# 2006-1782: THE PHENOMENA OF DECLINING GRADUATE APPLICATIONS AND ADMISSIONS OF INTERNATIONAL STUDENTS IN US ENGINEERING COLLEGES: AN INSIGHT FROM SABBATICAL IN INDIA (AT INDIAN INSTITUTE OF TECHNOLOGY)

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# The Phenomena of Declining Graduate Applications and Admissions of International Students in US Engineering Colleges: An Insight from Sabbatical in India (at Indian Institute of Technology)

#### Abstract

Traditionally, for a long time, India and China had been, by far, the largest supplier of well prepared scientists and engineers for the graduate research and degree programs in US and other developed countries. US universities and colleges had been the most popular and attractive destination for graduate studies and research for students and scholars around the world. Currently, India and China have caught attention of the world as being fastest growing nations in technology, industry, economy, and science & engineering education. That combined with the deplorable September 11 terrorist episode has set in motion a new phenomenon that relates to demand, supply, recruitment, and hiring of international graduate students in USA and in other developed countries. This paper is based on a case study to understand the cause of both (a) nation-wide decline in the number of high quality international applicants in engineering graduate programs, and (b) decline in numbers of those who actually end up joining after offers are made. The author conducted this study when he was on sabbatical from University of Wyoming in fall 2004. He worked at Indian Institute of Technology (IIT, Kanpur campus) in India. IITs in India are known for graduating the best and the brightest engineers and scientists in India and have been a prominent source of excellent quality graduate students and research scholars in American, European and Australian universities. I spent some time on doing recruiting for our graduate programs (for most part I was interacting with the engineering faculty on research projects). I gave seminars and conducted interviews with students focused on the recruitment of graduate students for the Engineering College. I also had interviews with administrators, professors, and research scholars with a focus on the topic of recruitment of graduate students for US engineering colleges. Interestingly, during that period several other recruitment teams visited IIT campus from other American and European universities. I participated in interactions and discussions with two noteworthy groups. One group was from Engineering College of Tulane University (led by the Dean of Engineering College) and other was a consortium of German Universities (several universities conducted a seminar). During these discussions some interesting sharing of experiences, problems, and issues related with recruitment of international students for American and European countries emerged. In this paper I'll discuss the details of those perspectives and observations and summarize the issues that are construed as hindering blocks for the recruitment of high quality engineering graduate students in US universities and colleges.

Since the author is still collecting data from several other IITs and some other engineering colleges in India on the subject of "placement trends" of their graduates (especially number of undergraduates going for graduate studies in foreign countries and within India); this paper is still a work-in-progress. And so, at this point, it is like an extended abstract. This paper will get fully completed (with all data and information in) in about two months.

# **Introduction and Background**

In the after-era of WW-II and during "cold war", research and higher education enterprise in US went through a drastic transformation and paradigm shift and re-design, especially in the disciplines of sciences and engineering. And that became the catalyst and engine of technological innovations propelling growth in industrial, economic, and defense capabilities and strengths that has been unparallel in the history of nations. One of the hallmark of the new engine (of engineering research and graduate education) has been the design of a system that attracted and brought in the best and the brightest engineers and scientists from all around the world, and kept them inspired to achieve their natural potentials in serving through science and engineering [1,2,3, 12]. This "brain gain" phenomenon, attracting and recruiting the best and the brightest in our system of research and graduate education from other countries has been the engine and the catalyst. This has also been characterized by scholars and observers of other countries as "brain drain", because that what it has been for them. [1,2,3,4,12].

In the September 11 aftermath, while recruiting graduate students (research assistants, teaching assistants, ...) is experiencing set-backs and challenges in all disciplines, engineering graduate education, in particular, has been affected most [11,12,13,14,16]. And, this has raised alarm. In several reports, studies, and publications conclusions have been made that this trend will have serious consequences for the preeminence of US in the area of science and technology followed by impacts on economy. Many questions have been raised, assumptions made, and theories proposed [5,6,7,8,9,10, 13, 16]. While we are trying to understand this imminent danger, I believe another paradigm shift has been taking place pertaining to this issue; and I'd call it "paradigm drift", "drift" because while the number of international scholars and graduate students entering US science and engineering enterprise has been on decline, during the same period the trend has been opposite for other developed countries (Europe and Australia) [12,13,14,15,17]. One of our biggest challenges is to understand what key factors are feeding this phenomenon. And then of course if we believe in the important role of the engine of research and graduate education in making and sustaining the industrial and economic growth, we shall search for the methods of solution. This paper tries to provide an analysis of this phenomenon with some conclusions; based on data from current literature, reports, and from a case study. In fall 2004, the author had the opportunity to spend sabbatical (approximately a semester) at Indian Institute of Technology (IIT) in India. IITs of India (widely known as the MIT of USA, similar to Tsinghua University in China) have been a long time source for recruiting excellent graduate students and scholars for the research institutions of research and higher education of the developed countries. The author conducted interviews with graduating students, research scholars, and meetings with faculty members and administrators on this topic. The paper describes the process, presents analysis and concludes that some specific things can be done by the recruiting universities and colleges to change the decline.

### **Process and Methodology:**

While I was there, a team of two recruiters came to the campus from Tulane University (Dean of the Engineering College, Dr. Altiero; and the Department Head of Civil Engineering, Dr. Gopu). They presented a graduate recruiting seminar to seniors and graduate students of IIT. I attended Tulane's seminar and joined them in a discussion with the Administration (Deputy Director) on recruitment and student/faculty exchange programs. During the period of my stay at IIT, over a dozen students from several disciplines of engineering contacted and visited with me for more information on UW's graduate programs. I provided them with appropriate pamphlets of information brochures that Dr. Suresh Muknahallipatna [18] had prepared for the recruiting trip though Asia Foundation, a for-profit organization for recruiting graduate students from India.

I had discussions with several faculty members and administrators at IIT on the topic of International Engineering program initiative. The IIT administration showed interest in student and faculty exchange programs with US universities, however they did not have a clear plan or experience in doing so. This campus was perhaps ahead of other IIT campuses in international activities (short term visitors from developed countries, research collaborations,...). Still, it seemed they were not prepared for providing facilities and resources that would be needed for accommodating international students from developed countries under a semester or year exchange program. In short the campus facilities and resources were not internationalized for students. Reason seems to be they did not have need for it so far. They did not have policy or experience on issues such as how to take care of costs involved in student exchange programs including compensations and living expenses and facilities for the stay of foreign students, etc. The situation with faculty exchange programs, however, was quite different and positive, for both short term and long term visits. One of my conclusions is that short-term faculty exchange with IITs would greatly help and enhance the graduate students recruiting from these institutions, if done with some pre-planning. I do not think that the whirl-wind type recruiting trips would work effectively. For example, above mentioned Tulane University's trip, in which they were spending about half a day on the campus essentially just giving a seminar, was perhaps not effective. And, so would be the case, in my estimation, with the for-profit-recruiting organizations like Asia foundation. These organizations are typically not allowed to do direct recruiting on IIT campuses, because of several other issues involved.

Interviews were conducted with approximately 25 students that involved discussing a set of questions (Table 1). To get better insight from these questions, a thematic categorization was used to focus on a few main themes. The students interviewed represented a diverse population with respect to gender, class standing and disciplines. Approximately 90% of the students interviewed were male and 10% female. Meetings and discussions were held with approximately 20 faculty members and administrators on the subject of graduate student recruiting by foreign countries, international student and faculty exchange programs.

#### Table 1: List of Interview Themes and Questions

These questions address different themes that are evident from the questions. Not all the questions were asked from each student, but care was exercised that all the thematic categories were covered. Some themes had more than one questions. Many times same question was phrased differently or asked from a different angle. Typically these questions were followed with discussions.

- 1. Your major? Graduate/Senior/Junior?
- 2. Suppose you were offered admission without financial assistantship from equal caliber graduate degree programs in USA, Canada, England, Germany, France, Australia, Russia... Which country will you choose?
- 3. Suppose you were offered admission with financial assistantship from equal caliber graduate degree programs in USA, Germany, France, England, Australia, Russia. Which country will you choose?
- 4. On Application process: in your experience and from what you have heard about admission process of universities, which one you dislike most, which one you like most. Most difficult part in the process?
- 5. On admission decision process
- 6. On Visa application process
- 7. On Visa decision process
- 8. On future plan of staying in the country you go to? Do you have a plan to stay back to work in one of these countries? Which one most preferable?
- 9. On GRE and TOEFL
- 10. Did you learn something new and worthwhile in this interview? Name one or two things?
- 11. What would you suggest changing in the application process?
- 12. What could have I done to help you more?
- 13. Do you have any suggestions as to how we could make this course better?

# Discussions

The International Division of National Science Foundation (OISE website of NSF) makes the following point: "The U.S. science and engineering (S&E) workforce is competing in a context that demands new and different skills and competencies, particularly those that provide maximum flexibility in meeting the current and future needs of employers that have a global reach. In this changed world, we need to educate our engineers and scientists beyond their technical expertise and prepare them for what is to come. The best technical training must be combined with an understanding of how that expertise fits into the larger societal environment, into our overriding national goals, and into the goals of other nations. East Asia presents clear challenges and opportunities for developing an approach to enhancing the competence of our S&E workforce. It is a region of strategic importance to the United States, with a strong cadre of scientific talent, a rapidly evolving technological base, and the potential to provide significant new markets for U.S. technological products. The scientific, educational and technological strengths of the region present the U.S. with a rich array of potential partners, customers, and competitors."

Washington Bureau of Inquirer did a thorough study of this phenomenon and published a report recently [16]. This report makes several key points. A summary of that report is abstracted here:

"A half-century ago, the Fulbright scholarships became an instrument of U.S. foreign policy, drawing the best and brightest graduate students from overseas and sending them home to become leaders in their own countries, imbued with the heady spirit of American-style democracy. In recent years, the emphasis has shifted to undergraduates, so that now, with nearly 600,000 foreign students in the United States, there is virtually an even split between undergraduate and graduate students. Private colleges tend to have more foreign-born undergrads, while public universities enroll more grad students. According to Harvard University government professor Joseph S. Nye, a former State Department and Pentagon official, international students make up the shortfall of homegrown doctoral students in science and engineering. The spread of American ideals is one by-product of globalization, but there's a huge financial payoff, as well. Educating foreign students is a \$13 billion-a-year industry, according to the U.S. Department of Commerce.

Events have altered that playing field. In 2003-04, international student enrollment in undergraduate, graduate and postdoctoral programs fell 2.4 percent for the first time since 1971, according to the Institute of International Education. Tightened visa requirements, a perception by some foreign students that the United States is not as hospitable to foreigners as it once was, and aggressive recruiting by schools in other English-speaking countries, particularly the United Kingdom and Australia, have depressed U.S. applications. Though 2003-04 saw the first decline in foreign enrollment in 30 years - a dip tied mainly to post-9/11 visa strictures - competition is fierce among colleges and universities racing to attract more international students. In recent years, Australia has opened 17 college recruitment offices around the world. American learning centers do not get federal assistance in recruiting, although some state university systems provide funding for marketing. The decline in foreign enrollment for 2004-05 slowed to 1.3 percent from the previous year, or a total of 565,039 - accompanied by actual increases in the number of students coming from top sending countries such as India, according to the Open Doors report by the Institute of International Education.

As competition for Asian students heats up, an increasing number of larger U.S. schools are opening graduate programs abroad. Cornell University, the University of Chicago, the Massachusetts Institute of Technology, Stanford University, and Johns Hopkins University have opened programs in Singapore. Most offer specific degrees rather than an entire curriculum. One tangible result of this commitment is Penn's Center for the Advanced Study of India, the only research institution in the United States focused on contemporary India. As part of the School of Arts and Sciences, the center's mission is to seed a new generation of policy-oriented scholars focused on India and trained in interdisciplinary perspectives. According to university-wide figures, the school had a total enrollment of 4,192 students from nearly 120 countries in 2004. There were 320 foreign students in the class of 2008 tops in the Ivy League. The Class of 2009 has declined to 281 international undergraduates. In the 1970s, only about 1 percent of undergraduates were from foreign countries; plan is to bring the international student ratio at about 12 percent."

In the current human-capital revolution that is taking place in the world (led by China and India), Chris Farrell writes [13]:

".....In (this) global human-capital revolution lays a greatly underappreciated force: universities. Discussions of globalization typically revolve around major economic trends, such as trade, foreign direct investment, and labor market competition. Yet a linchpin of the evolving integrated world economy is a common university structure. Certainly, the numbers are striking. About 20% of the world's relevant age group -- well over 100 million young adults -- is participating in higher education. That's up from a fraction

of 1% of this age group in 1900, or about 500,000 students, calculate John Meyer and Evan Schafer, sociologists at Stanford University and the University of Minnesota, respectively. To put that figure in perspective, the scholars note that Algeria, Kazakhstan, and Myanmar each now has as many students enrolled in higher education as the entire world did at the start of the 20th century."

# Mr. Heenan, who wrote a book, "Flight Capital: An alarming Exodus of America's Best and Brightest" [15] makes following observations:

"America's biggest problem isn't terrorism, it "reverse brain drain". And then he goes on to explain, "in recent years for a variety of reasons a lot of them (international scientists and engineers) have started now to make a U-turn, and that movement started to pick up dramatically after 9/11 when we really tightened up in a pretty heavy-handed way, and I think wrong-headed way, our immigration policies and created a much chillier environment for both potential overseas recruits and recent newcomers to the country." He continues, "No country, including the great United States, can afford to see its best minds walk, and that's what we're starting to see today in rapid numbers. By my estimates, every day we're losing 500 to 1,000 people, many of them highly gifted scientists, engineers, doctors and the like. To borrow terms, they're the guardian angels, Curtis, of the new economy, exactly the kind of people we want to keep our hooks into. On the other side, we've got to hang onto the trusted immigrants that we have and be much more active, in particularly recruiting very skilled, very bright immigrants which Australia, Canada, and more recently the European Union are doing very, very aggressively."

And, finally in Science [1], Jeffrey Mervis provides a very comprehensive description of the problem and issues, and makes points to the contrary while looking at the same phenomenon and data:

"..... Some university administrators and department chairs are worried that a post-9/11 United States has become a less attractive destination for many foreign students. Most can relate unhappy tales of a brilliant student who couldn't get through immigration to enroll, or a foreign-born colleague detained on the way home from an international meeting. Any interruption in this stream of foreign talent to U.S. shores, they say, could threaten the country's status as the world's leading scientific power.

In March (2005) came news that seemed to confirm the worst fears: Two university-based surveys reported a downturn in the number of graduate applications from foreign students for the 2004-05 academic year (*Science*, 5 March, p. <u>1453</u>). Research dean Lenore Kola of Case Western Reserve University in Cleveland, projected a 41% drop in the number of international grad school applicants for the 2004-05 academic year. "Sadly, the unpredictability and delays that characterize the new system have resulted in a growing number of the world's brightest young people deciding to remain at home or go to other countries for their graduate education," wrote Robert Gates, a former CIA director and current president of Texas A&M University in College Station, on the 31 March opinion page of *The New York Times*.

More broadly, what factors shape the flow of young international scientific talent into U.S. universities? For answers, *Science* talked with dozens of U.S. academics and examined admissions data from their institutions. We probed attitudes in China and India, the two biggest sources of overseas talent. We looked at what's happening in Australia, widely held to be an increasingly popular destination for young scientists.

The picture that emerges is different in many respects from the one many academicians have been painting. One important reason is that the number of applications to U.S. graduate schools from foreign students has soared in

recent years. Another is that the chances of a foreign applicant becoming a member of the next entering class are extremely low: As few as one in 50 receive an offer of admission, and fewer than half of those admitted actually enroll. In fact, policies affecting the "demand" side of the equation--the number of foreign students U.S. graduate programs want, or can afford, to admit--are likely to have a greater impact on quality than fluctuations in the supply side. The data also raise doubts about the pervasive fear that the top students are going elsewhere: The number of Chinese graduate students in science and engineering entering Australian universities, for example, is actually declining. The biggest--and so far unanswerable-- question, however, is whether the best students are being scared off. So far, at least, there's little indication that that's the case."

**Do fewer applicants mean fewer foreign students on campus?** It might seem logical to assume that a decline in the number of applications from abroad would lead directly to a drop in the number of international students on U.S. campuses. Wrong. Most U.S. universities receive so many applications from overseas--in particular China and India--that the number of applications often has no affect on the number admitted, much less on enrollment. Indeed, many universities have experienced such a surge in international applications in recent years that any drop-off this year leaves them still comfortably ahead of historical levels.

At Case Western, for example, the number of applications from Chinese students--who represent 80% of the school's foreign applicants--has more than tripled in the past 4 years. So this year's haul, even after a 41% decline, will still match 2002 levels and be twice the number that applied in 1999. Yet, despite the surge in applications, the number of international students admitted by Case Western has held steady for the past 5 years.

This experience is not unusual, because the number of foreign students enrolled in any particular U.S. graduate school depends on many factors in addition to the number and quality of overseas applicants. For public universities, a big one is money. International students cost more to educate, and that can be a limiting factor in how many foreign students a department can enroll. James Allen, chair of the physics department at the University of California (UC), Santa Barbara, explains how it works at his university.

Foreign students typically represent from 20% to 25% of the graduate students in Allen's department, a figure that places it below a nationwide average of 50%. It's not for lack of student interest: "We get 400 to 500 applications [each year] for 20 to 25 slots," explains Allen, "so there's plenty to choose from." Instead, Allen says, the demographics are influenced by reimbursements to the department for what he calls "excess tuition and fees" for out-of-state students. "It's never enough," he says. "So as the number of foreign students grows, we can either beg [the dean] for more money or get it out of department funds."

This winter, Allen says the department decided to "bite the bullet" and spend \$100,000 from its budget to pay for four or five more international students. "There was a lot of gnashing of teeth," he recalls. "But we all agreed that they were great students. So instead of accepting 60, we accepted 80." (The department's one-in-four yield rate--one student shows up in the fall for every four admitted--is fairly typical and adds some guesswork to the financial equations.) In return, he says, the department is tightening its belt by dropping one lecturer and adopting a series of one-time savings.

Some departments make the de facto cap explicit: The physics department at UC Berkeley, says chair Christopher McKee, aims for no more than 25% international students so that it can afford to pay their nonresident tuition rates. However, most adopt a more informal process. "Yes, there are financial constraints," says Richard Attiyeh, graduate dean at UC San Diego. "But our goal is to get the best students."

Some university administrators say that domestic students are simply a better fit for their programs. Vanderbilt University School of Medicine in Nashville, Tennessee, for example, currently has 34 different research training grants from the National Institutes of Health, which require participants to be U.S. citizens or permanent residents. Vanderbilt takes pride in its relatively small population--10% to 15%--of international students. "We don't have too much trouble recruiting good students, so we haven't needed foreign students as a source of labor," says senior associate dean Roger Chalkley, who oversees graduate biomedical research education and training at the medical school. "We also very much prefer them because their English skills are so much better than the Asian kids'." Still,

the high bar doesn't seem to deter applicants: Last year, for example, the school received 710 applications from foreign students and enrolled 14.

The good news for departments seeking to maximize the number of U.S. citizens in their graduate programs is that the drop in foreign applications has been offset at many universities by rising demand from domestic students. At Duke, for example, the number of domestic applications for graduate programs hit a 10-year high this year. It also exceeded the number of foreign applications for the first time since 2000. The University of Texas saw a similar flip-flop in the nationality of its graduate school applicants. "From my view, this is a very good thing," says Lew Siegel, dean of Duke's grad school. "It means that more U.S. students are interested in STEM [science, technology, engineering, and mathematics] careers, and that's a trend we desperately need."

Are visa barriers the reason for the drop? There is no doubt that many international students have a harder time entering the United States now than a decade ago and that non-U.S. citizens working here face more obstacles getting back into the country after personal or professional travel abroad. Viewed from India, however, a downturn in U.S. employment opportunities, as Asia's economy remains strong, appears to be a bigger disincentive for Indians thinking of studying in the United States. Vijaya Khandavilli, a microbiologist and educational adviser in the New Delhi office of the U.S. Educational Foundation in India, says students visiting her office complained of neither arbitrary visa decisions nor unduly long wait times. Instead, she says, fewer students see the point of spending a long period abroad when their job prospects after graduation are so uncertain.

Academic officials in China, the largest source of foreign applicants for many U.S. programs, say that anticipated visa problems are only one of several reasons Chinese students may be thinking twice about coming to the United States. A growth in postgraduate education in China is giving domestic students a better chance to complete their educations at home, says Yan Xuehong, deputy director of student affairs for the postgraduate school at CAS. And she says there is also a rising demand for these graduates. Another factor that may be affecting applications from China is a change last year in the qualifying test for graduate admissions. The Educational Testing Service (ETS) noticed that scores on its Graduate Record Examination from China, Taiwan, and South Korea would rise by as much as 100 points throughout the month, then dip at the start of the next month before resuming their climb. "This scalloping pattern was so obvious," says David Payne of ETS in Princeton, New Jersey, that there was "no doubt" students were obtaining answers to the test, which changes every month, from those who took it early in the month. By changing to a paper-and-pencil test and reducing the frequency and number of sites where the test is administered, ETS says it has rooted out the problem. But it wasn't good for business: The number of students taking the test fell by 50% this year in China and by 43% in Taiwan.

To be sure, the drop could simply reflect a reduction in the number of students who want to pursue graduate work in the United States. Indeed, Payne says the volume also dropped by 37% in India, where the exam procedures were not changed. But several university graduate deans believe that the more rigorous security might have scared off students less confident of their academic abilities. If so, that drop in applications may have come disproportionately from the lower end of the spectrum."

# **Concluding Summary**

This paper discusses data and observations from published literature and a case study involving interviews and discussions to find an insight into the cause of the phenomena of declining graduate student applications and admissions in US universities. Though more data is in the pipeline from institutions in India, the currently available pro and con arguments have been studied. At this point conclusion is that there are three driving forces for the phenomena: (a) strictures in the Visa process in the aftermath of September 11, 2001, (b) Keen competition for high quality international graduate students from all major universities and institutions of higher learning in the developed nations (US, UK, Canada, Australia, Germany, France, Russia,...), (c) Tremendous growth of economy, industry, information technology and other technologies, and

facilities for world class quality graduate education in developing countries led by India and China. This keeps their science and engineering graduates well employed at home.

**Future Work:** Since the author is still collecting data from several other IITs and some other engineering colleges in India on the subject of "placement trends" of their graduates (especially number of undergraduates going for graduate studies in foreign countries and within India); this paper is still a work-in-progress. And so, at this point, it is like an extended abstract. This paper will get fully completed (with all data and information in) in about two months.

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18. Personal Communications