Developing Highly Effective Industry Partnerships: Co-op to Capstone Courses

Chris Plouff
Assistant Director
Assistant Professor & Sebastian Chair
School of Engineering
Today’s Objectives

• What does a highly effective partnership look like?
• Mature internship / co-op programs
• Assessment of programs
• Added academic content during internships/co-op
• Industry-based projects in courses
• Putting it all together

ASQ Advancing the STEM Agenda Conference
June 3, 2013
ABET Linkages
Why Industry Involvement is Important

- Students must be prepared for engineering practice through a curriculum culminating in a major design experience incorporating appropriate engineering standards and multiple realistic constraints.

- There must be sufficient faculty to accommodate adequate levels of student-faculty interaction, student advising and counseling, university service activities, professional development, and interactions with industrial and professional practitioners, as well as employers of students.
Highly Effective Partnerships

• Accomplish work together that would be difficult or impossible to accomplish alone – define clear mutual benefits

• Build a shared sense of commitment and responsibility

• Offer opportunities for people to learn from each other and share resources

National Service-Learning Clearinghouse (2008)
Guidelines for Highly Effective Partnerships

- Make sure everyone shares a commitment to a common vision – goals and objectives
- Be sensitive to the needs, styles, and limitations of other collaborators
- Involve people at all levels
- Maintain frequent and open communication
- Be sure everyone understands expectations

National Service-Learning Clearinghouse (2008)

ASQ Advancing the STEM Agenda Conference
June 3, 2013
Characteristics of Effective Partnerships

- Commitment
- Relationships
- Trust
- Willingness to share
- Needs, wants and desires
- Constant and clear communication
- Ongoing assessment

National Center for Media Engagement (2010)
Types/Options

- Summer jobs
- Apprenticeships
- Part-time / Full-time
- Internships
- Co-ops
- Projects
Company – Student Work Relationships

Considerations:
• part-time, full-time
• length of time (short-term, semester, year-long)
• co-op (parallel, alternating)
• projects (workplace, course-based)
• paid, unpaid
• credit-bearing, noncredit-bearing
• location
• one consistent role, rotating roles
Engineering Co-op at GVSU

• Mandatory co-op
• 5 engineering programs: computer, electrical, interdisciplinary, mechanical, product design & manufacturing
• Secondary admission
• Three semesters of full-time work with the same organization
### GVSU Engineering Co-op Program

<table>
<thead>
<tr>
<th>Year</th>
<th>Fall (Sept - Dec)</th>
<th>Winter (Jan - April)</th>
<th>Spring/Summer (May - Aug)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009/2010:</td>
<td>Foundational Courses</td>
<td>Foundational Courses</td>
<td>Open</td>
</tr>
<tr>
<td>2010/2011:</td>
<td>Foundational Courses</td>
<td>Foundational Courses</td>
<td>Co-op I</td>
</tr>
<tr>
<td>2011/2012:</td>
<td>Major Courses</td>
<td>Co-op II</td>
<td>Major Courses</td>
</tr>
<tr>
<td>2012/2013:</td>
<td>Co-op III</td>
<td>Major Courses</td>
<td>Major Courses</td>
</tr>
</tbody>
</table>

ASQ Advancing the STEM Agenda Conference  
June 3, 2013
Engineering Co-op at GVSU

- 3 credits per co-op semester
- 10 total credits including co-op prep course
- Faculty assigned as advisers and evaluators
Focus on internship/co-ops and projects

In groups of three or four:

Come up with criteria of what will / what will not create an effective partnership between company - student - school/university
Mature Internship and Co-op Programs

“Effective Relationships”

• Regular, on-going communication
• Knowledge of needs and expectations shared by all, and at multiple levels of the organization
• Benefits to all parties clearly understood
• Jointly assess the status/progress
Mature Internship and Co-op Programs

“Effective Relationships”

• What does this look like?

• Research project on effective co-op experiences
What is Socialization?

- Transition from classroom to workplace involves socialization to an organization and occupational roles
- Socialization (Van Maanen & Schein, 1979):
  - Is the process by which people "learn the ropes" of a particular organizational role;
  - Is the fashion in which an individual is taught and learns what behaviors and perspectives are customary and desirable within the work setting as well as ones that are not;
  - Involves the transmission of information and values which is fundamentally a cultural matter;
  - Accompanies each move, from outside to inside and with each move in rank; and
  - Is more important at lower-level positions.
Why is Socialization Important?

Unsuccessful socialization results in…

Student Perspective:
- learning outcomes not likely accomplished
- satisfaction with the experience unlikely
- potential for dissatisfaction with the career field
- negative impact to self esteem and confidence

Education Organization Perspective:
- retention in academic programs negatively impacted
- exacerbated in high-demand academic areas
- less support from employer organization
Why is Socialization Important?

Unsuccessful socialization results in…

Employer Perspective:

- lower productivity from the student
- negative morale that could influence current full-time employees and other future students that may want to work for the organization
- greatly limited potential for retention of the student after the experience thereby minimizing the return on investment
Five Stage Model of Socialization for Internships / Co-op*

1. pre-entry
2. match-making for the intern/co-op position
3. entry for the intern/co-op position
4. match-making for the post-graduation position
5. accelerated entry for the post-graduation position

* Plouff (2006)
Co-op/Internship Prep Courses

Content:
- Job Search Prep
- Workplace Prep
- Co-op Role Prep
- Employer Involvement

Assessment for:
- Lifelong Learning
- Ethics
- Communication
- Contemporary Issues
Effective Employer Preparation for Internships/Co-op

• Develop an intern/co-op philosophy
  ➢ Communicate it internally and to educational partners and students

• Develop an intern/co-op plan
  ➢ Identify goals and objectives
  ➢ Identify need(s)
  ➢ Identify projects and tasks
  ➢ Identify knowledge/skills/abilities needed
  ➢ Identify supervisor(s) and mentor(s)
Effective Employer Preparation for Internships/Co-op

- Develop an intern/co-op plan (cont.)
  - Develop position description
- Secure needed commitments and resources
- Communicate description to partner institutions
- Network with students through partner institution events
Assessment During Co-op
(3 per student / 1 each semester)

By Student:
- Evaluation of Experience

By Employer:
- Evaluation of Student

By Program:
- Site Visit Evaluation
Co-op Program Involvement at Assessment Process Levels

Student:
- Supervisor + Student Evals

Course:
- Co-op Prep, Academic Components of Co-op

Program:
- Aggregate Co-op Feedback, Faculty Site Visits

ASQ Advancing the STEM Agenda Conference
June 3, 2013
Co-op Assessment Tools

• Industry Supervisor Evaluations
  Three per student (one per co-op semester)

• Faculty Site Visit
  Three per student (one per co-op semester)

• Student Evaluations
  Three per student
Program Outcomes and Performance Criteria

Program Outcome:

Student has the ability to identify, formulate, and solve engineering problems

Performance Criteria:

Student can troubleshoot a technical problem by logical deduction

Student can effectively engage in engineering projects within industry settings
Program Outcome:

Student has an ability to communicate effectively

Performance Criteria:

Student can produce a technical document written to industry standards

Student can effectively present technical information to an audience of peers, customers, or employers
Program Outcomes and Performance Criteria

Program Outcome:

Student has the ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

Performance Criteria:

Student can build a prototype of a design and demonstrate that it meets performance specifications.
Company A:
Participates in prep class practice interviews
Sponsors a co-op student (works with student)
Sponsors a junior-level course project
Sponsors a senior capstone project
Serves on Advisory Board(s)
Participates in surveys (objectives and outcomes)
Feedback Processes

**Formal/Direct**
- Co-op Site Visit by Faculty
- Evaluations of Students
- Surveys
- Advisory Board Meetings

**Informal/Direct**
- Planning Meetings
- Practice Interviews
Program Outcomes

Quantitative:
- Likert scale summaries
- Set goals/targets

Qualitative:
- Industry comments

ASQ Advancing the STEM Agenda Conference
June 3, 2013
Feedback Loops – When/How

Course Level:
- End of semester course assessment
- Semi-annual outcome assessments

Program Level:
- Program curriculum meetings
- Annual curriculum review/discussions
- Advisory Board meetings
New Co-op Student Preparation

Experience Matters:

➢ Summary completed each semester

➢ Used in freshman courses and co-op prep course
Academic Content to Enhance Internships/Co-ops

- Workplace environment relates well with delivery/application of many program outcomes
- Frees up time in core courses for other content
- Can make assessment from courses more robust (triangulate data)
Internship/Co-op Example Format

Materials posted online (Blackboard)

• Video
• Text (papers, notes, books)
• Web content
• Podcast

Online quizzes

Pre- and Post-tests

ASQ Advancing the STEM Agenda Conference
June 3, 2013
GVSU Co-op Example

- Targeted for 30-60 minutes of time commitment per module
- No more than 8 hours per semester
- Each module ‘open’ for 1 - 2 weeks
- Faculty member available for online office hours, video chat, discussion board
Engineering Ethics

A. Basics and codes, workplace ethics and responsibility dimensions
B. Background and theory, solving problems
C. Honesty, integrity, and reliability
D. Globalization; Environmental issues

Engineering Professionalism

A. Professionalism in the workplace (Unwritten Laws of Engineering)
B. Professional affiliation, lifelong learning and professional development
C. Entrepreneurship

ASQ Advancing the STEM Agenda Conference
June 3, 2013
Engineering Communications

A. General communication ethics (chain of command, emails, etc.)
B. Written documents (Project Reports and Progress Reports)
C. Written documents (Proposals and Technical Instructions)
D. Oral presentations

Engineering Economics

A. Time value of money, economic equivalence
B. Present-worth analysis, payback period
C. Equivalent-worth analysis, make or buy decisions
D. Rate of return analysis

ASQ Advancing the STEM Agenda Conference
June 3, 2013
Project Management

A. Project phases, work breakdown structure
B. Project planning and monitoring
C. Basics of supply chain management
D. Budgeting, cost-benefit analysis
E. Project risk and uncertainty
<table>
<thead>
<tr>
<th>Content</th>
<th>Coop I</th>
<th>Coop II</th>
<th>Coop III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>D</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Professionalism</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Communications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>D</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Engineering Economics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>D</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Project Management</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>D</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>E</td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
Industry-based Course Projects

- Project-based learning
- Follow same principles of effective partnerships
- Projects conducted in sophomore through senior-year courses
- Generated from internship/co-op relationships
- Requires clearly-defined and agreed upon scope and outcomes
- Require strong company project leader and mentor(s)
Integrated Course Involvement with Industry

Example from PDM Program:

Fall:
- Manufacturing Processes
- Analytical Tools for Product Design
- Dynamic System Modeling and Control

Winter:
- Manufacturing Control Systems
- Advanced Product Design
Senior Capstone Projects

- Interdisciplinary
- Larger scope and scale
- Graduating co-op student often the project leader
- Successful completion when employer signs off on project
- ABET criteria clearly satisfied
References


Further Discussion...