Online Experiential Education for Technological Entrepreneurs

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by

Thomas R. Ermolovich

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Advisor: Dr. John G. LaBrie

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Abstract

Technological Entrepreneurship is both an art and a science. As such, the education of a technological entrepreneur requires both an academic and an experiential component. One form of experiential education is creating real new ventures with student teams. When these ventures are created in an online modality, students work in virtual teams and never meet each other face-to-face. The impact of working in a 100% online environment with a focus on experiential learning was unclear and needed investigation. This study explores the processes that these virtual teams undertook to start new ventures and how these students established a sense of community, created a culture of trust and resolved conflicts that are inherent in creating a new venture.

A cohort of 17 master’s students in a technology commercialization program was studied for one year by tracking their steps from idea generation to the creation of a business plan. Since the problem being explored was unknown and crossed multiple disciplines, grounded theory was used. At the end of each of the program’s four quarters, students were interviewed and given a survey to measure their sense of community and satisfaction. At the completion of the program, the students produced a business plan and were evaluated by their instructor and a team of three outside reviewers who are business executives experienced in entrepreneurship and technology commercialization.

Keywords: virtual teams, entrepreneurship, commercialization, online education, experiential education.
Chapter 1: Introduction

Problem and Significance

The problem of practice under investigation is the processes that online student teams undertake to develop new high-technology business ventures as part of their experiential education in technological entrepreneurship. A large private university in the northeast serves as the test bed. The test bed consisted of an organizational construct called the I-cubator\(^1\) that is the experiential component of the technology commercialization program under study.

In the online I-cubator, online students work in virtual teams to transform an idea of their own choosing into a real commercial new venture. This venture could be a new company or a new product line within an existing company. This project work is worth 16 credits, which is part of the 40-credit master’s program.

The I-cubator concept was first developed for an on-the-ground modality by the faculty of the university’s business school in 2005 as a means to provide technological entrepreneurship students with an experiential education component. The objective of the I-cubator is to give students the practical experience of starting a new venture from its conception, at the point when there is only a wisp of an idea for a product or a company. Educational alternatives such as co-ops and internships cannot provide this opportunity because a host company’s fundamental ideas and culture are already well formed when the co-op or interns are hired. These I-cubator ventures\(^2\) consist of intellectual property provided by the university’s technical faculty. The

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\(^{1}\) A glossary of terms used in this document has been provided in Appendix A.

\(^{2}\) Students work on projects which can be become new ventures as a result of their work. The venture term is a more accurate description of the student’s work.
structure of the I-cubator consists of a student management team coached by a faculty advisor who had extensive entrepreneurial experience.

Inside the on-the-ground format, students are expected to meet weekly with their advisor, and in an ad-hoc manner with the technical faculty who is supporting the program. The entrepreneurship process often evokes passion in many of the team members. Quite often there are energetic face-to-face discussions between the students, their advisor, and the technical faculty about the future direction of their project.

While the online I-cubator shares the same objectives as its on-the-ground counterpart, in the current design, the online I-cubator students don’t meet face-to-face except in ad hoc meetings where geography is not a major obstacle. Students are not expected nor required to meet face-to-face. The extent of the need for face-to-face interaction and how students resolve conflicts online is unknown and is a focus of this research project.

In the online I-cubator, a collaborative environment is built with state-of-the-art collaboration tools such as Google Docs, wikis and Nings\(^3\). Even with the use of these tools, conflicts still occur, as the management and supervision of the new venture is delegated to the students. New ventures often experience conflicts over governance, especially at the inception of the venture. There is a need to understand whether these conflicts can be resolved effectively in an online environment. Learning how to resolve these conflicts is a significant portion of the student’s educational experience.

The unique nature of the I-cubator concept creates opportunities for students, but it also presents challenges. The repertoire of this type of course knowledge among university faculty is not deep. This is evidenced by market research done early in 2008 by Eduventures, which

\(^3\) A Ning is a social networking site that is similar to Facebook except it is a closed community.
revealed at the time that there were no academic institutions doing this type of experiential program in entrepreneurship education in an online modality (Eduventures custom inquiry report for CPS, 2008). Their research gave further support to the conclusion that the development of an online i-cubator is unique, and as such may present numerous opportunities for academic research and pedagogical understanding.

Entrepreneurship is critical to the constant renewal process for today’s market economies. It drives technological change and productivity growth. Entrepreneurship is a future-oriented process. It is targeted to “becoming” something new, as opposed to status quo, which is merely inheriting the past (Kuratko & Hodgetts, 2004 as cited in Kuratko, 2005). As a result of entrepreneurial efforts, newly created jobs enable millions of people to enter the economic mainstream. Entrepreneurship is also a vehicle for realizing the American dream, due to the wealth that is created when starting a company (Kuratko, 2005). As a longtime leader in experiential education, educators at the university under study believe that an entrepreneurship education steeped in the experience of starting a real venture is fundamental to the creation of technological entrepreneurs who in turn will benefit society on a larger level. This form of knowledge transfer from concept to innovation to marketplace is at the core of this study.

At the time of the research project, entrepreneurship education at this private university, as with most universities, was on the ground and campus-based. Students who wanted to study entrepreneurship had to travel to a campus and take courses in a traditional synchronous fashion. This posed several hardships and difficulties, especially for adult students looking to reenter higher education in this area. First, for those who are not near a university that offers an entrepreneurship program, geography is an obstacle. This is especially true for international students who come to the United States to learn about American-style entrepreneurship.
Globally, American-style entrepreneurship is a highly valued asset. Secondly, campus-based courses pose difficulty for the mid-career professional who may prefer asynchronous online courses as a means to balance career, family obligations, and education. Preventing these two populations from participating in entrepreneurship education slows not only the student’s educational process, but their community’s economic development as well. Society can be well served through an online entrepreneurship program. A significant component of this educational experience is the online experiential component, which is not currently being delivered by other universities (Eduventures custom inquiry report for CPS, 2008).

The development of an online experiential model is valuable to other universities around the world and may facilitate the adoption and refinement of other online models. As a result, there may be a greater proliferation of online entrepreneurship educational programs, which could dramatically increase the number of entrepreneurs.

Online entrepreneurship programs enable universities to extend their reach beyond their local geography. This enables entrepreneurship programs to significantly increase their enrollment and influence. Consequently, these programs, once viewed as boutique programs, can establish a critical enrollment mass with strong financial viability. Graduates of online entrepreneurship programs are fluent in working with virtual teams, and as such they have a high degree of comfort in starting geographically disbursed companies.

Practical and Intellectual Goals

This research project has both a practical and an intellectual goal. From a practical viewpoint, the goal of this research project is to create a methodology that can be used by other

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4 Fifty-four percent of current and past on-the-ground students in a similar program come from overseas, with the largest segment coming from India and China (STE Student Statistics, 2010).
universities around the world to educate technological entrepreneurs and other group related endeavors online. To accomplish this goal, the effectiveness of program strategies and processes needs to be evaluated. From an intellectual viewpoint, the goal is to create a theoretical framework that can be used to describe the behavior of virtual teams when they execute complex highly interdependent tasks over a long period of time.

**Summary of Research Questions**

**Primary question.** What processes do online student teams undertake in the development of new entrepreneurial ventures?

**Secondary questions.** How do online student teams participating in the development of an entrepreneurial venture (a) establish a sense of community, (b) create and develop a culture of trust, and (c) resolve conflict?

**Tertiary question.** What is the theoretical framework that characterizes student behavior in an online program in technological entrepreneurship?

**Summary of Paper Contents and Organization**

This paper begins in Chapter 2 with a literature review that examines the four major elements of the research project that are: entrepreneurship education, online education, sense of community and virtual teams. From this literature review, in Chapter 3, the research questions are placed into context and discussed. These questions are used as a basis for a grounded theory study. Following the research questions, a practical application of grounded theory is used to develop a methodology for the study.

Following the presentation of the methodology, in Chapter 4, the findings are developed. After an introductory discussion and context setting, the findings are presented on a quarter-by-quarter basis as the students matriculate through the experiential program. In Chapter 5, the
findings are discussed using a theoretical framework which is constructed using grounded theory.

Chapter 2: Literature Review

At a high-level, this research project is a study of student virtual teams operating in the domain of technological entrepreneurship. These student teams are developing real companies as part of their experiential education. During the research project, an analysis is performed of processes used by these students to develop their new venture in an online delivery modality.

The objective of the literature review is to discover what is known in the general problem areas that surround the student virtual teams in their work. The literature review is organized into four elements: entrepreneurship education, online education, sense of community, and virtual teams.

The first element is entrepreneurship education. In entrepreneurship education, there is an exploration of the challenges that the students face as nascent entrepreneurs. The second element is online education. Members of the teams under study are students as opposed to employees of a company. In this literature review, team members are explored from the perspective of their role as online learners. The third element is sense of community. There is an exploration of developing a sense of community in a virtual organization. The fourth and final element is virtual teams. In this literature review, team development and the behavior of virtual teams is explored.

Entrepreneurship Education

To explore entrepreneurship education, the entrepreneurship process needs to be described and characterized. This starts with a definition and then a look into the unique aspects of entrepreneurship that needs to be addressed in any education of entrepreneurs whether in an academic on non-academic environment.
Definition of entrepreneurship. The student virtual teams in the research project are creating real companies as part of their entrepreneurship education. What confounds the analysis of these student teams is the lack of consensus as to the definition of an entrepreneur and a lack of consensus around a unified theory of educating an entrepreneur (Bygrave & Hofer, 1991; Fiet, 2001; C. Jones & English, 2004; Kirby, 2004; Mwasalwiba, 2010). The term entrepreneur is often equated with small business (Gibb, 1996), owner management and self-employment (Kirby, 2004). However, Brockhaus and Horwitz (1986) pointed out that there is no generic definition of entrepreneur as defined in the research literature. This tends to confound the identification of the entrepreneur (Chell, Haworth, & Bradley, 1991). The origin of the word entrepreneurship comes from the French verb “entreprendre” which means to undertake. Essentially an entrepreneur is an undertaker, someone who starts something new (Kirby, 2004). Timmons further elaborated this definition:

Entrepreneurship is the ability to create and build something from practically nothing. It is initiating, doing, achieving and building an enterprise or {organization}, rather than from just watching, analyzing or describing one. It is the knack for sensing an opportunity where others see chaos, contradiction and confusion. (as cited in Kirby, 2004, p. 175)

In defining entrepreneurship education it can be thought about as educating for entrepreneurship and educating in entrepreneurship (Mwasalwiba, 2010). In educating for entrepreneurship, the goal of the entrepreneurship process is to create an entrepreneur. When the goal is to become more entrepreneurial in the student’s existing place of work, the student is educated in entrepreneurship.

In applying either view of entrepreneurship it is difficult to measure the efficacy of an entrepreneurship education program. Often there is a significant time lag between completing an education and starting a company. Due to the length of time and significant other factors, it is
difficult to establish a relationship between an education program and starting a company. It is also difficult to establish success metrics. One metric could be starting a new business. However, an additional set of metrics might include entrepreneurial activity over a career or job satisfaction (Hytti & O'Gorman, 2004). These metrics are easier to measure and may provide data that is needed to establish a causal link between entrepreneurship and entrepreneurship education.

**The entrepreneurship process.** The student virtual teams are engaged in the entrepreneurship process that is complex (Gartner, 1985). There is a wide variability in entrepreneurs, the firms that they create and the environments that they operate in. This complicates the study of entrepreneurship since each situation is different. This also makes it difficult in that future success can come from processes that were codified from past successful ventures. The student’s new venture will face many complex issues as well. Starting a company involves Porter’s five forces each of which can be complex: barrier to entry, rivalry among existing competitors, pressure from substitute products, bargaining power of buyers and bargaining power of suppliers (Gartner, 1985).

Entrepreneurs work in brand new situations. The situations themselves are complex, ill structured and open ended (Honig, 2004). The firm has limited resources and intense time pressure. Decisions are often immediate, with incomplete and dubious data (Kirby, 2004). This can lead to poor decision making through heuristics. Additionally, cognitive errors can occur due to unfounded optimism (Baron, 2000).

The planning process in entrepreneurship is flexible rather than rigid. The logic for execution is incrementally learned through observation and re-planning based on new information from the marketplace or the science of invention. Since plans need to change in
order to be successful, venture capitalists place a strong emphasis on the senior leadership team of the company and their ability to adapt (Honig, 2004).

Successful entrepreneurs use Piaget’s process of cognitive adaptation (Honig, 2004). This process consists of both assimilation and adaptation. In assimilation, the entrepreneur fits the reality that they see into the framework of their current understanding of either a new technology or marketplace. In a complementary process, entrepreneurs use accommodation to make adjustments in ideas and plans as a result of reality. Through these processes organizations adapt to the world that surrounds them and as such they reach a state of dynamic equilibrium. Throughout its life, an organization will vacillate in and out of equilibrium. When an organization is in a state of disequilibrium, learning occurs when the organization is brought back into equilibrium thereby enabling the organization to function at a higher level (Miller, 2002).

Through the process of cognitive adaptation, entrepreneurs translate their ideas into viable businesses. Often entrepreneurs will succeed in a market that was not their original intention nor did their customers envision it. The final product that delivers success may not be the one that was originally designed (Drucker, 1985). Successful entrepreneurs will systematically seek out unexpected success or failures. They spend time looking outside to customers in the marketplace. They continuously challenge their notion of the utility of their product and the value that they bring to the customer. The greatest danger for the entrepreneur is to feel that they “know more” than the customer. This creates an unwillingness to accept customer data and may create efforts to reform them when their sense of reality is incongruent from that of the entrepreneur (Drucker, 1985).
In contrast to the process of cognitive adaption, classic entrepreneurship education focuses on the generation of business plans and the skills needed to generate them. This represents the use of a static process to address a dynamic problem. The plan itself can cause entrepreneurs to be inflexible and fail to adapt to their environment (Honig, 2004). Realizing that plans need to be flexible, today’s venture capitalists now ask for PowerPoint presentations rather than formal written business plans.

**Learning through failure.** There is an expectation for most student projects that there will be a successful outcome and a corresponding grade. Grading rubrics are set up accordingly. This is not true for student teams developing real new ventures. There is a high failure rate of companies developed by nascent entrepreneurs (Fiet, 2001). If one believes that learning from failure is part of the entrepreneurship process, then failure must be an attribute of entrepreneurs. However, a distinction needs to be made between failing companies and failing entrepreneurs (Shepherd, 2004). This is a very important concept for the student entrepreneur. While grading criteria can be developed for this situation, the student as entrepreneur may experience a negative emotional reaction and increased level of stress (Shepherd, 2004). Learning to deal with these reactions is also part of the student’s learning process.

**Social competence and entrepreneurship.** Social capital refers to resources that can be obtained from one’s personal social network or can be obtained through one’s personal reputation (Baron & Gideon D. Markman, 2000). There is also a relationship between social capital and social skills. These are soft skills not directly related to the development of a new product or business. The challenge for the students in the research project is that they need to develop and execute these skills in an online environment.
Students as entrepreneurs need to have skills in social perception, impression management, persuasion and social influence and social adaptability. Social perception is the ability to read people. This includes their emotions, and motives, and intentions. Impression management is the skill of making a favorable first impression. Persuasion and social influence is the ability to convince others of your point of view. Social adaptability is the ability to adapt and adjust to new and varied social situations. All of these skills are key for the entrepreneur in meeting with venture capitalists, meeting with customers, establishing effective relationships with partners, managing the board of directors and hiring new employees (Baron & Gideon D. Markman, 2000). These skills are important to the entrepreneur early in the entrepreneurship process. They are often a factor in determining access to venture capital, early adopter customers, partners and key suppliers.

**The art and science of entrepreneurship.** Students as entrepreneurs face two very different kinds of problems. First, there are problems that are very analytical in nature. For the entrepreneur, such problems exist in financial sales and financial projections. For the technological entrepreneur there are analytical problems in the development of the product. Some of these problems could be improving the product’s performance or reducing its size and cost. These problems can use a process of reasoning to develop a correct or preferred answer. The second set of problems that entrepreneurs face are not as clear. These problems are ill formed, often missing data to make the best decision, and have multiple conflict tradeoffs. For example, how should a company react to new claims made by a product competitor? Are the claims real? Should the current product plan be changed now or in the future (Honig, 2004; Kirby, 2004)? Another example would be conflicting requirements from customers. One customer might want the product cheaper and another might want greater performance.
The human brain deals with these types of problems in a very different manner. From a neuropsychological perspective, the brain appears to be divided into two hemispheres (Ornstein, 1997; Sperry, 1969; as cited in Kirby, 2004). The left side (logical) of the brain handles language, logic and symbols. It is narrowly focused on systematic thinking (Kirby, 2004). On the other hand, the right (artistic) side of the brain manages emotional and intuitive functions. “Right-brained thinking is lateral, unconventional, unsystematic and unstructured. It is this right brained lateral thinking that is the heart of the creative process” (Kirby, 2004, p. 182).

Technological entrepreneurship is both an art and a science and thus requires the use of both the left side and the right side of the brain. The left side of the brain is used to establish a business based on facts, such as the crunching of financial numbers or the understanding of the details of a new technology. The right side of the brain is used to address multidimensional and interdisciplinary problems, where these problems are viewed in shades of gray and where no clear-cut answers are presented. It is through the right side of the brain that there is comfort with the chaos, contradiction and confusion that has been previously associated with entrepreneurship. For example, it is common to discover that a new venture’s technology doesn’t function as intended while also having the venture’s customers asking for functionality that the technology was never intended to perform. Solving this kind of conundrum requires art. This can be frustrating to the technological entrepreneur who may feel more comfortable within the domain of logic and analysis. There is a risk that business facts can obscure problems that are best addressed in an artful manner. Solomon (2007) cautioned entrepreneurs to avoid being caught up in the left-side-of-the-brain trap. Consequently, it is not uncommon to see successful entrepreneurs who were not successful in traditional academic studies. These entrepreneurs excel
at the artistic component of entrepreneurship that can determine the success or failure of a new venture.

**Entrepreneurship and experiential education.** Aronsson (2004) stated that you cannot teach people to become entrepreneurs without some sort of apprenticeship. For the student entrepreneur, this means experiential based education. Jones and English (2004, p. 416) believed that entrepreneurship could be best taught through “a teaching style that is action-oriented, encourages experiential learning, problem solving, project-based learning, creativity and is supportive of peer evaluation.”

To educate students in the art of entrepreneurship and in the process of cognitive adaptation, entrepreneurship education needs to include an experiential component. Early work done by McMullan and Long (1987) identified hands-on experience as a critical component in the education of the entrepreneur, if the educational program deems starting new companies to be a measure of success. This need for experiential education is also matched by student preferences. Student surveys done by Mitchell and Chesteen (1987) and Keane and Lyon (2005) show that entrepreneurship students prefer experiential activities to classic ones. While there is a student need and preference for experiential education, an analysis done by Solomon in 2007 shows that the dominant form of education for entrepreneurs today is still business plans, class discussions, guest speakers, and case studies (Solomon, 2007).

**Online Education**

Ally (2004) analyzes online education through four schools of learning: behaviorist, cognitivist, constructivist and connectivist. In an online experiential program, such as the one under study, two of these theories are more significant than the others: constructivism and connectivism. While the literature of both of these theories has been studied in depth, the extent
to which constructivism and connectivism influence the behavior of the virtual teams under study is not known. These theories are part of a set of frameworks that guided the gathering and analysis of data in the research project. Both of these theories will now be explored further. This will be followed by a discussion of situated learning (Lave & Wenger, 1990) and a sense of community. While both of these concepts are related to constructivism, their importance to the study warrants them being discussed in a separate section.

**Constructivism.** “Constructivism is probably the most dominant learning approach in online courses” (Weller, 2002, p. 65). Constructivism was shaped by the learning theorists Piaget, Dewey, Vygotsky and Bruner (Huang, 2002; Ruey, 2010). While, Piaget concentrated on individual cognitive constructivism, Vygotsky and Dewey stressed constructivism through a social environment (Ruey, 2010). In constructivist learning theory, the student constructs concepts through their personal observation and through active experimentation rather than having knowledge transferred to them from the external world or from their instructor (Ally, 2004; Dede, 2007; Mayes, 2004; Weller, 2002). This enables students to develop a deeper understanding of concepts allowing them to solve problems that they have not seen before (Dede, 2007; Mayes, 2004).

In constructivism, learning is an active process. Students are encouraged to: experiment and develop new ways of doing things, develop alternative viewpoints, test their viability, and reflect on what they have learned (Dede, 2007). They are internally motivated by their own desires and choice of direction with its corresponding challenges (Pintrich & Schunk, 2001, as cited in Dede, 2007). Often, the student’s work is project based. In constructivism, the control of the learning process belongs to the student causing the teacher to assume the role of facilitator. One of the principle roles for the facilitator is to make the student’s work meaningful. For
teachers new to the role of facilitator and constructivist learning methods, they may find that it takes longer to evaluate student’s performance (Ally, 2004; Weller, 2002). For students that are new to a constructivist process they may find it frustrating at first.

In constructivism, interaction is critical to creating a sense of community and transformative learning (Ally, 2004; Murphy & Cifuentes, 2001). Through collaboration, learners are able to draw on the strengths of other learners. Learners develop a support network that consists of relationships that are learner-to-learner, instructor-to-learner and learner-to-expert (Ally, 2004). The intensity of the learner’s interaction is strongly dependent on the intensity of the involvement of the facilitator. The facilitator needs to encourage students to discuss, argue and negotiate ideas. The facilitator also needs to provide students with both timely feedback and with a sense of support. Without this, interaction in the class may go stagnant (Ruey, 2010). While the facilitator’s intensity is important, the amount of structure in the class is also important. A balance needs to be found between a highly structured pedagogy which directs students in their tasks but stifles dialogue and a lowly structured pedagogy which provides little direction to students but stimulates their interaction (Murphy & Cifuentes, 2001).

The goal of constructivist learning is meaning making (Jonassen, Collins, Campbell, & Haag, 1995). Constructivism is a process of two sets of diametrically opposed forces. The first set of forces is articulation and reflection. Learners need to articulate what they know. While at the same time, learners need time to reflect on what they have learned. The second set of forces is social negotiation and internal negotiation. It is through social negotiation that learning is developed by comparing and contrasting ideas espoused by others. Ideas that are externally obtained then go through a process of internal negotiation where these ideas are rationalized with the learner’s own sense of beliefs.
Students do not emerge as constructivist learners on the very first day of their educational program. Collaborative learning, especially when it is delivered online, is not intuitive and must be learned (Murphy & Cifuentes, 2001). Constructivist learners go through a process. Salmon (2002, as cited in Ruey, 2010) suggested that the growth of the constructivist learner can be described in a five-stage model. In the first stage, learners gain access, establish motivation and are encouraged by their instructor. In the second stage, there is socialization among the learners. It is at this time that the culture of the learning group is developed. The third stage is information exchange. Through the use of the course materials and facilitation by the instructor, ideas are exchanged. The fourth stage is knowledge construction through conferencing and moderation. The fifth and final stage is personal development. Students go through these stages at different rates dependant on their computer literacy and their ability to learn collaborative tools. What this means is that one set of students may be still learning tools while others have moved on to learning content. Those learners with low computer system knowledge may experience learning disorientation and frustration (Murphy & Cifuentes, 2001).

**Connectivism.** As online learners, students may have two differing views of their learning experience. From a pessimistic view, students may feel a sense of isolation with the center of their interaction being their computer which is located in their home. On the side of optimism, students are connected to people and information from all over the world. In connectivism, students learn from their networked environment (Siemens, 2004). What is not known for the students under study is how connectivism will influence the students in their process of starting real companies.

Through their network connection, learners can interact with the world (Siemens, 2004). They can explore information through multiple domains where they have access to a rich set of
information and a diverse set of opinions. The students then determine what is meaningful to them. Their learning is informal, continuous and multidisciplinary (Ally, 2004; Kop & Hill, 2008). It is their interaction with their own preexisting knowledge that is important (Mayes, 2004). Cognitive development results through their connection to the network (Kop & Hill, 2008).

With their connection to the network, students do not have to know everything. Their understanding of know-how and know-what is supplemented with the ability to know-where. Their currency is having up to date and current knowledge. For them, the information pipe is more important than the content. This pipe must be maintained and nurtured. As knowledge grows and evolves the connection is more important than what is known (Siemens, 2004).

The students live in a world where chaos is a reality. As such, their capacity to know is more important that what is known. Being enveloped in reams of information, they must determine what is valid and what is no longer valid. For the students to be successful in this environment, it is critical that student have confidence and the discipline to work autonomously (Kop & Hill, 2008).

**Sense of Community**

A sense of community is an important component to learning, project execution and student satisfaction. Members of a community may participate in more that one community at the same time. This is especially true for a project based experiential program where students simultaneously participate in a classroom community and a project team community. At the classroom level, students are provided practical instruction. They learn from class materials and through discussion with the class as a whole. At the project level, students learn how to manage a project team. In doing so, they assign each other roles and responsibilities and execute a plan.
Learning happens both through practice and their mutual support which is developed based on their skill sets and experience.

In the next section, a sense of community is described and its relationship to online experiential education. The discussion starts with a definition of a sense of community. This definition will be expanded to include communities of practice that are a component of *situated learning*. From this foundation, the benefits of a sense of community will be developed. Given the benefits, methods will then be presented for developing a sense of community in the online classroom. This section will conclude with a discussion of the methodologies used in measuring a sense of community.

**Definition of a sense of community.** McMillan and Chavis (1986, p. 9) defined a sense of community as the following: “Sense of community is a feeling that members have a belonging, a feeling that members matter to one another and to the group, and a shared faith that other members needs will be met through their commitment to be together.” According to McMillan and Chavis (1986), there are four elements to their definition. These are *membership*, *influence*, *integration and fulfillment of needs*, and *shared emotional connection*.

*Membership* is a feeling that one is invested in becoming part of a group. This personal investment is an important contributor to the person’s feelings about group membership and their own sense of community. *Membership* results in a sense of belonging and identification and expectation that one fits in with the group.

The second element of the definition is *influence* which means a sense of mattering or making a difference to the group or its members. *Influence* is bidirectional in nature. The most influential people in the group are those who can share knowledge but at the same time listen and
adapt to the expression of needs, values and opinions of others. On the other hand, those who try
to dominate and ignore the wishes and opinions of others are often the least influential.

The third component of the definition of sense of community is integration and
fulfillment of needs. Through this mechanism there is a reinforcement of the behaviors that have
been established in order to be a productive group member. People choose group membership if
it meets their needs and they share the group’s values. People expect that group members will
have the skills and competence that can benefit them in some way.

The last element of the definition is shared emotional connection. This is a belief that
members will be open to sharing history and personal experiences. This sharing reinforces
member behavior and increases feelings of a sense of community.

Ten years later McMillan (1996) made some minor modifications when he reflected on
his original definition. The concept of membership was replaced by spirit as a defining principle.
With spirit, there is a greater emphasis on the spark of friendship in determining a sense of
community. The second element of the previous model influence has been replaced by the
concept of trust. Embedded in the concept of trust is a feeling of safety for group members.
Through this safety comes a willingness of members to speak freely. The third element of the
previous model, integration and fulfillment of needs was replaced by a concept called trade
which had more of an emphasis on individual satisfaction with group membership. The fourth
element of the previous model, shared emotional connection, was replaced by the concept called
art, where “art represents the transcendent values of the community” (McMillan, 1996, p. 322).

Rovai and Lucking (2000, as cited in Rovai, 2001) adapted McMillan’s 1996 model to
the classroom. In doing so, two significant changes were made to the model. McMillan’s
concept of trade became interaction and his concept of art became learning. The four elements of their model are: spirit, trust, interaction and learning.

In the concept of interaction, members achieve satisfaction through interacting with group members. As the frequency of dialogue increases, the distance between members decreases and a sense of community increases. Interactions may be task driven or they may be driven through socialization between group members. Task-driven interaction is driven under the control of the instructor. It takes the form of responses to instructor generated questions. In socialization, interaction is primarily driven by the students. This type of interaction ranges from the exchange of personal information to empathetic messages. The more that a person discloses encourages others to reciprocate with their own personal disclosures.

The concept of learning is a feeling that knowledge has been acquired by group members and the educational needs of its members are being satisfied. For the community to flourish, members must move beyond group identification to internalize and to accept or at least partially accept the goals and mission of the group. Evidence suggests that a sense of community is positively correlated to gains in academic achievement (Bryk & Driscoll, 1988, as cited in A. Rovai, 2001).

**Situated learning.** The students in the program under study are in a situated learning environment. Students are learning the craft of entrepreneurship by participating in the development of a real new venture under the guidance of their instructor who performs the role of facilitator, mentor and coach. In this apprentice form of relationship, students are learning from a community that includes their peers, their instructor and knowledgeable experts that they connect with throughout their matriculation in the program. Lave and Wenger (1990) defined this process as situated learning which has evolved from the concept of apprenticeship. The
apprentice learns by doing or in situ. The apprentice is situated in a community where the apprentice learns not only from a master craftsman but also from the entire community of practice that surrounds them.

Lave and Wenger (1990) define the characteristic process of situated learning as legitimate peripheral participation.

Learning viewed as situated activity has as its central defining characteristic a process that we call legitimate peripheral participation. By this we mean to draw attention to the point that learners inevitably participate in communities of practitioners and that the mastery of knowledge and skills requires newcomers to move toward full participation in the socio-cultural practices of a community. (Lave & Wenger, 1990, p. 29)

Legitimate peripheral participation is a social practice that is centered on the process of learning. Lave and Wenger (1990) point out that legitimate peripheral participation is more of an analytical viewpoint of learning rather than a teaching pedagogy although those that followed them created a technique called authentic learning which is a derivative of situated learning.

Brown and Duguid (1991) developed the concept of situated cognition. In their work, they proposed that learning only occurs through social interaction within groups of practitioners. The main features of this group learning are collective problem solving, displaying multiple roles, confronting ineffective strategies and providing collaborative work skills. In collaborative problem solving, groups are more than a convenient method for collecting knowledge. They are a means for developing learning through synergy and insights among group members. In displaying multiple roles, group members are afforded opportunities to play more than one role inside the group. These roles are framed by the group’s authentic learning activities. In confronting ineffective strategies, as a group, students have the opportunity to challenge what is known and the realities surrounding the problems that the group is facing. In providing
collaborative work skills students are given a situated opportunity to work and learn as a group as opposed to traditional individual methods that they have learned earlier in their education.

According to Herrington and Oliver (2000) situated learning environments have the following characteristics:

1. Provide authentic contexts that are a reflection of real life application of knowledge.
2. Provide authentic activities.
3. Provide access to experts and proven process models.
4. Provide opportunity to perform multiple roles.
5. Support the collaborative construction of knowledge.
6. Provide a process of reflection.
7. Promote student expression of learning.
8. Provide coaching and scaffolding.

Situated learning and authentic learning is related to the Zone of Proximal Development (ZPD) defined by Vygotsky. ZPD takes on a “collectivist” or “societal” perspective (Lave & Wenger, 1990). Vygotsky defined the ZPD to be the distance between current conceptual development and the learner’s potential capability that could be developed through the guidance or collaboration with more capable peers (Vygotsky, 1978 as cited in Mayes, 2004). Students learn from both support and practice. In a ZPD learning environment, students engage learning activities that model real world situations. Students are guided by an expert, who may be their instructor, tutor or facilitator. An environment is created where structured interaction can happen
between the students. As a result, control of the learning environment is increasingly passed to students (Mayes, 2004).

ZPD is developed through a process of scaffolding. In the scaffolding process, a tutor or instructor develops an outline and models that can guide the students and provide an environment for students to take control of their own learning process. Tutors need to balance their role as an expert with the student’s desire to participate and learn from their own practice (Mayes, 2004).

Why is a sense of community important to online learning? Building a sense of community is critical to the success of the online classroom. The benefits of a sense of community start with an increased flow of relevant information. With this increased flow of information, students feel less isolated and as a result, a stronger bond develops between them which results in reduced feelings of isolation (Slagter van Tryon & Bishop, 2009). Through a sense of community, students perceive greater cognitive learning and as a result transformational learning occurs when students confirm what they have already learned (Ally, 2004; Murphy & Cifuentes, 2001). In an online environment this is normally accomplished through the use of asynchronous discussion boards.

Through an increased sense of community students have a greater commitment to the goals of the educational program. This increases their level of cooperation (Rovai, 2002b). It reduces attrition levels and it decreases student burnout that can occur in an online environment. The end result of the process is an increased level of student satisfaction (Rovai, 2002b; Shea, Li, Swan, & Pickett, 2005).

Developing a sense of community in an online environment. A shared faith in the other people in the class is a cornerstone of a sense of community (Ke & Hoadley, 2009).
Students want to have confidence that others in the class can help them learn and meet their objectives. In doing so, members of the class must have shared objectives. It is through these shared objectives that students can move from an outsider to an insider perspective. This shared faith in others is easier to nurture if members of the class have similar backgrounds, experience and commitment (Conrad, 2002). Mixing students with very dissimilar amounts of experience could be problematic. For the adult learner in an experiential program, this is measured by industry experience.

A sense of community is a social experience and therefore it is dependent on the social ability of both the students and their instructor. Students must learn protocols and etiquettes for promoting interaction between each other that builds respect. For online discussion board postings, these protocols should include the number of messages, the length of messages, contributing new ideas, helping others, and the degree of empathy in the interaction (Ke & Hoadley, 2009).

Students do not start naturally with a sense of community on the first day of a course or a program. It must evolve (R. Brown, 2001; Ke & Hoadley, 2009). According to Brown (2001), this evolution occurs on three levels. The first level is making friends with people that the student feels comfortable communicating with. Some students will gravitate to making contact with students with similar backgrounds, interests or circumstances. The second level is community conferment. Students become members of the community after participating in long thoughtful threaded discussions in which the students feel a sense of personal satisfaction and kinship to others in the class. The third level is camaraderie which can be established after a long pattern of personal and intensive communication (R. Brown, 2001). This evolution of a sense of community is different for new and experienced online students. New online students start with
mastering the technology. They then move onto teaching methods and course content. Only after doing all of this do they move on to community building. For the experienced online student, the evolution begins in just the opposite order. The experienced online student starts with community building first and then moves onto course content, teaching methods and finally technology (R. Brown, 2001; Conrad, 2002).

Both the student and the instructor contribute to the building of a sense of community. Students must allocate sufficient time for class discussion. They must have a desire to be part of a sense of community and lastly they must place a high-priority on class interaction (R. Brown, 2001).

For the instructor, the interaction among the class is heavily dependent upon their presence in the class. Instructors need to model their behavior on what they expect from their students. If an instructor is missing for a prolonged period of time interaction in the class will go down (Dixson, 2010).

Instructor behavior is critical to the development of a sense of community (Shea et al., 2005). Instructors must provide collaborative activities and also provide students with regular and timely feedback. Instructor feedback on discussion boards must be balanced in that it both challenges students while at the same time provides them with respect and encouragement that will stimulate even more discussion from the class (Dixson, 2010). Instructors also need to balance structure with the student’s need for autonomy. A highly structured environment decreases intrinsic motivation resulting in poorer attitudes and poorer student performance. (Wighting, Liu, & Rovai, 2008). At the beginning of a program, students need to be given the opportunity to observe and learn the social characteristics of others and they need to be given opportunities to learn the communications technology (Slagter van Tryon & Bishop, 2009).
Instructors must promote an environment of group cohesiveness (Conrad, 2002). This starts with creating a class atmosphere that promotes openness, respect, and trust (Dixson, 2010). Students must feel safe to voice their opinions (Slagter van Tryon & Bishop, 2009). In voicing their opinions, students need to overcome the permanence that is involved with the use of discussion boards (Conrad, 2002).

**Measuring a sense of community.** Now that it has been established that a sense of community is desirable, how does one know if they have it and to what degree they have it? Two methods that could be used to measure a sense of community are through the discussion board postings (Preece, 2001) and through a survey (Rovai, 2002a). Discussion board postings are a means to measure the degree of interaction within a class. While this may be relevant to a particular class, it does not provide a more universal measure that can be used to compare different environments or measure how environments may change over time in a longitudinal study. The latter can be better accomplished through a survey instrument.

Preece (2001) suggests three discussion board measurements that can be used to measure class interactions.

1. The first measure is related to purpose. This can be measured by tracking the number of messages per active member. This is an indicator of how well the community serves his purpose. But it says nothing about the quality of the social interactions or whether these interactions are on-topic.

2. The second measure can determine the type of interactions. This can be done by measuring the thread depth. Typically, empathetic discussions have a very deep thread depth. On the other hand, discussions that are largely factual will have a much more narrow or shallow thread depth.
3. The third measure is related to reciprocity. This is a measure that examines giving as well as taking from the community. This can be measured by the ratio of the number of questions that an individual asks compared to the number of responses that they make.

These measures may be difficult to obtain and practice. Additionally these measures say nothing about the quality of the postings. The quality of the postings could be determined by the instructor but a much better method might be to have the quality measured by the students themselves. Preece (2001) suggests that this can be done through a rating scheme similar to Amazon’s reader’s ratings or through something similar to eBay’s reputation management. But both of these schemes are impractical to use in a classroom environment.

Rovai (2002a) suggests that a classroom community could be measured through a survey instrument. He developed a 20-measure survey to determine a Classroom Community Scale. Through a review of the literature, 40 items were selected to be evaluated for content validity. These 40 items were evaluated by three university professors who taught courses in educational psychology. Their evaluation and refinement pared the list to 20 items. One further refinement resulted in a reordering to avoid a response due to sequential placement of the survey measures. The survey was tested by collecting data from 375 graduate students enrolled in 28 different courses using the Blackboard e-learning system. Rovai (2002a) concludes that the classroom community scale is both a reliable and valid measure of classroom community. The survey produced two interpretable factors: connectedness and learning. These two items are distinguished through a pattern matrix. The survey and the pattern matrix are shown in Appendix E.
Virtual Teams

The research questions are explored through observation of an online experiential education program for technological entrepreneurs where students create a new venture as part of their experiential education working in teams of three to five students. Students are separated by both time and distance and work 100\% online never meeting face-to-face. Their work is sometimes ill defined, complex and highly interdependent. They communicate exclusively through their computer or through their phone. Information is shared using a variety of tools such as e-mail, discussion boards, wikis, web conferencing, instant messaging, document sharing, and collaborative document generation. In the literature, this is frequently referred to as Information and Communications Technologies (ICT) (Dede, 2007). Teams that work in this type of communications environment are referred to as virtual teams.

ICT is available to both virtual and traditional on-the-ground teams. However, virtual teams are denied some communications that happen exclusively on the ground. Remote communication does not allow virtual team members to see the non-verbal cues that happen face-to-face. These cues transfer valuable information that helps one to determine agreement or disagreement. While web cam technology may provide some mitigation, this is still an issue. Remote communications is done principally asynchronously. In this communications mode, team members cannot hear the pauses that happen in a synchronous meeting that are used to determine the ebb and flow of a conversation. Lastly, virtual student teams do not partake in casual ad-hoc meetings that can occur on the ground before or after class or in campus common areas (Montoya-Weiss, Massey, & Song, 2001). All of these can change one’s interpretation of the situation.
Asynchronous communication technology presents a unique set of challenges. While this technology can enable a continuous flow of communication, there are inherent delays in responses. When the delay is long, team members begin to wonder what the “silent” member is doing. Engaged team members then start to question the contribution and motives of the silent ones. This can create an air of mistrust (Jarvenpaa & Leidner, 1999; Piccoli & Ives, 2003). Some of the “silent” problem can be mitigated through the use of synchronous communication. However, scheduling and coordinating synchronous communication with the virtual team can be difficult given the demands of the student’s academic, professional, and personal lives.

To answer the primary research question “what processes do online student teams undertake in the development of new entrepreneurial ventures?” the growth and effectiveness of the virtual team needs to be explored. This exploration is done in three major themes: team development, the evolution of trust in the virtual team, and conflict management. Each of these topics will be explored in more detail.

**Virtual team development.** Team effectiveness is one barometer of team development. Team effectiveness, virtual or physical is defined as a combination of team performance and their member’s individual satisfaction (Shachaf & Hara, 2006). The first measure of effectiveness can be measured is the quality of the team’s work product. For the student teams in this study, this product is the business plan for their new venture. The quality of this task can be measured by their instructor’s grade, outside review and student self-assessment and measuring. The second measure of effectiveness, satisfaction, can be determined through interviews or surveys. Team effectiveness will be used as a means of determining the effectiveness of their work processes.
Teams have a life cycle and develop in stages. In each stage, there is increasing effectiveness and individual satisfaction. However, not all teams reach the most mature stage of development with the highest level of performance. Thus, these stages can be used as a framework to describe a team’s performance and serve as a guide for a grounded theory exploration of their performance.

The two theorists who have characterized the life cycle of teams are Tuckman (1965) and Gersick (1988). Tuckman’s stage model of development is characterized by teams maturing through a distinct set of stages which over time have become named: forming, storming, norming and performing. He developed this model by researching 50 articles that described group development over time in therapy groups, training groups and natural groups. He was able to correlate observed stages of development to his model. Almost 25 years later, Gersick developed a model of “punctuated equilibrium” to describe team behaviors and the way they approach their work. In this model, teams alternated between periods of inertia punctuated by a transition. This model was developed through detailed observation of eight heterogeneous teams over periods ranging seven days to six months. Both models were applied to a study of virtual teams by Furst, Reeves, Rosen, & Blackburn (2004). Both the work of Tuckman and Gersick can be used as a framework for describing a team’s behavior whether they are virtual or physical. Both models will be described in more detail and at the same time the virtual team application work of Furst et al. (2004) will be incorporated.

**Tuckman’s stage model of team development.** In Tuckman’s stage model of team development, Tuckman identified four stages of team development which he referred to as Stage 1, 2, 3 and 4 which over time have been come to be known as forming, storming, norming and performing. Tuckman studied interpersonal issues and problem solving activities. He assumed
that all teams go through these four stages of development in a linear fashion and that each stage represented a point in the team’s development. He further assumed that most of the team’s work would be done in the last stage: performing (Gersick, 1988; Tuckman, 1965).

Team development starts with the forming stage. Team members get to know each other. They begin to size up the task and the goals for the team and at the same time they start to gauge the trustworthiness of other team members based on conversation and observation. For physical teams, part of the trust development comes from the informal social interaction that happens before and after meetings or around the coffee pot, water cooler, lunchroom or other common areas or activities. For the virtual team, the forming stage is much different than in a physical team situation. Developing trust is much more difficult as the opportunities for informal interaction are much less and the opportunity to form unjustified stereotypes is much higher (Furst, Reeves, Rosen, & Blackburn, 2004; Tuckman, 1965).

The second stage of team development, called storming is characterized by intragroup conflict. Group members probe to discover similarities and differences. Individuals react emotionally to a tension between the demands of the task upon them and their own personal orientation to the task. Informally, this has been called signing up for the task. For the virtual team, the lack of social context and the inability to see and hear personal cues such as body language and facial expressions make resolving these conflicts more difficult and as such the storming period may be longer with the virtual team. Unresponsiveness to electronic communication will exacerbate feelings of mistrust which increases conflict among the team (Furst et al., 2004; Tuckman, 1965).

The third stage of team development, called norming, is characterized by the development of group cohesion. The group focuses on harmony and conflicts are avoided. Team
members either adapt or accept individual idiosyncrasies. A plan emerges through the team developing consensus around task assignments, schedules and team processes. Relationships between team members are strengthened. For the virtual team, the challenge is to create reliable communications between team members and a shareware infrastructure for sharing project information. Pair-wise communication between team members or not sharing information with all team members could be detrimental to the group. Virtual team members may withhold critical information from the group if they deem it to be personally embarrassing or if it will spark conflict in the group (Furst et al., 2004; Tuckman, 1965).

The fourth stage of the model is called performing. At this point, team members understand and have adopted their roles and have learned to interact with each other as social entities. There is an emphasis in the group on constructive progress on tasks by identifying and solving problems. Team members help and encourage others. For the virtual team, communication is a challenge for the group to maintain synergy. The use of asynchronous communications technologies can slow progress (Furst et al., 2004; Tuckman, 1965).

Gersick’s punctuated equilibrium model of team development. In contrast to Tuckman’s view of team development, Gersick saw team development as a series of transitions. Gersick observed teams move from a period of stability through a transition to another period of stability. Thus, Gersick’s team development theory has become known as “punctuated equilibrium.” This theory is described by phase 1, transition, phase 2 and completion. But Gersick did not believe that teams uniformly developed in linear stages as suggested by Tuckman. Gersick also observed that teams developed differently which he said could be attributed to outside factors on the team (Gersick, 1988).
Phase 1 of team development begins with the very first meeting. Gersick points out that this first meeting is very important to the team’s development. At this meeting, the team begins to develop a framework for their project work and unlike Tuckman’s model, work may actually begin. Without having social contexts, work agreements and a detailed understanding of their tasks, this initial framework tends to hold back team performance during this phase. Bits and pieces of work are done that lay the groundwork for higher performance in Phase 2. Team behaviors are similar to those identified by Tuckman in the forming and norming stages of development (Furst et al., 2004; Gersick, 1988; Tuckman, 1965). Since the first team meeting has been identified as important to a team’s development, this creates a challenge for the virtual team for previously stated reasons.

All of the teams that Gersick observed went through a transition halfway through their project life. Gersick was unsure why this happened at exactly the mid-point of the teams life-cycle and could only draw the analogy to the mid-life crisis in human beings. Gersick speculated that the time pressure of the group’s schedule was a major force causing the transition. The transition represented a revolution inside the group where the previous framework that was holding the group back is discarded and a new framework is developed which results in higher group performance (Gersick, 1988). For the virtual team, the challenges of distance, time and communications technology can make the transition period difficult.

After the transition period, the project team entered another stable period known as Phase 2. The behaviors inside the team approximate the behaviors of Tuckman’s norming and performing stages of team development (Furst et al., 2004).

The completion phase is characterized by team meetings that are used to prepare deliverables to the external environment. Discussions about outsider expectations are prominent.
Much of the activity during this time is editing material as opposed to generating new materials. The team learns to accept both the positive and negative consequences of their past decisions. Additionally, groups may express both positive and negative feelings about working together (Gersick, 1988). For the virtual team, the completion phase requires an intense amount of detailed coordination which may be difficult to deliver for the same previously stated challenges of time, distance and communications technology.

The evolution of trust in the virtual team. Trust has a positive impact on cooperation and team performance especially when tasks are highly interdependent. It affects team member commitment, their mutual support, and their excitement for their project and enables the formation of relationships (Jarvenpaa & Leidner, 1999; Robert Jr., Dennis, & Hung, 2009). Trust allows team members to fill in the gaps for what is not known about a person or a situation. It has a direct effect on outcomes (Jarvenpaa, Shaw, & Staples, 2004). Trust can be defined as the:

…willingness to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control the other party. (Mayer, Davis, & Schoorman, 1995, p.712 as cited in Jarvenpaa, Shaw & Staples, 2004)

Reina and Reina (2006) developed a model of trust and betrayal. In this model, trust develops through singular actions of individuals. The initial trust that is developed is called transactional trust and is of a temporary nature. Repeated actions of transactional trust lead to a more permanent trust called transformative trust. Reina and Reina (2006) describe three types of transactional trust: competence trust, communication trust and contractual trust.

Competence trust is a willingness to depend on others because they have the appropriate knowledge and skills which can be beneficial. An example of competence trust behavior is asking the advice of others. Competence on the student virtual team is measured largely by the student’s prior relevant experience. When student teams are formed from the constituents in a
cohort class, the competence on the team is determined by both the member selection process and the overall competence of the cohort which is determined by the program’s admission criteria.

Communication trust is established by speaking with proper purpose. Communication trust is reduced when there is gossip and it is increased when team members admit they have made a mistake. This is critically important in an online environment since asynchronous communication done through e-mail and threaded discussions are permanent.

Lastly, there is contractual trust. This is based on managing expectations and keeping agreements. Team member reliability is critical in the online environment where you cannot see your team members. Trust is built through accomplishing single tasks in a manner that meets the expectations of others.

Given the above definition and model, one would think that trust would develop slowly over time. McKnight, Cummings and Chervany (1998) point out that this view is consistent with several trust theorists. However, they also point out that paradoxically high levels of trust have been observed right after the formation of a team. Individuals come to the team with some level of a predisposition to trust. Individuals have a predisposition to trust based on three factors: personality-based trust, institution-based trust, and cognition-based trust. Personality-based trust develops in childhood when the infant receives help from their caregivers. Institution-based trust is derived from ones feelings about the situation and its inherent security. Lastly, cognition-based trust is derived from first impressions.

The initial trust established by team members is called swift trust (Jarvenpaa & Leidner, 1999; Jarvenpaa et al., 2004; Robert Jr. et al., 2009). Since individuals do not have any
understandings of the team members, this trust is temporal and fragile. Stereotypes, cultural identity and group categorizations may play a role in the formation of *swift* trust.

Using Gersick’s Punctuated Equilibrium Model, Jarvenpaa et al. (2004) developed a trust model that characterizes *swift* trust. In this model, they describe team behavior as totally dominated by *swift* trust from project inception to Gersick’s mid-point *transition*. After the mid-point, team member’s start to develop a *knowledge*-based trust using *swift* trust as its initial basis. *Knowledge*-based trust is determined through a cognitive assessment of the perceived abilities of team members, their integrity and their benevolence.

*Swift* trust is particularly relevant to online learning and the research project. When many students first join the program, they are returning to education after many years of working on their professional career. Additionally, Integrated Communications Technology, ICT, may be new for many of them as well. They perceive using this new technology as an additional risk to their educational performance. As a result, they may experience confusion, frustration and anxiety. Consequently, students will work to limit taking on any additional risk. Only when their trust is greater than the perceived inherent risks will the student engage in taking on additional risk that is inherent in building relationships. Building these relationships can be difficult using asynchronous communication technology since there is a time lag between responses. This time lag decreases the amount of trust and inhibits its formation.

Jarvenpaa and Leidner (1999) suggest a number of behaviors that can have the effect of increasing both the early formulation of trust and the formulation of trust later in the project. These behaviors are:

1. Social communication. Early social communication tends to increase trust.

2. Communication conveying enthusiasm.
3. Coping with technical and task uncertainty. Teams that can develop methods to work around problems will have a higher level of trust.

4. Individual initiative. Teams that have members that will propose solutions as opposed to continually discussing the same problems over and over again have higher trust.

5. Predictable communication. Teams that develop communication patterns that are consistent with their own schedules have increased trust.


7. Leadership. Virtual teams that have a leader will have a higher sense of trust.

8. Transition from procedural to task focus. Teams that can move beyond process agreements to work on their tasks will have a higher level of trust.

9. Phlegmatic reaction to crisis. Crisis can occur in a virtual team when there is a change in the division of work, communication patterns change or there are late team member contributions. Teams that can remain calm and work through these issues have a higher sense of trust (Jarvenpaa & Leidner, 1999).

**Conflict management in virtual teams.** In addition to affecting team development and trust, separation by distance and time creates conflict management challenges. How the team manages conflict is an important indicator of their overall performance. The same communication problems that hinder the development of trust also help to create conflict and hinder resolution (Montoya-Weiss et al., 2001). Conflict can arise in resolving temporal coordination problems such as the allocation of resources, synchronization of tasks, scheduling and meeting deadlines (Montoya-Weiss et al., 2001).

Thomas (as cited in Montoya-Weiss et al., 2001) identifies five conflict-handling behaviors: *avoidance, accommodation, competition, collaboration* and *compromise*. Each of
these behaviors may have a different effect on the virtual team performance. *Avoidance* behavior is characterized by an apathy towards conflict and the outcomes of the teams work. Team members maybe evasive or they may fail to confront other team members when they have a disagreement. This behavior manifests itself as nonparticipation or no response (Montoya-Weiss et al., 2001). For the virtual team where delays are the norm this behavior could be hard to discern. *Avoidance* behavior has a negative effect on virtual team performance. *Accommodation* is an obliging concern for others. This also has a negative effect on virtual team performance. *Competition* behavior is characterized by one pursuing their own interests at the expense of others or forcing their views on the other members of the team. At a first glance one might think that this behavior would have a negative effect on team performance but in practice this behavior may actually increase team performance if the other members are willing to go along. This behavior can be seen as a welcomed relief if the team is having difficulty in making progress. *Collaboration* behavior is characterized by attempts to integrate the views and the work product of all of the team members. There is an openness to the views of others, a sharing of information and a desire to reach a optimal solution produced jointly. *Collaboration* behavior increases team performance. Lastly there is *compromise* behavior where there is only an intermediate concern for self and for others. Team members acknowledge differences and settle for a middle ground solution. Compromise behavior increases team performance.

Hinds and Bailey (2003) identify three sources of conflict for the virtual team. They are task conflict, affective conflict, and process conflict. Task conflict represents disagreements over the group’s work product. Task conflict reduces a virtual team’s performance and it increases with complexity. Affective conflict is an emotional conflict characterized by anger and hostility towards others. Affective conflict has a negative effect on the virtual teams performance but this
is less likely to occur in the virtual team because friendship relationships, which are generally required for affective conflict, have not been developed that deeply. Lastly, process conflict is a disagreement over how the group is going to accomplish its task. Process conflict also detracts from the virtual teams performance. This conflict might be more difficult for the virtual team to resolve since any confusion about resources and responsibilities has to be resolved through problematic communication channels.

Distance has a negative effect on the development of: a shared context, familiarity, friendships and homogeneity. Each of these factors will heighten conflict for the virtual team (Hinds & Bailey, 2003). Each will now be described further.

A shared context is the common understanding that surrounds the project or project team. On-the-ground teams may derive a shared context through a common physical environment where they share both a physical context and have an opportunity to casually meet each other. A shared context includes norms which include the establishment of a shared work rhythm for coordination of the project. This shared rhythm is a powerful coordination mechanism. Without a shared context, team members may have difficulty establishing a mutual understanding resulting in a higher likelihood of process conflicts.

Familiarity within a team increases over time when the team is co-located. One of the benefits of collocation is the casual and unplanned conversation that increases familiarity which reduces coordination problems and also process conflict. Familiarity is lower in virtual teams since they tend to pass less information on to their distant colleagues.

Hinds and Bailey (2003) state that when there is homogeneity in a team, there is less conflict. They speculate that virtual teams are more heterogeneous than on-the-ground teams. For student virtual teams this may not be true.
Virtual teams use ICT to mediate the effects of time and distance (Hinds & Bailey, 2003). For the virtual team, technology mediation is just as likely to increase conflict as reduce it. As ICT becomes more advanced in its capabilities, conflicts may arise as team members struggle to learn the new technologies. Even with technology mediation, teams still have reduced social presence and cues when compared to on-the-ground teams. For some team members, a feeling of not being there may actually be enhanced through ICT resulting in increased affective conflict. Additionally, this feeling may inhibit team members from sharing the relational information that is needed to reduce conflict. When sharing information through ICT, there are risks that some team members will be excluded from receiving either all the information or communication. If this exclusion occurs, there will be an increase in conflict. When ICT is used for project coordination there are still inherent asynchronous delays which can cause conflict.

Conflict within the virtual team can be mitigated several additional ways. Montoya-Weiss et al. (2001) and Hinds and Bailey (2003) suggest different methods. Montoya-Weiss et al. (2001) state that temporal coordination mechanisms can reduce conflict in virtual teams. They define a temporal coordination mechanism to be a process structure that is used to direct the pattern timing and content of communication within a group.

Hinds and Bailey (2003) suggest three mechanisms to mitigate conflict. First the teams can meet face-to-face. But for the online team this is not an option. They also suggest that the team should make an effort to share the context that surrounds them. Simple information like sharing vacation schedules would be helpful. Lastly they suggest that the entire team use similar tools and learn how and when to use them. For example, it what situations is it better to send an e-mail, make a phone call or schedule a web conference.
Time is another force that will tend to mitigate conflict within the virtual team. The longer a virtual team meets the less likely there will be conflicts. Over time, teams will generate a shared identity which helps them to bridge distance by creating a psychological tie between team members. They will also gradually become more experienced in the communication technology thus reducing both frustration and conflict.

In virtual teams, handling conflict can be difficult. If team members decide not to collaborate to resolve their conflict they will have to use approaches such as avoidance, competition, compromise, or some combination. Each of these approaches can leave team members frustrated with the outcome (Thomas and Kilmann, 1974, as cited in Hinds & Bailey, 2003). To foster collaboration there must be trust, mutual respect, and cohesiveness. These factors are similar to those needed to develop a sense of community. While collaboration behavior is much more difficult using computer mediated communication as opposed to meeting face-to-face, when virtual teams successfully deal with conflict collaboratively, stronger bonds emerge.

**Chapter 3: Research Design**

**Research Questions**

The research involves the exploration of a number of issues. Beginning broadly, the processes by which on-line teams engage in the development of entrepreneurial ventures are documented. The exploration of a secondary set of questions grew out of this larger context. Primarily, the study is concerned with questions of community building, conflict resolution, and the overall development of intra-team trust. The research questions which guided this inquiry are as follows:
**Primary question.** What processes do online student teams undertake in the development of new entrepreneurial ventures?

At a detailed level, the processes that online students use in the creation of entrepreneurial ventures is not understood nor is it characterized. Through the evaluation of these processes, a qualitative understanding of the efficacy of the online program can be determined. These processes represent the core learning for the educators involved with this program. They form the basis for process knowledge that can be exported to other universities around the world.

**Secondary questions.** How do online student teams participating in the development of an entrepreneurial venture (a) establish a sense of community, (b) create and develop a culture of trust, and (c) resolve conflict?

When starting a new enterprise or venture, organizational behavior and culture may be just as important to the success of the venture as development of its technology or the acquisition of its customers. By answering these questions, the effect of the online environment can be observed and evaluated. Additionally, these questions facilitate the development of strategies to mitigate the effects of the online environment on the student teams.

**Tertiary question.** What is the theoretical framework that characterizes student behavior in an online program in technological entrepreneurship?

Through the development of a theoretical framework, a better understanding of the behaviors and motivations of the students is developed. Through this understanding, the educational program can be improved to better meet student needs. The theoretical framework will also serve as an aid to assist practitioners outside of the field of technological entrepreneurship to determine the relevance of the findings for their own educational programs.
Methodology

This research project uses grounded theory. Before describing the research project’s methodology, grounded theory will be described and a rationale for its choice will be presented.

Grounded theory. “The grounded theory approach is a qualitative research method that uses a systematic set of procedures to develop an inductively derived theory about a phenomenon” (Strauss & Corbin, 1990, p. 24). Through the application of grounded theory a theoretical formulation is constructed of the reality under study. Concepts and the relationships between them are developed and provisionally tested during the study. The purpose of grounded theory is to build a theory within the field of study that will have practical application (Strauss & Corbin, 1990).

Grounded theory was first created in 1967 by Glaser and Strauss (Glaser & Strauss, 1967). This theory was first applied in their studies of people’s behavior when dying. For example, one of their research questions was why terminally ill patients prefer to keep their illness a secret. At the time of their work, research was dominated by positivist quantitative research. Methods deployed concentrated on the scientific method, generality, hypothesis and theory. This was in stark contrast to the qualitative methods of the day (Charmaz, 2006). In grounded theory, Glaser and Strauss combined different philosophies. Glaser’s roots were in the positivist movement that existed at Columbia University at that time. On the other hand, Strauss was from the University of Chicago which was strongly influenced by the pragmatist views of John Dewey (Charmaz, 2006). Dewey believed that ideas, sensations, mental states and cognitive significance were all representative of one another (Dewey, 1905). Strauss’s work was also influenced by Herbert Blumer’s work on symbolic interactionism that assumed that people think about their actions rather than mechanically responding to external stimuli. Strauss added an
element of human agency, problem solving practices and open-ended study to grounded theory to balance the more scientific methods proposed by Glaser (Charmaz, 2006). Together, Glaser and Strauss brought the use of scientific methods to qualitative research.

While both Glaser and Strauss believed that the application of grounded theory should be flexible, after their original work, Glaser eschewed some of the methods being proposed by Strauss. In particular, Strauss advocated more rigor in categorization of coded data while Glaser believed that this rigor was in conflict with the openness espoused in grounded theory. The methods being proposed for this study are in line with Strauss and Charmaz (2006) who studied under both Glaser and Strauss. These methods are more focused and are the most appropriate for evaluating a business problem in contrast to a more open method that would be more appropriate for studying problems in health sciences. In the end, either method would work in either application. It comes down to a matter of personal choice.

While grounded theory is an open approach aimed toward producing theory, surprisingly the grounded theory methodology is formal and has a rigorous set of canons and procedures. Grounded theory researchers must blend a compromise between the flexibility that is needed for their research project and the rigor that is required in the grounded theory methodology. Corbin and Strauss (1990) suggest a number of canons and procedures:

1. *Data collection and analysis are interrelated processes.* Unlike traditional qualitative and quantitative methods, in grounded theory, data is analyzed right from the very first time a piece of data is collected. Data collection is not standardized. The analysis of current data influences the collection of future data.
2. *Concepts are the basis unit of analysis.* Grounded theorists deal with concepts and not the actual data per se. Data points such as events and incidents are deemed as indicators of a phenomena and are assigned conceptual labels.

3. *Categories must be developed and related.* Categories are created which are containers for concepts. These categories become the “cornerstone” for developing a theory.

4. *Sampling proceeds on theoretical grounds.* Sampling is not done based on drawing samples from specific groups but is based on concepts, variation, properties and dimensions which may require more investigation.

5. *Analysis makes use of constant comparison.* Just as data is analyzed as it is gathered, concepts and categories are constantly being compared in order to gain a greater precision for what future data needs to be gathered.

6. *Patterns and variations must be accounted for.* The researcher must look for patterns that support emerging theories and any variations in these patterns must be accounted for. This is done during the data gathering process as opposed to later in the process when the final report is written. These variations will help lead to more specific data that needs to be discovered.

7. *Process must be built into theory.* Grounded theory consists of process analysis. To the grounded theorist, process has several meanings. A phenomenon could be analyzed as a process that occurs in stages or steps or it could be examined through cause and effect relationships that may change over time depending on conditions.

8. *Hypotheses about relationships should be developed and verified as much as possible during research process.* Hypotheses are derived by looking for relationships
between categories. This is done during the research process before writing a draft of the research findings (Corbin & Strauss, 1990).

Grounded theory coding techniques are different from those found in traditional qualitative studies (Charmaz, 2006; Corbin & Strauss, 1990; Strauss & Corbin, 1990). These techniques are designed to start with a wide open view of the problem under study and to work towards synthesizing and categorizing this data in such a manner that theories can be produced through a process of induction. Coding takes place in a series of hierarchal phases.

The first phase is open coding. In open coding data is coded at a very detailed level. Grounded theory researchers may code at a line-by-line, word-by-word or incident-by-incident level. Data items are given conceptual labels and are constantly compared to other data items. Eventually concepts are sorted into category and sub-category containers (Corbin & Strauss, 1990). Chramaz (2006) suggests that this be followed by focused coding where the codes that are most significant to the field of study are identified.

The second phase of coding is axial coding. In axial coding, categories are related to each other and their relationships are tested against the data. Through the use of axial coding, data that was fractured during the open coding process becomes coherent (Charmaz, 2006; Corbin & Strauss, 1990).

The last coding phase is called selective coding (Corbin & Strauss, 1990) or theoretical coding (Charmaz, 2006). This phase is similar to axial coding but is done at a much higher level. The substantial codes that emerged during focused coding are woven together to form a hypothesis. Selective coding has families of containers some of which are causes, contexts, contingencies, conditions, degree, dimension or interactive (Charmaz, 2006).
**Grounded theory rationale.** Noticeably absent from this document is a discussion of a theoretical framework. In choosing grounded theory as a research method, a theoretical framework is constructed as a result of the proposed research. Prior to making this decision, adult learning theory and socio-cultural theory were explored.

In adult learning theory, learners are autonomous and self-directed. They bring to the classroom knowledge and experiences that have been accumulated over their lifetime. As adult learners, they bring a specific set of goals and objectives to an educational program. For the adult learner to thrive and succeed, the educational program must not only help them to achieve these goals but also show them the usefulness of the knowledge they have acquired in their professional careers. The learning environment is critical to the needs of the adult learner. They must feel comfortable that when they voice their views that they will be listened to and treated with respect (Knowles, 1973a, 1973b).

Socio-cultural theory was developed by Vygotsky. He placed an emphasis on learning through social interaction. This learning occurs through a Zone of Proximal Development where the learner expands what they know from collaborative problem solving and learning from more capable peers (Miller, 2002).

While the research project has elements of both adult learning theory and socio-cultural theory, the problem of practice and the research questions themselves led to an exploration of the unknown which is best done using grounded theory. The problem of practice involves using experiential education to teach technological entrepreneurs in an online modality. A market research study from Eduventures (2008) concluded that there were no universities doing this type of activity. My professional experience as an entrepreneur and as an entrepreneur educator has not revealed any similar program either. As a result, the phenomenon being studied is unique
with no direct research to be drawn from. While the research study draws on theoretical work in entrepreneurship education, online education, virtual teams and sense community, it is uncertain as to how these will influence or interact with the phenomenon being studied.

The research question “What processes do online student teams undertake in the development of new entrepreneurial ventures?” infers a study more driven by the exploration of the unknown than from existing theoretical frameworks. Since the processes used by the students are largely unknown, the objective of the study is to generate a theory that will describe and categorize their behavior.

**Approach.** Four student teams were studied as they went through the processes of starting a company. They were studied for a period of one year from their initial formulation through their dissolution. In the TC program, teams are guided through a general process scaffold. To the students, this appeared as a four-course sequence delivered over a year where they are supplied syllabi, lectures and other course materials. The exact governance of the team is left to the students to customize to their own preferences. At the beginning of the four-course sequence, students bring or create their own idea for starting a company. As a class, students evaluate these ideas and through a process of voting choose the ideas, which they believed, had the most promise for starting a company. At this point, students state their individual project preference. Guided by their instructor, students are assigned to teams. Once teams are formulated, they matriculate through a classical technology commercialization process by developing product requirements, building a prototype, performing customer validation and developing a business plan and an investor presentation.

**Site and participants.** Students in a master of science in technology commercialization program (TC) at a large private university in the northeast were used as a test bed. To date, this is
the only online program of this nature that contains an intensive experiential component making this the only test bed available.

TC students are adult learners. As such, they all have jobs and as typical adult learners they mix the challenges of their personal, professional and academic lives. For admission to the TC program, a minimum of five years work experience is required. Previous students have selected this program to either help reinvent their career or to learn how to start a company of their own. The career intentions of these students under study were explored.

All four teams in the fall of 2010 cohort were evaluated. The experiential program ran from September 2010 to August 2011. Some students started taking academic courses prior to September 2010. There are 17 students in the cohort ranging from 26 to 48 years old with the average being 37.3 years. There are 16 males and 1 female in the class. Ten students classify themselves as white, five as Asian and two as Hispanic. The student class is geographically dispersed: Barcelona-1 (Massachusetts resident taking an overseas assignment), Boston area- 3, California-2, Florida-1, Illinois-2, Minnesota-1, Mississippi-1, North Carolina-1, Oregon-1, Texas-2, Washington-1, and western Massachusetts- 1.

The class under study was divided into four teams each consisting of four to five students. As part of the research project, students were asked to participate in quarterly surveys and in one-on-one telephone interviews. Additionally data was received through access to the class Blackboard website, the class Ning and the student’s project website. Through these, the researcher had access to student postings and their project data. However, this was only a subset of all of the communications that happen between students. For example, the researcher did not have access to student’s e-mail, phone calls or weekly meetings.
Data collection. To answer the research questions, data is needed about the inner workings of the team and how the online environment affects the development of their work product and their level of satisfaction with the educational program. Data is also needed about their sense of community, how they approach and resolve conflicts and the feelings that they have for one another. Since the task complexity is high throughout the program, the teams often hit roadblocks to their progress. Data is needed about how the team realizes that there is a roadblock and how they work around it.

The TC program is split into four calendar quarters. The design for the research project is shown in Figure 1. An initial survey was done at the beginning of the four-course sequence. At the conclusion of each quarter, students were also interviewed and surveyed. The interviews employed predetermined questions. The questions were open ended to allow the students to drive the discussion in many directions.

The following data was collected:

1. Biographical sketches. This data includes work experience, entrepreneurial experience, family entrepreneurial experience, future career plans, and a self-assessment of business skill sets. This was obtained through the initial survey, a student profile form, their resume, and blog postings on the class Ning. The initial survey is shown in Appendix B.

2. Observation of student discussion board and class Ning. Discussion board postings were read weekly and summarized in field notes. This data was necessary to get the overall “feeling” of the class while it is happening.

3. Observation of student weekly reflections. Each week, students were required to post a reflective summary of their experiences. These postings can include
accomplishments, frustrations, challenges, activities in their personal life, etc. Weekly reflection postings are a component of the student’s participation grade.

4. Student interviews. All students were interviewed at the end of each quarter. This is shown as times T2, T3, T4 and T5 in Figure 1. Student interview questions for each quarter are shown in Appendix C. As the research project is using grounded theory, questions were developed quarter by quarter after analyzing results from previous interviews. This was the primary source of data for the research project. Student interviews and weekly reflections were compared against each other for validation purposes.

5. Interview with the student’s instructor at times T2, T3, T4 and T5. The instructor interview questions are shown in Appendix D. This data provides one of the assessments of student performance and it provides another validation point for the student interviews and reflection.

6. Sense of community. This was measured through a survey at times T2, T3, T4 and T5. This is shown in Appendix E. The establishment of a sense of community is contained in research question 2. The survey was chosen because it was well validated and it served as an objective mechanism to compare teams.

7. Student satisfaction. This was measured through both surveys and interviews. The student satisfaction survey is shown in Appendix F. The interview questions for student satisfaction are contained in the student interview questions in Appendix C. Student satisfaction is one measure of student and team performance.

8. Quality of student work product. Each quarter students were required to summarize their work in a multi-media presentation. Each presentation was reviewed by an
industry professional who was an entrepreneur or executive with relevant domain expertise. That professional provided the students and the instructor with one to two pages of feedback. Their instructor also graded the presentations. The instructor’s grade coupled with the outside reviewer’s evaluation provided a measure of quality of the student’s work. In the last quarter, the student’s presentation is their business plan which is the capstone of the TC program. In addition to the quarterly qualitative review from an outside professional, a panel of seven judges objectively reviewed all four presentations.

9. Observation of student team meetings with their instructor. Since it was not feasible to observe all teams, a single team was selected for auditing and observations were recorded in field notes. These observations were used as part of the validation of student interviews.

10. Evaluation of interim deliverables. Interim deliverables were used to shape an impression of the performance in the class.

11. Observation of the student’s internal website. This website contained all of the project’s data and may contain project specific threaded discussions. The web site provided an indication of the level of organization inside the project team. It also served as an indicator of both student activity and cooperation.

12. Instructor performance. This was measured through student survey evaluations.

**Data analysis.** Data analysis was done using grounded theory according to the procedures outlined by Strauss and Corbin (1990) and Charmaz (2006). Coding was done at a line-by-line, sentence and paragraph level. Coding levels varied by application. Summary memos were produced monthly. At the top level, the data was analyzed to see if the teams had successful
outcomes as determined by student satisfaction, sense of community within the team and the quality of their output. Student satisfaction and sense of community were obtained from both surveys and interviews. Team performance was evaluated through the student and team’s grade, an interview with their instructor and comments from outside reviewers. Outside reviewers were given a simple survey to generate an ordinal number of the team’s performance which can be used for comparison purposes. A quasi-statistical methodology was used where both survey and interview data is captured from each team. The survey instruments used have been calibrated by previous studies. Numerical data was compared between each of the student teams. Discrepant evidence to any findings was examined and reported.

Validity and Credibility

Validity and reliability is addressed in a number of different ways. Researcher bias was addressed by using a standard set of pre-developed interview questions for all interviews. These interviews were recorded and transcribed.

Students were followed for a one-year period and were interviewed four times to rule out any spurious data and any premature conclusions. During the one-year period, a rich set of data was specified to triangulate on conclusions. Interview data was member checked by having interview respondents verify the transcription of their interview and a summary conclusion reached through each of the interviews.

Ethical Issues

The researcher is the program director for the TC program and as such designed the online I-cubator program and its materials. These materials include recorded lectures, syllabi and assignments. As program director, the researcher has generated marketing materials, hired faculty, and reviewed and made decisions on student applications. The program director is also
the public face of the program and does webinars, information sessions, and also talks to prospective students.

For this research project, the student’s I-cubator instructor was another TC faculty member and not the researcher. This instructor was responsible for coaching and mentoring, daily interaction, answering discussion board questions and grading. There were no class specific interactions between the researcher and the students. A firewall was created between the instructor and the researcher so that no research project information was shared with the instructor.

The researcher’s relationship to the TC Program was described to the students before they were asked to volunteer as research subjects. It was made clear to the students that participation in the research project was completely voluntary and that there would be no consequences should they decide not to participate.

Confidentiality Issues

Only the researcher knew the names of the research subjects and their interview responses. At the beginning of the research project, each subject was assigned a random five-letter code. For surveys, this code was their participant code. For interviews, the research subjects were only referred to by their participant code thereby preventing any external transcriber from learning the research subject’s identity. As a further means of confidentially protection, the name of the university and the name of the program are not be published in any report.
Chapter 4: Report of Research Findings

Overview of the Program Under Study

The research subjects come from an academic program in technology commercialization (TC). TC is a master’s program offered at a large private university in the northeast. TC is an online program designed to prepare students with the core business and management skills needed to create wealth by transforming technical ideas into commercially successful products, product lines or businesses. TC is a 12-course program that is organized into parallel academic and experiential programs. The eight course academic program equips students to assess opportunities and identify customers, devise strategies for intellectual property protection, develop financial and project plans, develop and lead teams, and devise strategies for securing either internal or venture funding. In the four course experiential program, students work in small teams to develop a commercialization plan for a real technical idea of their choice. This experiential program was the test bed for this research study.

TC is a business program targeted toward the mid-career professional. For admission, the program requires an undergraduate degree from an accredited university or college plus five years work experience. In reality, previous graduates of the program have averaged over 10 years experience. Since TC is a business program, students need not have a technical degree for admission. TC stresses the cross-functional nature of technology commercialization and therefore students from all professional backgrounds are encouraged to apply. Previous graduates have come from engineering, information technology, sales, product management, marketing, operations management and technical support. Students have been a mix of individual contributors, supervisors, managers and executives. Some have an advanced technical or
management degree. Most students work in high-technology companies. Some have had previous start-up experience.

The TC program makes use of cohorts. Students have the option of taking their academic courses in a one-year fast track cohort format or they can take the courses at their own pace in a non-cohort format. The experiential part of the program under study must be taken in a one-year cohort format. Since there is a mix of both fast track and part time students, it is quite common for students to have taken some academic courses before they have started the experiential program. This gives them a chance to become familiar with the online learning format before they started the experiential program. It also gives them a chance to form some relationships with other classmates before the start of the experiential program.

**Online Instruction**

The TC program is 100% online. The program does not require students to come to campus at any time. On occasion, students may meet each other face-to-face if they are in the same locality or if they are travelling to an area where another student resides. In general, the first time students will meet each other or their instructor is at graduation. About 50% of the students attend graduation. As a 100% online program, students are widely geographically dispersed. Most are located in North America. Occasionally there will be a U.S. citizen who is either working abroad or is serving overseas in the military.

TC is delivered in an asynchronous modality using Blackboard as the course management tool. The university requires that all online courses use the same standard workflow. In doing so, the workweek is standard for all courses. The look and feel of the Blackboard web site is also standard for all courses. Course material for each week is located in the same six folders: learning objectives, readings, lecture material, discussion board, assignments and what is next.
Students begin their week by reviewing the learning objectives for the week. They start their work for the week by doing the readings posted by their instructor. The weekly lecture material follows. Instructor lectures are generally module based and delivered through a streamed multimedia PowerPoint presentation. Generally, lectures range from 10 to 20 minutes in duration. The discussion board folder specifies the discussion requirements for the week. Generally, there are three discussion questions per week. During the first half of the week, students are required to post a reply to the instructor’s questions. During the second half of the week, students are required to post responses to other student’s postings. The week may require assignments, which are specified in the assignment’s folder. Lastly, students get a view of what is coming in the week’s next folder. With the asynchronous modality of instruction, students are given the freedom to study and to do their postings whenever they want within the constraints of their program.

**The Experiential Program Curriculum**

The experiential program is also known as the *I-cubator*. Students work in teams to take a wisp of a technical idea and transform it into a commercialization plan that can be used to start a new business or product line. Of course, not all ideas will result in a feasible business. Success in those cases is the resultant education that the students receive and their satisfaction with the program. The *I-cubator* manifests itself as a one-year 4-course sequence delivered over four quarters. In the *I-cubator*, students are provided with a curriculum that guides the students from idea generation to team formation and ultimately to the generation of a business plan. Students are introduced to a process scaffold which consists of a set of best practices for opportunity assessment, risk management, product requirements, customer validation and business planning.

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5 Courses are delivered in quarters as opposed to semesters. For the program understudy, Quarters 1, 2, 3 were 12 weeks and Quarter 4 was eight weeks.
For each process that the students undertake there exists a template for the documents that need to be produced and corresponding lectures. For the lectures, an assumption is made that the students may not have had any previous academic instruction on a process or practice when they need to apply it. Throughout this process they are guided step-by-step by an I-cubator Director, who is their instructor.

**Quarter 1, venture selection and team formation.** The theme for Quarter 1 is venture selection and team formation. When students start the program they begin an orientation process where they review the goals of the program and the processes that they will use in Quarter 1. Students are informed that they need to submit a venture idea to the class for commercialization. Some students start the program with an idea that they have already been working on while for others this is a cold start. Students must gain the approval of their instructor before they submit the idea to the class for discussion. The instructor screens ideas to make sure that a prototype can be produced by the start of the third quarter of the program. Since TC is a business program, the general expectation is that a prototype will either be produced by an engineering partner or that it is simple enough for the TC students to produce on their own.

Students submit a one-page venture description to the class for discussion. They then perform an opportunity assessment of that idea using a template provided by their instructor. This opportunity assessment is also discussed with the class. The students then vote to select their most favored ventures. Students are asked to rank the class ventures in order based on viability and personal interest. The highest ranked ventures are chosen and the students who had their ideas selected become known as the Product Champion for that idea.

Once the class project list is determined, venture teams are formed. Students are asked to rank order their venture preference and the Product Champion is asked for teammate preferences.
Using this information, the class instructor assigns students to teams with a goal of assigning all students to either their first or second choice venture and for the Product Champion to have some of the requested students on their venture team. This team formation occurs in Week 8 of the 12-week term.

With four weeks to go in the term, the teams are immediately asked to perform a number of tasks. The teams are required to create a web site for their venture. They are also asked to create a schedule for the remainder of the program and they are asked to create a risk management plan. This quarter, as with all subsequent quarters, ends with a 10 to 20 minute multi-media presentation generated by the students intended for review by their instructor and an outside industry professional.

**Governance of student teams.** The governance of the student teams, the roles that students play and the assignment of tasks and responsibilities is completely decided by the students. It is required for the team to have a leader but students are free to rotate that leadership as they see fit. They are also free to define what the role of leader means for their team. However, students are required to have a gatekeeper. The gatekeeper’s responsibility is to: schedule meetings, ensure meetings have an agenda, ensure timely completion of tasks and post meeting minutes.

Student teams are also required to have weekly meetings and to have the minutes of these meeting recorded and posted on their venture web site. Student teams are also required to meet with their instructor either weekly or bi-weekly.

**Quarter 2, product requirements and prototype construction.** The theme for Quarter 2 is the creation of product requirements and the construction of the prototype. During the first six weeks of the quarter, the students create a product requirements document (PRD) and hold a
peer-review by having another student team review their work. The PRD is created from a template supplied by the instructor.

In parallel with the PRD, students are required to either oversee the construction of a prototype by a partner or construct the prototype themselves. Students also create a test plan and a plan for controlling revisions of the prototype.

The students are also required to update key project documents as they learn more information about prototype construction and their served market. Students also begin the process of creating a customer list that can be used for feedback and beta testing. The quarter ends with a multi-media presentation and review by their instructor and an outside reviewer.

**Quarter 3, customer validation.** The theme for Quarter 3 is customer validation. Students are required to validate their product concept, product requirements and prototype with potential customers. Early review may be with friends, family and professional colleagues but it is desirable to have a later review with real customers in terms of a beta test of the product. The PRD and prototype are constantly updated based on customer feedback. The quarter ends with a multi-media presentation and review by their instructor. There is no outside review. During the quarter, there are also three interim reviews with their instructor.

**Quarter 4, business planning.** Quarter 4 is the capstone for the experiential program. The theme for Quarter 4 is business planning. The objective for the students is to combine all of their knowledge about technology commercialization and their venture to produce a customer validated business plan. Students have interim deliverables of a business model and a financial plan that is reviewed with their instructor. Throughout the quarter, work continues on the prototype and obtaining feedback from customers.
The quarter ends with the production of a customer validated business plan. The plan is developed by using an outline supplied by their instructor that has been jointly developed with the aid of local venture capitalists. The plan is presented as a multi-media presentation along with an annotated PowerPoint presentation. The plan is reviewed by their instructor and outside industry professionals.

At the end of the program, the student teams determine if they want to go forward with their venture and who will participate and in what capacity. Assistance is available from the university’s staff even after graduation if desired by the students.

**Collaboration and Communication**

Through Blackboard students are supplied with two collaboration tools from Wimba Corporation. The first tool is Wimba Live Classroom. This tool is similar to Webex in functionality. Students can have voice and video conversations and they can share and discuss documents. Since there is no central administrator, students can schedule their own meetings without the help of their instructor or a university administrator. The second tool is Wimba Pronto. This is an instant messenger service whose buddy list is automatically populated from the class roster making it easy to find classmates. Students make frequent use of Pronto to contact each other as well as their instructor.

Communication patterns and instructor support function differently in the academic and experiential programs. For both programs, as a matter of policy, office hours are scheduled both ad-hoc and on a scheduled basis. Instructors usually avail themselves to students one hour per week using the Pronto office hours feature. For the experiential program, once venture teams are formed, instructors have weekly or bi-weekly meetings with the student teams. These meetings are done with a variety of technologies depending on the student’s preference. Meetings may be
done with Wimba Live Classroom, Webex, Skype or teleconference. Students may or may not choose to share their web cam video for the meetings.

Meetings with the instructor are structured. They have an agenda and minutes are recorded. During these meetings, students have a chance to ask the instructor for clarifications about assignments or the program. Student progress on their venture is also reviewed. This gives the instructor an opportunity to assist students when they hit a roadblock and also provides the student team with coaching and mentoring. Instructors for the experiential program have both teaching experience and industry experience in starting companies.

In the academic program, students may meet with each other as a group if a particular course has a group assignment. In the experiential program, once teams are formed, teams are required to meet among themselves at least once per week in addition to their meeting with their instructor. This synchronous requirement can place a strain on the student teams when they are spread across many time zones. In the experiential program, it is common for students to meet with each other frequently in pairs to discuss their project work.

The experiential program requires the use of a rich set of collaboration tools. This was done by design to provide a fabric for holding the venture team together while they are working across geographic boundaries. The class uses a social networking site to share personal information about each other. The TC program is using Ning. In a similar manner to Facebook, each student has a personal web page and can post blog entries about what is going on in their personal lives. The Ning is accessed through a button on the class Blackboard site. Each venture team is required to have a web site for their venture. The web site is used as a common repository for project documents and meeting minutes. The TC program is using Central Desktop for their venture’s web site. With Central Desktop, students can also have threaded discussions.
about their venture outside of the Blackboard infrastructure. Students are graded on their use of
Central Desktop. TC students are also encouraged to use Google Docs for the generation of team
documents. With Google Docs, a master document can be stored on Google and all team
members can edit the document simultaneously. As a consequence, all students have access to
the latest revision of the document. For project communication, students are encouraged to use
Skype in addition to the Wimba tools for team meetings.

Subjects

Students and teams. The research project consisted of monitoring, observing and
interviewing a cohort of students in a master’s program in technology commercialization from
September 2010 to August 2011. The initial cohort consisted of 17 students, 16 of which decided
to participate in the research project. During Quarter 1, these 17 students were divided into four
teams consisting of three teams of four students and one team of five students.

For the purposes of reporting the results of the research project, teams were given
abbreviated names based on the functionality of their venture. The teams were named RECON,
APP, RUN and WIND. The actual student teams described themselves by different names.
Teams RECON, RUN and WIND consisted of four students. Team APP consisted of five
students. The participants in this research project were referred to by their team name and
participant number. For example, the participants on Team RECON are referred to as RECON-
P1, RECON-P2, RECON-P3 and RECON-P4.

The TC program is targeted toward mid-career professionals. This is enforced by
requiring a minimum of five years work experience. The participant’s age spans from 26 to 49
years old with the mean being 36.7 years. The participants consisted of 16 males and 1 female.
The female participation rate for this cohort under study is slightly lower than previous cohorts.
Some of the students started the TC program prior to starting the *I-cubator* course sequence and therefore had reported a prior established relationship. The cohort and team characteristics are shown in Table 1.

Table 1

**Cohort and Team Characteristics**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Cohort</th>
<th>Team RECON</th>
<th>Team APP</th>
<th>Team RUN</th>
<th>Team WIND</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>17</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Age</td>
<td>36.7 (M)</td>
<td>32.0 (M)</td>
<td>33.0 (M)</td>
<td>38.5 (M)</td>
<td>38.5 (M)</td>
</tr>
<tr>
<td></td>
<td>6.8 (SD)</td>
<td>2.2 (SD)</td>
<td>4.1 (SD)</td>
<td>2.9 (SD)</td>
<td>11.7 (SD)</td>
</tr>
<tr>
<td>Male/Female</td>
<td>16 Male</td>
<td>4 Male</td>
<td>4 Male</td>
<td>4 Male</td>
<td>4 Male</td>
</tr>
<tr>
<td></td>
<td>1 Female</td>
<td>1 Female</td>
<td>1 Female</td>
<td>1 Female</td>
<td></td>
</tr>
<tr>
<td>Some worked together in a previous class</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

The participants all work for U.S. companies and are distributed across the continental U.S. except for one student who is an ex-patriot working on an assignment in Barcelona, Spain. Some of the participants live close enough to each other where they could drive to meet each other in person. The entire cohort spans nine time zones. The time zone range for each of the teams ranges from two to nine. A summary of team member locations and time zone span is shown in Table 2.
Table 2

<table>
<thead>
<tr>
<th>Team</th>
<th>N</th>
<th>Time Zone Span</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>RECON</td>
<td>4</td>
<td>2</td>
<td>Bulverde, TX</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Durham, NC</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Rochester, MN</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Tampa Bay, FL</td>
</tr>
<tr>
<td>APP</td>
<td>5</td>
<td>9</td>
<td>Belchertown, MA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Barcelona, Spain</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Boston, MA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Carrollton, TX</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Portland, OR</td>
</tr>
<tr>
<td>RUN</td>
<td>4</td>
<td>3</td>
<td>Hattiesburg, MS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Los Angeles, CA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>San Diego, CA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>South Hamilton, MA</td>
</tr>
<tr>
<td>WIND</td>
<td>4</td>
<td>2</td>
<td>Attleboro, MA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Deerfield, IL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Medfield, MA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Roscoe, IL</td>
</tr>
</tbody>
</table>

Local Distances:
1. Boston to Belchertown is 84 miles.
2. San Diego to Los Angles is 121 miles.
3. Attleboro to Medfield is 22 miles.
4. Deerfield to Roscoe is 82 miles.

The cohort is highly diverse in their undergraduate education and the current positions that they hold. Eight of the 17 participants hold a technology based undergraduate degree. Five of the 17 students have an undergraduate degree in business. Only one student has an advanced degree. That student has both a technical undergraduate degree and an MBA. Four of the 17 participants have management or supervisory responsibilities. A summary of the participant’s education and current positions is shown in Table 3.

\[\text{This student was on temporary assigned in Barcelona and moved back to Boston area at the end of Quarter 3.}\]
Table 3

*Team Education and Current Positions*

<table>
<thead>
<tr>
<th>Team</th>
<th>N</th>
<th>Education</th>
<th>Current Positions</th>
</tr>
</thead>
<tbody>
<tr>
<td>RECON</td>
<td>4</td>
<td>BS International Business, BS Psychology, BS Space Operations and MBA, Bachelor of Engineering</td>
<td>Financial Analyst, Technical Sales Specialist, Sector Manager, Data Base Administrator Consultant</td>
</tr>
<tr>
<td>APP</td>
<td>5</td>
<td>BS Computer Science, BA Business, BS Business, BS Interactive Media, BS Technology Management</td>
<td>Sr. Software Engineer, Sr. Systems Analyst, Systems Analyst, Information architect, Former VP and CTO</td>
</tr>
<tr>
<td>RUN</td>
<td>4</td>
<td>BS Physics, BS Advertising, Bachelor Political Science, BS Math</td>
<td>Sr. Scientist, Multi-media Developer, Lead Analyst, Supervisor Operations</td>
</tr>
<tr>
<td>WIND</td>
<td>4</td>
<td>BS Mechanical Engineering, BS Electrical Engineering Technology, BS Business Management, BA Computer Science and Speech</td>
<td>Engineering Project Manager, Sr. R&amp;D Engineer, (Web) Designer, Market Development Manager</td>
</tr>
</tbody>
</table>

**Student Ventures**

As a cohort, students selected four ventures from the list of 17 venture ideas that were submitted. All ideas were student generated. For three of the ventures, the students were working on the idea well before the start of the *i-cubator* course sequence. The following descriptions have been abstracted to protect the confidentiality of the student team.

**Venture RECON.** Venture RECON consists of the development of a low-cost personal aerial reconnaissance device for soldiers in the field. Aerial reconnaissance devices do exit today but they are deployed at the squad level. They are expensive, and they can take an hour to set-up which can be too long when there is an instant battle. This device looks like a tube that the soldier can carry in his backpack. From this tube, a small rocket is fired into the air carrying the
actual reconnaissance device. This device flies like a small helicopter and contains several cameras. Wireless pictures are then sent to the soldier’s backpack computer for processing.

This venture was created out of an engineering capstone project at another local university. The engineering students won an award at a business plan competition and received funding for the development of a prototype in their senior year of undergraduate school. The Product Champion had a previously established relationship with this student team and helped to bring this idea into the TC program.

For this venture, there are actually two student teams. There is the business team, which is the TC students and there is the engineering team from another local university. While the Product Champion acts as a liaison between the two teams, there have been meetings between all of the participants via a telephone conference. The students who joined this team felt that the product idea was well thought out due to the amount of work that had been previously done.

**Venture APP.** Venture APP consists of the development of a mobile phone application. This application is a location aware to-do list manager. Using the GPS function in the mobile phone, reminders are sent to the application user when the user is near a location where the to-do item can be fulfilled. For example, a to-do list item might be to pick up an item at the grocery store on the way home from work. The application will alert the user when they are near a grocery store and the application will provide a list of all of the items that need to be purchased at that grocery store. This team spans the largest amount of time zones of all of the student teams. The Product Champion is in Barcelona, Spain. The student that is furthest away from Barcelona is in Portland, Oregon resulting in a span of nine time zones.
The idea for this venture was generated by one of the students on the team. These students plan to build the prototype themselves with some additional help from outside resources. The students that joined this team are interested in working on digital media\(^7\) products.

**Venture RUN.** Venture RUN consists of the development a device that can determine when your running shoes are worn out and need to be replaced. Typically, running enthusiasts do not pay a lot of attention to the amount of wear on their running shoes and the timing of when those shoes should be replaced. Sometimes a runner may notice that their shoes are worn out when they slip on an uncertain surface such as wet fallen leaves. More typically, a runner starts to notice some pain when they are running because the shoe does not provide the same amount of cushioning as when it was new. In some cases the runner actually receives an injury due to worn out shoes. That is exactly what happened to the Product Champion. This student had been thinking about solving this problem long before starting the TC program. The students who joined this team are all avid runners.

The solution to this problem is a small device that is mounted in an insert that is placed inside the shoe. The plans to build the prototype for this device involved co-opting electrical engineering resources who are co-workers of the Product Champion.

**Venture WIND.** Venture WIND consists of building an aspirator for the gearboxes in wind turbines. The purpose of the device is to reduce wear on the gearbox as repair costs can exceed $250,000. Gearboxes in wind turbines are used to translate the varying speed of the wind turbine blade into a more constant speed which is delivered to the shaft of the electrical generator. These gearboxes deal with varying amounts of force. When the force is large, the

\(^7\) Digital media includes the following: Social networking web sites such as Facebook, web site companies such Google or Amazon, online delivery of music and video, and computer games.
gearbox can get very hot resulting in increased wear. Cooling the gearbox by airflow has the side effect of introducing small amounts of contaminants which also increase gearbox wear. Additionally, any contamination that gets into the gearbox also increases wear.

The aspirator acts like a smart lung. It has a sensor to determine the heat in the gearbox. When the gearbox is cool, aspirator valves are closed thereby preventing air and its unwanted contaminants from entering the gearbox. When the gearbox is hot, valves open allowing for filtered air to circulate through the gearbox chamber thus reducing its temperature.

The Product Champion works at a company that makes industrial components. Some of these components are supplied to the wind turbine industry. The idea for this venture also came along before the start of the TC program. The student actually got the idea from an existing customer of his company. This venture is being produced in partnership with the student’s company who retains the intellectual property rights to the product being developed. Resources at the Product Champion’s company were used to create the prototype. Students who joined this team have a strong interest in green technology.

Findings

Quarter 1.

Student goals. The students expressed three major themes when asked about their goals and expectations for the program. These themes were career boosting, technology commercialization and start-up. Some expressed multiple goals such as a career boost now and maybe starting a company later. Student preferences among these themes were evenly split: career boosting (8 of 16 [50%]), technology commercialization (8 of 16 [50%]) and starting a company (8 of 16 [50%]). It was not surprising that students were interested in boosting their careers since the student population was comprised of mid-career professionals. “Well I mean
my primary goal for getting the degree was to increase my marketability” (APP-P4, personal interview, December 7, 2010). What was surprising is the strong student interest in learning about technology commercialization and pursuing a career as an intrapreneur. From APP-P1:

So, my expectations are overall in this program was to sort of help provide some visibility and content and techniques to build more market driven technology products. So, I was interested in kind of the cradle to the grave process of doing that, as far as bringing viable technology to the market. And so, the expectation of the program was essentially to provide a framework and some additional details in context around how to be successful. (personal interview, December 8, 2010)

The student interest in starting a company was more of a long-term plan rather than something that they were going to do immediately upon completing the program. “Long term, I would like to, I'd like to (have, have) start my own company. I'd like to be an entrepreneur” (RECON-P3, personal interview, December 8, 2010).

**Initial program experience.** Through observation of class discussion boards, the students were enthusiastic about their work in the *I-cubator* course sequence. At the same time, students described their initial experience with the program to be a period of anxiety and adjustment. Over the 16 student interviews, initial program anxiety was coded with 17 incidents and initial program adjustment was coded with 12 incidents. Initial program anxiety was the single highest scoring code through the first round of interviews. Since the *I-cubator* program was to take place over an entire year, the program design allowed time in the beginning for students to settle in with the course tools and the workflow of the program. Some of the specific actions that were taken were: development of introductory videos, training course tools, a slower pace for the first three weeks and the use of a class Ning. The Ning was created for students to share personal

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8 An intrapreneur is a person who wants to pursue entrepreneurial activities within an existing company as opposed to an entrepreneur who wants to start new companies.
information with each other and this helped to create a sense of community. While the Ning had some value, the students stopped using the Ning after the first two weeks of the program.

Some students had previous online experience (6 out of 16 [38%]) with 5 out of 16 [31%]) having previous online experience within the TC program. Some students (4 out of 16 [25%]) observed that this initial anxiety appeared to be independent of past online experience.

Participant RUN-P3 (personal interview, December 11, 2010) made this observation: “And later on I found out that a lot of what I was feeling, and, that student anxiety seemed to be very common even with some of my classmates that do have the experience and background.” But for many it had been a long time since they were in school and the process of online education was yet another adjustment that they had to make. This sentiment was also echoed by WIND-P4:

Well it’s been a long time since I have been in a formal education setting. As I mentioned completed my bachelors in, way back in 1987, and not only is a return to formal education, but it’s the first time I've really been involved with any type of online education. So, I was quite nervous to get started and a spent a lot of time just trying to understand the navigation, finding my way around. (personal interview, January 12, 2011):

From observations and the student interviews, the time it took to make an adjustment was approximately three weeks. Two students believed that the initial slower pace of orientation was too slow for them. One student had prior online experience and the other had a significant amount of experience with online collaboration tools. One student, APP-P3 never quite made a complete adjustment to online learning and working with online teams:

I found because I’m online pretty much eight to 12 hours a day for my profession. (And in addition) The program added an additional somewhere between four and six hours of a day. I felt (I was) online quite a bit managing our communications. It took a long time to become comfortable with that. (And) I think even at the end of the semester now I’m still kind of going through that process of just learning how to communicate efficiently and effectively with both my professors and teammates. (personal interview, December 11, 2010)
As a result of this uneasiness, this student withdrew from the *I-cubator* course sequence during the second quarter.

**Idea formulation.** The first task that the students are asked to do is to develop an idea for a new company or new product line for the class to consider as one of the ventures. These ideas go into a pool for consideration by the class in the venture selection phase of the program. It was required that each student submit their own idea. There were constraints placed on the students. The idea had to be technology based as opposed to a non-technology idea such as a new dry cleaning operation or a new fast-food franchise. The idea also had to be simple enough for a prototype to be constructed in six months. One of the challenges that the students faced was developing resources for prototype construction. The idea had to be simple enough for the student team to develop themselves or outside resources had to be available to them at little or no cost. Since the program under study was a business program, it was not required for students to have the skills to develop a prototype. Students were encouraged to find outside resources or partners. However some ventures, in particular digital media ventures, are simple enough for students to create a prototype themselves.

Prior to starting the program, students were encouraged to either develop their own idea and bring it to the program or work with their employer to obtain an idea from them and to establish a partnership with them. Students who took this latter path had an advantage over those that developed an idea from a cold start at the beginning of the program. These students were a minority in the program (6 out of 17 [35%]). However, a majority of ventures selected by the class were selected from this prior work developed by the students (3 out 4 ventures [75%]). Two of the ventures selected were attached to a strong partner relationship.
One of the previously developed ideas came from a personal relationship with another local university. When asked where the idea for the venture came from, the student responded:

Well, basically it was some other people that I knew personally outside of the program that had entered into a research competition with another university in the (city) area. It started out as just kind of a hobby that actually after doing a little bit of research and diligence on the area, they were able to put it into a research competition and actually won it. (RECON-P4, personal interview, December 11, 2010)

Another one of these previously developed ideas came from a student’s work with customers in his employment. This became Venture WIND. A customer had brought him a problem that they wanted solved.

Through a relationship with a customer that is in wind power, they brought a challenge to us to help them solve the problem with this technology that we (they) have. We are trying to solve the problem that they have with their gearboxes on the wind turbine. (WIND-P4, personal interview, January 12, 2011)

These ventures comprised the two partnership-type of ventures in the program. RECON-P4 developed a partnership with engineering students at a local university. This team had the responsibility to develop the prototype. WIND-P4 developed a partnership with his company where the resources of that company were used to create the prototype.

For those developing an idea from a cold start, ideas came from a variety of places. Half of the ideas (8 out of 16 [50%]) came from student personal experiences or interests. One student recalls how he came up with his idea:

I thought about just having a project in line with one of my hobbies. Which is, I like to play guitar and mess around with music production. And I have a few friends in the area that are actual musicians. (RUN-P3, personal interview, December 11, 2010)

The students were required to develop their idea during the first three weeks of the program which, as previously stated, was a time of high anxiety. Their idea was required to be written down in the form of a venture description by the end of Week 3. Some students found it difficult to come up with an idea from a cold start and at least one student stated that the idea
formulation process contributed to their stress. APP-P2 (personal interview, December 11, 2011) recalls his experience with idea formulation: “I felt a little bit, I don't want to say apprehensive, maybe more a combination of anxiousness and sort of high expectations on the initial idea generation component of the program.”

**Opportunity assessment.** After submitting their idea in the form of a venture description, students were given two weeks to generate an opportunity assessment. This was not only an educational experience for the students but also a tool to assist the class in becoming informed about the other ventures. Students were given a template to fill out. This template was generated from the researcher’s past experience, best practices as noted by the faculty, and search of best practices on the Internet. This template is in Appendix G. The template was designed not only to help students do an opportunity assessment but for them to walk away with a best-in-class process for doing opportunity assessment. RUN-P1 (personal interview, December 11, 2010) noted that the processes are consistent with those that he is using on his job: “In fact I'm finding it very harmonious, (with) many of the processes that we have at work.”

While students were scheduled to learn opportunity assessment techniques in their entrepreneurial marketing class, some students had not taken this course at the time they were performing the opportunity assessment. The nature of the TC program was to have the students “dual educated” by receiving an education once in the academic program and again in the experiential program. At times, the experiential program had to redundantly educate students on techniques due to conflicts in timing. While not specifically asked about the learning value of the opportunity assessment, the opportunity assessment was mentioned as a learning experience by 25% of the participants. RECON-P3 made this comment:

The assignment and the deliverables within that assignment gave me a good opportunity to test out some new skills of looking at projects and products in a different way. And
really looking at what it’s going to take to see if it’s something worthwhile. (personal interview, December 8, 2010)

While it was anticipated that students would draw heavily on the use of the Internet, they also drew on a variety of additional resources. Personal experience was identified by (4 out 16 [25%]) of participants as a key element to performing their opportunity assessment. Domain experts\(^9\) were contacted by (4 out 16 [25%]). Prospects or potential customers were contacted by (5 out 16 [31%]) participants. WIND-P4 showed initiative by developing a survey of potential customers:

I actually wrote up a small survey and had (for) some people, I actually got the full competing device and set that up with a pair of headphones and MP3 player and gave that to people to listen to and see what they liked and disliked about it. (personal interview, January 12, 2011)

**Venture selection.** After completing the opportunity assessment, students moved on to the venture selection process. Since the work in the *I-cubator* course sequence is done in teams of three to five students, venture selection is essentially a down select process. For this particular cohort, 17 student ideas were down selected to four ventures that would exist throughout the rest of the program. Another part of the venture selection process is team formation. Once the ventures were selected, teams were assigned. By default, the Product Champion was assigned to the team developing his idea.

Essentially, the venture selection process began at the very beginning of the program when students introduced themselves on the class Ning and they started sizing up each other. Students began the process by measuring up ideas when ideas were submitted and discussed on the discussion board during Week 2. This measuring up process continued when students discussed their one page venture description during Week 4. The measuring up process

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\(^9\) In this context domain expertise refers to knowledge in a specifically technology area such as software, semi-conductors, digital media, medical devices, etc.
intensified as students discussed their opportunity assessment documents during Week 6. By this point, the students had sharpened their skills in asking probing questions to the other students.

After a week’s discussion, students began a four-day voting process. Students were asked to rank order their top 10 ventures. Their highest rated venture was to be given a score of 10. There second highest rated venture was to be given a score of nine and so forth. Students were given general guidelines about how to select a project. They voted for ventures based on what the students perceived to be the market opportunity, project viability (how easy is it to prototype and how easy it is to get or develop domain expertise) and their personal preference.

Ballots were e-mailed to the instructor and then the results were posted on a shared spreadsheet using Google Docs for all students to view the results as they came in. Students were allowed to change their votes if they wished. But no one decided to do that. After four days of voting, a venture list had been determined. The student voting for ventures is shown in Table 4. The class selected Ventures RUN, RECON, WIND and APP.
Table 4

<table>
<thead>
<tr>
<th>Student Venture Voting</th>
<th>Venture</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>RUN</td>
<td>89</td>
<td></td>
</tr>
<tr>
<td>RECON</td>
<td>84</td>
<td></td>
</tr>
<tr>
<td>WIND</td>
<td>76</td>
<td></td>
</tr>
<tr>
<td>APP</td>
<td>71</td>
<td></td>
</tr>
<tr>
<td>Venture 5</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>Venture 6</td>
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<td></td>
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<td>Venture 7</td>
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<td>Venture 8</td>
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<td>Venture 10</td>
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<td>Venture 11</td>
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<td>Venture 12</td>
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<td></td>
</tr>
<tr>
<td>Venture 16</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>Venture 17</td>
<td>21</td>
<td></td>
</tr>
</tbody>
</table>

With the venture list determined, students whose ventures were not selected were asked to rank order their venture preference. At the same time, the instructor asked the Product Champion to submit a list of teammate preferences. The instructor used both pieces of information to determine the composition of the venture teams.

Overall, the students (12 of 16 [75%]) believed that the best ventures were selected and only one student, RUN-P4 (personal interview, December 11, 2010) expressed disappointment in his venture assignment. RUN-P4 was assigned to a hardware project and he wanted to work on a software project. After the venture assignment, he did not bring his feelings forward to the instructor. Some students (5 of 16 [31%]) noted that while the venture selection process worked for the class as whole, they were disappointed that their particular venture wasn’t selected.

\[10\] For the purpose of readability, all pronouns were shown in male gender regardless of the actual gender of the participant.
Since the venture selection process was absent of external influences such as the instructor or business experts, the students (9 of 16 [56%]) realized that their empowerment transformed the venture selection process into an influence process. Some students saw the process from a purely political viewpoint: “It’s very funny, I feel like the selection process is, very close to a political campaign” (RECON-P2, personal interview January 12, 2011). Other students looked at the process a bit more deeply: “I think the majority of the class when they did the vote were looking for products that solved a problem that they can relate to” (APP-P4, personal interview, December 7, 2010). Several students noted their classmates would not vote for a venture that they could not easily understand. “And I early on, or kind of mid-through the process and of vetting the ideas, (I) pretty much made a decision or maybe an observation, that I didn’t think that the class itself understood the idea” (WIND-P3, personal interview, December 7, 2010).

While the students were given some general guidelines on how to make a venture selection, student satisfaction with the venture selection and team assignment process was determined more by their satisfaction with other people on the team more than any other factor (9 of 16 [56%]). Students who responded this way were spread across all four teams.

So the team has to be a really important (team). So, experienced, somebody that you could potentially you could work with and would complement you. As well as people that share your same work ethic and work values and for the most part (and) background. (WIND-P3, personal interview, December 7, 2010)

It was also surprising that team assignment satisfaction was influenced by any amount of previous relationship, no matter how small, with other members of the team. WIND-P4 described his previous relationship with a classmate:

---

11 WIND-P3 felt his idea was not selected because the class did not understand it.
Since we had some level of contact throughout the prior weeks, particularly through the discussion board, we got to know each other fairly well as far as interests and things of that nature, projects that they were working on, companies they work for etcetera. So it wasn’t an entirely, not like meeting a stranger, so to speak. (personal interview, January 12, 2011)

Another student, WIND-P3 had a similar experience:

Well one of my cohort mates was in my business class. And I had worked with him on our final project so we were already on a team. So that's how I knew how he functioned and I knew some of his business background(s). (personal interview, December 7, 2010)

There were two other factors that the students used in making their venture selection: 1. The venture was viable and well formed (7 of 16 [44%]) and 2. The venture matched their domain interest (4 of 16 [25%]).

First deliverables. With teams being formed at the end of Week 8, students had initial meetings to begin the process of assigning the work that was due in the remaining three weeks of the quarter. Both a project plan and risk management plan were due at the end of Week 10 and a final presentation was due at the end of Week 11. Note for this particular cohort, there was a one-week break between Week 10 and Week 11 for Thanksgiving.

For all of the teams, the first meeting was difficult from a personal, technology and logistical point of view. For the first team meeting of Team RUN, the Product Champion was missing because he scheduled the meeting for the wrong time zone (RUN-P4, personal interview, December 11, 2010). For the first meeting with Team RECON, the entire meeting was spent trying to get the conference call technology to work (RECON-P1, personal interview, December 11, 2010).

The initial student meetings were chaotic. Students were battling communication technology issues and upcoming deadlines while simultaneously being cautious in their interaction with each other. “(Things) were somewhat chaotic. I think just putting all the (pieces
the) communication pieces, in place and having a very short timeline to kind of get things done” (APP-P3, personal interview, December 11, 2010). When asked about the initial team meetings, APP-P4 expressed these sentiments:

It’s kind of strange because you could sense that everybody's trying to be nice. Nobody wants to hurt anybody's feelings you know so the comments are really light. One of the things I was talking to (Product Champion) about was we want to be nice to each other but we also need to be a little bit more frank when it comes to criticizing our work because we have such a short amount of time to get a lot of this stuff done. So we don't have a lot of time to dance around certain topics. (personal interview, December 7, 2010)

Other teams recognized this behavior and started to add some process to help get over the initial teamwork challenges. RECON-P2 reflected on some of the initial team meetings:

At various points within the conference call as you can hear the silence voice which means no one wants to talk. So we quickly realized that. And, from that point on (though) every meeting we actually have (has) an agenda put together… things (have) become much easier and much fluent. (personal interview, January 12, 2010)

But for some, the slow introductory process was painful because they wanted to push the process faster than some others on the team. “I think with the engineers, they were not as comfortable with pushing the conversation and making quick decisions” (WIND-P3, personal interview, December 7, 2010).

All of the teams settled into at least two meetings per week. One of these meetings would be with their instructor and the other meeting was an internal meeting. When a deliverable was due, the teams would meet more often. Meetings were held using a variety of conferencing technologies with the most prevalent being Wimba Live Classroom since that was provided to the students as part of their Blackboard package. Meetings used an agenda and at the instructor’s direction and a gatekeeper was assigned within each venture team.

As the team meetings progressed and the team developed, students realized the benefits of being a diverse team. Diverse Team was the most frequent occurring code in the first quarter
interviews. It occurred 19 teams and was mentioned by (9 of 16 [56%]) of the participants. Diversity helped to establish a natural order for the assignment of tasks. For example, if there was a marketing person on the team, it was natural for that person to be assigned marketing tasks, although some students recognized that this was not the best strategy to promote learning. Diversity also helped to establish boundaries between team members. These boundaries helped to facilitate role definition. From RECON-P4 (personal interview, December 11, 2010): “Fortunately everybody really came from a different kind of background. They bring different skills to the team. There’s not a whole lot of overlap.”

Diversity also helped students to satisfy their desire to make a contribution to their ventures. WIND-P3 (personal interview, December 7, 2010) echoed the sentiment of many wanting to make a contribution on their venture: “I kind of have my own niche here. I’m thrilled. I think we are really a complementary project mix on the team with a really good project that has a lot of upside.” Participant RECON-P1 (personal interview, December 11, 2010) stated how diversity aids into role definition: “I think our skill mix was good and I think that we went ahead and kind of fell into the roles pretty easily.”

In the early stage of team formation, it was important for team members to feel not only that they were contributing to the venture but that there also was a balanced contribution by others. This was mentioned by (9 of 16 [56%]) of the participants. Each of the teams made some attempt to define roles for team members. But role definition alone did not result in all tasks being assigned. Almost half of the students (7 of 16 [44%]) said they had volunteered for some tasks.

The leadership of the team was a sensitive issue with the participants. The initial jumpstarting of the venture fell to the Product Champion who in some cases was uncomfortable
with taking a leadership role at this early stage. They were uncertain how their leadership would affect team dynamics and team formation. The leaders of Teams RUN and WIND deliberately held back being assertive which caused some conflict with some team members. At the same time, in the case of Team RUN, RUN-P4 (personal interview, December 11, 2010) wanted the leader to be more assertive and lead the venture. This developed into a minor personality conflict. In the case of Team WIND, the initial democratic style of leadership led to everyone discussing every issue before any decision could be made. Team WIND erred on the side of being inclusive, which had the side affect of generating over 50 e-mails per day among the team members. WIND-P3 expressed some of the initial frustrations in establishing an effective team:

I keep pushing the team to quickly make decisions, more quickly make decisions versus the: What do you think? What do you think? What do you think? What do you think? Conversation that goes back and forth, especially since we are geographically distributed, doing that type of thing was killer. (personal interview, December 7, 2010)

Due to the short time (four weeks) that the teams were together this quarter, the students had not yet experienced the full extent of the geographic dispersion problems that they might hit later in the program. However, some team members expressed some skepticism that geographic dispersion wasn’t going to create a problem at some time in the future. This was best expressed by RUN-P4:

Unfortunately, you know, we got a physical product and we’ve got a champion on the East Coast, New England. And the other person who had, who, and I didn’t realize he had an electronics background. I didn’t realize his academic background until the presentation. But he’s in LA unfortunately so I don’t know how they’re going to work this together. (personal interview December 11, 2010)

Each of the four teams adopted different strategies for prototype development. When they made these decisions, the teams did not realize the full extent of how this strategy would affect their venture, especially its impact on their workload.
Team RECON is partnering with a student engineering team at another local university. This is a team of senior undergraduate students who started this project in their junior year. They had been working on this project concept for 11 months. The Product Champion was aware of this team’s work because he had previously established a relationship with a member of the engineering team. This team won a monetary award at a business plan competition. This award was being used to fund the development of the first prototype. The engineering team was significantly younger than the participants of Team RECON. This diversity made a good match between the two teams and served as basis for establishing mutual respect.

Team APP’s approach was to do the prototype development themselves. At least three of the members had direct skills to construct the prototype. However, the Product Champion had the most suitable skills for developing the prototype and took on the largest portion of the prototype development himself. Team APP was also looking for an additional technical resource with specific software development skills that they did not have. The team jumped into the task without a clear understanding of how a prototype could be developed with everyone contributing to the effort in a balanced way.

Team RUN’s approach to the prototype development was also to develop the prototype themselves. In this case, only the Product Champion had a suitable technical background for working on the prototype. From his degree in physics, he understood the basic engineering process, but he was not an engineer. His skills were insufficient and not current enough to do this on his own. His plan was to seek assistance from an engineer at his place of employment. In a manner similar to Team APP, the scope and the magnitude of the prototype effort was unknown. But the enthusiasm for developing the prototype was high in both cases. The prototype
development responsibility fell completely on the shoulders of the Product Champion. Team members were willing to let the Product Champion take the lead on this effort.

For Team WIND, their prototype was manufactured and assembled by their industrial partner. With the assistance of their partner, Team WIND created the engineering drawings and the parts list required by the manufacturing department to build the prototype. Team WIND took on the additional tasks of building preliminary prototype versions to be used for early testing and customer feedback before the final prototype was delivered by their partner.

A summary of these approaches is contained in Table 5. Teams that used partners for prototype construction operated as pure business teams. For the teams that developed the prototype themselves, there was a blur between the business and the engineering responsibilities.

Table 5.

<table>
<thead>
<tr>
<th>Team</th>
<th>Approach</th>
<th>Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>RECON</td>
<td>Partner with a local university engineering team.</td>
<td>Award from business plan competition.</td>
</tr>
<tr>
<td>APP</td>
<td>Mostly done by Product Champion</td>
<td>No funding required.</td>
</tr>
<tr>
<td>RUN</td>
<td>Developed by Product Champion</td>
<td>Student team.</td>
</tr>
<tr>
<td>WIND</td>
<td>Developed by sponsor. Team develops drawings</td>
<td>Sponsor.</td>
</tr>
</tbody>
</table>

One of the first deliverables for the newly constituted teams was the development of a risk management plan. Students were supplied a lecture on risk management and they were supplied a template that could be used to describe each risk. The template was developed through the author’s own personal work and through the work of DeMarco and Lister (2003). The template is shown in Appendix H.
At the end of the quarter, each participant was asked to give their perception of the risks in their venture. The principle risk for Team RECON was in the development of the prototype by the local university. Since the engineering team consisted of undergraduate seniors, there was a concern about these students staying with the project after they graduated. There was also a concern about the quality of the engineering since the engineering team was very inexperienced. Additionally, there was some doubt that the engineering team could make a prototype at an attractive cost to the military.

Team APP was worried about a different set of risks. Their principle risk was developing a business model. There was another concern about finding a viable revenue model. Team APP was also worried about not having all of the technical skills that they would need to build a prototype.

Team RUN was worried about making a functioning prototype. They also had worries about their intellectual property position. They were worried that a patent search would uncover some prior art that would prevent them from moving forward. Lastly, Team RUN was worried about the lack of management expertise on the team. They also heard this concern from an outside reviewer.

Team WIND’s principle risk was the relationship with their sponsor. If the sponsor backed out of their commitment, this venture would not be viable. The team also had a risk of customer acceptance of their approach since their product was an add-on to an existing solution and how liability issues would be resolved when there was a failure. A summary of risks for each team is shown in Table 6.
Table 6.

**Venture Risks as Perceived by Team Members**

<table>
<thead>
<tr>
<th>Venture</th>
<th>Perceived Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>RECON</td>
<td>Prototype team and costs, selling to the government</td>
</tr>
<tr>
<td>APP</td>
<td>Developing a revenue model, obtaining all of the technical skills required for prototype development.</td>
</tr>
<tr>
<td>RUN</td>
<td>Building a working prototype, intellectual property prior art, management skills of the team.</td>
</tr>
<tr>
<td>WIND</td>
<td>Sponsor relationship, customer acceptance of the approach, protecting the intellectual property of the solution.</td>
</tr>
</tbody>
</table>

**End of Quarter 1 evaluation and reflection.** During the interview by the researcher at the end of the first quarter, students were asked to reflect on their experiences. They were asked about their satisfaction with the work that they accomplished as a team and they were asked how satisfied they were with the educational program as a whole. Students were mostly (13 of 16 [81%]) satisfied with the program and expressed their satisfaction during the interview process.

Some of the satisfied students expressed dissatisfaction with some particular aspect of the program. Participant RUN-P4 was typical of this sentiment. RUN-P4 (personal interview, December 11, 2010) was satisfied with the program but expressed dissatisfaction with his venture, the instructor and the organization of the class in Blackboard. However, RUN-P4 was satisfied with what his team accomplished. Another participant expressed dissatisfaction with the organization of materials in Blackboard.

One of the principle drivers of student satisfaction in the program was helping students to achieve their personal goals that had been expressed at the beginning of the program. Participants RECON-P3 and WIND-P2 expressed this.
I’m really comfortable and happy with what’s going on right now. One, I think it is benefiting me a lot. Especially this is my first online course and I never expected this amount of attention being paid to the students. (RECON-P3, personal interview, December 8, 2010)

I'm very satisfied with the program. It's the right mix of product development and the business. I thought it was a very good mix for what I wanted to accomplish and to get some more understanding in my day-to-day business. I mean I could either be in the lab or in meetings discussing our next move in the industry. (WIND-P2, personal interview, January 12, 2011)

Students also expressed areas of the program that could be improved (5 of 16 [31%]).

The most frequent (4 of 16 [25%]) idea for improvement of the experiential program was the development of a more structured process and using supplemental books. This was a typical comment:

Within the venture development portion of it, I would like to see more structure as far as, perhaps a textbook or some methodology that the instructors subscribe to themselves or some sort of processes put in place that kind of helps an individual that is new to commercialization and understand the whole ideation to market process. (WIND-P4, personal interview, December 17, 2011)

At the end of Quarter 1, a survey was administered to measure both sense of community and student satisfaction. These surveys served as an additional piece of qualitative data used for validity triangulation. The sense of community questions were developed by Rovai (2002a). The survey questions are shown in Appendix E and the survey results for all four quarters are shown in Appendix K. The student satisfaction questions were developed by Valacich, Dennis, and Nunamaker (1992). Those questions are shown in Appendix F and the results for all four quarters are shown in Appendix K. A summary of the results for Quarter 1 is shown in Tables 7 and 8.

For questions regarding sense of community, the results were compared with a baseline established by Rovai’s population sample of 375 students and each of the teams. The results show that the cohort under study had a slightly higher (58.63 vs. 56.62, 3.5%) sense of community than Rovai’s baseline. When comparing the sense of community between the teams,
Team APP and Team RUN, the teams who were self-developing their prototype, had a higher sense of community than Teams RECON and WIND. When looking at student satisfaction with the outcome of their project, Team WIND who had a productive relationship with a partner scored the highest (5.0) and Team APP who was the most geographically distributed team with the highest prototype challenge scored the lowest (3.5).

Table 7
Quarter 1 Mean Classroom Community Survey Results

<table>
<thead>
<tr>
<th></th>
<th>QTR 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum</td>
<td>80</td>
</tr>
<tr>
<td>Cohort Overall</td>
<td>58.63</td>
</tr>
<tr>
<td>Team RECON</td>
<td>55.00</td>
</tr>
<tr>
<td>Team APP</td>
<td>61.75</td>
</tr>
<tr>
<td>Team RUN</td>
<td>61.25</td>
</tr>
<tr>
<td>Team WIND</td>
<td>56.50</td>
</tr>
<tr>
<td>From Rovai</td>
<td>56.62</td>
</tr>
</tbody>
</table>

Raw scores vary from a maximum of 80 to a minimum of zero. Interpret higher scores as a stronger sense of classroom community.

Table 8
Quarter 1 Mean Student Satisfaction with the Outcome of their Project

<table>
<thead>
<tr>
<th></th>
<th>Overall</th>
<th>Team RECON</th>
<th>Team APP</th>
<th>Team RUN</th>
<th>Team WIND</th>
</tr>
</thead>
<tbody>
<tr>
<td>QTR 1</td>
<td>4.13</td>
<td>4.00</td>
<td>3.50</td>
<td>4.00</td>
<td>5.00</td>
</tr>
</tbody>
</table>

A five point Lickert scale was used:
5= Highly satisfied
4= Satisfied
3= Neither satisfied or satisfied
2= Dissatisfied
1= Highly dissatisfied

Quarter 2. Between the first and second quarters, there was a four-week break for the end-of-the-year holidays. Students started Quarter 2 with a fresh perspective and renewed enthusiasm. The major work for the quarter was the product requirements document (PRD) and
the construction of a prototype. Students also started the process of customer validation by generating a list of customer prospects. As much as the first quarter served as an introduction, the second quarter represents some of the most intense work in the program. One team member, APP-P3 dropped from the program due to increased professional responsibilities. APP-P3 also had some illness during Quarter 1, which resulted in falling behind in the workload and being unresponsive to teammates.

**Product requirements.** To start the product requirements process, students were given a PRD document template and a corresponding lecture. This template had been derived from best observed best practices by the researcher, Internet research and reaching out to other professional colleagues. The template is found in Appendix I. The students (7 out of 15 [47%]) stated that creating the PRD was both a challenge and a learning experience.

Some of the challenge was due to the holistic nature of the PRD template. For students that had prior experience with PRDs, they were expecting to specify only the technical details needed to construct the product. However, the template also included the business requirements to make this product into a new venture. These requirements forced those students who had a technical background to think of the business aspects of their new venture which was one of the objectives of the TC program. RUN-P1 noted that specifying the product’s technical details was very consistent with his past experiences. But this wider view presented a new challenge:

That wasn’t the hard part. The hard part had to do with the rest of the business proposition and that’s kind of the new part in the PRD. And so… in as much as I was surprised that that’s considered as part of the PRD, I in retrospect, now actually find it valuable. So, some of the PRDs that we produced at work were missing things like how manufacturable the item is, you know, what some kind of scalability about the manufacturability. Some of (the) idea(s) about how to service it and, you know, so we were missing certain features and details (if) you guys include in your PRD. So, I think in hindsight that’s probably a useful thing. (personal interview, March 22, 2011)
As a result of the product requirements process, several, deficiencies in the student’s ventures were brought out into the open. Two of the four teams (APP and RUN) noted that substantial work had to be done on the business model before the requirements could be written. These two ventures had more difficulty with this as compared to RECON and WIND since these were the ventures that were completely developed by the students without any assistance from a partner. Student teams also noted that they lacked sufficient customer information and validation to provide all of the details that were required at this time and they identified this as a risk.

All four teams used a divide-and-conquer and a then comeback-and-discuss strategy for developing the PRD document. Essentially, sections of the PRD document were handed out and team members developed their own sections independently. Some participants (7 out of 15 [47%]) noted that the diverse nature of their team made it easier to handle the product requirements task. This comment from WIND-P3 was a typical comment made about team diversity:

In general the process that we have used for all the deliverables, for the product requirement document in particular, we split the work up according to where our kind of main expertise of focus area is so, for instance I do a lot in marketing and sales and, you know, business value definition in my regular day job and so I cover that section and then, you know, ….WIND-P1….would cover more of the customer focus section and then WIND-P4 and some of the other participants did some of the (covered more) the engineering and test sections because that’s kind of what they have the most expertise in. (personal interview, March 24, 2011)

After completing their individual assignments, the team would then come back together to discuss and review the document as a whole. The PRD template was provided in Google Docs to facilitate cooperation among the students. Students only had a minimum of differing viewpoints. When asked specifically “did differing view points emerge and if so how did you resolve them,” only three students stated that differing viewpoints emerged in the PRD process. One student couldn’t recall any disagreements.
Three of the four teams (RECON, APP and WIND) cited discussion as the means for resolving differences. In RUN there was significant deference to the Product Champion since he proposed the product, was the sole developer of the prototype and was the keeper of the product’s vision. Student teams were insular in resolving differences. Only three students RUN-P3 (personal interview, March 28, 2011), RECON-P1 (personal interview, March 21, 2011), and RECON-P3 (personal interview, March 23, 2011) mentioned the customer as a means to resolve differences. This was a disappointment since developing a customer focus was one of the objectives of the TC program.

Most students had no previous experience in working on a PRD. But two students, RUN-P1 (personal interview, March 22, 2011) and APP-P1 (personal interview, March 23, 2011) had been doing product requirements work as part of their jobs. Those students also contributed processes from their companies to enhance the PRD process. As part of the product requirements process, some students (5 out 15 [33%]) did additional market research or searched for similar products in the marketplace.

**Prototype construction.** The goal for Quarter 2 was to produce a complete prototype that could be used in customer trials in the next phase of the program. While each team made progress toward that goal, only Team WIND met the goal. All of the venture teams built their prototype in incremental stages as suggested by their instructor. This enabled each team to tackle the problems in small manageable steps. This process tried to mirror agile development practices being used in industry. When asked about their prototype development, WIND-P3 responded this way:

(There was) prototypes stage base one, two and three. The first one being a virtual, (virtual prototype or be able to create a ) detailed animation of a product. The second one being a scaled down version of actually a physical prototype where we were able to actually do some do some tests to make sure that our assumptions were correct and then
the, the last one being a full scale prototype that we’re just completing now. (personal interview, March 24, 2011)

For RECON, the local university engineering team was now at the stage of testing the product with increasing levels of functionality. The first stage was to test the helicopter blade\(^\text{12}\) rotation while the helicopter was held in your hand. Afterwards, the helicopter was to be flown around the lab. The final stage would be launching the helicopter through the deployment rocket. A problem had developed this quarter with the hinging mechanism that allowed the helicopter blades to open up after deployment through the rocket tube. Team RECON was very concerned about destroying materials in the testing process since funds were limited. RECON-P2 gave his perspective on the efforts of the engineering team:

They are being as careful as they can, (to) try to make sure that we don’t waste all the material that we have. A lot of times though, if we don’t have a careful planning this will go up there you know, this flight might be able to fly up there, or even you know (the) rocket will launch up there in the air and it might explode and we might have to start from, start back from square one. (personal interview, March 21, 2011)

For Team APP, they were still looking for the additional engineering resource that they had identified earlier in Quarter 1. Their previous inability to estimate the time required for prototype development was now starting to cause problems and was adding substantially to the workload of the team. They were constantly being surprised about the amount of work that they had to do each week. Additionally, through their own preference, prototype work took precedence over other work in both the experiential program and their academic courses. APP-P2 described this situation:

The efforts to create the prototype was very significant and just amount of a level of effort that we put in was a lot of man hours, we were easily putting in about; I know, I was anywhere from 10 to 16 to 18 hours per week in trying to do my bit for the prototype requirements documentation. (personal interview, March 20, 2011)

\(^{12}\) Helicopter blades rotate around the top of the helicopter and provide vertical lift.
Team RUN was also running into difficulties with their prototype effort. The Product Champion, RUN-P1 (personal interview, March 22, 2011), who was also building the prototype, succeeded in getting coaching and assistance from the engineer at his place of employment that he had previously identified. However, to build the prototype, RUN-P1 had to learn to become an engineer and there was insufficient time in the program to accommodate his learning curve. As a result, the prototype effort became his main contribution to the program during this quarter.

RUN-P1 described his engineering efforts:

I went to RadioShack and bought some basic wiring components. I went to the DigiKey and I bought some of the electrical components and I basically put together a counter. You know, and so I proved in the first prototype that we know how to build the counter. (personal interview, March 22, 2011)

With the prototype as the center of the project, the other members of the team became very deferential to the Product Champion and his vision for the product. Recalls RUN-P4:

The Product Champion is the person with the real domain expertise and he is the best individual. (And he) did all the prototype work, taking input from the team but for the most part the team on a gave him carte blanche, to do it. (personal interview, March 28, 2011)

Team WIND had the advantage that their partner was going to develop the final prototype. This afforded the team the time to develop two early stage prototypes without the assistance from their partner. The first stage was an animation that was used to prove the product concept and demonstrate the concept to others. A lot of this work was done by WIND-P1 (personal interview, March 9, 2011) who was not the Product Champion. The second stage was a test bed that could be used to measure airflows and check the performance of the values being used. This prototype was built with PVC piping by the students themselves. Two prototypes were constructed. One prototype was built on the east coast and the Product Champion, who was in the Midwest, built one. The last prototype stage was an actual facsimile of the real product
that was built by the industrial partner. The quarter concluded with the industrial partner delivering the actual prototype that could be used in a customer trial.

**Customer validation.** In Quarter 2, students were setting the stage for doing customer validation in Quarter 3. Since developing a customer list can take some time, students were asked to identify prospects and domain experts that they could contact next quarter. Student teams gathered as few as 20 names to well over 100. This work was described by RECON-P4:

> Then the other big assignment that we had this semester was putting together the customer list. So, the customer list was a, (you know, a ) work in progress that lasted basically throughout this semester and what we did was we put together a list of about a 140 names (and) from various agencies both military and non military. (personal interview, April 3, 2011)

Students had a strong desire to obtain customer information and validation as soon as possible, even sooner than the planned work for the next quarter. For example, Team RECON created a survey to gather some immediate customer information.

> We created a survey (as well) using the Excel format as well as a web-based format through Survey Monkey. So, with that information we’ve kind of gathered the input from our potential users to try to incorporate that into the technical side of the work this semester, which was the prototype development. (RECON-P4, personal interview, April 3, 2011)

**Team processes.** All student teams met at least twice per week synchronously. They had one private meeting and one meeting with their instructor. All teams, except for APP, used additional synchronous meetings on an as needed basis. This synchronous communication flow was supplemented with asynchronous communication mostly through Central Desktop.

Team APP had significant difficulty in finding a mutual time to meet since they were stretched across nine time zones. They scheduled only one meeting per week where the first half of the meeting was private and the second half was with their instructor. Team APP had a high rate of absenteeism in their meetings. When asked about team communications, APP-P1 replied:
Yeah, it's pretty difficult to be honest. We used to span multiple time zones. I think we are actually in all time zones except Mountain and then we have one person who's actually in Europe. So, the weekly meeting has especially been challenging with some people who don't have flexibility to get out of work versus, you know, the person who's in Europe, that being (up) very late at night. (personal interview, March 23, 2011)

With urging from their instructor, all student teams used a similar workflow. Issues and deliverables were tracked on a weekly basis. This tracking process was assigned to one student who was called the gatekeeper. Prior to the meeting, a list of issues was gathered either through e-mail or Central Desktop discussion threads. From that list, an agenda was created. Most decisions were made in their private meeting. Decisions and meeting minutes were recorded by the gatekeeper and placed on Central Desktop. For some teams, the gatekeeper role rotated and for some the role was permanent. For some teams, the meeting with their instructor dovetailed into their private meeting.

The meetings with the instructor were more free form than structured. Typically, these meetings took an average of 30 to 45 minutes. Students brought issues to the meeting that needed clarification or coaching and the instructor brought his own issues as well. When there were no scheduling conflicts, the researcher attended the instructor meetings with Team WIND as an observer. In these meetings, the instructor did most of the talking except when students had a prepared presentation. Observations were recorded in field notes.

In between synchronous meetings, there was a free flow of information among the students. Students heavily used Pronto, e-mail and text messaging and if needed, students would just pick up the phone and talk to each other. Students were very pleased with the functionality of GroupMe.Com. They found this service to be invaluable when coordinating team activities especially during the workday when team members may be away from their desks for an

\[13\] GroupMe.com is smartphone application that enables users to send a text message to an entire group.
extended period of time due to meetings or travel. WIND-P3 talked about the continuous flow of information:

Throughout the day as we need as things come up, we are able to handle, the kind of things on the fly. And then we do a lot a phone calls based on, you know, what people are working on so just to keep in touch (to) make sure that the coordination is happening. So there is a lot of also informal traffic going back and forth just to keep things in sync and keep things moving. (personal interview, March 24, 2011)

All teams found it relatively easy to make product decisions. Teams used a consensus driven approach. When there were differences of opinion, teams used a majority rules process or if the area involved an area where some of the students had expertise then the team would defer to the expert. The decision process in Team RUN was slightly different. In Team RUN, the Product Champion was also the sole builder of the prototype and as a result he exercised more control and influence over the process. RUN-P3 (personal interview, March 24, 2011) commented on the decision process within that team: “Our Product Champion, pretty much already had a vision of what he wanted with the device which was really good. It really kind of helped to address a lot of the question that we’ve had.”

As a consequence of a consensus driven product decision process, when asked about conflicts within their team, students reported little conflict within their team. In this context, students may have interpreted conflict as unresolved issues. Students reported three levels of conflict: 1. No conflict; 2. Conflicts that were easily resolved through a consensus driven process or 3. Conflicts that were resolved because the disagreeing parties did not feel strongly about their position.

Even though the students did not respond directly when asked about conflict, conflicts were observed through interviews and the student’s reflective journal. These conflicts fell into four categories: time, task, role and instructor.
Throughout the end of the second quarter interviews, time constraints were mentioned nine times. The most significant time constraint, mentioned three times, was conflicts with other courses. Since the program was being offered in both a one-year intensive format and a part time format, the intensity of student academic course work varied widely. During the quarter, some students were taking the Intellectual Property class and the Accounting class both of which were very time demanding. On the other hand, some students were not taking any academic courses at all. As a consequence, the time that students spent on the I-cubator course sequence varied. At times some students were not very responsive. Students also mentioned that they felt there was a time conflict trying to fit their project development schedules into the timelines that were dictated in the syllabus. Even though the I-cubator course development sequence was an experiential program, students were required to produce very specific deliverables at specific times. This was done for both grading purposes and as a means of providing the structure that is required to keep online students on track. Students also mentioned that the high synchronous component of the program had created a conflict with their family life.

The teams made an effort to balance the workload among the team members. There were strong workload conflicts in Team APP and more minor workload conflicts in Team RUN. Team APP’s conflicts involved team members APP-P3 and APP-P2. This was voiced by the higher performing members of Team APP (APP-P1, personal interview, March 23, 2011; APP-P4 personal interview, March 21, 2011). This was also voiced in the reflective journals of members of Team APP.

From the outset of Quarter 2, APP-P3’s participation in the weekly discussion boards was weak. Inside Team APP, members reported that APP-P3 had consistently taken on tasks and not delivered (personal communication, March, 2011). Worse yet, APP-P3 did not communicate any
reason for this to the rest of the team (personal communication, March 2011). In Week 6, APP-P3 decided to drop from the *I-cubator* course sequence but remain with the TC program. When asked about the reason for withdrawal APP-P3 (personal interview, March 15, 2011) cited a challenging travel schedule and long meetings with clients. APP-P3 was also in the hospital for a week during Quarter 1. APP-P3 also cited some dissatisfaction with the program during Quarter 2 citing his contribution to the venture was very similar to what was being done during his day job. Additionally, APP-P3 was having difficulty getting used to online learning technologies.

The withdrawal of APP-P3 resulted in a shuffling of work assignments within the team as other team members had to pick up APP-P3’s work assignments.

The conflict with APP-P2 was less severe (personal communication, March 2011). Team members noticed that the work output and quality of APP-P2’s work was less than the rest of the team. Several team members noted this in their reflective journal. One such entry said, “Where is APP-P2?” At the same time, APP-P2 posted in his journal that he did not appreciate the way he was being treated by other members of the team (personal communication, March 2011). Team APP decided that they would confront APP-P2. A meeting was held where one team member chaired the meeting while another team member represented the team’s point of view. The team was surprised that APP-P2 cited a lack of equity in the venture as a reason for the lack of commitment. After the meeting, it appeared that APP-P2’s performance improved but not enough to satisfy the other team members.

In Team RUN, the conflict centered on RUN-P4 and the Product Champion RUN-P1. In Quarter 1, RUN-P4 cited some dissatisfaction with the program when he was not assigned his first choice venture. He preferred to work on a digital media venture (personal interview, December 10, 2010). RUN-P4 did not express this dissatisfaction to the instructor as the
instructor presented team assignments as a final decision. RUN-P4 also cited an immediate personality clash with RUN-P1 (personal interview, December 10, 2010). During the quarter, RUN-P4 was both the gatekeeper and fabricator of one of the team’s presentations. Both of these tasks required the cooperation of the other team members. RUN-P4 cited two incidents where he received no response from team members for many days resulting in personal frustration. In citing this frustration, RUN-P4 said he knew he needed to be patient because the other team members were busy with their academic courses but it was still frustrating (personal interview, March 28, 2011).

The individual students had differing perspectives of their I-cubator course work. For some, they felt that they were working at a start-up and hoped to have residual benefits from the program that would help them start their new venture post-graduation. For others, the program was purely an academic exercise within a master’s program. It was easy for those with this viewpoint to cap their efforts in the program. As a result, the commitment and quality of the work done within the venture team varied. This sentiment was expressed by APP-P4:

One other things that we had found challenging is trying to keep everyone in the team, giving the same amount of effort. So while the overall deliverables I think have been more than satisfactory, the level of involvement from all the team members has… and a lot of it is because, you have people that join the team with the intention of making this a business and then doing something with us. And other people are looking at this as just an academic exercise. (personal interview, March 21, 2011)

During Quarter 2, there were several minor conflicts with the I-cubator instructor. The most intense conflict was with Team RECON (personal communication, March, 2011). The instructor had added an extra task for each team to perform at the last minute outside of the normal course workflow. This task was not in the syllabus nor was it in the expected place in Blackboard. As a result, Team RECON did not pick up on this new task and had to manage the assignment as a crisis. However, they were the only team that missed the assignment. This
miscommunication resulted in Team RECON challenging the validity of the task and challenging the authority of the instructor. A meeting was held with the program director to listen to everyone’s concerns. After both sides had aired their feelings, Team RECON and the instructor settled back into a more productive relationship.

**End of Quarter 2 evaluation and reflection.** Students (9 out 15 [60%]) expressed satisfaction with the overall program at the end of Quarter 2. Students were happy with the congruence between their expectations and what the program was delivering. This was expressed by RUN-P1:

I am very actually, very excited and, and I’ve, I’m surprised that I am learning so much in such a little amount of time. I’m much more satisfied with this program than I would be if I pursued an MBA. (personal interview, March 22, 2011)

They were also happy about starting to learn about the technology commercialization process. This was expressed by APP-P4:

I think it’s great, I mean it’s really exciting to be able to put some of these documents together and see what the processes (are) and some of thinking is behind (some of) these documents and watching how this can develop into a business. (personal interview, March 21, 2011)

In reflecting on their work in the I-cubator course sequence, students expressed a level of satisfaction (11 out of 15 [73%]). One of the drivers of this satisfaction was their accomplishment on their venture. APP-P1 was pleased with his team’s accomplishments on the PRD:

As far as the quality of work it’s very high. I spent a lot of time writing PRDs and I thought that the one that we presented was excellent. It’s extremely comprehensive. I think (it’s) close to 30 pages and (a) lot of market research. (personal interview, March 23, 2011)

Other teams evaluated their accomplishments by the construction of the prototype. Team RUN was pleased with their progress but disappointed in not completing the prototype. Since
Team WIND actually completed a prototype, they were very pleased with their progress. This was mentioned by WIND-P4:

I think, I think that we have quite a bit to be proud of. We have a real working prototype that should be done earlier this week that we are going to test and then send out to the field for testing as well. (personal interview, March 21, 2011)

Another member of WIND also expressed satisfaction with the social value of their accomplishment:

So, we are just really, I would say excited and very cognizant of the fact that this could have a good impact in the market for what needs to be done which is having more reliable wind energy. (WIND-P2, personal interview, March 4, 2011)

Students (6 out of 15[40%]) expressed sentiments of dissatisfaction or sentiments about how the program could be improved. Approximately half of the comments were related to the instructor’s style, lack of clarity and organization of material and unclear grading criteria. The remaining comments were split among: intense workload, dissatisfaction with synchronous meetings and dissatisfied with the work distribution in the team.

At the end of Quarter 2, the same two surveys that were administered at the end of Quarter 1 were administered again. The results for both Quarters 1 and 2 are shown in Tables 9 and 10. For Teams APP and RUN, the teams that were developing their own prototype, their sense of community went down. The team’s satisfaction with the outcome of their work, however, remained the same as it was at the end of Quarter 2. (See Table 10.)
Table 9

**Quarters 1 and 2 Mean Classroom Community Survey Results**

<table>
<thead>
<tr>
<th></th>
<th>QTR 1</th>
<th>QTR 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td>Cohort Overall</td>
<td>58.63</td>
<td>58.00</td>
</tr>
<tr>
<td>Team RECON</td>
<td>55.00</td>
<td>55.50</td>
</tr>
<tr>
<td>Team APP</td>
<td>61.75</td>
<td>56.00</td>
</tr>
<tr>
<td>Team RUN</td>
<td>61.25</td>
<td>58.00</td>
</tr>
<tr>
<td>Team WIND</td>
<td>56.50</td>
<td>56.50</td>
</tr>
<tr>
<td>From Rovai</td>
<td>56.62</td>
<td>56.62</td>
</tr>
</tbody>
</table>

Raw scores vary from a maximum of 80 to a minimum of zero. Interpret higher scores as a stronger sense of classroom community.

Table 10

**Quarters 1 and 2 Mean Student Satisfaction with the Outcome of their Project**

<table>
<thead>
<tr>
<th></th>
<th>Overall</th>
<th>Team RECON</th>
<th>Team APP</th>
<th>Team RUN</th>
<th>Team WIND</th>
</tr>
</thead>
<tbody>
<tr>
<td>QTR 1</td>
<td>4.13</td>
<td>4.00</td>
<td>3.50</td>
<td>4.00</td>
<td>5.00</td>
</tr>
<tr>
<td>QTR 2</td>
<td>4.07</td>
<td>4.00</td>
<td>3.50</td>
<td>4.00</td>
<td>4.75</td>
</tr>
</tbody>
</table>

A five point Lickert scale was used:
5= Highly satisfied
4= Satisfied
3= Neither satisfied or satisfied
2= Dissatisfied
1= Highly dissatisfied

**Quarter 3.** The major objective for the student teams in Quarter 3 is to validate their product concept and business model by meeting with potential customers, domain experts, partners, and distribution channel members. Central to these meetings is showing, demonstrating and beta testing a prototype. Through the prototype, teams can establish a level of credibility, which is necessary to earn the commitment of time and energy that is required to obtain review and feedback from customers and domain experts. Students take this feedback and compare it to their existing notions of their product concept and business model. Honig (2004) refers to this
process as assimilation. With this data, student teams can make changes to improve their product; add specificity to their product; and improve their business model. Honig (2004) referred to this change process as accommodation. Student teams work towards creating a business plan that is grounded in validated facts obtained from customers and other external sources. In the TC program this is referred to as a customer-validated business plan. This customer validation process distinguishes the TC program from competing business program alternatives.

In Quarter 3, the TC curriculum requires customer validation to be done with a previously constructed prototype. Coming into Quarter 3, only the WIND venture had completed a working prototype. As a result, to comply with the curriculum, teams RECON, APP and RUN needed to simultaneously work on prototype development and customer validation. This posed some challenges which will be discussed in more detail later in this section.

Prototype update. Before discussing validation, it is necessary to understand the prototype work that continued into Quarter 3. The efforts of each team will now be discussed.

Team RECON had the fear that the prototype development could unravel if their student engineering team left to pursue other careers after they graduated. They were also worried about losing the lab space that they had secured at the university. However, these fears did not come to fruition. When the development team graduated, all except one member decided to stay on and pursue graduate degrees at their university. The departing member left the team due to personal issues and his decision did impact the prototype development schedule. The development team also secured use of the lab space for the foreseeable future. Even with this stability, managing the development team remained an issue since they were geographically separated from the rest of the team. RECON-P1 described this situation:
One of the things that we definitely learned is that these long distance team relationships are difficult, especially when people have a competing set of objectives. You know that the development team, because they are not in our program. Their success is not tied to our success and that’s probably the biggest risk and definitely the biggest hindrance to success. (RECON-P1, personal interview, June 21, 2011)

The RECON development team also solved the last remaining technical problems which was with the helicopter blade hinge mechanism. They also made improvements to the blades themselves. The prototype was fully assembled and the helicopter was able to fly around the lab at 15 mph. (The end goal for the prototype is to fly at 45 mph.) The helicopter could be dropped from someone’s hand and fly before hitting the floor. More software needed to be written to improve the stability of the helicopter in flight. The date for the final prototype with a helicopter launched from the rocket tube was reported to be some time between September and December. However, the team produced an early demonstration video of the helicopter flying in the lab.

Team RECON continued to worry about destroying materials during testing since they were on a low budget. RECON-P2 first described this issue in his Quarter 2 interview and further elaborated in his Quarter 3 interview:

We do have a video and we are not concerned with the helicopter flying. It’s pretty cool. But I guess one of the major issues that we currently face is, we are really worried about if we were to take this outside and do a full rocket launch in the air and have the helicopter deploy. What if something happens? We are kind of running low on budget. So that's the kind of the fatal things that we are kind of working in parallel, but we do have videos which show that the helicopter is flying. (RECON-P2, personal interview, June 23, 2011)

Team APP’s situation was much different. They had both the problem of few engineering resources to build the prototype and constantly changing business direction. The prototype development effort degenerated to only one student. At the same time, their business model kept constantly changing as they learned more information about the competitive environment. They were struggling with how to develop an application that customers would buy at a profitable
price. This created a stressful situation, as the team made less progress than they had hoped for. Their product consisted of two parts: an application server which ran in the network cloud and an application that ran on a user’s smart phone. As a result of insufficient staffing and changing direction, only the application server was completed. No work was done at all on the smart phone application. This work was scheduled to be completed at the end of the fourth and final quarter of the TC program.

For Team RUN, the project champion was designing the prototype. Since he was not an electrical engineer, this was a learning experience. A three-phase strategy for prototype development was created. The first phase was a three-dimensional (3D) drawing of the product. The second phase was a rather large, one-inch square prototype with wires to LED indicator lights. In the third and final phase of prototype development, a much smaller integrated product was going to be developed that could actually be used in a running shoe. The Product Champion struggled with basic design issues that would be common for a newly minted engineer. As these struggles intensified, the team first asked the Product Champion to focus solely on the development of the prototype. But because this was a skills issue, this singular focus did not resolve the issue. Finally, the team agreed to outsource the remaining development of the prototype to an outside contractor. This cost the team $1000 and they all shared equally in the cost. This led to an acceleration of the prototype development. An actual complete and functioning prototype was to be delivered at the end of Quarter 3. The Product Champion reflected on this experience:

As a team, we had to kind of wrestle with this. And finally, I gave in to my own arrogance and said, all right, so we will go ahead and outsource that, or we will go ahead and contract the design of this board. And that’s where we went from the Radio Shack stuff and purely Digi-Key stuff. And so we hired an electrical engineer. When I asked him, hey do you know how to do this stuff, and he was like, oh, I use this program all the time. He knew how to do it. And so within a week, (we had had from him that) he
actually resolved some of the technical issues about switching, the bounce you get, and the errors that had occurred. (RUN-P1, personal interview, June 17, 2011)

The last team to be discussed is Team WIND. They had the easiest effort in updating their prototype. While they had a functioning prototype, they made some small improvements in their materials to improve manufacturability.

Validation. The validation efforts consisted of finding and contacting customers, assimilating information and making accommodations based on comparing new information with previously held beliefs and concepts. Each team was encouraged by their instructor to reach out to over 100 contacts.

Team RECON actually contacted 153 potential customers, domain experts and partners. They met with people face-to-face, through e-mail and by phone. An interview script was developed to guide each customer interaction. Additionally, an online survey was developed to capture demographic information. Contacts were moved through a five step sales process that was developed by one of the students who is a salesperson in a high technology company. These contacts were primarily former generals and military officers. The list of these contacts was developed by one of the students who works in the military industry and is a former service academy graduate. To supplement their outreach efforts, contacts were referred to an external web site that was developed by the students.

Shortly after the helicopter started flying in the lab, a demonstration video was produced for potential customers. While the development team was impressed with their video, potential customers were less impressed as their expectation was a working prototype where the helicopter was launched from the rocket. The lack of a complete functioning prototype was making it difficult to maintain both credibility and customer interest. RECON-P1 described this problem:
We thought we'd be further along and when we initially went out and talked to our customer base. We said, hey we’re going to have a prototype and some video and some things we can show you. And they said, hey that’s neat, that’s great, get back to us. (and) What we have kind of found is that we’re limping along trying to get to the point where we have something new to show them. (RECON-P1, personal interview, June 21, 2011)

Team APP reached out to customers through social networking by using Facebook and LinkedIn. Since Team APP did not have a prototype, their discussions with customers were more about concepts rather than a product, business model or company. APP-P4 expressed some frustration with the validation efforts:

Part of the difficulty is that, you know, we’re soliciting feedback from customers (who are) (and) actually having something there for them to look at. So we are kind of designing around, you know, ideas. We give them our thoughts on what we are trying to build and, you know, they tell us like, you know what it would be cool if you did this, it would be cool if you did that, or this I wouldn’t be too crazy about. (And) We’re kind of building based on that. Kind of a I don’t know how to explain it. It’s not really valued feedback. It’s not feedback on our product but, just feedback on the ideas. (APP-P4, personal interview, June 20, 2011)

Team RUN developed extensive and comprehensive methods for contacting customers. They started first with friends who were runners. Subsequently, they reached out to running clubs and they went to road races where they networked during pre-race and post-race events. They also had networked to the president of the Independent Retailer’s Association and built a relationship with a strategic retailer called Road Runner Sports. The student team also attended trade shows where running shoes would be promoted. Lastly, Team RUN used Facebook to reach out to running enthusiasts. At first, they received a tepid response on Facebook. But after running a $200 advertisement on Facebook they quickly had a list of over 200 friends.

In a similar manner to Teams RECON and APP, the lack of a complete prototype diminished credibility and slowed down the validation process. RUN-P4 described this problem:

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\textsuperscript{14} Road Runner Sports has a significant mail order business in running shoes, accessories and apparel. Their flagship running store is in close proximity to one of the team members.
I would say the whole team kind of felt the same way that we kind of felt stuck in the water because we didn’t know how far we could progress asking customers our series of questions; because overwhelmingly we were getting positive feedback that was a great thing. But, by the same token it made us concerned that all we’re doing is talking to them about a product that we don’t have anything to demonstrate. And that concerned everybody because, as far as we were concerned, we were selling them snake oil (personal interview, June 24).

Team WIND also developed a set of comprehensive methodologies to reach out to customers. Team WIND made 110 contacts to 90 different organizations during Quarter 3. Contacts were made in person, by phone and by e-mail. Team WIND’s contacts consisted of industry sources, academics and researchers, competitors, and national organizations. These contacts were developed from a variety of sources. Some contacts were easily developed through networks available to them from their place of employment or from their industrial partner. Additional contacts were developed through the Internet, personal networking and by networking at tradeshows and industry forums.

Although Team WIND had developed a prototype, they also hit some barriers not related to the prototype in getting feedback from customers. Some of their problems were caused by their management philosophy. Team WIND took a very conservative view of intellectual property. They decided that they could not divulge any details for the product, even under a non-disclosure agreement, until they applied for a provisional patent. This limited the feedback that a customer could provide. Once they applied for the patent, much more information was exchanged with the customers resulting in more meaningful data and feedback.

At the beginning of Quarter 3, Team WIND was scheduled to start two customer beta trials. However both customers backed out for tactical reasons. Members of Team WIND had extreme demands from their professional careers during this quarter. With the large effort that was put into contacting customers, there was not enough time to develop an immediate set of
replacement customers for beta trials.

Despite any problems the teams were having with their prototype, each of them worked towards customer validation as required by the Quarter 3 syllabus. With a flow of information established from potential customers to the student team, the validation process became one of assimilation and accommodation. In the TC program, the assimilation-accommodation process was implemented through beta testing with the customer. While none of the teams were successful in launching a beta test during Quarter 3, all of the teams learned about their product concept and business direction through customer engagement. The accommodation process had an immediate impact on items such as product focus and marketing direction implementation. However, when changes to the prototype were needed they had to be scheduled for a later date.

Team RECON learned about product features. Customers provided feedback that they were worried that an enemy could shoot down the helicopter. To accommodate this, the helicopter flying altitude would have to been increased from 900 feet to 1500 feet and the flying speed would have to be increased from 15 mph to 45 mph. Additionally, customers wanted the students to investigate the use of stealth technology to avoid helicopter detection by radar. Customers also asked for thermal imaging capability for better detection of the enemy and for a small weapon delivery system to eliminate identified enemy targets.

The most significant learning for Team RECON may have come from their efforts to test their business concept and plan with two local business plan competitions. There were two goals in presenting at the competitions. The first goal was to raise more money and the second goal was to have an independent business audit. Team RECON was turned down from both efforts. In one effort, they were told that they needed a functioning prototype. In the other effort they were told that they needed industry expertise on the venture team. To accommodate this, Team
RECON formed an advisory board and recruited their first member who was a retired general. Team APP learned about their business model. As they learned about their business model, they made major accommodations by changing the design of their prototype. This resulted in delays. APP-P2 expressed disappointment with their progress:

We did not get as far as we would have originally liked to the prototype product and the reason for that is because our business model kept changing. We weren’t sure if the direction we were heading in the business model was viable or feasible as we had originally planned to be. (APP-P2, personal interview, June 26, 2011)

The original focus for Team APP was to develop a location aware application that could be used in a business-to-business environment. One of the problems with this concept was the ability to get market data to support the validity of the concept. APP-P4 commented on this problem:

Three or four months ago we were, when we first started that was project the product (our) focus was to develop a marketing network. From the perspective of developing, (you know) an advertising business off of this platform. And it became very difficult to get the data that we needed to validate that business model. (APP-P4, personal interview, June 20, 2011)

Also during Quarter 3, additional instability was introduced when Apple introduced a product that was similar to the Team APP application. At the same time, Team APP was receiving feedback that they had to support multiple mobile phone software platforms. As a result, Team APP made two major changes to their product direction. First, they switched their focus from developing for the iPhone to developing for the Android Google phone operating system since Android ran on many mobile phones from different manufacturers. Secondly, they switched focus from business-to-business to end-user. These incremental changes in the product direction made it difficult for team members to feel comfortable with their focus. APP-P1 talks about the challenges of the APP venture: “This is definitely been one of (I would say that) the challenges with this project, the shifting focus and the inability to kind of nail down scope on
what the product is” (APP-P1, personal interview, June 23, 2011).

The delays in product definition and the development of the prototype put Team APP out of sync with the TC program curriculum and the other teams. The curriculum specified that Quarter 3 was to be validation followed by business planning in Quarter 4. However, Team APP was still working on product ideas, a Quarter 1 deliverable and product requirements which was a Quarter 2 deliverable. The students started to question whether they could be successful within the curriculum as specified. APP-P4 expressed this challenge:

It’s been very challenging to develop this product. Just because, you know, we (are) trying to follow along with the curriculum. But, the curriculum is really focused on getting something out to an investor (you know, something, some type of) developing the business model first as opposed to developing the product. (APP-P4, personal interview, June 20, 2011)

Other students expressed that they felt boxed in by the curriculum in the wake of having to make significant product changes. This sentiment was expressed by APP-P1:

Like, you know, you always need a place to start. But I guess at, at times we sort of felt like, well we are on this trajectory and we can't really change, either because we didn't feel like there was enough time to go back and change or because we felt like we were going to get too far behind. So anyway that was a kind of a challenging scenario to get through, where I think if this was in a more real-life scenario you know, we would do that even at the cost of maybe delaying the product launch or something but we can’t really delay the semester or delay the graduation or delay the, you know, the end of the program. (personal interview, June 23, 2011)

As a result of a lack of synchronization, students start to lose their sense of purpose as it relates to the program. Students began de-committing from program goals. This was expressed by APP-P2:

There was only three months to do this product germinating so to speak in maybe a four or five month time period. And trying to squeeze this germination into three months resulted in a number of shortcut(s) and resulted in feeling more like a student project as opposed to growing a venture. (personal interview, June 26, 2011)
As a result of this, Team APP changed their focus from business to engineering. They were determined to engineer the product first and then determine business models and a business plan for the venture. This course ran counter to one of the goals of the TC program which was to let the customer and business plan drive the product development. This new direction was expressed by APP-P4:

But we figured if we can build the application we can generate the interest from the users the, you know, the business model will follow. I think a lot of successful ventures have started the same way. I mean Twitter was that way. It wasn’t necessarily planned to be a business model but, this thing exploded overnight and now, you know, everybody using this thing. (personal interview, June 20, 2011)

Team RUN started their process of assimilation-accommodation when they learned that the Product Champion could not develop the prototype on schedule and they had to hire an engineer to complete the task. Through their customer engagements, Team RUN assimilated feature attributes about the product they were developing. The number one concern from runners was would they feel the sensor in the running shoe while they were running. Team RUN did to a test among themselves with an early version of the prototype and they discovered that it couldn’t be felt unless it was installed in ultra-lightweight running shoes that are primarily used for competitions. They also learned that the end-user price should be approximately two times what they pay annually for their socks. That set the price to be between $15 and $25. Retailers told Team RUN that they required a 60% margin. This enabled Team RUN to determine their product cost. Team RUN also was informed that they should be wary of feedback from runners in Boston. Due to the influence of the Boston Marathon, runners in the Boston area were well informed when it came to running injuries and they were very pragmatic in injury avoidance. However, runners in the rest of the country would not be as aware that running on worn out shoes can lead to serious injury.
Team RUN discovered that retailers and consumers required different types of prototypes. Retailers think very strategically about a new product and what it might mean for their business. Retailers were hungry to get any information they could about a new product or future trends. They were comfortable commenting with 3-D drawings or a preliminary prototype. On the other hand, end consumers could only relate to a final complete and polished product. They paid little attention to the 3-D drawings and provided only marginal feedback. RUN-P1 describes his experience with the 3-D drawings:

So the problem the whole team was having is that when you go to runner customers and you say to them, I have a 3D model, can you imagine this in your shoe that I guess so, you know, it’s too imaginary. At that point and the rest of the team pushed me that we really need prototypes that we can actually take the runners (personal interview, June 17, 2011).

When consumers were viewing the large unfinished intermediate prototype they kept interpreting it as a final product and as such it created a negative impression. RUN-P2 described his experience with it “it just looked, you know, large and sort of Frankenstein looking” (RUN-P2, personal interview, June 23, 2011).

Despite these problems with prototype, Team RUN learned more about running shoe distribution channels. They learned that it was very difficult to get a new product into running retail stores and that the Internet may be a better channel for selling their product. They also learned that many people were willing to help them with the development of their venture. For RUN-P4 who at times was an outspoken critic of the project, this was quite uplifting:

This has been the most enjoyable semester of this capstone element so far. It’s been very rewarding. One thing that I will remark, talking to both consumers and retailers alike, the one response I have been, I shouldn’t say the one response, but, one of the most positive rewarding feedback I have been getting has been such a willingness to want to help us. I have always read that people want to help young businesses succeed. But, it’s the first time I’ve really experienced it and it’s been very positive (personal interview, June 24, 2011).
In the beginning of the program, RUN-P4 struggled with the distributed nature of the program and the project. But after completing Quarter 3, RUN-P4 saw significant value in learning how to work in a distributed environment:

One of the most intangible benefits of doing this Capstone that I wouldn’t have thought of going into the Capstone in the team environment is working in a distributed environment. That’s another big thing that I am taking away from this. This is both challenging, but, boy am I, I feel like I am learning things that I can’t quite define yet. (and that’s been ) I know that I am going to take a lot away from this and be able to apply it in future work (personal interview, June 24, 2011).

Through their attempts to find beta customers, Team WIND learned that the wind energy industry is very conservative. They are risk adverse to any technology improvements if there is even the slightest chance that it could affect their uptime in delivering energy. This was described by WIND-P2:

In the wind energy industry, it’s a little bit segregated from the rest of, I would say the energy industry. (is probably a little more so) The reliability considerations that they are addressing. (but ) They are very resistant to change. (personal interview, June 17, 2011)

Team WIND also learned that while their value proposition seemed overwhelming to them, customers wanted to see test data in a side-by-side comparison before they would agree to use the product. Additionally, customers were reluctant to be the first one to install the product. This situation was described by WIND-P3: “They want(ed) to see it live in another customer first. They don’t want to be the first customer. But I think that a trial at a university would provide solid results and hopefully entice in any group of customers” (WIND-P3, personal interview, June 20, 2011).

Team WIND made several accommodations to this situation. First, they directed their marketing focus to the owner-operator wind turbine market as opposed to the manufacturers. The idea was to pick off early adopter customers and then build a customer base that could be used as references to sell to wind turbine manufacturers. Additionally, the first beta trial should be at a
university owned wind turbine since turbines in this environment are used for both research and power generation. As such, these owners are the least risk adverse of the owner-operators. Team WIND learned that the sales cycle will be long and would require significant sales support. As such, a small focused direct sales force would be required. To support their initial selling efforts, Team WIND did financial modeling to demonstrate their value proposition. This model demonstrated a return on investment by reducing the number of service calls. They also created an external website that was used to supply marketing collateral and a survey of their prospects.

Unlike the other student ventures, Team WIND’s product design was almost universally accepted by the prospects that they talked to. They learned that in the future, as a product enhancement, they could connect their product to the electronic device that monitors the critical parameters of the wind turbine performance. They also learned that at times oil could blow back out of the gearbox creating extreme contaminates. A small design change would have to be made in the future.

With their success of talking to prospects, Team WIND was getting more visibility with their industrial partner and as a result the partner wanted to accelerate the commercialization process. Depending on the product volumes, the venture was on a path to becoming a new product, product line or a new division.

**End of Quarter 3 evaluation and reflection.** During their one-on-one interviews at the end of Quarter 3, students were not specifically asked about satisfaction. It was felt that this interview would be too close to the end of the program interview and students would wind up repeating themselves thus clouding the gathering of data. This evaluation and reflection was constructed through the other interview questions, reflective journal entries and a survey.
The work this quarter was characterized by the development of the prototype, customer validation and other team accomplishments. For Team RECON, they made progress on their prototype and they had two meaningful external engagements with business plan competitions. The feeling on the team was that through all of their hard work, the project was coming together.

For team APP, they were experiencing a myriad of problems. They had a shifting business model, one team member was making a minimal contribution and their prototype effort had been reduced to contributions from a single team member. Team APP was no longer able to effectively keep their project in sync with the TC curriculum and the other teams in the program.

For Team RUN, the quarter was characterized by the ineffective prototype development that was being done by the Product Champion and the decision to switch to a contract engineer near the end of the term. For Team RUN, a functional prototype was being delivered at the very end of the quarter therefore it provided no results within the quarter.

For Team WIND, through their industrial sponsor, they had the most amount of support. They started the quarter with a complete prototype and they were able to devote all of their time and energy to business development and customer validation even though they failed to start a beta test.

The end of Quarter 3 survey results are shown in Tables 11 and 12. For sense of community, there was sharp increase for Team WIND (56.50 to 66.75, +18.1%) and there was sharp decrease for Team APP (56.00 to 46.00, -17.9%). However, this number may be low since one of the three team members did not participate in the survey. However, this data is consistent with the data that had been gathered about these teams and their performance. At the same time, Team RUN saw a decrease in their satisfaction with the outcome of their project (4.0 to 3.5, -
12.5%). This is consistent with the struggles that Team RUN was having in the development of their prototype.

Table 11

*Table 11: Quarters 1, 2 and 3 Mean Classroom Community Survey Results*

<table>
<thead>
<tr>
<th></th>
<th>QTR 1</th>
<th>QTR 2</th>
<th>QTR 3</th>
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</thead>
<tbody>
<tr>
<td>Maximum</td>
<td>80</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td>Cohort Overall</td>
<td>58.63</td>
<td>58.00</td>
<td>59.50</td>
</tr>
<tr>
<td>Team RECON</td>
<td>55.00</td>
<td>55.50</td>
<td>59.50</td>
</tr>
<tr>
<td>Team APP</td>
<td>61.75</td>
<td>56.00</td>
<td>46.00</td>
</tr>
<tr>
<td>Team RUN</td>
<td>61.25</td>
<td>58.00</td>
<td>59.00</td>
</tr>
<tr>
<td>Team WIND</td>
<td>56.50</td>
<td>63.00</td>
<td>66.75</td>
</tr>
<tr>
<td>From Rovai</td>
<td>56.62</td>
<td>56.62</td>
<td>56.62</td>
</tr>
</tbody>
</table>

Raw scores vary from a maximum of 80 to a minimum of zero. Interpret higher scores as a stronger sense of classroom community.

Table 12

*Table 12: Quarters 1, 2 and 3 Mean Student Satisfaction with the Outcome of their Project*

<table>
<thead>
<tr>
<th></th>
<th>Overall</th>
<th>Team RECON</th>
<th>Team APP</th>
<th>Team RUN</th>
<th>Team WIND</th>
</tr>
</thead>
<tbody>
<tr>
<td>QTR 1</td>
<td>4.13</td>
<td>4.00</td>
<td>3.50</td>
<td>4.00</td>
<td>5.00</td>
</tr>
<tr>
<td>QTR 2</td>
<td>4.07</td>
<td>4.00</td>
<td>3.50</td>
<td>4.00</td>
<td>5.00</td>
</tr>
<tr>
<td>QTR 3</td>
<td>4.21</td>
<td>4.25</td>
<td>3.67</td>
<td>3.50</td>
<td>4.75</td>
</tr>
</tbody>
</table>

A five point Lickert scale was used:
5= Highly satisfied
4= Satisfied
3= Neither satisfied or satisfied
2= Dissatisfied
1= Highly dissatisfied

**Quarter 4.** In Quarter 4 of the TC curriculum, students create a business model, business plan and an investor presentation. For the cohort of students understudy, Quarter 4 was delivered in the summer term which is only eight weeks rather than the normal 12. As a result, students had to perform assignments and tasks that were much more amenable to a 12 week quarter. In addition, some students were taking in parallel two academic courses also on a compressed time
line. These factors, coupled with the normal interruptions that occur during a summer quarter, created challenges and a stressful situation for the students. In anticipation of this, the students were supplied advanced instruction on business modeling and planning in Quarter 3.

At this point in the program, students were completely self-managing their projects at the same time they were performing tasks and completing deliverables as outlined in the TC curriculum. While the compressed nature of the summer quarter made this quarter more of a “clean-up,” students performed tasks beyond what was outlined in the curriculum. The teams knew that there was uncertainty about the future of their venture and whether or not they would be working together after the program concluded.

Team RECON continued to work their customer engagements and to evaluate which business segment would be most appropriate for initial market penetration. At the same time, the engineering team worked on cost estimates that were required for the business plan and development tasks that were required to complete the prototype. The final item to be completed was the autopilot stabilization software for flying the helicopter. The prototype completion date was currently September.

At the end of Quarter 3, the Product Champion for Team APP relocated from Barcelona back to the Boston area. This reduced the time zone span of Team APP from nine to three. By the end of Quarter 4, Team APP has completed all of the development work on the mobile client. This coupled with their previous work on server infrastructure gave them a complete product but not in time to test it with customers before the end of program. Even with the completion of the prototype, Team APP continued to struggle with strategy and the development of an effective business model. This was exemplified when APP-P2 described his work during this quarter:

I focused on specific areas of business model requirements and financial and pricing and distribution strategy. So, it was, I guess, tying up a lot of loose ends in trying to get a
cohesive strategy by factoring all of (the, all of) the different components of the program (personal interview, August 17, 2011).

In Quarter 4, Team RUN took the prototypes that were completed in third quarter and sent them off to earlier identified beta testers for form, fit and function testing. Each beta tester was asked to fill out a survey. While they did not learn anything new from the feedback, it did serve as a reaffirmation of their product concept and value proposition. This proved to be reinvigorating for the team as they received satisfaction in overcoming significant hurdles toward this objective. RUN-P1 was responsible for the beta testing and described the process that was used in the beta test:

So, I have three prototypes in circulation right now. (I actually had given one of) So what I did with the prototypes is that I would simply hand them to them. They would take these prototypes. I would describe, there is a little button you press and it shows up the LED so they can figure out how many miles they ran, and they put them inside their shoe. So anyway, I would hand it to them, I would instruct them on how to use it and then they would go off. And during the week when in their normal run they would, they would lift up the sock liner of their shoe and insert it according to how I instructed them. I didn’t actually show them. I just kind of instructed them. Apparently all of them, in their survey results indicated that it was very easy to install. They went for, but we asked them to run for half a mile at least, and many of them went for their full runs, multiple miles, and came back and filled out a survey, removed the prototype from their shoe and sent it back to me. Either I picked it up physically or people dropped it in the mail and that kind of stuff. (personal interview, August 17, 2011)

RUN-2 has assumed a lot of the marketing responsibilities for the team. In that light, RUN-P2 analyzed the feedback from the beta testers. RUN-P2 the described feedback from the beta test:

We didn’t learn a whole lot new except for what we had anticipated. Our competition is not as strong as we had thought. So we thought that smart devices would replace the functionality of what we were trying to do and we were honestly surprised that not a single person we had interviewed used the smart phone for either logging their miles or doing any sort of…or keeping track. So, I thought that was kind of interesting. In terms of price, we were right on the money, I think. It’s…everybody…using the range of $10 to $20 in terms of what they would be willing to pay. So, that was not really a surprise. And really…I think that more than anything else we were concerned with the size of the unit and whether they could feel it in their shoe. So that’s something that we can really take a guess on but I think we’ve been surprised that a lot of people can’t really feel it in their
shoe. So that’s a good thing and that was probably our biggest concern. (personal interview, August 20, 2011)

Team RUN also revisited their marketing plan with a focus on increasing their revenue.

Team WIND continued to make some minor improvements to their prototype. They also worked on developing a package that would facilitate the process of handing off the project to the sponsor. These activities included additional work on the product animation, executive summary, sales literature, marketing collateral and market analytics that was derived from their customer information.

*Comparison of prototype efforts.* Three of the fours teams, APP, RUN and WIND had managed to complete a prototype. Team RECON was disappointed that they did not complete this task. They had suffered a scheduling setback when one of the engineering students left the program. This student was responsible for the blade hinge mechanism which was the cause of problems late in the prototype development effort.

Of the four teams, only Team RUN was able to build a prototype; do a beta test; and get feedback from users. Team WIND was positioned to do this at the beginning of Quarter 4 but with a high amount of business travel for team members, this task was deemed lower priority than creating a sponsor transfer package.

*Business model and business plan.* The teams started developing their business plan and business model from the templates and lectures that were supplied to them as part of the scaffold. Most has started doing this in Quarter 3 when the materials were given to them. The business plan template manifested itself as a set of 15-20 suggested PowerPoint slides. The presentation outline is shown in Appendix J. The students were instructed to use this template as a starting point and then to create a 15 to 20 minutes streamed multimedia presentation which could be easily reviewed by external reviewers or investors. The presentation outline was derived from the
program director’s personal experience, Internet research and consultation with local venture capitalists.

All of the teams used the financial model that was supplied to them in their finance class. The model manifested itself as a multi-sheet Excel spreadsheet. This model was developed from (Cornwall, Vang, & Hartman, 2009). At this point in the program, students were behaving in an independent manner. All four teams did their own research on business planning which was a new activity for them. Only one student, APP-P2 had prior experience in developing a business plan. For the students, this was an “eye-opening activity.” RUN-P4 described his experience with the business planning process:

It was just very eye-opening, just seeing all these interrelationships and how the process is. The interdependent processes end up being able to demonstrate how you are able to make a business profitable, depending…with all the inter-connective processes. We had an illustration that defined interrelationships (between) that go from engineering to manufacturing, to assembly, as well as our cost, as well as how we get to the consumer, both in terms either consumer direct as well was our retail channel as well. (personal interview, August 17, 2011)

The teams had active discussions among themselves and they actively sought feedback from their instructor and classmates. They worked to combine what was learned in the I-cubator with the learning from their academic classes. RECON-P1 described the interactive process with the team:

We had a series of meetings. We'd meet on Sundays. We'd meet with the instructor on Wednesdays. And if we had to, we'd call the engineering team on some of the evenings to get their inputs wherever those were required. Those were required for a lot of the costs on the actual materials to build the product itself. (personal interview, August 16, 2011)

As a result of examining a variety of sources including examining business models of their competitors, students chose the most appropriate business model for their venture. APP-P2 described this experience:
I think we looked at any best practices, any templates, any presentations, but we could actually access (and, access) whether if that was going to be applicable to what work that we are doing or see if we can actually customize that based on our business model. (personal interview, August 15, 2011)

Viability of ventures. Ultimately, the success of a new venture is measured by the creation of a financially successful company and a return on investment for investors. This success is difficult to objectively measure and often takes years to come to fruition. For the student teams, it is too early in the life of their ventures to use these types of assessments. At this time what is more appropriate is the viability of the new ventures. Measuring viability can also be subjective. Consequently, for this research project, no absolute measure or statement was determined. However, an insight to viability was determined through student interviews and having the student’s final investor presentation rated by a panel of outside reviewers. These results are presented later in this section.

During the final interview, students were asked to make a personal assessment of the viability of their venture. A majority of the students [10 out of 15 (67%)] thought their venture was viable and should move forward. Of the five students who did not believe their venture was viable, three responded that they were not confident in the venture’s future and two responded that they were unsure of the venture’s viability. The student’s perception of viability varied by venture. These results are shown in Table 13.

For Team RECON, their perception of viability was heavily influenced by their failure to

Table 13

<table>
<thead>
<tr>
<th>Student Perception of Venture Viability</th>
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<tbody>
<tr>
<td>Team</td>
</tr>
<tr>
<td>--------</td>
</tr>
<tr>
<td>RECON</td>
</tr>
<tr>
<td>APP</td>
</tr>
<tr>
<td>RUN</td>
</tr>
<tr>
<td>WIND</td>
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</table>
deliver a prototype to a customer and obtain their feedback. By this point in the program, the students had set expectations with many prospects that they would be seeing a prototype in either Quarter 3 or 4 of the program. The lack of a prototype diminished their credibility in the eyes of their prospects and tended to negate the effort that it took to develop a pool of prospects.

RECON-P1 described this situation:

Because when we initially went out and touched a lot of customers, they said, “Everything sounds real neat what you're telling me. Now, show me what it looks like when it's actually operational.” We felt we'd be farther long than we are now, to the tune of three to six months. I'd say at this point in time, I wouldn't say that our venture could be successful. (personal interview, August 16, 2011)

RECON-P3 (personal interview, August 18, 2011) described how the lack of a prototype made him unsure about the viability of the venture: “So though we have spoken to some customers about the conceptual model, we really don’t know what the real interest will be from the customer once we (have) demo (modeled) the prototype.”

Team APP’s continuing struggles with their business model influenced their perception of the viability of their venture. This sentiment was expressed by APP-P2:

So as far as viability of the product, I think that one of the things that we continuously struggle with, with a challenge was our business model, because the landscape shifting is so dynamically and frequently and we would have to consider perhaps going back to the strategy phase to really determine what features or what business model, how we can actually modify the business model to be more, to have more of a successful launch when it does enter into the market. (personal interview, August 15, 2011)

The APP product was entering a product space where there are a number of competitors and the barrier to entry for any one competitor is fairly low. This left Team APP struggling to define a set of features that would differentiate itself from the competition. This situation was described by APP-P2 when he was asked about the viability of his venture:

I think pretty high risk. It’s a very competitive space with low barrier to entry and there are a number of competitors out there that have emerged.
There is still some opportunity in the way we structured the product to sort of address specific gaps that have been identified that other competitors are not meeting but they are really gaps. A couple of feature gaps and a couple of gaps on what platforms are supported. But it wouldn't take a lot of engineering effort, especially somebody who had a good amount of engineering resources to quickly replicate that.

I think there's some potential there but in its current form I think there is a pretty high risk of viability. (personal interview, August 17, 2011)

For Team RUN, positive feedback from prospects buoyed their confidence that the venture was viable and should move forward. There was a debate in the team whether they should be producing simple sensors and let the shoe manufacturer integrate them into the shoe or should they integrate the sensor into the sock liner and go for the running shoe after market. Since a single sensor could be produced for the entire market, the volume of this product would be high but the margin would be low. With the sock liner approach, different sock liners would have to be produced based on shoe size. This approach had lower volume, higher margin and had no dependency on shoe manufacturers.

RUN-P1, who was the Product Champion expressed his enthusiasm for the product as a result of customer feedback:

The first version of viability is, would someone buy it, and our surveys are a resounding yes.

So, one of the things that we discovered in the initial surveys, the second tier of surveys is that we asked people, would you buy this for yourself, and we had about 50% of the people said, yes they would be interested to buy this themselves. And 100% of the survey participants said yes they would recommend our product to someone else. (RUN-P1, personal interview, August 17, 2011)

While RUN-P4 expressed his lack of confidence in the product direction, this lack of confidence was determined more by the current product packaging rather than the concept itself. He was planning on trying to influence his teammates to his position when things were less hectic after the program was completed. He expressed these feelings when asked about the viability of the venture:
Currently, I'm not confident. I had these feelings for a while, but I think I've been fearful of expressing them because of the academic requirements. I do believe that with some small changes... in fact the irony is, going back to one of our original ideas I think would make it more viable. One of the reasons we tested it in terms of... originally we're going to have a running insole or insert. Then we went to just a utility sensor that would be insole or shoe agnostic. The reason was so that we could perhaps get a larger volume. Then it would translate into perhaps more interest from investors. What we've discovered over time is that we probably don’t need the help of investors. I'm looking at the small margin of the sensor versus the higher margin that we could get for our insole. (personal interview, August 17, 2011)

All members of Team WIND believed that their product was viable. They were able to successfully position the product versus competing alternatives and they were getting positive feedback from prospects. As a result, there was a strong pull from their industrial sponsor to accelerate bringing this product to market. This pull from the sponsor made it less important for the team to get feedback from a beta test and their lack of feedback did not diminish their confidence. WIND-P2 described the product's competitive advantage and it’s positioning:

And we are targeting the wind turbine market, but the, the few points that I, I noted that were similar is that companies, our competitors are using simple filtering to achieve the end with their solution for the issue but the simple filter is not a perfect solution, it will overtime degrade in carbon issue. So, to keep the oil clean there are some other systems and they range from a few tens of thousands to more than that and some of them are very complex and it requires extra electricity, and extra utility, resources. Our product is in the middle there, between the very simple solutions and the very complex, and price range wise it also fits in there right now. (personal interview, August 15, 2011)

As confident as they were, Team WIND realized that that they still had to overcome the risk adverse nature of the wind turbine market. This was described by WIND-P4:

We believe that, I shouldn’t say we. I believe that viability of the product is an 85% to 90%. In the lab testing we know that the unit will work. We're dealing with the risk-adverse market. However, they do have a pretty costly paying point which is the failure of gear boxes. It's going to take the right wording, right timing and the right price of the right value proposition to get in. (personal interview, August 16, 2011)

In addition to the student interviews, another perception of viability was obtained by having a panel of seven judges review the student’s final investor presentation. The judges
consisted of six members of the TC program’s Board of Advisors\textsuperscript{15} and the student’s I-cubator instructor. The judges were asked to rate the presentation on nine dimensions which were derived from the business plan template that was given to the students. These nine dimensions consisted of team, mission, problem, solution, prototype validation, market, green field (a.k.a. competition), barrier for others and financial plan. Judges were asked to rate the students based on trying to achieve their objective using a 5 point Lickert scale: 5- very strong, 4- strong, 3- average, 2- weak and 1- very weak. The judge’s instructions given are shown in Appendix L. The complete results are shown in Appendix M and the summary of the results are shown in Table 14.

Table 14

<table>
<thead>
<tr>
<th>Team</th>
<th>Average score</th>
</tr>
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<tbody>
<tr>
<td>RECON</td>
<td>3.4</td>
</tr>
<tr>
<td>APP</td>
<td>3.0</td>
</tr>
<tr>
<td>RUN</td>
<td>3.6</td>
</tr>
<tr>
<td>WIND</td>
<td>3.9</td>
</tr>
</tbody>
</table>

Scale:

5= very strong
4= strong
3= average
2= weak
1= very weak

These results were consistent with the student’s own perception of viability. Both rating methods came up with the same rank order of viability with WIND being the most viable, followed by RUN, RECON and APP.

\textsuperscript{15} The TC Board of Advisors consists of senior high technology executives who had previously held executive positions in high-technology companies. They had experience with both start-ups and large technology companies.
**Review of student’s final work.** The student’s final work was evaluated and graded by their instructor. In making his evaluation, the instructor had an external senior executive review each student investor presentation. There was a different reviewer for each presentation and one to two pages of feedback was provided to each venture team. These reviewers provided a combination of high-level and low-level feedback. At the high-level, there was consensus that the students created clear and understandable presentations where the strength of their ventures was the problems they identified and the solution that was provided. Across the board, there was a perception that the student ventures were weak in intellectual property position, revenue size and growth, and the potential for outside investment. This qualitative feedback was consistent with the survey data that was obtained from the survey of the seven-judge panel.

The instructor based his final grade on more than the final investor presentation. He also factored in the maturation of the ventures, the quality of work delivered and the consistency of their work when measured against his counseling and guidance (Instructor, personal communication, September 10, 2011). The instructor’s final grades are shown in Table 15.

<table>
<thead>
<tr>
<th>Team</th>
<th>Grade</th>
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</thead>
<tbody>
<tr>
<td>RECON</td>
<td>87</td>
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<tr>
<td>APP</td>
<td>92</td>
</tr>
<tr>
<td>RUN</td>
<td>96</td>
</tr>
<tr>
<td>WIND</td>
<td>98</td>
</tr>
</tbody>
</table>

**Future of ventures.** Independent of student feelings about viability, all of the ventures were going to continue in some way. With the time pressure of the summer quarter, students had not had a chance to come to a consensus among themselves for the future direction of their
venture although when interviewed each had feelings about what should be the next steps. For each venture there was a unique story.

For RECON, there was a need to get some limited funding to finish the prototype. An angel investor, who met the students at the local business plan competition where they had competed, was interested in funding the development. The project champion wanted to find a strategic partner and license the technology. He currently worked in a large multi-national corporation and was looking to make a career change into sales rather than continue with the venture. Some of the students sensed his loss of enthusiasm for the project and questioned whether they personally should move forward with it. This sentiment was expressed by RECON-P1):

One of our team members is the CFO of the company. He indicated that they are going to have a real hard talk with the CEO and gauge what is his interest level and what his commitment level is. Because, at this point in time, it's a little bit questionable. If the leader in the middle of it isn't giving a 110%, a lot of other folks I feel like probably ought not to be doing that as well. (personal interview, August 16, 2011)

At the same time, another team member was considering being part of the prototype funding round. He expressed this in his interview:

So, I actually offered to invest a little bit of money into this so I can stay on board and sort of guide things. I don’t have a lot to offer so I kind of offered $1,000 which is probably enough to make a couple of rockets and a couple of helicopters from there if they want to give me something. Number one is continue and further my learning and $1,000 to further my learning and make something out of it is not too bad and also one thing I want to do is, really, now I become an ambassador. I’m no longer just an interested guy from outside, just looking in and say, “Hey, I’m here to help, because I need to fulfill my academics.” (RECON-P2, personal interview, August 19, 2011)

For Team APP, now that they have completed the development of their prototype, their prevailing attitude was to be flexible and launch the product and see what happens. Three of the four students interviewed wanted to continue with the project. This team expressed that they
have no need for funding and that they could continue with product development as they had been doing throughout the program. APP-P4 expressed his feeling about the project:

You know, we are not, we are not building it with the idea of generating revenue right now, because one of the nice things about this project is that it’s I mean, we can bootstrap it so heavily we don’t have to rely on outside investment. (personal interview, August 15, 2011)

While the members of Team RUN had not had a chance to discuss their future plans among themselves, each had expressed a desire to move forward with the venture. This was even true for the venture’s biggest critic, RUN-P4. While he couldn’t directly participate in the project because he still had further course work to do to complete his degree, he expressed a desire to participate in the funding of the venture. The plans for the RUN venture were to form an LLC corporation immediately after completing the program. Future funding would include a to be determined mix of angel and personal investment. A board of advisors would be immediately constituted. The plan is to work on this venture part time until revenues were large enough to support paying salaries. This situation was described by RUN-P2:

I think it would be fairly manageable to handle a part-time job sort of thing and work our way through that period of time where we’re not drawing salaries to build it up, to make it a business and then make some connections and try to make direct sales. And then after that, once the salary start getting…once we get into year one/year two, then we may consider saying, “Okay, let’s…we need to either dedicate more time to this or hire some people or something to take of this issue.” So I think we still have about a year left before we need to make that decision. (personal interview, August 20, 2011)

For Team WIND, the future direction of their venture was the most clear of all the teams. The WIND venture was going to be transferred to their industrial sponsor. Depending on the product volume it will become a new product, product line or it will be spun out to become its own company. WIND-P4, who was the Product Champion and employee of the industrial sponsor commented on the situation:
I would like to see it be its own product line. However, spin off (but) the numbers certainly justify that. But it’s a small division, as this company knows. As long as we have to pass viability at this location, we would probably keep it under one roof to control cost. We do think that, at minimum, it will be a product line extension for us. (personal interview, August 16, 2011)

WIND-P4 will continue to have responsibilities for this product, as well as some other products.

With the conclusion of the program, beta customers will be signed up by the partner’s sales force who will receive an incentive to do this. For WIND-P4, there is an opportunity for a career boost as a result of this program. A few students expressed interest in working for the partner going forward with the most interest coming from the student who lived in the same state.

**Principle learning from the program.** When asked about their principle learning from the program, student responses were varied and were both transactional and transformational. The transactional responses were focused on how what they learned could be applied to improve their venture. For example, RUN-P1 commented on how he was able to perfect the marketing strategy for his venture. Transformational responses were aimed at how the experiences in the TC caused the student to think or to see the world through a different lens. Those responses were most relevant to the research project and are now described in more detail.

RUN-P3 thought the TC program had changed his mind. “And I think, going through that and having to experience that journey I think that really is the mind changer for me at least for my initial expectations” (RUN-P3, personal interview, August 14, 2011). In a similar manner, WIND-P3 described how the program increased his confidence to go out and start a new business:

My biggest take away is just the knowledge of having done it. It gave me the knowledge to know what I needed to do to go start something and then gave me the confidence to be able to go do it because I went through this and did it once already in this structured manner…. I was having this conversation with some friends the other day, is I feel very confident that I can go and execute this. (personal interview, August 15, 2011)
Others described how the program gave them a holistic picture of the commercialization process which they did not have before. This was described by WIND-P2 and RUN-P2.

The principal learning is absolutely, when I sit at a meeting with management or I am in discussions with people on the business end of things. I get the aspects that are not something that I’m only exposed to in a laboratory setting or working on a design, or some new technology, but I’m getting more of the, the full picture. (WIND-P2, personal interview, August 15, 2011)

In a similar manner, RUN-P2 (personal interview, August 20, 2011) commented on how putting things into practice allowed him to see the whole picture of the commercialization process: “You can talk theory all day and do case studies all day long but until you put those lessons into practice, you’re not really…you’re not getting the whole picture.”

Building on this holistic picture, students described how the program taught them how to start a company. RECON-P3 described his journey learning the start-up process:

I think I’d like to start with saying how I was a year ago when I started the course and how I am now. So there is a huge amount of difference in terms of the knowledge, what I gain, as far as how to run a start up. (personal interview, August 18, 2011)

WIND-P4 also described how he learned to not only take an idea to market but also how to make a successful company: “We not only learned how to take a good idea to market, but we learned how to take a good idea and make it into a great company” (personal interview, August 16, 2011).

Students also described the learning about processes. One of the principle goals for the TC program was to teach students about the importance of validating ideas, concepts, products and business plans with the customer. APP-P2 described these concepts in his interview:

The principal learning for me is which was something that I guess, I had some assumptions about but, you know, kind of got confirmation and a lot of approaches on validating it. It was really to build market-driven products, to build products that you know, meet specific needs that people want, you know, add value to them that they are willing to pay for. So, the key learning is really to essentially validate the value proposition and validate the problem that you are trying to solve before investing a lot of
time, money, and resources into building it. So, that is I guess the key learning, and I get customer feedback is, is really a key, a key indicator of that. (personal interview, August 17, 2011)

What was surprising was that students who had originally espoused having problems working in a distributed environment now stated that this element of the program was one of their principle learnings in the program. RUN-P4 described his experience working in a distributed environment:

The biggest thing I've learned is working in a distributed environment. That is by far, with a virtual team. Working in this virtual team environment, it's not the input that really matters. It's what each individual member, in terms of output and trying to manage that across three different time zones. Only having personally met one of the team members, it's a challenge, but it's doable. That's the biggest thing I've learned. It is the thing that I share with people about this. That by far, the biggest take away from this curriculum and it's not something I would have expected. Some of the project management tools that we've been exposed to had been very eye-opening. I've even explored others on my own for different feature sets. I do know that it's possible to manage a team distributedly. So I'm very excited about what I can do in a distributed environment and make things happen. I do plan to pursue something on my own, particularly web or internet-based. (personal interview, August 17, 2011)

In a similar manner, RUN-P3 (personal interview, August 14, 2011) expressed his optimism for working in a distributed environment: “You could be all geographically separated, you could be in various countries. So, as long as there’s a good, you know, business out there with a good strategy and vision, I think anything is possible.”

I-cubator satisfaction. Student satisfaction is one measure of the effectiveness of the I-cubator processes. Student satisfaction was measured with both qualitative and quantitative methods. In the interview process, students were asked directly about their satisfaction with their I-cubator experience. At the end of each quarter, student’s expression of satisfaction or dissatisfaction was also captured through a survey where both a sense of community and their satisfaction with the outcome of their venture were measured. The two survey results were compared for consistency and they were also compared to qualitative statements made by the
students to create a holistic view of satisfaction. This holistic view was then compared for consistency to the behavior and outcomes of the ventures as captured by the qualitative data.

Results from the interviews point to student satisfaction with their I-cubator experience. Almost all of the students (14 out of 15 [93%]) expressed statements of satisfaction. This was broken down further into statements of high satisfaction (9 out of 15 [60%]) and statements of mostly and moderately satisfied (5 out of 15 [30%]). One student stated that he found challenges making the program work for him. His experience will be described in detail later in this section.

_Sense of community_, as captured by Rovai’s (2002a) Classroom Community Survey, is shown in Table 16. The complete survey results are shown in Appendix K. The class as a whole scored significantly higher in _sense of community_ (+14.3%) than the baseline established by Rovai (2002a) in his survey of 375 online students. For each team, their _sense of community_ increased from Quarter 3 to Quarter 4. The smallest increase (+2.5%) was for Team RECON. The largest increase (+34%) was for Team APP\(^\text{16}\). Team WIND scored the highest _sense of community_ at 71.00. Their score increased 6.3% and was 25.4% over the Rovai baseline.

_Student satisfaction with the outcome of their project_ is shown in Table 17. The complete satisfaction results are shown Appendix K. As a class, their satisfaction with the outcome of their project was relatively unchanged (4.21 in Quarter 3 vs. 4.20 in Quarter 4). However, the team results changed from Quarter 3 to Quarter 4. Team RECON experienced a 13.3% reduction in their satisfaction. Team APP experienced a 9.0% increase in their satisfaction. The largest increase in satisfaction (+28.6%) was recorded by Team RUN. The score for Team WIND was unchanged, however they already had a high score of 4.75.

\(^{16}\) Part of the increase for Team APP may be due to one survey participant missing in Quarter 3 thus artificially lowering the Quarter 3 score. Team APP’s score is still higher than their Quarter 2 score when all participants competed the survey.
Table 16

*Mean Classroom Community Survey Results*

<table>
<thead>
<tr>
<th></th>
<th>QTR 1</th>
<th>QTR 2</th>
<th>QTR 3</th>
<th>QTR 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum</td>
<td>80</td>
<td>80</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td>Cohort Overall</td>
<td>58.63</td>
<td>58.00</td>
<td>59.50</td>
<td>64.73</td>
</tr>
<tr>
<td>Team RECON</td>
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<td>59.50</td>
<td>61.00</td>
</tr>
<tr>
<td>Team APP</td>
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<td>56.00</td>
<td>46.00</td>
<td>61.67</td>
</tr>
<tr>
<td>Team RUN</td>
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<td>58.00</td>
<td>59.00</td>
<td>64.50</td>
</tr>
<tr>
<td>Team WIND</td>
<td>56.50</td>
<td>63.00</td>
<td>66.75</td>
<td>71.00</td>
</tr>
<tr>
<td>From Rovai</td>
<td>56.62</td>
<td>56.62</td>
<td>56.62</td>
<td>56.62</td>
</tr>
</tbody>
</table>

Raw scores vary from a maximum of 80 to a minimum of zero. Interpret higher scores as a stronger sense of classroom community.

Table 17

*Mean Student Satisfaction with the Outcome of their Project*

<table>
<thead>
<tr>
<th></th>
<th>Overall</th>
<th>Team RECON</th>
<th>Team APP</th>
<th>Team RUN</th>
<th>Team WIND</th>
</tr>
</thead>
<tbody>
<tr>
<td>QTR 1</td>
<td>4.13</td>
<td>4.00</td>
<td>3.50</td>
<td>4.00</td>
<td>5.00</td>
</tr>
<tr>
<td>QTR 2</td>
<td>4.07</td>
<td>4.00</td>
<td>3.50</td>
<td>4.00</td>
<td>5.00</td>
</tr>
<tr>
<td>QTR 3</td>
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<td>4.25</td>
<td>3.67</td>
<td>3.50</td>
<td>4.75</td>
</tr>
<tr>
<td>QTR 4</td>
<td>4.20</td>
<td>3.75</td>
<td>4.00</td>
<td>4.50</td>
<td>4.75</td>
</tr>
</tbody>
</table>

Scale:

5 = Highly satisfied
4 = Satisfied
3 = Neither satisfied or satisfied
2 = Dissatisfied
1 = Highly dissatisfied

Across the entire cohort, both of the quantitative measures of *I-cubator* satisfaction, *sense of community* and *satisfaction with the outcome of their project* indicate that overall students were satisfied with their *I-cubator* experience. These quantitative measures are consistent with student’s expression of satisfaction in their interviews.
When coupled together, student satisfaction, venture viability and the instructor’s grade create a framework that can be used to examine behaviors and outcomes at the venture level. While it is impossible to draw causal relationships between quantitative and qualitative data, consistency can be established between the two methods which reinforces the validity of the qualitative data.

Team WIND scored highest in viability, sense of community, satisfaction with the outcome of their project and final instructor grade. Their work at this point can be viewed as a tangible success since their industrial sponsor is enthusiastically adopting their project and their chance of commercial success is relatively high. The researcher personally observed this team in their weekly meetings with their instructor for a period of nine months. The meetings were well organized and very professional. There was also a good working chemistry among the students.

Team RUN ranked second on viability, sense of community, satisfaction with the outcome of their project and final instructor grade. Team RUN also showed the largest increase from Quarter 3 to Quarter 4 in the satisfaction with the outcome of their project. It was during Quarter 3 where the venture started to make progress on their prototype as a result of farming out the work to an outside contractor. By the end of Quarter 3, this decision proved right as 10 prototypes were produced and were used in a successful beta test during Quarter 4.

For Team RECON, their sense of community remained relatively the same between Quarters 3 and 4 but their satisfaction with the outcome of the project decreased. Team RECON also received the lowest final instructor grade. As a result of staffing issues with the engineering team, Team RECON did not complete their prototype and as a result could not perform a beta test nor do a comprehensive customer validation. Members of the team expressed their dissatisfaction with their customer validation efforts and their loss of credibility with their
customer prospects which took a significant effort to develop. Members of Team RECON also sensed reduced enthusiasm from the Product Champion as that team member has made a decision not to stay with the venture after graduation.

For Team APP, there was a surprising increase in their *sense of community* score and a moderate increase in their *satisfaction with the outcome of their project*. Reduced survey participation may have artificially lowered the Quarter 3 score since there were only two participants in this survey as opposed to the three participants that were in all of the other quarterly surveys. The increased score may have also been due to a shorter time zone for the team in Quarter 4.

For Team APP they succeeded in completing their prototype and had developed a plan to launch the company with minimal capital needs. Since a strong business model had been elusive throughout the entire program, their only alternative was to test the product concept in the marketplace which they were now poised to do.

For students that expressed satisfaction with the *I-cubator* they stated that they had found the experience tangible, hands-on and fulfilling. They stated that they felt their teammates were strong contributors. They found the experience relevant to their career goals. For WIND-P4, the *I-cubator* experience exceeded his expectations:

> But overall, the experience had been greater than I initially expected. Because, once again, I was thinking about the process of idea to market and it went beyond idea to market. It was idea to how to create a great business around a great idea. So it expanded my vision on what I initially thought I would learn. (WIND-P4, personal interview, August 16, 2011)

For APP-P2, the *I-cubator* was not a positive experience. He cited numerous issues that stemmed from working in a virtual group environment. In his reflective journal, there were numerous entries citing the unbalanced workload among team members and having to take on
more responsibilities. As such, he stated that he was not happy being with the same group of students for the entire program. He also stated that there were difficulties with the fundamental premise of the program of trying to start real companies with students who were only capable of putting forth a part time effort. APP-P2, summarized his experience:

I personally had a bit of challenges in, in the virtual group environment. I’m a little bit more effective working with people kind of face-to-face, so I think that, over the next couple of weeks we are going to have some discussions of whether the project is going forward. But I found that the virtual, I guess its combination of virtual and then sort of part-time work effort has been a little bit challenging. Being tied with the same group for a year was challenging at times, and the other thing was it, the pacing of the venture courses seemed a little bit challenging in that, it didn’t seem there was, there wasn’t a lot of opportunity to essentially be correct. (personal interview, August 17, 2011)

There was a challenge for the venture teams to produce deliverables on the rigid timelines that were stated in the syllabus. For Team APP, they already stated that their entire venture was out of sync with the I-cubator program because they couldn’t develop their venture on the schedule that was required in the curriculum. For other students, there were minor problems when they had to produce required program documents on a specific date whether or not this was in sync with the state of their venture. This was expressed by RECON-P3:

For example we have an occurrence where in two weeks we need to finish the product requirements document, so for all of us we kind of a little bit struggled to finish it up. So we were like really, really working around the clock to get that done. So those were some of the challenges we faced in terms of this program but otherwise, overall I’m happy with what I got. (personal interview, August 18, 2011)

**Program satisfaction.** In a manner similar to satisfaction with the I-cubator, students expressed a high degree (14 out of 15 [93%]) of satisfaction with the TC program. This broke down into very satisfied (9 out of 15 [60%]) and satisfied (4 out of 15 [27%]). Students felt that the program was tangible and that they could bring what they learned immediately back to their jobs where they could boost their careers and potentially get a promotion in the short term. This was expressed by WIND-P1:
I thought it was a really great course to participate in. From the beginning, when I selected the group that I wanted to be a part of, I wanted something that was tangible and versus, you know, something that’s intellectual or you know, not object-oriented so to speak. (personal interview, August 17, 2011)

One student stated that he was only half satisfied with the program because his team failed to conduct a beta test of their product.

Students (5 out 15 [33%]) gave unsolicited suggestions for improvements to the program. The predominant suggestion was to improve the synchronization between the academic and the experiential programs so that students acquired needed skills academically before they were needed in the I-cubator. They also stated that in an ideal sense, academic classes should be completed before entering the I-cubator. However students realized that under such a scenario it would take longer to graduate from the program and this might not be acceptable to some students.

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**Student future plans.** In their final interview, students were asked about their future career plans. The largest category that emerged was the desire to start their own company in the future (9 out of 15 [67%]). This comment from RUN-P4 was typical:

But I definitely want to pursue something on my own, particularly web-based, or not necessarily web-based, but internet-based. So it would be both mobile and/or web, or anything else that might emerge over time, particularly in the area of digital media, education, which was one of the projects that I had proposed at the beginning of New Venture Development. (personal interview, August 17, 2011)

The second largest category that emerged from the students was their desire to make a career change (6 out of 15 [40%]). This comment from WIND-P4 was representative of students in this category:

What I would like to do is move to a position between engineering and marketing such as doing business development and try to ferret out the opportunities that will allow us to leverage our know-how as manufacturers. At the same time, bring in opportunities for our unmet needs in the market, and using the academic and hands-on experience that I learned through this program to tie those into all together in the manufacturing, the
marketing, the business planning, and the financial planning. In this case, it's entrepreneurial for me. (WIND-P4, personal interview, August 16, 2011)

There were also smaller categories of future student plans. These broke down into no immediate change (4 out of 15 [27%]), like their current job (2 out of 15 [13%], would like to improve in their current job (2 out of 15 [13%] and pursue an MBA (2 out 15 [13%]).

Student future plans were not noticeably different at the end of the TC program than they were at the beginning. When interviewed in the third month of the TC program, (8 out 16 [50%]) said they would want to start a company in the future. When asked the same interview question at the end of the TC program this had only changed to (9 out of 15 [60%]).

Summary of findings.

Finding 1: Students followed the supplied scaffold and suggested project management practices (All teams). In following the suggested scaffold, students were guided through the basic steps of entrepreneurship and technology commercialization. These steps were idea generation, opportunity assessment, product requirements, prototyping, customer validation and business planning. Students developed variations of the scaffold based on their personal experience and research that they had done on the Internet. One of the principle concepts that was learned from the program was customer focus. Students presented their ideas and venture concepts to potential customers for feedback which took the form of either validation or the identification of changes that needed to be made.

Students received strong guidance and support from their instructor who also performed the role of advisor and mentor. This guidance was done in the form of commenting and grading student deliverables such as plans, specifications and prototypes and weekly conference meetings with the students where the students would present their accomplishments and ask for guidance and assistance. When a student team was stuck on an issue, the instructor would help by making
suggestions. The instructor also provided coaching as to how to circumvent future stumbling blocks.

Students were supplied lectures on each component of the scaffold and they were given templates for the documents that they needed to produce. These templates represented best-in-class practices that had been developed through the personal experience of the program director, senior staff at the university, Internet searches as well as discussion and review with accomplished entrepreneurs and venture capitalists. These practices form the basic processes needed to start a company. Additionally, as part of the TC program, students were receiving an education in the fundamentals of small business management through the academic courses. These courses were designed to provide the core knowledge that a first time CEO would need in starting a company. These courses consisted of business fundamentals, project management, intellectual property, accounting, finance, marketing, leadership and small business management.

The scaffold also included syllabi for each of the four quarters of the TC program. The syllabi included concrete dates for all of the deliverables in the program. Essentially, this was a 52-week project plan. Through the syllabi, each of the student teams were kept in lock step. This made it easier for the instructor to provide direction and for the student teams to learn from each other. The rigid structure provided cohesion that is required in an online environment for students to make progress and have satisfaction with their efforts.

For three of the four student teams, RECON, RUN and WIND, they were able to manage their venture within the constraints specified in the syllabi. As issues came up and the teams were faced with deadlines, the teams were able to make both short term and long-term accommodations. For Team APP, this was not the case. Right from the beginning, their product idea was the least formed, most open to change, and had the highest amount of risk. This was
compounded with their high amount of geographic dispersion. As new data was assimilated from potential customers and the competitive environment, Team APP had to constantly make changes to their product concept. As a result, the development of their prototype was constantly being reset. This placed Team APP at least three months behind the other student teams. When teams RECON, RUN and WIND were actively talking to potential customers about concrete products and showing prototypes, Team APP was still developing their product idea. Essentially, during Quarter 3, Team APP was working on Quarter 2 deliverables.

This was dysfunctional for both the student team and the instructor. In Quarter 3, to conform to the curriculum and get a grade, they had to meet with customers. However, due to the lack of a completely developed product idea, customers could only give high-level feedback about product direction as opposed to detailed feedback on the product concept or the prototype. While they were continuing to meet their deliverables for the program, they felt that they were not doing quality meaningful work and as a result their enthusiasm was reduced. Team APP felt like this was more of a student project than a real venture. Consequently, Team APP continued to emphasize the engineering of their prototype as opposed to the business planning that was required by the program.

Finding 2: Students made strong use of synchronous communication technology (All teams). Online courses, at the university under study, were delivered in an asynchronous format. Most had very little synchronous components with the exception of the occasional group project. Students in the I-cubator course sequence made strong use of synchronous communication technology. At a minimum, students would have two synchronous meetings per week. They would have one meeting with their instructor and one private meeting among themselves.
Students used conference calls and Wimba for these meetings. The Wimba white boarding feature was used frequently.

Students cited the value of these synchronous meetings. However, the students also stated that these meetings were difficult to manage given the constraints of their personal and professional lives. For some, the synchronous requirement came as a surprise with which they had to cope. For the instructor, who had to meet with all four teams each week, synchronous meetings were also a challenge.

**Finding 3: Information flow between students was continuous (All teams).** Even through the students were separated by time and distance, the flow of information between them was more continuous than discrete. In between their synchronous meetings, students used e-mails and discussion board postings to exchange the bulk of information. However, they were continuously connected to each other through instant messaging and through text messages. Students made use of a group text messaging service. Text messages were a particularly valuable tool for communicating during the day when the students were busy at their jobs.

**Finding 4: Students were a key ingredient of the program (All teams).** The students and their attributes were a key part of the program under study. The students were mid-career professionals averaging 15 years of work experience. These students were accomplished professionals in their careers and they were looking to take their careers to another level. The students were looking to either advance their own career in their own company as an intrapreneur or they were looking to develop the knowledge to start their own company at some point in the future. As a consequence, the students were very serious about their new venture work and were looking at this **I-cubator** program as more than an academic exercise.
The students were driven to find a way where they could contribute to their venture. Students were not satisfied with simply sitting on the sidelines. One of the catalysts for engaging students was the diversity of the class. The cohort under study was highly diverse. This enabled the construction of diverse teams. As a result, students settled into roles that were based on their distinctly different professional careers. This made students comfortable in their roles but it also made the teams comfortable in that they had resources to draw upon.

As experienced professionals, students were very respectful of each other. They were respectful in the manner in which they interacted with each other and they were also sensitive to the problems that occurred when balancing work, academics and professional lives. Students would routinely cover for each other when one of them had a problem.

**Finding 5: Prototyping was a significant challenge (Teams APP, RECON and RUN).**
The development of a prototype was a significant challenge for Teams APP, RECON and RUN. At the beginning of the program, Teams APP and RUN set out to develop the prototype themselves and Teams RECON and WIND set out to develop a prototype using a partner. For the teams that developed the prototype themselves higher levels of stress and inter-personal friction were observed compared to those teams that used a development partner. Each of the three teams had their own challenges. For Teams APP and RUN, only a single team member worked on the prototype development. Team APP remained with this strategy for the entire program and only completed a prototype right at the very conclusion of the program. Team RUN started with this strategy but when it became evident that the Product Champion didn’t have the time or the required skills, they farmed out the prototype development to an external resource who was able to quickly create a prototype based on the previous work that had been done. Team RECON relied on an undergraduate student engineering team at another university in the same
city as the TC program. When one of the students on that team resigned due to personal reasons, the prototype schedule was pushed out to one to two months beyond the end of the 1-cubator program.

**Finding 6: Moderate separation by distance did not affect team performance (Teams RECON, RUN and WIND).** Three of the four teams, RECON, RUN and WIND were separated by three time zones or less. One team, APP, was separated by nine time zones. This team found it very difficult to have all team members attend all of the meetings which became moderately dysfunctional. When team members could not attend a meeting, those attending would run a meeting trying to make up for those who were absent. Agreements were made and tasks were assigned. E-mails were sent to the absentee members to seek their agreement.

**Finding 7: Task conflict was low (All teams).** Task conflict\(^{17}\) was low among all teams. Teams adopted various processes to resolve differing points of view. Teams used voting, consensus through discussion or deferring to a subject matter expert if there was one on the team. Teams did not get stuck on an issue and team members were able to get behind a decision even if their viewpoint was in the minority.

Even though task conflict was low, there were some conflicts. In Team APP, there was a conflict about equitable distribution of work among the team members. One team member’s contribution, in particular, was problematic. In Quarter 2, a meeting was held to with that student to address the issue. After that meeting, the student’s performance improved but not enough to make that student a significant contributor to their venture. In Team RUN, the conflict surrounded the development of the prototype. When the Product Champion began to struggle with the prototype development, the team convinced him to focus solely on the development of

\(^{17}\) Task conflict is a disagreement about how to perform a specific task.
the prototype and to relinquish all of his other responsibilities on the project. When his struggles continued, the Product Champion came to the self-realization that he was stymied. As a result of his significant personal efforts, it was easy for him to convince the team that the prototype development work had to be farmed out.

**Finding 8: Task reliability was important (All Teams).** While task conflict inside the team was insignificant, task reliability was important. Team harmony was a function of team members doing their tasks on time and doing them with sufficient quality so that other team members were proud of the overall effort put forth by the team. Responding to e-mails and text messages was also part of task reliability. When task reliability fell off, there was an almost immediate dissatisfaction with the team and the I-cubator program. When this happened students reported that morale within the team was very low. On the other hand, when task reliability was high, students reported a high degree of satisfaction with their team and the I-cubator program. Task reliability was less for those teams that developed their own prototype.

**Finding 9: Students were very satisfied with the I-cubator and the TC program (14 out of 15 [93%])** Students were very satisfied with both the I-cubator and their overall academic program. This was measured by surveys and through interviews. High satisfaction can be attributed to both the realness of the experiential program and the related academic work. Students developed satisfaction through gaining knowledge that would help them immediately in their professional career. When students reflected on their experiences in the program it was important to them that they had achieved something significant in the I-cubator.

**Finding 10: The quality of the team’s work was high but inconsistent (All Teams).** The quality of the student’s work was very high when judged by professional standards. As the students were experienced professionals, they were able to measure their work by professional
standards. Students took pride in doing work that was equal to or greater in quality than the work that they were doing in their professional careers. At times, it was observed that the quality of the student’s work would be lower than what they had hoped or what the instructor had expected. Most of this was due to the time pressures within the program. As this was an academic program that was to be graded, components of the I-cubator program needed to be turned in on a rigid time frame. Occasionally, quality was compromised to meet a delivery deadline.

**Finding 11: The assimilation-accommodation process was key to student learning (All teams).** The assimilation-accommodation process was key to student learning in the TC program. At the beginning of the program, students were naively technology focused in the generation of their ideas and placed little emphasis on a business model. However, through the validation process students learned to ground and shape their ideas with information obtained from customers, competitors and the marketplace. As with all entrepreneurs, the students had strong beliefs in their venture. As such, when information was assimilated that was different from the current status quo, accommodations had to be made.

For the student teams, the assimilation-accommodation process created a reality and a sense of truth which could not be dismissed or argued with their instructor. The goal of the student venture was to build a business and this became just as important as the grade or the degree that the students received. It also provided them with a level of motivation which could not be achieved with a normal academic assignment. In progressing through the assimilation-accommodation process students were able participate in the “art” of entrepreneurship.

The assimilation-accommodation process involved creating relationships with prospects to gather feedback on their venture. During this relationship, feedback might be gathered multiple times as the venture came to life and more details were known. As prospects had
competing demands for their time, the students needed to establish credibility to earn a commitment of their time. While credibility may be earned in a number of different ways, for the students, the availability of a prototype was an essential element.

All four teams ran into varying difficulty when the prototype was either not available or delayed. Some of this difficulty was mitigated by the incremental production of prototypes and having a large (80-150) list of prospects to contact. However, there was a dependency on having a complete and final prototype.

This situation was the most difficult for Team APP as they did not have a complete prototype until very late in the program when their product concept was firm enough for them to talk to customers. For Team APP, they had received only high level feedback throughout the entire program.

Team RECON was able to show a video of the helicopter flying around the lab as an interim prototype. However, during Quarter 3 prospects started to lose interest, as they wanted to see a full functioning prototype. However, Team RECON still managed to gather requirements from prospects.

Team RUN was the only team to successfully perform a beta test. They did this in Quarter 4 which was three months later than the original plan. While they did not learn any new information, the reaffirmation of their product concept was an essential component for determining viability and moving forward after the completion of the TC program.

At the end of the second quarter, Team WIND was the only team to complete a prototype on the schedule specified by the syllabus. Two beta tests were scheduled for Quarter 3 but for logistical reasons, both customers backed out. When the team moved into the fourth quarter, conflicting demands on the student’s time prevented them from scheduling a beta test. In a
manner similar to Team RECON, an interim prototype was produced that consisted both of an animation and pictures of the actual prototype. This, coupled with the backing from their industrial sponsor, gave the students the credibility they needed to get quality feedback from their prospects.

Chapter 5: Discussion of Research Findings

Introductory Discussion

Entrepreneurship is a future oriented process targeted toward the creation of new companies as opposed to growing and maintaining the life of an existing company. The entrepreneur builds something from practically nothing. He has the ability to sense opportunity when others see chaos, contradiction and confusion (Timmons as cited in Kirby, 2004, p. 175).

The entrepreneurship process is complex (Gartner, 1985), ill-structured and open ended (Honig, 2004). The process is framed by limited resources, intense time pressure and an ever-changing operating environment. Entrepreneurs have to make immediate decisions with incomplete and dubious data (Kirby, 2004).

The information that surrounds a company and its technology is constantly changing and can only be learned through a process of observation and re-planning. As a consequence, planning needs to be flexible and adaptable as opposed to rigid. Leadership in this environment becomes more critical that the plan itself. Organizations constantly validate themselves with their customers and external environment. When this validation proves false, a state of disequilibrium occurs as the company adapts to the environment to create a new state of equilibrium.

The entrepreneur deals with two very different kinds of problems. First are the problems that are very analytical in nature such as the financial management of the company. These represent the science of entrepreneurship. Secondly, there are problems that are ill structured,
may appear in shades of grey, have incomplete data and often involve complex tradeoffs between customers and technology. These problems represent the art of entrepreneurship.

Given that entrepreneurship involves both art and science, an entrepreneurship education program needs to contain both an academic and an experiential component. The academic component can educate student in the science of entrepreneurship while the experiential program can educate students in the art of entrepreneurship. While there are many forms of experiential education, the program under study offers a unique implementation where student teams try to start real technologically based companies. In doing this, students participate in a process defined by Lave and Wenger (1990) as situated learning. In this process students are apprentices. They are given what Lave and Wenger referred to as a scaffold and they are guided by an expert.

The problem of practice is centered on the delivery of an entrepreneurship program with a complex experiential component delivered in an online modality. The online modality represents several challenges to the student teams as they are executing complex and ill-defined tasks that change when more data is obtained about technology, markets and customers. Some of these challenges are establishing effective teams, developing trust and resolving conflicts.

The purpose of the research study was to create a set of methodologies that can be used by other universities around the world to educate technological entrepreneurs. This led to the development of the research questions. The primary question is “What processes do online student teams undertake in the development of new entrepreneurial ventures?” The secondary questions are “How do online student teams participating in the development of an entrepreneurial venture (a) establish a sense of community, (b) create and develop a culture of trust, and (c) resolve conflict?” Lastly, the tertiary question is “What is the theoretical framework that characterizes student behavior in an online program in technological entrepreneurship?”
To study the research questions, a test bed was needed. One university in the northeast had an online TC program where students were trying to start real companies as part of their experiential education. To answer the primary research question about student methodologies, students needed to be studied for a year as they went through the entire entrepreneurship process from idea generation to completion of a business plan. No research to date has studied the development of real companies by students in a longitudinal manner. A longitudinal study affords the opportunity to not only evaluate entrepreneurship processes and practices but also to evaluate team development and team management which occurs in parallel. To study teams over a year, it was required to interview students periodically throughout the program to ensure that the information they were providing was fresh and an accurate accounting of what they had accomplished. The students were provided with a scaffold and an instructor who was their coach and mentor. The purpose of the study was to understand the practices and methodologies that students developed given the scaffold as a starting point.

**Theoretical Framework**

Using grounded theory, a set of core categories emerged that were related to the primary research question “What processes do online students undertake in the development of new entrepreneurial ventures?” The development of these categories was guided by a process scaffold and a set of suggested business practices which were supplied to the students and the data that was gathered. These categories were *idea generation, opportunity assessment, venture selection, risk management, product requirements, customer validation, business model and business planning*. To answer the secondary research question “How do online student teams participating in the development of an entrepreneurial venture (a) establish a sense of community, (b) create and develop a culture of trust, and (c) resolve conflict?” a secondary set of categories emerged
related to the students, teams and team processes. These major categories were: conflict, decisions, leadership and team process. At the end of the I-cubator program, a set of categories emerged that captured results and student reflections. These categories were: venture viability, principle learning, future career plans, future venture plans, I-cubator satisfaction and program satisfaction.

Using the core categories as a guide, the summary findings were woven into a theoretical framework which is shown in Figure 2. Since the primary research question is a process question, the theoretical framework is presented as a process model which has inputs and outputs. The input to the model is the students and their attributes as they enter the program. The output of the model is a new venture. Students create these new ventures over a one-year period by transforming their ideas into a business plan and an investor presentation. At the core of the model is a process scaffold that is supplied to them by their instructor. This scaffold is presented as a foundation and suggested business practices. In parallel to this scaffold are team process and development and communication process. Each of these components of the model will now be described in more detail.

**Students.** The TC program is selective in choosing the students who enter the program. The entrance criteria is a minimum of five years experience. Ideal candidates have established themselves in their career, have built a set of skills and have domain expertise. Candidates need a strong degree of professional maturity and need to understand how to operate both independently and in a team. Typically, these students are in or about to enter a period of transition in their professional careers. While they are accomplished and proficient in their careers, they are also looking for something new which could be the dream of starting their own company. Often these
students have pent up desires to experiment with ideas for new ventures. The I-cubator provides an outlet for these desires.

While the TC program has technology built into its name, it is a business program that encourages students from all domains and all functional disciplines to apply. Consequentially, students are diverse by age, skills and experience. Students also have a wide range of management expertise. Some of their job responsibilities include individual contributor, project leader, manager, executive and CEO. What the students have in common are their goals. At the center are their desires to either start a company or become an intrapreneur and lead technology commercialization efforts in their own company. For these students, returning to school represents a significant hardship, as time is taken away from their professional and personal lives. Consequently, the students are quite serious about their work in the TC program. They perform their work with a specific personal goal in mind. For all, there is a desire to increase their skills. For some, this represents an opportunity to develop their own idea into a commercial venture. While for others, their student venture represents an opportunity to work as a founder in their first start-up company.

While the program is selective in student attributes and experience, a wide geographic net is cast for student enrollments. The program draws students from around the globe, although to date all of the students have been working for American companies or have been in the American military.

**Foundation and suggested business practices.** Once in the program, the students are guided by a process scaffold and suggested business practices. The scaffold is a step-by-step process for translating an idea into a commercial venture. The steps are similar to what would be in a process handbook at a medium to large company. These steps have been adapted to the
The process of venture creation and the goals of the TC program. The scaffold consists of document templates, lectures and instructions. It represents a how-to-do manual for the students. While the process scaffold is a starting point, it does not tell the students every detail they need to run their venture. The students are empowered to develop their processes and practices using the scaffold as a base. The student adaption and application of this scaffold has been the central point of this study.

The process for the students begins with venture formation which consists of a number of discrete steps. These steps are: idea generation, opportunity assessment, venture selection, and team formation. In the venture formation process, individual student ideas are transformed into team ventures each consisting of four to five students.

Idea generation starts with each student contributing a venture idea to the class. Some bring ideas into the program that they have already developed while others develop ideas when the program begins. Students learn that idea generation is difficult and that there are more bad venture ideas than good ones. They also learn to concisely describe their venture in terms of a customer problem and their unique solution to this problem.

After their idea is approved by their instructor, students perform a detailed opportunity assessment. Through this assessment, students further connect their idea to the customer problem and their solution. In the opportunity assessment process students also examine markets, barriers to entry and competition. Students begin to realize that they don’t have all of the information that they need to do a comprehensive opportunity assessment. Some information on competitors or markets may be difficult to obtain or may be unknown. However, in a manner similar to a real venture, students move forward, meet deadlines, and make decisions with less than perfect information. As a result, students begin to learn the art of entrepreneurship.
The venture descriptions and opportunity assessments are discussed with the class through Blackboard discussion threads. Students learn to ask questions that can highlight the viability of a venture idea. Through the discussions, students begin the process of selling their idea to their fellow students. After class discussions, the list of class ventures is determined through a student voting process. With the selection of the ventures, students are assigned to teams by their preference.

Once in their teams, students go through a standard process of new venture development and technology commercialization. The first step in this process is the generation of product requirements and a prototype that meets those requirements. In a manner similar to the opportunity assessment, students learn that they may not have all of the detailed information to create the PRD thus they need to make assumptions when they are constructing the prototype. As such, students find that making these decisions requires some art.

Having completed the product requirements and the prototype, customer validation begins. The principle validation process is a customer trial using the prototype. Prototypes are produced in an incremental manner. Early prototypes may be as simple as an animation while later versions may be a complete facsimile of a product. The goal of the customer validation process is to validate the product idea and definition with the customer and make modifications to both the requirements and the prototype. This is an iterative process that occurs as feedback is obtained. Students discover that there is not a perfect match between what the customer requires and the product they are proposing. They also discover that there is an art to making product definition changes as the students are short on both time and resources. Once the customer validation process begins, it occurs continuously until the program is completed. As a result, incremental changes may be made right through the completion of the program.
In the final process step, knowledge gained through research and customer feedback is combined to produce a customer-validated business plan and an investor presentation. In the customer-validated business plan, students are able to cite specific customer examples and testimonials that validate their definition of their product and venture. This increases their credibility with inventors and it increases the likelihood that the venture will receive funding. Students leave the program having had the opportunity to experience and practice all of the steps required to create a new venture.

The scaffold also consists of guidance from their instructor who is also an experienced entrepreneur. The instructor reviews the student’s progress and is also responsible for grading student progress through each of the steps in the scaffold. The instructor offers guidance and provides assistance to the students when they become stuck or blocked from making progress.

The process scaffold is augmented by a set of suggested business practices. These practices facilitate student progress and the control of their ventures. Students are required to have two synchronous meetings per week. One meeting is with their instructor and the other meeting is a private meeting among themselves. These meetings are required to have an agenda and meeting minutes. The students are also required to have a gatekeeper function within their team and to store all project information in a central web site for all to see including their instructor. The web site serves not only as a repository for project documents but it also serves as place for threaded discussions pertinent to the project.

**Team process and development.** While the students are organized into virtual teams, they still go through a team development process that was described by both Tuckman (1965) and Gersick (1988). Student virtual teams progress through the team development stages as described by Tuckman (1965): *forming*, *storming*, *norming* and *performing*. However, student
progress is not sequential through these stages. Since the I-cubator program is an academic program that needs grading, student deliverables are required on specific dates. This creates time pressure and forces teams to come together quickly. For the teams, they have to make an instant transition to performing irrespective of their development as described by Tuckman (1965). When this occurs, the team’s behavior is characterized more by Gersick’s (1988) “punctuated equilibrium” theory. Students are also empowered to create their own team practices and governance structure for their ventures. These practices and governance structure are also part of the research project.

**Communication processes.** In parallel with team process and development, student teams are also empowered to develop their own communication processes and practices. These communication process and practices are also part of the research project. Students developed communication processes based on their own experiences, practices implemented at their place of employment and the suggested collaboration tools which are part of the scaffold.

**Interpretation of Findings**

The core component of the program under study is an online experiential program whose tasks are complex, ill defined and change over time. The findings do show that the tasks are as complicated as once thought in the beginning of the research project. The results show that students can execute these tasks and that they can be effective.

The findings also show that there is an interaction between the students and the problems posed by online education where the behavior of the students change or mitigate these problems. Students do this by constructing their own processes and norms which help them adapt to the situation. The students are empowered to build on the scaffold that was supplied to them and to
craft this to meet their personal needs as well as the needs of the venture. This becomes a powerful motivational force which encouraged students to take charge of the situation.

While the findings show a successful result, they do not show that starting student companies is to the most effective method of experiential learning when compared to other alternatives such as simulations and fieldwork. The TC program adopted the method of creating real companies as a means to promote the entrepreneurship program on campus and across the nation. The TC program also has the unwritten goal of creating companies as a means of stimulating the local and national economy.

The findings also do not show that the online modality is a better way to start a company than an on-the-ground modality. Comparisons would be needed and this data would be very hard to obtain. However the results do lead to a conclusion that virtual teams can be effective if the circumstances surrounding the team is managed and set up for success.

**Interpretation of findings with respect to the research questions.** The research study consists of three research questions. In the following section, research questions 1 and 2 are interpreted with respect to the study’s finding. Research Question 3 addresses the development of a theoretical framework which has already been discussed earlier in this chapter.

The primary research question is a process question. The secondary research questions, 2a, 2b and 2c, are questions that address team behavior in a distributed environment. Findings 1 through 11 help to shape the answers to these questions. The binding of research questions and findings is shown in Table 18.
Table 18

*Relating Findings to Research Questions*

<table>
<thead>
<tr>
<th>Finding</th>
<th>Research Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finding 1: Students followed the supplied scaffold and suggested project management practices.</td>
<td>X</td>
</tr>
<tr>
<td>Finding 2: Students made strong use of synchronous communication technology.</td>
<td>X X X</td>
</tr>
<tr>
<td>Finding 3: Information flow between students was continuous.</td>
<td>X X</td>
</tr>
<tr>
<td>Finding 4: Students were a key ingredient of the program.</td>
<td>X X X</td>
</tr>
<tr>
<td>Finding 5: Prototyping was a significant challenge.</td>
<td>X</td>
</tr>
<tr>
<td>Finding 6: Moderate separation by distance did not affect team performance.</td>
<td>X X X X</td>
</tr>
<tr>
<td>Finding 7: Task conflict was low.</td>
<td>X</td>
</tr>
<tr>
<td>Finding 8: Task reliability was important.</td>
<td>X</td>
</tr>
<tr>
<td>Finding 9: Students were very satisfied with the <em>I-cubator</em> and TC program.</td>
<td>X X</td>
</tr>
<tr>
<td>Finding 10: The quality of the student work was high but inconsistent.</td>
<td>X X</td>
</tr>
<tr>
<td>Finding 11: The assimilation-accommodation process was key to student learning.</td>
<td>X</td>
</tr>
</tbody>
</table>

Research Question 1: What processes do online student teams undertake in the development of new entrepreneurial ventures?

Research Question 2: How do online student teams participating in the development of an entrepreneurial venture (a) establish a sense of community, (b) create and develop a culture of trust, and (c) resolve conflict?

The major answer to the primary question was through Finding 1: Students followed the supplied scaffold and suggested project management practices. In the discussion of the scaffold and its components the core processes that the student teams undertook to develop their new venture are described and categorized. Often, these processes started with giving the students a template or an outline as a starting point. The core processes that were described are: idea
selection, opportunity assessment, product requirements, prototype construction, validation, and the development of a business plan.

As it relates to the TC program, the most important and unique aspects of the program are the construction of a prototype and the validation process. Since the TC program is a business program, the construction of the prototype is challenging since students come from a wide variety of disciplines and are not required to have any engineering or software development skills. For the student team this creates a challenge. Projects either need to be simple enough for them to do themselves or they need to find a development partner. In the first case, it is very difficult for students to estimate and budget the time required to work on prototype development. This effort needs to be balanced against academic work, professional work and personal needs. In the second case, students need to learn to work with resources that are beyond their control which for many is a new experience.

The validation process, as defined by its core components assimilation and accommodation, represents the key student learning in the program. In order to be effective, this process requires the development of a prototype.

The student processes are also characterized by their results. In Finding 10, the quality of the student’s work is found to be inconsistent. However, in Finding 9, students express a high degree of satisfaction with the I-cubator and the TC program.

Ancillary findings describe the team processes that are used in the virtual environment. These findings help to answer Research Questions 2a, 2b and 2c. These processes became the fabric for the teams to execute their core mission of creating a new venture. These ancillary findings consist of two classes: 1. communication and 2. trust and conflict resolution. To communicate with other, students are required to make use of synchronous communication.
Their weekly meetings with their instructor and the weekly meetings that they had among themselves were handled this way. The students added to this process by creating a continuous flow of information among themselves through the use of a group text messaging service. As a result, moderate separation by distance was not an issue that affected team performance.

Teams developed trust through demonstrated task reliability. This consisted of doing tasks on time with a quality level that the rest of the team would be proud of. Related to trust was task conflict which was low throughout the entire TC program for all teams.

**Interpretation of findings with respect to the literature review.** The four major theories of the literature review are entrepreneurship education, online education, sense of community and virtual teams. They provide a basis for further interpretation of the findings. Each of these themes will now be interpreted with respect to the findings.

*Entrepreneurship education theory.* Entrepreneurship is characterized by solving problems that are ill-defined and have dubious data to make a decision (Kirby, 2004). Throughout the development of a new venture, the knowledge about the venture’s technology, customers, competition and markets is constantly changing. Consequently, the entrepreneur needs to sense and learn from the environment and adapt through Piaget’s process of cognitive adaption (Honig, 2004). When the data surrounding the company is stable, the company remains in a state of equilibrium. When new data is assimilated that is incongruous to current understandings, a disequilibrium occurs and the company makes an accommodation. This accommodation may manifest itself as a change in product strategy or organizational structure. New and changing data creates a dynamic where the company is constantly vacillating in and out of equilibrium. As a result, plans are flexible rather than being rigid. Entrepreneurs themselves are flexible and open to change (Honig, 2004). This ability to change and adapt becomes more
important than the plan itself. Consequently, venture capitalists place a strong emphasis on a
company’s management team and their ability to adapt.

In creating real new ventures, the students in the TC program have the same experiences
as the entrepreneur. As the entrepreneur, they are short on time, have few resources and have to
make decisions with incomplete information. One of the key processes developed by the student
teams was validation. Validation consists of validating concepts and product ideas and changing
them when there are disagreements between what is being done and what is required by the
customer or the external environment.

The process of validation occurred at every step in the program. When ideas were
generated, they were validated with domain experts. When the PRD was generated, it was
validated with domain experts and potential customers. This process was repeated again for the
validation of the prototype. Student teams were constantly going through this process of
assimilation and accommodation in an online environment. In doing so, students were practicing
the “art” of entrepreneurship as identified by Kirby (2004).

There was also tension in the student teams between the right-side-of-brain thinkers and
the left-side-of-brain thinkers. This was most evident in the teams that constructed their own
prototypes. Prototype construction can be viewed as a logical left-side-of-brain activity. On
the other hand, learning from customers that what you are producing may need to be changed in
an environment where you have few resources and little time requires art and the use of the right-
side-of-brain.

**Online education theory.** One of the components of online education theory is
constructivist learning. In a constructivist manner student teams took control of their own
ventures. In doing so, they became responsible for their own learning as they only used their
instructor for guidance. As a result, the students constructed the core processes which are the basis for the findings of the research project.

Student teams went through the five-stage process model as developed by Salmon (2002, as cited in Ruey, 2010). These five stages are: establishment of motivation, socialization among learners, information exchange, construction of knowledge through conferencing and moderation, and personal development. The constructivist process started with the students developing the motivation to become entrepreneurs or leaders of technology commercialization before they entered the TC program. Upon entering the TC program, students began the socialization process by reaching out to each other on either the class Ning or the Blackboard discussion threads. After a brief period of socialization, information was exchanged between the instructor and the students and between the students themselves. Once students were assigned to the project teams, students began to conference and moderate with each other which resulted in student learning and personal development.

The students constructed these processes in a situated learning environment as identified by Lave and Wenger (1990) and further characterized by Herrington and Oliver (2000). While constructing these processes, the student operated in an apprentice relationship with their instructor.

*Sense of community.* Once in their project teams, the development of a sense of community became a cohesive force. Ke and Hoadley (2009) noted that the cornerstone of a sense of community was a shared faith among participants. This shared faith was developed through trust and a rich information flow between students. Increased information flow reduces the sense of isolation. Typically in an online environment, information is exchanged asynchronously. Ally (2004) and Murphy and Cifuentes (2001) in their studies of online
education characterized this information flow through asynchronous discussion boards. Students in the TC program made heavy use of synchronous technology which took them slightly outside of the norm of online education.

Trust was a key component in developing a sense of community. Reina and Reina (2006) identified that transformative trust can only be built through repeated events of transactional trust. Transactional trust first starts through competence trust. Students in the program under study valued both the experience level of their classmates and their diversity of skill. The students built communication trust by relying more on synchronous communication for team communication and decision making rather than asynchronous communication which is more prone to frustration through delay and misunderstandings. Lastly, students built transactional trust through contractual trust. Contractual trust was developed through the opinions about both the timing and the quality of the students work. When there were significant gaps in either communication or performance, mistrust developed quickly. This was behavior identified by Furst et al. (2004) and Tuckman (1965).

Virtual team theory. The students worked in virtual teams. Their development was characterized by both Tuckman (1965) and Gersick (1998). With the absence of external time pressures, the student teams progressed on the path of forming, storming, norming and performing. But for a student team, participating in this program as a university class, there were deadlines and deliverables that needed to be submitted for grading. In the first quarter, venture teams had their first deliverables due just three weeks after the teams were formed. At that time, the teams were in the storming stage as identified by Tuckman (1965). Once the teams realized that they had an assignment due, they went through a transition as identified by Gersick (1998) and then started performing their tasks. The teams continued to develop according to Tuckman
(1965) in Quarter 2 and in parallel they behaved according to Gersick (1998) when tasks were due.

**Key learning from findings.**

*Student attributes are key to an experiential program.* Student attributes are key to an experiential learning program. Students create knowledge from their own experience and by learning from each other. The student population needs to be segmented by experience or some other relevant factor. Once students are segmented, they should not be co-mingled across segments. For the TC program, the discriminating factor for segmenting is the length of student industry experience. The TC program requires a minimum of five years work experience and in reality, the student population averaged 10-20 years work experience. This experience enables students to learn from each other. Since experiential learners want to learn from their respected peers it also forms a basis for their satisfaction with the program.

While it was important to have experienced students in the TC program, it is also important to have diversity within the student teams. Entrepreneurship by its very nature is cross-functional. Entrepreneurial teams consist of engineering, marketing, business planning, sales and product management. In constituting new venture teams, their instructor asked both the students and the Product Champion for team member preference. Universally, the Product Champions had a strong desire to build diverse cross-functional teams. Their instructor took both perspectives into consideration when building the venture teams. Throughout the program, students repeatedly cited the diverse nature of their team as a source of satisfaction. This manifested itself in two ways. First, the team contained the key skills it required. Secondly, it made team members feel valued because it was easy for them to identify where they could make
a contribution. Making a contribution was another factor that was cited as contributing to student satisfaction.

Students also brought their own personal goals into the program. For the experienced mid-career professional, their goals were clear and a significant factor in their decision to apply to the TC program. Students wanted to either start a company or learn about the technology commercialization process. Most students accepted the goal of starting a real new venture and worked at a very high level that would be commensurate with a start-up venture. However, this was not true for all students. A minority of students viewed their new venture work as merely another academic exercise and put forth only a modest level of effort. Clashes developed between students of differing perspectives. These clashes were not evident until mid-way through the second quarter. Discussing their beliefs in the beginning of the program might have mitigated some of the clashes that occurred.

*Students will interact with the problem to change the problem they are solving.* The student teams were faced with the problem of trying to start new ventures in an online environment. When the student teams confronted this problem, their interaction with this problem fundamentally changed the shape and scope of the problem. This was primarily accomplished through the application of collaboration tools. Students used tools to change the flow of information on the ventures from discrete, separated by time, to a continuous flow of information. They did this through instant messenger and a group text messaging service provided by GroupMe.com. The learning here is that when students are empowered, they will seek out and develop new and innovative solutions. The state-of-the-art in collaboration tools is constantly changing and improving. At the same time, each new class of students will be more
comfortable with the technology and these tools. As a result, future students will address online collaboration in new and innovative ways.

_A well designed scaffold is key._ Distance learning problems can be minimized through a well-designed scaffold. Problems associated with distance learning can be mitigated through tools and protocols. One of the significant problems associated with a distance learning project is that project information may be out of synchronization. Two synchronization problems can occur. First, all venture team members may not have a complete set of the project documents. If these documents were shared through e-mail, it is conceivable that not everyone has a complete set of documents. This problem was resolved at the scaffold level by having the students use a web site for a central point of control and for the storage of documents.

The second synchronization problem that can occur is with document revisions. This happens when a group is simultaneously editing a document. For distance learners who are working asynchronous to each other this is a very probable scenario. To solve this problem, the students were instructed to use Google Docs. Through Google Docs, everyone reads and edits the same document revision.

The scaffold also included governance procedures that eliminated some of the other common problems with distance learning. The students were required to have a gatekeeper. To maintain focus, this was a purely administrative role that was separated out from venture leader or Product Champion. The scaffold also required the students to meet twice a week, once among themselves and once with their instructor for coaching and mentoring.

_Synchronous technology can mitigate problems associated with distance learning._ One of the problems associated with distance learning is the frustration that can occur due to the use of asynchronous discussion technologies such as e-mail or discussion threads. The use of a
mixture of synchronous and asynchronous technology mitigated these problems. Students would use asynchronous technology to share information before meetings that were held synchronously. Most project decisions were made in these synchronous meetings where students were able to sense the ebb and flow of the meeting, ask for clarifications and follow up with further questions. Even though these meetings were not face-to-face, students reported that they were able to sense the chemistry of the meeting by the tone of the person’s voice or by unexpected and prolonged silence. A few students complained about synchronous technology conflicting with their personal lives. The person who had the most difficulty with synchronous technology was the instructor as he had to meet with each team and often these meetings were in the evening when the students were not at work.

First three weeks of confusion and stress for the students. The first three weeks of the program were confusing and stressful from the student’s perspective. A mix of student issues precipitated this. Some students were new to online learning. Some students were returning to school after a long absence. For some others, the use of collaborative tools was a challenge. During the very first week, some students were wondering if they could proceed with the program. The learning here is to be cognizant of the stress that is on the students. The instructor needs to be very accessible to answer questions. One observation was that the students were overwhelmed and not reading the material they were given. Consequently, information needs to be passed to the student in multiple formats. Podcasts and synchronous web conferencing can be helpful during this period. Where possible, instructors should not push the students too hard during this first three weeks.

Extreme distance is an issue. While the student teams have proved that they can manage across geographic boundaries, managing across extreme distance is an issue that was not
resolved during this research project. Student teams that were managing across three time zones found it was not difficult to schedule their synchronous meetings. However, the APP team stretched across nine time zones for three quarters of the program. For team APP, while it was not impossible to schedule their synchronous meetings, it was very difficult for them to have 100% attendance at the meetings. This caused the behavior in team APP to be different from the other teams. The APP team accepted some amount of dysfunctional behavior in their meeting process. Decisions were made and tasks were assigned even though there were absentees. On the day after meeting, e-mails were sent to the absentees to see if they concurred with either a decision or a task that was assigned to them. In this manner, students felt that they were doing the best they could within the program constraints whether this was the most optimal situation or not.

Claims.

1. Experiential education of technological entrepreneurs can be delivered effectively in an online modality.

The results show that experiential education of technological entrepreneurs can be delivered effectively in an online modality. This effectiveness was measured by the student’s satisfaction with their venture as derived from surveys and interviews and from the review of their work by a panel of judges. There was consistency in the data gathered from all methods.

The effectiveness of experiential education for technological entrepreneurs was not known at the beginning of the research study. This effectiveness was most exemplified by Team WIND. Not only did this team have the highest satisfaction score and rating from the judges but they also had a review from their industrial
sponsor who found their work to be of a sufficient high quality that they wanted to use the student’s work as the basis for a new product or product line.

Effectiveness was not uniform across all of the students and projects. This was most evident in the case of Team APP. They were the most geographically dispersed team with the least clear business model. This team also had some student commitment issues. This lack of effectiveness resulted in frustration which was espoused the most by APP-P1.

2. Experiential education is a motivating force.

Experiential education has proven to be a motivating force for the students. This was evidenced through their satisfaction scores and observed through their reflective journals. This motivation helped them to confront problems that can occur in a distance learning environment. It fueled their creativity through the use of constructivist learning methods to design solutions that were relevant to them, their team and their project environment. For example, the students deployed the GroupMe text messaging tool without any assistance or guidance from their instructor.

Motivation did vary by student. One of the major determinants of this motivation centered around the student’s view of the experiential program. For those that viewed their project as real and something that they wanted to work on after the program was completed, their motivation was high. For the few with lower motivation, most notably APP-P2, there was a view that the experiential program was an academic exercise that would provide them with the experience needed to start their own venture when the program concluded.

3. Complex tasks can be accomplished by teams in an online environment.
The students accomplished complex tasks effectively in an online environment. These tasks required a high degree of interaction among team members and their instructor. The most notable complex process performed by the students was the *accommodation-assimilation* process identified by Honig (2004) as fundamental to the entrepreneurship process. This process requires a complex interaction among the entrepreneurs on the team and between the entrepreneurs and their external environment. In an on-the-ground environment, a significant amount of these interactions occur face-to-face. The students in the program under study were able to overcome problems created by geographic separation through the use of collaboration tools and a defined set of workflow procedures.

There were numerous examples of students executing the *assimilation-accommodation* process during the course of the research project. When Team RECON received feedback that they could not be funded without domain expertise on the team, they quickly started a board of advisors and drafted a retired military officer as its first member. When RUN-P1 struggled with the development of the prototype, the team was able to transfer the development of the prototype to an external contractor which resulted in quick progress. Lastly, when Team WIND realized that they did not have enough credibility to sell directly to wind turbine manufactures, they switched their focus to selling directly to owner-operators. When they found that these prospects to be highly risk adverse, they switched their focus to owner-operators in a university environment as these prospects were less risk adverse.
The student’s success in performing complex interactions leads to a question as to whether other academic programs that have complex tasks can also be delivered in an online environment under the right set of circumstances.

**Limitations**

This study showed how a small group of students could be effective in starting real companies as part of their experiential education. The sample was small and thus there is a risk of trying to extend these results to other situations. The sample was also limited to students with experience in the range of 10 to 15 years. Students with less experience might not have the same results because they might not be as mature and they wouldn’t necessarily have a significant amount of project based experience to draw upon. While these results may be viewed as similar to what might happen in an industrial setting, these results may not be applicable. In an industrial setting, team member motivation may be jaded by their personal aspirations. Additionally, team members may have deep prior relationships which can affect their behavior.

No claims are made that the methods and processes presented here are the most effective methods for use in an experiential program. Other methods such as fieldwork or simulation may be just as effective or even more effective.

Lastly, this research project was a study done at a specific point in time with respect to the state-of-the-art of the collaboration tools and student’s acceptance and proficiency with these tools. In future studies, there will be improved tools and students will be much more fluent in their use of them.

**Significance**

**Theoretical.** The research project is the first longitudinal study of a group of online students performing the complex task of attempting to start a real new venture. As such, the
The research project confirms the work of Tuckmann (1965) and Gersick (1988). Both models provided insight into student behavior. As presented by Gersick (1988), the Tuckman (1965) model did not factor in how time or fixed deadlines can affect a team’s behavior or development. When these two models are combined further insight and understanding can be developed about a team’s behavior. In particular, what is the team behavior when there is a transition from phase 1 to phase 2 while the teams are still in the forming and storming stage of development as described by Tuckman (1965). This is exactly what happened during the early stages of the research project. Students experienced both confusion and stress when they worked on deliverables early in the program before the team was in the performing stage.

The research project also confirms the work of Jarvenpaa and Leidner (1999) and Reina and Reina (2006) with respect to the development of and the importance of trust in an online environment. Independent of technology use, trust in an online environment can only be built through repeated successful transactions where the work product is delivered on time and its quality meets the expectations of the other members of the team.

The research project advances the state of entrepreneurship education theory. Building on the work of Kuratko (2004) and Kirby (2004), the study provides new insights for the education of technological entrepreneurs. The study suggests that entrepreneurship students find a high degree of relevance between their goals and their empowerment to start real new companies. For the mid-career professional, the subjects in this study, this experience provides an outlet that might not be being satisfied in their current professional lives. This experience also fuels their motivation for resolving problems or roadblocks that can prevent them from completing their
venture. The study shows that students repeatedly solved problems or broke down barriers that were associated with time and distance. This motivation could also be relevant to entrepreneurship students working on-the-ground.

**Practical.** In the research project, a methodology for educating technological entrepreneurs has been described and evaluated. A scaffold has been developed which can be transported to other higher education institutions. The scaffold consisted of core processes and governance procedures. The core processes described were opportunity assessment, venture selection, risk management, product requirements, prototype development, customer validation, business model development and business planning. Where relevant, these processes have been characterized by a template which is available as an Appendix. While the technology for online collaboration may change significantly, these core processes will remain stable although they will be incrementally improved over time.

The governance procedures for managing the student teams are also a practical contribution. These procedures consisted of the following:

1. The requirement to hold regularly scheduled meetings among the team and with their instructor using synchronous technology.
2. The use of an internal web site for the storage of documents and project coordination.
3. The requirement to have a gatekeeper on the team to ensure that meetings were scheduled and deliverables were met.

The student teams also used technology to coordinate their efforts. Future student teams will also use technology but it will not be the same exact tools used in the research project. Most likely it will be improved versions of these tools or tools that have yet to be invented. However,
the core processes used by the students most likely will remain the same. These core processes were e-mail, tele-conferencing, text messaging, threaded discussions and telephone.

**Directions for Future Research**

One area for future research is a comparative study on methods for experiential education for technological entrepreneurs. The methods used in this research project were costly and labor intensive from an instructor viewpoint. Additionally, with the methods employed in this program, the educational results may vary by student team and their venture. Are there experiential methods that are more cost effective? Are there methods that would achieve more uniform results across the entire student population?

**Conclusion**

It is through entrepreneurship that economies grow and are reinvented. This results in the creation of wealth and jobs. Entrepreneurs are a key resource for any market economy. Academic institutions can stimulate the development of these entrepreneurs through experiential educational programs. As entrepreneurship is both an art and a science, the critical element of the program is an experiential component. The reach of these programs can be extended beyond the campus through an online delivery model. The online entrepreneurship program provides an economic benefit to both the academic community and the society that it serves.

During the exploratory discussions about the creation of the online TC program used in this study, there was a healthy amount of skepticism, since it was believed that an experiential program in technological entrepreneurship could only be taught on-the-ground due to the complex interactions that are needed within student teams. Furthermore, at the inception of the program, there was an expectation by some that the program would be of a lower quality than a similar on-the-ground program. The results clearly show that is not the case. These results were
affirmed through 66 interviews over a calendar year, student’s satisfaction scores and ratings of their work from the panel of judges. For these students, the online modality was the only option available to them given the complexities of their personal and professional lives. Without an online TC program, these students would not have pursued a graduate education.

Given the successful experience of the online TC program, educators are encouraged to revisit educational programs that they once thought could not be delivered effectively online. With the right program design and student support, most on-the-ground programs can be delivered effectively online even if they require complex interactions between the students.
Figures

Technology Commercialization Program

Figure 1

Research project design
Theoretical Framework

Legend:
F-1 Finding 1: Students followed the supplied scaffold and suggested project management practices.
F-2 Finding 2: Students made strong use of synchronous communication technology.
F-3 Finding 3: Information flow between students was continuous.
F-4 Finding 4: Students were a key ingredient of the program.
F-5 Finding 5: Prototyping was a significant challenge.
F-6 Finding 6: Moderate separation by distance did not affect team performance.
F-7 Finding 7: Task conflict was low.
F-8 Finding 8: Task reliability was important.
F-9 Finding 9: Students were very satisfied with the I-cubator and the TC program.
F-10 Finding 10: The quality of the work was high but inconsistent.
F-11 Finding 11: The assimilation-accommodation process was key to student learning.
References


Entrepreneurship Education, 1(1), 65-86.


Appendix A: Definition of Terms

*Commercialization:* The process of introducing a new product to the marketplace, aided by the creation of business and marketing plans.

*Digital media:* Digital media includes the following: Social networking web sites such as Facebook, web site companies such Google or Amazon, online delivery of music and video, and computer games.

*Domain expertise:* Refers to knowledge in a specifically technology area such as software, semi-conductors, digital media, medical devices, etc.

*Gatekeeper:* An administrative role on the venture team. The gatekeeper’s responsibility is to: Schedule meetings, ensure meetings have an agenda, ensure timely completion of tasks and post meeting minutes.

*I-cubator:* A faculty-student learning organizational structure developed to create new companies using students as the company’s management team.

*Intrapreneur:* A person who wants to pursue entrepreneurial activities within an existing company as opposed to an entrepreneur who wants to start a new company.

*Ning:* A social networking site that is similar to Facebook except it is a closed community

*PRD:* Product Requirements Document

*Product Champion:* The student who submitted the idea for a venture that was selected by the class.

*Technological entrepreneurship:* The creation of commercial high-technology new ventures. This is much different from the wider field of general entrepreneurship that includes retail, family businesses, franchises, etc. Technological entrepreneurship involves starting companies that have both market and technology risks.
Venture: A project that has the potential to become a new company.

Virtual teams: Teams that work on a common task or toward a common goal and that are separated by geography and/or time.
Appendix B: Initial Survey Questions

Questions 1-19 and question 22 came from Duval-Couetil, Reed-Rhoads, and Haghighi (2010).
1. What is your sex? (Male, female)
2. Please indicate your residence status? (In-state(MA), Out-of-state, International
3. If you are an international student, what is your home country? ()
4. What is your ethnic/racial background? Select all that apply (American Indian or
Alaskan Native, Asian, Black or African American, Hispanic or Latino, Native Hawaiian
or Pacific Islander, White, Multiracial, Other (Please specify), Decline.)
5. Are either of your parents entrepreneurs? (Yes, No, I’m not sure).
6. Is anyone in your family (not including your parents) an entrepreneur? (Yes, No, I’m not sure).
Questions 7 through 19 are to be answered: Strongly disagree, disagree, neither agree nor
disagree, agree or strongly agree.
Considering your post-graduation options, please rate your level of agreement with the
following: I plan to:
7. Start my own business or be self employed
8. Work for a small business or start-up company
9. Work for a medium- or large-sized company
10. Work for the government
11. Serve in the military
12. Work for a non-profit organization
13. Attend graduate/professional school
14. Undecided
Please answer the following statements in terms of your level of agreement.
15. I have my own business
16. I would like to start a business in the next year
17. I would like to start a business in the next 5 years
18. I would like to start a business in the next 10 years
19. I don’t have any plans to start a business at this time.
20. If you have a business, what was the first-year gross revenue ($) ? (Less than
$25,000, $25,001- $50,000, $50,001-$100,00, $100,001-$200,000, Greater than
$200,001).
21. If the business is a going concern, how much do you expect it to grow in the next
year? (Zero or negative growth, Less than 10%, 10-25%, 25-50%, 50-100%)
22. Overall, how would you rate your entrepreneurial ability? (Poor, Below Average,
Average, Above average, Excellent)
Questions 23 through 48 came from McGhee and Peterson (2009)
Please answer the following question with: (1) Very little confidence, (2), (3) Some
confidence, (4), (5) Complete confidence
How much confidence do you have in your ability to….?
23. Work long hours in my business
24. Train employees
25. Save or personally accumulate the necessary capital to fund my business
26. Recognize a business opportunity before others do
27. Read and interpret financial statements
28. Delegate tasks and responsibilities to employees in my business
29. Organize and maintain financial records of my business
30. Inspire, encourage, and motivate my employees
31. Deal effectively with day-to-day problems and crises
32. Recruit and hire employees
33. Prepare projected pro-forma financial statements balance sheets without assistance
34. Design an effective/marketing advertising campaign for a new product or service
35. Identify the need for a new product or service
36. Get others to identify and believe in my vision and plans for new business
37. Manage the financial assets of my business
38. Gain the confidence and trust of people who do not know me very well
39. Design a product or service that will satisfy needs and wants
40. Supervised employees
41. Find individuals with the necessary capital to fund my business
42. Estimate customer demand for our new product or service
43. Design appropriate incentives and rewards for my employees
44. Clearly and concisely explain verbally and in writing my business idea in everyday terms
45. Brainstorm a new idea for new product or service
46. Estimate the amount of start-up funds and working capital necessary to start my business
47. Network i.e. make contact with and exchange information with others
48. Determine a competitive price for a new product or service
Appendix C: Student Interview Questions

Quarter 1 Interview Questions
1. Describe your professional background.
2. What were your expectations in taking this program?
3. How did you feel during the first three weeks of the program?
4. How did you come up with your project idea?
5. What process did you use for your opportunity assessment?
6. How well did the project selection process work for you?
7. How did you choose the project you want to work on?
8. Was this your idea? If not, how did you feel when your project idea was not selected?
9. What is your opinion of the project that you are working on?
10. What was your first team meeting like?
11. Does your team have a leader? If so how was the leader chosen?
12. What was the process that you used to produce your first team deliverables?
13. What is your team’s plan for building your prototype?
14. What do you perceive to be the risks in your project?
15. How satisfied are you with your team’s deliverable?
16. How satisfied are you with this educational program?

Quarter 2 Interview Questions
1. Please describe your team’s work this semester.
2. What was the process that you used to create your product requirements document?
3. How did you resolve differing points of view in creating this document?
4. Please describe your team’s efforts to create the prototype?
5. How was the prototype tested?
6. Do team members have roles? If so what are they?
7. What process was used to distribute project work this semester?
8. How do team members communicate?
9. Please describe a typical team meeting.
10. How are decisions made in your team?
11. At this point in the program, what is your perception of the current risks in the project?
12. How satisfied are you with your team’s deliverables this semester?
13. At this point in the program, how satisfied are you with this educational program?

Quarter 3 Interview Questions
1. Please describe your work this semester.
2. Please describe your ongoing prototype development efforts.
3. What was the process that you used for customer validation?
4. What did you learn from your product validation and did you need to make any changes to your prototype or product requirements?

Quarter 4 Interview Questions
1. Please describe your work this semester.
2. What was the process you used to create your business model?
3. What was the process that you used to create your business plan?
4. How viable do you believe your new venture is?
5. What was your principle learning from the new venture development program?
6. What are your plans after graduation- for this new venture and for your career?
7. How satisfied are you with the new venture development course sequence?
8. How satisfied are you with this academic program?
Appendix D: Instructor Interview Questions

For each team, please answer the following:
1. Please summarize the performance of each team.
2. Please describe the teamwork in each team.
3. How are team members engaged?
4. Has the team experienced any conflicts?
5. How have they resolved the conflicts?
6. From your vantage point are team members reliable?
7. Does the team have a leader?
8. How would you rate the performance of the leader?
Appendix E: Sense of Community Survey

Survey Items
From Rovai (2002a)
Each item was scored strongly agree, agree, neutral, disagree, or strongly disagree.
1. I feel that students in this course care about each other.
2. I feel that I am encouraged to ask questions.
3. I feel connected to others in this course.
4. I feel that it is hard to get help when I have a question.
5. I do not feel a spirit of community.
6. I feel that I receive timely feedback.
7. I feel that this course is like a family.
8. I feel uneasy exposing gaps in my understanding.
9. I feel isolated in this course.
10. I feel reluctant to speak (or post) openly.
11. I trust others in this course.
12. I feel that this course results in only modest learning.
13. I feel that I can rely on others in this course.
14. I feel that other students do not help me learn.
15. I feel that members of this course depend on me.
16. I feel that I am given ample opportunities to learn.
17. I feel uncertain about others in this course.
18. I feel that my educational needs are not being met.
19. I feel confident that others will support me.
20. I feel that this course does not promote a desire to learn.

Scoring Keys

Overall raw score.
Raw scores vary from a maximum of 80 to a minimum of zero. Interpret higher scores as a stronger sense of classroom community. Score the test instrument items in the following manner. For items: 1, 2, 3, 6, 7, 11, 13, 15, 16, and 19, weight strongly agree 4, agree 3, neutral 2, disagree 1, and strongly disagree 0. For items: 4, 5, 8, 9, 10, 12, 14, 17, 18, and 20 weights strongly Agree 0, agree 1, neutral 2, disagree 3, and strongly disagree 4. Add the weights of all 20 items to obtain the overall score.

Subscale raw scores.
Subscale raw scores vary from a maximum of 40 to a minimum of zero. Calculate subscale scores in the following manner. For connectedness, add the weights of items: 1, 3, 5, 7, 9, 11, 13, 15, 17, and 19. For learning, add the weights of items: 2, 4, 6, 8, 10, 12, 14, 16, 18, and 20.

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Appendix F: Student Satisfaction Survey

From Valacich, A. Dennis, and Nunamaker (1992)

1. How satisfied were you with your team’s process?
2. How satisfied were you with the outcome of your team’s project?
3. How satisfied were you with the other members of your team?
4. Overall, how satisfied were you participating in this global virtual team collaboration?

A five point Lickert scale was used:

5= Highly satisfied
4= Satisfied
3= Neither satisfied or satisfied
2= Dissatisfied
1= Highly dissatisfied
Appendix G: Opportunity Assessment Form

<table>
<thead>
<tr>
<th>Name:</th>
<th>Project Name:</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is the product?</td>
<td></td>
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<tr>
<td><strong>Who is the customer?</strong> (Demographic profile)</td>
<td></td>
</tr>
<tr>
<td><strong>What problem does this solve?</strong> (Customer benefit)</td>
<td></td>
</tr>
<tr>
<td><strong>How is this problem being solved today?</strong> (By whom and with what technology?)</td>
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<tr>
<td><strong>Is the product good enough to make people switch?</strong> (Use of new product, factors that determine buying decisions, desired price)</td>
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<tr>
<td><strong>How do you plan to get the product to the customer?</strong></td>
<td></td>
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<tr>
<td><strong>Who are the competitors today?</strong> (What do customers like and dislike about competitors?)</td>
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</tr>
<tr>
<td><strong>Who might be future competitors?</strong></td>
<td></td>
</tr>
<tr>
<td><strong>What are the barriers to entry for a future competitor?</strong></td>
<td></td>
</tr>
<tr>
<td><strong>What are the barriers to entry for this product?</strong></td>
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<tr>
<td><strong>Is there unique intellectual property in this product?</strong></td>
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<tr>
<td><strong>What are the key trends in the industry that can affect this product?</strong> (Describe the industry and its trends.)</td>
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<tr>
<td><strong>What is the market potential for this product and how might that change over time?</strong> (Size, market trends and desired timeframe for the product.)</td>
<td></td>
</tr>
<tr>
<td><strong>What are the key risks in this project?</strong></td>
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</table>
Appendix H: Risk Management Form

Developed through the author’s experience and the work of DeMarco and Lister (2003).

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<td>Risk Description:</td>
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<table>
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<th>Risk manager:</th>
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<tbody>
<tr>
<td>(name of person assigned to manage this risk)</td>
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<table>
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<tr>
<th>Severity:</th>
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<tbody>
<tr>
<td>(Quantify schedule and cost impact)</td>
<td>(Circle one) High medium low</td>
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<table>
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<tr>
<th>Likelihood:</th>
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<tbody>
<tr>
<td></td>
<td>(Circle one) High medium low</td>
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<table>
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<tr>
<th>Risk mitigation:</th>
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</tr>
</thead>
<tbody>
<tr>
<td>(actions taken before risk materializes)</td>
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</table>

<table>
<thead>
<tr>
<th>Risk indicators:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(Actions that indicate a risk has occurred or is more likely to occur.)</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Backup strategies:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(actions taken after risk occurs)</td>
<td></td>
</tr>
</tbody>
</table>
Appendix I: Product Requirements Form

TC Product Requirements Template

Revision History

<table>
<thead>
<tr>
<th>Date</th>
<th>Revision</th>
<th>Description</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1.0 Executive Summary

*High-level description of the product to be developed with the key features defined.*

2.0 Market Overview

*Who are the customers?*

*Value proposition*

*Market size*

*Key factors for penetrating this market?*

*Summary of customer interviews and/or results from prototype evaluation*

3.0 Product Overview

*Include a written description and a high level overview of the product concept or architecture.*

4.0 Customer Requirements

*Do not write in shaded cells.*
Summary of business requirements:

<table>
<thead>
<tr>
<th>Business requirement</th>
<th>Priority</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time to market</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Features</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Product cost (define volume and year)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Development budget</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Summary of feature requirements:

*This table should like to the feature definition in Section 5.*

<table>
<thead>
<tr>
<th>Customer Requirement</th>
<th>Supporting Features (if applicable)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 5.0 Features

<table>
<thead>
<tr>
<th>ID #</th>
<th>Priority</th>
<th>Summary of Feature:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Target market:

Driver:

Description:

Response:

Open issues:

<table>
<thead>
<tr>
<th>ID #</th>
<th>Priority</th>
<th>Summary of Feature:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Target market:

Driver:

Description:

Response:

Open issues:

### 6.0 Customer environment

Customer expertise, physical environment, safety, agency approvals, packaging, installation, training, documentation, prerequisite hardware and software, compatibility with other hardware and software products.

### 7.0 International requirements

Countries, languages, agency approvals.

### 8.0 Reliability

Mean time between failure, # of open bugs allowed in terms of priority 1, priority 2 and priority 3.

### 9.0 Human factors definition

Define ease of use requirements.

Define the customer user interface here or in a separate document. This should include screen shots and workflow.

### 10.0 Evolvability
Will the product be the basis for other future products? If so, what features enable this to happen?

11.0 Serviceability and maintenance requirements

What features are required in the product to make it serviceable and maintainable?

12.0 Manufacturability requirements

Manufacturing strategy.

Manufacturing test equipment required.

Manufacturing capital equipment required.
Appendix J: Business Plan Presentation Outline

1. Title page- 1 slide
   • Name of company
   • Short mission statement or tag line

2. The Team (1 slide)
   • Founding members and key employees
   • Current roles and past positions
   • Key relevant biographical details

3. Corporate Summary (1 slide)
   • What is the mission of the company?
   • Key company facts:
     o Current stage of the company
     o Key milestones achieved
     o Existing customers
     o Amount invested in company to date

4. The Problem (1 or 2 slides)
   • What is the problem the company is going to solve or the new opportunity it is going to create?
   • What are the current solutions in the marketplace?
   • Why are current solutions inadequate?
   • Supporting data that the problem is real
   • Quotations from market participants

5. The Solution (4-6 slides)
   • What will the company do to solve the problem?
   • Products, features and benefits
   • Medium to high level
   • Don’t ruin your meeting with too detail!

6. Prototype status (1 slide)
   • What have you built?
   • Simple description- not a demo!

7. Customer feedback (1 slide)
   • What have you heard from customers, channel partners and domain experts
   • High quality customer contacts
   • What did they say
   • Keep it simple!

8. Market size (1 or 2 slides)
   • Total addressable market
• Supporting data and evidence
• Price and positioning
• Customer ROI analysis

9. Competition (1 or 2 slides)
• Who is the competition?
• Incumbents
• Start-ups
• How should one think about the competitive landscape?
• Why will company win?

10. Barriers to entry (1 slide)
• Barriers
• IP position

11. The Plan (1 slide, graphic)
• Graphic
• Major milestones
• Beta, FCS, cash flow breakeven
• 2 or 3 year horizon
• Overlaid with:
  o Funding requirements
  o Headcount requirements by functional area

12. Financial plan (2 slides)
• First two years quarterly P&L, Yearly for years 3 and 4
• Cash position
• Revenue, net income
• R&D
• Sales and Manufacturing
• G&A
• How much $ are you looking and what milestones are you going to achieve with that investment

13. Summary
• Mission
• Opportunity
• Some positive ending:
  o “We are excited about the possibility of working together”
Appendix K: Survey Results

Table 1

<table>
<thead>
<tr>
<th></th>
<th>Connectedness</th>
<th>Learning</th>
<th>Classroom community</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>Maximum</td>
<td>40</td>
<td>40</td>
<td>80</td>
</tr>
<tr>
<td>Cohort Overall</td>
<td>16</td>
<td>28.88 (3.30)</td>
<td>29.75 (3.97)</td>
</tr>
<tr>
<td>Team RECON</td>
<td>4</td>
<td>27.75 (3.40)</td>
<td>27.25 (4.19)</td>
</tr>
<tr>
<td>Team APP</td>
<td>4</td>
<td>30.25 (4.99)</td>
<td>31.50 (4.43)</td>
</tr>
<tr>
<td>Team RUN</td>
<td>4</td>
<td>30.25 (1.26)</td>
<td>31.00 (4.76)</td>
</tr>
<tr>
<td>Team WIND</td>
<td>4</td>
<td>27.25 (2.50)</td>
<td>29.25 (2.06)</td>
</tr>
<tr>
<td>From Rovai</td>
<td>375</td>
<td>26.45 (7.23)</td>
<td>30.17 (6.51)</td>
</tr>
</tbody>
</table>

Raw scores vary from a maximum of 80 to a minimum of zero. Interpret higher scores as a stronger sense of classroom community.

Table 2

<table>
<thead>
<tr>
<th></th>
<th>Overall</th>
<th>Team RECON</th>
<th>Team APP</th>
<th>Team RUN</th>
<th>Team WIND</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N=16</td>
<td>N=4</td>
<td>N=4</td>
<td>N=4</td>
<td>N=4</td>
</tr>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>1. How satisfied were you with your team’s progress?</td>
<td>4.25 (0.68)</td>
<td>4.50 (0.58)</td>
<td>3.75 (0.50)</td>
<td>3.75 (0.50)</td>
<td>5.00 (0.00)</td>
</tr>
<tr>
<td>2. How satisfied were you with the outcome of your team project?</td>
<td>4.13 (0.72)</td>
<td>4.00 (0.00)</td>
<td>3.50 (1.00)</td>
<td>4.00 (0.00)</td>
<td>5.00 (0.00)</td>
</tr>
<tr>
<td>3. How satisfied were you with other members of your team?</td>
<td>4.25 (0.77)</td>
<td>4.25 (0.50)</td>
<td>3.75 (1.26)</td>
<td>4.00 (0.00)</td>
<td>5.00 (0.00)</td>
</tr>
<tr>
<td>4. Overall, how satisfied were you in participating in this global virtual team collaboration?</td>
<td>4.00 (0.89)</td>
<td>4.00 (0.00)</td>
<td>3.50 (1.00)</td>
<td>3.50 (1.00)</td>
<td>5.00 (0.00)</td>
</tr>
</tbody>
</table>

A five point Lickert scale was used:

5= Highly satisfied
4= Satisfied
3= Neither satisfied or satisfied
2= Dissatisfied
1= Highly dissatisfied
Table 3

*Quarter 2 Classroom Community Survey Results*

<table>
<thead>
<tr>
<th></th>
<th>Connectedness</th>
<th>Learning</th>
<th>Classroom community</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>Maximum</td>
<td>40</td>
<td>40</td>
<td>80</td>
</tr>
<tr>
<td>Cohort Overall</td>
<td>15</td>
<td>28.87 (3.13)</td>
<td>29.13 (3.16)</td>
</tr>
<tr>
<td>Team RECON</td>
<td>4</td>
<td>27.75 (3.50)</td>
<td>27.75 (2.87)</td>
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<tr>
<td>Team APP</td>
<td>3</td>
<td>26.50 (2.31)</td>
<td>29.00 (4.51)</td>
</tr>
<tr>
<td>Team RUN</td>
<td>4</td>
<td>29.25 (0.96)</td>
<td>28.75 (2.63)</td>
</tr>
<tr>
<td>Team WIND</td>
<td>4</td>
<td>32.00 (2.58)</td>
<td>31.00 (2.94)</td>
</tr>
<tr>
<td>From Rovai</td>
<td>375</td>
<td>26.45 (7.23)</td>
<td>30.17 (6.51)</td>
</tr>
</tbody>
</table>

Raw scores vary from a maximum of 80 to a minimum of zero. Interpret higher scores as a stronger sense of classroom community.

Table 4

*Quarter 2 Student Satisfaction Survey*

<table>
<thead>
<tr>
<th></th>
<th>Overall</th>
<th>Team RECON</th>
<th>Team APP</th>
<th>Team RUN</th>
<th>Team WIND</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N=16</td>
<td>N=4</td>
<td>N=3</td>
<td>N=4</td>
<td>N=4</td>
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<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>1. How satisfied were you with your team’s progress?</td>
<td>4.20 (0.68)</td>
<td>4.50 (0.58)</td>
<td>3.75 (0.50)</td>
<td>3.75 (0.50)</td>
<td>5.00 (0.00)</td>
</tr>
<tr>
<td>2. How satisfied were you with the outcome of your team project?</td>
<td>4.07 (0.70)</td>
<td>4.00 (0.00)</td>
<td>3.50 (1.00)</td>
<td>4.00 (0.00)</td>
<td>4.75 (0.50)</td>
</tr>
<tr>
<td>3. How satisfied were you with other members of your team?</td>
<td>4.20 (0.77)</td>
<td>4.25 (0.50)</td>
<td>3.75 (1.26)</td>
<td>4.00 (0.00)</td>
<td>5.00 (0.00)</td>
</tr>
<tr>
<td>4. Overall, how satisfied were you in participating in this global virtual team collaboration?</td>
<td>3.93 (0.88)</td>
<td>4.00 (0.00)</td>
<td>3.50 (1.00)</td>
<td>3.50 (1.00)</td>
<td>5.00 (0.00)</td>
</tr>
</tbody>
</table>

A five point Lickert scale was used:

5= Highly satisfied
4= Satisfied
3= Neither satisfied or satisfied
2= Dissatisfied
1= Highly dissatisfied
Table 5

*Quarter 3 Classroom Community Survey Results*

<table>
<thead>
<tr>
<th></th>
<th>Connectedness</th>
<th>Learning</th>
<th>Classroom community</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>Maximum</td>
<td>40</td>
<td>28.93 (5.56)</td>
<td>30.57 (3.48)</td>
</tr>
<tr>
<td>Cohort Overall</td>
<td>14</td>
<td>28.93 (5.56)</td>
<td>30.57 (3.48)</td>
</tr>
<tr>
<td>Team RECON</td>
<td>4</td>
<td>29.75 (0.96)</td>
<td>29.75 (2.97)</td>
</tr>
<tr>
<td>Team APP</td>
<td>4</td>
<td>23.33 (4.24)</td>
<td>29.00 (1.41)</td>
</tr>
<tr>
<td>Team RUN</td>
<td>2</td>
<td>28.50 (2.52)</td>
<td>30.50 (1.91)</td>
</tr>
<tr>
<td>Team WIND</td>
<td>4</td>
<td>33.50 (5.00)</td>
<td>33.25 (4.57)</td>
</tr>
<tr>
<td>From Rovai</td>
<td>375</td>
<td>26.45 (7.23)</td>
<td>30.17 (6.51)</td>
</tr>
</tbody>
</table>

Raw scores vary from a maximum of 80 to a minimum of zero. Interpret higher scores as a stronger sense of classroom community.

Table 6

*Quarter 3 Student Satisfaction Survey*

<table>
<thead>
<tr>
<th></th>
<th>Overall</th>
<th>Team RECON</th>
<th>Team APP</th>
<th>Team RUN</th>
<th>Team WIND</th>
</tr>
</thead>
<tbody>
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<td>N=2</td>
<td>N=4</td>
<td>N=4</td>
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<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>1. How satisfied were you with your team’s progress?</td>
<td>4.21 (0.70)</td>
<td>4.50 (0.58)</td>
<td>3.67 (0.71)</td>
<td>4.00 (0.00)</td>
<td>4.50 (1.00)</td>
</tr>
<tr>
<td>2. How satisfied were you with the outcome of your team project?</td>
<td>4.07 (0.73)</td>
<td>4.00 (0.00)</td>
<td>3.33 (1.42)</td>
<td>4.00 (0.00)</td>
<td>4.75 (0.50)</td>
</tr>
<tr>
<td>3. How satisfied were you with other members of your team?</td>
<td>4.21 (0.80)</td>
<td>4.25 (0.50)</td>
<td>3.67 (0.71)</td>
<td>3.50 (1.00)</td>
<td>4.75 (0.50)</td>
</tr>
<tr>
<td>4. Overall, how satisfied were you in participating in this global virtual team collaboration?</td>
<td>3.93 (0.92)</td>
<td>4.00 (0.00)</td>
<td>3.33 (1.15)</td>
<td>4.00 (0.00)</td>
<td>4.25 (1.50)</td>
</tr>
</tbody>
</table>

A five point Lickert scale was used:

5= Highly satisfied
4= Satisfied
3= Neither satisfied or satisfied
2= Dissatisfied
1= Highly dissatisfied
Table 7

**Quarter 4 Classroom Community Survey Results**

<table>
<thead>
<tr>
<th></th>
<th>Connectedness</th>
<th>Learning</th>
<th>Classroom community</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>Maximum</td>
<td></td>
<td>40</td>
<td>32.87 (3.72)</td>
</tr>
<tr>
<td>Cohort Overall</td>
<td>15</td>
<td>31.87 (4.86)</td>
<td>32.87 (3.72)</td>
</tr>
<tr>
<td>Team RECON</td>
<td>4</td>
<td>30.50 (1.93)</td>
<td>30.50 (1.73)</td>
</tr>
<tr>
<td>Team APP</td>
<td>3</td>
<td>29.50 (8.50)</td>
<td>33.75 (5.86)</td>
</tr>
<tr>
<td>Team RUN</td>
<td>4</td>
<td>32.00 (2.00)</td>
<td>32.50 (2.52)</td>
</tr>
<tr>
<td>Team WIND</td>
<td>4</td>
<td>35.75 (4.57)</td>
<td>35.25 (4.11)</td>
</tr>
<tr>
<td>From Rovai</td>
<td>375</td>
<td>26.45 (7.23)</td>
<td>30.17 (6.51)</td>
</tr>
</tbody>
</table>

Raw scores vary from a maximum of 80 to a minimum of zero. Interpret higher scores as a stronger sense of classroom community.

Table 8

**Quarter 4 Student Satisfaction Survey**

<table>
<thead>
<tr>
<th></th>
<th>Overall</th>
<th>Team RECON</th>
<th>Team APP</th>
<th>Team RUN</th>
<th>Team WIND</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N=15</td>
<td>N=4</td>
<td>N=3</td>
<td>N=4</td>
<td>N=4</td>
</tr>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>1. How satisfied were you with your team’s progress?</td>
<td>4.20 (0.86)</td>
<td>4.00 (0.82)</td>
<td>3.75 (1.15)</td>
<td>4.50 (0.58)</td>
<td>4.75 (0.50)</td>
</tr>
<tr>
<td>2. How satisfied were you with the outcome of your team project?</td>
<td>4.20 (0.77)</td>
<td>3.75 (0.86)</td>
<td>3.50 (1.00)</td>
<td>4.00 (0.58)</td>
<td>4.75 (0.50)</td>
</tr>
<tr>
<td>3. How satisfied were you with other members of your team?</td>
<td>4.40 (1.12)</td>
<td>4.75 (0.50)</td>
<td>3.75 (1.26)</td>
<td>4.50 (1.00)</td>
<td>4.75 (0.50)</td>
</tr>
<tr>
<td>4. Overall, how satisfied were you in participating in this global virtual team collaboration?</td>
<td>4.40 (0.91)</td>
<td>4.50 (0.58)</td>
<td>3.75 (1.50)</td>
<td>4.75 (0.50)</td>
<td>4.75 (0.50)</td>
</tr>
</tbody>
</table>

A five point Lickert scale was used:

5= Highly satisfied
4= Satisfied
3= Neither satisfied or satisfied
2= Dissatisfied
1= Highly dissatisfied
Appendix L: End of Program Review

The students have been working for a year developing a commercialization plan and a business plan for starting a new product line or a new company. Please rank the students on the following attributes based on trying to achieve this objective.

5 = very strong
4 = strong
3 = average
2 = weak
1 = very weak

Students were supplied a presentation template that was developed through personal experience, Internet research and consultation with local venture capitalists. The student’s presentation should have a slide or a set of slides that addresses each attribute you are rating them on.

Table 1.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Clarification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team</td>
<td>Skills and experience.</td>
</tr>
<tr>
<td>Mission</td>
<td>Provides a unifying view justifying starting a company or product line.</td>
</tr>
<tr>
<td>Problem</td>
<td>The problem is worth solving.</td>
</tr>
<tr>
<td>Solution</td>
<td>The solution solves the problem in some unique way.</td>
</tr>
<tr>
<td>Prototype validation</td>
<td>A prototype has been produced and validated with potential customers.</td>
</tr>
<tr>
<td>Market</td>
<td>The market is large enough to support the objective.</td>
</tr>
<tr>
<td>Green field</td>
<td>The competitive forces are low making this a green field opportunity.</td>
</tr>
<tr>
<td>Barriers for others</td>
<td>There are barriers for others to get into this market or solve this problem.</td>
</tr>
<tr>
<td>Financial plan</td>
<td>The plan is appropriate for the problem being solved.</td>
</tr>
</tbody>
</table>
Appendix M: Results of End of Program Review

Results of End of Program Review

<table>
<thead>
<tr>
<th></th>
<th>Overall M (SD)</th>
<th>Team RECON M (SD)</th>
<th>Team APP M (SD)</th>
<th>Team RUN M (SD)</th>
<th>Team WIND M (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team</td>
<td>3.36 (0.34)</td>
<td>3.86 (1.21)</td>
<td>3.29 (0.49)</td>
<td>3.14 (0.69)</td>
<td>3.14 (0.69)</td>
</tr>
<tr>
<td>Mission</td>
<td>4.18 (0.73)</td>
<td>4.29 (0.76)</td>
<td>3.14 (0.69)</td>
<td>4.43 (0.79)</td>
<td>4.86 (0.38)</td>
</tr>
<tr>
<td>Problem</td>
<td>4.00 (0.26)</td>
<td>4.29 (0.76)</td>
<td>3.71 (1.50)</td>
<td>3.86 (1.07)</td>
<td>4.14 (1.07)</td>
</tr>
<tr>
<td>Solution</td>
<td>3.96 (0.46)</td>
<td>4.14 (1.21)</td>
<td>3.29 (1.50)</td>
<td>4.14 (1.07)</td>
<td>4.29 (0.76)</td>
</tr>
<tr>
<td>Prototype validation</td>
<td>3.29 (0.76)</td>
<td>2.71 (0.95)</td>
<td>2.57 (0.98)</td>
<td>3.71 (1.25)</td>
<td>4.14 (1.46)</td>
</tr>
<tr>
<td>Market</td>
<td>3.96 (0.38)</td>
<td>4.29 (1.50)</td>
<td>3.43 (0.98)</td>
<td>4.00 (1.15)</td>
<td>4.14 (0.69)</td>
</tr>
<tr>
<td>Greenfield</td>
<td>2.68 (0.39)</td>
<td>2.29 (0.95)</td>
<td>2.43 (1.13)</td>
<td>2.86 (0.90)</td>
<td>3.14 (1.21)</td>
</tr>
<tr>
<td>Barriers for others</td>
<td>2.36 (0.47)</td>
<td>2.00 (0.82)</td>
<td>2.00 (0.82)</td>
<td>2.43 (0.79)</td>
<td>3.00 (1.15)</td>
</tr>
<tr>
<td>Financial plan</td>
<td>3.46 (0.36)</td>
<td>3.00 (1.00)</td>
<td>3.29 (0.76)</td>
<td>3.57 (1.13)</td>
<td>4.00 (0.82)</td>
</tr>
</tbody>
</table>

5= very strong
4= strong
3= average
2= weak
1= very weak

N= 7