Professional Practice of Engineering: A Course that Addresses the Non-Technical Enablers of Successful Engineering Practice

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Abstract

This course introduces the student to the various non-technical enablers for success in engineering practice and employment. The first part of the course focuses on managing oneself in a knowledge economy. The second part concerns co-op education and the framework of learning through practice. The third part develops in the student the cultural understanding to successfully navigate cross-cultural professional practice. The fourth part relates anthropology and interpretive research methods to the process of innovation. The last part of the course covers effectuation (entrepreneurial decision making under uncertainty) and contrast it to the predictive/causal decision making that is the hallmark of engineering training. The course involves a number of written and oral presentations. This paper briefly discusses the structure of the course.

Course Topics

Topic #1: Managing Oneself in a Knowledge Economy

The human psyche is a very complex entity and affects the way people learn, prioritize tasks, communicate and interact with others. Graduating engineers are employed into large organizations and made to work with many people on teams, yet very few have an understanding of their own selves, let alone understanding the rich mosaic of personalities. This can have serious career limiting consequences and thus must be introduced to the student as early as possible. The objective of this topic is to develop in the student a sense of metacognition and an awareness of the interpersonal skills necessary for professional success.

Topic #2: Co-op education and learning through practice

The engineering curriculum at UDM includes three co-op semesters totaling one year of industrial practice. Learning trough practice is an important construct in professional education as historically, professions were learned entirely through practice. After all, the pyramids of Giza, the Roman aqueducts and the Great Wall of China were not built by people who took engineering classes. Even in the modern day, two centuries after the advent of the engineering curriculum, the most significant and valuable part of the development of an engineer takes part in practice, as evidenced by the majority of job postings requiring several years of "experience." The objective of this topic is to introduce the student to the pedagogy and epistemology of learning at work and to develop in the student an understanding of the rich learning environment that is their place of employment.

Topic #3: Navigating Cross-cultural Professional Practice

Significant numbers of graduating engineers, particularly mechanical and electrical engineers, will spend their careers working in foreign-owned corporations. An understanding of the cultures that permeate these work environments is critical to a prospective employee. Of particular interest are: Japanese culture (Toyota, Honda, Denso…); Italian culture (Chrysler, Camau); French culture (Forecia); German culture (Bosch); as well as Chinese, Indian and Hispanic cultures by virtue of demographics and the modus operandi of multinational corporations. The objectives of this topic is to develop in the student a strong awareness of different cultures, particularly as it relates to business communication, conflict resolution, decision making, scheduling, giving feedback, etc.

Topic #4: The Anthropology of Innovation – Interpretive vs. Positivist Research Practices

Positivist research methods such as the Scientific Method and other laboratory-based techniques are the hallmark of engineering and are practiced exclusively in the lower echelons of the companies that hire co-op students. These methods are capable of leading to innovations, but in the majority of cases, these innovations are confined to the technology itself. However, engineering is about creating innovations that improve people's lives and as such, people are an important element that deserves research focus. One may still conduct positivist research, such as focus groups and surveys, but the more effective approaches, in terms of potential for breakthrough innovations, are interpretive tools such as ethnographic research. The objective of this topic is to introduce the student to the technique of ethnographic research in the context of Design Thinking, which is an emerging technique for solving design and social problems.

Topic #5: Contrast between Effectual Logic and the Scientific Method

The scientific method is the cornerstone of the sciences (physical and social science) and engineering. The scientific method is premised on causal logic of decision making. Such logic can be encapsulated by the following saying: "To the extent that we can predict the future, we can control it." However, decision making in a corporate environment concerns strategic opportunities whose future is unknown and unknowable. The recently developed theory of Effectual Entrepreneurship postulates that many decisions are made under the effectual logic framework which can be encapsulated by the following saying: "To the extent that we can control the future, we do not need to predict it." Engineering students are trained under the rational (causal) logic framework that one can only control what can be predicted, either exactly or probabilistically. In the course of engineering practice, one will encounter decisions that are made under the effectual logic framework which could seem strange and at odds with one's classical engineering training. A practicing engineer might be faced with situations where rational logic might not be useful and he/she might have to resort to effectual logic. The objective of this topic is to introduce the student to the processes of decision making under effectual logic and to contrast that with causal/rational logic which is the foundation of the scientific method.

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