



# ***Being a true IT professional***

## ***Musings of a retired professional***

A lecture delivered at IIIT- Delhi

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By

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Respected Chancellor Lieutenant Governor of Delhi Sri Tejendra Khanna, Chairman Kiran Karnik, Director Pankaj Jalote, members of the Governing Council, faculty, staff, parents of the graduating students, students, guests and most importantly, the graduating students, thank you all for giving me an opportunity to be part of this exciting day. My congratulations to the graduating students. This day is also called the commencement day since you are indeed commencing your life today as a professional. You are very lucky to have had two of the finest professionals as your Chairman and Director.

I have known Kiran for the last forty years. I have known Pankaj very well over the last fifteen years. I worked very closely with him when he came to Infosys on sabbatical for two years from IIT, Kanpur. He headed our Quality and Productivity Group, and demonstrated that he is not just a good academic in Computer Science but also a *good software professional* by leading the company to become the first Indian software company to be certified as Level 5 compliant of the Capability Maturity Model of the Software Engineering Institute at Carnegie Mellon University in the US. Based on that experience, he has written two highly regarded textbooks. I have learnt a lot from my interactions with him both in software engineering as well as in leadership.

Some of you will go on to do your graduate studies and most of you will start your career as software professionals. Unfortunately, almost all of the advances in the Indian software industry - other than the Global Delivery Model and 24-hour productive day - in software engineering, quality, productivity, security, and user interface design have come from the western nations. Except for books written on Operating Systems by Prof. Dhamdhare and Shri. Godbole and a couple of books on software engineering and quality by Pankaj Jalote, every book, we use, has been written by people who work abroad. Every gadget we use and every invention that we see around us have been invented abroad. Why is it so? I believe it is because we do not use much of what is taught in the college and what we do as professionals. For us, education ends with passing the last examination in the college. Our students put enormous focus on rote learning and passing the examination. They hardly remember even fundamentals learnt from their college education. They do not see college education as the instruments to solve problems around them. Making education purposeful is a key aspect of gaining recognition for our education system. No wonder then that there is no Indian institution of higher education in the top 200 in Shanghai rankings. The class of 2012 from IIITD has to take the first steps to set this right. Therefore, today, I would like to speak to you on how you should use the outcome of these four years of your undergraduate study and two-years of graduate study which form the foundation

of your future accomplishments whether in pursuit of a higher degree or as a professional.

How do we use our education to make the society around us a better place? We do it by learning fundamentals taught in the college, ensuring that these fundamentals become part of our DNA in our work, constantly updating our understanding of these fundamentals by being connected with advances in academia and industry, applying these fundamentals to the transactions in the real world around us day after day, seeking opportunities to use these fundamentals to produce better products for our customers and to make our work more productive and comfortable, and in the process invent new ideas. My young friends, the easiest way to do this is to use your college education as the stepping-stone for enhancing your ability to constantly learn new things and apply them to make life around you better. Every day, just ask how you can use your professional knowledge to make what you do cheaper, faster and better.

College education is about learnability. Learnability is the ease with which you learn new things. It is also the ability to extract generic inferences from specific instances and using them in solving new unstructured problems. Such a learning paradigm requires that you have a clear grasp of a posse of fundamentals. For example, I learnt the concept and mathematics of negative feedback, and the power of modeling and simulation from my Control Theory class in my undergraduate years forty-seven years ago. I make it a point to use these ideas in my work even today. You will be surprised to know that I have used these ideas very successfully even as a CEO.

If you studied Operations Research, then you should internalize at least the power of simplex algorithm, Integer Programming, and Dynamic Programming. Not being able to use the ideas of probabilities, Bayes Theorem, or those of Uniform, Normal, Binomial and Poisson Distributions, having done a course on Statistics, means you have wasted your time. If you studied a course on algorithms, you should at least know basic attributes and applications of a few important sequential, parallel, distributed, concurrent, event-driven, randomized, approximate and genetic algorithms. You should understand the concept of P and NP. If you have taken a course on operating systems ~~course~~, you should be able to write the pseudo code for P and V semaphores. You should be able to explain the concepts of critical regions, LAN and WAN communications, memory allocation, file management, device drivers and interrupt handling, re-entrant coding, graphical user interface, scheduling, inter-process and inter-task communications, and virtual memory. If you took a course on databases, you should be able to explain at least the concepts of B\* trees, transaction processing, normal forms, logging and recovery, distributed databases and multi-phase COMMITs. I can go on and on but let me just say that you should focus on some fundamental ideas in each of these areas and internalize these ideas so well that they become part of the DNA of your learning.

Why I am saying these things? It is because an important attribute of you, as successful software professional, is to have these basic concepts on your fingertips and to constantly seek opportunities to make your work more productive and to produce the best quality of outcomes from your work. It is about keeping up-to-date on advancements in these ideas. It is about thinking how you and your team can bring in transformational progress by leveraging the power of these ideas.

How does one keep these ideas on fingertips? I will repeat some of the ideas I spoke earlier just to emphasize how important they are. First of all, you must internalize every one of the fundamental ideas that you learnt in the college. That

is, make sure you visit these ideas as often as you can by reading about them often and seeking opportunities to use them as often as you can. One way of being in touch with them is to read and reread fundamental ideas from classical textbooks as often as you can during your spare time. Thanks to advice from some smart young people, I have created a library of some of the classics in Computer Science. I try to read them as often as I can. These days, I have become very, very slow in understanding technical stuff but I still try. Reading them puts me in an uncomfortable zone which makes me think. But, when I start reading them, I get inspired by the smartness of ideas and of authors, and realize how small I am. That motivates to work harder and smarter in whatever else I do. That motivates me to think more carefully and relate my thinking to the real world. Let me name just five of the seventy and odd classical Computer Science books in my library. The Art of Computer programming (4 volumes) by Donald Knuth; Modern Operating Systems by Andrew Tanenbaum; Computer Networks – A Systems Approach by Peterson and Davie; Mathematical Theory of Computation by Zohar Manna; Introduction to Algorithms by Cormen, Leiserson and Rivest; and Transaction Processing: Techniques and Concepts by Jim Gray and Andreas Reuter. My suggestion is that you choose your own set of classical text books for your library and read them as often as you can.

Some of you will perhaps not appreciate why you should read these books if your job is to be just a programmer. I introduced the job title of Software Engineer in the private sector in India way back in 1976. A programmer designs an efficient program based on what he has read from the manuals. An engineer performs the same task even better by leveraging the power of advances in the field. An engineer understands the theory behind every one of his design decisions in constructing an efficient program. For example, when I taught software engineers in the early days of Infosys, I first taught them fundamentals of algorithms, computer architecture, operating systems and databases. The result was that these engineers understood how a simple READ or WRITE statement in a high-level language actually translated to machine level commands to disk controller. They also appreciated how one *logical record* access in their high level program might result in many physical accesses of the disk system. They learnt how inefficient design of overlays in programs (in those days of 16 bit machines) led to thrashing and consequent slowing down of programs.

Performance is an extremely important aspect of quality. Generally, engineers appreciate performance engineering of systems better than just programmers. For example, the engineers, I taught at Infosys, understood the impact of key size and the logical block size on the number of levels in the B\* tree design of an index file. They understood the power of normalization of databases to eliminate duplication of fields and thus avoid incorrect update of databases. In other words, every design decision, they made, was based on their understanding of theoretical concepts.

Let me give you two examples of engineering skills bringing tremendous value to our customers at Infosys. An important customer of Infosys in Japan wanted us to review an existing system for performance improvement. The end-of-day batch programs were taking huge amount of time and running into the on-line day. Our engineers reviewed the design of the programs and the database, made improvements based on their knowledge of theory, and reduced the end-of-day procedure from 12 hours to about 1.45 hours! In 1981 when we were designing a large on-line application package, we found that programmer-productivity was hindered by the lack of screen management software on the machine. Mr. Shibulal, the current CEO of Infosys, and I designed our own screen management package and improved the productivity of about 80 programmers by as much as 25%.

The engineers at Infosys have designed a modern, real-time shopping experience software package by leveraging the advances in retail technology that they gained through their education, internet, conferences and colloquia. Therefore, please join the weekly colloquia in your company or university right from day one. If such a facility does not exist, please start one. Invite well-known experts from academia and the industry to give lectures on advances in areas of your work. Access internet to get the latest ideas in your area of work.

Become a member of ACM and IEEE with subscription to at least an important Special Interest Group (SIG). These professional bodies bring immense value to your work. They are the source of unlimited knowledge to improve your productivity and innovative capabilities. They open doors to interactions with global experts. Take examinations conducted by professional societies like IEEE. Such examinations help you to be up-to-date in the knowledge you require to succeed as a professional. These examinations help you to benchmark yourself with professionals globally. They raise your confidence to tackle advanced problems in your workspace. They help you to innovate at the leading edge. Take part in programming and design contests held by professional bodies, the industry and your own company. Such contests will help you retain your analytical and skills capabilities. They help you learn what your colleagues in the industry are doing to improve their innovation and productivity. Please remember that the most important requirement to be a successful professional is to constantly update technical ideas you learnt in your college, ask how these ideas can be used to deliver better value to your customer, and how you can make your life and your team's life easier, better and more productive.

Any success as a professional requires that you develop a mindset of curiosity and respect for intelligence and knowledge. That means you should hold your teachers with the highest esteem, meet them as often as you can, and learn from them. Please listen carefully to people smarter than you are at workplace and elsewhere. Develop the habit of spending at least an hour a day in enhancing your professional knowledge. Attend refresher courses conducted by your company, your alma mater or elsewhere.

Of course, none of these will help you if you do not practise pride in your nation and profession, team work, discipline, good work ethics, honesty, courtesy, commitment and hard work. Knowing Pankaj, I am sure he would have prepared you all to be worthy members of a professional team.

My congratulations again and best wishes for a great future.

Thank you.