

Technical Entrepreneurship Case Studies at the University of Detroit Mercy

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Abstract

As part of the Kern Entrepreneurship Education Network (KEEN) Program sponsored by the Kern Family Foundation, UDM is developing a number of entrepreneurship case studies that are being integrated into existing engineering fundamental courses. These case studies are intended to illustrate how entrepreneurs have capitalized on their knowledge of specific engineering topics. The aim is to provide routine exposure to successful engineering entrepreneurs and principles of entrepreneurship throughout the curriculum. The ideal, long-term vision is that most engineering/technical courses would have one or more corresponding case studies. This paper will summarize the three cases that have been developed and piloted thus far. The materials were developed using rich media and will be made freely available to KEEN partners and other colleges wishing to utilize them.

Introduction

There is a strong emerging consensus that traditional higher education curricula (business, engineering, and professional curricula) need to be supplemented with the “soft” skills attributed to entrepreneurship. The understanding is an entrepreneurial and enterprising workforce will help shield itself and the economy against the various global factors. These benefits are evident whether a person starts a small business, launches a technology start-up, becomes employed by a smaller company, or simply excels in a large multi-national corporation.

Stipulating the need for some entrepreneurship education, the discussion will shift to questions of how, when, and where. The simplest mechanism is to include classes on entrepreneurship in the core curriculum. A quick web search reveals that some schools have been effective in integrating entrepreneurship into their core curricula. Unfortunately, the authors’ first-hand experience (UDM is currently in the process of redefining its core curriculum) is that entrepreneurship will not be part of the core curriculum at UDM in the foreseeable future. Furthermore, technology and engineering curricula are so overloaded that adding extra content in the form of additional courses is extremely difficult. The question inevitably arises as to what needs to be taken out of the curriculum to make room. There is seldom an easy answer to this question.

One avenue developed at UDM is the Technical Entrepreneurship case study. These case studies illustrate how a successful entrepreneur capitalized on his/her knowledge of specific technical or scientific topics to create a successful business venture. The short case studies then become part of the relevant engineering or science courses. This approach requires minimal alteration to the existing curriculum.

The case studies are designed to instill the seeds of entrepreneurship in the student audience. However, there is a great ancillary benefit to them in that they allow the student to better appreciate the usefulness of what might be initially construed as a boring and dry technical topic. It is that mutually beneficial relationship that makes it easier for a course instructor to give up a contact hour of his/her class. The authors’ research into existing entrepreneurship case materials revealed a large number of cases, but several factors led us to develop our own case studies rather than try to adopt those existing cases. These factors include:

- The focus of many case studies is mainly on the business and entrepreneurship aspects as opposed to the application of engineering principles in an entrepreneurial venture (though many of the products are highly technical in nature).
- The desire of the author to engage area technical entrepreneurs to begin to build relationships with that community.

- Many of the cases are quite long (would take more class time than the authors envision being available, at least before the idea catches on and gains wider acceptance at UDM).
- The cases are not typically free; we would like to develop cases that may be freely used by other institutions participating in the Kern Entrepreneurship Education Network (and beyond).

The basic premises of the entrepreneurship case studies are as follows:

- Relatively short (thirty to forty-five minutes or so) entrepreneurship case studies integrated into existing technical courses.
- Cases that illustrate how an entrepreneur has capitalized on his/her knowledge of specific technical/engineering topics covered in the course.
- Besides illustrating the practical relevance of the subject matter, each case study focuses on few key aspects of entrepreneurship. Collectively, the cases are structured to provide as broad an exposure as possible with minimal duplication of content/topics.
- The aim is to provide routine exposures to successful engineering entrepreneurs and principles of entrepreneurship throughout the curriculum.
- The cases include a videotaped interview with the entrepreneur and will be made publicly available for use at other institutions.
- To strengthen the tie to the course, a relevant in-class exercise, lab, or homework assignment accompanies each case study.
- The long-term vision is that many engineering/technical courses will have a corresponding case study. Case development participation by and sharing of cases amongst other KEEN institutions is one way to quickly develop curricular materials that can have a wide-reaching impact at the participating institutions.

Case Studies

To date, technical entrepreneurship cases have been developed around three different entrepreneurs and their ventures: Jonathan Smith and Wave Dispersion Technologies, Ray Gunn and his work with Somanetics and Clarity, and Matt Younkle and Laminar Technologies' Turbotap.

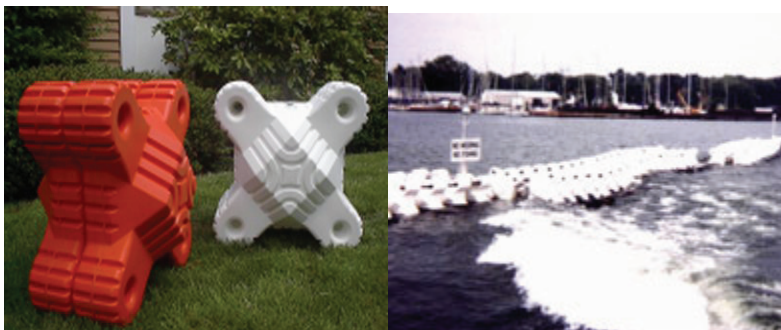
Each of these case studies will be briefly summarized below. Keep in mind that the actual delivery of the case studies involves heavy use of video clips with the subject entrepreneur plus engaging dialog with the students, hence a paper format renders the presentation comparatively dry and uninspiring. Supplemental materials and additional background information on each of the cases is also available for any other instructors wishing to adopt the cases.

Case 1: Jonathan Smith and Wave Dispersion Technologies

Jonathan Smith Case: Background Material

Jonathan Smith and his father, Dennis, motivated by the need for erosion protection for an oceanfront condominium development in New Jersey embarked on what would become Wave Dispersion Technologies (WDT). Their erosion-prevention product is a modular and highly engineered marine floating breakwater system shown in Figure 1.

Figure 1. Floating Breakwater System (left) Consisting of an Array of Modules (right)



In addition to erosion protection, WDT has developed another market for their system: a line of demarcation for security purposes.

Jonathan Smith Case: Outline of Case Content

To convey the nature of the case study presentation as much as possible without being able to include the video clips or detailed slides for size considerations, a rough content outline is provided below:

- Video: Jonathan Smith defines entrepreneurship and traits of an entrepreneur
- Video: Jonathan Smith explains what distinguishes technical entrepreneurship
- Tech transfer cycle
- More about an entrepreneur from Jonathan Smith and NCIIA/KEEN
- Video: Jonathan Smith explains how beach erosion problem represented a business opportunity
- Review of existing breakwater solutions
- Video: Jonathan Smith discusses the finances of establishing WDT
- Image showing array of modules comprising a waterbreak
- Video: Jonathan Smith explains how WDT got into security barriers
- Video: Jonathan Smith discusses some of the non-technical challenges in creating and marketing their products
- Role of scale model testing in developing the product, including some images of the full size and $\frac{1}{4}$ scale models
- In-class exercise: The fluids instructor leads the class in a live exercise, asking the students to set up the appropriate non-dimensional analysis terms for the scale model testing
- Video: Jonathan Smith discusses exit strategy for WDT

Jonathan Smith Case: Course Integration

This case study is ripe for deeper exploration along a variety of dimensions; for our purposes we chose to focus on the technical aspects of their use of scale model testing to optimize the module geometry and array layout for maximum effectiveness. As such, the case has been embedded into our undergraduate Fluid Mechanics course. The case study is presented after the students have had the lecture on non-dimensional analysis, and, as part of the case study delivery, the students are engaged in an exercise where they are asked how they would proceed to setup appropriate scale model tests/non-dimensional parameters for this situation.

Case 2: Ray Gunn and Somanetics and Clarity

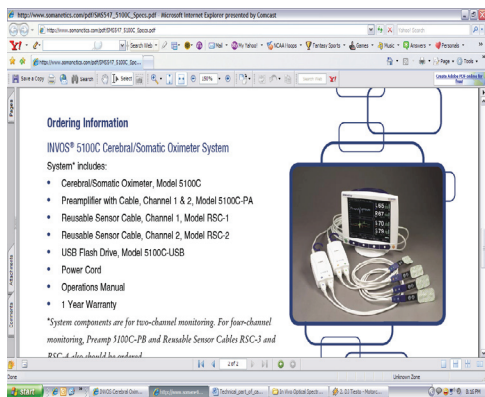
Ray Gunn Case: Background Material

This case study is about a man named Raymond (Ray) Gunn, whom Professor Weaver first heard speak at an NCIIA Invention to Venture Workshop at Lawrence Technological University. Ray Gunn has spent his career acting as the principal financial and strategic architect to build concept technologies into commercialized ventures/companies. He has led ten teams through their formation, funding, growth, and ultimate sale or Initial Public Offering (IPO). Additional information about Ray Gunn's background can be found at http://www.wingspanco.com/wst_page2.html.

Somanetics and Clarity are two of the companies resulting from Ray Gunn's efforts. In order to contain the scope of this case study, the focus is on these two ventures.

Somanetics develops, manufactures, and markets the INVOS Cerebral Oximeter (Figure 2), the only noninvasive patient monitoring system that continuously monitors changes in the blood oxygen levels in the brain commercially available in the US.

Figure 2. INVOS Cerebral Oximeter (image from somanetics.com)



Prior to the in-class case study presentation, students are given a handout and asked to visit a website to learn more about the Cerebral Oximeter. In addition, depending upon the instructor's intentions with the case study, the students may be asked to review a related patent.

Clarity Technologies is a leading provider of software and services for echo and background noise cancellation in voice-based products. Its Clear Voice Capture technology (CVC) is their principal product; it has found widespread application in a variety of wireless headsets, cell phones, and automotive hands-free systems. In March of 2005, Clarity Technologies was acquired by CSR plc (LSE: CSR.L), ("CSR") a wireless solutions provider and leading supplier of Bluetooth technology.

Students are asked to familiarize themselves with Clarity and CVC before the in-class case presentation by visiting <http://www.csr.com/products/cvc.htm>.

A handout the students are given in preparation for the case study is provided as Appendix A.

Ray Gunn Case: Course Integration

The nature of the technical content in this case relates closely with content we normally cover in a Mechanical Measurements course (although many institutions refer to their similar course as Instrumentation). Our Mechanical Measurements course covers a variety of transducers and signal processing techniques used to analyze the resulting data, making for a good discussion on how this case study relates to the course content. In addition, we are planning to add a lab demonstration of a directional two-microphone system similar to what Clarity experimented with early in its history.

This case study went a bit longer than the planned 30-45 minutes intended, so other institutions using this case may wish to eliminate either the Somanetics or the Clarity portions of the case.

To convey the nature of the case study presentation as much as possible without being able to include the video clips or detailed slides for size considerations, a rough content outline is provided below:

- Video: Ray Gunn defines entrepreneurship
- Reflection on that definition and traits of an entrepreneur per NCIIA/KEEN
- Video: Ray Gunn discusses technical entrepreneurship
- Video: Ray Gunn describes his viewpoint on risk and failure
- Video: Ray Gunn explains origins of the Cerebral Oximeter
- Review of how the Cerebral Oximeter works
- Video: Ray Gunn explains more about the technology and how he got involved
- Video: Ray Gunn discusses the process of bringing the Cerebral Oximeter to market
- Video: Ray Gunn explains their approach to IP
- Video: Ray Gunn discusses their manufacturing strategy
- Transition to Clarity Technologies
- Video: Ray Gunn introduces Clarity's Clear Voice Capture (CVC)

- Video: Ray Gunn describes the two-microphone value proposition
- Video: Ray Gunn explains how they morphed to a single microphone solution to get to market
- Video: Ray Gunn explains some of the challenges bringing CVC to market
- Details of how CVC works
- Video: Ray Gunn explains how to use a pain/pleasure test to screen an idea
- Video: Ray Gunn gives advice on what to do if you have an idea
- Additional idea evaluation suggestions
- Video: Ray Gunn on how he as a VC evaluates an idea
- Video: Ray Gunn asked when the best time to become an entrepreneur may be

Case 3: Matt Younkle and Laminar Technologies' TurboTap

Matt Younkle Case: Background Material

A current UDM graduate student, Anita Bersie, went to school with Matt Younkle at the University of Wisconsin Madison. She provided Professor Weaver with the lead to create this case study.

While a student at UW-M, Matt was frustrated by how slowly the beer line in the student union moved. He decided to do something about it by teaming with a few friends and entering into a creativity contest at UW-M. They won that contest, and went on to create Turbotap, a beer-dispensing apparatus that combats the head-producing effects of gravity and turbulence to quickly dispense perfect glasses/pitchers of beer with no waste. A variety of Turbotaps are shown in Figure 3.

Figure 3. Turbotaps



This case study provides some of the story behind Turbotap. When the authors spoke to Matt Younkle over the summer, he was planning his imminent retirement to the Bahamas.

Matt Younkle Case: Outline of Case Content

To convey the nature of the case study presentation as much as possible without being able to include the video clips or detailed slides for size considerations, a rough content outline is provided below:

- Video: Watch CNBC story on Turbotap²
- Video: Matt Younkle discusses initial inspiration and winning school creativity competition
- Painstorming as an idea generation technique
- Video: Matt Younkle discusses raising money for Turbotap
- Video: Matt Younkle describes the fluid mechanics principles of how Turbotap works
- Images of the product itself and some of the figures from their patent illustrating the inner geometry
- Video: Matt Younkle describes their attempts to use modeling and simulation, ultimately to resort to iterative testing
- Video: Matt Younkle describes the business model (Turbotap is leased rather than sold)
- Video: Matt Younkle describes the manufacturing approach
- Video: Matt Younkle discusses invention vs entrepreneurship

- Video: Matt Younkle discusses risk from his perspective as an entrepreneur
- Video: Matt Younkle discusses how engineers are in the driver's seat of entrepreneurship and that leadership, creativity, and communication skills are vital as an engineer

Matt Younkle Case: Course Integration

This case study is integrated into the fluid mechanics course at UDM. Since one of the key functional attributes of this product involves maintaining laminar flow during the dispensing of beer, students are asked to do a homework assignment comparing the Reynold's number of several possible nozzle architectures in comparison to a single circular nozzle.

Pedagogical Content Map of Cases

Pedagogically, the technical entrepreneurship case studies at UDM can be thought of as bits and pieces of the desired entrepreneurship content spread across the technical courses into which the case studies are embedded. As such, it is essential to maintain a big-picture understanding of which content is covered in which cases. This can facilitate thorough coverage by the cases taken collectively while minimizing redundancies. Of course, not all cases will be received by every student, and not all students will see the case studies they do see in the same order, so some overlap/redundancy is reasonable—particularly on many of the basics of entrepreneurship.

In order to keep track of the knowledge areas covered by each of our case studies and the collective set of case studies, we have adopted the hierarchical model of entrepreneurship content presented by PUIeship, a web-based collaboration area for institutionalizing entrepreneurship at Primarily Undergraduate Institutions (PUIs). The content matrix available³ was taken and each case study has been mapped onto that matrix to indicate which knowledge areas are covered. Given the brevity of these cases, most knowledge areas are covered only at an introductory level, with a few topics perhaps receiving a medium level of coverage. The content mapping for the cases is given in Appendix B.

Student Reaction to the Cases

After each case presentation, the students have been asked to discuss their opinions on the case study. The response has been overwhelmingly positive, with numerous comments essentially saying how refreshing and inspiring it is to see what someone can do with the course materials they are currently learning. Many students have also expressed a desire for much more entrepreneurship content, and instructors have noticed a heavy level of engagement by students who sometimes seem less than fully attentive in class. When the students are asked if they would like to see more such entrepreneurship cases embedded into their classes, the consensus is strongly in favor of that. These cases seem particularly valuable in attracting and retaining the underrepresented students that UDM prides itself on, since there are research findings that suggest that underrepresented students respond well to a more applied approach to engineering studies. The authors plan a more structured student survey on the cases for the near future to supplement the traditional course evaluations.

Conclusions and Future Work

The authors feel that the technical entrepreneurship case study approach is one of the key pieces in our attempts at UDM to broadly instill the entrepreneurial mindset in as many students as possible. Several more case studies will be developed as part of a recently received KEEN Phase II grant from the Kern Foundation. The process of preparing a proposal for a minor in entrepreneurship is also underway.

References

1. <http://www.whisprwave.com/>
2. CNBC video at <http://video.msn.com/?mkt=en-us&vid=6ecedcac-00e6-466e-a2co-74bc3bof8d4b>
3. <http://www.pui-eship.org/>

Appendix A

Student Handout for the Ray Gunn Case Study

UDM Technical Entrepreneurship Case Study: Ray Gunn

Development supported by the Kern Entrepreneurship Education Network (KEEN)

Developed by Jonathan Weaver and Arun Aakaluashok

April 2007

Background

This case study is one of several being developed as part of the KEEN initiatives at UDM. The purpose of these case studies is to illustrate how entrepreneurs have capitalized on their knowledge of specific technical topics such as those being covered in the course you are currently taking. At UDM, this case study is planned for integration into the Mechanical Measurements (Instrumentation) course; other institutions may find the content perfectly suitable for embedding into alternative courses (signal processing, biomedical engineering or physics for example—not to mention any course in entrepreneurship).

Introduction

This case study is about a man named Raymond (Ray) Gunn. Ray Gunn has spent his career acting as the principal financial and strategic architect to build concept technologies into commercialized ventures/ companies. He has led ten teams through their formation, funding, growth, and ultimate sale or Initial Public Offering (IPO). Additional information about Ray Gunn's background can be found at http://www.wingspanco.com/wst_page2.html.

Somanetics and Clarity are two of the companies resulting from Ray Gunn's efforts. In order to contain the scope of this case study, the focus will be on these two ventures.

Somanetics

Somanetics develops, manufactures and markets the INVOS Cerebral Oximeter, the only noninvasive patient monitoring system that continuously monitors changes in the blood oxygen levels in the brain commercially available in the U.S.

Prior to the in-class case study presentation, learn more about Somanetics' INVOS Cerebral Oximeter by visiting www.somanetics.com (make sure you visit www.somanetics.com/invos.htm and www.somanetics.com/invos_principles.htm) and developing answers to the following questions:

1. What is the basic principle of operation of the INVOS Cerebral Oximeter?
2. Who is the target market?
3. What was the purpose of the clinical research and was it necessary?
4. What things which we have learned in this course relate to this product?
5. What are Soma Sensors and do you think it makes business sense for Somanetics to make them a disposable commodity?

Optional: Review Somanetics' U.S. Patent Number 5,902,235 entitled *Optical Cerebral Oximeter*. (To do so, go to <http://patft.uspto.gov/netahtml/PTO/search-bool.html> and enter *Somanetics* for **Term 1**, choose *Assignee Name* for **Field 1** and click on search; a list of Somanetics' patents will appear allowing you to click on the above patent).

Clarity Technologies

Clarity Technologies is a leading provider of software and services for echo and background noise cancellation in voice-based products. Its Clear Voice Capture technology (CVC) is their principle product; it has found widespread application in a variety of wireless headsets, cell phones, and automotive hands free systems. In March of 2005, Clarity Technologies was acquired by CSR plc (LSE: CSR.L), ("CSR") a wireless solutions provider and leading supplier of Bluetooth technology.

Some of the story behind Clarity's CVC will come out in the presentation of the case. In order to familiarize yourself with Clarity and CVC before the in-class case presentation, visit <http://www.csr.com/products/cvc.htm> to learn a bit more.

Appendix B

Content Area Matrix: UDM KEEN Case Study Coverage (matrix based off of PUI matrix online at <http://melchior.muhlenberg.edu/twiki/bin/view/PUIeship/ContentAreasMatrix>) (last update 20071003)

Note: PUI Matrix breaks out each item to three depth levels (Intro, Medium, or Advanced). At this point, all our coverage is felt to be at the intro level.

Legend: JS = Jonathan Smith Case, RG = Ray Gunn Case, and MY = Matt Younkle Case

| Topic | Sub-topic | Sub-subtopic | Case | |
|--------------------|------------------------------|----------------------------|-------------------------|--|
| Background | what is eship | | JS, RG, MY | |
| | self-assessment | | | |
| | role models | | | |
| | successes/failures | | JS | |
| | history of eship | | | |
| | eship philosophies | | social entrepreneurship | |
| | | | bottom-line driven | |
| academic | | | | |
| entrepreneurship | | | | |
| | | intrepreneurship | | |
| | | lifestyle | | |
| Idea generation | creativity | | RG | |
| | brainstorming | | | |
| Planning | opportunity evaluation | | RG, MY | |
| | initial business planning | concept plan | | |
| | | business plan | | |
| | | stakeholders | | |
| | ongoing strategic planning | | | |
| | exit strategy | | JS | |
| | product life cycle | | JS | |
| forecasting | | | | |
| economic modeling | | RG | | |
| Stagegate model | | | JS | |
| Project management | scheduling | | | |
| | logistics | | | |
| | time management | | | |
| | staffing/human resources | | RG, MY | |
| | leadership delegation | | | |
| Legal | business/tax legal structure | S, C, sole, LLC, LLP, LTD | | |
| | | nonprofit: 501c3, etc. | | |
| | Intellectual property | copyrights | | |
| | | trademarks | | |
| | | trade secrets | | |
| | | utility and design patents | RG, MY | |
| | | provisional patents | | |
| | | nondisclosure agreements | | |
| | | noncompete agreements | | |
| regulatory issues | | | | |

| Topic | Sub-topic | Sub-subtopic | Case |
|------------------------------------|--|---------------------------------|--------|
| | incorporation | | |
| | liability | insurance | |
| | | product-liability | |
| | | personal-professional liability | |
| | | corporate liability | |
| | contracts | | |
| | labor laws | | |
| | international business law | | |
| | | | |
| Economics | micro economics | | |
| | macro economics | | |
| | currency | | |
| | import/export | | |
| | tariffs/trade | | |
| | | | |
| Financial | accounting | balance sheets | |
| | | cash-flow statements | |
| | | payables/receivables | |
| | start-up finance | bootstrapping | JS, MY |
| | | angel capital | RG |
| | growth finance | venture capital | RG |
| | taxes | | |
| | development cost estimation | | |
| | pricing models | | |
| | financial statements and reporting | | |
| | stock | stock types: public private | |
| | | | |
| International business | culture | | |
| | products | | |
| | | | |
| Corporate organization and culture | small business | | |
| | family business | | JS |
| | corporate (S,C, ...) | | |
| | consulting | | |
| | lifestyle | | |
| | non-profit | | |
| | | | |
| Technology | | | |
| | | | |
| Human resources | staffing planning | | |
| | personnel manuals | | |
| | benefits | | |
| | hiring procedures | | |
| | evaluation strategies | | |
| | training and prof. dev. writing job descriptions | | |
| | compensation | | |
| | pensions | | |
| | liability | | |
| | | | |

| Topic | Sub-topic | Sub-subtopic | Case |
|---------------------|---|--------------|------|
| Market research | market studies | | RG |
| | focus groups | | RG |
| | survey generation | | |
| | data analysis | | |
| | industry analysis | | |
| | competitive analysis | | RG |
| Marketing | niche advantage | | RG |
| | competitive advantage | | MY |
| | product life cycle | | |
| | market identification/target market | | MY |
| | market capacity | | |
| | profit potential | | MY |
| | branding and logo | | |
| | promotion | | |
| | product identification | | |
| | economies of scale | | |
| | franchising | | |
| Sales | | | |
| Teaming | leadership | | RG |
| | trust | | |
| | team dynamics | | JS |
| | team communication | | |
| Ethics | | | |
| | inventory control | | |
| | design for manufacturing | | JS |
| | staffing | | |
| | logistics | | |
| | statistical process control/QC certifications (ISO,etc) | | |
| | supply chain management | | |
| Risk analysis | decision making | | |
| | risk identification | | |
| Professional skills | oral communication | | |
| | written communication | | |
| | leadership | | |
| | conflict management | | |
| | emotional intelligence | | |
| | etiquette | | |
| | attire/comportment | | |
| | networking | | |
| | negotiation | | |
| | interviewing | | |
| | resume building | | |
| | attire | | |
| | risk taking | | |
| | failure acceptance | | |

| Topic | Sub-topic | Sub-subtopic | Case |
|----------------------------|--------------------|--------------|------|
| Distribution | | | |
| Design and development | specifications | | |
| | concept generation | | MY |
| | concept selection | | MY |
| | decision making | | |
| Management and governance | | | |
| Opportunity identification | | | |