Second, extensive research was done based on the interviews, including visits to institutions and government departments, which led to follow up interviews with leading education researchers. Finally, on the basis of the interviews and preliminary research, three surveys were conducted that targeted graduating seniors, recently graduated software professionals, and HR professionals in major software companies.

3.1 Interviews

Interviews were conducted on the principles of anonymity and informality. This allowed the subjects, many of whom were in delicate positions, to speak freely about their opinions of the higher education system, as well as provide critical analysis. Though the interviews were recorded, no subsequent transcripts have been made, and the interview tapes have been disposed of. During the interviews, the subjects often asked for the recorder to be switched off if a particularly controversial topic was being discussed. Quotes from the interviewees have been taken with their permission, but are given here without mentioning specific names in order to protect identities.

3.2 Surveys

Three groups were surveyed: graduating seniors in software engineering courses across ten colleges, recently graduated software professionals across thirty four companies, and HR professionals in leading software engineering companies across twelve companies.. The graduating seniors were aged between twenty-one and twenty three. The recently graduated software engineer professionals were between twenty-two, and twenty-six years, and the HR managers was between twenty-eight and forty years.

The survey solicited the participants' opinions on the quality of software engineering education in India. Participants were solicited for participation either through their campuses, online, or by phone. Participants had the option of filling out the forms in person, or filling out the forms online. College participants were recruited at their campuses by setting up a stall, and requesting their participation in the study. Prior permission was obtained from the college's administration to setup the stall and to distribute the survey in paper format, and links to the survey online.

Industry participants were recruited through three methods:

1) Referral from existing contacts – i.e. the survey link is passed on to colleagues.
2) Cold calling, followed by an e-mail link to the survey
3) Interfacing with management at the company to give employees the url of the survey.
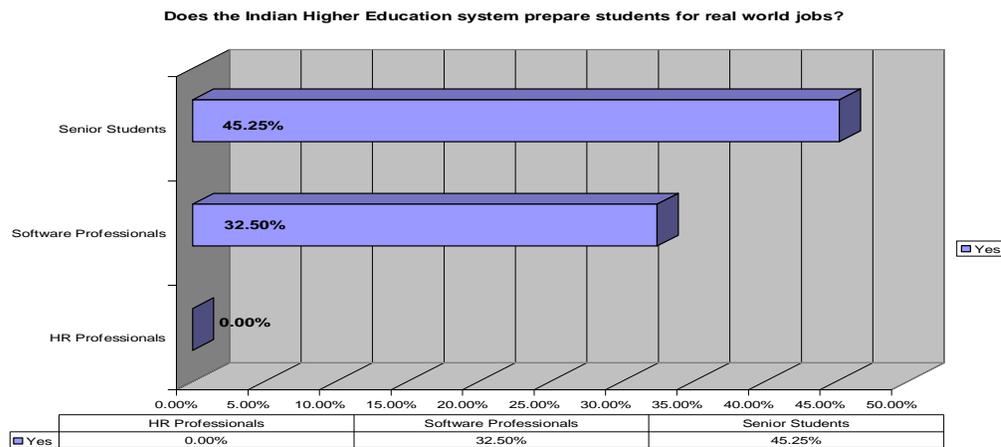
The time needed to complete the survey was between five and ten minutes.

To lower the risks to participants, the survey did not ask for any information by which they could be identified, including the college or company the individual belonged to. The investigator did not ask or link any personal identifiers to the information collected, and ensured that he/she did not have any relation or connection to the participant. The investigator did not keep any records that could lead to possible identification of the participants linked to their responses. The consent form as per new guidelines had the participant acceptance signature as optional. In almost all cases participants did not sign the form. In the case of industry participants, the survey did not contain any questions that involved opinions about their company or its activities. Only the results and the analysis of study will be shared, not the data set, or results particular to a college or company. In almost all cases such individualized data is not even available.

3.3 Results of the Survey

Numerous questions were posed on the quality of teaching, quality of education, capabilities of the institutions, and their satisfaction with the education. Statistically significant results are presented below. There were some questions that were general to all three groups, and the rest were specific to each group.

Respondents were asked directly if they felt, given their experience, that the four-year college system prepares graduates for real world jobs.

Does the Indian Higher Education system prepare students for real world jobs?

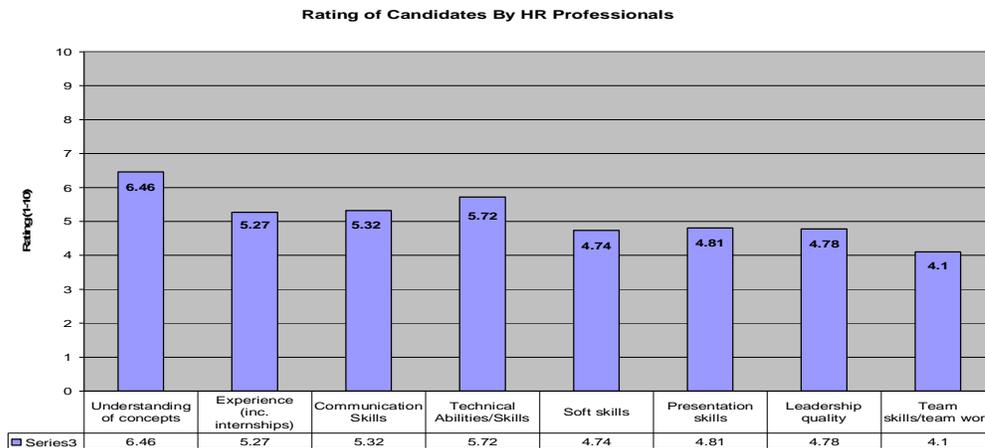|	HR Professionals	Software Professionals	Senior Students
Yes	0.00%	32.50%	45.25%

In response to the above non of the HR professional were in favour that the four-year college system prepares graduates for the real world jobs while only 32.50 % of the Software Professionals accepted the same. As far as Senior Students are concerned 45.25% of them were in favour of the four year course.

HR professionals were asked if the candidates required additional training before they joined the company full time.

Average Training Time

All of the responses indicated that intensive training was required with the average time period of training being **two and half months**.

HR professionals were asked to rate the jobs of candidates on a scale of 1-10 for several criteria.

Rating of Candidates By HR Professionals

	Understanding of concepts	Experience (inc. internships)	Communication Skills	Technical Abilities/Skills	Soft skills	Presentation skills	Leadership quality	Team skills/team work
☐ Series3	6.46	5.27	5.32	5.72	4.74	4.81	4.78	4.1

Various Skills	Mean
Understanding of concepts	6.46
Experience (inc. internships)	5.27
Communication Skills	5.32
Technical Abilities/Skills	5.72
Soft skills	4.74
Presentation skills	4.81
Leadership quality	4.78
Team skills/team work	4.1

Students were asked to judge the quality of teaching in their colleges. Respondents were asked to rate the *quality* on the scale of 1-10, where five was set as average.

Quality of Teachers

Rating	1	2	3	4	5	6	7	8	9	10
Number of Students	0	0	12	30	25	12	6	3	2	0
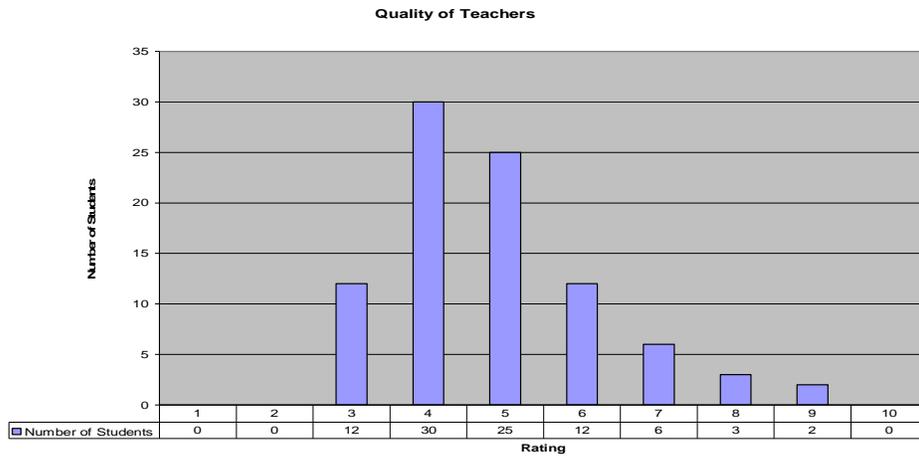
The mean response **was 4.86.**

Faculty Industry Affiliation

	NO	YES
Series1	63.72	26.28
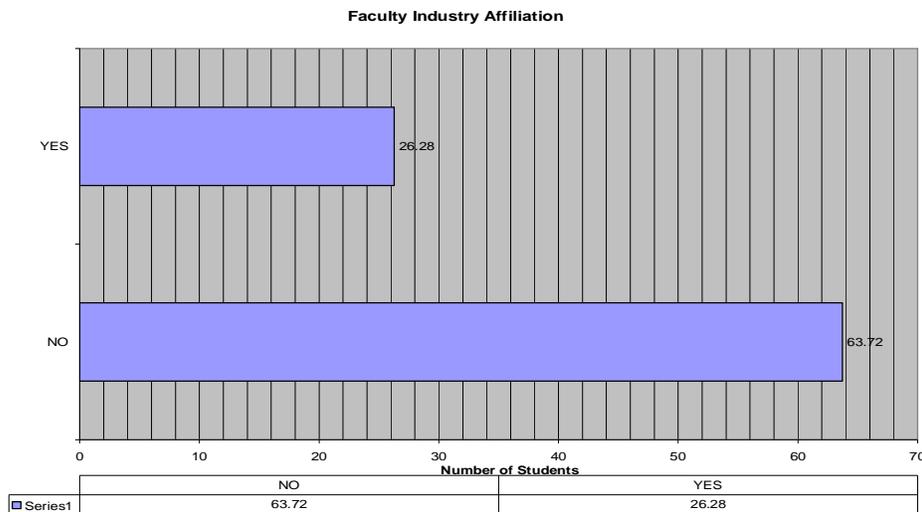
Students were asked if they had any faculty that had industry affiliation, or were from the industry. Only **29.2%** of the respondents replied in the affirmative.

Students were asked their opinion on how to increase the quality of education in their institutions. They were free to write any number of responses, some of these were specific and others in paragraph format. These are often written responses against open ended questions.

Students' opinions on how to improve quality of education in their institutions

	Practical Training	Industry Visit	Personality Development	Faculty Training
☐ Responses	83%	72%	68%	53%
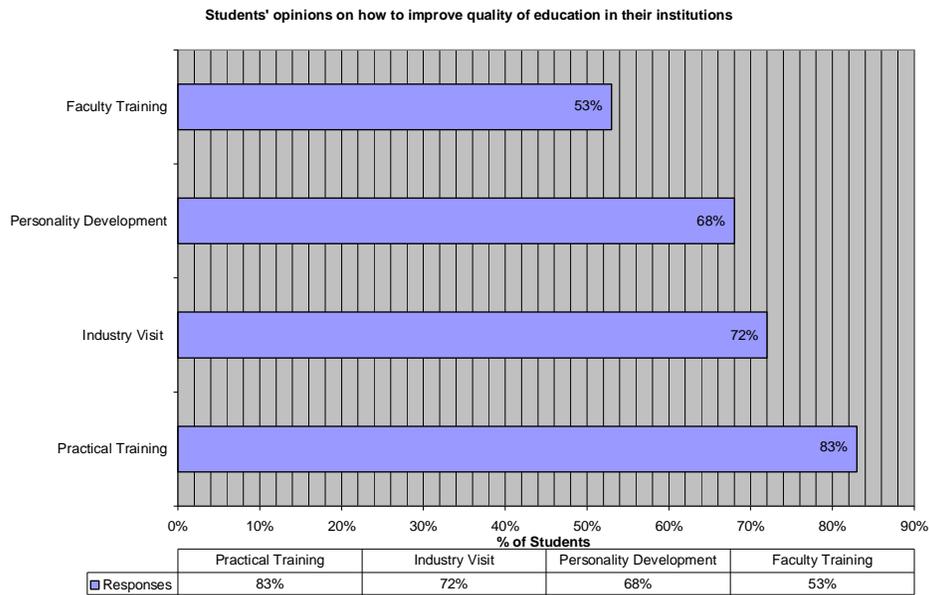
The software professionals were asked if their institution taught them any courses, or conducted any workshops beyond the mandated Technical and Professional Statutory Body (AICTE) curriculum.

Additional Courses Beyond Mandated Curriculum

	NO	YES
☐ Responses	49.5436	8.4564
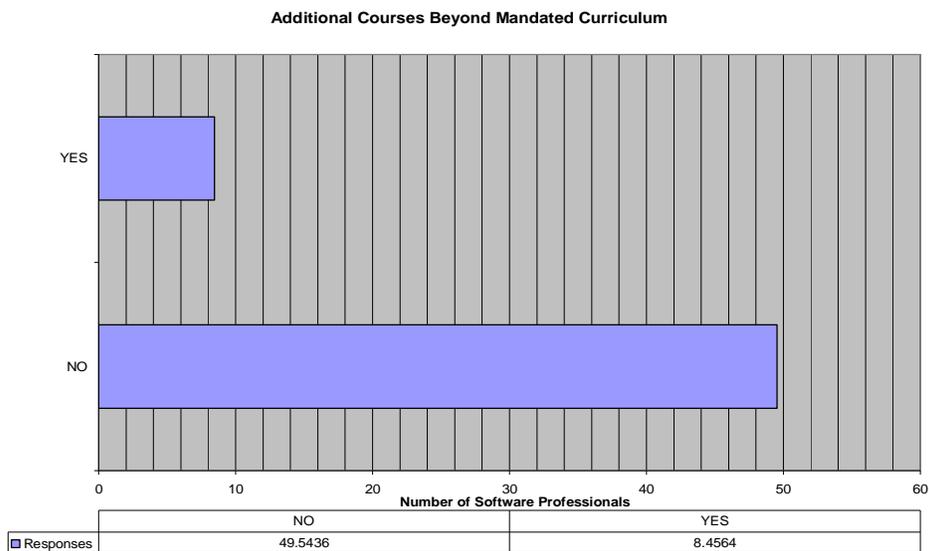
Only **14.58%** replied in the affirmative, with the majority of the courses being additional technology courses.

Software professionals were asked to rate the degree of extent their institutions prepared them for their current jobs.

**Rating the Degree the Insititution Prepared Professional for Current Job
(1-10)**

	1	2	3	4	5	6	7	8	9	10
No.	0	0	5	11	13	12	6	7	4	0

Rating

Number of Professionals (y-axis)
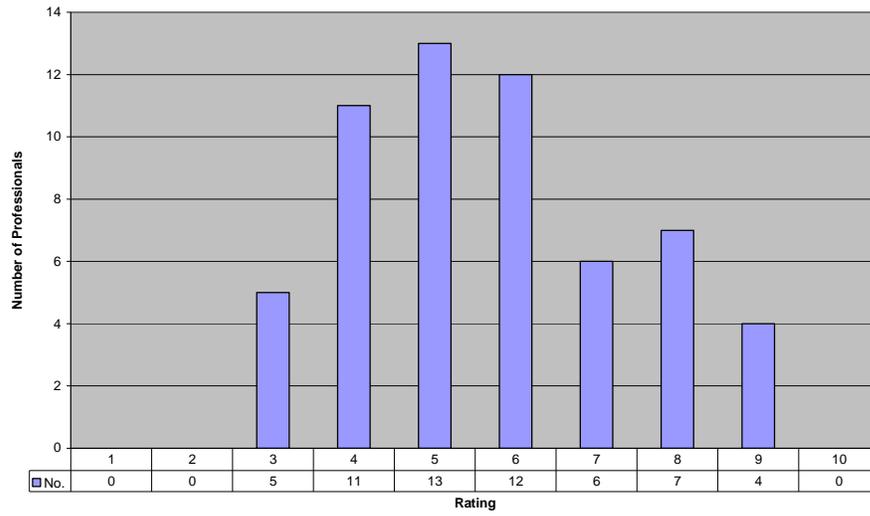
4. The Debate

4.1 Preparation for Real World Jobs?

The results of the field survey clearly indicate a problem with the quality of education provided. This is in agreement with the current literature as well as the interviews. The most striking result is the opinion of the HR professionals who felt that the four year college experience and education does not prepare the candidates for real world jobs at all. This also correlates with the average training period of new inductees being almost two and half months before they are able to perform the jobs which they were hired for. Interviews with some of the HR professionals who agreed to answer questions via e-mail as well as the comments section in the survey lead to two conclusions: first, that the syllabus being taught at the schools is not up-to-date or relevant, and second, that the soft skills (teamwork, communication, etc) are not developed. One HR director offered an insight into some of their candidates, "They can not speak proper English, they are not very articulate (lack of conceptual clarity), they are immature, their social skills have not been nurtured, they are unable to work in teams, and they lack work ethic and discipline." Another director highlighted the problem with the content, "Most candidates are very smart. But their skills are old, and no longer applicable to what most companies do today. It's the fault of their colleges; they use old books, and old syllabuses. Curriculum have not been revised-updated since years" Both of them outlined the training programs that were created to address these problems. They involve boot camp like discipline, external teachers and experts, as well as an introduction to the humanities. One director proudly stated that everyone had to read, *Gone with the Wind,* again and again, to try and inculcate some liberal arts.

Interviews with corporate professionals were on a similar line. They pointed to the need for extensive training programs for graduates of even specific technical fields, including software engineering. One Managing Director echoed the common sentiment, "we are unable to find suitably trained candidates for most of our jobs out of college, we have to retrain them, or poach from our competitors. Even the top colleges in the country merely act as sieves to give an idea to who is brilliant, or not." A good indication of the degree of training required is the syllabus of Tata Consultancy Services (TCS)'s (one of India's largest software companies) induction program which every new entrant must go through.

Appendix A – Structure of the Induction Training

I. **Foundation Module:- 42 sessions**

- Operating Systems
- Data structures
- Analysis of algorithms
- Discrete Mathematics
- DBMS
- Object Technology
- Internet Technology
- Soft Computing

II. **Software Engineering Module with a running case study:- 117 sessions (Includes an introduction to UNIX & C for implementing case study)**

- Software Development Process
- Systems Approach to Consulting
- Requirements Engineering
- System Design
- Reviews, Walkthroughs, & Inspections
- Testing and Debugging
- Project Work
- Software Maintenance
- Quality Management System

III. **Advanced Technology Module:- 45 sessions**

- Web design basics & Scripting Languages
- Java Programming & XML

IV. **Life Skill Programs:- 84 sessions**

Source: Building Software Engineering Professionals: TCS Experience, R. Narayanan and S. Neethi, TCS

Based on the interviews, surveys and research the educational gaps in candidates' resumes can be placed in a few distinct categories. a) Updated and relevant skills; b) Communication abilities; d) Liberal arts, the ability to think; d) People and Social skills; and f) Leadership experience.

4.2 Updated and Relevant Skills

The software engineering industry is relatively new and has been constantly transforming itself. Every year technologies change, along with the paradigms and tools. Software professionals spend a good amount of their time updating their skills, and often companies will provide incentives to adapt to new technologies. Curriculum in the institutions are seldom changed or updated andin practice it only changes once or twice a decade. With the lack of industry linkages and faculty, as well as inflexibility to change the curriculum, faculty in colleges often teach outdated material which is no longer relevant. To compound this problem, faculty themselves have no incentive to keep themselves up to date as there is very little interaction on their part with the industry, and negligible research. Students often reach out to the informal education system to train themselves. Some colleges, however, have taken the initiative and offered courses as extra training. However, even if the classroom is up to date with the latest technology industrial utilization and application is very different. In an interview one software engineer explained, "Good companies are CMM certified, which is like an ISO certification, there are special things you need to know and do to work in this environment, such as application lifecycle tools, and documentation, which colleges don't teach." In America this is bridged with the colleges getting projects from industry, getting industry people to conduct workshops, and through a system of internships. In India this has been slow to catch on.

4.3 Communication Abilities

One of the biggest complaints from HR professionals was the level of English of the graduates. In comparisons between India and China, India is often quoted as being a superior software engineering destination due to the focus on English. Unfortunately, though the software engineering education is entirely in English, English is not the first language of many Indians. India has at least eighteen major languages which are still in use by large portions of the population. The quality of English instruction primarily depends on the family of the student as well as the school. Students from urban areas and private schools have excellent English abilities, but those from less urban, rural and government schools have mediocre English communication skills. Reason, most of the schools are vernacular medium i.e the medium of instruction is not English. Since colleges in India are focused on the education of a singular subject, English comprehension is not something that colleges and universities concentrate on, require or even provide. As a result many graduates are able to communicate in technical English very well, but are unable to master the subtitles of the language, and its effective presentation. This creates problems for them in the software engineering industry which is very international, particularly, the portion of the industry which focuses on outsourcing.

One managing director commented, "going abroad I am always frustrated to see all the stereotypes of Indian call center employees as being incomprehensible, but there is a good degree of truth to all this, I would not let half my technical staff go anywhere near my customers." Another engineer expressed frustration with his colleagues who could not understand the spirit of the customer requirements that came in from their US office.

4.4 Liberal Arts

Educationists have often accused the British as trying to create a nation of (Babus) clerks by imposing an arbitrary education system. Ironically, it is this education that is helping India thrive in the world, by becoming the world's clerical back office. However, the software engineering industry is very different from the BPO and Call Center industries. The software engineering industry requires an element of creativity, maturity, and ability to critical thinking. A software engineer not only has to write code, but needs to understand the demands and situation of the end user and customer. The focus on technical superiority produces graduates who are very well versed with computing technologies, but are unable to grasp the basics of humanities, and the human existence. Major companies in their intensive training programs try and bring this liberal arts education by forcing their employees to read and discuss current and classical works of importance to try and expand their critical thinking abilities. For example, Tata Consultancy Services has group discussions on *Gone with the Wind.* Apart from requirements to get a job, liberal arts are also required to build the foundation of a good citizen. Legions of engineers with disposable incomes and influence, without the ability to think critically, will be hard pressed to contribute in a positive manner to the Indian democratic process.

4.5 People and Social Skills

HR Professionals and corporate professionals expressed great dissatisfaction at the people and social skills of the available college graduates. The HR professionals especially characterized them as immature, and of needing "second parenting" in the workplace. In the professional realm this extends to software engineers being unable to work effectively in teams, and to cope with a high-pressure environment that makes severe demands on emotions and time. An educationist hinted at what may be the fundamental cause of this, "the problem is that in India a twenty-two year old is still treated and mollycoddled as a child, we don't give them the responsibility and the respect they need to grow up." Interviews with the director of a college collaborated with this statement, "We (the college) are the guardians of the students, if something goes wrong, we are directly responsible, you can think of us as the parents in absence of the real parents."

However, apart from a societal problem, colleges do not do enough to ensure that their students are learning people and social skills. The survey results indicate that only a fraction of the students were offered additional courses, and majority of

them were technically fine tuned. In the software engineering industry globally distributed teams are commonplace, as well as the need for tightly integrated teams, which are comprised of stable people. A complaint of HR professionals was the emotional instability of the new employees. One described them as "kids set loose upon the professional world," and good naturedly talked about how being an HR professional was like being a camp counselor. He described the incompetence in social interactions between the employees at a social level. "Unfortunately," he said, "they tend to bring in the social into the professional, and then I need to get involved."

Colleges which have taken the initiative to address these problems have brought in outside consultants to work with their students. They offer and sometimes mandate courses in personal grooming, social behavior, public speaking, team building and leadership. Unfortunately, these courses are not built into the AICTE mandated curriculum, and therefore the time and the expense that can be devoted to them are minimal.

4.6 Leadership Experience

In India it is an old societal custom to measure someone's status by the number of people that work under him/her. In the Indian software industry, these means that with a few years of experience, professionals expect to start climbing the management ladder, going from Engineer/Professional, to Team Leader, to Project Manager, and then into senior management.

However, the majority of software professionals are ill suited and ill trained to take up the task of leadership. But, they expect to by virtue of their experience, rather than of their leadership abilities. Software companies have experimented with various alternate systems, such as having a new title called "Senior Software Professional" that pays the same as the Team Leader position. The industry is facing a serious lack of latent in software engineering management. Bagchi (1999) [5]describes India's, "…lack of senior architects and project managers." He goes on to state that, "This deficit could affect India's chances of moving up the value chain by building products or taking on larger assignments, going beyond working on a purely time-and-material basis."

All the HR professionals interviewed expresses frustration in finding good managerial talent. Most companies have taken to starting their own training programs, and human resource development services. But, in the market, there is clearly a shortage. The Indian college system has been blamed partially.

Educationists interviewed commented about how the Indian schooling system is designed to sap students of their individuality, and teaches them to conform to standards, leaders are made by appointment rather than by training or natural ability. In college there are few leadership opportunities. In India non-technical

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[5] India's Software Industry: The People Dimension, Bagchi, Subroto; IEE Software May/June 1999

colleges have thriving student groups, which are especially active in politics. However, in the technical colleges they are often considered to be a waste of time and a distraction from the primarily academic goals of the student.

4.7 Failing, Why?

It is clear that the answer to question one of this thesis, "Is the formal education system for science and technology failing to prepare its graduates for real jobs?" **is a definite yes.** The answer to the second question "why?" is more complicated.

There are many complexities and issues involved in the education process which may be the cause of this failure, some more apparent than others. Most of these problems are general symptoms of an ill-administered and designed education system, and some of them relate specifically to the unique needs of software engineering which does not seem to fit in well with more traditional areas of study. The problems can also viewed at two different levels, one is the pragmatic and bureaucratic issues which stem from poor execution and implementation, and the other are at the structural and design of the entire education system.

4.8 Corruption:

A good example is a news article widely circulated among university scholars published in *The Tribune* which talks about the donation of a college in to the Punjab Technical University. This article [6] explains the "horrific" ordeal a non-resident Indian (NRI) faced while trying to establish and run a not-for-profit college in India. He claimed in the article that he had to bribe officials at every level to simply do charitable work. His resultant frustration led him to wash his hands of the entire college and donate it lock, stock, and barrel to the affiliated university. The university accepted the college, but was unable to make use of some of the facilities as they did not have the resources to run several types of courses. Resources it is presumed the NRI was willing to pump in before his scrape with the Indian education system.

This incident highlights the problems faced in higher education in India due to the current structure wherein government permissions are required at every step of the way, even if the colleges are independent of the government in vision and finances. Colleges are not free to decide the number of students they can educate, who they can hire, what they can teach or even what they can charge. Due to the various regulatory bodies in a misguided attempt to cure the education system of profiteering and perceived bad quality a structure of centralized permissions has surfaced. As a result, the inspectors gain complete power over the education system, and are not just susceptible to bribes; they assume it is part of the perks of the job[7].

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[6] Dismayed at corruption, NRI to donate IT institute, Hoshiarpur, January 10th
   Tribune India, http://www.tribuneindia.com/2006/20060111/punjab1.htm
[7] Examples of a few newspaper articles: It's called BE or Bankruptcy of Education, R Akhileshwari, Dec 12, 2005, Deccan Herald

4.9 Finances

An essential feature of the Indian higher education system is the focus on education as non-profit work. The AICTE and other regulatory organizations are mandated to make sure education does not become a commercial interest. Politicians on the other hand have made it a policy matter to ensure costs of education to their constituents stay low. Unfortunately, the Indian budget can not support this type of a high subsidy. For example according to the ex-vice chancellor of Delhi University Prof Deepak Nayyar in an interview with *The Hindu* on May 2005, "In Delhi, university fees have remained Rs.15 a month for undergraduates and Rs.18 for postgraduates for almost 50 years." [8] Rupees fifteen is approximately thirty cents, the Vice-Chancellor in the interview laments that affiliated colleges have started charging almost ten to twenty dollars a month through questionable entries such as library dues. A soda Can in the cafeteria costs around Rs. twenty. In practicality, the cost of quality education is very high, and is dependant on market forces of supply and demand. In the private sector, this creates two problems, first, education institutions are required to charge extremely low tuition while attempting to maintain good infrastructure and second a black market is created which criminalizes the regular activities of institutions.

The tuition is set by the fee committee which consists of a number of political appointees and members of the regulatory bodies. The education institution does not have a say in the process and can only make requests. The objective of the fee committees to keep costs low is in direct conflict with the college's desire to finance education. On one hand the government bodies expect the institutions to provide the best facilities in the world; on the other hand they refuse to let the same institutions charge international rates for the education. As a consequence this leads to only the appearance of quality. The college is unable to provide the best infrastructure, a diverse array of programs, or hire the most qualified people. This is not the case in government institutions, where there is a budget allocation from the government, but it is inefficiently or even misappropriated spent leading to poor quality. The director of a private college commented, "They charge the same tuition as we do, give the same quality of education as we do, but they have ten times the budget because of the government subsidies, if we had the money we could do wonders here. Right now we can barely keep running, forget about expansion." The government instead of providing loans to the students is trying to subsidize their education at the expense of the health of the institutions.

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http://www.deccanherald.com/deccanherald/dec122005/panorama18102520051211.asp

Case of, and for, private universities, Bhanoji Rao, The Hindu Business Line, March 8th 2005, http://www.thehindubusinessline.com/2005/03/08/stories/2005030800190800.html/ Articles which describe some of this corruption

[8] http://www.hindu.com/2005/05/16/stories/2005051603561100.htm

Recently, due to the very apparent mismatch between supply and demand, there has been a flood of private players entering into this field, including politicians through side routes. Since, it is barely possible to run an institution with the given finances, making money legally is out of the question. These new entrants rely on the desperation of parents and students to charge ten to twenty times the tuition for admission. This was earlier being done under the guise of a management quota which gave 10-20% of the admissions as discretion to the college, and the rest on the basis of norms set by the regulatory body. Recently, there has been a move by the courts and the government to eliminate the management quota. The monetary sums are large enough for these new entrants to find new loop holes or bribe / influence the regulatory authorities. However, a large number of entrepreneurs have attempted to circumvent the regulatory authorities with varying consequence. Usually, these efforts have been detrimental to the interests of the students, who are not informed that the degree they are getting is not recognized by the majority of institutions in the country and the world, and that therefore they are not eligible for further studies.

4.10 Teacher Quality

The quality of faculty is a key factor in the overall quality of education in an institution. The results from our survey and interviews indicate a problem in the quality of faculty Hiring and retaining the right faculty is especially difficult in the case of software engineering institutes, as the institute usually competes with the industry for the same candidates. However, the pay scales of the professors are set by the government bodies uniformly across all disciplines, which in the case of software engineering are a fraction of what is being offered by the industry. An article [9] in the Christian Science Monitor says, "Today, a fresh engineering graduate can get paid twice as much as an assistant professor who has spent a minimum of six extra years and a hefty Rs. 300,000 to 400,000 ($6,896 to $9,195) more to earn his master's degree and PhD." Thus, there is a sense that apart from the minor number of faculty which join institutions for the pleasure of teaching, the majority are those not entirely suitable for industry, and are in most cases unemployable. Unfortunately, this results in the severe problem that the most qualified and knowledgeable graduates to not consider academia or teaching as a profession.

Another problem is the strict definition regarding the paper qualification of the faculty. The regulatory bodies demand that the faculty has at the very minimum a Ph.D in software engineering which is application based discipline, a post doctoral degree is rare. In the guidelines industry experienced individuals are considered eligible, but in practice is has not been allowed. The education institutions in the country therefore lose access to a vast resource of knowledge.

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[9] India's engineering teachers flee classroom for hot jobs, Nachammai Raman,July 13 2005, Christian Science Monitor, http://www.csmonitor.com/2005/0713/p07s01-wosc.html

Apart from the inability of institutions to attract qualified faculty in the field, there is a general lack of professionalism in the field of education in India. Interviewees talked about how education was considered the work of a quasi housewife, and how the faculty members were not motivated as professionals to improve their skills or knowledge base. Internationally, faculty members take it upon themselves to review their teaching methodology, outcomes and knowledge base. They strive to find out the latest in their field of expertise, as well as the general field of teaching and learning. This attitude is absent from the Indian education system. Faculty, use the same method, same lecture and same knowledge year after year without changing, adapting, or making it relevant to the latest scenarios.

4.11 Lack of Research

The top tier universities internationally base themselves on research. Through research they attract the best faculty as well as provide the most current education, and expose their students to cutting edge technology. In India however this has not been the case. There has never been a good linkage between universities and technical research. In America, the government outsources its research to University laboratories and funds them accordingly. In India however the decision was made to keep these laboratories separate from the education infrastructure of the country. Private industry prefers to set up its own laboratories, finding the approach simpler and cheaper in the long run. They do not have to deal with the extensive bureaucratic hurdles, and can pay researchers far more directly than compared to the educational institutions.

The trend is changing, particularly with the IITs (Indian Institute of Technology) taking the lead primarily because of their independence from the general higher education system. However, the total technical research produced by Indian universities remains negligible.

4.12 Lack of Industry linkages

In the comments section of the survey, the greatest criticism of the current students of the placement process was the lack of connections of the colleges to industry, connections in terms of on going research and projects, but also in terms of linkages for the specific purpose of recruitment. There is also a lack of direct guidance by the industry on the educational outcomes that are required to make a graduate employable. Comments by the Human Resource professionals in the survey form mentioned sharp disconnect between the required skill sets of the industry, as well as the personal or soft skills. Part of this reason is the institutions inability to involve industry due to regulations and bureaucracy, and part of it is due to the lack of motivation on the part of the institutions. A director of an engineering college explained that they want to have career development centre, but they were financially trapped. Recently, they had managed to collect money from interested students to hold a type of job fair. Unfortunately, such activities are rarely recognized by the tuition fees committee and proper funds can not be allocated. Lack of funds in not the only reason, another major factor is the ivory

tower effect. Since, the majority of faculty inside the institution is academic, they tend to prefer teaching software engineering from a theoretical and academic perspective rather than a practical approach which industry demands. The faculty is not comfortable interacting with industry as it exposes their lack of knowledge in their own fields of expertise, i.e. even if they knew what the industry required, they would not be qualified to teach it.

4.13 Regulatory Problems – AICTE

A large component of the problem is with the organization and running of the AICTE. A computer scientist in one engineering college explained their trouble with the regulatory body. The college procured a mainframe level computer with dumb end terminals with the objective to provide the fastest and latest technology to their students. The inspectors from the AICTE were unable to understand the infrastructure and equipment. On their list it said the college must have a number of Pentium 4s which were one-tenth the computational power provided by the system of the college. They refused to clear the college for the year's accreditation until they produced the required Pentium 4s. In the end the college had to procure an additional set of computers to show the AICTE inspectors. There are many such examples where the AICTE in its zeal to implement strict guidelines and its substandard training of its employees has sapped innovation from the institutions. Another interviewee confidential narrated example of an institute which bought old Pentium 1 computers from the market, polished them up, put Pentium 4 computers' stickers on them and had a little program installed that would pop-up a window claiming the computer was running the latest version of windows. The inspectors could not tell the difference even as they allegedly evaluated the software that had been installed on the computers.

Further, due to wide spread corruption in the organization, many institutes get away with sub standard infrastructure as the inspectors either look the other way. The problem is compounded when these inspectors who are used to getting bribes, start extorting money from well meaning institutions which are then held hostage to the system.

Recently the AICTE has applied for membership to the Washington Accord, a prestigious group which allows the cross accreditation of university systems around the world. Some of it's official documents and guidelines which are published and distributed internationally contain information that mirrors some of the best standards in the world. However, the organization proclaims these standards and methods only as an academic exercise, and currently still implements its old form of checklist based accreditation and quality control. Tooley (2001) gives the example of three-hundred-and twenty five checklist of norms and regulations that the AICTE publishes and updates which every technical and engineering institute must follow. He studies a few in detail highlighting the absurd logic behind many of them. The AICTE is an example of the what was called in India the "inspector raj" or the rule of inspector, where the inspector is the absolute monarch and all permissions and decisions are made centralized. Apart from

slowing down the process of education, and curbing innovation at an institutional level, the AICTE causes faculty to no longer have the freedom to teach what they think their students require.

The organization insists on standardizing every single type of technical degree with very little variance and inter-disciplinary features. Faculty which disagrees with the syllabus does not have a say in the process, and nor can the faculty make modifications. The argument of the AICTE is that it standardizes everything for better administration. But, most educationists interviewed called it counter productive, and say it only serves the interests of the employees of the AICTE to make their lives simpler and grant them the ability to control education.

4.14 Evaluation Systems

Evaluation of learning is a central aspect of all education systems around the world. In India, due to a demand to make the process transparent, over the years there has been a move for a completely objective evaluation system through singular examinations. Even, those exams where there is a paragraph form subjective element, mark sheets are given out which objectively state the points for each word or thought mentioned. Objective exams unfortunately can not capture the full depth of a student's knowledge, and character, and may not be able to measure accurately the understanding of required concepts. In India due to the focus on objective examinations as the tool to measure all value of the student, teachers in school and faculty in colleges have begun to teach for the test, than to educate.

Teacher's interviewed spoke of how they had to tell students they could not cover topics of interest or even market relevance because they had to make sure they completed every possible permutation and combination of the examination test question. The focus of the education system becomes on the repetition of facts, and the ability to mechanically solve mathematical and computational problems. The upshot of this is that Indian graduates are exceptionally talented in computation and the application of a preset number of formulae, but lack the ability to create, innovate, and grasp fundamentals. Since, the testing takes place at the university rather than the college level the institutions mandate becomes to train their students for a onetime academic evaluation, than to make sure they are able to perform in the real world.

4.15 Student Motivations

So far this paper has concentrated on the problems associated with the educational system. However, the students are a large part of this system, and the quality of students plays a large role in shaping the quality of education. A major problem faced by colleges and faculty is the huge influx of students into the software engineering field. Student's encouraged by media and political hype view software engineering as their best bet to get a job. This view, along with parental pressure forces many students to go into software engineering even if they don't

have an interest in it or an aptitude for it. Since the system is exam based, they are able to work hard, take help from the coaching centers and graduate with a degree and even good grades. But their lack of enthusiasm and commitment to the software engineering field and work shows clearly in their experience, knowledge, capabilities and job satisfaction. A HR professional put it into perspective, "they will only do software engineering, and find out more about it, if it is part of the job." Unlike their nerdy peers in the United States they are not motivated to learn and adapt themselves to the latest technology out of love for learning; rather they only learn new technologies when they have to. The same HR professional said that the only reason why most of the technical people there learnt new things was because either they were told to, needed to do it as part of their jobs, or thought they could make more money with the increased skill set. This was a common view shared by the other interviewed software professionals. Unfortunately, there are not many solutions for this problem primarily due to the accuracy of the job market assessment by the students; the software industry is their best bet.

4.16 Reservations

Reservations for particular groups are a main feature in the socio-economic and political landscape in India. The British used this system effectively to play different groups (especially the Hindus and Muslims) against each other. Post independence, Dr. B R Ambedkar, a vocal supporter of a group termed as SC/ST (schedule caste/schedule tribe) was assigned the role as the principal lead on the Indian constitution. The SC/ST group was the main victim of the caste system as being the lowest caste it was heavily discriminated against. It had been given the little "untouchable," wherein a person could lose their caste and social standing if they even touched a member of the group. The constitutional committee decided it would adopt five to ten years of quota based reservations for SC/ST and other caste based minorities in key government jobs as well as in government educational institutions. In the coming years in diverse Indian political system these minorities proved to be the swing vote block which decided Indian elections. As a result, the ten year reservations became institutionalized.

In January 2006, the government made a constitutional amendment with the intention to strike down a Supreme Court order, and made 25% quota reservation a minimum in all higher education institutions government and private. The amendment sailed through with only a minor opposition from the opposition party, which took the stance that it wasn't sweeping enough. The educationists knowing they could not win the battle, asked for a concession, that the government would let them price education for the non-quota seats. This concession was not granted. Even before this sweeping legislation, every state government made sure that colleges kept a large quota of seats for minorities. The politicians used these measures to gain the swing votes of these minorities.

Apart fro that the Human Resource Development Minister in April 2006 has mooted the proposal to add 27 per cent reservation for Other Backward Classes

(OBC) to the existing 22.5 per cent reservation for Scheduled Castes (SC) and Scheduled Tribes (ST) in the IITs, Indian Institutes of Management, All the Central Universities and other institutes managed by the Central government.

Looking at the current status of some of the backward groups in this country, affirmative action is indeed required. However, any affirmative action without responsible approach is loaded with long-term repercussion. The action must take into account school education and then subsequently, higher and professional education".

There are several problems with the reservation system. First, the reservations are not based on financial consideration, and thus even the children of rich and successful parents who qualify as minority can get the seats. Second, the reservations reduce the merit requirements by a great deal, both for admission and graduation. Educations often lament that they are producing doctors and engineers who are barely passed their science exams. Often there will be a difference of almost 40-50% of required in marks between the reserved seats and the normal ones. Third, the institutions are made to teach these students for almost free, without increasing fees from the other students, creating a financial impossibility. Fourth, since it is impossible to tell the difference between minorities unless there is certified proof, this system only serves keeps the caste system alive. Also, there is a brisk business in fake minority certificates. Society would be much better served if the reservation was built upon a financial need foundation, as well as an proven effort criteria, which would ensure students who are given this privilege are both in need and deserving of it.

To suggest a few - The most important issue, i.e. of increasing the number of seats has somehow been sidelined. This would ensure that the demographic liability becomes the demographic dividend. Equally while following affirmative action, principles of excellence cannot be ignored in the operation and growth of the educational institutions. Keeping this in mind there are many ways of affirmative action keeping in view the objectives".

Reservations become even more detrimental for those who are not admitted on comparative merit in professional education. It seems as if they are been programmed failure. It would be more laudable to spend the same in bringing them up to the competitive merit by focusing on their education during the schooling years.

It is also critical to remember the interest of the consumers of the professional category of students who would be responsible for the goods and services being produced in the economy. In such an event, it must be kept in mind that these consumers also include people of the backward class, and all consumers deserve the best. What would actually happen is that the, meritorious professionals will always be in demand and therefore will be taken by those who can afford and therefore others would have to be accepted by those who cannot.

It is often argued that less meritorious students get admission by paying donations. In fact, this also needs to be steamed by increasing the supply of institutions so that the premium which is being demanded for admissions essentially due to gap between demand and supply as it was in other sectors of the economy in pre-liberalization era. A regulatory activity of the type that is being exercised by SEBI on the capital market would ensure the general category student's interest calculating that of the backward class as currently protected. The biggest hindrance of the merit is the proliferation of professional coaching institutions which benefits the most from the gap in supply and demand without making any expenses in terms of infrastructure or quality or delivery on the one hand and charge fees which are higher than the institutions to which demand are sought on the other. The benefit of reservations should not be multiple. Every individual should have the benefit once in his or her lifetime. To be more specific only one generation should get the benefit of reservation and only at any one stage.

4.17 The Paternal and the Power Hungry

India is a unique country in its politics. Officially it is a "Sovereign, Socialist, Secular, Democratic Republic," with strong connections to socialism and even communism. Over the years with market reforms its industry has begun to thrive with end of government interference. However, education has yet to see the type of reforms that cause the industry in India to boom. A senior minister in the government informally interviewed claimed that the state does not trust consumers to make accurate decisions for themselves when it comes to education. The attitude of the government and the regulatory bodies is that since consumers do not know what is good for them, the government and the regulatory bodies need to step in and make the decisions for them by policing extensively the entire education system, as well as setting the services and education that is offered. This was the same attitude the Indian government adopted for the first forty years after independence in all sectors. The result was it took four years to get a phone line, there were three types of cars available and it took three years to get one, there was one brand of toothpaste, one hmt brand watch, and a handful of soap brands. After the reforms and opening up of these sectors in takes less than five minutes to get a cell phone, there are hundreds of types of cars to choose from, and numerous other products of varying price and quality. Politicians and bureaucrats lost a significant amount of power while consumers reaped the benefits of choice, price and quality. Education is one of the last bastion of control for the government and bureaucrats and they are adamantly refusing to let go. It empowers them, as they are able to please their constituents by artificially reducing the cost of education, get their friends, relatives, and patrons coveted seats in institutions, and exercise direct control of the fundamental instrument of democracy.

Suggestions and Recommendations

So far this paper has concentrated on the problems associated with the current education system. The problems elaborated have been theoretically outlines by the past literature. However, in the past literature concrete solutions have not been expressed or explored. This chapter attempts to provide a few suggestions and recommendations in the form of modeled solutions to help mitigate the problems faced by the higher education system in India

5.1 National Education Bank

The major problem faced by the government is its inability to control the costs of education. Around the world the costs associated with higher education are rising, and the Indian education system is feeling the same pressure. The government's traditional reaction has been to institute hidden subsidies, and to regulate by passing laws the fees the students can be charged with. One solution to the government's problem would be to set up a Central Education Bank, which would be the direct target of monies budgeted for higher education subsidies. The bank would act as a loan agency towards the institutions as well as the students. The organization would operate as a bank, and require the same degree of accountability from its customers as a traditional financial services institution.

In the case of the educational institutions, it would force the administration of government run institutions to make sure they have sustainable financial models. It would cut down on wasted expenditure, as well as prevent a good degree of corruption. Since the loan would be given through the bank, the institution's records would come into audit by financial experts rather than academic experts. Thus, the nation's best universities would be built on sound financial foundations, and would not have to rely continuously on the whims of the current government in power, or the politically appointed boards of trustees.

The case is even stronger for students. Currently, with its hidden subsidy system the government does not take into consideration students who are able to finance their college education. This places an unnecessary burden on the state exchequer, and in the case of private institutions deprives them of the amount that could have been judiciously used. The bank would extend education loans at low interest rates to students for their tuition and other expenses. Once the student has been gainfully employed, the bank can start recovering payments taking a piece of the new worker's salary over a period of time. This type of arrangement would ensure that the government is able to sustain its educational investments as it would recover the majority of the funds it put in. The cascading effect year after year (assuming funds flow in from the government's yearly budgeted expenditure) would create a large fund to finance the education needs of the nation's youth without the large financial drainage associated with subsidies and scholarships.

5.2 Education Institutions as Companies

A foundation of the current education policy is the non-profit and charitable nature of educational institutions and societies. The institutions are thus treaty differently

from corporate entities which over the years have created a system of checks and balances. Since the internal workings of the institutions are set by policy instead of market dynamics, there exists a huge inefficiency as well as lack of quality in the services institutions are willing and able to provide to their students. Educational institutions should be treated as corporate entities and brought under the existing systems and mechanisms of the market economy. Special provisions can easily be provided to encourage certain practices through the market economy means. There are a number of benefits.

5.3 Addressing the market needs of students

The main topic of this paper has been the outcomes of technical higher education in relation to real world jobs. This disconnect is due to the inability or the lack of willingness on the part of the educational institution to address the changes in market requirements. There is often complaint by teachers is that they need to conform to the central syllabus which is often out dated instead of imparting the latest education required by industry. Opening up the education sector to corporate independence, and market competition would force and allow the institutions to address the current needs of their students, and the economy.

5.4 Institution – Industry Interface

Industry has a vital stake in higher education. It is not only because of the fact that the institution of higher education provide trained man power for jobs in the industry, but also because they, through research and development, open up new vistas of scientific and technological development. It is therefore essential that there should be a closer relationship between industry and universities.

Industry should be involved in curriculum development particularly in courses, which have integral relationship with industrial process. In fact, the Institutions should identify the specific needs of the industry and draw up their curriculum taking that in account. Industry should also be represented on the decision-making bodies of the Institutions/universities. Industry should also provide faculty support in subject areas, where industry has expertise

There are a number of avenues, through which professional schools/institutions collaborate with industry. Some of the commonly used avenues are:

- Guest Lectures by industry representatives;

- Suggestions in curriculum and content designing;

- Executive Education and Management & Technical Development Programmes;

- Joint seminars by academia and industry both for executives and students;

- Consulting on management, technical and related issues by academia;

- Academia generating ideas and acting as incubators to new business;

- Inclusion of industry experts in governing councils and other board of studies;

- Industry providing financial and infrastructure support to professional schools/institutions for their development; and

- funding academic and applied research.

5.5 Prevention of Fraud and misrepresentation

Fraud and misrepresentation are the main problems that are linked to greater privatization of Indian higher education. In the formal system, there is the recent example of the Chattisgarh debacle. The state of Chatisgarh passed a law allowing for private universities to operate and grant degrees under the laws of the state. This created a number of educational institutions overnight, which proceeded to misrepresent their quality, their accreditation and their legal status to prospective students. A few years later the Supreme Court declared the new state law illegal and all the universities were disbanded. Most students were unaware of the dangerous legal status of their educational institutions, as well as the lack of recognition and accreditation. Students had been lured to join through fancy advertisements in the newspapers and on television. Under the corporate and consumer laws these institutions would have faced stiff penalties for false advertisements and misrepresentations, with a clear array of people facing liabilities. However, this was not the case due to the education institutions not being under corporate law, and corporate structures.

Under a market based model, the educational institutions, the directors and the promoters would face civil and criminal liabilities for all their actions. This would discourage fraud, and misrepresentation, as even if the educational institution is bankrupt or closed, those responsible for promoting it as well as those of the board, would be left open to incur liabilities and face prosecution. This would then encourage the proper management of institutional affairs, as directors to protect themselves would ensure the legal compliance of the institutions, in the same manner as directors in the case of corporate entities.

5.6 Financial best practices

The corporate sector has had years of experience in the handling of investments, finance and cash flows. Currently, educational institutions have only a few options in terms of investments they can make and methods of raising capital. Brining the knowledge and the flexibility of financial structuring to educational institutions would enable to increase their cash flows and finances, and thus have more money available for projects. There is a certain amount of risk involved in many financial transactions, but these should be controlled by the board of the educational institution, the same way it is controlled in the corporate world. Again, corruption and problems would be handled by the same laws that handle corporate affairs of similar nature.

5.7 Increase of quality of education

In the market model the institutions which offer the highest quality of product are the ones which are sought after by consumers. With a market economy in place, colleges will be forced to compete for students by increasing the quality of their offers. This would been greater investment in infrastructure, better pay scales of teachers, greater accountability of educational outcomes, and money to properly finance education.

There would be a range of education institutions which would be able to cater to every need of students. Educational institutions would always search for the brightest students, and thus would have an incentive to provide scholarships and financial aid to the students. Also, banks and other lending institutions would be more comfortable extending educational loans to students, as they will be able to see a transparent system, which has clear market targets and outcomes.

5.8 Accrediting the Accreditors

Education is a broad and vast field, and even in particular specialization there is great diversity in views of how education should be taught. A major problem that has been facing the government is how to make sure education is practically relevant, as well as theoretically comprehensive. Instead of regulating and legislating into either corner through laws, and councils such as the (NBA) National Board of Accreditation under AICTE, the education ministry should begin to accredit organizations which will accredit independent universities and colleges. The accreditor would have to prove itself to be grounded in sound education fundamentals, and its members have a long track record in education. Its accreditation policies should be upfront and publicly available. Colleges would accredit themselves directly with these organizations, and Universities could be accredited as accrediting organizations in themselves. A similar model has worked reasonably well in the United States, where the Department of Education certifies accrediting agencies as long as they meet a broad criterion. These accrediting agencies have different approaches to education, different requirements, and different reputations of quality. There are of course several issues that are raised by a decentralized system of accreditation. The primary one is abuse and maintenance of quality.

6. Conclusion

The problems faced by the Indian education system are similar in many ways to the problems faced by the education systems of other countries. What makes India unique is that fact that its industrial sectors are marching on to privatization, while the educational sector seems to be taking many steps backward. Education has always been a politicized subject, but in India it is taken to the extreme. Most of the people involved have good intentions, but intentions are simply not enough. Members of the government try to please their constituents, but also try and give cheap education, which ends up being exactly that. Regulatory bodies hang on tightly to every detail worried that the quality will further deteriorate, and suffocate the very system they are trying to protect. Private players come into the market with intentions of mutual benefit, but end up burning themselves and their consumers by being unable to navigate the molasses of the regulatory system. Students take hard subjects such as software engineering only to find that they are ill-suited, and teachers start with the best intentions of teaching but find themselves ill qualified and motivated for the job. Unfortunately, the Software Engineering industry is a hundred and eighty degrees to this situation. It has almost no regulation, no government interference, highly motivated entrepreneurs, brilliant leaders and technologists, and international connections and support. Apart from just the stark contrast between the systems, it amazing that graduates from the education system have found great success in the software engineering system. The credit could go to the undying spirit of the Indian youth to make something of itself against all odds. It is in this spirit the Indian education system will have to place its future in. Until then, hopefully, the software engineering industry will take matters into its own hands as we have seen with the extensive training courses, and create for themselves the top quality students that they need. The changing industry and economy will not wait for an education system breaking on all seems to get its act together.

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Education considered as an instrument of social change shapes the foundation and empowers the individual with necessary skills and competency for achieving important personal and social goals. It's the education, which has to ensure that values and ideals of a culture of peace prevail, and that the intellectual community be motivated to that end. The priorities have to be specified both for basic and higher education, and create a balance to ensure the stability in the social system. The educational programmes and processes should be related to the needs of contemporary man looking towards a fast changing future. The integrity, ability and willingness of man, achieved through a new system of education can be the most precious asset of the individual and his society, and it is this aim which needs now to be translated into a curricular content required by the emerging conditions and learning that is primarily directed to the development and sustenance of the learner's integrity as a free and creative person and his independence of mind and spirit.

India's education system has expanded exponentially over the past five decades, but its current achievements need more headway to realise its potential greatness. In the present situation, need is to reflect on the precise alternatives that may be helpful in overcoming the current problems and making our education more relevant and purposeful. Need is to respond to the wider (internal & external) challenges confronting it.

The Apeejay-Stya Education Research Foundation (AERF) has been established to act as a nodal agency working towards the cause of education in the country, both for school and higher. The Foundation would serve as a think-tank to analyze the emerging trends and technologies in education, work towards promoting excellence in education at all levels through teaching and learning, research and development, training and guidance, course development, and enable education to serve as a foundation and means of growth of the society and nation. It will attempt to shoulder the efforts in serving the broader issues of Access, Quality, Equity & Relevance and gear up to face the challenges of the new world order using collaborative and multi-disciplinary approach. The Foundation will become the repository of information on education and conduct research in new educational methodologies while collaborating with premier educational institutions globally and in India.

ASERF