Partnering for Excellence: Industry/University Programs at Lehigh University’s Enterprise Systems Center

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Abstract

This paper presents the history and evolution of the industry/university partnership at Lehigh University’s Enterprise Systems Center (ESC). Since 1983, the ESC, part of the Department of Industrial and Manufacturing Systems Engineering, has partnered with more than 115 companies to create opportunities for student experiential learning and industry value creation. The partnership has involved more than 1000 students in over 250 industry projects and currently performs $2 to 3 million worth of project work per year. In some cases the Ben Franklin Technology Partners, an economic development organization within the Commonwealth of Pennsylvania, has also been an important partner. The paper reviews the types of projects undertaken and identifies the benefits that each participant gains from the program.

In particular, the paper highlights the use of the ESC’s Learning Collaboratory as a resource to facilitate real-time broadband and web-based interactions between students and industry experts and to bring the industry experience into the classroom setting. The opportunities that industry/university projects provide for technology and information transfer between the university and the private sector are also explained. Included is a review of the development and use of industry case studies and project work as a component of the information and systems engineering curriculum. Finally, the paper considers the next step in the evolution of university/industry interaction – the Enterprise Leadership Program, designed to couple the Information and Systems Engineering degree with intensive, industry-led project experience over the entire four-year period.

Partnership History

Industry/university collaboration has a rich and successful history at Lehigh University. As the needs and requirements of industry have changed over the years, Lehigh’s partnership programs have similarly evolved to meet those needs. Lehigh’s Enterprise System Center (ESC) is an excellent example of these mutually beneficial relationships.

The roots of the ESC, a part of the Department of Industrial and Manufacturing Systems Engineering, can be found in the industry/university interactions of the Computer-Aided Manufacturing Laboratory of the mid-seventies and, more intensively, of the Computer-
Integrated Manufacturing Laboratory (CIM Lab), beginning in 1983. In a deliberate effort to provide Lehigh students with valuable real-world experience, the CIM Lab leadership actively cultivated industry partners interested in realizing the benefits of a university relationship. Early, critical support for the CIM Lab came from IBM Corporation, which created a two-way exchange of technology and research, including seminars for IBM personnel and support for research by Lehigh graduate students.

Another important partner in establishing industry/university interactions has been the Ben Franklin Technology Partners (BFTP), an economic development organization within the Commonwealth of Pennsylvania focused on providing technological support to start-up companies and small and mid-sized Pennsylvania manufacturers. Beginning in 1983, the ESC (then the CIM Lab) became the primary resource utilized by BFTP to supply critical manufacturing expertise to its industrial clients.

In 1995, driven by industry and research needs to seek performance improvements beyond the traditional manufacturing domain, the CIM Lab expanded its mission to encompass the entire enterprise, becoming the ESC. This multi-disciplinary center is committed to fusing student experiential learning with industry value creation. Its resources include faculty, graduate and undergraduate students, engineering and consulting professionals, and industry experts and executives.

Representative Projects

The ESC has partnered with more than 115 companies in over 250 industry projects. Typically ESC and company personnel develop a project plan that falls into one of three categories:

- Operational Improvements
- Enterprise Resource Integration
- Product Development and Enhancement

Within these broad categories, project content has included strategic manufacturing support, development of decision support systems, work-flow analysis and facility reorganization, constraint analysis and throughput improvement, manufacturing process improvement, supply chain management, business process re-engineering, creation of performance measurement systems, analysis and selection of Enterprise Resource Planning (ERP) systems, evaluation and improvement of existing products, new product development and concurrent engineering support, integrated product development using advanced computer modeling and simulation, and design for manufacturing and assembly support. Cross-functional teams are configured to work a specific technical thrust area for each project.

The following paragraphs describe representative projects completed through the ESC's industry/university collaboration. Specific project content information is provided so that the reader can understand better how these projects are structured.

At Day-Timers, a major printing company, advanced simulation techniques were applied to design and implement a cellular manufacturing system for products customized for individual
customers. Savings of $100,000 in capital costs, $300,000 to $500,000 in annual operating costs and $2,000,000 in reduced work-in-progress inventory were achieved.

An ongoing project with the Pennsylvania Department of Transportation (PennDOT) has the objective of implementing agility principles in a governmental organization. Project work has focused on the highway maintenance sector of PennDOT’s business. Teams of PennDOT employees, ESC students, and consultants have identified areas for cooperation in virtual partnerships, leveraging of people, information, and technology, mastering change and uncertainty, and enriching the customer. This work has resulted in more than 600 agility partnerships with stakeholders in fifty counties. Savings resulting from this and other initiatives within the Departments were recently reported as nearly $6,000,000 by Pennsylvania Governor Tom Ridge.

A three-year project with Kraft Foods involved developing a strategic plan based upon agility principles. This effort led to operational projects in the areas of changeover reduction, economical batch size, layout, productivity improvement, rework reduction, staff planning, and material handling/storage/inventory. In aggregate, these initiatives have yielded annual savings in excess of $1 million. These projects provided project experience for 31 undergraduate/masters degree students and the technical problem basis for one Ph.D. thesis.

A large customized precision sheet metal fabricator needed to re-engineer numerous business processes in order to implement a new ERP system. Results of the project included revamping order administration, developing new algorithms for production planning and job order scheduling, implementing inventory management and quality procedures, and collecting real-time production data to aid in work scheduling and costing. The dollar impact was savings of $400,000 - $500,000 per year.

A manufacturer of precision extruded aluminum parts sought to optimize and modernize its material flow and packaging. Working with ESC engineers and students, the company reduced double handling of material between the anodizing and packaging departments and increased the throughput in anodizing by packaging material directly off the anodizing racks. In a second area, analysis of the flow, productivity, processes and materials utilization in the packaging function yielded solutions to improve packaging throughput and lower overall packaging costs. A third project component undertook a comprehensive review of overall logistics practices in order to streamline the outbound freight process.

A meat processor and meat products manufacturer undertook a multi-year project with the ESC to evaluate a new product line that represents a major growth opportunity for the company. This effort was designed to identify short-term improvement opportunities for the present operation while assisting the company in developing a detailed strategic plan. Fifty-two different current products were process mapped and an As-Is condition scenario developed. Improvements were made to the current operations by analyzing the As-Is situation, identifying appropriate changes, and assisting company personnel in implementing the changes. Concurrently, work was conducted with the sales and marketing organizations to determine three to five year product requirements. A gap analysis conducted between these needs and the current operational

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capabilities served as the basis for developing short-term and long-term operational/strategic plans.

A provider of unique management information software to the property and casualty insurance industry created a partnership with ESC students and personnel to speed the delivery of their product to market. The project focused on the need to web-enable the client version of their newest release, achieve ISO 9000 certification for the product and defend the company’s patent application. Earlier company/ESC interactions included extensive student involvement in actual development of the product.

These projects provide a small sample of the range of industry/university collaborative projects undertaken by the ESC in the past fifteen years.

**Benefits to Partners**

The ESC’s industry/university partnerships provide benefits to the corporate partners, the university and students. Companies involved in these industry/university partnerships benefit in a number of ways. They receive expert assistance at competitive rates, particularly those involved in BFTP projects where the Commonwealth provides a 100% match for company funds. Companies are exposed to the latest technical innovations and developments coupled with evolving best business practices. In those situations, companies have the opportunity to “try before they buy”, testing new technologies or philosophies before investing in them.

The availability of ESC project personnel as an “extra pair of hands” often permits companies to tackle issues that would normally be set aside because of the pressure to run the business on a day-to-day basis. In addition, the involvement of outside observers often leads to fresh perspectives and innovative viewpoints. This is especially helpful in areas such as process improvement.

Many of the projects include some component of training and education. Partnership with a university gives the company access to the highest level of education as well as access to information services, databases and libraries, and, in an environment like the ESC, multidisciplinary assistance.

Another often-overlooked benefit to companies is an inside track to the pool of prospective employees. Companies have the opportunity to meet and analyze potential employees as well as offer them employment before they enter the general employment pool. This gives partner companies a first shot at “the brightest and best”.

For universities, the benefits of industry/university partnerships are also substantial. Industry projects keep university personnel up-to-date on the current state of industry. This knowledge can then be incorporated into the curriculum, keeping engineering courses timely. In addition, research areas can be focused to complement evolving industry needs. Industry projects also provide a real-world test bed for new hypotheses, philosophies, and technologies in different sectors of both private and public organizations.

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For students, industry/university interactions provide exposure to real world learning environments. Students develop valuable business and leadership skills through their involvement in actual shop-floor activities and project management. Their problem-solving skills are also challenged as they grapple with the issues of real companies making real products for (hopefully) real profits. In addition, students have the opportunity as members of cross-disciplinary teams to draw on the expertise of individuals from different fields of study. These skills and specific knowledge enhance the student’s value in the marketplace.

Extending the Value

Although the ESC’s industry/university partnerships have been very successful over the past eighteen years, ESC leadership has sought to extend the value of those partnerships through the development and application of a variety of new technologies to the educational process. These include the creation of the ESC’s learning Collaboratory, the development of case studies, and the integration of project content with engineering curriculum.

ESC Learning Collaboratory

The ESC Learning Collaboratory provides the means to link university students directly to industry project personnel and environments through the use of asynchronous and synchronous multimedia communication. Collaboratory participants can take advantage of powerful communication methods such as broadband exchanges, Internet conferences, and digital real-time linkages, as well as electronic management of information. For example, students in the ESC’s Collaboratory can observe shop-floor processes and communicate in real-time with company personnel to better understand the problem under discussion. They can simultaneously view the same documentation being used by managers to make production decisions. Industry leaders can be brought into the classroom through video teleconferencing facilities to interact with students, allowing for more extensive interchange of ideas and information. In addition, IMSE seniors utilize Collaboratory facilities to prepare and present their culminating project. These presentations are enhanced by visual images from the company illustrative of the problem that the student sought to solve. Preparation of these presentations also enhances the student’s communication skills.

The Collaboratory also provides the capability to deliver education beyond the walls of the university. In its long-term partnership with the Focus:HOPE program in Detroit, the ESC has implemented the use of multimedia in the classroom. Learning modules developed by the ESC are taught from the Collaboratory via V-TEL connection to the students in Focus:HOPE’s learning factory in Detroit. These modules also contain computer-generated programs that allow for access to additional information, explanations and help screens. In this instance, manufacturing industries have combined with six universities and Focus:HOPE under the auspices of the National Science Foundation to deliver academic curriculum and practical knowledge of machining to a targeted audience. The goal is to create a skilled workforce to meet the needs of the manufacturing industries involved.

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Case Studies

One of the drawbacks to the traditional industry/university collaboration is the inability to capture the valuable learnings from successful projects for use in other educational settings. There is a practical limit to the number of students that can be engaged in any one project. Likewise, not all projects are uniformly successful. But in many cases, project content and the resolution of problems encountered in project completion could provide useful educational material across a variety of disciplines. Because of this, the ESC has initiated the development of multimedia case studies that focus on particular project topics or problem resolutions. The goal is to create resources that can then be incorporated into different educational formats.

For example, a recent industry/university project involved a company that manufactures a specialty type of furniture. Because of the price sensitive nature of its market, the manufacturer sought out the ESC’s help in improving the manufacturability of their product and the productivity of their production lines. A case study based on such a project could focus on design issues, reducing part costs, and increasing production line efficiency for use in an engineering curriculum. It could also, however, include information regarding make vs. buy decisions or product pricing that would make the same case study useable for accounting or marketing classes. Multimedia case studies provided on CD-ROM or through the Web would also contain visual information regarding the processes involved, the manufacturing environment, and the product being produced. These case studies enhanced with real-world information provide a more complete and intensive educational experience. In addition, cross-disciplinary teams of students have the opportunity to work together to develop possible resolutions to the problems identified.

Multimedia case studies also provide the opportunity to capture previous company project work for future application. While printed materials and static pictures have always been available for these purposes, these enhanced case studies provide dynamic images of both problems and solutions. An effective knowledge management system would then provide access to these past solutions for consideration of current problems.

The Enterprise Systems Leadership Program (ESLP)

The ESC’s most recent step in extending the value of industry/university collaboration is the Enterprise Systems Leadership Program, currently under development. Created as a further enrichment to Lehigh University’s new Information and Systems Engineering (I&SE) degree, the program is designed to provide an opportunity for the very finest high school engineering students to work on and lead systems improvement projects with a diverse cross section of U.S. and international corporations over the course of the four-year I&SE degree.

As part of the program, world-class faculty and industry experts will provide education that focuses on the bottom-line improvement of enterprise systems. The challenging I & SE curriculum will be augmented with hands-on design and implementation of projects throughout the entire four-year program. Each project will be measured on its return-on-investment (ROI) business result. Students will receive on-going faculty/industry-expert mentoring as they learn to

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make real, up-to-date systems improvements. Business executives will present the latest developments and key trends in systems.

An additional feature of the program will be field trips to leading industry and business organizations directly examining today’s largest information technology driven systems challenges, as well as the opportunity for numerous relevant paid internships.

The ultimate goal of the Enterprise Systems Leadership Program is to graduate students with highly valued executive leadership skills and competencies, including self-knowledge and the ability to work well with others, the confidence to lead change, the ability to identify and solve unstructured problems, and the proven ability to design, build and implement high value-added systems.

Summary

Lehigh’s Enterprise Systems Center has fostered a successful, ongoing relationship with industry for more than fifteen years. From that experience, the authors believe there are several factors that can be identified as contributing to the program’s success. First, the ESC has been deliberately committed to meeting the needs and requirements of industry. This has required staying current with technology developments and evolving business trends. In addition, ESC/industry projects have been highly focused on areas that can provide significant value-add for industry partners. These areas—operational improvements, enterprise resource integration, and product development and enhancement—deliver results that are clearly measurable and attractive to participating companies.

Another factor in the ESC’s success seems to be the ability first to visualize and then to articulate the project benefits for each partner. Project deliverables are clearly identified and partner expectations are proportional to the work undertaken. This helps avoid dissatisfaction on the part of the industry partner and an unwillingness to consider future collaborative efforts, a common shortcoming of industry/university interactions that are poorly defined.

To move industry/university partnerships to the next level, the ESC has undertaken the development of a learning collaboratory, helping companies by incorporating technology enablers into projects. These tools permit real-time interactions between ESC personnel and students and industry partners without incurring excessive travel costs. Concurrent with the evolving technology of the Collaboratory is the creation of multimedia case studies to communicate project learnings to both industry personnel and students. Finally, the Enterprise Systems Leadership Program provides an additional opportunity for industry/university interaction and integration.

The ESC continues to explore new ways to put the fruits of its industry/university relationships to broader use both to improve its services to industry and to enhance its educational offerings to its students. The authors hope that the description of the ESC model can provide useful information to those seeking to implement an industry/university collaborative program.

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