

Engineering Management is often confused with Industrial Engineering; this equivalency might have been acceptable when manufacturing and production dominated the economy. However, today, an engineer / professor, whatever the emphasis (research, development, teaching, project coordination, invention and innovation, technology transfer, service, manufacturing, etc.,) can benefit from the collective wisdom that has evolved in management. I found it out the hard way in late 1990s, after failing to make our college-wide center thrive on its earlier successes in mid-1990s thanks to funding from Motorola and NSF (National Science Foundation). At the insistence of a close friend of mine, Dr. Raymond J Barrett, Jr., and against my own misgivings, I signed up for the Executive MBA program at our university and graduated in 2000 with an MBA. That turned out to be the turning moment for the center, as the consistent and high funding from Motorola since then has proven. So, here is my plea for all engineers to gain more management background. This will empower you to strategize and control your future better!

Engineers and Managers do not see eye-to-eye, thanks to the mostly quantitative and qualitative outlooks, respectively, that the two professionals are trained with. However, as with any other field, some one who is congruent with both the perspectives, can communicate the issues better and lead to higher team productivity and satisfaction.

My father retired about fifteen years ago as the top civil engineer in the state of Karnataka in India. As a top civil engineer in the state, he had to not only build roads and bridges, but had to acquire land from farmers to build these on, and had to keep the contractors who built them honest and productive. He did not need a management degree to pull this off; he obviously had the natural talent and human insight needed. My mother also retired fifteen years ago as the founding principal of a women's college. The college today has 5000 students and has succeeded beyond anyone's dreams. She obviously had the skills and talents to communicate with different stakeholders (professors, students, and the investors) and obtain their cooperation for the common good. When faced with a similar task, of building a successful college-wide center, I obviously did not have full appreciation of the different stakeholders and their perspectives, and strategies to develop a synergistic win-win environment; perhaps this was the result of conducting advanced research in a narrow area of focus for my Ph.D. Perhaps this is a missing link in the engineering curriculum which makes us good engineers and productive workers, but not successful entrepreneurs and business people.

My early years as an engineer are remarkable for their singular focus on engineering as the solution for all society's needs. I recall seeing a paper-weight in my father's office, when I was growing up in India, that had this inscription: "Nothing is Impossible - *Napolean Bonaparte*." I also recall hearing the story of an Indian King who repeatedly failed in his attempt to win a neighboring kingdom and finally won, in his one-hundredth attempt. This shaped my earlier efforts - an optimism that my engineering insight was correct and that my engineering skills could deliver on that insight sooner or later. I have evolved many innovative ideas over the years (see the section on innovation); however, They were individual efforts that did not take advantage of synergistic cooperation and collaboration. Further, transitioning from a solitary researcher/innovator to a team builder and leader is not easy and needs skills distinctly different from engineering.

I got thrust into that position twice during the early 1990s, in two diverse areas, viz., in development of a clinical research system and in building a college-wide center on chip design and automation. The first one was the consequence of my patents on early and noninvasive detection of atherosclerosis (the cause behind heart attacks and strokes) - the small company that licensed the patents from the university wanted us to develop a clinical instrument quickly. The second one was the consequence of a rapidly expanding Pager Division of Motorola that wanted a local university to provide skilled and trained chip design automation engineers. The first one brought together 30 engineers and scientists with primary emphasis on signal processing (electrical engineers), hardware (electrical and computer engineers), and software (computer science majors). We delivered a clinically useful product on-time, but philosophical differences and differing engineering approaches caused unnecessary conflicts. The university stakeholders did not have a buy-in which caused misunderstandings and delays. The same repeated with our attempt to establish a college-wide center. The university stakeholders were not convinced of the utility of close interaction with a profit-driven company with quarterly deadlines. The collaboration brought in \$57 M of state-of-the-art EDA (engineering design automation) and chip design software tools. We were in engineering heaven! However, revenue of the center had to be suddenly ramped up to pay for building the infrastructure, training, and maintenance; Professors and administrative leadership had to be convinced to participate in and support this new multi-disciplinary field. The center required close cooperation of professors and students from electrical, computer, and mechanical engineering, and computer science. Many professors and students, even from other universities, did cooperate. The administrative leaders supported too. We did write many large NSF proposals, but they lacked the depth and conviction of a well-knit research team. Something had to change. I decided to change!

As one knows, there are many competing projects and interests in an university. Each person has a right and the opportunity to pursue their version of the future. Unlike a company where the manager has full control over the engineers' work, an university is by and large a voluntary environment. Both professors and students can choose to define their activity profile. Under the guidance of a visionary leader, an university workforce can rise above others. In a similar manner, with good win-win strategy for all stakeholders concerned, even a smaller unit, such as our college-wide center can rise above other centers. After obtaining my MBA in 2000, I decided to go on leave of absence to study the industry trends and define a goal for the center that could exploit our strengths, benefit the industry, and help the center grow. I joined Cadence Design Systems (the #1 EDA software company) as a TAM (Technical Account Manager) and represented Cadence at the South Florida centers of Motorola. During that period I understood the practical issues and challenges that Motorola engineers faced and how companies like Cadence tried to resolve them. Of course, both had to look out for their interests, other stake holders, while responding to the needs of each other. During this time, Mr. Jaime Borrás, VP, iDEN, Motorola, floated inside the industry his vision for developing a wireless mobile product in one day instead of the then 2 year turn-around time.

Because of my multi-faceted background in engineering and the newly acquired appreciation of management, I believed that we could develop synergies at the university that could address this. And we have done that. We are now in our 5th year of funding from Motorola, who have funded us consistently, through difficult times; we have delivered on our commitments and communicated to all stakeholders. A typical year brings together 10 faculty members and 10 students from the computer engineering and science department and the electrical engineering department. The group has changed year to year as we have moved on to newer goals; however, attempts have been made to benefit every ex-participant - Motorola has already hired 7 of our center's graduates. Motorola provides matching funds for NSF proposals of the faculty members. And more recently, we have started submitting SBIR (small business innovative research) proposals to take advantage of the synergy and the developed infrastructure to address similar challenges in other fields. The university administration deserves appreciation for their support and concurrent efforts that facilitate the same - for example, the Office of Technology Transfer now supports faculty members with \$15,000 grants (we received one of the first two) to bridge the gap between invention and technology transfer. At the college level, an institute for innovation is being developed. Great days are ahead for our university and our Center!