Industry / University Partnerships: Barriers / Success Factors / Key to Innovation

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Introduction and Overview

Accelerating technological advances, increased competitive pressures, and other environment turbulence have driven U.S. industry to make rapid and pervasive changes to stay competitive in global markets. Industry is now placing similar pressures on universities to re-engineer their programs and produce "industry ready" graduates capable of immediately delivering integrated solutions and facilitating the rapid changes required for competitiveness in the 21st Century.

Six industry CEOs, in an "open letter", stated their belief that "business and academia have a shared responsibility" and recommended collaborative actions including: opening an industry/university dialogue, setting up joint formal relationships, making industry leaders available to universities, communicating industry needs, and reviewing the curriculum. Specifics on "how" were left undefined, and completely open to the imagination and/or creativity of the faculty and industry personnel committed to implementation.

The paper presents "how" these collaborative actions can be enabled and effectively implemented so as to achieve synergistic opportunities and benefits for all involved. To provide a specific context, the Cal Poly dual-degree MS MBA Engineering Management Program (EMP) and the associated EMP Industry/University Partnership are presented as one specific scenario of "how" the collaborative actions can be effectively implemented. The paper covers barriers to success of such programs and to industry/university partnerships, along with the Critical Success Factors (CSFs) based on the seven (7) years of collective experience with the EMP of the co-authors as members of the EMP Faculty Team. Overall, the partnership is key to sustaining challenges to the program and the partnership and to providing the vision, the strategic framework, and the operational foundation through which the CSFs can be achieved, thereby enabling the collaborative innovative educational approach needed to develop the "industry-ready" graduates required in the rapidly changing environment of the future.

Industry Change Requires University Change

Accelerating technological and business change have dramatically impacted the global competitiveness of firms and their ability to manage the increasingly rapid change. The accelerating pace of change, shorter product life cycles, faster competitive product introductions, increasing quality expectations, and an urgency to implement all multiple changes "now" often results in a chaotic change environment.

Success for firms via traditional methods is mostly history! New methods emphasizing highly integrated, cross-disciplinary, fast, and innovative approaches have become critical for sustaining the competitive advantage of firms.

Similarly, success for academic institutions via traditional and narrowly focused disciplines is becoming increasingly obsolete. The MBA degree, traditionally the ticket to fast-track positions in prestigious firms, now frequently is not even a guarantee for getting a job. Now and in the future, it is increasingly clear that universities must change to a new paradigm; a paradigm emphasizing collaboration and integration across engineering/business disciplines and across industrial/academic sectors.

The belief that 'business and academia have a shared responsibility" and the call for collaborative actions by the six CEOs of Fortune 100 firms [1] and responding academic leaders [2] represents one of several similar calls. They recommended six collaborative actions: (1) open a dialogue between academia and industry, (2) create joint formal relationships, (3) conduct collaborate joint seminars, (4) make industry experts available to academia, (5) establish a mutually beneficial research agenda, and (6) open up the university curriculum for change. In another example, a high technology industry executive [3] called for universities to produce "industry ready" graduates, and emphasized that in the future, educational programs and collaborative industry/university partnerships or alliances should have as their primary focus the development of those graduates.

Clearly, new paradigms for educational quality excellence are needed to break the traditional barriers and move toward an integrated educational vision of the 21st Century. However "what" needs to be done is more clear than "how" to do it. Let's look at an example of "how" it can be done.

EMP Partnership Model

One Industry/University Partnership model that enables the collaborative actions and develops "industry ready" graduates is summarized next. (Also see [4], [5].) Cal Poly initiated an innovative MS / MBA Engineering Management Program (EMP) in 1990 and the EMP Partnership in 1992 to integrate the graduate curriculum with the changing industry needs caused by the chaotic change environment. The Program and the Partnership have continuously evolved over the past several years. The "partners" in this Program include the College of Engineering, the College of Business, 15 mostly California-based Industry Partner organizations, and (of course) the EMP students.

The EMP Partnership Mission (depicted in Figure 1 and stated below) was created jointly by all stakeholders and has served well to direct the focus of the program and its partnership.

EMP Partnership Mission

The EMP is a partnership between Cal Poly, industry, and government to create and deliver educational leadership for improving the competitiveness of U.S. industries. The primary purpose of the EMP is to develop high quality graduates who will be facilitators of change and integrators of engineering, business, and people issues.

EMP Partner Organizations

Industry Partners in the EMP Partnership are firms/organizations representing a broad cross-section of manufacturing, information, and service industries. For reference, these organizations include: Andersen Consulting; Frito Lay; Hewlett-Packard; Hitachi America; Hughes-Santa Barbara Research Center; IBM; Intel; Pacific Bell; Pacific Gas & Electric; Silicon Graphics; Sun Microsystems; Tandem Computers; TRW; U.S. Navy; and Xerox. The organizations are highly diverse, yet all are in need of highly integrated and innovative approaches to doing business.

The inclusion of these Partners in the education process has allowed the evolution of several collaborative actions initiated in order to better educate the student and develop him/her into an "industry ready" graduate. Some of these actions include: (1) innovative curriculum changes involving Industry Partner organizations and team-teaching; (2) class visits to Partner companies, (3) representatives, executives and technology experts participating in EMP classes, (4) summer internships at the Partner sites; (5) sponsored Team Projects involving faculty from both the Colleges of Engineering and Business, the industry sponsor/mentor and one or more students; and (6) a comprehensive culminating class conducted as an Executive Seminar Series. The key to the success of the seminars is that all presenters are Industry Partner executives and other company experts, while the knowledgeable audience includes nearly-finished EMP students, faculty, and industry attendees.

EMP Curriculum

The student entering the program has several unique requirements/qualifications including: an undergraduate degree in engineering, work experience, and the ability to score high on both the GMAT and GRE entrance exams so as to be jointly admitted to the Colleges of Engineering and Business. The first year of the program is focused mostly on the required core courses from both Colleges, including a business/technology competitive issues class done in collaboration with Industry Partners and involving EMP class visits to several Industry Partner sites. The second year offers a mix of technical and business electives and team taught classes with industry partners. Many courses have been modified and several new courses created to better serve the needs of the joint Program. Also, the EMP has always received favorable comments for creativity, in particular, during internal and accreditation reviews of the Program. An example course developed specifically for the EMP is described next.

The joint design and development of a two-quarter sequenced course on Integrated Product Development (IPD) was completed recently. The graduate level course was open to EMP, MS in Engineering, and MBA students on an elective basis. The concept was to start from scratch and go from product concept through market introduction over a six-month period. The course was team-taught principally by 2 faculty (1 business and 1 engineering), involved a total of 11 faculty from both Colleges, and during its inaugural year, featured three companies that provided speakers and advisors throughout the course.

For reference, a similar course is taught at Cornell. One primary difference is that the Cornell course is taught over one full semester with the students taking no other courses, and the Cornell course is focused primarily on manufacturing issues.

EMP Summer Internship

Each EMP student is required to complete a summer internship with industry in order to better understand the critical business and technological issues for companies in a rapid change environment. The internship company essentially "hires' the student for a summer job that allows maximum exposure to emerging issues in the organization and on a project encompassing both engineering and business issues. For instance, Andersen Consulting had an EMP student working as part of a "re-engineering" team during the summer internship.

The EMP Faculty Team, the 4 co-authors from both Colleges, visits each company site during the summer to review student activities, to aid in developing the student's final report and to discuss the follow-on Team Project. At the completion of the summer, each student must present a written report to summarize the work experience and to propose a follow-up team project that would be sponsored by the company.

EMP Team Project

The Team Project requires a student to function as a "project manager" in collaboration with an internal "sponsor/mentor" at the company who has agreed to participate and to fund the project. The student selects two faculty advisors (one each from the Colleges of Engineering and Business) to complete the "team". Projects are expected to encompass both business and engineering issues and are designed to be very applications oriented, 6-9 months duration, and allow the student to stay closely involved with the sponsoring company during the second year of the EMP. In one recent example, an EMP student managed the ISO 9000 project activity for a division of a larger organization.

Depending on the nature and scope of the project, the student is typically compensated directly by the company for the work performed, plus a portion of the second year tuition may be covered with these funds. Faculty working on the project team are typically compensated in the form of discretionary professional development funds and/or course release time. Faculty must commit to company site visits during the project duration, plus provide dedicated advising time for the student during the course of the project.

Another variation of the internship/project activity is done by MIT Leaders for Manufacturing. Their projects require the student to be on-site for a period of six months, with monthly visits by a faculty team for collaborative activities. In many cases, the MIT projects are more research focused, are aligned with a longer term research agenda, and are significantly more expensive to the sponsoring firm.

EMP Culminating Seminars

The final element of the Program is a series of seminars usually during the last quarter of the Program. The seminar sessions involve presentations and discussions on current problems and opportunities facing industry, and critical issues for companies in becoming World Class leaders in their industry or sustaining that position. Overall themes, developed with Industry Partners, for these seminars vary each year and in recent years have included: (1) Managing Technology Integration for Success, (2) Managing Technology for Competitive Advantage, (3) Future Directions of Winning Organizations, and (4) Sustaining Global Competitive Advantage. Within these themes, a specific seminars are offered which, for example, have included topics such as: emerging markets; emerging technologies; global emerging markets, information technology; project management, supply chains; technology transfer; and presidents' perspectives.

EMP Continuous Improvement / Future Revisions

The Cal Poly EMP and EMP Partnership activities are constantly being reviewed by students, faculty, and Industry Partners through a series of regular EMP Partner Meetings. Recently, the students created a student association to better integrate the first year and second year students into the program through mentorships, advisement, and informal student/faculty discussions and seminars. In addition, the EMP Faculty Team has collaborated with the EMP student association to possibly offer a rapid prototype "orientation course" designed to better serve the incoming students. The concept is to offer a one-week "boot camp" featuring several short workshops on topics like computer tools, statistics, team development, communications, introduction to campus operations, and overview of EMP Partnership processes. Numerous other continuous improvement revisions can also be expected into the future

Industry/University Partnerships: Barriers to Success

The EMP Industry/University partnership has been key to enabling the innovative and collaborative education achieved in the Program over the past few years. Our experience also makes it clear that the path to collaborative education is not without roadblocks. Numerous barriers have been faced in creating and implementing an integrative program focused on developing "industry ready" graduates that are agents of change and integrators of engineering, business, and people issues. A partial list of these barriers follows.

- **Few Ground Rules** are available to guide the developers of such programs and partnerships. Risk-adverse faculty prefer the tried-and-true, and frequently well-worn, path of traditional approaches.

- **Divergent Perspectives on Focus**. Numerous conflicting viewpoints come forth on what is of critical importance. Thus the relative appropriate emphasis on topics within and across various engineering and business disciplines are not easy to resolve.

- **Risks of Breaking New Ground**. The inherent risk of breaking new ground with new courses and new approaches mean that mistakes and subsequent criticism will occur. Thick skins and tenure armor help.

- **Lack of Faculty Incentives**. There are few incentives for faculty to devote significant attention on such challenging, and sometimes thankless, integrative endeavors. Maintaining the traditional research and courses in their own knowledge specialties is a much easier and more tranquil path.

- **Inadequate Funding**. Incenting faculty for approaches that require significant extra time, and providing extra funding for program development, team teaching, and collaborative activities with industry, are often insufficient or not available.

- **Unavailability of Industry Reps**. Given the down-sized nature of most organizations these days, company representatives as well as faculty are operating on the margin, with each having a very limited time to devote to activities that are above and beyond their primary job.

- **Turf / Boundary Issues.** Some knowledge and skill areas are taught by both the College of Engineering and the College of Business, or by more that one discipline in a college. Thus, conflicts over who is most qualified and should cover what subjects will arise. Be prepared to face conflicts.

- **Tenure Metrics**. Often the measures used to drive an untenured faculty towards attaining tenure (i.e., publications) are not consistent with the requirement for increased collaboration with industry and with faculty outside the untenured faculty's discipline.

- **Critical Colleagues**. Faculty moving in a new direction diverging from that of the past can expect to encounter much criticism from traditional colleagues. Such colleagues may feel jealous or threatened by the new direction, or they may be staunch guardians of the academic status quo.

- **Program Awareness.** Lack of awareness of a new program can hurt from two directions. Building awareness of the program is required to attract highly qualified applicants. Also, companies must have positions to utilize the change agent and integrative roles of graduates.

The above list of barriers is not exhaustive. One item that is NOT a barrier (but may erroneously be cited as one) is accreditation concerns, whether from the College of Engineering or the College of Business. Both ABET and AACSB allow (even encourage) MS and MBA programs to focus on more integrative objectives now than has historically been true in the past.

Industry/University Partnerships: Critical Success Factors

Given the number of significant barriers that can arise when attempting to implement a multi-discipline program requiring joint collaboration with the College of Engineering, the College of Business, and industry organizations, it is not surprising there are few such integrative programs. Also, it should not be surprising that the EMP and the EMP Industry/University Partnership have encountered some difficult challenges since their inception. Several Critical Success Factors

(CSFs) have been identified as being critical for sustained success of the EMP and the EMP Partnership. These CSFs include:

- **Strong University Executive Support.** Strong support by the University President /Chancellor and both Deans (Colleges of Engineering and Business) are all essential. Support is required from all three positions to bridge the gap when a personnel transition occurs in one of the positions, and to emphasize and communicate the importance of integrative educational approaches to resistant faculty.

- **Cohesive Core Faculty Leadership Team**. Having a core team of faculty with representatives from both Colleges is critical. This core team must be cohesive, must speak with a common voice, must have a clear understanding and belief in the importance of cross-disciplinary integrative education, must be immune to the criticism of traditional faculty, must find "can-do" approaches to traditional barriers, must find "can't do" answers unacceptable, and must be persistent in the pursuit of the core team's and Partnership's goals.

- **"Loose-Tight" Controls.** Overall, there must be clarity regarding the focused integrative goals of the joint program and Partnership (i.e., "tight" controls here). Then the core team must be given the maximum freedom possible to work with Industry Partners, to not be too encumbered with academic bureaucracy, and to be allowed to experiment towards achieving the program goals (i.e., "loose" controls here).

- **Sufficient External Funding.** Sufficient funding is a continuing problem and can easily squelch an otherwise great program. People not involved in such an integrative effort find it very difficult to fully recognize the wasted energy and time spent to overcome the resistance to change and the inertia for maintaining the status quo. New courses, team teaching, collaboration with industry, visits to companies, and meetings/seminars with Industry Partner organizations all require an extraordinary amount of time and effort. Funding must be adequate for such needs, or a great idea will die.

- **Active Involvement of Industry Partner Reps.** The active involvement and collaboration with Industry Partner representatives is critically important. Developing "industry ready" graduates requires industry participation. For the EMP, Industry Partner participation has been needed in program development, in student/faculty visits to companies, in team-taught classes, in internships, in team projects, and for the culminating seminars. Such involvement is at the heart of producing "industry ready" graduates, yet such involvement is not always readily available from company representatives, in down-sized organizations.

- **Program Flexibility Driven by Industry Partner Needs.** Developing "industry ready" graduates with the integrative knowledge and skills needed for the rapid change in environment of the future requires flexibility and the freedom to experiment with non-traditional alternatives. For the EMP, we have made liberal use of experimental courses. The focus on the creation and delivery of new non-traditional integrative courses has been to meet one or more needs identified through the EMP Partnership.

- **Early Winning Experiences.** Critical and skeptical colleagues will delight in mistakes made or failures encountered, so the initial changes should focus on changes that are the easiest to implement and are most likely to provide positive outcomes (i.e., maximize early wins). For the EMP, implementing the EMP Executive Seminars was an early win.

- **Multiple Faculty Involvement from Both Colleges.** Increasing faculty support by increasing the number of faculty supporting the program is strongly suggested and can significantly mitigate the impact of the program's critical colleagues. The EMP implemented this idea through the EMP Team Project where students identify one faculty from the College of Engineering and one from the College of Business to advise them on their Team Project course. The faculty selected receive discretionary funding for their involvement.

- **Team Teaching of Select Courses.** Some subjects are naturally integrative and require the background and expertise of faculty from both Colleges. Courses on such subjects should consider a team-teaching approach. For the EMP, the Integrated Product Development Course was the first course identified. Other courses have followed, and still others are in the process of being created.

- **Continuous Improvement Philosophy.** Whatever is implemented, it will not be perfect initially. Feedback in all areas should be obtained from students, faculty, and company representatives involved from their perspectives. Continuous improvement ideas should be implemented as soon as practical after identification.

Although not a CSF for getting started, once an Industry/University Partnership has begun its journey, it must be ready to re-engineer its processes and/or curriculum as needed. In fact, be prepared for needing a major curriculum overhaul, rather than fine tuning. The accelerating change, increasingly technological, and integrated needs environment of the 21st Century will demand continuous changes to university education and will require increasingly collaborative roles between the university and its industry partners/customers.

Final Thoughts

The EMP Industry/University Partnership provides the critical foundation and strategic framework required for the educational model of the future. Also, the Cal Poly EMP Faculty Team has been working with the MIT Leaders for Manufacturing Program and other universities over the past few years to develop the National Coalition for Manufacturing Leadership (NCML) which now represents several universities throughout the United States committed to similar models for graduate education. At this point, there are 10 other universities actively participating in the NCML activities. In addition, there is an effort to encourage industry "partners" to participate in coalition activities. The goal of the coalition is to create a critical mass of graduates to address and facilitate the changes taking place as we embrace the integrative educational model for the 21st Century.

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Biographical Sketches of Authors

Dr's Don White, Ray Haynes, Earl Keller, and Reza Pouraghabagher (the EMP Faculty Team) are all Professors at Cal Poly in the Colleges of Business or Engineering. All have: significant industry experience, extensive cross-disciplinary industry and/or teaching background and experience, all have significant records of scholarly papers in their disciplines, and together recently have collaborated on cross-disciplinary research and publications. They jointly have been working with MIT and other universities in initiating and developing a National Coalition of similar programs around the country.