BOARD FOR IT EDUCATION STANDARDS

In association with

Dharwad
ज्ञानेन विकासः

IIIT - Dharwad

and

BMS College of Engineering

PROCEEDINGS OF BITES ANNUAL CONVENTION – 2018 (New Paradigms in Higher Education)

November 23-24, 2018 @ BMS College of Engineering, Bengaluru

The Focus of BITES is to create an effective IT eco-system by networking industries, institutions, Government, Faculty and students on a voluntary and self-financing basis

Board for IT Education Standards (BITES)
II Floor, Innovation Centre, IIIT Campus
Electronics City Phase I
Bengaluru – 560 100
www.bites.org.in

Motto

Helping to keep Karnataka at the forefront of IT

Vision

To establish Karnataka as the acknowledged leader in Information Technology by fostering high quality industry-relevant IT education

Mission

To serve as a catalyst for nurturing excellence in our IT educational institutions, ensuring employability of our graduates, promoting quality of work of our faculty, strengthening interactions and networking among stakeholders, and enhancing global competitiveness of our IT industry

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21	MS Ramaiah Institute of Technology, Vidya Soudha, M.S.Ramaiah Nagar, Msrit Post, Bengaluru-560 054	22.	P D A College of Engineering, Gulbarga-585 102

23	PES University (Formerly PESIT) 100 Feet Ring Road, BSK III Stage, Bengaluru-560085	24.	Gurunanak Dev Engineering College, Mailoor Road Bidar – 585 403
25	Reva University (Formerly Reva Institute of Engineering and Management), Baglur Cross Yelahanka, Bengaluru- 560 064	26.	SDMCE College of Engineering Dhavalagiri, Dharwad-580 002
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About the Theme - “New Paradigms in Higher Education”

Indian higher education system is the THIRD largest in the world after US and China. Higher Education milieu has changed significantly in 21st century and India is no exception. An unprecedented rise in the number of university students, their changing social profile, and rise of interconnected networks of knowledge facilitated by new technologies, greater integration of world economy and the emergence of new problems that challenge existing solutions define the context of higher education all over the globe. This provides challenge as well as opportunity for institutions and nations to excel with innovation that spans academics, research methods and approach to management, governance and financing. However, so far, Indian universities have been rather hamstrung in responding to these challenges. The Indian universities/institutions need to seize the unprecedented opportunity to lead in competitive landscape of higher education with all eagerness and earnestness. This may require a culture that encourages experimentation and innovation nothing short of a paradigm shift. It calls for going back to basics and revisiting the way knowledge is defined, contextualized, conceptualized, organized and structured. We need re-imagine the way teaching-learning, research and practice of art and craft is done. As we do this, we need to explore current boundaries and redraw them. These aspects are deliberated in this convention through interactions among the concerned stakeholders to arrive at possible strategies and solutions.

About Board for IT Education Standards (BITES)

BITES is an autonomous body promoted by Government in association with Institutions and industries in Karnataka in the year 2000. GoK has setup BITES with the intent of maintaining high standards and quality in IT education. The main objectives of BITES are to enhance the quality of IT Education and improve the employability of Engineering Graduates. The Vision of BITES is "To establish Karnataka as the acknowledged leader in Information Technology by fostering high quality industry-relevant IT education". The key activity areas of BITES are: Advice on Policy, Challenge / Competitions and Awards, Curriculum Development, Databases, Industry–Institute Interaction, Institutional Development, IT Education Standards and Leadership Development. BITES promotes, encourages, and deep dives into industry-academia equations on a number of platforms. It is this equation which will differentiate Winners from Losers. This is more so because of the exponential changes and transformations taking place in the tech space. Industry

relevance of education is the only mantra for survival in the TED-Age. BITES is the quintessential bridge to help in bringing together academia-industry and in setting benchmarks, in line with industry expectations. BITES is the way forward and partnering with it is imperative for every teaching institute, benefiting both the faculty and the student community.

About Indian Institute of Information Technology – Dharwad (IIIT-Dwd)

IIIT-Dharwad is an Institute of National Importance set up in Public-Private-Partnership (PPP) mode by the Ministry of Human Resource Development (MHRD), Government of India, Government of Karnataka and industrial partner KEONICS. Located in the twin cities of Hubballi-Dharwad, the Institute has faculty in Computer Science as well as Electronics and Communication Engineering with several of them having research interest and experience in the areas of Machine Learning, Artificial Intelligence and Data Analytics.

About BMS College of Engineering (BMSCE), Bengaluru

BMS College of Engineering (BMSCE), an autonomous aided engineering college in Bengaluru, started in 1946 by Sri. B.M.Sreenivasaiah and nurtured by his illustrious son Late Sri. B. S. Narayan. It was the first private sector initiative in technical education in India and is run by the BMS Educational Trust. The college is affiliated with Visvesvaraya Technological University from 1998 and became autonomous in 2008. BMSCE today offers 13 Undergraduate & 16 Postgraduate courses both in conventional and emerging areas. 15 of its Departments are recognized as Research Centers offering PhD/M.Sc (Engineering by Research) degrees in Science, Engineering, Architecture and Management. The College has been effectively practicing outcome-based education. BMSCE is the only institution from India adopted by the Melton Foundation, USA. BMSCE IS TEQIP Phase I and Phase II as well as Phase III Institute (a world bank project). BMSCE is accredited with A Grade by NAAC (2013-2018) and Accredited by National Board of Accreditation (NBA), New Delhi (BMSCE has the unique distinction of being one of the first Institutions in India identified by NBA for evaluation under Tier-I NBA Accreditation Washington accord).

ANNUAL CONVENTION - 2018 Theme - New Paradigms in Higher Education November 23-24, 2018		
PROGRAM SCHEDULE		
Day-1		
1	8.30 AM - 9.30 AM	Registration
2	9.30 AM - 10.50 AM	Inauguration Guests – Dr. S. Sadagopan, Dr. Karisiddappa, Prof. B.S. Sonde, Prof. M.N.Channabasappa, Dr. Ragini Narayan, Dr. KNB Murthy, Dr. Kavi Mahesh and Dr. B.V. Ravishankar
3	10.50 AM - 11.20 AM	Tea
4	11.20 AM-12.00 Noon	"Instruction in Digital Era" Prof N.J. Rao, IISc
5	12.0 Noon - 12.35 PM	"Modeling knowledge transfer in learning communities" Dr. Kavi Mahesh
6	12.35 PM-01.10 PM	"The Future of Work and Implications for Higher Education" Sri. R. Lakshmi Narayanan, Chief Learning officer
7	01.10 PM-01.50 PM	Lunch
8	01.50 PM-02.05 PM	Music Interlude by BMSCE Students
9	02.05 PM-02.45 PM	“Building Research Culture on Campuses” Prof D.Manjunath, Electrical Engineering, IIT - Bombay
10	02.45 PM-03.05 PM	Tea
11	03.05 PM-03.45 PM	“Future Work Skills” Sri. Mohana Krishnan Head of the COE for AI and data sciences, NASSCOM
12	03.45 PM-04.30 PM	“An Indian Innovator’s Dilemma” Dr. Joy Prabhakaran, KRP, KSIT, Bengaluru

Day-2		
13	9.30 AM - 10.00 AM	"Design and Pedagogy of the Introductory Programming Course", Prof. Abhiram, IIT-Bombay, Mumbai
14	10.00 AM - 10.30 AM	"Assessment Design & Industry-relevant Competencies" Dr. Viraj Kumar, Visiting Professor, Divecha Centre for Climate Change, IISc
15	10.30 AM - 11.10 AM	"Preparing for the Industry" Sri. R. Venkatesh, chief scientist, TCS Research
16	11.10 AM - 11.30 AM	Tea
17	11.30 AM-12.05 PM	"Employability of graduates & Skill Augmentation-Xcelertor model" Mr. Aniruddha Kannal, CEO -Xcelerator
18	12.05 PM-12.40 PM	"The Critical Role and Impact of Entrepreneurship Education" Prof. Sathya Prasad, Director - CIE, PESU
19	12.40 PM-01.10 PM	"Telecom 2020" Mr. Dhananjay Joshi, CEO, QuadGen Pvt. Ltd.
20	01.10 PM-01.50 PM	Lunch
21	01.50 PM-02.05 PM	Music Interlude by BMSCE Students
22	02.05 PM-02.45 PM	"Shocking Journey - Engineering Educator to Entrepreneur" Prof. G. Jagadeesh, IISc
23	02.45 PM-03.05 PM	Tea
24	03.05 PM-04.35 PM	Valediction Presentation of "BITES Life Achievement Award-2018" Guests – Dr. V. Rajaraman, Dr. H.P.Khincha, Prof. BS Sonde, Dr. Ragini Narayan, Dr. KNB Murthy, and Dr. Kavi Mahesh

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FOREWORD

In the current globalized world, development and progress of a country is assessed in terms of richness of knowledge and skill levels of its populace. India has civilizational history of more than 5,000 years with unparalleled continuity wherein valuing and revering knowledge has been an article of faith. That intellectual leadership of yore once again reasserted with India's global leadership in Knowledge-based IT industry over the last three decades. This leadership in IT and ITES industry resulted in consistent growth to Indian economy with population of 1.25 billion. This unprecedented growth was possible thanks to stellar role played by India's higher education sector. India could deliver a unique value proposition to the world in the form of bright young minds passing out from colleges every year, who are adept at learning new technologies and tools in a facile manner. This contribution from India in turn resulted in much higher operating efficiencies in developed world, making experimentation, adoption and deployment of advanced technologies far easier. In this journey our colleges and universities served as a resource pool to rest of the world and those markets are now gradually consolidating. Hence going forward, we need to take a long- term view where India leads in Research and Development and sets the agenda for rest of the world. Some green shoots of such pioneering behavior are already visible if you take into account enthusiastic adoption of digital payment solutions, universal biometric identity and home-grown companies which use internet as core to their business model. Despite these achievements there are gaps in terms of inadequate Government funding of higher education, inability to attract quality human resources, limited research infrastructure and almost miniscule investment by industry to promote R&D in academia. Majority of funding makes it way to selected elite institutions thus limiting the pace and scale with which country can progress. There is a need now more than ever before for new paradigms to take India's higher education to new wave of growth.

Board for It Education Standards (BITES) has been set up in year 2000 with the objective of helping educational institutions offering IT education in terms of enhancing quality and adopting industry-relevant curriculum as well as improving employability of the graduates. BITES has taken a step to organize Annual Conventions, on concurrent themes, from the year 2018-19 to create awareness among stakeholders in the higher education system in the state to improve some

these factors. This year's Convention was theme-based on "New Paradigms in Higher Education" with thirteen talks by eminent persons from academia, Research organizations as well as industry and held at BMSCE, Bengaluru which was attended by about 200+ stakeholders that included faculty, students, researchers and industry experts. In the Convention, "BITES Lifetime Achievement Award-2018" was presented to Professor Vaidyeswaran Rajaraman, an outstanding academician cum researcher who has contributed immensely for the growth IT education in the country in the form of writing books, research articles and defining computing infrastructure for developing computer education in the country.

Professor K.N.Balasubramanya Murthy
Chairman, BITES and
Vice-Chancellor, PES University

Instruction in Digital Era

Prof. N.J. Rao
Former Professor, IISc
njraoiisc@gmail.com

Profile

N.J. Rao was the Chairman of CEDT (Centre for Electronics Design and Technology, IISc during 1981 – 1996, and Chairman, Department of Management Studies at Indian Institute of Science, Bangalore, during 1998 – 2006, and superannuated in July 2006.

He is presently a Consulting Professor at International Institute of Information Technology (IIIT), Bangalore, a member of Core committees that defined the present NBA Accreditation process, and a member of the Core Committee that defined the new Accreditation processes of NAAC. His research areas included Control Systems and System Dynamics. His present research interests include higher education, pedagogy and education technologies, particularly assessment and metacognition.

He is presently working with Kerala Sate Higher Education Council for improving quality of learning in Higher Education in Degree Colleges, and conducts faculty development programs in both engineering institutions and degree colleges in curriculum design, OBE, NBA/NAAC accreditation, ADDIE based course design, assessment and quality of learning.

Abstract of the Talk

Information and Communication Technologies (ICT) are growing at a very rapid pace and influencing every facet of present-day life. Higher education can greatly benefit from the many open source and proprietary ICT systems and tools available. Unfortunately, the use of ICT by higher education institutes is still very limited in spite of both teachers and students becoming more and more ICT savvy. Use of ICT

at present is limited to Learning Management and Academic Management Systems by a very small number of Institutes, and by teachers to power point presentations. Access to content in general and even to personalized content is adequately addressed. But these have not led to any major improvements in the quality of learning. One major reason is classroom instruction continues to be lecturing, which still remains as one-way communication.

Instruction in digital era can take advantage of significant knowledge available from Instructional Design theories, Learning theories, Educational Psychology and Educational Neuroscience. Instruction conducted as per Merrill's principles greatly enhances students' active engagement with the knowledge. Merrill's Principles state learning is promoted when learners:

- Acquire knowledge and skill in the context of real-world problems or tasks (Course Outcomes);
- Are clear about the relevance of the Course Outcome;
- Activate a mental model of their prior knowledge and skill as a foundation for new knowledge and skills (Activation);
- Observe a demonstration of the knowledge and skill to be learned. (Demonstration);
- Apply their newly acquired knowledge and skill. (Application); and
- Reflect on, discuss and defend their newly acquired knowledge and skills (Integration).

Instruction conducted in the framework of Merrill is also directly compatible with NBA and NAAC Accreditation framework. ICT tools are available for all evidence based instructional components that facilitate Effective, Efficient and Engaging (E3) instruction.


ICT

Modeling knowledge transfer in learning communities

Dr. Kavi Mahesh
Director, IIIT - Dharwad

Profile

Dr. Kavi Mahesh, the Director of Indian Institute of Information Technology, Dharwad, has many years of experience in both industry and academics in India as well as USA. Previously, he was the Dean of Research at PES University and Director of the World-Bank funded Research Centre for Knowledge Analytics and Ontological Engineering – KAnOE. He has three US patents and has published two books, 16 book chapters and over 80 research papers. He was previously with Oracle Corporation, USA and New Mexico State University and has consulted in the area of Knowledge Management with Infosys, Hewlett Packard and United Nations. He holds an M. Tech. in Computer Science from IIT, Bombay (1989) and an MS (1991) and a PhD (1995) in Computer Science from Georgia Institute of Technology, USA.

Abstract of the Talk

One of the important objectives of higher education is to equip graduates to become life-long knowledge seekers. To meet this objective, most good programmes of higher education focus on teaching fundamentals, providing practical hands-on experience and inculcating a culture of research and innovation. They also stress on the importance of team projects as a way of encouraging students to form effective learning communities.

However, the conventional mode of education had been stuck for a long time in the outdated model of direct knowledge transfer through classroom lectures wherein the teacher is the primary source of knowledge, the textbook a secondary source, the lecture the mechanism of transfer and the student, for the most part, a rather passive

participant in the whole process. Other effective mechanisms such as experimentation and apprenticeship had at best a secondary role in this model.

This model of lecturing was first disrupted by the introduction of technology that could project slides onto a screen in the classroom. The teacher could now re-use his own content as well as borrow others' slides. With the arrival of video lectures, e-learning platforms, MOOCs, animations and encyclopedic notes in the likes of Wikipedia, the role of the teacher has clearly changed: he is no longer the primary source of knowledge and his lectures are not always the primary mechanism for knowledge transfer to the student. At the same time, the modern student enjoys a broad exposure to the world as well as a more goal-oriented approach to his own education.

At this juncture, it has become quite popular to say that classroom teaching is no longer relevant, that those classrooms need to be "flipped," and that the student is now a "learner" and the teacher is mainly a "learning facilitator." How do we understand and implement such statements?

The field of Knowledge Management has developed good models of knowledge transfer in various contexts, although its focus has remained almost exclusively on corporate scenarios. Are those models applicable to higher education? What can knowledge management tell us about models of knowledge transfer in technical education?

To begin with, Knowledge Management tells us that the direct mode of knowledge transfer through lectures can be enhanced through active modes such as dialogues, debates and working groups. Although these are well known practices, they are hardly ever used in technical education in India. On the other hand, all of the technology-enabled mechanisms of obtaining knowledge can be modelled as indirect transfer of knowledge through a repository of text, Web, audio, video or other types of digital content.

Knowledge management research tells us that both direct and indirect knowledge transfer are essential and together they need to be enriched with peer-to-peer learning and effective engagement with every member of the learning community. It

is therefore a a primary responsibility of every teacher now to continually experiment with and adapt a variety of means to keep the learners engaged with the subject matter both inside and outside the classroom and laboratory.

Can we simply stop all classroom lectures and let these learning communities loose on the digital content? Will such an adventure accomplish the goals of a technical education programme? We do not live in an ideal world where all students are intrinsically motivated to learn on their own. The curriculum, the "regimen" of classes, tests and exams, and the discipline of engagement through "contact hours" is very much essential for the majority of the students to make knowledge transfer effective. As such, it is unrealistic to opine that the old model can be abandoned altogether.

The theory of knowledge, called epistemology, at a deeper level outlines the methods for obtaining valid knowledge. Epistemology is also closely related to science, as articulated famously by Albert Einstein. However, the epistemology of modern science is rather limited since it allows only:

- repeatable verifiable experimental observation under controlled conditions, and
- logical (mostly deductive) inferences from those observations.

The hypocrisy of science is that it rejects any other method of knowledge and yet, scientists themselves as well as all of us routinely seek and obtain knowledge in other ways – in unscientific ways. For example, a quick poll of an audience may show that the majority of them believe in global warming, even though none of them may have bothered to verify the data on global warming and the validity of the inferences derived from the data. In India, for instance, most state governments have been advised to account for containing the effects of global warming in their budgeting exercises. Little attention is given to facts such as that the rate of increase of temperature is about 0.01 degree per year, the data has been collected by weather centres as long ago as 1871, and the precision and calibration of instruments for measuring temperature may have changed significantly over a century. While this does not mean that global warming is not to be believed, there is clearly a need to look carefully about any claims if we are indeed scientific.

An important consequence of the limited epistemology of science is that its scope is limited to the physical universe alone, covering only matter and energy across space and time. This is evident by reading the definitions of "science" and "universe" in Wikipedia, for instance. As such, psychology or any other study of human cognition is not science. With such a strong indoctrination throughout schooling and higher education, it is only natural that graduates tend to dismiss anything that is unscientific. Yet, the larger society complains often that today's graduates are not a being prepared to face real life. Is it not an obvious consequence of such indoctrination about the exclusive role of the limited epistemology of science thereby disallowing from consideration any topic or question that is not within the scope of experimental observation and inference?

Indian tradition has a well-developed epistemology with a broader scope than that of science. Even those who believe that they have a scientific mind-set routinely listen to and believe what others say (albeit through peer-reviewed journals or technology media). The hypocrisy lies in not acknowledging this as an admissible method of knowledge. Indian epistemology called pramana Shastra legitimizes this method in the name of shabda / shruti / aptavakya. Shouldn't our students know about this?

However, whether in science or in traditional Indian theories of epistemology, popularity is never a valid method of knowledge. Yet, our students and citizens in general are being led to take popularity as a method of validating knowledge by social media (with its number of likes or up-votes), Web and even television news media. Merely because a large number of people like or believe something, it does not become true!

Another way in which the methods of science are of limited use in real life arises from its insistence on a strictly binary (or Boolean) notion of truth. In real life, things are not always black or white. Indian traditional systems of knowledge have well developed logics and ways of reasoning with multiple views. For example, there is even a seven-valued system in Indian philosophy (the seven values of "truth" being: is, is not, is and is not, is not expressible, is and is not expressible, is not and is not expressible and is, is not and is not expressible).

It appears that teachers in the higher-education system must first get a big picture of what it is all about and how knowledge can be effectively transferred directly as well

as indirectly through technology to students. Students must be properly guided through the entire system, including with the effective use of indirect learning technology. Students must also be well equipped with a proper understanding of epistemology so that they are ready to face their real lives, knowing what is true and how to obtain valid knowledge even from social media. Only such graduates can be expected to become life-long knowledge seekers.

The Future of Work and Implications for Higher Education

Mr. R. Lakshminarayanan,
Chief Learning officer
iNurture Education Solutions

Profile

Lakshminarayanan has been with iNurture Education Solutions since 2009 and is one of its earliest employees. An alumnus of IIT(D) and IIM(B), He looks after all the UG & PG Programs across Information Technology; Marketing Leadership & Innovation; Finance & Business Analytics and Animation & VFX & Digital Film Making & Gaming.

He leads a team of over 25 Domain Experts at the Corporate office as well as almost 350 faculties spread over 30 campuses and 250 class rooms across the country.

His areas of interest include Outcome Based Education; Technology Enabled Teaching; Inter-disciplinary Pedagogy and Learning for the 21st Century Student and Employer.

On September 28, 2013, he was conferred the Guru Vandana award by the Hon'ble Governor of Karnataka—as one of 100 senior professionals across multiple fields.

He is an Independent Director on the boards of Jyothy Labs, Jyothy Fabricare Services and Wonder La Resorts.

Abstract of the Talk

The Changing World of Commerce:

- Our WORLD---Connected. Global. Digital. Unbundled. Data Driven. Automated.
- Global Platforms delivering Local Services and The Gig Economy.
- 3 out of 5 current jobs may not exist in 10 years.
- 6 out of 7 jobs of 2030 not created yet.

- Hybrid Jobs and Augmented Workforce.
- A Career no more a Ladder but a Web of Experiences...with build Vertical & Horizontal Capabilities...
- Learn followed by Earn replaced by Learn...Earn...Learn...Earn...
- Top-down & Hierarchical will yield to Nimble, Open, Transparent and Communicative.

And what are some key trends specifically related to Work?

Trend # 1 The World of Work will become more transparent:

- Productivity metrics will be key. Will cover RoI's across Organizations, Functions, Departments, Teams and Individuals.
- Compensations and Growth Paths will be dictated by Results, Effectiveness and Efficiency.

Trend # 2 Organizations will be flatter. Work will be geography & time neutral and truly Global. Professionals will compete based on Quality, Cost, Time and Track Record.

- Theoretical Knowledge will lose to Application Practice.
- Abundance of Informal and Free Education of very high Quality.
- Learning to Learn in place of Teaching for Recall
- Specific trends...
- Unique/ Customized Learning Journeys.
- JIT and Learning in Sachets.
- The Long Tail of Learning & Teaching.
- Passionate & Empathetic Teachers connected to Motivated & Self-driven Learners...
- Tools & Skills replaced by Application & Business Problem Solution.


The Future of Work
Its Implications
Higher Edu

Building Research Culture on Campuses

Professor D. Manjunath
Department of Electrical Engineering of
IIT - Bombay, Mumbai

Profile

D. Manjunath received his BE from Mysore University, MS from Indian Institute of Technology, Madras and PhD from Rensselaer Polytechnic Inst, Troy NY in 1986, 1989 and 1993 respectively. He has worked in the Corporate R & D center of General Electric in Schenectady NY during the summer of 1990. He was a Visiting Faculty in the Computer and Information Sciences Dept of the University of Delaware and a Post-Doctoral Fellow in the Computer Science Dept of the University of Toronto. He was on the Electrical Engineering faculty of the Indian Inst of Technology, Kanpur during December 1994 - July 1998. He has been with the Dept of Electrical Engineering of IIT, Bombay since July 1998.

Abstract of the Talk

The research agenda of a large part of the international scientific community is set by American agencies, notably NSF, DARPA, NIH, and Department of Energy. This is, in large part due to the pioneering vision of Vannevar Bush who set up NSF just after the second World War. India has had many such visionaries who have helped organize the scientific community around Indian agendas: Sir M Visvesvaraya, SS Bhatnagar, Vikram Sarabhai, Homi Bhabha, and PC Mahalanobis easily come to mind. Sadly, the founding vision that they provided has not translated into a long-term success on the scale of the NSF or of the other agencies mentioned above. One can speculate and attribute a combination of social structures and strictures, culture, political leadership, and even poverty, as being among the causes of failure to develop a strong research based higher education that addresses *our* problems.

The sporadic regulatory attempts at mandating a stronger research environment in a larger number of educational institutions appears to have only exacerbated the problem. Much of this `research' is motivated by neither an urge to ask a fundamental question, nor by a desire to develop engineering solutions to solve problems around us. The large number of papers on genetic algorithms, fuzzy systems, ant colony optimization and the like on irrelevant problems in inconsequential conferences and venues that get published to satisfy the regulatory mandate is a testimony to the general failure of forcing a cultural change through diktats. To be sure, state of the art in research can be applied to Indian problems and still be state of the art! Several of my personal research attempts have been motivated by Indian problems and yet have been published in high quality venues, thus proving, albeit anecdotally, that our milieu does give us challenging research problems; some actionable, some explanatory but all relevant. In fact, many of these problems can be solved using interested and motivated students, even undergraduates; pushing state-of-the-art with *our* problems is indeed possible.

I posit here that the beginnings towards a meaningful research culture in our institutions would be via a cultural change to our curriculum. We should begin by changing student behavior and expectations from the program in general and from the courses in particular. Make the students `do more' and `on their own', i.e., think about problems from around us, define suitable abstractions, and solve them on their own. Relate every course to problems and idioms from our milieu. This will also force the instruction to include more societal engagement problems and hands-on components. Hopefully, this will also convert the courses into being less information-oriented and provide an `attitude correction' to the students to confidently define problems and their solutions. While developing such a curriculum, it is useful to realize that in any discipline, including computer and information sciences, there are very few "must know" subjects. Thus it is better to strengthen the delivery in the expertise that is locally available in the institution than to conform to an `ideal content' that is delivered imperfectly. Admittedly, this is hard work, and possibly unrewarding in the short-term, for the faculty and the administration.

Most of our campuses can provide the civil infrastructure and a host of motivated students. However, faculty involvement and seriousness about research is rather hard to achieve. Specifically, it is my observation that in most institutions, the

ability of the faculty for abstraction and theoretical fundamentals is lacking and would need a lot of attention, and some infusion. I believe that research does flow from the top and hence it is essential to change from the top i.e., the faculty and the management. Specifically, the management should be open to experimenting with new, possibly economically inefficient paradigms. Toward this it is important not to imitate other institutions. Rather, each campus should develop its own specialties and evolve its own culture. One possible approach would be to develop streams of interdisciplinary research and exploit opportunities that local conditions offer.

I conclude by reiterating that leapfrogging, a favourite phrase of planners and administrators, will not happen. The change will have to be necessarily gradual requiring patience and perseverance in time and money! It is low on short term returns. And jugaad, or dishonesty (that is rather widespread amongst us) will not get us there.

Future Work Skills

Mr. Mohana Krishnan
Head, Centre of Excellence for Data Science & Artificial Intelligence, NASSCOM

Profile

Mohana Krishnan heads the Centre of Excellence for Data Science & Artificial Intelligence at NASSCOM. Mohan is responsible for augmenting the DSAI ecosystem in the country with a mandate to develop India as an innovative country & position India amongst the top 3 destinations globally.

He is excited about technology, the convergence across domains & platforms, and the value it can create for the stakeholders and public.

He has 20+ years of corporate experience and expertise in developing strategies for outsourcing and offshoring for large IT-BPM organizations. He is an alumnus of Indian Institute of Management, Ahmedabad, Cost & Management Accountant, and has done his bachelor's degree in Commerce from St. Joseph's College of Commerce, Bangalore.

Abstract of the Talk

The world is changing and technological shifts, changing geopolitics, economic volatility is having a deep impact. Tech Shifts are the most profound and reshaping businesses, and how we live. Companies are making big bets on digital business. This change is occurring across every sector. IT industry is not only driving these changes, but is itself impacted by it – the move to `As a Service Economy' is a key shift transforming business models. Technology industry is increasing investments in digital. There is a global shortage of tech talent – a new paradigm for skilling. NASSCOM has identified 9 emerging technologies, 66+ Job Roles, 155+ Skills that will help redefine the technology industry. Artificial Intelligence is one the key areas where the industry is developing its core capabilities and there is un-met demand.

Learning & Skilling has to move from traditional methods to new-age platforms which include mentoring, self-learning, hackathons, gamifications, Techtalks leading to Institutionalized continuous learning. At the same time, the faculty themselves need exposure to real life business problem solving leveraging AI to impart the right learning.

An Indian Innovator's Dilemma

Dr. Joy Prabhakaran
Key Resource Person
KS Institute of Technology
Bengaluru

Profile

Joy Prabhakaran is a Professor in the ECE department of KSIT. Joy did his B.Tech from IIT Kharagpur and his MS from Michigan Tech. He started his professional career in 1989. He has worked for various organizations including C-DAC, Honeywell, Technicolor and Yahoo. He also ran his own company, Techline, for about ten years. He has two patents from his work at Honeywell, one patent filing for his work as a consultant at TCS and two that he filed as an individual inventor. He was also part of the Patent review board at Honeywell. In 2011, he moved out of a full-time career and started working towards his PhD at IIIT Bangalore. He completed his PhD earlier this year. His current research is broadly in the areas of image and video technologies.

Abstract of the Talk

The talk focused on the challenge faced by academic researchers in establishing a connect with people who would benefit from the research. It was suggested that one of the reasons for this is that sometimes the output of academic research is not in a form that project teams can use without putting in a lot of additional effort.

This talk discussed a specific innovation called Content and Consumption aware Ingestion (CCIngest) of videos. The speaker showed quantitative and qualitative results showing how it helps in improving quality of internet video in low bandwidth conditions. The talk also brought out how it fits in and helps in the video pipelines of providers like YouTube, Facebook and Brightcove.

In the second part, the talk covered the attempts made to get the companies who are potential users, interested. The challenges faced in doing this and the inability to get to a stage of technology evaluation was discussed. It was shown that the challenges

were in-spite of demonstrable results, solid academic pedigree and experience working in this field for some of the marquee companies in the area.

The talk ended by posing a couple of questions. The first question was, "Is this a one off scenario or is the case study more representative. The second was “Can bodies like BITES play a role in this challenge faced by academicians”.

Design and Pedagogy of the Introductory Programming Course

Prof. Abhiram Ranade
Indian Institute of Technology-Bombay
Powai, Mumbai

Profile

Abhiram Ranade is a Professor of Computer Science and Engineering at IIT Bombay. Before joining IIT Bombay he was on the faculty of the Electrical Engineering and Computer Science Department at the University of California, Berkeley. He received his doctorate in Computer Science from Yale University in 1988 and the Bachelor of Technology degree in Electrical Engineering from IIT Bombay in 1981. His research interests are in Algorithms, Combinatorial Optimization, and Programming Education.

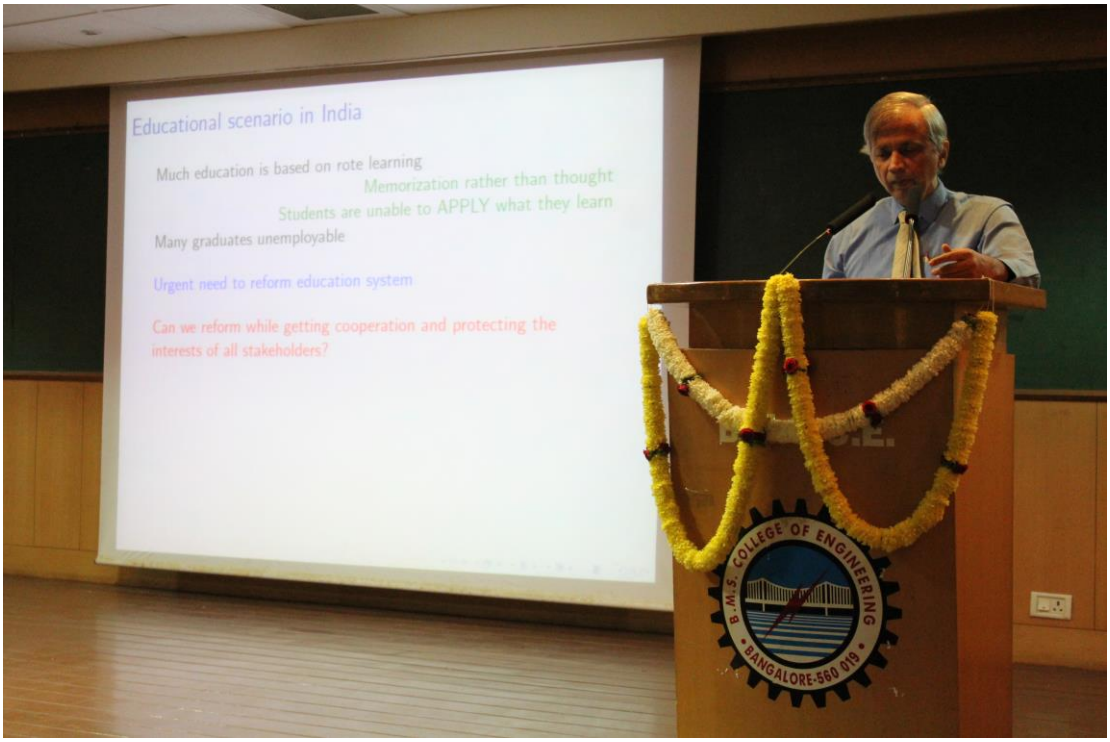
Abstract of the Talk

World over, and in India, teaching of programming is ineffective. The failure rate in the introductory programming course is about 30% worldwide, while in India many surveys report that graduates are unable to write simple programs. Although the introductory programming course is foundational for the computing disciplines, and is a source of employment for other graduates, there does not seem to be much interest in improving it in India. Indeed, most Indian universities are more concerned with offering and improving advanced courses and electives rather than building the up the basics. Such an approach can end up perpetuating the rote learning culture that plagues Indian education.

We believe that the introductory programming course must be taught most effectively because of the reasons already mentioned. It should be taught as an exemplar of deeper learning, where students don't just memorize facts (or language constructs in this case), but are able to apply the facts to real life (write programs to solve problems that they might encounter). For this we feel the course design must be detailed, and must include pedagogical strategies to draw students to the subject

emotionally. It should specifically contain strategies for teaching difficult topics, as might be documented in the educational research literature.

We propose a design for the course. The design has been documented in a book and has been used in teaching for several years. Some of the important features of our approach are as follows. We use a specially designed graphics library and a "repeat" statement which can be used to very quickly enable students to write exciting programs. Graphics is very useful for explaining and understanding concepts such as recursion and inheritance. The repeat statement is implemented as a macro and it allows students to perform iteration easily -- in contrast to standard looping statements which are trickier and harder to understand as documented in the literature. We also consider the issue of explaining program design -- another difficult topic as noted in the literature. Our experience is that our approach works well.



Assessment Design and Industry-relevant Competencies

Prof. Viraj Kumar
Visiting Professor – Divecha Centre for Climate Change, IISc Bangalore and
Vice-Chair of iSIGCSE, ACM India

Profile

Dr. Viraj Kumar is a Visiting Professor at the Divecha Centre for Climate Change, IISc. He was a consultant to the Committee to draft the National Education Policy (2017-18), and contributed to two education-related task groups of the Karnataka Knowledge Commission (2014-16). He holds a PhD in Computer Science from the University of Illinois at Urbana-Champaign and is the present Vice-Chair of ACM India's Special Interest Group in Computer Science Education (iSIGCSE). Prior to joining IISc, he headed the Applied Research in Technology for Education research group at PES University (2013-18).

Abstract of the Talk

Competencies: It is widely recognized that our graduates need more than "just knowledge", and the recent emphasis by accreditation agencies (NBA and NAAC at the national level) on learning outcomes – explicit statements that specify what a learner is expected to know and is able to demonstrate at the end of a course module, or an entire course, or after completing a full program – is reflective of this need. However, learning outcomes tend to be defined within an institutional frame of reference, and there is a perceived gap to a broader notion of outcomes that indicates "professional readiness". The educational community refers to these as competencies, and they have three broad dimensions:

- **Knowledge -** Students are expected to have mastery of content in their core domain as well as the ability to apply their learning to new situations arising within their core or related domains (This is where institutions traditionally place greatest focus).

- **Skills -** Students must develop capabilities and strategies for higher-order thinking and must learn to interact with others and the world around them in professional contexts.
- **Dispositions -** Not only must students have the requisite knowledge and skills, but they must also be disposed to apply their knowledge and skills. Hence, students must develop their personal qualities (including attitudes such as confidence in dealing with complexity, tolerance to ambiguity, persistence in working with difficult problems, etc.).

ACM India's present focus: In the current national context, many of our institutions produce graduates who are poor along all three dimensions. We note that improvements along the latter two dimensions (Skills and Dispositions) require systemic changes to whole programs and institutional mechanisms. ACM India is therefore initially focusing improving competencies along the Knowledge dimension, starting with the introductory programming course.

Assessments: This talk focused on improvements to assessments, which includes examinations, homework assignments and laboratory work. We noted that it is valuable to explicitly link assessment items to Bloom's Taxonomy levels (for the cognitive domain), but there is apparent confusion when such linkages are made. Further, examinations (which account for a substantial fraction of the overall course grade, particularly in affiliated colleges, and are hence a powerful determinant of student effort) primarily have questions at Levels 1 and 2 of Bloom's Taxonomy, with a small fraction at Level 3 and almost none at Level 4. To advance competencies along the Knowledge dimension, it is necessary to increase the proportion of questions that are genuinely at Level 4 of Bloom's Taxonomy. Such a proposal naturally leads to several valid concerns: How will weaker students score sufficiently well to pass such examinations? How will such questions be designed afresh year-on-year? Will such questions be difficult to evaluate efficiently and without significant subjectivity?

ACM India recognizes the genuine challenge posed by these questions, and looks forward to working with BITES (at the state level) as well as AICTE (at the national level) to create question banks and other instructional resources to help faculty and institutions raise the quality of education.

Preparing for the Industry

Mr. R. Venkatesh
Chief scientist, TCS Research

Profile

R. Venkatesh is a chief scientist with TCS Research and heads its Verification and Validation Program. He has been with TCS for more than 25 years working primarily in the areas of software development, formal methods and verification. During this tenure he has lead several tool development projects including TCS ECA a static analysis tool that was sold commercially by TCS

Abstract of the Talk

Students with a CS degree joining the industry need to work on a variety of projects that require them to apply their understanding of CS concepts and not just use their knowledge. Thus curriculum, teaching and assessment should be designed to discourage a mere gathering of knowledge and an ability to recall that knowledge from memory on demand. As an example, a project to test a software application will require the software engineer to reason about the adequacy of tests written and argue about their need. This requires her to have a good understanding of Software Engineering concepts like coverage criteria and also be able to judge the appropriate criteria that is applicable to a given context.

To achieve the above it is important to design a curriculum aimed at achieving an overall goal. For instance, if an institute aims at producing high quality software engineers to cater to the demands of the tech industry then the curriculum should be designed to impart appropriate skills like problem solving ability, logical thinking and ability to program among others. For a student to have the right level of programming skills it is important that they know one programming language well and have written around ten thousand lines of code in that language. This could be written across several courses including introduction to programming, data structures, algorithms and course project. They should also have the ability to pick

up new languages quickly. Since different institutes will have students with varied interest and skill levels the amount of content taught in these institutes should also be different. Thus, depending on the interest shown by the students some institutes may also introduce advanced programming concepts like generic types and others may include language semantics as part of their curriculum.

Similarly teaching students how to implement quick sort does not add much value as none of them will be required to implement it in their careers. Instead quick sort should be used as an illustration of how to develop divide and conquer algorithms and work out their complexity. Deriving the average time complexity of quick sort need to be taught only by institutes where the students have an appetite for it. The overall aim of the algorithms course should be to teach them when and how to apply standard algorithms, and also teach them to evaluate complexities of algorithms they write.

For course project our suggestion is that they add a feature or two to a well written open source project. This will expose them to good design and coding and also prepare them for the industry where they will have to maintain code written by others. Each project should follow an agile process and should require students to take decisions regarding algorithms, data structures and also features to be implemented.

Employability of graduates & Skill Augmentation – Xcelerator model

Mr. Aniruddha Kannal
Founder and CEO, Xcelarator

Profile

A Deloitte Consulting veteran for over 10 years. In his last position, Aniruddha fondly also known as ANI, was the VP of engineering for their Life Sciences and Health Care product portfolio.

By education, Ani is a computer engineer and holds an MS in Computer Science from SUNY Binghamton, and a BE from M.S. University of Baroda.

Ani is the founder and CEO of Xcelerator, a skill augmentation platform for higher education. It helps institutions improve their learning outcomes and increase their industry outreach. Xcelerator has more than 50 institutions, 1000+ mentors, and 400+ companies on its platform - all working towards helping more than 25000 students augment their portfolios with industry relevant skills.

Abstract of the Talk

Higher education sector in India was primarily focussed on building physical capacity over the last two decades. We now have more than 900 universities and in excess of 40,000 colleges. On one hand a large number of seats go empty every year and on another we can't meet our GER goals as a country. As we at Xcelerator like to put it, "A lot of educational institutions but not enough education!" The focus is quickly shifting to quality and relevance.

Xcelerator is a skill augmentation platform for higher education. We help academic institutions modernize content and delivery methodology for better learning outcomes and enhanced industry alignment.

We serve multiple stakeholders in the higher education value chain - students, academic institutions, and prospective employers. Traditionally, the entire value

chain has been dealt with in bits and pieces - content design and authoring, content delivery, assessments, and recruitment have been treated as independent silos. This is reflected in the solutions proposed in the past - they tend to address challenges in each step of the value chain without an end-to-end, big picture perspective.

Xcelerator runs traceability through the entire journey - we help companies articulate their skill requirements, we help institutions understand and quantify the skill gap which then feeds the mitigation strategy, companies and institutions collaborate to curate/create content and deliver focused interventions aimed at skill augmentation. The platform enables tagging of every learning intervention to outcomes, skills, and job roles to facilitate an end-to-end traceability of the entire value chain. The platform implements OBE and experiential/project-based learning to ensure immersive learning experiences.

The Xcelerator method and platform is designed for creation and delivery of student centric learning experiences for optimum learning outcomes aligned to industry expectations.

Role and Impact of Entrepreneurship Education

Prof. Sathya Prasad
Director, Centre for Innovation & Entrepreneurship
PES University, Bengaluru

Profile

After leaving Intel in 2017 to follow his passion, Sathya joined PES University as the Founding Director for Centre for Innovation & Entrepreneurship (CIE).

Prior to joining PES University, Sathya Prasad spent 25 years in the tech industry and 20 years at Intel, spread across US & India in a wide range of roles across Corporate Innovation, R&D, Strategic Planning, Product Management and Marketing.

A significant achievement was leading the Product Management for Intel Xeon servers including a brand-new product line (Intel Xeon-D) which was widely recognized by the industry as an outstanding new product.

As an intrapreneur and Director of New Products/Business, Sathya led incubation efforts at Intel India's Idea-to-Reality (I2R) and mentored early-stage tech startups under 'Intel India Maker Lab' program.

Outside Intel, as the founding President of SEMI India, he built the India subsidiary of global firm SEMI and launched the B2B platform SOLARCON India. Sathya has several publications in Technology Management (co-authored with IIM-Bangalore) and is regularly invited for Exec Education & Guest Lectures at leading business schools.

Sathya is an alumnus of MIT Sloan School of Management (Executive Program in General Management) and holds Master of Science in Electrical Engineering from Arizona State University and Bachelor of Engineering from Bangalore University.

Abstract of the Talk

The talk examined the role and impact of entrepreneurship education in general and technology undergraduates and graduates in particular. Below is a synopsis of the talk.

The talk started off with a couple of key questions:

- Is entrepreneurship a new phenomenon? What has changed?
- What role does entrepreneurship play (at a national and global level)?
- Can we 'teach' entrepreneurship? If so, how? What are the challenges?

Using the CIE experience, the talk sought to address the above questions.

The topic of entrepreneurship as a formal topic in economics has been around at least from the time of Joseph Schumpeter when he addressed this in his book ("Capitalism, Socialism and Democracy" in 1942). Schumpeter also called this as 'creative destruction'.

Humans have always been entrepreneurial in the course of history seeking to create value all along the way. This quote from Nobel Laureate Mohammed Yunus, exemplifies this: *"All human beings are entrepreneurs. When we were in the caves, we were all self-employed…finding our food, feeding ourselves. That's where human history began. As civilization came, we suppressed it. We forgot that we are entrepreneurs"*

What has changed is the basis of key drivers for value creation in an economic sense: from capital economy (till mid-20th century) to knowledge economy (late 20th century) to entrepreneurial economy (21st century). The key drivers for entrepreneurial economy are disruptive changes brought upon by forces redefining industries and work such as Artificial Intelligence (AI) and Machine Learning (ML), value creation through scaling of entrepreneurship (there are more than 200 'Unicorns' – startups with >$1B valuation.

At a national as well as global level, the key impact of entrepreneurship is the creation of jobs. By most accounts, the *net* creator of jobs in an economy can be attributed to entrepreneurship (in the broadest sense and not just technology entrepreneurship).

While there are several forms of entrepreneurship, we find that the value creation can be found to the highest at the intersection of technology, innovation and entrepreneurship.

From an education perspective, we need to ensure that we are teaching our students to be *entrepreneurial* and not just stop at teaching entrepreneurship. The *entrepreneurial thinking* can manifest in several ways and can include startup (entrepreneurship) and within companies or existing enterprises (also called 'intrapreneurship'). The choice of becoming an entrepreneur is and should be a personal one where someone equipped with the right skills and attitude can chose to be an intrapreneur or an entrepreneur or both in one's life.

How do we create the innovation engine and impart the same to aspiring student entrepreneurs? One of the models that is intuitive and backed by research is the 'innovation engine' (attributed to Stanford Professor Tina Seelig). This comprises of internal attributes – *Imagination*, *Knowledge* and *Attitude* and external attributes that nurture and influence the individual in the form of *Culture*, *Habitat* and *Resources*.

Based on this, we at CIE have 3 aspects that form the backbone of all our activities and offerings: *Mindset*, *Business acumen* and *Technology*. We have looked at several pioneers in this field (IIT Bombay, IIT Madras, NSRCEL, Stanford, MIT, UC Berkeley and more) to come up with a 3-tier course for entrepreneurship which is open to all branches (& semesters) of engineering.

The guiding principles for entrepreneurship education at CIE are:
Student-centric approach, *Experiential* learning, *real-world* examples/challenges for problem set and *Ecosystem linkages* with industry and other institutions of higher learning. We have found that it is better to resist the temptation for perfection and just get started in this journey and to adopt the Lean Startup methodology of 'Build – Measure – Learn'.

Several examples of guiding principles were shared in the talk (Design Thinking session conducted by an industry expert, Basecamp sessions from Jan through April 2018 that included live-interviews of successful startup founders, etc.) and a very popular Bootcamp (7-day residential program for students to take their Idea → Final

Pitch, judged by a jury of mentors from industry - for more details, please see www.cie.pes.edu).

The journey has just begun for us and we have only taken the first few steps. CIE would be happy to share our learnings with the members of BITES and would like to thank BITES for including this important topic in the deliberations related to IT education.

Telecom – 2020

Mr. Dhanunjay Joshi
Chief Executive Officer
QuadGen Wireless Solutions Private Ltd, Bengaluru

Profile

Twenty-Eight Years of diverse and challenging experience in deploying Telecommunication Networks and Business Management of Mobile Telecommunication Infrastructure Projects. Having taken up international assignment at Caribbean Islands & USA, As Vice President Worked as Customer Unit Head /Key Account Manager responsible for complete end-to-end business cycle with P&L responsibility, Innovative Business Models to work with Mobile Operators, Establishing C level Relationship in the Customer Organizations as well as in the Telecom Industry. A successful track record in meeting the revenue targets, rolling out Mobile networks GSM / CDMA and managing large pool of skilled resources. Last 4 Yrs as COO at Bharti Infratel Ltd Managing Mobile Infrastructure PAN India to ensure Seamless Mobile networks are Functioning.

At present Working as CEO at QuadGen Wireless Solutions Private Ltd, A Subsidiary of QuadGen Wireless Solutions INC, USA together has proven credentials with a time-tested history of growth in profitable businesses by building high quality, reliable Telco Grade Wi-Fi networks, Network Engineering for Smart Cities & Fiber Grids. The QuadGen team has industry experts of 500+ professionals with Subject Matter Expertise (SME) in 4G/3G/Wi-Fi based Wireless Networks, IP & Optical TX Networks. QuadGen partners with Tier 1 Telecom Carriers in USA, such as AT&T, T-Mobile, Sprint, Verizon and BSNL/BBNL in India & OEMs like CISCO and Nokia to build high-quality, reliable next generation Wireless, IP, IoT, Optical and Smart city networks for operators.

He has undergone the following professional training:

1. Management training at Ericsson Academy & Technical Courses on GSM, India / Sweden / Malaysia
2. Intensive Training at Motorola Factory in Swindon, UK
3. Ericsson Executive development program I & II at London Business School, UK
4. Evaluated & passed through Ericsson Executive Assessment by personal decisions UK.
5. Executive Engagement on Leading with New Realities at Boston Management School
6. Executive Leadership Program at ISB in Hyderabad
7. Executive Sales Development at Wharton School of Business Management in USA and Cambridge in UK

Abstract of the Talk

The physical and the digital worlds are getting closer too fast, forcing telecom carriers (and other industries) to transform themselves, their partner ecosystem and their business models at the same speed. The telecom industry will continue to play a central role in addressing a whole range of social, economic challenges or issues. "By working together, the mobile industry is truly connecting everyone and everything to a better future. That must be at the forefront in everything we do role of mobile technology in improving tomorrow's society".

India's telecom sector has been growing at a phenomenal pace. The intense competition among the telecom operators is driving world's second-biggest market, with a subscriber base of 1.17 billion and has registered strong growth in the past decade and half, with 512.26 million internet subscribers, as of June 2018, India ranks as the world's second largest market in terms of total internet users. Further India is also the world's second largest telecommunications market with 1,191.40 million subscribers, as of September 2018.

Over the next five years, rise in mobile-phone penetration and decline in data costs will add 500 million new internet users in India, creating opportunities for new businesses. Revenues from the telecom equipment sector are expected to grow to US$ 26.38 billion by 2020. The number of internet subscribers in the country is expected to double by 2021 to 829 million and overall IP traffic is expected to grow 4-fold at a CAGR of 30% by 2021. The Indian Government is planning to develop 100 smart city projects, where IoT would play a vital role in development of those

cities. The National Digital Communications Policy 2018 has envisaged attracting investments worth US$ 100 billion in the telecommunications sector by 2022.

World's largest youth population 356 Million in 10-24Yrs old bracket is in India are moving to digital society , digital democracy with high expectations on connectivity, E governance being the buzz word by all State Govt. agency to extend citizen services leading to data explosion is forcing Mobile Operators to enhance their network to support leading to 4G/5G Technology & efficient bit / Mhz, New Technology like Massive MIMO, Beam Forming, Spectrum Sharing, Distributed Cloud, Automation, Network Slicing & AI are being explored to Augment Network to meet the data explosion. Radio Technology is also improving to provide efficient / Capacity Needs through Millimeter Wave & Massive Antenna Technologies, Multipurpose, Multi Cho-ration Radio, Flexible Spectrum, Software Defined Networks, Machine Intelligence like Machine learning & Big Data, Cognitive Technologies, Virtualization to meet the customer expectations.

Most Communications Service Providers (CSPs) are in the midst of large digital transformation programs in response to the disruptions plaguing them. Adding blockchain to this equation offers potential to both rationalize a CSP's current operations and develop new blockchain-based services. Moreover, as demands for transparency and trust continue, a robust blockchain foundation can be the springboard for increased ecosystem involvement, enabling new business models for revenue generation. Blockchain's importance is only expected to grow. CSPs should seek a long-term view as they evaluate how blockchain can help drive revenue growth and platform business opportunities.


Mobile Subscription by Technology 2017 & 2023 – India
COLLEGE OF ENGINEERING

Shocking Journey - Engineering Educator to Entrepreneur

Professor Gopalan Jagadeesh
Department of Aerospace Engineering
Indian Institute of Science
Bangalore-560012

Profile

Gopalan Jagadeesh is a Professor in the Department of Aerospace Engineering, IISc Bangalore. He is the Founder Chairman of Centre of Excellence in Hypersonics in IISc. He is also the Founder Director of Super-Wave Technology Pvt. Ltd – an Initiative with equity participation from IISc to commercialize several of his discoveries related to shock waves. He is an honorary professor in the School of Engineering, University of Glasgow, UK and the President of Indian Society for Shock Wave Research.

His research areas include Hypersonic Aerothermodynamics and shock wave propagation in complex fluids. He has published over 99 papers in peer reviewed International Journals, and edited 3 books. He has many patents on various innovations related to Shock Waves.

He is a Fellow of Royal Aeronautical Society, (UK), National Academy of Engineering (India) and an Associate Fellow of American Institute for Aeronautics and Astronautics. He actively works with voluntary organizations for popularizing science among high school/college students especially in rural India.

Abstract of the Talk

In the last two to three decades, there has been substantial growth in Indian higher education with the participation of private sector (started in medicine, Engineering and liberal arts), which has helped in scaling up, higher education sector, across the country. However, efforts are required to establish quality benchmarks, by following the core principles of IITs as well as IISERs and IISc, to compete at the global level. IISc, IISERs and IITs have been following the principle of “Hire the best people and

give them freedom to do their research". One criticism leveled against IITs, IISERs and IISc is that they are over-dependent on government funding for their activities and of late, the government has been pushing leading institutions such as IITs, IISERs and IISc to reduce their dependency on the government by raising their own resources. Although, a few individuals have come forward to fund the research activities at these institutes (such as The Brain Research Centre sponsored by Infosys co-founder Kris Gopalakrishnan at IISc), it is necessary for generating funds out of research findings on the lines of Professor Robert Langer, in his laboratory at Massachusetts Institute of Technology (MIT), becoming responsible for creation of 25 companies, award of 800 patents and technology licensing to 250 companies with an annual revenue generation of $10 million.

Taking clue from MIT, Professor G. Jagadeesh and Professor KPJ Reddy from Aerospace Engineering of IISc, have started Super-Wave Technology Private Limited (SWTPL), a company engaged in research in the area of shockwaves and its applications, that resulted in many inventions, protected under patents, which have high commercial, educational and social value in the country. Some of these

inventions have evolved as marketable products include Needle less drug delivery system, Shock wave assisted bamboo treatment plant, Hand operated shock tube for university education (Reddy tube), Reddy tube driven table-top hypersonic shock tunnel and Artificial insemination gun for animals (SuperBull). In addition to high commercial potential, these inventions will contribute significantly to the improvement of quality of life and education across the globe.

Professor Jagadeesh concluded by saying that this country has given best format of education to the world in the form of Nalanda and Takshashila and therefore, he suggested to faculty as well as the youth of this country to be very proud of Indian culture and heritage as well as higher education systems.

BITES LIFETIME ACHIEVEMENT AWARD – 2018

presented to

Professor Vaidyeswaran Rajaraman
Hon. Professor, IISc, Bengaluru

Profile

Board for IT Education Standards (BITES) organized an Annual Convention from the academic year 2018-19. This year's theme of the Convention was "New Paradigms in Higher Education" with an objective of providing a status update of recent developments in various facets of higher education such as Curriculum Design, Assessment, Research, Development, Innovation & Entrepreneurship, and employability issues by organizing the talks by eminent academicians, researchers and industry leaders.

BITES also instituted "BITES Lifetime Achievement Award" from this year to recognize the outstanding contributions of an individual for the growth of IT education / sector in the state / country. This award carries a cash reward of Rs.25,000 and a citation.

For the year 2018, an awards committee constituted under the Chairmanship of Prof. H.P. Khincha, Prof. Sadagopan and Sri. Aravind Srinivas unanimously recommended the name of Professor Vaidyeswaran Rajaraman. Professor Rajaraman, Hon. Professor at IISc, is well-known for his immense contributions in the form of book publishing, research articles as well as development low-cost supercomputing facility at IISc to promote computer literacy in the country. Professor Rajaraman's contributions span many decades concomitant with the evolution of computer science education in India starting from early days.

“BITES Lifetime Achievement Award-2018” was presented to Professor Vaidyeswaran Rajaraman at the valedictory session of “BITES Annual Convention-2018” held at BMSCE, Bengaluru on November 24, 2018 at 3.00 PM in the august presence of Prof. B.S. Sonde, Prof. H.P. Khincha, Prof. Kavi Mahesh, Prof. KNB Murthy and Sri. M.N. Vidyashankar. Following the award presentation, Professor V. Rajaraman delivered a talk highlighting the growth of computer education by summarizing the important milestone developments in the field of IT and also provided a few inputs for the growth of BITES in enhancing the quality of IT education in the state.

The citation presented to Professor V. Rajaraman is given below:

BITES BOARD FOR IT EDUCATION STANDARDS	**CITATION TO PROFESSOR VAIDYESWARAN RAJARAMAN**	

Professor Vaidyeswaran Rajaraman is an engineer, academic and writer, known for his pioneering contributions in the field of Computer Science education in India. Born on 8 September 1933 to Ramaswami Vaidyeswaran and Sarada at Erode, Tamil Nadu, Rajamaran married Dharma in 1964. He was awarded a scholarship by the Delhi University after passing the All India Entrance Scholarship Examination and graduated with honors in Physics from St. Stephen's College of the University of Delhi in 1952 and continued his higher studies at the Indian Institute of Science, Bangalore to obtain a Diploma in Electrical Communication Engineering in 1955 and an associateship in 1957. He was awarded an overseas scholarship by the Government of India and joined the Massachusetts Institute of Technology, Cambridge from where he obtained his master's degree in electrical engineering in 1959. He obtained his PhD in 1961 from the University of Wisconsin-Madison and returned to India to work as

an assistant professor of electrical engineering at the Indian Institute of Technology, Kanpur. He was a visiting assistant professor of Electrical Engineering at the University of California, Berkeley in 1965-66 when he shifted his focus to the then nascent discipline of computer science.

In early 1965, with the encouragement by Prof. H.K. Kesavan at IITK, Rajaraman initiated a new MTech programme with Computer Science as an option, the first time the subject was being offered as an academic discipline in India. He moved to the Indian Institute of Science, Bangalore and developed low-cost parallel computers as well as a supercomputing facility, of which he served as the chairman from 1982 to 1994. He published over 70 scientific papers in national and international peer-reviewed journals and 23 text books, including the first on computer programming published in India titled *Principles of Computer Programming*, *Computer Programming in FORTRAN 90 and 95*, *Computer Oriented Numerical Methods*, *Analog Computation and Simulation*, *Analysis and Design of Information Systems*, and many others. He also wrote a monograph, *History of Computing in India: 1955-2010*, on the invitation of IEEE Computer Society in 2014.

Rajaraman designed computer science curriculum for All India Council for Technical Education (AICTE). He was a member of the Electronics Commission during 1979-82 where he chaired a committee which recommended the introduction of a new academic programme called Master of Computer Applications for BSc and BCom students foreseeing the impending human resource shortage for the IT industry. He was a council member of the Indian National Science Academy from 1986 to 1988. He served as a consultant to Bharat Electronics, TCS, and several other organizations, chaired a committee that recommended establishing Centre for the Development of Advanced Computing, was TataChem professor at IISc from 1991 to 1994 and the IBM Professor of Information Technology at Jawaharlal Nehru Centre for Advanced Scientific Research from 1994 to 2001. He was a member of the Technical Advisory Panel of the Government of Karnataka from 1985 to 2014.

Rajaraman received Shanti Swarup Bhatnagar Prize, the highest Indian Science and Technology award for young scientists, in 1976, Homi Bhabha Prize in 1984 and the Indian Society of Technical Education (ISTE) Award for Excellence in Teaching in 1988. He was awarded Om Prakash Bhasin Award and Rustom Choksi Award of the Indian Institute of Science in 1993. The Government of India included him in the Republic Day Honours list in 1998 for the civilian award of the Padma Bhushan. The Indian National Academy of Engineering

(INAE) honored him with the Lifetime Contribution Award in Engineering in 2005 and he received the Distinguished Alumnus Award of the Indian Institute of Science in 2014. He received the S.H. Zaheer Medal (1998) of the Indian National Science Academy and is a recipient of the Lifetime Achievement Award of the Computer Society of India, Dataquest, and Systems Society of India. The Bengal Engineering and Science University and the Indian Institute of Technology Kanpur have conferred the degree of Doctor of Science (honoris causa) on Rajaraman.

In recognition of his immense contributions to the growth IT education in India, Board for IT Education Standards (BITES), as an expression of high esteem, humbly present Professor Rajaraman the

"BITES LIFETIME ACHIEVEMENT AWARD – 2018"

on this day, 24th November 2018 (Saturday), at "BITES Annual Convention - 2018" held at BMS College of Engineering, Bengaluru.

Prof. HP Khincha Chair, Awards Committee	Sri. MN Vidyashankar Co-Chairman, BITES	Dr. KNB Murthy Chairman, BITES