open
MARCH 25-27, 2010
SAN FRANCISCO

Technical Entrepreneurship Case Studies for Incorporation into Technical Undergraduate Classes

Jonathan Weaver and Nassif Rayess, Mechanical Engineering Department,
University of Detroit Mercy

Abstract

The University of Detroit Mercy (UDM) has developed a number of technical entrepreneurship case studies that are designed to be integrated into existing engineering fundamentals courses. These case studies are intended to illustrate ways that entrepreneurs have capitalized on their knowledge of specific engineering topics covered in typical undergraduate courses to create successful business ventures. The aim is to repeatedly showcase successful engineering entrepreneurs and to provide routine exposure to principles of entrepreneurship throughout the curriculum. The ideal long-term vision is to have one or more case studies for each engineering course. This paper summarizes the twelve cases that have been developed thus far (several more are under development). The materials have been developed using rich media and are freely available online. Initial feedback has been very positive, and the results of ongoing assessment will be shared in later publications. This work is sponsored by the Kern Family Foundation through its Kern Entrepreneurship Education Network (KEEN).

Introduction

The flattening of the world has diminished the traditional competitive position of the United States overall and of the typical US educated engineering graduate in particular. The best way to succeed in a competitive world is to be competitive, and that is true for countries, companies, and individuals. The last few decades have seen the erosion of many of the traditional competitive advantages enjoyed by the US and its workforce. One place where the US maintains and has even increased its competitive advantage is in the graduate engineering programs of research universities, along with their technology parks and high-tech start-up incubators. The undergraduate engineering programs have taken a page from the success of the graduate programs and have introduced innovation and entrepreneurship to varying degrees.

In order to contribute and compete in today's entrepreneurial economy, an engineering graduate need not be an entrepreneur in the sense of starting one's own business. Possessing an entrepreneurial mindset is very beneficial whether one starts a business, excels in established corporations, or joins a university or non-profit. The Kern Entrepreneurship Education Network (KEEN), which is sponsored by the

Kern Family Foundation, models the entrepreneurial mindset by a Pyramid of Principles (see Figure 1) that includes technical fundamentals, an awareness of customer needs, the business acumen to create sustainable business value, and the societal values needed to promote positive social change (2010).

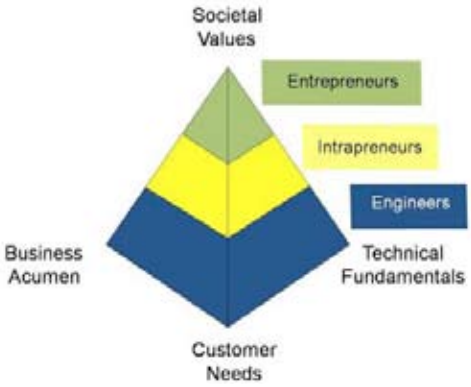

Figure 1. KEEN Pyramid of Principles for the Entrepreneurially Minded Engineer

An engineer educated with strong emphasis on all four corners of this pyramid will be well poised to contribute as an *intra*preneur within an organization of any size. That engineer will also possess the skill set to become an *entre*preneur. Goldberg (2006) proposes that engineering programs need to educate "entrepreneurial engineers." He makes the case that strong technical skills are not enough, and that engineers should have an ability to communicate effectively, sell ideas, manage time, and recognize and properly evaluate opportunities.

The idea of including entrepreneurial engineering elements into engineering curricula has taken hold, and many universities have technical entrepreneurship programs. This is true for the twenty private universities that constitute KEEN. Within the network, the discussion has been focused on finding ways to better develop the entrepreneurial mindset in technical and engineering students without sacrificing the technical fundamentals or jeopardizing accreditation.

To address this concern, the authors have leveraged the financial support from KEEN and developed a number of entrepreneurship case studies, which are being integrated into existing engineering fundamental courses. These case studies are intended to illustrate the ways that successful entrepreneurs have capitalized on their knowledge of specific engineering topics to create a successful venture. In general, each case uses a set of PowerPoint slides with numerous embedded video clips to provide a documentary of the entrepreneur's story. Each case is designed to fit in one lecture slot. The case for including these examples in existing technical courses is helped by maintaining strong ties between the technical content of the case and the technical subject of the course. The cases also address numerous learning outcomes related to entrepreneurship and the entrepreneurial mindset. Additional background information can be found in an earlier paper by the authors (2008) that was written after the development of the first three cases. This paper provides an update, as the number of available cases has increased to twelve (several more are still under development). The cases are currently freely available online to KEEN partners and other colleges wishing to utilize them (UDM 2009).

These case studies are designed to plant the seeds of entrepreneurship in the undergraduate engineering

student population. They are in no way a substitute for rigorous courses on entrepreneurship. The aim is to raise the interest level among the students, making them aware of this important field and giving them an overview of the subject. If a student develops a strong interest in entrepreneurship, there is a good chance that he/she would choose to study entrepreneurship either as a minor degree or as a set of elective courses. It is in those courses that the all-important hands-on training and actual project work will take place.

Overview of the Technical Entrepreneurship Case Studies

The twelve cases developed to date are summarized briefly in this section. These case studies are in the form of a classroom presentation with several video excerpts of the interview with the subject entrepreneur, interspersed with still presentation slides to guide the audience and stimulate discussion. The treatment presented here consists of only a short description and one figure and thus are unable to showcase the engaging nature of the actual in class presentation. They are given here as a general overview.

Case 1: Jonathan Smith and Wave Dispersion Technologies

Motivated by the need for erosion protection for an oceanfront condominium development in New Jersey, Jonathan Smith and his father Dennis developed an erosion prevention product that is a modular and highly engineered marine floating breakwater system. This product, shown in Figure 2, led them on a venture that would become Wave Dispersion Technologies (WDT).

Figure 2. Floating Breakwater System (left) Consisting of an Array of Modules (right)

While the floating breakwater system was developed originally for erosion protection, the company took advantage of an unintended market opportunity having realized that the same product worked well as a line of demarcation for security purposes. Company background and product information are available on the company website (http://www.whisprwave.com/) (n.d.).

This case is intended to be included in a fluid mechanics course. The technical content is focused on the use of scale model testing to optimize the module geometry and the array layout for maximum effectiveness. This case study has been embedded in the undergraduate fluid mechanics course at UDM and is presented after the lecture on non-dimensional analysis. In the course of this case study, the students are asked to choose non-dimensional parameters and to comment on how one would setup appropriate scale model tests for this situation.

The discussions within this case include a definition of entrepreneurship, the traits of an entrepreneur, and the distinguishing characteristics of technical entrepreneurship. The discussions also cover the recognition of a business opportunity, possible avenues for financing a venture, non-technical challenges in creating and marketing products, and what constitutes an exit strategy.

Case 2: Ray Gunn and Somanetics and Clarity

The subject of this case study is an entrepreneur named Raymond (Ray) Gunn, who has spent a career as the principal financial and strategic architect to build high technology innovations into commercial ventures/companies. He has led ten companies through their formation, funding, growth, and ultimate sale or initial public offering (IPO). A biographical statement for Ray Gunn can be found at his venture's website (http://www.wingspancapital.com/Professional_Team.php) (2010). Two of the companies that resulted from Ray Gunn's efforts were Somanetics and Clarity, both of which are the subject of this case study.

Somanetics develops, manufactures, and markets the INVOS Cerebral Oximeter (Figure **3**), which is a noninvasive patient monitoring system that continuously monitors changes in the blood oxygen levels in the brain. At the time this case was developed, the INVOS Cerebral Oximeter was the only commercially available system of its kind in the US (Somanetics 2009).

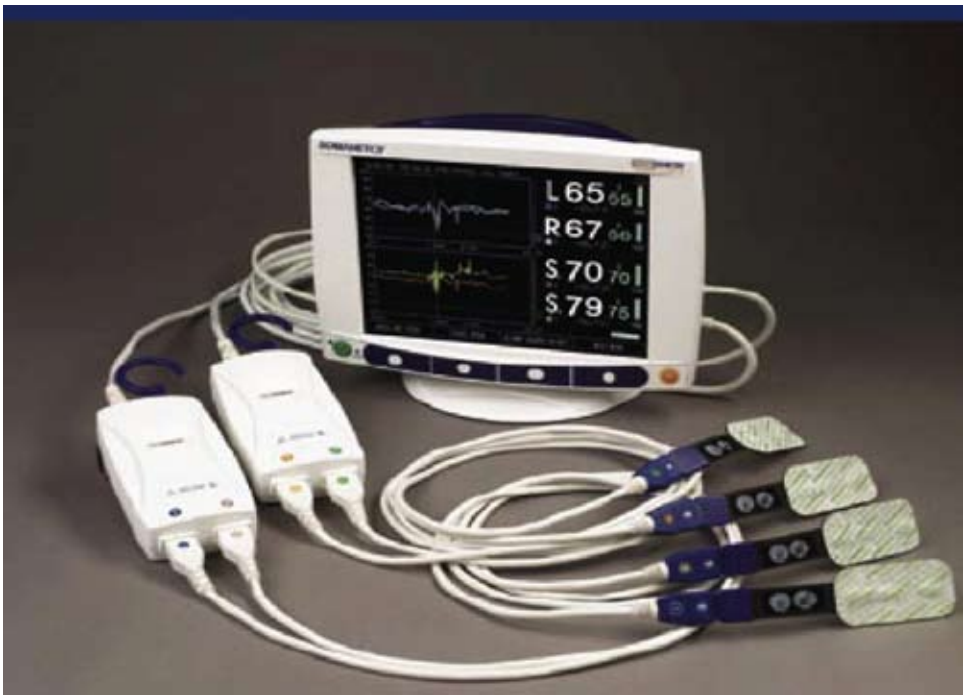

Figure 3. INVOS Cerebral Oximeter (image from somanetics.com)

Students are asked to visit the website to learn about the Cerebral Oximeter prior to the in-class case study presentation. In addition, they could also be assigned to review one of the many patents related to this technology, if the instructor intends to discuss the subject of intellectual property.

The other company featured in this case is Clarity Technologies, a leading provider of software and services for echo and background noise cancellation in voice-based products. Clear Voice Capture technology (CVC) is the company's principal product. It has found widespread application in various wireless headsets, cell phones, and automotive hands free systems. In March of 2005, Clarity Technologies was acquired by CSR PLC (LSE: CSR.L), which is a wireless solutions provider and leading supplier of Bluetooth technology.

The technical subject of this case relates well to content that is normally covered in a measurements and instrumentation course. At UDM, this course is called Mechanical Measurements and covers a variety of transducers and signal processing techniques used to analyze measured data. In addition to the case study presentation and resulting discussion, plans are underway to add a lab demonstration of a basic directional two microphone system for noise cancellation. This type of experimentation is similar to early work at Clarity and is intended to provide students with a hands-on experience.

This case includes a definition of entrepreneurship as well as technical entrepreneurship, viewpoints on risk and failure, strategies and difficulties of going to market, and issues of intellectual property. The case discusses how a venture capitalist screens and evaluates ideas.

Case 3: Matt Younkle and Laminar Technologies' TurboTap

While a student at the University of Wisconsin Madison (UW-M), Matt Younkle was frustrated by the slow-moving beer line in the student union. He spotted an opportunity, teamed up with few friends, and entered an innovation contest at UW-M. The team won that contest, and went on to create TurboTap, a beer dispensing apparatus which combats the head-producing effects of gravity and turbulence to quickly dispense perfect glasses/pitchers of beer with no waste. A variety of TurboTap models are shown in Figure **4**. This case study showcases the technical and business developments of Laminar Technologies, and Matt Younkle's journey toward becoming a successful entrepreneur.

Figure 4. Various TurboTap Models

This case study is integrated into the Fluid Mechanics course at UDM. Since maintaining laminar flow during the dispensing of beer is a key functional attribute of this product, this case is presented shortly after covering the topic of laminar to turbulent flow transition and the Reynolds number (a measure of onset of turbulence in fluid mechanics). Student are assigned, as homework, the task of calculating the Reynolds number for flow in several nozzle architectures and comparing it to a single circular nozzle.

A central element of discussion in this case is the opportunity recognition and initial inspiration for a possible innovation. Discussion also covers raising money, the marketing/sales model (TurboTap is leased and not available for sale to commercial entities), and manufacturing concerns. The entrepreneur discusses the difference between invention and entrepreneurship, how one should handle risk, and key soft skills that are beneficial for engineers.

Case 4: Dennis Carmichael and OnSite ERT

OnSite ERT is a startup, founded in 2005, that provides tracking and monitoring of first responders at incident scenes such as fires and accidents. The company's product is shown in Figure 5. The venture was co-founded by John Ellis (an experienced firefighter and incident commander) and Dennis Carmichael (a successful information technology entrepreneur). They developed a fully automated and easily deployable system that keeps track of the location of all first responders, both inside and outside of buildings. After an initial trial in 2006, the product was further developed into a salable configuration and was first adopted by a municipality in 2007. OnSite ERT has won a number of awards, and is included on the Department of Homeland Security Authorized Equipment list, thus making it eligible for grant funding.

Figure 5. OnSiteERT's Emergency Resource Tracking System

The possible technical courses that could benefit from this case study are in the areas of computer science, software development, or geographic information systems. At UDM, this case has been embedded in an introductory computer science course. Technical discussions involve software requirements and techniques to sub-divide the software development, as well as verification methods.

This case study focuses on Dennis Carmichael's entrepreneurship philosophy, the challenges surrounding the development of this product, and the importance of working closely with end-users and decision-makers to foster adoption. Specific entrepreneurship content includes definition/traits of an entrepreneur, corporate structures, testing/validation, regulatory concerns, exit strategy, business plans, support for entrepreneurs, and intellectual property. This case study deals with decisions about whether to fabricate components or purchase them off-the-shelf.

Case 5: Martin Fisher and KickStart International

Martin Fisher is a social entrepreneur who has applied his passion for improving things to the challenge of eliminating poverty in rural Africa. Along with Nick Moon, they co-founded ApproTEC (which later became KickStart), a non-profit organization aimed at getting millions of people out of poverty. In collaboration with co-workers, Fisher invented low-cost, human-powered irrigation pumps (shown in Figure 6) and other simple moneymaking tools that enable subsistence farmers to double or triple their annual net family incomes. He also pioneered a sustainable supply-chain model for his products that allows for their manufacture and service in or near the communities where they are used.

Figure 6. KickStart's Super MoneyMaker Irrigation Pump

Fisher has been recognized for his inventions and work as a social entrepreneur, and has been awarded the IDEA Design Gold Medal, TIME Magazine's "2003 European Hero" award, the 2005 Skoll Award for Social

Entrepreneurship, and the Schwab Foundation's "2003 Social Entrepreneur of the Year" award.

This case study is a bit different from the others in this series in the sense that UDM personnel did not actually interview Martin Fisher. However, KickStart personnel supported the development of the case study and provided a number of pre-existing videos and still pictures.

At UDM, this case study is integrated into a Physics-1 course and the students are asked to do a work/energy calculation relating to pumping water. This case study could be integrated into a machine design course, as well as a number of other courses.

Case 6: Joe Parker and C&B Machinery

C&B Machinery is a manufacturer/re-manufacturer of grinding equipment. The business has been grown by Joe Parker (CEO and Founder) from a one-man operation refurbishing grinding machines on-site to a successful small business that manufactures new grinding machines and refurbishes older grinding equipment.

This case study focuses on Mr. Parker's entrepreneurship philosophy and his intrapreneurship (expanding his product line with a grinding wheel change cart that is a key competitive advantage). The case study also illustrates an excellent example of engineering ethics (Joe Parker standing behind his wheel change cart customers), and opportunity recognition (e.g., recognizing the opportunities for improved safety, a better way to change grinding wheels). An example of his innovations includes reorienting the grinder hood access hatch from a conventional horizontal hinge axis to having a vertical hinge axis, to improve safety. This is shown in Figure 7.

Figure 7. Original Hood Design (left); Hood with Vertical Hinge Axis (right)

This case is being integrated into UDM's Manufacturing Processes course. Other schools may find it applicable in other course areas as well.

Some of the topics covered that are related to entrepreneurship include ethics, opportunity recognition, intellectual property, the creative process at C&B, and starting a business.

Case 7: Aarun Crumm and Adaptive Materials

Adaptive Materials, Inc. (AMI) is an innovator in the development of portable power generated by solid oxide fuel cell technology. Unlike the more familiar hydrogen-powered fuel cell technology, AMI's products use readily-available fuels such as propane, and provide organizations and individuals with clean, compact, long-lasting portable sources of electric power. AMI's fuel cells have been field tested by the military and could soon replace batteries in many portable power applications. An example of AMI's technology is shown in Figure 8.

Figure 8. Adaptive Materials' Fuel Cell-Powered Mobile Robot

Prior to founding AMI, Aaron Crumm gained insight into electric power generation as a nuclear engineer. He earned his bachelor of science degree in nuclear engineering from Purdue University and a PhD in material science from the University of Michigan. His doctoral research led to innovations which ultimately enabled the manufacturing of the fuel cell tubes used in AMI's products. Information on AMI, including interviews with Aaron Crumm and an overview of the company's products, can be found at the company website (www.adaptivematerials.com) (n.d.).

At UDM, this case study is integrated into the Materials Science course required of all mechanical engineering undergraduates. The technical focus is on ceramics and solid oxide fuel cells. The entrepreneurship aspects of the case include starting a business, intellectual property, traits of an entrepreneur, scope expansion/contraction, creating a supply chain, and celebrating/embracing failure. The entrepreneur discusses his vision of what future engineers/entrepreneurs should know to be successful.

Case 8: Jayson Pankin and Delphi/Monarch Antenna

Monarch Antenna is a spin-off of Delphi Automotive. It is a partnership between Delphi, NASA, Automation Alley, Ann Arbor Spark, Michigan State University, The University of Michigan, Purdue University, Virtual EM, SC Solutions, and SmartSynch. Its core technology is a self-structuring antenna (SSA) consisting of a matrix of small antenna segments connected by switches. An example of this product is shown in Figure 9.

Figure 9. Monarch's Self Structuring Array

The system uses a proprietary algorithm to activate various combinations of these antennae, ultimately selecting the one that yields the best performance. The antenna can be dynamically restructured as signal conditions change, ensuring optimal signal reception.

The technical content in this case is most closely related to undergraduate electrical engineering courses

related to radio frequency communication, microprocessor control, and/or genetic algorithms. It could also be integrated into a computer science course to discuss the software/logic needed to implement the SSA.

This case study focuses on Delphi's intrapreneurship processes, spin-off strategy, and specifics related to Monarch Antenna's technology and development. Some specific entrepreneurship/intrapreneurship-related content includes team building, "the Skunk Works," cost considerations, growth strategies, and identifying and evaluating intellectual property. The entrepreneur provides advice for academia.

Case 9: Mark Kerbel and REGEN Energy

Mark Kerbel and Roman Kulyk co-founded REGEN Energy in Toronto in 2005. The company's Envirogrid Controllers form a wireless energy management solution designed to lower utility bills by reducing peak current draw. The principles in Johnson's Emergence (2001), coupled with inspiration from the swarm logic of bees led to the development of the product. The product and the book Emergence are shown in Figure 10.

Figure 10. Regen Energy's Module (left); Emergence (right)

At UDM, this case study is planned for integration into an engineering economics course, and students will be required to compute the return on investment for a potential customer considering the purchase of a REGEN Energy solution. It could also be integrated in other courses including a controls course, a communications course, or a software development course.

Within the case, Mark Kerbel presents advice for anyone considering technical entrepreneurship. Specific entrepreneurship topics include the elevator pitch, biomimicry, financing, the business model, distribution channels, and developing an exit strategy. Mark Kerbel discusses how one realizes the entrepreneurial calling and gives advice for engineers who seek to be entrepreneurs.

Case 10: Oliver Baer and Clean Emission Fluids

Oliver Baer founded Clean Emission Fluids (CEF) on the principle of environmental responsibility and to empower customers with the means to make a positive environmental impact while meeting or exceeding their bottom line obligations. The company's mission is to serve as a dedicated support center for all items relating to Diesel Exhaust Fluid (DEF). They support the diesel market with DEF supply, equipment, and service. Figure **11** shows one of their filling stations.

Figure 11. CEF's Biofuel and Emissions Fluids Dispensing Station

This case could be slanted in many technical directions. At UDM, it will be incorporated into the heat transfer course, and students will be required to do sample heat transfer calculations on the energy needed to maintain safe fluid temperatures in winter. Other course options include internal combustion engines, chemistry, or fluid mechanics.

The entrepreneurship-related topics covered in this case include definitions/traits of entrepreneurship, applying knowledge learned in industry, evaluating and launching an idea, and advice for engineers/entrepreneurs.

Case 11: Paul Angott, Serial Entrepreneur

Paul Angott is an engineer turned serial entrepreneur. He has invented and brought many innovative products to market, including programmable thermostats, wireless door chimes (see Figure **12**), belt-driven ceiling fans that enable use of small motors, wireless home security systems, wireless ceiling fan controls, and self-guided lawn mowers. He is currently working on a breast cancer diagnostic tool.

Figure 12. Angott's Wireless Door Chime

This case study provides a documentary of the development and marketing of the aforementioned inventions. From a technical standpoint, UDM is incorporating this case into an Introduction to Design course for freshman engineers. This case study is fairly rich in content and thus is fairly lengthy. Instructors with a one hour class limit will likely have to skip over some of the inventions.

The entrepreneurship content of the case includes opportunity recognition, raising capital, the dangers of growing too fast, importance of differentiation in the marketplace, and advice for entrepreneurs.

Case 12: Craig and Randy Rubin and Crypton Super Fabrics

Craig and Randy Rubin launched Crypton Super Fabrics to offer highly engineered textiles that are resistant to stain, liquid penetration, and bacteria. The target markets include furniture, restaurant linens, and pet products (Figure **13**). This case study tells the story of the development of Crypton Super Fabrics.

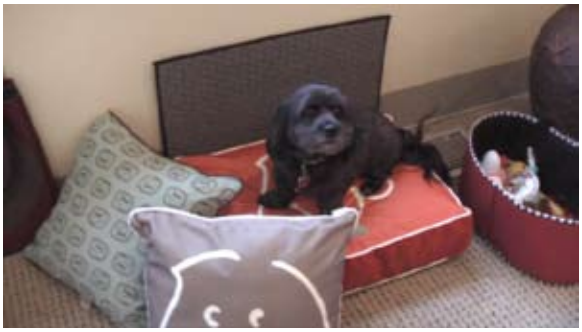

Figure 13. Sample of Crypton's Pet Products

From a technical perspective, the focus of the case is chemistry in general and the principle of crosslinking in particular. The plan is to incorporate this case study into a freshman chemistry course required of all engineers.

The entrepreneurship aspects covered in this case include traits of entrepreneurs, the importance of diversification, branding, growing a business, patent litigation, the right time to start a business, and advice for entrepreneurs.

Pedagogical Aspects of the Collective Cases

The entrepreneurship knowledge areas covered by these case studies are tracked using the hierarchical model of entrepreneurship content presented by PUI-eship (http://www.pui-eship.org), a web-based collaboration area for institutionalizing entrepreneurship at primarily undergraduate institutions (PUIs). Each of the case studies presented here is mapped onto the PUI-eship content matrix, indicating the knowledge areas that are covered. A more detailed discussion is presented in an earlier paper by the authors (2008). The updated matrix can be found at the following website: http://weaverjm.faculty.udmercy.edu/udmkeencases.html.

Preliminary Assessment

Following every case presentation, students were asked to give feedback on the particular case study and its effectiveness toward developing the entrepreneurial mindset. Without exception, all feedback has been positive. A sample of the student comments is presented here:

- I found the case study to be very interesting and would like to see and hear more of peoples' journeys to complete their dream projects.
- It helped show how interdisciplinary skills are very valuable.
- The case fuels motivation and makes us want to learn more than what is presented in courses. This type of material makes us want to search for opportunity.
- This presentation really makes me feel that some of the material science I have learned so far could go very well with [an idea] of mine.

The authors also developed and piloted a pre/post self-efficacy survey in order to quantify any shift in the mindset of the students as a result of the cases. The survey form is provided as Appendix A. This form of assessment only been recently instituted, but results for an initial pilot of the survey are summarized in

Table **1**. This table includes only the items that showed statistically significant difference when analyzed using a paired-t test. The "90%diff" value is an upper (or lower where relevant) bound on the difference with 90% confidence.

Collectively, if successful, the case studies should move all sixteen indicators of the survey in Appendix A. However, each case covers only a subset of those indicators and is thus expected to cause statistically significant movement in only that subset. In the result of the pilot survey shown in Table 1, indicators 4, 5, and 11-16 were not addressed by that particular case and were not found to indicate any statistically significant shift.

	Pre	Post
1. Technical content in this class can be applied in innovative and entrepreneurial ways.	4.19	4.57
	p=0.021 90%Diff=0.15	
2. There is a strong correlation between outstanding written and oral communication skills and success – even for technically oriented people.	4.14	4.71
	p=0.001 90%Diff=0.29	
3. I know the difference between invention and innovation.	3.76	4.24
	p=0.028 90%Diff=0.16	
6. I understand the basic steps necessary to translate an idea into a product or company.	3.10	4.00
	p=0.004 90%Diff=0.54	
7. I have a basic understanding of how capital is raised to support an entrepreneur with an idea.	2.71	4.00
	p=0.000 90%Diff=0.92	
8. I have a basic understanding of the different types of intellectual property and their importance in a business setting.	3.29	4.14
	p=0.004 90%Diff=0.48	
9. I believe problems are really opportunities.	3.91	4.38
	p=0.019 90%Diff=0.19	
10. I am motivated to pursue my 'great ideas' with passion and tenacity.	3.95	4.33
	p=0.036 90%Diff=0.12	

Table 1. Summary of Pre/Post Case Assessment for Adaptive Materials Case in Materials Science Course, Fall 2009

Comprehensive assessment plans are underway involving the use of the pre/post survey in Appendix A in every case study presentation. This assessment will be published and shared in the future.

Conclusions and Future Work

The technical entrepreneurship case study is a seemingly successful mechanism used by the authors to broadly instill the entrepreneurial mindset in undergraduate engineering students at UDM. As these are taking place during a course lecture, the instructor of the course is also exposed. Twelve cases have been developed, and several more are under development. As part of the KEEN network, the authors are actively disseminating these cases and lobbying other schools to adopt them. Assessment thus far has been overwhelmingly positive.

References

Adaptive Materials, Inc. n. d. Homepage. www.adaptivematerials.com.

Goldberg, David E. 2006. *The entrepreneurial engineer*. Hoboken, NJ: John Wiley & Sons.

Johnson, Steven. 2001. Emergence: The connected lives of ants, brains, cities, and software. New York: Scribner.

Kern Entrepreneurship Education Network. 2010. Theory of Change. http://www.keennetwork.com/about-keen/theory-of-change/.

PUI-Eship. Homepage, http://www.pui-eship.org.

Somanetics. 2009. Homepage. http://www.somanetics.com.

University of Detroit Mercy. 2009. UDM Keen Technical Entrepreneurship Case Studies. http://weaverjm.faculty.udmercy.edu/udmkeencases.html.

Weaver, Jonathan, and Nassif Rayess. 2008. Technical entrepreneurship case studies at the University of Detroit Mercy. Paper presented at the NCIIA 12th Annual Meeting, Dallas, TX, March 20–22.

Whisprwave. n. d. Homepage. http://www.whisprwave.com/.

Wingspan Capital Partners. 2010. Professional team. http://www.wingspancapital.com/Professional_Team.php.

Appendix A

UDM Technical Entrepreneurship Cases Pre/Post Self-Efficacy Survey

(Note: Post Survey is identical to the Pre Survey, with the exception of a written feedback section included on the Post Survey. The survey is provided on a single double-sided page so that analysis can be done in pairs by students.)UDM Keen Technical Entrepreneurship Cases

Pre-Case Assessment (*Enter date, case, course*)

Please rate your agreement with each statement.	**Rating <-disagree agree->**				
	1	**2**	**3**	**4**	**5**
1. Technical content in this class can be applied in innovative and entrepreneurial ways.					
2. There is a strong correlation between outstanding written and oral communication skills and success – even for technically oriented people.					
3. I know the difference between invention and innovation.					
4. Successful entrepreneurs are motivated mainly by the quest to make themselves a lot of money.					
5. It is important for a technical person to have a deep understanding of the end customers' needs.					
6. I understand the basic steps necessary to translate an idea into a product or company.					
7. I have a basic understanding of how capital is raised to support an entrepreneur with an idea.					
8. I have a basic understanding of the different types of intellectual property and their importance in a business setting.					

9.	I believe problems are really opportunities.					
10.	I am motivated to pursue my 'great ideas' with passion and tenacity.					
11.	Ambiguous problem statements make me uncomfortable.					
12.	Risk taking hinders achievement.					
13.	I see value in non-conventional, open-minded, lateral thinking and plan to routinely try to think that way.					
14.	A technical person needs to know very little about marketing, finance and management of people.					
15.	I understand the importance of having strong societal values.					
16.	I am motivated to design solutions to unmet needs in the marketplace and in the world.					