# Developing a Marketing High-Technology Products and Innovations Course: First Year Review

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## Background

Nationally, there are a growing number of undergraduate students from the science and technology disciplines with great product ideas, but with an insufficient understanding of the go-to-market strategies that will enable them to commercialize their concepts. National Collegiate Inventors and Innovators Alliance (NCIIA) Course grants support innovative new course ideas. The goal of these competitive grants is to improve existing programs or build new programs in invention, innovation and technology entrepreneurship. With the generous support of an NCIIA Course Grant totaling $44,100 over three years, the University of Maryland has developed a Marketing High-Technology Products and Innovations Course to navigate this challenge.

This course merges the academic side of learning marketing concepts with their applications in real life. The objectives of the course are (1) To increase in the number of students launching innovative, technology-based ventures at the University of Maryland and at other universities once the new course model is propagated; (2) To increase in student development of skills to successfully commercialize inventions in a dynamic marketplace; and (3) To increase in student understanding of high-technology market research principles, affordable design, and technology innovation.

This paper is the ongoing exploration of the development of the Marketing High-Technology Products and Innovations Course from idea to delivery to evaluation. The review will focus on the first year deliverables including: (1) the creation of the "Marketing High-Technology Products and Innovations" curriculum, (2) selection of equipment and materials to support course activities, and (3) lessons learned from teaching the marketing course.

## Creation of the "Marketing High-Technology Products and Innovations" curriculum

Marketing of high-technology products occurs in turbulent environments, and requires rapid decision making with incomplete information. Innovations are introduced at frequent intervals, research-and-development spending is vital, and there are high mortality rates for both products and businesses. The Marketing High-Technology Products and Innovations course is designed to provide a balance between conceptual discussions based on readings of concepts and practices and applied, hands-on analysis based on analyses, workshops, and projects. The four steps used to design the course include: (1) defining the topics and deliverables, (2) establishing the schedule and budget for student teams, (3) determining a strategy and timeline for team selection and advancement, and (4) developing a format for customer validation and business model development.

## Topics and deliverables

The first step to designing the course was to define the topics and deliverables. In order to define the topics and deliverables we performed a university and private sector assessment of innovative courses and training programs in this area. We also consulted with product

development and marketing experts within our own university based network including faculty and practitioners.

Upon careful research and consideration of the candidate topics, the goals of the course were defined and themes finalized. Course goals related to technology marketing in this unique, fast-paced environment, include: (1) Learning models and tools used to gather marketing research and customer intelligence; (2) Understanding the need for, and difficulties in, adopting a customer-orientation; and (3) Adapting and applying the marketing mix to a fast-paced, high-technology environment. The course focused on 11 themes to be discussed and applied throughout the semester. The list of themes include: (1) understanding customers, (2) market orientation, (3) relationship marketing, (4) market research methods, (5) pricing considerations, (6) advertising and promotion, (7) societal, ethical, and regulatory considerations, (8) distribution channels and supply chain management, (9) sales strategies, to include online marketing and sales, (10) product development and management issues, and (11) partnerships and alliances.

The themes were applied throughout the semester using the textbook "Marketing High-Technology Products and Innovations" 3$^{rd}$ Edition by Mohr, Sengupta, and Slater. The schedule was divided into four modules: product pitch, go to market strategy, prototyping and testing, and team presentations. There were three to four topics and one deliverable per module. The deliverables included a (1) product pitch, (2) marketing plan, (3) visual prototype, test plan, customer feedback analysis, and functional prototype, (4) final presentation, (5) funding proposal, and (6) peer evaluation. See Tables 1 and 2.

Table 1. Schedule (Part 1 of 2)

| Topic | Deliverable | Description | Grade % |
|---|---|---|---|
| Module 1: Product Pitch | | | |
| Course overview<br><br>Strategic market planning<br><br>Market orientation and cross-functional interaction, partnerships, and alliances | Product Pitch | Individually, or as a group of 2, develop a 2-page paper on an original new technology-based product or service.  Discuss the core features and functions of the product or service, market orientation, and key partnerships and alliances assistive in development and market entry. | 8% |
| Module 2: Go to Market Strategy | | | |
| Market research and understanding customers<br><br>Product management and pricing<br><br>Supply chain management and distribution channels<br><br>Advertising, promotion and branding<br><br>Company selection and reassignment | Marketing Plan | Integrating and expanding on deliverables to date, as a group of 2 or 3, develop a comprehensive 10-page marketing plan based on the outline provided in the text on page 43-44. | 10% |
| Module 3: Prototyping and Testing | | | |
| Visual prototype<br><br>Test plan<br><br>Testing and customer feedback<br><br>Functional prototype<br><br>Funding proposal for class-based funding<br><br>Marketing | Visual Prototype, Test Plan, Customer Feedback Analysis, and Functional Prototype | Prepare a brief in-class presentation, to include visual aids, highlighting new knowledge and next steps.<br><br>Visual Prototype<br>Test Plan<br>Customer Feedback Analysis<br>Functional Prototype | <br><br><br><br><br>6%<br>6%<br>6%<br>6% |

Table 2. Schedule (Part 2 of 2)

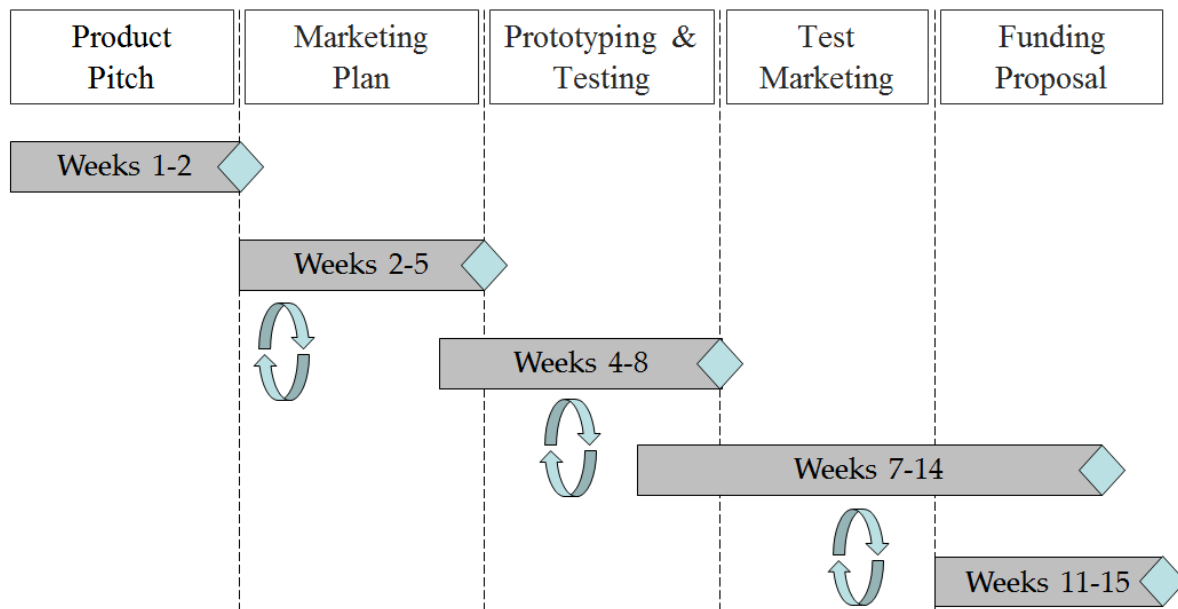| Topic | Deliverable | Description | Grade % |
|---|---|---|---|
| Module 4: Team Presentations | | | |
| Final presentations<br>Final presentations<br>Final presentations | Final Presentation | Develop an integrated presentation based on the NCIIA E-Team Grant criteria and including highlights of the test plan, customer feedback analysis, prototype, and marketing plan. E-Team criteria (http://nciia.org/eteam_guidelines) to include: (1) Technology innovation and feasibility, (2) Business model and commercial potential, (3) Positive social and/or environmental impact, and (4) Team composition, commitment, and expertise. | 15% |
| | Funding Proposal | Develop a funding proposal for an NCIIA E-Team Grant Program ($75,000). | 15% |
| | Peer Evaluation | Each team member submits a confidential peer evaluation of the other member of the group. At least 10% of the course grade is based on this evaluation. Deductions from the team deliverable grades will also be made in cases of poor peer performance. | 10% |
| Activities and Events | | | |
| | Class Participation | | 6% |
| | Events | | 6% |
| | Quizzes | | 6% |

**Schedule and budget for student teams**

The second step was to establish the schedule and budget for student teams. During the 15 week semester, student teams went from concept and product pitch through the process of developing a marketing plan, prototyping and testing their concept, test marketing, and final presentations and funding proposal development. This aggressive timeframe to achieve the full cycle of concept to market-ready product is detailed in the Chart 1 Overview of deliverables and timeline. The course schedule allows opportunities for parallel processes and to rework deliverables. During week 6 teams were realigned into eight advancing product teams. Students not advancing on an original team were allowed to join another product team, or create an investment team to develop the funding proposal and alternative funding sources for the product teams.

To support the accelerated timeline and a highly interactive classroom environment we employed the use of the "flip classroom." Select class lectures and course content was presented online through video and PowerPoint presentations of material and in-class time was focused on presentations and group activities.

Chart 1. Overview of deliverables and timeline

## Deliverables and timeline for completion within the course, to include parallel processes and rework.

| Product Pitch | Marketing Plan | Prototyping & Testing | Test Marketing | Funding Proposal |
|---|---|---|---|---|
| Weeks 1-2 | | | | |
| | Weeks 2-5 | | | |
| | | Weeks 4-8 | | |
| | | | Weeks 7-14 | |
| | | | | Weeks 11-15 |

The integration of experiential learning is key to teaching entrepreneurship and innovation. To foster the highly entrepreneurial environment both in the classroom and outside experiential learning was integrated into each stage of the course. This is evidence from the development of marketing ready concepts and through classroom activities. These entrepreneurial activities include prototype development and testing, customer feedback, and product pitches and investor presentations with live question and answer periods, and the utilization of actual venture funding. See Appendix 1 for photographs of the class in action.

Experiential education using active learning models where the student is engaged in real-world or applied learning has been more effective in producing entrepreneurs than the traditional approaches to learning[3]. Action is a central component to how an entrepreneur learns and assimilates new knowledge[1]. Active forms of learning encourage thinking and working more creatively to develop innovative problem-solving strategies for uncertain situations students may encounter in the workplace[2,4].

The initial budget for the course and for advancing concepts was based on the NCIIA grant award. Funding was awarded to support student teams' prototyping, materials and supplies, and

equipment as detailed in Table 3, Year 1 NCIIA grant funding.  Following the completion of the three-year NCIIA grant, the funding for this course will be generated through an alumni seed fund to support student venture creation from this course.

Table 3. Year 1 NCIIA grant funding

| Budget Item | Fall 2012 |
| --- | --- |
| Prototyping | $ 4,000 |
| Materials and Supplies | $ 4,500 |
| Equipment | $ 2,600 |
| Total | $11,100 |

**Strategy and timeline for team selection and advancement**

The third step was to determine a strategy and timeline for team selection and advancement.  In the inaugural offering of ENES 462 "Marketing High-Technology Products and Innovations" course in fall 2012, 14 innovative product concepts were developed. In part one of the course, each of the 14 teams created a full marketing plan to analyze the opportunities and challenges for their concepts. Based on alignment with NCIIA's E-Team Program and overall feasibility and uniqueness of these concepts, eight concepts were advanced to part two of the course.  Selection criteria included technology innovation and feasibility, business model and commercial potential, positive social and/ or environmental impact, and team composition, commitment, and expertise.

The remainder of the term was focused on prototyping and customer validation of these eight concepts. Based on the design and schedule of the course, students with concepts not selected to advance chose one of two paths: (1) join an advancing product team or (2) form an investment team to focus on modeling the financials and developing funding proposals for one of the advancing concepts. The instructor worked from team and student preferences and student skill sets to match the students from non-advancing concepts with advancing product teams.

There were two funding rounds for advancing concepts.  The first round funding was based on the marketing plan. The second round funding was awarded after the final presentation.  During each stage, funding was awarded based on market readiness and the social impact of the concept. Table 4, Finalist concepts, details the advancing concepts and funding distributions.

Table 4. Finalist concepts

| Company Name | Concept Description | Round 1 Funding | Round 2 Funding | % of total |
|---|---|---|---|---|
| Allied for Life | An iOS application to aid in disaster response and recovery by sharing information and allowing users to donate money for disaster recovery and spread awareness through social media. | $600.00 | | 7% |
| Carpe | The CarpeMuse holster is an iPhone 5 exercise holder that provides full interaction and a seamless fit enhancing ones' workout experience. | $400.00 | $374.00 | 9% |
| Deal Wizard | An online application targeted at helping small business owners approach daily deals opportunities. | | $374.00 | 4.4% |
| Engineering in a Box | A discipline specific project kit designed for in-class use at the high school level that gives students a comprehensive foundation of engineering. | $685.00 | $3,363.00 | 48% |
| Group Creste | A networking web site for people interested in the fashion industry, connecting designers with creators to bring projects to fruition. | $129.00 | | 2% |
| Knode | Through the use of smart phone location-based services and/or a radio dongle, users can quickly find others who share common interests and hobbies. | | $374.00 | 4.4% |
| Pianotes | An iPad application that teaches students to play piano and actually listens to you play your own piano and instantly informs you of your accuracy. | $422.00 | $1,121.00 | 18% |
| Shareific | A web service where users can take advantage of their social networks and friend circles to share products with their friends, as well as receive recommendations for products they are in market for. | $600.00 | | 7% |
| | Total | $2,836.00* | $5,606.00* | 99.8% |

*Total funding awarded between rounds 1 and 2 totals $8,442.00. The remaining $58.00 of the prototyping and materials and supplies budget was used for the PLA plastic material needed for the 3D printer. 100% represents total awarded to student ventures.

The prototyping budget of $4,000 was competitively awarded to students teams following the approval of their product pitch and marketing plan. Funds were to be used for the creation of virtual and physical models of the product concepts including devices, hardware, and software. Prototyping expenses were dependent on the concept and could be requested in real-time by the student teams.

The materials and supplies budget of $4,500 was focused on online and offline marketing campaigns. Materials and supplies expenses were to be spent on developing and managing online advertising campaigns including Google AdWords and Facebook advertising. Funding could be used to drive prospective customers to Kickstarter and other websites to assess consumer demand. The materials and supplies budget could be awarded for the development and production of print and online marketing collateral. The materials and supplies budget was also used to purchase prototyping materials for the 3D printer.

Understanding the best use of $2,600 for equipment to support students was a central challenge with the inaugural offering of the course. We leveraged existing physical resources at the University and beyond campus; including computers, scanners, printers, white boards, and meeting spaces and production labs. We knew we may need various computer software and new media technology to support student efforts.

**Customer validation and business model development**

The fourth and final step to create the course was to design a format for customer validation and business model development. The 20 minute final presentations included the highlights of the test plan, customer feedback analysis, prototype, and marketing plan, followed by a five minute question and answer period. The final presentations were graded based on (1) technology innovation and feasibility, (2) business model and commercial potential, and (3) team composition, commitment, and expertise. Ventures with a social impact were encouraged but not required; therefore, students were not graded on this aspect. Appendix 2, Final presentation team score sheet, details the factors used to evaluate customer validation and the business model development.

**Selection of equipment and materials to support course activities**

While we leveraged existing physical resources at the university and in the community where we could; we knew we would need to augment these resources with additional resources to support student efforts. Prototyping equipment was required including the purchase of a 3D printer, server space, and design software.

**Lessons learned**

The most significant expected challenge was how students would respond to working on their concept and developing a full marketing plan in part one of the course (6 weeks), only to be selected as a non-advancing team and having to join or support an advancing team of students. Would they be disappointed, angry, or resistive? Thankfully, all of the non-advancing students accepted their non-selection favorably, and eagerly joined the advancing teams. In many cases,

upon writing their marketing plans, students saw the flaws and challenges in their concepts and desired to join other "better" teams. All students recognized the significant level of work expected within the course and desired to be part of a larger team to share the workload and integrate more ideas and skills.

Three students on non-advancing teams chose to be part of the investment teams instead of joining an advancing product team.  The investment teams were created to focus on modeling the financials and developing funding proposals for an advancing team.  The investment teams did not add as much value as expected.  The next time the course is offered all students from non-advancing teams will be added to advancing product teams.  There will be no investment teams in the next course offering, this option will be eliminated.

The most significant unexpected challenge to date is educating the students on social impact concepts. While past events and speakers on campus have exposed students to the concept of social entrepreneurship, the development of concepts aligning with these principles, and the recognition of how to integrate social impact into students' concepts, has occurred at a lower than expected rate. To address this challenge in week 10 of the fall 2012 offering we dedicated a class session to defining and exploring social impact with a speaker from the university's center for social impact and venturing. When this course is taught again next semester, the social impact session will be addressed earlier in the term and will include a speaker and readings on the topic. This session will occur in advance of concept down selection when concept selection criteria are discussed.

In teaching an experiential marketing course from concept to market-ready product in one semester the inherent challenge is maximizing time to learn, time to prototype, time to test and develop, and time to market.  First, in order to maximize the time, we will contact students enrolled in the course before it begins to get them thinking about ideas.  Giving the students some preliminary direction before the first day of class will help to jump start the idea generation.  Second, class time for team work and activities will also be maximized by integrating an online component to the course by holding more flip classroom sessions.  The amount of course content to be covered necessitated bundling session topics that would traditionally be two lectures into a single lecture.  This effort proved to be hurried with insufficient time for the lecture and question and answer periods in class. In the next offering, many of the early lecture topics will be split into two lectures. Additionally, these sessions will utilize recorded lectures and slides online to be viewed outside of the classroom time.  Additional content to expand student knowledge will be shared in the flip classroom.  The intended result is that we will be able to accelerate funding awards earlier on in the semester to increase the market readiness of the products by the end of the term.  We plan to either award the second round funding earlier in the term or have only a single round of funding after the marketing plan is presented.

## Evaluation, progress and next steps

Evaluation of the success of the course is being measured in four ways.  First, the University of Maryland assesses all courses at their conclusion with course evaluations surveying the course content, format, and instructor effectiveness and responsiveness. University student course

evaluation data is not currently available for the fall 2012 offering but we anticipate it being available to share and discuss in early spring semester. Second, students in this inaugural offering are part of a specific Program. These students complete Entrepreneurial Mindset Surveys which are administered at Program entry, at the completion of the first year, as a midpoint measure, and upon graduation. This 100-question written survey is based on Robinson's Entrepreneurial Attitude Orientation scale in addition to examining opportunity discovery and interpersonal skills to understand longitudinal impacts. Third, the number of E-Teams, individual students, and alumni that win grants and awards will be measured. And fourth, we will measure the number of founding companies by evaluating the number of E-Teams, individual students, and alumni actively managing their ventures on a full-time or part-time basis.

The stated objectives are lofty and each offering of the Marketing High-Technology Products and Innovations course brings us closer to their achievement.

Objective 1: To increase in the number of students launching innovative, technology-based ventures at the University of Maryland and at other universities once the new course model is propagated. Progress: The preliminary step of developing a complete syllabus and launching the course has been accomplished. As the course is presently in process this semester, we are now seeing an increase in venture creation activity through this course. At the conclusion of this course, there is the potential for eight new concepts to launch as a direct result of the course.

Objective 2: To increase the student development of skills to successfully commercialize inventions in a dynamic marketplace. Progress: The inaugural class of 36 students are developing the skills to successfully commercialize inventions through a number of activities with real concepts to include performing product pitches, recruiting students to join their teams, developing a marketing plan, designing prototypes, collecting customer feedback, and refining concept plans and prototypes. Within the course, students competed for funding, from the NCIIA grant, for further prototyping, as well as funds for materials and supplies for their marketing efforts.

Objective 3: To increase in student understanding of high-technology market research principles, affordable design, and technology innovation. Progress: Through applied activities, course deliverables, and readings we are increasing students' understanding of high-technology marketing research principles, affordable design, and technology innovation. We will better understand the impact at the course completion when all skills have been applied and in their continued application.

The year 2 milestones will continue to advance the achievement of the objectives. The milestones are: 1. To maintain prototyping equipment and materials, such as the renewal of software licenses as appropriate; 2. To teach the marketing course, including evaluation, and incorporation of feedback for the next course offering; and 3. To continue to help propagate the course model by presenting a paper on some element of the curriculum at a national conference. We will use course feedback and successful completion of the deliverables to better understand if the course is achieving the objectives as desired. Any new learning will be incorporated into the next offering of the course in spring 2013.

1. Holcomb, T. R., Ireland, R., Holmes Jr., R., & Hitt, M. A. (2009). Architecture of entrepreneurial learning: Exploring the link among heuristics, knowledge, and action. Entrepreneurship: Theory & Practice, 33(1), 167-192. doi:10.1111/j.1540-6520.2008.00285.x
2. Huggins, R., Jounes, M. & Upton, S. (2008). Universities as drivers of knowledge-based regional development: a triple helix analysis of Wales. *International Journal of Innovation and Regional Development, 1*(1): 24-47.
3. Taatila, V.P. (2010). Learning entrepreneurship in higher education.  Education + Training, 52(1), 48 – 61. doi: 10.1108/00400911011017672
4. Tenenbaum, G., Naidu, S., Jegede, O., & Austin, J. (2001). Constructivist pedagogy in conventional on-campus and distance learning practice: an exploratory investigation. *Learning and Instruction, 1*(2): 87-111.

Appendix 1. Course in action

During the class meeting time, students actively work within their product teams and regularly pitch ideas and lessons learned to their classmates.

Interesting product concepts emerged in the inaugural course offering.

Appendix 2. Final presentation team score sheet

**Evaluator:** _____
**Student Team:** _____          **Date:**          _____

Time: 20 minutes plus 3-5 for Q&A

    (1)  The Evaluator should include a '0' or '1' in each shaded cell.
    (2)  Sum totals for each column and apply the multiplier.
    (3)  Add the three columns to get the total grade.

| | No Discussion *(0 or 1)* | Average Discussion *(0 or 1)* | Excellent Discussion w. Supporting Data *(0 or 1)* |
|---|---|---|---|
| **Technology innovation and feasibility** | | | |
| • What is your invention or technology innovation and is it technically feasible? <br> • Have you demonstrated proof of the key principle(s)? Does it work? <br> • Have you developed a physical prototype or proof of concept? <br> • What problem are you solving for what customers? In what way is it better than other solutions on the market? | | | |
| **Business model and commercial potential** | | | |
| • Describe the market and customers that you intend to reach, and explain how you will engage them. <br> • Who are your target customers, and have you talked to any? <br> • How does what you are proposing compare with the competition? <br> • What is your commercialization plan? How will you approach the manufacturing, marketing, sales, distribution, and support of your product or service? <br> • How do you intend to make this economically sustainable? Describe the costs to produce and support your product and your expected sales price. <br> • What is the structure you envision for your venture? Do you expect to (or have you already) formed a non-profit, for-profit, joint venture or considered a licensing arrangement? Do you have rights to any key intellectual property? | | | |
| **Team composition, commitment, and expertise** | | | |
| • Who are the key team members and what roles will they play? <br> • Who will lead the technical and business model development? <br> • Do you have outside mentors, advisors, and/or partners? <br> • Identify any partners (individuals, community leaders, nonprofits or NGOs, etc.) outside of your institution who will provide connections and access to the field and end-users. | | | |
| **Subtotal count per column  (4 max)** | | | |
| **Multiplier** | X 0 | X 27 | X 34 |
| **Subtotal points per column ( 100 max)** | | | |
| **Sum of points per column (100 max) = TOTAL GRADE** | | | |