



# Innovations Unlimited:

Advancing Education, Investing in Change

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## Growing Up Through Entrepreneurship: Case Studies of Student Ventures

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### **Abstract**

This paper examines a five-year history of business plans developed by senior and graduate-level industrial design students. The intellectual growth and innovation of student teams is reviewed through the semester-long process of refining business propositions. Discussion focuses on a selection of business plans of product/service concepts and key elements in the course that nurture that development, such as contemporary literature on innovation, intellectual property searches, and venture capitalist reviews of the plans. Product/service ideas range from post 9/11 communication/rescue concepts to nutrition and housing systems. Intellectual property of students' work is traced through patent filing and awards using the supportive Virginia Tech Intellectual Properties infrastructure. The aim of the course is to expand the industrial design students' understanding of the product development process such that they are able to make comprehensive decisions within the design process (involving their market, economics, development costs, teamwork, etc). Further, the mission of the class is to position graduates to participate more fully in future employers' development processes, thereby preparing them for leadership positions or to pursue their own startup ventures. The projects reviewed in this paper illuminate the course steps and exercises that collectively enable the entrepreneurial maturation of students just before graduation. The intent of the discussion is to present a professional practice model for industrial design education as well as a design perspective on entrepreneurial courses for other disciplines.



level courses, the PP&E course takes the essential components of the classes and frames them for undergraduates who are specifically engaged in industrial (product) design. Professional practice coursework is a typical part of any design curriculum, but this course approaches the concept of practice atypically through business plan development. This type of course is certainly not unusual for business degree programs or even professional elective courses for design programs, but it is not a usual format for professional practice classes in industrial design curricula. However, this paper purports that students can learn more intently the challenges and components of practice through the actual building of a business. Further, the probable result is a powerful deliverable as part of their design portfolio and intellectual property if they choose to pursue it.

### **Viable Business Concepts**

The PP&E course at Virginia Tech begins with an invitation to all students in the class, called *One Page–One Slide*, to prepare a concise argument and statement about an idea for a business. Many of the ideas originate from earlier or simultaneous studio projects. The students may have already developed prototypes and completed usability testing within their studio courses, or they may bring new ideas to this class as business propositions. In either case, the students develop a level of specification and cost estimates for goods and production, which feed into an abbreviated spreadsheet of financials.

The *One Page–One Slide* proposals must be brief in the sense of the *pecha-kucha* method as created by architects Mark Dytham and Astrid Klein: saying what you need to say in exactly twenty slides, twenty seconds each (Pink 2007). In this case students are asked to explain their concept through one designed page and one slide, in two minutes. This method is used because it immediately throws the students into mandatory conciseness, which is one of their greater hurdles. ID students are making presentations throughout their tenure in design studios, but preparing for an investor presentation ups the ante and requires a more focused and professional disposition. This first assignment also compels the students to quickly narrow down the prospects for businesses, focusing quickly on the strongest possibilities. They must learn fast what the key components to successful start-ups are in order to have a full semester to develop plans.

Local experts in start-up thinking are invited into the class to help vet the options and settle on five or six ideas upon which to build teams. Three key issues are considered during the selection process: *technical merit* (What is the stage of development? Is it beneficial? Is it robust?); *commercial viability* (What is the market size? What is the pos-

sible return on investment?); and *protection* (Is the intellectual property protectable? Is there freedom to operate?). The proposal concepts and teams of four to five students are typically established by week three in the semester.

### **Review on Innovation: What Does it Mean for the *Current Future*?**

Throughout the development of the business plan, teams are assigned various readings to present to the class. All reading material directly or indirectly involves contemporary thought on innovation. In addition to chapters and essays from assigned textbooks, the class reads one book for several class-long open discussions. During the past three years, this book has been *The World is Flat* by Thomas Friedman, selected because it explains the historical trajectory of key technologies and how innovation has shaped and reshaped the American economy. It is used as a platform to discuss with twenty-somethings how they use technology in their everyday lives (e.g., text messaging and online social networking) and the benefits and pitfalls of that access. Moreover, the book provides a base for students to project what role industrial design/product development should have in the continuing trajectory of technological innovation. The discussion is one of the most powerful moments in the class because it involves necessary examination of the interconnected systems of our culture: politics, economics, ecology, education, and social structure.

Literacy about worldwide technologies is critical now as claims from journalists, economists, and educators report the decline in the competitiveness of the US in the global economy. Most of these claims point toward the fall in the technological deftness of US industry, stemming from a fundamental dearth of imagination. Friedman suggests that it is our intellectual property—our “creative imagination”—that can and must now define our strategic position (2005, 469). Walter Isaacson, author of the biography *Einstein: His Life and Universe*, comments similarly on the early twentieth century as an era of “breaking classical bonds” and as a model for this new century, which must “nurture the creativity needed for scientific innovation” (2007, 2). In discussing Isaacson’s book, Friedman laments the lack of imaginative teaching of math and science in the US and the necessity of change if we are to compete with new intellectual powers, such as China: “A society that restricts imagination is unlikely to produce many Einsteins—no matter how many educated people it has. But a society that does not stimulate imagination when it comes to science and math won’t either—no matter how much freedom it has” (2007). How do we as designers and developers contribute to this necessary innovation? What is the broader impact of our imagination? These are the central questions put before the students as they think through their business plans, preparing for a response to the issue of *technical merit*.

Around this longer conversation, the students are asked to read chapters and essays from other books as a way of checking and framing the more theoretical discussions. Moreover, these additional assignments are intended to assist teams with due diligence in responding to the second issue of *commercial viability* for their propositions. During the past five years the course has used *Harvard Business Review on Innovation* (HBS Press), *Creating Breakthrough Products* (Cagan & Vogel), *The Art of Innovation* (Kelley), and *Made to Stick* (Heath & Heath). Business plan teams are assigned sections for discussion where they use the *pecha-kucha* method to initiate an open forum. Students are further evaluated on how well they interweave concepts from the discussions into their business plans and presentations.

Finally, guest speakers are invited into class discussions to explore with teams the history and breadth of intellectual property (IP) and to further assist with due diligence on patent searching and future technology transfer. The course has a longstanding relationship with Virginia Tech Intellectual Properties (VTIP), which deals with the protection and marketing of Virginia Tech intellectual properties resulting from student and faculty research. Members of the staff routinely visit the class, lecture, and review team proposals, which provides student teams with assistance in vetting the *protection* issue in their plans. VTIP is also closely involved with IP disclosures of student product development within the industrial design program.

## Top Ten Questions

In addition to reading assignments and guest lectures, the teams are given a guide for developing their business plans. We use *Ten Questions Your Business Plan Must Answer: Key Elements of Successful Business Plans*, which was developed by Daryl Scott, CEO of Attaain™ (<http://www.attaain.com/index.asp>), located in the Corporate Research Center in Blacksburg, Virginia. Scott is one of the local venture capital experts who has worked with the course. He has a long history of product development in Silicon Valley and now nearly ten years in Blacksburg, Virginia. Students are required to produce plans and investor presentations that follow his guide of ten questions:

1. Where is your company now?
2. What is your product/service?
3. What is your market?
4. How will you reach the market?
5. Whom will you be competing against?

6. How will your product be produced?
7. Who are the people?
8. What are your financial projections?
9. How much money do you need?
10. What are the risks?

## **Investor Presentations**

By the final month of the semester, teams have drafted, reviewed, and edited their five-year business plans. Teams are given a template, designed by Daryl Scott, for creating their investor presentations. This guide explains the critical sections and optimal flow of the presentation: The Business and Product; The Market and Competition; Strategy; Business Drivers and Risks; Management; Financials; and Funding Requirements. Students present at the end of the semester to a panel of venture capitalists, local entrepreneurs, and IP specialists. The following discussion highlights three case studies of business propositions by student teams during the past five years. Excerpts from each plan are included in italics.

### *Case Study 1 –APT™: A proposal for autonomous personal transportation for college campuses*

The Autonomous Personal Vehicle (APV™) is a single-occupant, electric-powered, autonomous vehicle for commuting college students. The APT™ is a shared system, owned and operated by a university where vehicles can be *called* from any location within a ten-mile radius of campus. The company's motto:

*“We bring efficiency to commuting.”*

There are many problems in current commuting systems for universities ranging from the aggravation of a commuter searching for a parking spot to the valuable real estate that a university must devote to parking. Autonomous Personal Transportation (APT™) has designed a cost effective system using centrally controlled, single-person, autonomous vehicles that alleviate commuter hassles by providing a safe transportation system free of route and time constraints while generating revenue for the university.

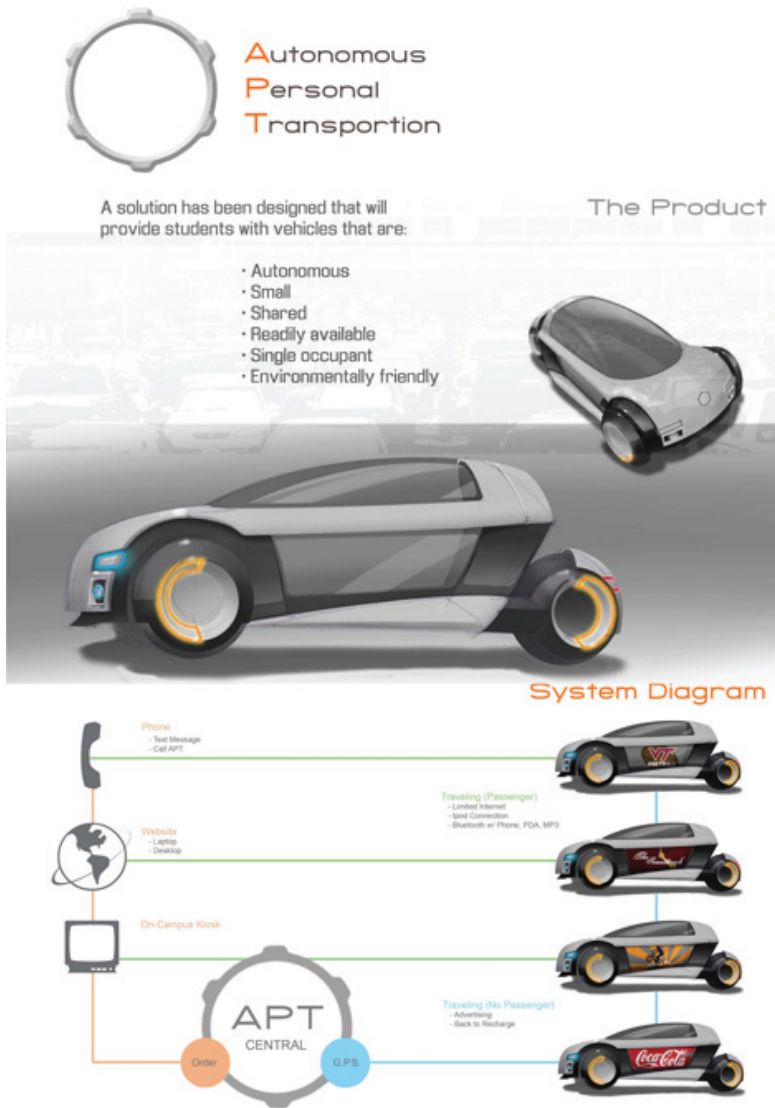


Figure 2. Excerpt from Autonomous Personal Transportation (APT) – 2007  
**Team:** David Chapaitis, Howard Chen, Mandy Cowley, Joseph Han, and Patrick Healy

APVs will be sold to universities for student commuting. The APT™ system provides advantages to both the client (the university) and the end user (the college commuter). The APT™ system operates within a university’s pre-existing framework while providing them with extra revenue from students and advertising space. Also, this system will provide student commuters a cost- and time-effective solution to the hassles of commuting with an automobile or bus service.

The APT team tied together several value opportunities as defined in *Creating Breakthrough Products*, where the authors, Cagan and Vogel, define seven value opportunities as opportunities that add value to a product: emotion, aesthetics, identity, ergonomics, impact, core technology, and quality (2002, 62). APT saw key value opportunities in

a core technology of electric locomotion and in environmental and social impact. The APT system addresses problems of street congestion, insufficient parking, accessibility and time constraints while simultaneously reducing the carbon footprint of student users and campuses at large. Currently some members of the original faculty-student team continue to develop this project through patent filing through VTIP and start-up funds awarded by Virginia Tech.

*Case Study 2 – RescueCOMM™: A proposal for an interoperable communication system for disaster situations*

“We provide interoperability solutions that connect rescue workers with a common set of equipment during chaotic, quick response situations.” Current relief workers face communication difficulties while responding to disaster situations across the US. An opportunity exists for an interoperable system of communication devices. RescueComm™ is a system of products that supplements a relief worker’s equipment and allows for easy transmission of information between organizations.



Figure 3. Excerpt from the RescueComm™ Plan – 2008

**Team:** Jeff Cooper, Margaret Lally, Emma Nason, and Stephen Laurent

RescueComm™ provides a line of products and services for the rescue community to address the type of communication failures of recent disasters such as Hurricane Katrina and the Indian Ocean tsunami. Three communication devices, RCM™, HeadSafe™, and BoatReady™ utilize an organizational system of information and messages. The RCM City System™ increases the overall efficiency of the communication network by providing training, installation, updates, and technical support. Subsequently, the RescueComm Disaster Database™ provides public access and input. Anyone with Internet access and a computing device can obtain basic information about the conditions of a disaster area and the current rescue activity and needs of rescue workers and volunteers on the scene.

The RCM™ interface features a map, a directory of important locations and local officials, and a text-based messaging system. Individual organizations can purchase additional features, which are included in the RescueComm City System™ package options: installation, training seminars, yearly technical support, and product care

warranty. RCM™ simplifies communication into a transfer of preset or customized text messages while also supplying critical location information including the whereabouts of other workers, supplies, and central hubs. In this manner, RCM™ quickens the response time of workers and reduces chaos during a crisis.

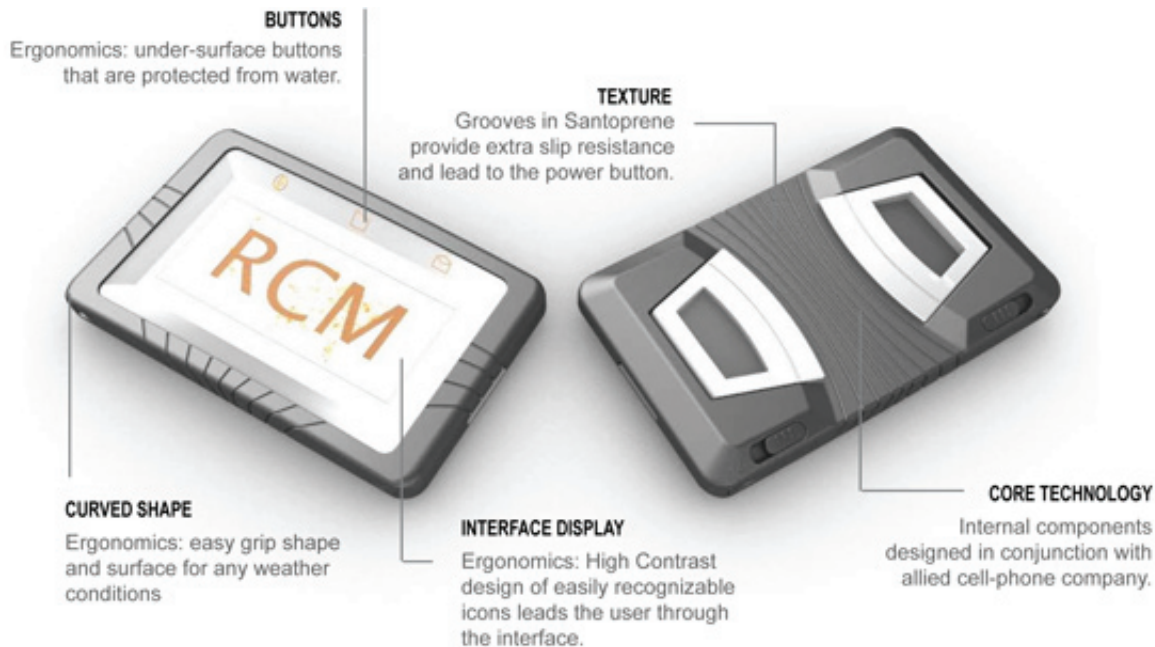


Figure 4. The RCM™ from the RescueComm™ Plan

The RescueComm team seized an opportunity found in the recent challenges of large-scale disasters and appealed to the social sector aspect of the groups involved. As Rosabeth Kanter suggests in her essay in the *Harvard Business Review* on innovation, “From Spare Change to Real Change,” the students saw a solution in private-public partnerships by nurturing the characteristics of: partners committed to change, investment by all parties, a community foundation, and links to other critical organizations (2001, 154).

RescueComm™ targets the rescue community and the general public. We will raise public awareness of interoperability problems experienced in past disasters through news stations such as FireRescue and officer.com, billboards, and YouTube, which will serve as a freeway for RescueComm to build public awareness and understanding of our mission. RescueComm aims to equip police and fire departments, the American Red Cross, the US Coast Guard, the National Guard, and medical response units.

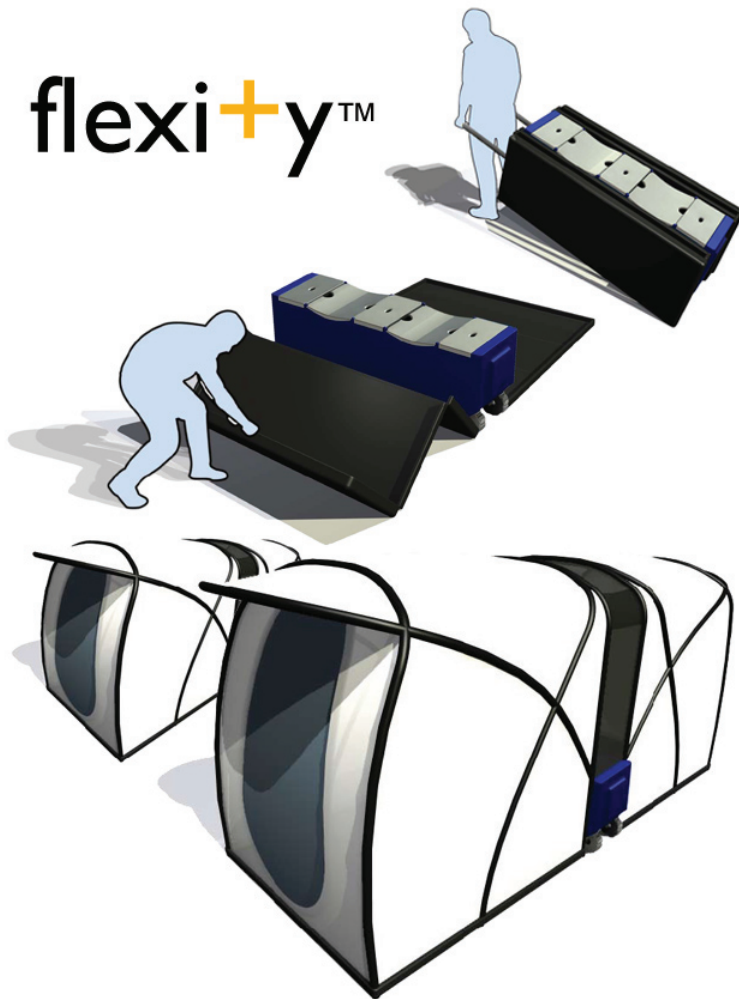


Figure 5. Excerpts from Flexity™ – 2008

**Team:** Ryan Altenburger, Keenan Biermann, Andrew Camardella, and Patrick Nally

### Case Study 3 –Flexity™: A proposal for modular, adaptable, deployable, and reusable shelter

”We provide livable shelter and an instant community setting in disaster situations.”

Flexity™ creates a sense of community through the implementation of temporary structures in a variety of applications. By providing these shelters to civilians displaced by tragedy we can fulfill their immediate physical need for shelter as well as providing an organized infrastructure of support. By expanding our product line, Flexity™ will bring the same sense of community to recreational usage.

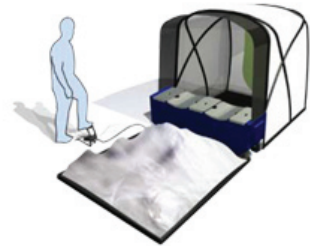




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#### INFLATE SIDE ONE

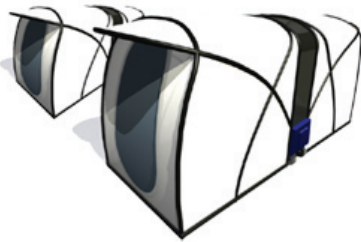
The pneumatic ribs are inflated using the included foot pump. Each side is inflated separately.



5

#### INFLATE SIDE TWO

The pneumatic ribs are inflated using the included foot pump. Each side is inflated separately.



6

#### CREATE COMMUNITY

The Neighbor unit is now ready for use. The fully stocked unit provides enough resources to support four people for five days. Additional supplies are provided by relief organizations.

As with RescueComm, the Flexity™ team found needs and product and service opportunities in the challenges of large-scale disasters. The team looked closely at the pervasive problem of shelter, especially in natural disasters where time and scale are primary issues.

Currently, temporary shelters are not simultaneously modular, adaptable, deployable, and reusable. Flexity™ provides an organized temporary shelter with a built-in infrastructure.

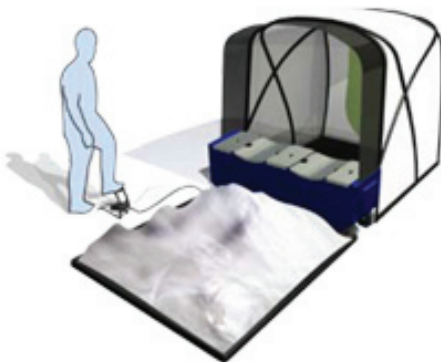
Flexity's core ideas will enable us to create a family of products that allow people to develop an instant community setting. Currently there are methods in place that attempt to solve long-term housing issues, however there are no short-term shelter solutions for immediate response. Flexity™ will produce its temporary shelter called the Neighbor, which can singularly support a group of four for five days. The ideas behind Flexity™ will enable us to create a family of products that allow people to develop an instant community setting—a livable unit and support. Flexity™ will work with the FEMA Alternative Housing Pilot Program to further the concept and gain funding for project roll out. Through that partnership we will further refine our design and make appropriate changes to fit in-line with government specifications.

The Flexity team made a connection to the concept of “concrete,” as defined by the Heath brothers in *Made to Stick*: “What makes something ‘concrete’? If you can examine something with your senses, it’s concrete...Most of the time concrete boils down to specific people doing specific things” (Heath and Heath 2007, 104). The students took the FEMA steps of easing disaster-related stress (<http://www.fema.gov/rebuild/recover/cope.shtm>) as a guide to match concrete design ideas and features to their Neighbor™ product line and service support.



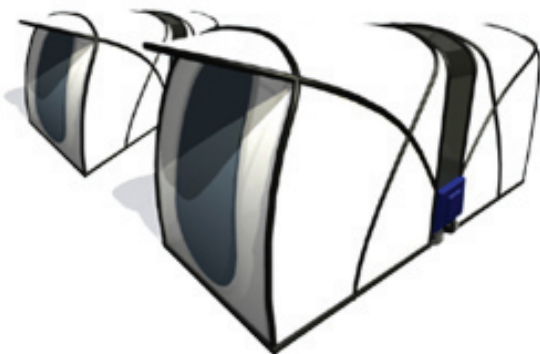
#### **INFLATE SIDE ONE**

The pneumatic ribs are inflated using the included foot pump. Each side is inflated separately.



#### **INFLATE SIDE TWO**

The pneumatic ribs are inflated using the included foot pump. Each side is inflated separately.



#### **CREATE COMMUNITY**

The Neighbor unit is now ready for use. The fully stocked unit provides enough resources to support four people for five days. Additional supplies are provided by relief organizations.

Creating a sense of community was also one of the design criteria. In traumatic situations it is important to be around other people who have experienced the same event. Our product allows people to have a private space but

also facilitates the creation of a community. Another benefit is that the shelters can be easily cleaned and restocked for reuse. Material choice was also important in the design of the Neighbor™ because of the harsh conditions the product will withstand. It must be strong and durable to stand up to weather abuse and rough use. To help maintain a sanitary environment the product is constructed using anti-microbial materials. The unit in its unassembled state is 26" x 18" x 72". The compact unit allows for the shipment of 180 units in one 48' trailer. When expanded, the Neighbor™ will provide adequate housing for four people with a total footprint of 6' x 14' split into two equal rooms divided by the monolith that contains enough supplies for the four occupants for five days. The strength of our solution is its ability to provide shelter as well as basic necessities in an all-in-one inclusive product.

### Key Points and Assessment

These projects are samples of the trajectory of subjects that our design students are now pursuing, which are indicative of their own thinking about the *current future*. If the mission of the course is to prepare the students for forward and professional thinking, then there are a few key points from the past five years worth noting for the evolution of this course and for similar endeavors at other institutions:

- Balance the entrepreneurial development work of business plans and product development with microcosmic reflection using a range of current literature (i.e., Friedman and Heath) as not just required reading but as subject matter of open forums where students lead those discussions.
- Encourage introspection even more by introducing individual projects that parallel the business plan development in the class, such as resume building and sharing and discussion leadership during class meetings.
- Direct students to directly explore intellectual property protection during business plan development, both for the practical experience and to develop an understanding of its importance as a venture capital lure and business plan feature.
- For industrial design programs, be proactive in using studio project development as sources of business plan development; encourage senior projects as fodder for entrepreneurial development. Business courses might consider collaborating with design programs to do the same to develop business plan concepts for their classes.
- Create a professional network for the course that not only brings people into the class once, but over the course of the semester and to participate in final reviews.

- Develop a formative and summative evaluation plan once enough material has been developed in the course.

The Professional Practice & Entrepreneurship course continues to evolve. We are now at a point where we have enough material and alumni that we can collect assessment data. In fact we are just now forming an alumni database for graduates of the industrial design program at large. We are also forming an alumni week for spring term, which will feature speakers for the PP&E course. From these endeavors we will be able to conduct a formative and summative evaluation plan. Our plan is two-fold: to conduct surveys and interviews and to compile an online gallery of alumni intellectual property development for our program website. We will triangulate our data by using multiple methods of collection: an online survey and a sample of short phone and in-person interviews. The following measures are examples of what would guide the assessment: the students' ability to recall key concepts, their application of the principles of the class to their working situations, intellectual property pursuits, and their own entrepreneurial experience.

## Conclusion

Every year more contemporary literature compels a rethinking of what the current future is. How we as designers think about innovation is necessarily influenced by the current state of our global economy and ecology. In his book released this year, *Hot, Flat, and Crowded*, Thomas Friedman suggests a strategy, called Code Green, for responding to the current state of hot, flat and crowded. It means "making America the world's leader in innovating clean power and energy-efficient systems and inspiring an ethic of conservation toward the natural world" (Friedman 2008, 7). This publication prompts a new deliverable for the PP&E course for spring 2009, which is a further influence from the Stanford course, Global Entrepreneurial Marketing. Since the early 1990s, the entrepreneurial marketing course has required a mid-term paper, called the Strategic Thinking Paper (STP), designed by professor Thomas Kosnik, which is a ten-year vision and one-year marketing plan for a personal career. This assignment, if redesigned for the PP&E undergraduate class, can augment the team business plan, compelling students to develop a personal portfolio and professional ten-year aspiration. The STP takes the Professional Practice & Entrepreneurship course to a new level: the assignment coupled with the team business plan requires students to view themselves, back and forth, at both the micro and macro scale. The hope is that we see ourselves as both smart individual designers and as collectively intelligent teams, like bees, making imaginative, innovative leaps toward a current future, which right now happens to be green.

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