Panel - Models of Entrepreneurship Education and its Role in Increasing Creativity, Innovation and Leadership in Computer Science and Engineering Students

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Abstract - **Creativity, innovation and leadership are among the essential attributes of future engineers as identified in the Engineer 2020 report by the National Academy of Engineering. It is critical for students to have the ability to identify new needs and opportunities for technological innovation in highly complex and inter-disciplinary domains. Historically, entrepreneurship has fueled innovation and the advent of many technological advances. Therefore, education in entrepreneurship for engineering or computing disciplines that complement strong analytical and technical skills, is likely to significantly enhance students' lifelong ability and desire to innovate. The goal of this panel is to discuss a number of education models in entrepreneurship, innovation, and leadership at different types of computing and engineering schools across the country and internationally, in order to identify common themes and effective components for such programs.**

Index Terms – creativity, entrepreneurship and computing education, innovation, leadership.

INTRODUCTION

Entrepreneurship is the process of starting a new business, based on a product or a service. People immersed in this process, the entrepreneurs, are driven by the desire to innovate and to change the way things are done as a competitive advantage for their business. Entrepreneurs usually set high-goals for their enterprise and have the desire for their innovations to impact a large number of people. The world in which engineering graduates will have to work is described in The Engineer 2020 report by the National Academy of Engineering [1] as one with a rapid pace of technological innovation, globally and technologically interconnected and highly interdisciplinary. In such a society, engineers, in addition to other attributes, will have to be creative, innovative, and have good knowledge of business, management and leadership principles.

Much of the research on entrepreneurship has focused on investigating the relationships between personal characteristics of entrepreneurs and their business creation or success [2]. Such research has implications for understanding the role of entrepreneurship education on future entrepreneurial intentions. It was found, that general personality traits such as the "Big Five" did not correlate significantly to business creation or success [2]. But, more specific traits, such as innovativeness, ability to communicate the vision of an organization, ability to manage new resources and new skills, proactivity (i.e. initiate actions to change one's environment), self-efficacy (i.e. task-specific self-confidence), stress tolerance, need for autonomy, passion, tenacity were all found to be directly or indirectly related to business creation or business success [2]-[5]. Research on students in entrepreneurship found that high self-efficacy is related to entrepreneurial intentions [3], while models of entrepreneurial intentions imply that there is a direct relation between entrepreneurial intentions and future entrepreneurial behavior such as business venture formation [6]. Perceived learning experiences from formal entrepreneurial education, or previous entrepreneurial experience, are all related to self-efficacy, with perceived entrepreneurial training as the most dominant factor [3]. Also, highly proactive and creative students manifest high entrepreneurial cravings and intentions [4].

GOALS AND OBJECTIVES

The main goals of this panel are: (a) To discuss a large number of education models in entrepreneurship, innovation, and leadership at different types of computing and engineering schools across the country and internationally and (b) To analyze each program's outcomes, (c) To identify the most effective components of each program and (d) To discuss how creativity, innovativeness, and self-efficacy are affected by entrepreneurial training.

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PANEL DISCUSSION TOPICS

The following topics will be presented and discussed by panel members:

1. *Models of entrepreneurship education at different types of universities and types of degrees*. Panelists will present four distinct entrepreneurial education models implemented at their schools ranging from liberal arts institutions such as Hofstra University to large state research Universities such as Ohio State University, Stony Brook University and Florida Atlantic University. The panel will identify successful elements of each program that are characteristics for a particular institution and/or student body and could be transferred at similar schools. Available results on the effectiveness of the different programs will be discussed.

2. *How to best integrate entrepreneurship education with discipline related education*. Panelists will present and discuss different approaches for instilling entrepreneurial spirit, activities and knowledge in all CS/CE and engineering students by integrating entrepreneurial education in discipline-related education. Inside class and outside class activities will be compared and the best practices and their merits will be identified.

3. *How to increase creativity and innovativeness of computing students through entrepreneurship education.* Panelists will discuss the impact of different educational models and practices on student's creativity and innovation.

4. *The value of Global E-Teams in which engineering students and students from foreign countries work together on common senior design projects*. In this topic, we shall discuss and share experiences in forming teams of interdisciplinary students with foreign nations working together on different aspects of an entrepreneurial project, the difficult issues encountered and the rewards garnered.

5. *How to increase student entrepreneurial knowledge and motivation through a team of interdisciplinary mentors?* In this topic, we shall discuss and share experience of mentoring students by a team of mentors in engineering, business, and entrepreneurs during their senior design project.

6. *How to prepare students to recognize technical opportunities and turn them into entrepreneurial ventures?* For students in engineering disciplines, it is not always clear how this can happen, as their constant focus is on acquiring fundamental engineering knowledge and technical skills. Panelists will present case studies to illustrate the idea.

EXPECTED AUDIENCE

We expect the panel to attract a large number of educators from computer science and engineering departments interested in ways to add effective entrepreneurial components to their programs that will increase students' entrepreneurial desire and knowledge.

PANEL MEMBERS

Simona Doboli is an Associate Professor of Computer Science Department, Hofstra University, NY. Dr. Doboli is currently the PI for NSF CPATH collaborative grant with Stony Brook University on Introducing Entrepreneurship Education in Computer Education: Project EXCE2L (Excellence in Computer Education with Entrepreneurship and Leadership Skills). She has lead the effort at Hofstra University to develop two new programs and courses in Entrepreneurship for CS and CE students and to introduce activities which expose all students to entrepreneurial ideas. Her research interests are in neural cognitive modeling, creativity and group brainstorming research, and computational neuroscience.

Wendy Tang is an Associate Professor of Electrical and Computer Engineering Department, Stony Brook University, NY. Dr. Tang is an accomplished educator who has dedicated considerable efforts in promoting entrepreneurship in engineering education and increasing women students in engineering. Her dedication in promoting women in engineering was recognized by an IEEE Region 1 Award in 1998 and an IEEE Third Millennium Medal Award in 2000. In 2004, together with Dr. Serge Luryi, Dr. Tang initiated a project that promotes engineering entrepreneurship in four institutions of higher education across Long Island. For their pioneering contributions, the IEEE Long Island Section awarded Dr. Luryi and Dr. Tang, the Athanasios Papoulis Education Award in 2006. Dr. Tang is currently the Project Director at Stony Brook University for Project EXCE2L (Excellence in Computing Education with Entrepreneurial and Leadership skills), a joint project between Stony Brook University and Hofstra University that is supported by the National Science Foundation. She also serves as the Faculty Director for the Undergraduate College of Information Technology Studies at Stony Brook University.

Rajiv Ramnath is the Director of Practice Collaborative for Enterprise Transformation and Innovation (C.E.T.I) in the Computer Science and Engineering Department, Ohio State University. Dr. Rajiv Ramnath is a former entrepreneur and former Vice President and Chief Technology Officer at Concentus Technology Corp., in Columbus, Ohio where he led R&D and product-development. At OSU, he is engaged in industry-facing programs of applied R&D, undergraduate, graduate and professional education With respect to entrepreneurship and technology transfer CETI has been engaged in over 60 projects with local companies and entrepreneurs, and Dr. Ramnath is a co-PI on a NSF-CPATH grant named NEWPATH: Nurturing, Through Entrepreneurship, IT World Leaders. His expertise ranges from wireless sensor networking and pervasive computing to business-IT alignment, enterprise architecture, software

engineering, e-Government, collaborative environments and work-management systems.

John Impagliazzo is the ictQATAR Endowed Chair and Professor of Computer Science and Engineering, Qatar University, Qatar. ictQATAR is the supreme ICT governmental agency in Qatar that provides oversight for all issues dealing with information and communication technology throughout the country. Dr. Impagliazzo is also professor emeritus at Hofstra University and he has an extensive background in worldwide computing education. His continuous involvement with the ACM Education Board covers two decades. He is the editor-in-chief of the new magazine *ACM Inroads*, and the *SIGCSE Bulletin*, a position he has held continuously for over twelve years. He has extensive experience in computing accreditation and he has published books in the area of computing history. He started his own construction company where he was its president and CEO for seven years and he has developed entrepreneurial ideas for ICT communities. He just became a Life Fellow of IEEE. He received the Outstanding Achievement Award from both IEEE Computer Society (2005) and from CSAB (2008) and the Lifetime Service Award (2007) from ACM SIGCSE. As part of the NSF CPATH grant Project ExCE2L, Dr. Impagliazzo has developed and taught entrepreneurship modules in his Computer Ethics courses both at Qatar University and at Hofstra University.

Tim VanEpps is the Director of the Innovation Leadership Honors Program for the College of Engineering & Computer Science at Florida Atlantic University. He brings 32 years of experience in industry and business to the University that he has brought to bear on the development of the new Honors program. This program, in just its second year, provides a select group of students with enhanced background and training in innovation, entrepreneurship, leadership and communication.

Ankur Agarwal is an assistant professor in the department of computer science and engineering at Florida Atlantic University, USA. Dr. Agarwal is a member of the new Innovation and Leadership Honors Program for the College of Engineering & Computer Science. His main research interests include Network-on-Chip, system level designs and issues, embedded system design, VLSI design, FPGA design and mathematical modeling of real-time-operating-systems. Ankur Agarwal is the vice president of IEEE, and the chair of IEEE Computer Society, Palm Beach chapter. He also serves as the assistant director of the college wide Center of Systems Integration and assistant director of Mobile Technology Consortium in South Florida. He is also Co-PI for NSF funded Industry/University research center located at FAU. Dr. Agarwal has published more than 40 papers on low power processor designs, low power VLSI implementations of ALU, Network-on-Chips architecture, and power management at operating system level.

Rodrigo Romero is with the Computer Science Department of the University of Texas at El Paso. He is the faculty mentor of the IEEE CS LeaD student chapter at UTEP, which was funded by the Kauffman Campus Initiative to develop entrepreneurial, leadership, professional, and business acumen among students in computer science, computer engineering, and related fields. He is also the Associate Director of the Cyber-ShARE Center of Excellence, an NSF CREST-funded center focused on advancing research and education through cyber-infrastructure.

Edward H. Currie is an Adjunct Professor at Hofstra University, Computer Science Department and CEO Resonance Publications. In Spring 2010, Dr. Currie has developed and taught a new course called Foundations of Leadership and Innovation in Computing for CS and CE undergraduates. He is a co-founder of *PC Magazine.* He was the CEO of the software publishing companies Intersoft Corporation and ImageSoft Incorporated and the lead team of several successful start-ups since the early days of microcomputer industry. He is the co-author of a textbook on *Mixed-Signal Embedded Design.* He has pending patents in the areas of biometrics, database technology, encryption and telecommunications.

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