Report on the

Faculty Summit on Research and Innovation

organized by

Association for Computing Machinery (ACM), India
(india.acm.org)
and
Microsoft Research, India
(research.microsoft.com/en-us/labs/india)

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Background

The tremendous progress made in the last twenty years in the areas of software development and IT services has made IT and computing areas attractive to a large fraction of the population. The next natural step for India is to get into research, products, and other high-end involvement, given the large and youthful population in the country. This needs very active and effective involvement of all players: academic policy makers and institutions, the larger computing community in the country, industry researchers and leaders, industry associations, and national policy makers and the government. The Faculty Summit was a small step to bring the computing community together to start the process of brain-storming.

The summit brought together 50 faculty members from 32 top institutions and 18 researchers from 10 industry research labs. The objective was to discuss the state of research in the computing sciences in the country, as it is popularly accepted by the community that research at the doctoral level in the country is highly inadequate. Research in academic institutions play the most vital role in any country towards leadership in the underlying sciences and in technologies that come from the sciences. The focus of the discussions was the strengthening of doctoral research in the country in both quantity and quality.

A specific high goal discussed at the summit was that of achieving an intake of 1000 PhD students in Computer Science per year in 5 years time in the top 30 institutions of the country, with the research quality comparable to the top 30 universities of the world. This involves scaling up both in quantity and quality of doctoral research in the country. It may also involve enhancing faculty numbers and other resources in these institutions. The larger context for enahancing research in the country also involves broadening the base from these 30 institutions to the next 50 or 100 institutions in the country. A number of IITs, deemed universities, PPP IIITs, etc., are being started in the country in addition to the several new IITs that came up recently. The NITs also have the ambition to ramp up their research output.

Executive Summary

1. Computer Science and allied areas are very popular among students at bachelor's and masters levels in India, with several lakhs of students enrolled in different programmes. However, only about **100** quality PhDs are produced in the top institutions of the country annually. This adversely affects the long-term ability of the country to produce institutions that define and drive the technologies of the future. This issue needs immediate attention of the academia, the industry, and the policy makers.
2. It is only natural that India as a country aim for a global leadership position in the computing-related areas through technologies, products, and high-value services, as a follow-up to the impressive achievements of the last 2 decades in software development and IT services. Computing is an area that is ideally suited for India due to (a) the low requirement of capital investments, (b) easy global reach of the products, and (c) high availability of young manpower with skills in logic and mathematics. Active intervention by academia, industry, and government can help Indian computing community achieve a pre-eminent role in the next decade.
3. The challenges in increasing the enrollment in the doctoral programmes include: (a) attracting more enthusiastic students to the doctoral programmes, (b) keeping them challenged academically and comfortable economically during the programme, (c) providing opportunities and support for fruitful careers as teachers and researchers in the academia, researchers or product developers in the industry, or as independent entrepreneurs, and (d) spreading the awareness about computing research to the society at large, especially to the schools.
4. The academia, the industry, and the government should act in concert to achieve these goals. This documents lists a few possible steps towards overcoming some of the challenges listed above, as discussed during the two-day summit. These are presented for leaders of the academia, leaders of the industry, and the policy makers. The computing research community is eager to partner with all stakeholders to make this possible.

Specific Recommendations and Suggestions

Building Awareness

1. Wide publicity should be given to the opportunities and thrills in research. This should be aimed at the society at large the bachelor students in particular, so that those whose heart is in research start thinking early about a PhD as an option on graduation. This needs to be done by academic institutions, industry, and the government by targetting students already in all types of institutions as well as younger students in high school and the plus-2 stages.

2. Conducting open houses to showcase research outputs by academia and industry labs is one way to communicate about research in practice to students. Most of the bachelors or M.Tech students do not have any direct exposure to research or researchers. They are more likely to believe research is not a feasible or viable career option for themselves. Seeing research in action and interacting with researchers and especially research students will help them think of research as a natural and exciting career.

3. The entry requirements for a PhD in Computer Science is a bachelors degree in an overwhelming majority of institutions world over. However, the wide impression in India is that an M.Tech degree is the requirement, though many institutions do not need that. This misinformation works against pursuing a PhD by many due to the perceived lateness of entering the full fledged job market. An explicit proclamation by all institutions making the bachelors as the entry point and giving it wide publicity will help break this non-existent barrier from the minds of potential students and their families.

Expanding the Supply Base

4. Growth in PhD in the country cannot be restricted to the top institutions alone. The next level institutions also need to develop a research culture and track record. Research awareness sessions need to be conducted in different institutions such as the NITs, the deemed universities, and other good engineering institutions. This can include technical and motivational talks by inspiring researchers, workshops on research methodology, sessions on societal problems, etc. This can both help create the desire for PhD among students and help create the right mindset among the faculty to guide research.

5. The faculty of such institutions expanding their PhD programs can be guided and mentored by more experienced researchers from other academic institutions or from the industry. This is essential in the ramp-up phase as these starting institutions are to have a few individuals passionate about research but unlikely to have a broader ambience of research. The mentoring can involve faculty summer internships in which the supervising faculty from the starting institutions spend a month or more in the summer with reputed research institutions.

6. Another way to promote a research culture in colleges is to setup active student seminar series in which their students learn and present an important topic to other students. These talks can be interspersed with talks by own faculty members or visiting PhD students or researchers.

7. Fellowships that are attached to individual students such as those given by CSIR have played a major role in increasing the PhD enrolment in sciences. Such a scheme should be introduced into CS and other engineering areas. For example, the top 1% of the GATE scholars could be given a 5-year PhD Fellowship that they can avail of in any recognized institution they join for a PhD. This has twin benefits. Firstly, more top students of GATE will consider PhD as a serious option instead of their current target of M.Tech/ME. Secondly, this can bring good PhD students to newer and lesser known institutions with potential in a few areas.

Partnering with the Industry

8. Industry should communicate to students and others about opportunities for PhDs and other research trained individuals in their organizations. Research training is increasingly being valued by product groups in addition to the research groups in the industry. Clarity on this will help students see industry opportunities after a PhD.

9. Bring research-oriented individuals back from industry to full-time PhD. Several individuals realize their passion for research after a brief stint in the industry. Others may be compelled to start working in industry for a few years due for economic reasons. The overall system should facilitate their smooth return to academia to do a PhD. These individuals will bring a lot of value into the research scene and can revolutionize the technology-based entrepreneurship scenario in the country by combining their real-world experience with research training. Tapping into this vast resource may require significant changes in admissions process and increases in stipend levels. It may also help if the industry can support them financially.

10. Professionals in the industry may want to pursue a PhD while continuing employment. The organizations can derive immediate benefits if this happens. Industry should facilitate and encourage this using financial support as well as providing the required time to the employees. Academic institutions should setup a research process that ensures high quality while providing additional flexibility to individuals.

11. Academic institutions should form appropriate policies so that professionals from the industry can get admitted easily into the PhD program, either in the full-time or in the part-time mode. More flexibility may be required on the admission process as such individuals may not perform well on highly competitive examinations at the stage of life they are in. Such individuals, however, bring enormous value to the PhD program and can help take the research in the institutions to the larger society.

12. Clarity and flexibility will also be needed from both industry and academia on Intellectual Property issues when employees pursue a PhD degree on a part-time basis. Both sides need to be aware of the great value brought in by the arrangements and support each other accordingly. Full-time employees pursuing PhDs provide value to both the academic institution in seeing real-world problems and the industry to branch into more challenging products and problems.

Well-Being of the PhD Students

13. Attractive stipend levels is essential to keep students happy while doing a PhD. Entry-level salary of IT services companies can be the baseline. In today's terms, a stipend of Rs 35000 per month will be a game-changer that will persuade research-oriented students to join a PhD programme. Funding from projects for those doing PhD should be at this level also.

14. Several UG and M.Tech students have student loans which keep growing while they do PhDs. Government should set up a scheme which freezes the loan burden of PhD students during their course of study. Thus, their burden remains the same after a PhD. Another progressive step will be to completely waive the education loan if the individual joins academia as a faculty member after completing the PhD.

15. Another option to provide increased stipends to PhD students is by enabling them to teach courses at nearby colleges that offer undergraduates degree in CS, while being full-time PhD students at their home institutions. This, apart from providing the much-needed enhanced incomes to them, gives them the essential teaching skills that will help in their future careers. The students of the colleges where they teach are being exposed to teaching by active researchers. This will both add value to their own education and make them think about PhD research as a serious option on completion of their bachelors programs.

16. Performance-based rewards in the academia can foster quality research by the students. An element of competition in the top-rate PhD fellowships can prompt students into high action. Ability to earn significantly more than the base scholarship level based on top performance can be a way to push quality and quantity upwards simultaneously.

17. It will no longer be the case that all PhD students are single during their studies. A tradition of treating PhD students as employees or staff of the institutions should be encouraged. Quality accommodation for married students in campuses is a must for attracting students of all types, especially those returning from the industry after a few years. An active social environment on campus will also help keep students productive.

Scaling up the CS Departments

18. The CS departments in these institutions will need to be expanded significantly to sustain an intake of 1000 PhD students. About 2000 faculty members will be needed to meet the target, which represents at least a 4-fold increase in the present faculty strength. This is a daunting task, given the production of quality PhDs in the country or influx of foreign-trained PhDs, but should be taken up on a priority basis. One way to scale up advising capacity is to establish an active and extensive post-doctoral researcher track in these institutions. Good researchers should be attracted from India and especially abroad for 2-3 year stays. Europe is a very possible source of supply of such researchers, given their academic system. The post-doctoral researchers will need to be paid nearly on par with starting assistant professors (approximately Rs 65000 per month in today's terms) but will play a crucial role in scaling up the numbers and quality of doctoral research.

19. Quality research in CS today requires multi-institutional and multi-national collaboration. Fortunately, communication and collaboration technologies have made this possible and highly economical. However, institutional models may need to be tuned to facilitate and appreciate such activities, especially in the academia.

20. Mentorship or co-guidance from capable individuals in the industry is another way to reduce the gap in advising resources immediately. Industry personnel can bring practical perspectives and experience onto the table. This can help both the student and the research group s/he is part of. The process can start early with B.Tech or M.Tech students, wherein the industry can play a crucial role in persuading mentored students to pursue a research career, which s/he may otherwise not consider.

21. Performance-based rewards can foster high quality research by the faculty members. Expectations from individual faculty member should be set high, while providing them with all institutional support including ample time amidst the teaching and other institute service to devote to research.

22. Industry can also facilitate faculty members to spend their sabbaticals or other research time with them. This is also a mutually beneficial proposition that can lead to more technology transfers, real-life problems coming to academia, as well as more industry folks pursuing their PhDs later.

23. Computer Science is a conference dominated area where the top conferences are valued higher than many journals. Attending and presenting one's work at such conferences is absolutely essential for faculty and students to keep abreast of developments in the field. The present institutional and governmental policies for travel act as an impediment to high quality research in CS as travel abroad is supported with great reluctance, if at all. It should be possible for a PhD student to attend at least 2 top international conferences during the PhD. It should be possible for all academic guides to attend at least one conference annually. Research projects and private sector can play a significant role in facilitating this. On the whole, CS research will be inexpensive compared to sciences and other engineering disciplines even with this travel budget as the equipments used is far from costly.

24. A faculty job in the academia is the top choice to most PhD graduates for the freedom and flexibility it provides and the impact it can have. Indian academia is going through a phase of massive expansion. The roadmap towards increasing PhD intake to 1000 per year entails increasing the faculty strength by a factor of 4 or more. PhD students should be exposed to all these options from the beginning. Industry should also continuously advertise their own plans to hire PhD students and keep in touch with different research groups.

25. Those who return to do a PhD after significant years in industry bring great value and outlook to academia. Current hiring policies of traditional academia may need tuning to facilitate their induction as faculty members. Many institutions have strict age limits for new assistant professors and/or may not value industry experience at all. Such policies come in the way of scaling up the quality and quantity of computing research performed in such institutions. Academic lifestyle and flexibility are the topmost reasons for those in industry to return to a university for a PhD.

Enabling Policy & Environment

26. Enabling policies and a conducive environment should be setup for a thriving start-up culture in the country. Technology-based startups have a lot of potential in India. The entrepreneurship ambience of Israel is one worth emulating in India. Graduates of a PhD program are ideally suited to make this happen by taking the technology they develop in the laboratory to the market. The entrepreneural spirit needs to be kindled in India for her to become a true powerhouse. It is only natural that the country strive hard in this direction after the success of the past two decades in software development and IT services.

27. Those returning to do a PhD after medium to long stints in industry have a great potential to create a true revolution in startups and entrepreneurship in the country. They bring maturity, experience, and a desire to make a difference with them. This combined with the research training they receive while pursuing a PhD make them potential game-changers in technology-based entrepreneurship. This should be encouraged using coherent policies to encourage academia, incubation centres, angel investors, venture capitalists, etc.

28. Industry can play critical roles in promoting entrepreneurship and startups from the academia. Models in which industry actively partners with academia to build centres focussing on specific areas with the right orientation will benefit the Indian CS research community immensely. The engagement should go beyond providing funds, to actively mentoring and enabling top-class research as well as technology transfer from academia. Fraunhofer institute provides another good model for industry-academia engagement. NASSCOM or iSpirit can be the point of contact from the industry side for such activities.

29. Several of the above steps require significant changes in the present models and are either difficult to extend (or irrelevant) to all engineering and sciece fields. Some of the interventions are unique to the computing or engineering discipline, where the motivation to do a PhD is lowest due to attractive options in the industry. Computing is also an area that has great potential in India's growth due to its low infrastructure requirements and the requirements for highly trained manpower that the country can produce.

30. It is best to create a CS-specific funding mechanism to address these CS-specific requirements, such as enhanced stipends, conference travel support, post-doctoral support, etc. For instance, traditional funding from institutions and projects can be augmented suitably from a special fund setup and administered for this purpose through the Ministry of Communication and Information Technology (MCIT). This provides the means to offer solutions to CS-specific problems through the appropriate ministry without affecting the entire S&T funding mechanism of the country.

31. Large inspirational projects can galvanize research, attract new students, and maintain the high level of intensity in the academic environment. Grand challenge problems are plenty especially in the Indian societal and economic context. These can bring institutions and disciplines together towards higher goals. Such problems with significant computing components should be addressed with suitable incentives for the faculty members and PhD students to take part in them.

List of attendees

CN Krishnan	Anna University (AU-KBC)
Viswanath Poosala	Bell Labs (Alcatel) Registered but didn't attend
Bijendra Nath Jain	BITS Pilani- Registered but didn't attend
Navneet Goyal	BITS Pilani
Uma Mudengudi	BVB College, Hubli
K V Subrahmanyam	Chennai Mathematical Institute
Madhavan Mukund	Chennai Mathematical Institute
Shree Nayar	Columbia University
Vasudha Bhatnagar	Delhi University
Anish Mathuria	Dhirubhai Ambani Institute of ICT
Ashwani Sharma	Google
Muthian Sivathanu	Google
Pankaj Jalote	IIIT Delhi
P J Narayanan	IIIT Hyderabad
Rajeev Sangal	IIIT Hyderabad
Jayprakash Lalchandani	IIIT, Bangalore
V N Muralidhara	IIIT, Bangalore
A.K. Tripathi	IIT BHU, Varanasi
R.S. Singh	IIT BHU, Varanasi
Saroj Kumar Nayak	IIT Bhubaneswar
D Manjunath	IIT Bombay
Subhashis Chaudhuri	IIT Bombay
Supratik Chakrabarty	IIT Bombay
M Balakrishnan	IIT Delhi
Naveen Garg	IIT Delhi
Bireswar Das	IIT Gandhinagar
Krishna Prasad	IIT Gandhinagar
Amit Awekar	IIT Guwahati
N.R. Aravind	IIT Hyderabad
Naveen Sivadasan	IIT Hyderabad
Anupam Basu	IIT Kharagpur
Gaurav Raina	IIT Madras
N S Narayanaswamy	IIT Madras
Anil Kumar Sao	IIT Mandi
Arti Kashyap	IIT Mandi
Shanmuganathan Raman	IIT Rajasthan
Venkata Ramana Badarla	IIT Rajasthan

Apurva Mudgal	IIT Ropar
Sudarshan Iyengar	IIT Ropar
Deepak D'Souza	Indian Institute of Science
Dipanjan Gope	Indian Institute of Science
Shalabh Bhatnagar	Indian Institute of Science
Lokendra Shastri	Infosys Labs
P Suresh	Infosys Labs
Srinivas Padmanabhuni	Infosys Labs
Bharat Kaul	Intel
Ansuman Banerjee	ISI, Calcutta
Krishnendu Mukhopadhyaya	ISI, Calcutta
Christina Sandhu	MSR India
P. Anandan	MSR India
Satish Sangameswaran	MSR India
Sridhar Vedantham	MSR India
Sriram Rajamani	MSR India
Vidya Natampally	MSR India
Tony Hey	MSR Redmond
S.D Madhu Kumar	NIT Calicut
Vineeth Paleri	NIT Calicut
A.K. Bakthavatsalam	NIT Trichy
DVLN Somayajulu	NIT Warangal
NVSN Sarma	NIT Warangal
Kavi Mahesh	People's Education Society, Bangalore
Onkar Dabeer	Tata Institute of Fundamental Research (TIFR)
R K Shyamsundar	Tata Institute of Fundamental Research (TIFR)
Gautam Shroff	TCS Labs
Rajeev Khushu	Texas Instruments- Registered but didn’t attend
Narendra Ahuja	Univ of Illinois and ITRA
Tathagat Varma	Yahoo! SDC India Pvt Ltd –Registered but didn’t attend
Srini Ramaswamy	