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Embedding Innovation Process And Methodology In Engineering Technology And Business Management And Marketing Courses

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2006-1610: EMBEDDING INNOVATION PROCESS AND METHODOLOGY IN ENGINEERING TECHNOLOGY AND BUSINESS MANAGEMENT AND MARKETING COURSES

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Embedding Innovation Process and Methodology in Engineering Technology and Business Management and Marketing Coursework

Abstract:

For many business segments, true “out of the box” innovation occurs in entrepreneurial companies where the founders aren’t hindered with the research paradigms established by mainstream businesses. The founders of these companies, many times technologists and scientists, see the application of the technology long before potential customers develop an understanding of the capabilities that the new technology can bring to the marketplace. Many times these “new technology ideas” have been developed though modifying an existing dominant design (product or service) to meet an unforeseen market need or through the development of a new design that may become the new industry standard. The competitors of tomorrow may reside in radically different markets yet have the insight to envision the application or modification of an existing technology to a market segment that they are currently not involved in.

Teaching engineering technology students techniques and visioning tactics related to the innovation process has been difficult. Several of the authors have experienced, both in the classroom and in industrial settings, that many engineering and engineering technology students see innovation as the application of engineering principals resulting in small incremental changes in a process. Although these changes may result in a more efficient process through increased productivity, reduced waste, faster cycle times, etcetera; continuous improvement projects many times do not generate the dramatic market changes seen with a new dominant design. In fact in many established industries, disruptive innovation is discouraged in favor of continuous innovation because of the uncertainty of the risk/reward quotient and the impact that failed experimentation (increased research and development costs) can have on Wall Street’s perception of a company. Our university recently merged the colleges of Business and Technology and Applied Sciences resulting in a cross-pollinated faculty and the establishment of courses in the graduate and undergraduate curriculum where business and engineering technology student’s work together on class projects, many of which involve an innovation component.

It is interesting that many of the faculty who incorporate a discussion or exercise related to the innovation process in their classroom have had extensive experience in an industrial setting prior to joining the university faculty. Industry seasoned faculty bring their “real-world” experience to the classroom and challenge students to move beyond continuous improvement projects. In several cases, ideas generated in the classroom or through collaborative efforts between the business and technology faculty have resulted in prototypes being built in the laboratory for further testing of the prospective innovation.

The presence of a technology-centered business incubator located within walking distance from campus provides students the opportunity to observe several high technology businesses that have developed new technology niches in established market

segments. These businesses provide consulting opportunities for cross-disciplinary graduate student teams to observe the challenges of introducing a new technology to address previously met market needs through introduction of a superior product. The business incubator is further linked to a sister technology-centered business incubator in Europe providing students (graduate and undergraduate) the opportunity to evaluate if a new technology should be launched initially in the United States or Europe. The creation of these learning opportunities mimic the industrial setting where graduates will be required to operate in cross-disciplinary teams that may address global manufacturing and marketing decisions.

This paper discusses the pedagogical approaches several faculty members have developed to introduce and cultivate a creative innovation process to undergraduate and graduate students enrolled in technology engineering and business marketing and management classes. These approaches include identifying unmet market niche opportunities, identifying technologies utilized in alternative markets that could be utilized for different market segments, classroom exercises to compel students to search existing patent literature, ideation and brainstorming exercises and researching business entities to identify their technology strategy and implementation plans.

Introduction:

Is innovation becoming a "lost art" in the United States? A recent text suggests that this might be the case, they state "in 1970, U.S. companies represented 66 percent of the stock market capitalization of all of the companies in the world. By 1990, even after 20 years of remarkable growth, U.S. companies accounted for only 33 percent of the world's total"[1]. A 1996 U.S. Department of Commerce report indicated that 90 percent of all new products fail within four years and less than 10 percent of the U.S. companies introduced a new product within the past ten years[2]. Several of the authors of this manuscript have speculated that the Research and Development focus of numerous U.S. corporations appear to be centered on continuous improvement projects where the probability of success is predictable and definable. Unfortunately, continuous improvement projects result in diminishing returns as the low hanging fruit is harvested and identification of high yielding improvement projects becomes more difficult. However, dramatic growth and revitalization of a company occurs when disruptive innovation triggers a change in the market segment dominant design and consumers and competitors rush to adopt the new technology. A prime example of this is the recent dramatic change in transportable music where the dominant design changed from the personal compact discs and the personal disc players to MP3's and the iPod™. Much of Apple's stock and financial rebound has been driven by the iPod™ and its investment in retail stores and analysts will be looking to determine if Apple's R and D will have a new product line that will be the next generation growth driver. Efforts on continuous improvement are already being seen as the iPod™ transitions to the iPod nano™ and other models with various bells and whistles. Are we providing our graduates training to develop the skills necessary to be comfortable with the process of both continuous and disruptive innovation?

Discussion:

Knowledge of the innovation process becomes a valuable asset when graduates from Engineering Technology or Business Management leave the university and enter the workforce. Whenever possible, courses should include some component of the innovation process in the course syllabus to help familiarize and acclimate students to terminology and the processes involved in bringing an idea from concept to commercialization. Up to this point, inclusion of components of the innovation process in engineering technology and business (marketing and management) courses has been at the discretion of the instructor responsible for the course. The authors believe that intentional design of courses to include components of the innovation process is in the best interest of the engineering technology students and are encouraging professors from engineering technology and management and marketing to integrate components of the innovation process in their course content where applicable. The following sections of the paper will address the authors' attempts to embed concepts of the innovation process in their courses and their assessment of the utility of these exercises in teaching the necessary concepts. In our experience, professors that have had both academic and industrial experience are more inclined to include innovation concepts in their coursework because of the utility these concepts have in technology based businesses. Concepts taught can be as complex as how to develop a technology strategy to as simple as understanding the difference between copyrights, trademarks, trade secrets and patents. Course numbers and prefixes are listed to enable interested parties to locate and download course syllabi from East Tennessee State University's (ETSU) College of Business and Technology website.

Introductory undergraduate coursework:

One of the authors adopted a concept he learned about from a professor (University of Arkansas) at a recent ASEE meeting and utilizes it in a course on *Technical Communication* (ENTC 3030*)*. This course is a required core class for all technology undergraduate students. In this class, students are required to search the United States Patent Office database and find a patent application or patent authored by someone with the same last name as the student. Students are required to provide a printed copy of the patent and a two-page paper discussing the highlights and claims of the invention and their assessment of the invention. In their assessment, students are asked to differentiate whether the invention is a modification of an existing design or if it is a technical breakthrough that potentially will change the current dominant design. Although this exercise is a minor part of the overall course structure, students are introduced to the unique writing style utilized in patents, learn where to search for inventions that have been patented or are in the process of being patented, are required to make some assessment as to the patent viability and uniqueness and have fun searching for a patent authored by someone with the same last name. Utilization of the last name search reduces the likelihood of recycled papers finding their way back into the classroom. In the unlikely case that the student cannot find a patent with the same last name as theirs, they find the closest name and complete the exercise.

In another introductory class in technology, *Technology and Society* (ENTC 3020), students learn how technology has changed the way we live and is another great opportunity to embed the innovation process into existing core curriculum coursework. Unfortunately this course is currently taught as a "filler course" where professors who have the need for a class to fill out their schedule are assigned to teach the course and several professors view the course as a burden rather than an opportunity. Two of the authors have taught this course in the past and utilize it as an opportunity to discuss how the new innovation changed the dominant design of the time and how that change impacted history. This helps the student to understand the impact that a new innovation can have on society and on the course of history. In addition the instructor can differentiate between an incremental change (flaming arrow) and dominate design change (flaming trebuchet) in technology and reinforce this concept to the students. One of the nice elements that this course provides is that the instructor can modify the course to teach in areas where they have a particular expertise, for instance, Sims highlights changes in aviation and electronics whereas Clark highlights changes in biotechnology and chemistry. These two introductory courses provide a framework where students are taught basic innovation principals that can be further expanded upon in upper level courses.

Upper-level undergraduate coursework:

Another course, *Computer Integrated Manufacturing* (ENTC 4357/5357), team taught by author Turner from the management department and a technology department professor, provides an even more integrative structure, bringing together undergraduate and graduate students from the technology and the business schools. While the idea of bringing students from diverse programs to exercise their functional expertise may not be a significant step forward in the educational process, placing them in functional teams outside of their field of expertise does create a unique new learning opportunity. The primary objective of this class is to create a marketable product (idea generation and market analysis), set up an efficient computer integrated production process, establish a management structure (includes accounting, finance, production, procurement, and marketing), and produce a pre-established number of units.

In this course, students are placed into the functions related to their areas of expertise, however, they are also placed into groups that are outside of their formal training. By cross-assigning these students they are exposed to the processes that support, provide inputs, and must be integrated with their specialty. Accountants operating heavy machinery may sound like a recipe for disaster (we provide safety training and monitoring for them), however by involving them directly in these processes they develop a better understanding of the phenomena they are seeking to quantify in their reports. This in turn provides greater accuracy in the cost reports that they provide to the decision making team (made up of graduate students from both programs). It also gives them better input into the potential solutions to bottlenecks and other inefficiencies in the production process as they interact with the experts (the technology students). This is an integrative style that has implications for technologically oriented organizations that need to constantly evaluate and reevaluate their ongoing projects from a perspective of potential future returns and profitability. On the technology student's side, they learn to look at the project with a cost/benefit perspective, and can relate the findings from their external group (management, procurement, accounting, or marketing) to their peers to provide a more efficient use of their efforts to reach the ultimate goal. This would be indicative of a Level 4 (Scale of 1-4 with 4 being the highest degree) integration as defined by Klien[3] or the "Networked" integration (Highest Level) as described by Fogarty[4].

Students are required to read the book by Eliyahu Goldratt called "*The Goal*"[5]. They then write a term paper discussing their experience in the class as compared to the characters in the book and their coursework to date (senior level for undergraduate students). This provides the students with a basis from which they can evaluate their experience[6]. While the instructors are primarily used as advisors, they are careful not to provide too much input and thereby negate the learning experience for the students. It is noteworthy to acknowledge that students tended to be rather frustrated at times during the semester, but their sense of accomplishment and their appreciation for their learning was quite evident upon completion of the project. Nevertheless, the instructors direct students to their answers rather than give them the answers to their dilemmas. For students with intra-disciplinary issues, the instructors direct them to search the appropriate sources from their completed coursework. For interdisciplinary issues, they are directed to examples from "*The Goal*" and/or a simplified discussion from the area of concern. The richness of their papers indicated that their learning exceeded the traditional integrative coursework (each student practicing their trade exclusively) and indeed created a better understanding of the processes necessary for firms to be economically successful.

One specific example of a course that requires students to develop innovative ideas is *Technical Practicum* (ENTC 4600). In this course students at the end of their degree process are mixed into groups from different concentration areas. These groups are normally made up of 6-8 students from Electronics, Bio-Medical, Construction, Surveying, Manufacturing and Digital Media. In this course the students are required to act as a group process team to define, design, plan and cost a product. More emphasis is placed on identifying the process of production and developing the manufacturing capability than to produce it. The students are also required to develop a working model of the developed product.

The course structure is laid out to allow the groups to function as a team with team members responsible for specific areas. A typical set of reports for the class would include one individual report (supported by other group members) and two sets of team reports. As an example, each individual (or pair of students) within a group does one of the following reports listed below. This will be the report grade listed for the individual or pair of students. The student(s) will present this report to the class. This becomes the student's individual grade, which affects the whole group since these grades are averaged together to make a "group average individual grade".

Reports:
1 – Initial Product Specification – This will include layouts, concepts, analysis of competition and other data sets as covered in class, including a justification for the initial product specification.
2 – Manufacturing Analysis – Resources, method of manufacture, quality requirements, special equipment, process specification – single run, packaging and other data sets as covered in class.
3 – Production Analysis – facilities, labor, market requirements, overseas vs. US production, regulatory requirements, plant layout, quality audit, production flow, warehousing and other data sets as covered in class.
4 – Cost / Marketing / Sales Analysis – Production cost, market strategy, sales strategy, distribution, wholesalers and other data sets.
5 - Final Product Report – To include all above data plus projections of growth (based on data, not conjecture). The report must include the *Hofer Cycle*[7] analysis to be included for full life cycle.

Once these reports are completed the students present a final Product Report including both a presentation from all members and a formal report that is the combined output from the above sections.

The students are given a set of limitations upon which they can base their design. These are given to allow the students to utilize existing manufacturing processes and standard design principles to base their product on. This gives them a better chance to map their design against existing designs. This does not limit creativity; it simply makes the project more realistic and definable. The set of limitations listed below have been used for the last four years and have provided some real boundaries to the developed designs. As an example, one student wanted to develop a golf club with a very interesting design. However there was no existing production equipment capable of producing the part he wanted to produce so he would have to develop both the design and process which could have been done but at the sacrifice of the other parts of the project. From the learning aspect these limitations make the design possible in the limited scope of a classroom environment.

The requirement for the factory visit instills in students the real complexity of producing a part or product. Many times this is the first time these students have been required to step out of the classroom and venture into the "real world". The factory must also produce a related product to what they are working on. As an example, one of the past student groups had an innovative idea for a laser level. They visited a factory making plastic bulb levels and both parties benefited. The manufacturer used some of the data the students had developed and the students were able to see the manufacturing process as it was occurring. In one of our student groups the students designed a backpack with special load handling features. They visited a clothing manufacturer to understand the requirements for sewing, part make up and quality requirements.

Design Limitations:

- Must be technically feasible.
- Must have real competitors for sales.
- Must have some kind of manufacturing or building process required.
- Must be an item that will be mass (DMM, Calculator) produced and sold.
- Group or at least two individuals of the group must visit a factory making similar product or at least part of the product they are building.
- A mockup is required of the product.

These students are required to draw on their course background to help develop the technical requirements for designing, producing, and moving the goods to the customer. In many of the courses such as Plant Layout and Material Handling, Project Scheduling, Process Control these students are driven by the professors' requirements for learning and developing skill sets in these areas. In this class the students are able to put these skill sets to work on a project they define. The instructor acts more like a mentor making sure the design is practical and producible.

Examining three past projects developed by these student groups provides better understanding of the course process and highlights some of the many innovative ideas these groups have developed. One group developed a student backpack that was built on the concept of matching the human body to the backpack frame. The case was that students typically carry very heavy loads which often have a center of gravity many inches from the plane of the back. Common commercially available backpacks are not designed for these leveraged loads. The students interviewed orthopedic surgeons from the campus medical school and also did a good deal of research to develop the design. They developed the initial product specification and went about the process of learning how to manufacture the design. Using skill sets from other classes they began the process of identifying equipment and processes required. The group also identified a local clothing manufacturer who provided significant input to their product. The group wanted to have the backpack made completely in America. However, they discovered that they could not source the many zippers required and still have a competitive product so they utilized a China based zipper manufacturer; the remainder of the backpack would be of U.S. components. They decided to use university bookstores as their outlets by tying the backpack to the school with school branding. Part of the course also requires the students to identify the next step in the product life cycle (Hofer Cycle). In this case one of the students, a female, identified how hard it was to find a baby carrier backpack. They realized that the leveraged load of books was not that dissimilar to a baby in terms of loading so designed a baby carrier utilizing the existing frame structure. This gave them two different market outlets with the same basic frame structure.

Figure 1 below shows the model pack they developed which had working zippers, buckles, straps and even had product labeling attached to the pack. The students also used some software the medical school had to match the pack to an anatomical body (See plats above the pack). The picture of the baby carrier is also shown in Figure 1 at the bottom right.

Figure 1: Model and Layouts for “University Backpack”

Another project was based on one student’s experiences of trying to find a remote light which he could use while working in tight areas. The students used their course backgrounds again to develop a remote light using fiber optics and a lens system to focus the light into a combiner. They also designed the housing so that the light would also illuminate and allow the user easier control of the light while working in dark environments. The students had both a low cost version using cheap plastic cable and a more costly version using an armored glass cable that transferred more light to the end of the cable. They also designed the housing to fit common flashlights. To do this they made the cone such that it would fit over and conform to many different housing sizes, and also by employing rubber o-rings to insure a tight fit. This group also did an excellent job laying out and specifying the required manufacturing equipment. Figure 2 below shows the unit mated to a standard flashlight and the plastic fiber optic cable. The camera flash tends to show an apparent weak output from the fiber but in reality the light is very usable. The students were very innovative in designing the housing and six different flashlights from different manufacturers were able to mount to the housing.

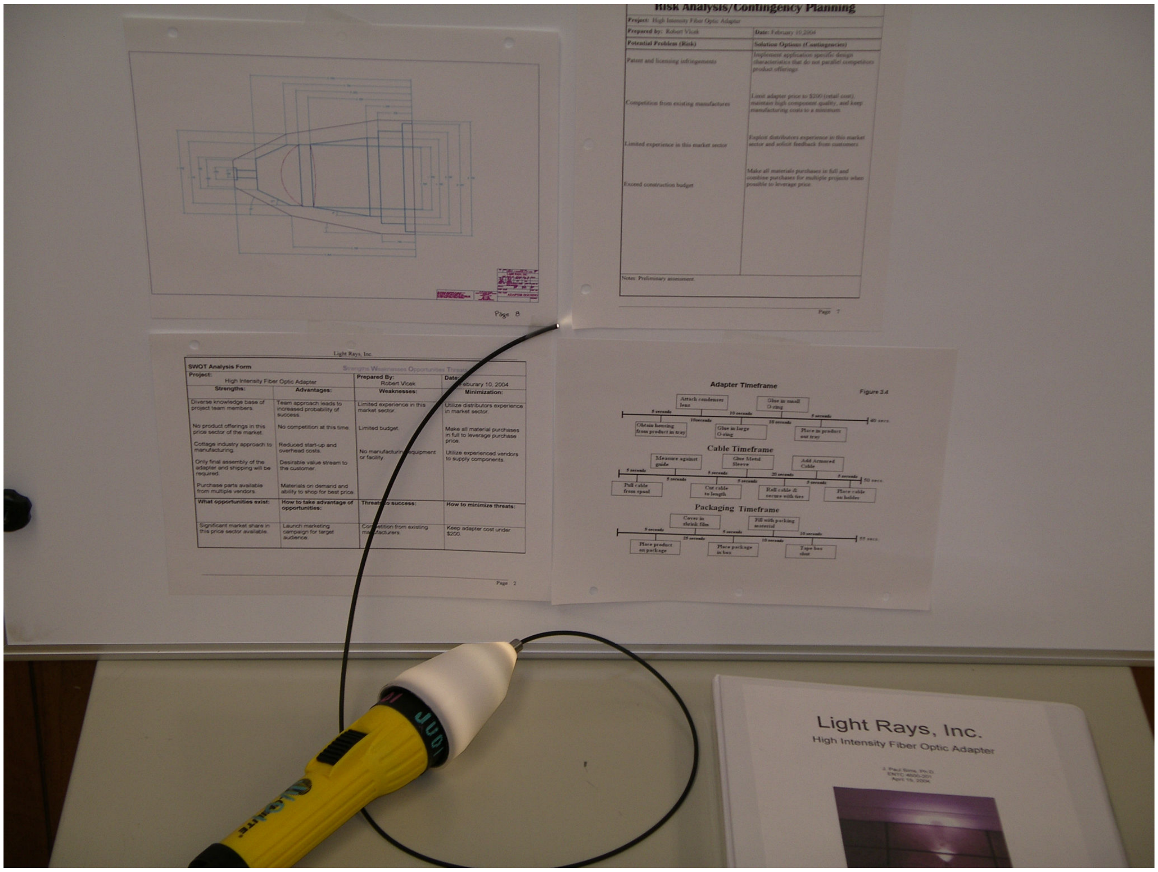


Figure 2: Remote Light Model and Production Process

The final example was a common item which is currently mass-produced but this group of students felt that an innovative design could make them competitive with cheaper labor markets. They designed and built a flagpole. However this flagpole had some interesting design concepts. Instead of making a common pole, they made a unit capable of being extended into any size required. They used a heavy-duty steel tube of common size with enough wall thickness to be turned down and threaded. They then made an interchangeable tie ring that would allow multiple lengths to be fitted; so using the same standard five foot section they could source 5, 10, 15, 20, 25, and 30 foot poles. The students utilized their course work from materials, statics and dynamics to help define and proof the concept. They also investigated lightning requirements as well as looking at building codes and restrictions.

The innovative and practical designs these students developed shows the need to require boundaries on the innovative process so that students develop realistic and producible concepts. As an example the reasons a set of restrictions was placed on the students in terms of the project they could consider was that many groups developed projects impossible to build or would require such a large amount of capital that even Bill Gates would need a loan to fund it. One group conceived a satellite system for visual phone calling worldwide. Nice idea, but both technically and financially unachievable at the time proposed. After watching this for two years the set of restrictions listed earlier was developed to help the students funnel their innovations into reasonable concepts.

Graduate Coursework:

In a graduate course, *Investigations in Technology* (ENTC 5030), students learn how technology impacts the marketplace and investigate how major (dominant design change) and minor (incremental changes to current dominant design) technology change the fortunes of companies involved in the impacted market segments. Students are taught these concepts through a variety of different pedagogical means including lecture, case studies, current concept analysis and in-depth market segment analysis. In this course it is imperative that the students understand the change that is taking place in corporate research and development in the United States and the textbook authored by Miller and Morris, *Fourth Generation R and D: Managing Knowledge, Technology and Innovation*[1], provides an excellent historical perspective and forward looking analysis of these changes. Over the course of the semester, students are assigned to prepare six two-page summaries of companies that are featured in the technology section of popular finance/market analysis magazines (i.e., Forbes, Smart Money, Kiplinger's, etc.) discussing the company and what they offer, how the company's technology is positioned in the particular market segment that they participate in and what is the current dominant design for the market segment. This course is populated by students pursuing either an M.B.A. or M.S. in Technology and these exercises help students to begin to evaluate how companies are implementing their technology strategy through product offerings. Students further delve into understanding corporate technology strategies and intent as they prepare an in-depth report detailing how companies embracing the current dominant design differ from fledgling technology companies embracing a competitive technology in regard to their approach to marketing, product offerings, patent filings, public announcements, annual reports and other outward signs documenting their implied technology strategy. The students are required to make an assessment of the likelihood of the challenging technology surviving for five years after their commercial product launch and if the new technology has the market strength to become the new dominant design for the particular market segment.

Graduate students interested in learning about entrepreneurship can elect to take a class entitled *Innovative Entrepreneurship* (ENTC/MGMT 5640), where students focus on new business creation based on technology innovation. Students learn how to develop a business plan, listen to life experiences from entrepreneurs that started technology based businesses and have their business plan critiqued by a panel of local entrepreneurs and businessmen. Several graduate students from this class have gone on to launch businesses where the business model and plan were conceived in this course. The university sponsored technology business incubator provides an excellent facility for these businesses to transition into with faculty mentors and specialized office and laboratory space available. Students not interested in launching the business conceived in this course can elect to participate in a *Strategic Experience* class (ENTC/BADM 5800) where the skills developed from the *Innovative Entrepreneurship* course can be refined through a consulting experience with startup businesses domiciled in technology based business incubators. This experience is further defined in the following section.

Leveraging Innovation and Learning Through Technology Business Incubators:

For many students, moving from classroom based lectures and exercises to the "real world" environment represents an enormous cognitive leap as the move from theory to application often entails shifts in perspective that may range from the subtle to the profound. The university's creation of a technology-based business incubator provides students with an educational mechanism that facilitates this "leap".

In 2002, the university opened its Innovation Laboratory. The Innovation Laboratory contains a business incubator oriented towards technology based start-ups. Co-located within the facility is the Small Business Administration' Development Center (TSBDC). Since its opening, the Directors of the Innovation Laboratory and the Development Center have been receptive to incorporating both graduate and undergraduate student interns and student teams into their activities. The TSBDC has volunteered to train students as "student business counselors" and the Innovation Laboratory has agreed to allow students to work as interns assisting Laboratory clients. Several papers have already been published regarding the establishment of ETSU's high technology business incubator[8] and the utilization of this facility and affiliated incubators in coursework[9].

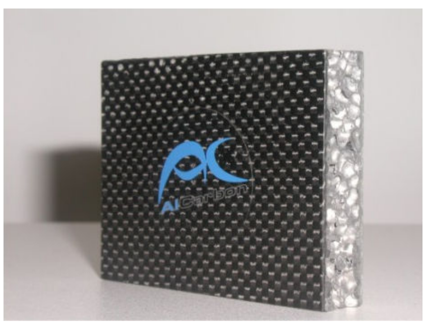
This relationship offers business and technology students the opportunity to work closely with entrepreneurs during the formative stages of their development of a business concept. As students assist in the development of business plans and market research projects, they are forced to view the world through the prism of market realities rather than from an academic standpoint.

The Laboratory has established a network of ten regional business incubators. Several of these incubators have also expressed an interest in providing opportunities for student interns to interact with client firms. In addition to these connections, the Innovation Laboratory has established a "sister incubator" relationship with a business incubator sponsored by one of the university's partner schools in Germany. Through this relationship, incubator clients have an opportunity to explore markets within either the EU or the U.S. Currently, a client from the incubator in Bremen, Germany has established a presence in the U.S.

As part of this relationship, graduate students from the EU and the U.S. have opportunities to explore innovation on both sides of the Atlantic. Students can work closely with resident entrepreneurs and aid in the preparation of business plans and market research reports. Students enrolled in the M.B.A. program are required to complete a *Strategic Experience* course as a degree requirement. Students enrolled in the Master of Technology program are also able to engage in a strategic experience course as part of their degree program. The *Strategic Experience* courses (BADM/ENTC 5800) are to be taken in the students last semester of their graduate program. The course is

"…designed to provide the … student with an opportunity to apply the knowledge and skills developed in the program in a realistic problem solving environment". As part of the course, student teams are required to engage in a project involving companies, governmental agencies or individuals outside of the university. The team meets with their "client" and works to develop solutions for relevant problems. Student teams have developed business plans, conducted market research and have engaged in impact studies among other projects. The teams are usually interdisciplinary and have in the past included both M.B.A. students and Engineering Technology students.

Recently, a team of business graduate students traveled to Germany to meet with the founder of a firm that has acquired the license to produce products using an innovative new material. Using a process developed by the Fraunhofer Institut Fertigungstechnik Materialforschung of the University of Bremen, the company, AlCarbon Technology GmbH, is developing products using metallic foams and carbon fiber coatings. As the pictures below demonstrate, the product can be cast into a variety of shapes including "sandwich plates" shown below using aluminum foam coated with carbon fiber layers to increase the strength of the product. The firm is currently exploring a variety of applications for this product including wall structures, ceiling panels, tables and aircraft floorings.



These structures are relative light while being extremely strong. They can also be produced as either an "open cell" or "closed cell" foam thereby offering a wide variation in weight and strength combinations. The product can also be produced with a variety of coatings yielding different colors and textures. The foams can also be shaped using injection molds to produce specialty products. As this picture shows, the firm is using this technique to product impact absorption posts for motorcycles.

This "after market" product is attached the sides of the motorcycle and is used to absorb the impact resulting from the bike's being "laid down". Both man and machine are protected from immediate contact with the ground as the post absorbs the impact of contact with the ground. This product also illustrates the product's extraordinary ability to absorb impact forces. The firm's owner illustrates this feature by slamming a ceramic coffee cup into a large piece of uncovered closed-foam aluminum casting. Ordinarily, such an impact would shatter the cup. The foam, however, absorbs the impact forces with almost no deformation while the cup is unbroken.

While the firm has developed a number of products using the materials, they were still in the process of attempting to define additional applications. As part of their project, the students were able to meet with the entrepreneur and engage in visioning sessions geared towards suggesting new markets for the product. This activity clearly demonstrated that innovation is often not an incremental process.

Upon their return to the United States, the students developed a competitive analysis of the aluminum foam industry, the sandwich plate industry, and the ceiling panel industry in an attempt to develop a better understanding of the US market. They also prepared an analysis of AlCarbon's strengths and weaknesses to identify the firm's best opportunity to create value in the market. A business model was then proposed to help guide the firm in its efforts to become a competitor in the US sandwich plate and ceiling panel markets. The model proposed the formation of strategic partnerships with customers and suppliers as a way to combine the competencies of AlCarbon with those of suppliers and buyers to create value and overcome barriers to entry. This report was presented to the firm's owner for his review.

In addition to the activities of the U.S. students, a graduate student in product design program of the University of Applied Sciences of Bremen, who has been working with AlCarbon, came the our university and began exploring other products which the firm could develop. He also worked closely with the manager of the Innovation Laboratory to aid the firm's owner in establishing a presence in the business incubator.

During his time with us, the student participated in a number of classroom activities at the university. He worked with professors teaching entrepreneurship and joined a robotics class for a semester. This brought to the U.S. classroom a new prospective introducing both faculty and students alike to creative innovation from an international and practical standpoint.

These opportunities have enabled students to not only observe the creative innovation process in which the incubator clients are engaged, but to also participate albeit in a rather limited way. This type of close contact with the entrepreneur often facilitates the cognitive shift from student to innovator; the proverbial "aha" moment where the student suddenly realizes that the true nature of the problem is not to respond as he thinks that his instructor wants him to, but to "see the vision", to understand what drives the innovator and entrepreneur and to become part of the process.

Conclusions:

At ETSU we believe that it is imperative that students develop an understanding of how their jobs are integrally related to all elements of their organization and those organizations that are their customers', suppliers', and other stakeholders' within their network. We seek to offer courses that provide a variety of degrees and types of interactions designed to expose the students to a wide spectrum of experiences that they will likely encounter in their professional careers. This exposure will enhance their understanding of how they benefit from developing insights and knowledge related to the expertise of others, how others can benefit from their knowledge within their field, and finally, the synergistic value enhancement achieved via the development of socio-cognitive capabilities[10].

We believe that this emphasis on cross-disciplinary learning will have a positive impact on the problems noted by the prominent strategy scholar Henry Mintzberg in his recent book, "*Managers Not MBA's*"[11]. The opportunities that we provide for students to truly lead, follow, and learn, provide them with experiences that will be invaluable to them in their future career, whether that be in an established business, or a startup enterprise. It is our hope that through the challenges, successes, and even the failures, they achieve will be better prepared to address the realities of the world in which they will be competing and cooperating.

Finally, by incorporating concepts critical to the innovation process in a coursework that the student will be exposed to from their sophomore year and into graduate studies, we hope that our graduates will keep an open mind toward their contribution to innovation process regardless of their functional assignment in corporate or academic communities. We need to train students in the innovation process such that when they move into management positions they have the courage and experience to develop research programs that include components from both continuous improvement and disruptive innovation processes.

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