

Establishing a B.S. Degree Program in Mechanical Engineering in Partnership with Industry: A Case Study

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Abstract

The creation of a new baccalaureate degree program in mechanical engineering at York College of Pennsylvania took place with the guidance and input provided by an industrial partnership of over 20 local and regional industrial organizations. Initial start-up contributions amounting to \$400,000, along with approximately \$45,000 provided annually by industry, has resulted in the establishment of state-of-the-art laboratory facilities as well as partial scholarship support for students in the program. The program had its first class of students enter in fall 1995 and currently consists of approximately 100 students majoring in mechanical engineering. The ABET evaluation visit under EC2000 occurred in September 1999 and resulted in accreditation of the program. Designing a new engineering curriculum—in concert with industrial partners—within the broad context of a private, moderately sized, comprehensive college posed many challenges. This presentation will review these challenges, the process used for establishing a new program in mechanical engineering, and the role industry has played in developing and supporting the program.

I. Introduction

The purpose of this paper is to provide a set of guidelines and suggestions for developing and maintaining partnerships between industry and academic programs in engineering. These guidelines are based on the recent experience by the author in developing a mechanical engineering program at a non-technical, comprehensive college with the cooperation of regional industrial organizations. Although the process described here was the result of a “clean slate” approach to developing and implementing a new engineering program, most if not all of the challenges that were faced can certainly apply to existing programs, particularly those facing critical issues such as declining enrollments and curriculum overhaul.

II. Historical Background

Tracing its institutional lineage to the York County Academy founded in 1787, York College of Pennsylvania is today an independent, comprehensive, predominantly undergraduate college of moderate size with nearly 4000 full-time and over 1300 part-time students. Situated in the Susquehanna Valley region of South Central Pennsylvania, the College occupies over 110 acres in suburban York County, an area rich in diversified technology and manufacturing. Over 80 degree programs are offered in arts and humanities, music, social and behavioral sciences, natural and physical sciences, foreign studies, business, education, nursing, and engineering.

The last of these programs began with its inaugural freshman class of mechanical engineering majors in 1995.

The process of developing the engineering major began in 1991 with the arrival of the College's new President, Dr. George Waldner. Under his direction, a systematic and broadly participatory strategic planning process was undertaken, the result of which was a five-year strategic plan to commence in 1992. One of the goals of the newly adopted plan was to "determine whether York College should extend its current associate degree program in engineering to the bachelor's degree level...with an institutional decision no later than the end of 1993-94 academic year...."

Two projects were initiated to accomplish this goal. First, engineering educational consultants were retained to survey the college's academic structure and prepare recommendations regarding the addition of a bachelor's degree engineering program. Second, the president and board of trustees would ascertain the extent of interest and financial support available from regional firms to underwrite the initial capital costs and continuing equipment needs of such a program at York College.

The first of these projects began in early 1992 with a meeting at York College with the engineering dean of a neighboring university to explore the feasibility of initiating a four-year engineering program. This meeting was informative and resulted in the recommendation that mechanical engineering be the first four-year engineering program to be offered. This was followed by the invitation of a consulting mechanical engineering department head from a program in a neighboring state to visit the college and prepare a recommendation specific to initiating a program in mechanical engineering at York College. The consultant presented his final report in November 1992. Among the suggestions provided by the consultant was a recommendation for the development of laboratory facilities, primarily in the solid-body mechanics and thermo-fluid sciences areas. He suggested a cost range for these laboratories of between \$300,000 and \$400,000.

With the report in hand, President Waldner and a subcommittee of the board of trustees began a systematic effort to develop the recommended financial base of support for engineering at York College. In early 1993 an Industry Advisory Council (IAC) was chartered to guide the development of the program and help raise \$400,000 needed to establish the laboratories described in the consultant's report. The IAC was led by an executive committee made up of three trustees of the college. The committee was chaired by Mr. Robert N. Pokelwaldt, who at that time was Chairman and CEO of the York International Corporation.

III. Partnership with Industry—Phase I: Establishing the Relationship

A. The Industry Advisory Council (IAC)

Together with administration and faculty, the three-member IAC executive committee prepared a prospectus for the Bachelor of Science Degree in Mechanical Engineering at York College, which was distributed to a number of presidents and CEOs of industry in the York region. In August 1993 the IAC Chairman, Mr. Pokelwaldt, sent letters to his fellow corporate CEOs

soliciting financial support and membership in the IAC. These letters described “...*the development of a mechanical engineering major that will emphasize:*

- (1) *well-rounded graduates;*
- (2) *a program component of practicum or “hands-on” learning in actual industrial settings;*
- (3) *a longer instructional period than the typical eight-semester bachelor’s degree program; and*
- (4) *a program-design process conducted via one-on-one and group consultations between the York College Engineering Program Coordinator and members of the Industry Advisory Council.”*

By the end of 1993 a total of \$230,000 toward the goal of \$400,000 had been received from companies comprising the IAC membership. By mid 1994 all \$400,000 would be pledged by the 19 regional industrial organizations who belonged to the IAC at that time. Membership of the IAC consisted of (as it does today) representatives of regional industry who are CEOs, vice presidents of engineering, engineering managers, and human resources representatives.

In January 1994 a national search to hire an Engineering Program Coordinator was begun and in July 1994 the position was filled with the arrival of Dr. Paul H. Wojciechowski, formerly Associate Professor of Mechanical Engineering at the Rochester Institute of Technology.

In the first weeks after his arrival, Dr. Wojciechowski prepared an engineering program planning document entitled *MECHANICAL ENGINEERING AT YORK COLLEGE OF PENNSYLVANIA—Vision Statement, Strategic Overview and Implementation Plan, July 1994*. Input to this plan was provided by many sources including York College faculty and administration, ABET accreditation documents, engineering educational literature, consultation with colleagues, review of mechanical engineering programs across the country, and, in particular, meetings with the presidents, CEOs, and/or chief engineering officers of nearly all IAC member organizations.

Since the development of engineering at York College was the result of direct involvement with, and support of, regional industry and business, it was deemed particularly important to obtain and evaluate feedback from these companies, and to implement this information in formulating the engineering curriculum. Throughout these meetings, a few key words and phrases repeatedly emerged:

- technical competence
- curriculum relevance
- communication skills
- hands-on learning
- practicum and experiential learning
- team skills and orientation
- high academic standards
- broad-based knowledge
- business sense
- ability to design

The result of this direct input, as well as of the focus on the four program-emphasis items (given above) delineated in the Pokelwaldt letter, was the development of an engineering program—consisting of 12 educational objectives, a program philosophy, and a program mission statement—the creation of which was literally guided by the IAC. (A definition of these items along with a complete description of the engineering program including IAC membership and co-op program information can be found on the York College Web site.¹) The effect of this process was to provide the IAC membership with a sense of ownership of the newly formed program and stewardship of its ongoing operation. This continues to this day through several venues including quarterly luncheon meetings with faculty, students and IAC industrial representatives, and the co-op process. (These and other interactions are enumerated later in this paper.)

B. Industrial Curriculum Advisory Board (ICAB)

Within three years of the start of the engineering program, an additional industrial advisory group was formed by the program coordinator for the purpose of working more closely with him and the faculty in areas directly related to curricular issues. This body, an outgrowth of the IAC and complementary to it, consists of a small working group of engineers and engineering managers—active in their fields—who advise the Program Coordinator and help maintain a relevant focus for the engineering program. The group is called the Industrial Curriculum Advisory Board (ICAB).

The ICAB, which meets on a regular basis with the Program Coordinator, provides a venue for direct, two-way, working-level involvement of industry with the YCP engineering program. The ICAB mission is to work with the head of the engineering program—and to bring to bear an industrial perspective—to accomplish the following:

- Provide input in formulating the mission, goals, and objectives of the York College engineering program.
- Provide input related to curriculum structure, course content, and classroom and laboratory needs for the purpose of maintaining program relevancy and focus.
- Assist in determining appropriate outcomes (and their measures) required to achieve program objectives.
- Help assess program outcomes from an industrial point of view and assist with the use of these assessments in the continuous improvement of the program.
- Assume, as needs arise, a proactive role in proposing new engineering programs—as well as alternatives to existing ones—for the purpose of both improving and expanding the base of engineering and engineering education in the York region.

Since receiving its charter in June 1998, the ICAB has assisted greatly in the above areas. One of its major contributions was the delineation of appropriate outcomes (and their measures) for the program required to achieve our educational objectives. This process was completed in February 1999, and was an important factor in the successful outcome of the EC2000 ABET accreditation evaluation visit that took place in September 1999.

C. Developing a Program in Mechanical Engineering in Concert with the IAC

Establishing any new academic program requires a broad view and an open mind by the director or coordinator of the program. The first step is to identify and accurately define the challenges that exist, and must be met and overcome. Input from numerous resources is an absolute necessity. These resources include the faculty, administration, and trustees of the institution; one's network of colleagues from past experiences; access to similar programs at other institutions (by either descriptive materials, Internet, or actual visits) as well as candid discussions with the heads of these programs; marketing research data; and above all, open and active communications with industrial constituents including both IAC and non-IAC representatives, and potential employers. This last group is invaluable in helping to establish program philosophy, which directly determines the program mission. It is important to point out that the use of a committee and the method of consensus in this process is not recommended.

D. Identifying the Challenges: A Ten-Point Primer

In establishing the engineering program at York College, ten challenges were identified, articulated, and shared with the stakeholders. Once this was accomplished, the task of developing the program philosophy and mission, and implementing its initial steps was made much easier. These challenges are highlighted here:

1. **Fear abatement.** For many, change at any institution can be somewhat uncomfortable and/or disruptive. Others may have a sense of fear—either perceived or real—that the impending change may somehow have a deleterious effect on their work and well-being, and on the institution as a whole. Among the first steps to be taken by the program director is a “walk about” within the institution to introduce himself/herself and openly discuss the issues concerning the development of the new program. At issue here is fear abatement and, in most instances, the remedy is candor. An understanding of, and sensitivity to, the issues related to “imposing” an engineering program in what is understood by many to be a liberal arts college is imperative.
2. **Know Thy Constituency.** The director should identify and communicate with constituents, understand their needs, and discuss with them, their perceptions of the new program. He/she should articulate his/her plans and use the constituents as sounding boards for examining and working out program details. Regular communication is essential in this regard.
3. **Budget Planning.** A budget plan for capital expenses over a set number of years should be developed and adhered to. For our program, the initial two-lab, \$400,000 budget suggested by the consultant was expanded by the program coordinator into a nine-lab¹, \$1,000,000 budget to be allocated over a five-year period. To help meet the increased expenses imposed by the additional laboratories, IAC members were asked to provide annual contributions based on the size of their operation. An annual amount of approximately \$45,000 from 22 IAC organizations (averaging about \$2000 per organization per year) has been used to continue funding laboratory development and scholarships for engineering students.
4. **Early Involvement with ABET.** Early, nonbinding communication with ABET for the purpose of obtaining useful guidance in the creation of new programs, or the revision of existing ones, should be explored. Mutually beneficial results might be derived from early

- discussions with ABET and/or attendance at one or more annual meetings, such as EAC Day.
5. **Curriculum.** Curriculum must be developed to reflect the program philosophy and mission. Two essential ingredients are (i) a thorough process of “benchmarking” with similar programs at other institutions, and (ii) close interaction with industrial constituencies.
 6. **Student Recruitment.** The challenge of recruiting students to a program that exists only on paper requires a great deal of inventiveness, individual hard work, and help from the institution, particularly the Office of Admissions. The director should meet personally and often with the admissions staff to articulate the program in as many ways as necessary. A large mailing campaign with appropriate literature should be conducted by the institution. In addition, the director should work closely with the Office of Public Relations in generating program visibility, hold open houses for prospective students, invite high school guidance counselors to meetings at which the program is presented, and be prepared to make numerous on-site personal visits to high schools and two-year colleges.
 7. **Faculty Recruitment.** National searches should be conducted to build a faculty diverse in rank. Involvement of the IAC in this process—before, during, and after a faculty position has been filled—is strongly recommended.
 8. **Facility Development.** This is an area in which an IAC can interact strongly with a program. In many instances, companies are eager to provide an assortment of equipment used for research, testing and manufacturing of their products. Particular attention should be paid to organizations that are being sold or downsized. The appointment of a laboratory-development coordinator is important in this regard. He/she should be discriminating in terms of what equipment will be important and useful to the program and what equipment will ultimately be useless.
 9. **Experiential Component—Co-op.** Of the four program elements delineated (see above) in the Pokelwaldt letter, item (2), the experiential component is arguably the most significant. At York College, this has been addressed in the form of a one-year co-op requirement in semester blocks alternating with academic semesters. Students may complete their engineering degree requirements in four years including summer semesters.² Co-op occurs for sophomores during the summer semester, for juniors during the spring semester, and for seniors during the fall semester. Students complete their senior year of engineering study during the spring and summer of their fourth year. The co-op work experience is the keystone of engineering education in that it connects engineering students, faculty and engineering mentors in real-world engineering practice. In addition to the initial challenge of developing relationships with potential employers of co-op students, a greater one has been maintaining the three-semester per year balance of supply and demand of students for co-op employment.
 10. **Career Services.** For new programs in engineering, the institution’s Office of Career Services (OCS) needs considerable lead time to develop an understanding of the culture and issues related to providing engineering graduates with effective assistance in securing engineering employment. In this regard, regular communication should occur between the program director and the OCS staff. In addition, significant effort is required on the part of the OCS in attracting corporate recruiters of engineering graduates. For the students, contact with the OCS should begin early in their college career. These interactions occur naturally and are greatly facilitated when co-op is involved.

IV. Partnership with Industry—Phase II: Maintaining and Growing the Relationship

Once the initial phase of program development and implementation is completed, a new phase begins that is characterized by several new activities including (i) minor modifications to the curriculum, (ii) continuous development of the laboratory facilities, albeit at a slower pace, (iii) expansion of the number of course/lab sections and the number of faculty to accommodate increased enrollment, and (iv) development of the industrial partnerships to include a greater balance of benefits for the industrial partner. The remainder of this paper focuses on the last of these items.

Obviously, during the development (or revision) phase of an academic program, the benefits derived from the industrial partnership proceed virtually in one direction—to the academic program. The words that were used, in part, to develop IAC membership for the program described here, promised that membership in the IAC would help “...contribute to the advancement and growth of technology throughout South Central Pennsylvania through support of a locally based program in engineering education.” This is a fine ideal for local industrial organizations and may provide a warm feeling on their part. However, there is a reality that is sometimes missed on the part of the academic institution. Simply stated, that reality is the fact that industrial partners expect to derive more than a “warm feeling” in their interaction with the engineering program of a given institution. To be more specific, the institution must attempt to view and understand the partnership from the perspective of the industrial partner, and proceed with that view in mind. This is the point where Phase II begins, and the basic question is, what benefits can the industrial partners derive from this association?

The response to that question by the program described here includes a number of policy items that are considered to be benefits of membership in the York College IAC. First and primary among these is:

- 1. Input to the engineering curriculum.** Members of the IAC advise the York College engineering faculty on course offerings, student design projects, and the co-op program. In this way members of the IAC have significant input to the evolution and improvement of the York engineering program and help align the curriculum with the industrial operations in this region. For local industry hiring graduates of the program, the result is better prepared candidates with greater potential for stable, long-term employment.

Other benefits include:

- 2. Priority access to engineering co-op students and graduates.** IAC members get first access to a proprietary book of student resumes and, therefore, the first opportunity to hire co-op students and our graduates. In a tight job market this is an important advantage. Co-op placements are supervised by members of the York engineering faculty through on-site visits. This creates another powerful link between the participating companies and the engineering program.

3. **First opportunity to sponsor student design projects.** These projects involve student design teams solving real-world problems under the guidance of a faculty advisor and mentoring engineer(s) for the sponsoring company. IAC members are not charged any additional fees (beyond the modest annual assessment), but only pay direct expenses for each project. Several IAC member companies already have sponsored successful and valuable projects.
4. **Direct access to engineering faculty.** Faculty participate with IAC members on a broad range of professional activities such as research projects, consulting, professional society functions, and the design of specialized courses.
5. **Access to a peer network of outstanding technical and managerial talent.** IAC members gain from meeting with both York College engineering faculty and other company representatives on the Council. Through regularly scheduled luncheons and other “neutral” venues, IAC representatives can meet and discuss both technical issues and business operations.
6. **Access to York College engineering facilities.** York College has sophisticated and advanced engineering laboratories and test facilities that are available to IAC members.
7. **Access to York College library resources.** The increased holdings on engineering and technology are particularly useful. All IAC members have Internet access through York College.

V. Current Status of the Program and Future Plans

The York College Mechanical Engineering Program¹ consists of 151 semester credits: 17 credits of Common Core Requirements, 24 credits of Area Distribution Requirements, 26 credits of Science and Mathematics, and 84 credits of engineering topics, seven of which are co-op and co-op related. The current program enrollment is approximately 100 undergraduate students; there is no graduate program yet in place. Twenty-two mechanical engineering freshmen entered the program in Fall 1995. Of those, a total of 14 have completed their degree requirements--the first ten having finished in August 1999. Faculty size in 1995 was one (this author) and currently stands at five. The ABET accreditation-evaluation team visit took place in September 1999, and in August 2000, notification of EC2000 accreditation was received. It is anticipated that additional engineering programs will be developed, beginning perhaps with electrical and computer engineering.

VI. Conclusions

In this paper, the process of establishing a new program in mechanical engineering at a comprehensive college with the cooperation and guidance of an IAC, has been presented and analyzed. Two phases of IAC interaction have been discussed: program development and implementation in which the IAC serves to help support the initial stages of program start-up, and a second phase in which the program serves to help its IAC constituents by providing a well-

rounded, technically competent pool of graduates. It is hoped that the lessons learned and treated in this paper may be useful to others embarking on similar projects.

REFERENCES

1. URL: www.ycp.edu. Information under Departments, Mechanical Engineering
2. *Ibid.* Information under Departments, Mechanical Engineering, Suggested Course Sequence.

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Since 1994, Dr. Paul Wojciechowski has been Professor and Program Coordinator of the Mechanical Engineering Program at York College of Pennsylvania. Dr. Wojciechowski received his BSME (1965), MSME (1967), and PhD (1971) in Mechanical and Aerospace Sciences, all from the University of Rochester. Dr. Wojciechowski's professional experience includes 16 years on the mechanical engineering faculty at the Rochester Institute of Technology where he received the Eisenhart Award for Outstanding Teaching. His other experience includes eight years in industry and one year at NIST and NASA. Dr. Wojciechowski is principal architect of the York College engineering program, which was created in 1994-95. Its first freshman class entered in fall 1995 and graduated in August 1999. It has a one-year co-op requirement and has a close association with local industry. The program is ABET accredited under EC2000. Dr. Wojciechowski's research interests include thermo/fluids system design, alternative energy sources, system dynamics and control, and thin films.