# A case study of eradicating weakness in accreditation owing to vital role played by industrial and government leaders in academia

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## Introduction

In the fall of 2000, we were visited by ABET for regular accreditation for our Electrical Engineering Program. We were cited 'weakness' in our course 16.499 Capstone Project. Although the design content was of great quality, but it lacked in elucidating the design impact on society, its environmental implication, ethical content, and economic considerations. So we were awarded three years accreditation instead of six, and given couple of years to show how we are going to address this problem. According to the ABET's visiting team, broader education in all four aspects for engineers is of crucial importance in modern times of global competition. So a proposal was made to the prime reviewer that we would institute a one credit course, which would be taught primarily by the industrial and government leaders addressing these issues. Such a course 16.400 Engineering Topics was initiated in the spring 2001 coordinated by the author, and is being taught each semester thereafter.

## Challenges to the Engineering Educators

The prime objective of the course Engineering Topics was to provide the students with various illustrations of engineering successes and/or failures by the experts from the regional Hi-Tech industries in the classroom.

Capstone Project is the most challenging experience in any student's career. This presents an opportunity of integrating one's design knowledge acquired through various courses and disciplines in consummating the project. In modern times, however, design expertise-only is not sufficient for engineering profession. These days one must be broadly educated in issues pertaining to environment, society, ethics, economics, and manufacturability. The course

depicted the importance of these issues, in general, and their integration in the capstone design, in particular.

Various issues pertaining to society, ethics, environment and economics were depicted by these experts, which were successfully integrated by the students in their capstone projects. This helped in eradicating our weakness in capstone projects as cited by the ABET reviewers.

## Prime Contributors and their Contributions

The prime contributors who participated in the program are leaders of acclaim from R&D community, the managers of Hi-Tech industries and Technology leaders of national and international repute from government R&D organizations.

Leaders from Analog Devices Corporation emphasized the integration of social aesthetics in technical design. The design of cell phone along with needs such as video integration, text messaging etc., were described in details. But the case of how the change in facial appearance of the cell phone resulted in quadrupling the sales of the cell phones in china. Although the technical design was exactly the same, but Chinese people liked a special facial feature in the cell phone. Robert Meisenhelder talked about the ethical and social issues for engineers and also showed the impact of MEMS and artificial intelligence. Bob Sulouff discussed the effect of technology on day to day life and future of MEMS as it is “up and coming”. He gave an actual insight into the transportation world with the usage of MEMS in airbags and vehicle collision avoidance.

Dr. Bill Quinn emphasized the need of environment awareness in semiconductor processing; especially the water discharged after processing was of superior quality than the water used for the processing. Dr. Brad Barber emphasized how his bulk acoustic wave filter integration in cell phone resulted into a compact phone. This phone also resulted into cost reduction and thereby was more affordable in the face of global competition. Dr. Frank Gao spoke about the semiconductor technologies (GaAs) with microwave applications and how is it going to impact the future of wireless communications.

Leaders from Raytheon in general Lisa Aucoin and Chris McCarroll in particular delineated the need of economic considerations to be incorporated for any successful design. They also talked about the latest Wireless Technologies in the market and the economic constraints that kept it away for years. Also the research and infrastructure needed for satellite communication was explained. The case cited of “Iridium”, which was a great success and a milestone in technical design of the satellite phone, but was a failure at large for commercial sector as it lacked integration of economics in their design. But because of its uniqueness it is still being used by our military in Afghanistan, where

infrastructure for phones does not exist. Dr. Tom Kazior cited advancement in MHEMT technology, which stretches up to 400 GHz, which is being integrated in non-lethal weapons and also holds a promise in detecting suicide bombers.

Leaders from M/A-Com emphasized the need for ethics in the industry, citing the case of Tycoelectronics where some practices were less than ethical based on questionable accounting procedures. J.P. Lanteri discussed about the various RF, micro and millimeter wave technologies and use of semiconductor technology for public safety, homeland security and other federal agencies. He also enlisted the steps for a successful engineer and the ways for balancing ones needs. Peter Ersland talked about semiconductor affecting the industry and the wireless arena.

Government leaders emphasized on safety aspects for the society. Mike Dinning portrayed the need of acceptable security template to the society. He talked about various challenges that have to be faced because of privacy, and economic constraints. He even cited a case of smart card in the State of Utah, where a company with state permission would have provided drivers license with smart card free of charge. Some people contemplated that National Guards are snooping on them through Smart Cards. The move was defeated in the legislature because it was conceived as “Mark of the Beast” as revealed in the Bible.

Mark Safford and Dr Richard John emphasized on the impact of Transportation R&D on the society and various considerations such as political, social, and environmental have to be taken care of before the actual implementation of the project is done. They cited several examples where countries have prospered based on their improved transportation infrastructure. Gregg Fleming and Dr. Aviva Brecher delineated the importance of combating the noise pollution through erecting noise barriers. These barriers however must be economically feasible and acceptable by the society at large living in the vicinity of highways and airports.

Richard Wright explained the importance of his advanced traffic management system (ATMS) project. Under this endeavor, the map of continental U.S. is displayed along with all the airports and the planes in the air. The moment congestion is noted at any airport, the planes are directed to other nearby airports, or are delayed even at their ports of departure. This is updated minute by minute and has really helped in solving the traffic congestion problem and therefore helped the society at large.

Karen Van Dyke and the author explained the fundamentals of GPS and its applications in the transportation systems including that of collision avoidance systems deployed in airplanes and motor vehicles. The enormous impact of GPS on the society was explained through the deployment of this technology even in the modern warfare e.g. in Iraq very recently.

## Conclusion

The author required a two page summary from each student on all these lectures and demonstrations. The papers were graded with help of a teaching assistant based upon their contents presented by the lecturers and grammatical accuracy. The best, worst and average papers pertinent to economical, environmental, ethical, and societal impact on Capstone Design were submitted to the ABET evaluators in the year 2003. The ABET removed the weakness in our program granting us a full six year accreditation.

The speakers clearly delineated the importance of issues such as economics, ethics, environmental, and societal impact on their design during their presentations. All of these issues were addressed by the students in their capstone projects. The course 16.499 Capstone Design, therefore now exhibits not only the excellence in design, but consummate integration of economics, ethics, environment and societal impact in their design.

The partnership between academia, industry and government is of vital importance, which author has envisioned all along, especially through sponsorship of UMass Lowell, VLSI Design and Fabrication activity since 1984. As is evident from this case study, this partnership has helped us in eradicating our weakness as cited by the ABET team in our Capstone Design. Such an endeavor is of vital importance for the success of our engineering graduates in modern times. It is for this reason that the author recommends that such an approach should be made an integral part by the academia at large.

## About The Author

Dr. Kanti Prasad is a professor in the department of Electrical and Computer Engineering and is the founding Director of Microelectronics / VLSI Technology Laboratories at the University of Massachusetts Lowell. Professor Prasad initiated the Microelectronics / VLSI program in 1984, and is teaching 16.469 and 16.502 VLSI Design and 16.470 and 16.504 VLSI Fabrication courses since its inception. From the spring of 1986 Professor Prasad developed 16.661 Local Area / Computer Networks, and since 1994 VHDL Based Digital Design and taught up to 2001. From the spring of 1998, Professor Prasad also developed and taught 16.517, MMIC Design and Fabrication course to meet the growing demand of regional semiconductor industries. He is also coordinator for Graduate Studies in VLSI and Semiconductors certificate program. He is the author of over 150 theses, dissertations and papers published and presented in journals/conferences of national and international repute.

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