The HCO3 STEAM E-Team Experience: Course & Program Faculty Grant

Abstract

Many students at James Madison University (JMU) develop entrepreneurial solutions to pressing social and technological problems as part of their required capstone experience. These solutions often leverage sophisticated software, data mining, and emergent technologies. Unfortunately, students are not prepared to turn their ideas into real businesses upon graduation, and miss the chance to create opportunities for both themselves and their local economies.

This proposal seeks to close both of these opportunity gaps. The **HCO3** (**H**ackerspace for **CO**operative **CO**mmunity **CO**working) **STEAM** (Science, Technology, Engineering, Art, and Math) **E-Team Experience** is a naturally multidisciplinary one-year experiential program for undergraduate seniors working in entrepreneurial teams (E-Teams). It is made possible by the synergy created by 1) a *place* to do work together and share experiences in, 2) a *course sequence* to learn about effective business processes and business models (based on existing experimental courses), and 3) optional *travel* to San Francisco to spend time with the vibrant creative and entrepreneurial crowd there. The *place* is an active "hackerspace"/community coworking and art space in downtown Harrisonburg, Virginia, which will catalyze relationships between students and local professionals. It doesn't exist yet: a student E-Team will help build, develop, and manage it themselves. The *course sequence* spans the fall and spring semesters of the student's senior year, and provides a way to become professionally certified in quality. It includes material in quality and creativity management, social responsibility, alternative economic models, the arts, data-driven process design and process improvement, value proposition design, business model development, and business model innovation. The *travel* will bring the students to San Francisco during one week of the senior year, introduce them to hackerspaces, and embed them with other creative young entrepreneurs in residential "innovation hives" to help them connect more powerfully with their own capabilities. This model for HCO3 has drawn from several successful templates, including Freespace (http://freespace.io) and HackCVille (http://hackcville.com/), whose founders have shared their experiences with us.

HCO3 directly supports JMU President Jonathan Alger's goal of becoming the "national model for the engaged university" and the JMU mission of "preparing students to be educated and enlightened citizens who lead productive and meaningful lives." Long-term goals will be to: 1) maintain an active presence as a productive community/university partnership, 2) bring at least one new venture to market each year, 3) become financially self-sustaining by reinvesting support from businesses who share the coworking space. We (the proposers) have led entrepreneurial teams in our senior capstone projects for JMU Integrated Science and Technology (ISAT) for several years now, and already teach courses in operations management and venture creation. What's missing is a *place* where our students can actively engage with the community on a regular basis to form solid relationships, and the *resources* to make the entrepreneurship process more *real* for them.

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1. Proposed Course Sequence Description and E-Teams

The HCO3 STEAM E-Team Experience is an 11-credit sequence that spans the fall and spring semesters of a student's senior year. It includes a 5-credit capstone pair that is already well established in the ISAT program, coupled with two courses at the 400-level to help students create and launch successful products, processes, organizations, and business models:

Fall Semester (5 credits):
- ISAT 44x -- Quality, Creativity, and Lean Six Sigma (3 credits)**
- ISAT 492 -- Senior Capstone Project II (2 credits)

Spring Semester (6 credits):
- ISAT 44x -- Agile Venture Creation (3 credits)
- ISAT 492/493 -- Senior Capstone Project III (3 credits)

** = This course will prepare students for CQIA (http://asq.org/cert/quality-improvement-associate) and QPA (http://asq.org/cert/quality-improvement-associate) professional certifications upon graduation.

ISAT 44x (Quality, Creativity, and Lean Six Sigma) is a *revised* course based on HON 300/ISAT 680 (Quality and Process Improvement in Action) which was developed by Radziwill and collaborator R. Simmons in the JMU College of Business, and piloted during Spring 2012 and Spring 2013 as a client-facing learning experience. The course was further updated and delivered to graduate students as MBA 720 (Operations Management) in Fall 2014, and to business students as MGT 370 (Quality Management) in Summer 2015. It will be revised to make the connections between traditional quality management and creative entrepreneurial efforts more explicit. Although this course will be revised into its proposed form over the 2015-2016 academic year, it will not be offered to the first cohort of HCO3 students, and instead key topics will be inserted into ISAT 44x (Agile Venture Creation).

ISAT 44x (Agile Venture Creation) is also a revised course, tested by the proposers in Spring 2015 as an elective with 12 students. It covers topics such as Lean Startup (Ries 2011), agile processes in technology development, corporate social responsibility and the ISO 26000 Guidance for Social Responsibility, formulating and financing new "sharing economy" ventures, fundamentals of quality systems for startups, value proposition design, and approaches to structured business model innovation. We discovered that students have particular difficulty understanding that the work they do in college doesn't have to end at graduation, and their ideas can help them *create their own jobs* rather than find a job!

E-Teams: The first year of HCO3 will support four E-Teams, each of which has already formed and has started to generate results. The focus areas are not limited to product development, but also include open source software and services:

- **SmartClickr** (Product) - This is a mobile polling app that can be used in classes and at conferences on a per-use basis, without requiring a monthly subscription. It updates poll

information in real time, and produces charts and graphs that can be captured for future use. A prototype has been created, but the architectural framework must be revised to scale up before commercialization.

- **ZPortal** (Educational Service) - During the 2014-2015 academic year, one of our teams prototyped an interactive zonohedral dome (or "zome") with a sound and light show to respond to movements of visitors within the dome. This will be scaled to develop a full-scale participatory educational platform, helping students "discover" elements of programming by interacting with a network of zomes.
- **CONNECT** (Open Source Software) - This software middleware product helps government healthcare applications talk to each other and share data more effectively. In partnership with a local healthcare informatics company, one of our E-Teams will help build community around this project to stimulate software services consulting.
- **HCO3** (Service) - The HCO3 space will also be its own "commercializable" project. By creating a model for a community space for students and local professionals to come together to solve problems, this E-Team will generate a template for how to start a self-supporting community hackerspace. This will also help provide young entrepreneurs with much needed office space, stimulating local economies in unique and creative ways.

2. History and Context

The Integrated Science and Technology (ISAT) program at James Madison University (JMU) is an undergraduate, interdisciplinary, applied science degree program accredited by ABET. At the lower level, students get a strong foundation in critical thinking, social context analysis, biology, chemistry, physics, calculus, statistics, and computer programming. At the upper level, students combine these foundational elements into interdisciplinary areas such as biotechnology, environmental science, alternative energy, green manufacturing, telecommunications, and computer application development. All ISAT graduates complete a capstone project during their senior year in which they are required to examine carefully the social, political, economic, and environmental ramifications of their projects. The product of the ISAT program is a technologically and scientifically literate, versatile problem-solver who embodies the Problem-Centric Habits of Mind (PCHOM) (Brent et al. 2013).

Gaps in the ISAT Capstone Experience: The traditional university setting suppresses the marketplace viability of ISAT capstone projects in several important ways. First, few (if any) students are free to focus their time and energy exclusively on their project, as they are still busy taking other courses necessary for graduation and hunting for jobs. Second, students typically spend a great deal of their capstone time developing basic knowledge and skills necessary to conduct the project. Third, students tend to choose “traditional jobs” over finishing and commercializing their product. By situating them in a vibrant location where innovation is a way of life, HCO3 will help to close these gaps.

Gaps Between Industry Teams and University Group Project Teams: In some ways, the work environment of a modern technology company already mirrors the university. Flexible schedules, telecommuting, and requirement for physical presence only at specific meetings mirror student class meetings, late night study sessions, and online learning. However, important

differences between these environments make it difficult to give students a realistic view of the day-to-day life and attitudes of a technology developer and entrepreneur (see Table 1). ***University group projects*** face many challenges. Projects can be contrived or artificial. Narrow, instructor-defined learning objectives force students to develop uniform skillsets, rather than diverse, individual, and complementary ones. The project is only one assignment in one course, and therefore not able to demand students' full attention and commitment; nor is it fully integrated into their daily schedule. Consequences for failure are low, and proximity to the cutting edge is typically bounded by the instructor, who may have little or no recent actual exposure to the latest technologies and processes. Achieving (graded) milestones is overemphasized. Limited time means instructors must emphasize content over teaching (agile) process. ***Industry teams***, in contrast, work on real projects where failure can be costly. Team process forms the foundation of a culture of enthusiasm and commitment. Members are naturally drawn to find their niche and develop complementary talents. Achieving intermediate milestones is less important than delivering a high-quality product. Competitive pressure keeps projects near the cutting edge and forces team members to develop the ability to evaluate the soundness of emerging technologies. Industry projects don't end each semester, providing (perhaps ironically) a much more fertile environment for learning and personal growth than any traditional classroom. HCO3 will help close this gap by creating an environment analogous to modern industry teams.

Dimension	Industry	University
Focus/Motivation	Final Contribution	Individual learning/Grades
Duration	Ongoing	(Very) Short-term
Proportion of Daily Effort	High	Low
Impact of Failure	Company fails	Bad project grade
Skillset Development	Complementary	Duplicate
Level of Realism	100%	Highly Variable
Focus on Process	Integral/Foundational	Rarely addressed
Leadership/Management	Professional Leader/Champion	Instructor
Member Commitment	Typically High	Varies
Audience	Customers/Clients	Instructor
Proximity to Cutting Edge	Close	Varies

Table 1: Comparison of Industry and University Group Project Teams

Gaps in Inclusion of the Arts and Design (STEM to STEAM): Reconnecting the arts and sciences so that learning can happen at the intersection of the two is gaining increased recognition as a "gateway drug" for stimulating interest in Science, Technology, Engineering and Math (STEM) programs and careers. Despite its interdisciplinary focus, JMU ISAT has only started to embrace STEAM projects. Because E-Teams will be co-located with community members at HCO3, and because they will all create art in the space together to stimulate their

entrepreneurial creativity, this will provide opportunities to raise awareness of STEAM among students as well as local entrepreneurs and professionals.

3. Team and Partners

The HCO3 program will be led by Dr. Morgan Benton and Dr. Nicole Radziwill, Associate Professors in ISAT. They are uniquely qualified to co-create and deliver this experiential program. **Background and Accomplishments:** Benton has a Ph.D. in information systems, over a decade of experience developing software and web-based technologies for clients and startups, and studies learning and creating productive learning environments. Radziwill has a Ph.D. in technology management and quality, and 15 years experience as a software development manager and national lab executive. She researches how to achieve quality and stimulate innovation in transformational cultures. Together, they have hosted weekly "hacking sessions" at JMU for over 7 years, developed active learning communities that cut across course boundaries, and supervised over 35 technology development projects. In addition, they are part of the Burning Man camps that host the largest number of technology entrepreneurs, providing a rich and diverse professional network in the arts and technology. Based on these experiences, their pedagogy combines agile principles with the culture of radical innovation, encouraging students to find and share their gifts to help society. HCO3 will provide the platform for Benton and Radziwill to share the spirit of these experiences with their students, naturally extending the work they have been doing independently since 2000, and over the past six years as partners.

Pedagogy: Passion to make meaningful contributions to society forms the heart of our pedagogy. Our core assumption is that given the time, freedom, structure, support, and guidance that they need, students' innate talent and drive will flourish to yield success. Our approach (Benton & Radziwill 2011, Radziwill & Benton 2013) is informed by recent work in motivation (Deci et al. 1991, Deci et al. 2001), positive psychology (Fredrickson 2009), mindfulness (Langer 1998), pull-based systems (Hagel et al. 2012), peer learning (Rheingold 2012), and value systems for radical innovation (Radziwill & Benton 2013). Guided by these principles, multidisciplinary E-Teams will coalesce around projects that aim to bring the latest technologies into the service of solving some of society's most pressing problems.

Administration Roles: Radziwill will prepare work plans and report progress; Benton will develop and administer the budget with JMU administration, leveraging his experience as Director of JMU study abroad programs in Japan and the Philippines. They will co-manage the HCO3 space. **Teaching Roles**: They will team-teach the new ISAT 44x Quality, Creativity, and Lean Six Sigma and ISAT 44x Agile Venture Creation courses. **Experiential Learning Roles**: They will continue to co-advise E-Team/Capstones in this program.

Local Partners, Institutional Support, and Entrepreneurial Ecosystem: The vision for HCO3 resulted from many meetings with the Small Business Development Center (SBDC), the Shenandoah Valley Innovation Council (SVIC), and the Shenandoah Valley Technology Council (SVTC) with whom we will remain in close collaborative contact. HCO3 will also receive logistical and administrative support from several institutional structures at JMU. These include the ISAT Department and James Madison Innovations (JMI), a non-profit affiliated with JMU for managing intellectual property and commercialization efforts for undergraduates.

4. During the Grant Period (8/1/2015 to 7/31/2016): Work Plan and Outcomes

The **requested funding of $49,916** will support the launch and 10-month pilot of HCO3. Because we envision a creative *coworking* space, we will recruit local business owners who need workspace to co-develop HCO3 with us. On 8/1/2015, we will begin identifying and securing a location for the hackerspace. *There are several candidate spaces in downtown Harrisonburg which our real estate agent expects will remain vacant until fall.* The target for opening HCO3 will be 10/1/2015, allowing our E-Team students to participate actively in the launch; grant funding will cover the activities over the 10-month period from 10/1/2015 to 7/31/2015:

- **Rent, utilities, and liability insurance** to support the first 10 months of HCO3 operations, from October 2015 through July 2016. There are several candidate spaces in the downtown area averaging $13/sqft per year x 2500 sqft x 10/12 months = $27,083. Utilities (+ internet) est. at $600/mo x 10 mo = $6,000. Liability insurance est. at $4,000/year x 10/12 = $3,333 or $333.30/mo. Funds would be disbursed monthly.
- **Materials** for E-Teams to prototype, build, and market their developments. For example, scaling up the zome to create a full-scale version of ZPortal will require a significant amount of wood or composites and lots of programmable LED light strips, breadboards, Arduinos, and Raspberry Pis. The exact materials, requirements and configurations are TBD by the E-Team's research in Fall 2015. Amount requested: $10,000.
- **Art supplies, paint, whiteboard paint** for E-Teams and community members to decorate the HCO3 space on an ongoing basis to create STEAM atmosphere and culture. Amount requested: $1,500.
- **Travel** to San Francisco for program co-directors: $500/person airfare x 2 = $1000. $100/day room and board (to stay in communal residences, e.g. EmbassySF) x 5 days x 2 people = $1000. Student travel will be supported by student program fees.

We also plan to ask for donations of scrap materials and tools from local suppliers and hardware stores. We have been very successful with procuring materials by donation (e.g. fiberglass, plywood, tiles) for other senior capstone projects.

Year 1 Operations Outcomes	Year 1 Commercial/Partnership Outcomes
• A new group of 3-4 E-Teams, consisting of 12-16 students, is queued up for the 2016-2017 academic year • ISAT 44x (Quality, Creativity, and Lean Six Sigma) course developed • Funding from coworking partners during Year 1 crowdsourcing efforts has accrued to support the rent, utilities, and insurance for Year 2	• How many ventures were launched? How many people were able to find employment as a result of the work done by E-Teams? • How many products were launched? • How many productive relationships did students and community members form? • What stories demonstrate the ripples of impact from partnerships between students and other local participants in HCO3?

5. Beyond the Grant

The vision for HCO3 *will* be enacted; the only question is *when* it will happen. Harrisonburg needs a creative space where partnerships between students and the community can grow and

thrive in unexpected ways. We believe that such a venture can be successfully crowdfunded, but the challenge is in getting supporters who are willing to commit on a basis longer than month-to-month *without seeing the physical space up front*. Support from VentureWell will help us bootstrap the financing for the project, which will ensure its launch. HCO3 will become **financially self-sustaining** as the revenue from businesses that share the coworking space is redirected to supporting future months' rent, utilities, and insurance. We will continue to engage James Madison Innovations (JMI) to guide the technology transfer and commercialization process. **Program fees** from students will support the travel requirements in out-years, much like Study Abroad programs. The business model, program structure, and new courses will be replicable and could be shared with or recreated at other member institutions to launch hackerspaces that are driven by community/university partnership.

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References for Project Narrative

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