Creating Virtual Teams Through a University-Industry Partnership

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Abstract

A different educational model was adopted where industrial consultants acted as advisors, coaches and trainers, and universities implemented the lessons learned. They consulted in integrated product development on such issues as intellectual property, team formation, team communication, and project evaluations. The teams set up virtual companies using Internet software, ipTeamSuite, from Nexprise, Inc.

I. Introduction

Global out-sourcing of technology and new products is starting to take place in virtual teams in order to reduce costs and development times[1]. In this way, the product team members are not co-located in the same place at the same time. It is important to introduce this into the classroom, because virtual collaboration is becoming increasingly important as separated teams jointly develop products [2].

Over the last few years, a problem has evolved in the teaching of Loyola Marymount University's New Product Development graduate course. The course requires that team of engineering and business students' work together to develop new products[3]. Over the last several years, the graduate students have had great difficulty meeting together in co-located teams due to their busy schedules, off-site travel in their full-time jobs and driving long distances in traffic in order to meet with their teammates. This problem could be solved by utilizing the Internet for team interaction. Here the team members would be able to interact at their own convenience, which would enable them to save time by not having to meet as often as a co-located team.

Within the last year, ipTeamSuite software by Nexprise, Inc. has been successfully tested at LMU on collaborative team projects[4]. The next challenge involved working on joint design

projects with another university. Here student teams from Loyola Marymount University (LMU) collaborated with students' teams from East Tennessee State University (ETSU) on joint projects for a "New Product Development" graduate course. The ipTeamSuite software was used for data exchange, information sharing, messaging, and group scheduling and design documentation. This paper represents the formation of joint courses and teams between LMU's Engineering and Production Management and MBA graduate programs and East Tennessee State University's (ETSU's) Engineering Technology Department. The courses also involved industrial consultants from TRW and Boeing, who were experts in concurrent engineering and virtual teaming.

The purpose of this paper is to discuss the product development process, the role of our industrial partners, how virtual teams were formed, and how they communicated with each other.

II. Product Development Process

Prior to describing our industrial partnership and team arrangements, it is important to discuss our overall process for developing new products. Since universities are not set up to develop products and since the product development cycle is incompatible with a university's curriculum structure, new guidelines had to establish. However, since courses in new product development and entrepreneurship are offered, the university should provide "real world" experiences for the students.

In order to commercialize new products within a university system, a preliminary process has been designed in Figure 1. It comprises three courses (shown in bold boxes) along with key activities that should take place. First, it is important that decisions be made early on the patent ownership and the distribution of profit (if the products generate revenue). Course 1 ("New Product Deign and Development") is performed in teams of engineering and business students. The course identifies the products, markets and customer needs, product design, manufacturing, and payback period. The funding for the products has come from outside grants[5-7]. One of the outputs of this course should be a patent evaluation. A product review board of experts will determine the best product opportunities from Course 1. These products will be developed further with additional outside funding.

Product development will continue with Course 2 ("Entrepreneurship"). In this course, again multi-disciplinary student teams will develop products. Their goal is to prepare a business plan, fabricate prototypes for field testing the product, and finalize the design of their product. Then a product review board will evaluate the potential success of the products from a business and technical perspective. Their approval will be necessary before the products are commercialized. This will be the same review board that selected the best products from Course 1. For those products that make it through the final screening process, both engineering and business students will be eligible to take Course 3 depending upon the scope of the project. Funds will be obtained from various sources to form incubators that will bring the products to the marketplace. Due to the difficulty in obtaining funds and the time lag involved, this process will be initiated prior to Course 2 (when the best products are selected).

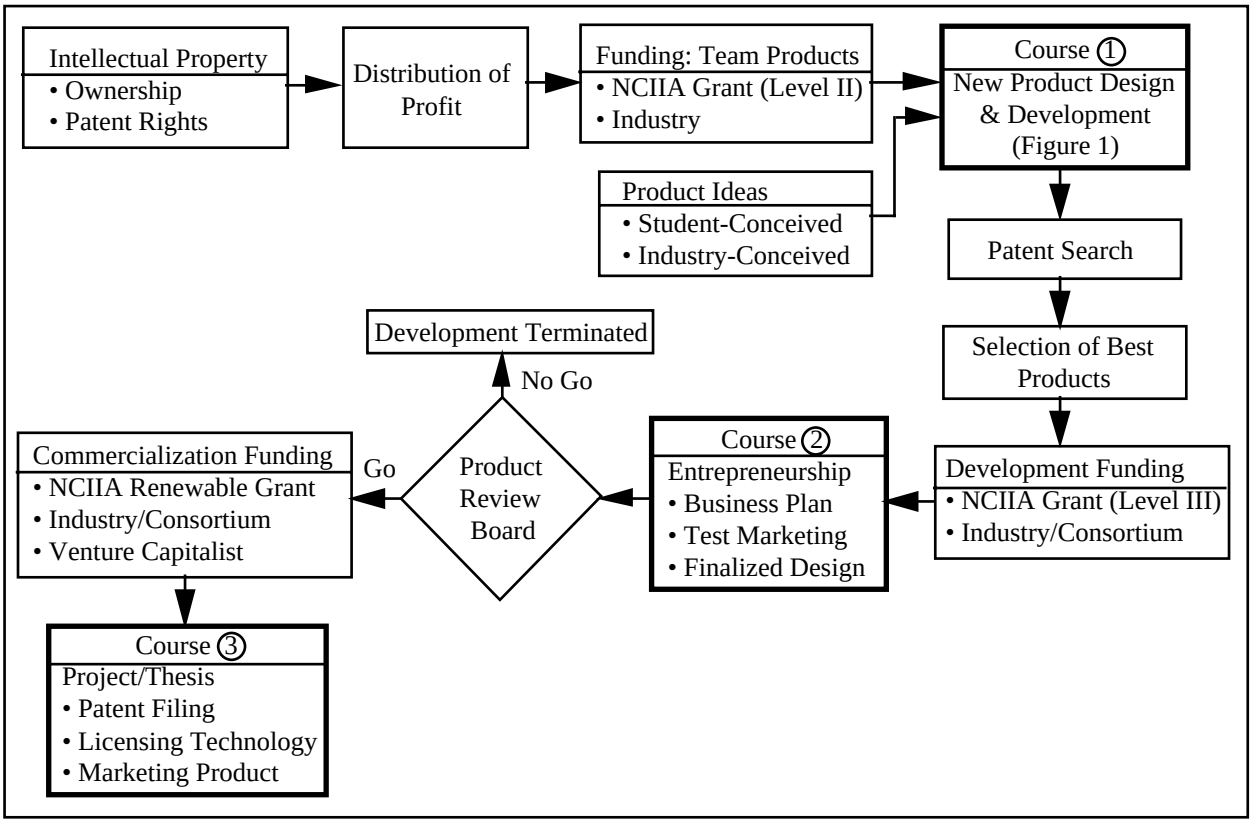

Figure 1. Proposed Process for Product Commercialization within the University System.

III. University-Industry Partnership

The close working relationship with our industrial consultants was necessary in order to make this project a success. In fact, the strong interaction between universities and industry has contributed to the success of companies in Silicon Valley over those in Massachusetts's Route 128[8]. In the area of concurrent engineering, industry clearly had a leading role over academia, because they perform product development in multi-disciplinary teams. Universities are skilled in teaching and research, not set-up to develop team-based products. In this regard, our industrial consultants acted as advisors, coaches and trainers to the universities. Here, a new model for university-industry partnership was established where the universities were learning from private industry. Our consultants assisted us in the following areas:

- Grants and product concepts
- Intellectual property guidelines
- Forming teams and companies
- Team collaboration
- Product review board

Grants and Product Concepts. Four years ago, our New Product Development curriculum was developed through the help of private industry. Northrop-Grumman initially provided funding for the student projects with a higher education grant [5]. In the beginning, small

companies brought their product concepts to our class. The "teaching factory" approach [9] was used to help the small businesses with their marketing, design and manufacturing. It was a win-win situation, because the students were given a problem to solve, and the small businesses were assisted in their product planning. One of the issues that arose was the graduate students felt they being exploited by the small companies. In order to appease the students, an intellectual property policy was initiated whereby the students and university could share part of the royalties if the product was successful in the marketplace.

Intellectual Property Guidelines. . This year, it became apparent that the intellectual property policies had to be modified in order to accommodate our new joint university grant form the Lemelson Foundation [7]. Before the project started, the issue came up on how the universities would share ownership of patent on the jointly developed products. Our consultants proposed two solutions: (1) have both universities own the patents, or (2) select the university that contributed the majority of the novel ideas. Since the intellectual property policies of LMU and ETSU were very different [10], it was advised that the second solution be used.

In order to do this; a patent committee was created that included the principal investigators from both universities (Drs. Mendelson and Rajai) and a patent attorney [11]. The purpose of the patent committee was to recommend to the vice president of both universities, which products could be patentable and which university would own the patent(s). The names of the involved students would be listed on the patents. Once the ownership of the patents was established, the university could apply its own policy to the sharing of revenue (with the students) if the technology was licensed or if products were sold at profit.

Forming Teams and Companies. . In the past years before the two universities had interacted, the teams had been formed around the students' product preference, which was determined by multi-voting of the students [12]. LMU and ETSU students were selected by the instructors in order to create an even mix of students. The mix was determined from the results of two surveys. The first survey evaluated the students' background and capabilities, where our consultants assisted us in the questions for the students. The second survey evaluated whether the students' thought process and behavior came predominately from the right-brain or the left-brain. Throughout the semester, the consultants gave their ideas on creating effective self-directed, virtual teams [1]. The results of our experiences are given below.

There were 20 students from LMU, and 12 students from ETSU. Our guidelines were 3-5 students on a team, and the same number of teams between the two universities. Hence, four teams of five students were formed at LMU, and four teams of three students at ETSU. These four teams from the two universities were organized around four common product concepts, and each team was expected to work jointly work on the same product concept. In order to create a real-world experience, the teams were formed into four joint companies, where the primary company was from LMU and their affiliate company was from ETSU. The companies had to collaborate in order to determine the company name, their responsibilities within the company (e.g., marketing, design, and manufacturing), and their roles for conducting meetings and communicating (e.g., president, vice president, secretary, treasurer, and time-keeper). In addition, they had to establish guidelines on how they would work together.

Each company had to establish a mission statement with a vision, goals/objectives, a strategy, and an implementation plan. The companies had to organize their tasks around the schedule of course milestones that was established by the instructors. Each task was linked to a responsibility that had one manager organize the activities with input and discussion from the other team members. Each joint company had a budget of $1000 to spend on developing their product concept, which was funded by our grants[6-7], and each company had to account for its time spent on the project. In addition, each company had to document its activities in a log book and to submit weekly progress.

Each company had the right under certain guidelines to fire "free-loaders," i.e., students who were taking a free ride and not doing the work. This concept was adopted from the work of Wellington and David[13] and modified slightly. The firing would occur only as a last resort, after verbal and written warnings had been given and time period for corrective action. If the free-loader still had not made a strong positive change in the time period, the company had the option to fire the person, as long as there was at least 2/3 consensus to do so. The instructors were to be made aware of the problem after the verbal warning was given so that they could provide mediation. If a free-loader was fired, he (she) had to apply for a job at another companies (another product team). If the other company would not hire the person, then he (she) would fail the course!

At the conclusion of the course, the students had to evaluate the performance of their teammates in their company, which determined their course grade. The survey form that was used to evaluate the students' performance is shown in **Appendix A**.. In the survey, the students were not allowed to evaluate their own performance.

Team Collaboration. . Over the last two years, LMU has been implementing ipTeamSuite software into its graduate curriculum, which provided the communication infrastructure for virtual teams. This was brought about through our interaction with the industrial consultants from Boeing and TRW. Various automotive companies have currently been testing this and other software to streamline their supply chain management of existing products [14]. Our industrial partnership allowed LMU and ETSU to obtain licenses from Nexprise to use ipTeamSuite software. In addition, due to the efforts of our consultants, Nexprise had agreed to post the software on the Nexprise server. Since the server could be accessed across the World Wide Web from any Internet browser using any computer platform, virtual teams could be formed between institutions that are located anywhere in the world.

The teams would transfer information, data and drawings both within each team (company) and between the LMU and ETSU teams (companies). The data transmission occurred in a totally secure environment. IpTeamSuite used commercially secure servers that worked with firewalls to provide total security for the virtual team and its information products. Each virtual team member had to be authenticated (with a name and password) before information could be accessed. Communications occurred through use of e-mail and workflow routers. IpTeamSuite retained data for the teams with its project areas, which contained document vaults, virtual notebooks, scheduler and consensus builder.

Since most of the students and faculty were unfamiliar with ipTeamSuite software, our industrial consultants provided about 8 hours training on the software for the students and faculty at both universities. The consultants were also available during the semester to resolve any problems in their utilization of the ipTeamSuite. They also gave feedback to Nexprise on possible improvements to the software.

Having the teams store (upload) files and retrieve (download) files to and from the notebook and document vault completed most of the communication between the universities. The LMU and ETSU companies collaborated using ipTeamSuite and by meeting as co-located teams, using the telephone, FAX machines, e-mail, and chat rooms on the Internet. Upon the advice of our consultants, at least once a week the president of the LMU company phoned the president of their ETSU affiliate company to make sure the tasks were coordinated and problems were resolved between the two companies.

IpTeamSuite software allowed the teams to communicate in both a synchronous and asynchronous mode. Synchronous work occurred when team members were working together to create the same new information at the same time. Asynchronous work occurred when the team members worked on different information or work at different times (for the information that the team is producing). The software allowed the team members to share and modify information, sketches and CAD drawings across the team. It allowed the team members to revise files and team presentations, as they are throughout the semester. These features enabled virtual teams to work together and simultaneously create new products.

Product Review Board. At the end of the semester, the student's teams gave presentations to a product review board, and the board evaluated the products that the teams developed. The product review board comprised outside consultants who were seasoned professionals in patent law, business, marketing, design and manufacturing. The products were evaluated in terms of their design innovation and manufacturability, market potential and profitability, and potential for attracting investor capital. A patent attorney advised the projects with regard to the likelihood the products would be patentable. **Appendix B** shows the survey form used by the patent attorney. The product review board to evaluate the above criteria used a similar survey form. Based upon this evaluation, a decision was made on whether to patent a product and form a technology/business incubator.

IV. Conclusions

A close partnership with industry was formed that went beyond conceiving product concepts and donating funds for the student projects. This partnership was for developing and implementing a curriculum in integrated product development between Loyola Marymount University's Engineering and Production Management graduate program and East Tennessee State University's Engineering Technology Department. Since industry was ahead of the universities in this area, the industrial consultants did the advising, coaching and training, and the universities did the listening and applied the lessons learned in the curriculum. This method was applied to two courses: new product development and entrepreneurship. Our industry experts consulted in the areas of patent law, team formation collaboration, and project evaluations. A product review

board of industrial experts evaluated the products based on their design and manufacturing, market and profit potential, and ability to obtain investor capital.

The industrial partnership allowed the universities to obtain licenses from Nexprise, Inc. to use ipTeamSuite software so that the virtual teams could be formed. In addition, Nexprise had agreed to post the software on their server. Our industrial consultants provided 6-8 hours training on the software for the students and faculty at both universities. The consultants were also available during the semester to resolve any problems in using the software. They also gave feedback to Nexprise on possible improvements to the software.

The teams from LMU and ETSU were formed into joint companies with roles and responsibilities for jointly developing new products. The companies had the right to fire students who were not performing. The teams communicated using phone, FAX. E-mail, chat rooms. In addition, ipTeamSuite Internet software was used to store, brainstorm, and modify files. The teams used this software mainly for sending messages, sharing data and information, and modifying drawings.

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Bibliography

1. J.Lipack and J. Stamps, Virtual Teams: Reaching Across Space, Time and Organizations with Technology, John Wiley and Sons, Inc., New York, 1997.
2. J.F. Nunamaker, "The Case for Virtual Teaming Systems," *IT Pro*, pp. 52-57, Sept/Oct. 1999.
3. M. Mendelson and C. Caswell, "Integrated Product Development in the Classsroom," *ASEE Conference Proceedings*, CD-ROM Publication, 1997. (Session 2563: Teaching Product Design and Manufacturing, June 17, 1997, ASEE Annual Conference, Milwaukee, WI, June 15-18, '97).
4. Web site of Nexprise Co. – https://demo.nexprise.com/.
5. Northrop-Grumman Corp. (El Segundo, CA), grant, developing curriculum in integrated product development, 1996.
6. F. Kiesner, Lemelson Foundation, Grant #73-97, "New Product Development," 1997-99.
7. M. Mendelson and M. Rajai, NCIIA, Lemelson Foundation, Grant #262-99: "Curriculum for Inter-University E-Teams," August 1999 - May 2000.
8. A. Saxenian, Regional Advantage: Culture and Competition in Silicon Valley and Route 128, Harvard University Press, Cambridge, MA, 1996.
9. M.I. Mendelson, "Teaching Factory Approach to Engineering Management Education," *ASEE Conference Proceedings*, 1996. Published on CD-ROM. (Paper was presented in Session 2542 - Innovations in Engineering Management Education on June 25, 1996, Annual ASEE Conference, Washington, D.C., June 23-26, 1996.
10. M. Mendelson, G. Sibeck, M. Rajai, B. Bostick, H. Bostick, "Inter-University E-Teams Working on Joint Products," paper to be presented at 4th Annual National Collegiate Inventors and Innovation Alliance (NCIIA) Conference, Washington, D.C., March 9-11, 2000.
11. Jeff Sheldon (patent attorney), Sheldon & Mak, 225 S. Lake Ave., 9th floor, Pasadena, CA 91101; phone: (626) 795-4000.
12. P.R. Scholtes, The Team Handbook: How to Use Teams to Improve Quality, Joiner Associates Inc., 1988.
13. C. Wellington and J.S. David, "Facilitating Student Control of Group Activities Through Self-Directed Work Groups," *National Collegiate Inventors and Innovators Alliance* (*NCIIA) Conference Proceedings*, Washington D.C., March 11-13, 1999.
14. "E-assembly Lines – How GM and Ford Think Web Can Make Splash on Factory Floor," Wall Street Journal, p. A1, December 3, 1999.

Appendix A: Grading Individuals on a Team

Instructions: Each person should determine the grade of his (her) teammates based on creativity, thoroughness and collaboration. Determine the average score for each person on your team by summing the scores for I, II, III and dividing by 3. Go to the row where your name appears and enter the score for each team member horizontally in the cells. This is to be performed individually without consulting your team members. Please feel free to enter your comments at the bottom of the page.

I. Creativity - Person came up with new and different ideas/concepts throughout the project.

Consistently	5	Seldom	2
Most of the time	4	Never	1
Some of the time	3		

II. Thoroughness - Person completed his (her) assignments and designated tasks with a high degree of detail and accuracy.

Consistently	5	Seldom	2
Most of the time	4	Never	1
Some of the time	3		

III. Collaboration - Person attended team meetings and used ipTeamSuite software to actively communicate his (her) ideas and findings with the team members**.**

Consistently	5	Seldom	2
Most of the time	4	Never	1
Some of the time	3		

Team Member's Score: Walker Team

	Ken	Ben	Bob	Edward	Cynthia
Ken	xxxx				
Ben		xxxx			
Bob			xxxx		
Edward				xxxx	
Cynthia					xxxx

IV. Comments:

Survey B: Potential Product Patentability

Product:_____

1. How unique is the product concept? Circle

5 = Very innovative	3 = Somewhat innovative	1= No innovation

2. How non-obvious is the concept? Circle

5 = Non-obvious	3 = Somewhat obvious	1 = Obvious

3. What is the utility of the concept? Circle

5 = Many uses/markets	3 = Some uses/markets	1 = Few uses/markets

4. What is the patent potential? Circle

High potential	Some potential	Little potential

5. What is your recommendation? Circle

File a patent	Maybe file a patent	Don't file a patent

6. Comments of reviewer: What needs to be done to make it patentable?

I have evaluated the team projects to the best of my knowledge.

Signature: _____ Date: _____
Patent Attorney

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