Making a Partnership Work: Outcomes Assessment of a Multi-Task, Multi-Institutional Project

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This paper describes the ***Manufacturing Engineering Education Partnership (MEEP)*** project's ***summative assessment strategy***. Since 1994, three universities, Penn State, University of Washington and University of Puerto Rico at Mayagüez, in collaboration with Sandia National Laboratories, have been working together to develop a new, practice-based curriculum and physical facilities for product realization and manufacturing. The overall outcome is the development at each participating institution of what we call ***The Learning Factory.*** In addition to describing the project's four major tasks and deliverables, we present the assessment plan, its principal elements, and the tools used for qualitative evaluation. Finally, the paper highlights some of the assessment results and reviews some of the elements that made this partnership a success. The assessment strategy presented in this paper could be used as a model for similar multi-institutional, multi-task projects.

BACKGROUND

During the last decade, the National Science Foundation (NSF) has sponsored coalitions and partnerships between various higher educational institutions, which focus on enhancing undergraduate engineering education.[1] The goals and objectives of these projects - oftentimes multi-million dollar, multi-institutional, and interdisciplinary - are carried out by working teams. In 1994, NSF granted (with funds from the ARPA Technology Reinvestment Program) a unique group of universities - Penn State, University of Washington and University of Puerto Rico at Mayagüez - in collaboration with Sandia National money to a project called ***the Manufacturing Engineering Education Partnership (MEEP)***. The overall outcome of the project was the development of what we call ***The Learning Factory*** at each participating institution**.** The program calls for the development of a new practice-based curriculum and physical facilities for product realization and manufacturing. The major goal is to provide an improved educational experience that emphasizes the interdependency of manufacturing and design in a business environment. The overall outcome intended to graduate better engineering professionals exhibiting the knowledge and skills needed to succeed in the highly competitive world of today and tomorrow. The key element in this approach is *active learning*: the combination of curriculum revitalization coordinated with hands-on experiences. Thus, the gap is reduced between traditional lecture vs laboratory, academia vs industrial experiences. Through extraordinary teaming efforts, MEEP institutions have achieved the goals of the partnership with singular success.

However, working together to achieve goals is not an easy task, especially among diverse engineering schools such as the constituents of engineering education coalitions. On March 1996, leaders from the eight established engineering coalitions discussed their productivity and problems. They concluded that while they made progress in achieving their goals, they still face several challenges. [2] Most of these have to do with *communication and managing logistics* of operating large, diverse projects involving faculty from multiple disciplines and different institutions. Teamwork plays an important role in achieving goals in these kinds of projects. However, bringing a group of people together to work independently and accomplish difficult tasks does not always guarantee success. Certain unique conditions and synergy need to exist in order for a team to achieve its goals. Although much has been said and written about the success and pitfalls of working teams, there is no perfect recipe for success. Some literature states that effective teamwork depends on many variables - among them vision, expectations, team's goals and composition, leadership, and support.

Another aspect identified as critical by coalition leaders was *assessment*. Some found it difficult to design a strong assessment program implemented project-wide to measure the impact of their novel curricula. Therefore, outcomes assessment, which is required by many granting agencies, also seems to play another important role in ensuring success.

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[1] Robert J. Coleman, ***The Engineering Education Coalitions, A Progress Report,*** ASEE PRISM, September 1996

[2] Ibid.

The assessment strategy must be designed at the project inception and should be intimately associated with the project's goals and objectives. Basically, there are two kinds of assessments: formative and summative. The purpose of the formative assessment is to assess *progress* in meeting a project's or task's goals, whereas the purpose of the summative assessment is to evaluate the project's *outcomes*. Assessment and subsequent evaluation of the results are critical for any project or program, since they provide feedback and suggestions for improvement.[3,4]

This paper briefly describes MEEP's tasks and deliverables and presents the project's outcomes assessment strategy. It also presents and discusses results.

MEEP'S GOALS AND TASKS[5]

MEEP's goals were achieved through four major tasks, namely:

1. *Curriculum Development*: to develop a practice-based undergraduate engineering curriculum which balances analytical and theoretical knowledge with manufacturing, design, business realities, and professional skills;
2. *Integrated Learning Factory*: to develop a "Learning Factory" at each partner institution, integrated with the curriculum, for hands-on experience in design, manufacturing, and product realization;
3. *Industrial Partners*: to develop strong collaboration with industry; and
4. *Outreach:* to share the project's deliverables with other academic institutions, government and industry.

More than 90 corporate partners covering a wide-spectrum of US industries and government, and more than 40 faculty members from three institutions have teamed for two and a half years to achieve these goals.

ASSESSMENT STRATEGY

MEEP's assessment strategy has both *qualitative* as well as *quantitative* components intimately linked to the project's goals. The MEEP Strategic Plan pinpointed the qualitative data that needed to be gathered. Some of the data for each task currently being gathered at the three institutions include the following:

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[3] ***User Friendly handbook for Proejct Evaluation,*** Floraline Stevens, et al,NSF 93-152

[4] ***Stepping Ahead: An Assessment Plan Development Guide,*** Gloria M. Rogers, and Jean K. Sando, Rose-Hulman Institute of Technology, 1996

[5] ***The Learning Factory: A New Approach to Integrating Design and Manufacturing in Engineering Curricula,*** John Lamancusa et al, 1995 ASEE Conference Proceedings.

Curriculum Development
• number of new courses developed
• number of existing courses modified to use the Learning Factory
• number of students choosing to take new courses
• number of faculty and staff involved in the project
• job placement statistics
• number of industrial projects integrated into the capstone design course
• number of "engineers in the classroom", seminars and lectures by visiting professionals
• number of courses or modules transferred internally
• number of requests for information or course modules by other institutions

Integrated Learning Factory (ILF)
• resource acquisition /donations
• student usage
• projects or process activities
• shared use within the institution
• training activities

Industrial Partners
• number of industrial partners
• number of program graduates recruited by industrial partners
• number of courses/hours provided to partners in continuing education
• number of hours that industrial partners participate in education programs
• number of students enrolled in internship programs
• number of industrial projects
• number of co-authored papers between faculty and industrial partners

Outreach
• number of courses developed suitable for transfer or distance learning
• number of outreach institutions
• number of courses utilized by other institutions
• number of students participating in outreach activities
• number of journal papers and presentations
• number of participants in annual workshops
• ILF outreach activities

This paper describes the strategy designed to gather qualitative data to evaluate the project's outcomes.

OUTCOMES ASSESSMENT

The following methodology was used:

1. The project goals, tasks, expected outcomes, and metrics were identified, as per the project's Strategic Plan.
2. Specific criteria and assessment tools for each task were designed. The assessment plan had the following elements:
    - internal (self-assessments)
    - external (outside the partnership)
    - multiple criteria (variety of modes and viewpoints)
    - holistic (integrated)
    - qualitative and quantitative components.
3. The assessment schedule was established.
4. An assessment workshop was held at a Partnership meeting.
5. Assessments were conducted and recorded.
6. Report.

An assessment team, composed of one representative from each institution (PSU, UW, UPRM), was in charge of the design and implementation of the assessment process. The team had the following responsibilities:

- ***Leader***: coordinate team activities; develop drafts of assessment criteria and tools; conduct assessment workshop; and, record and report assessment findings to project PI, and project task leaders.
- ***Institutional representatives:*** review and provide feedback to team leader on assessment criteria and tools; conduct assessment workshop with team leader; and, conduct assessments at their institution.

ASSESSMENT TOOLS[6,7]

The most critical phase of the assessment strategy was the development of the qualitative outcomes assessment tools. Faculty, students and industrial partners participated actively in the design of the following tools:

- SURVEYS. Various surveys were designed using the following strategy:
    1. Assessment Design Matrix: The first step was the development of an *Overall Project Assessment Design Matrix*, where each task's goals - as defined in the Strategic Plan

[6] **Resource**: Stevens, Floraline et al, ***"User Friendly Handbook for Project Evaluation: Science, Mathematics, Engineering and Technology Education***, *NSF 93-152.*

[7] **Resource:** Suskie, Linda A., ***"Questionnaire Survey Research, What Works,*** 2nd edition, Association for Institutional Research, Florida State University, 1996

were outlined. Associated with each goal and objective, the matrix also included the stakeholders (or those identified as having a vested interest in the information gathered). Table 1 shows the Overall Project Assessment Design Matrix.

2. Individual Task Design Matrices: Once the overall project's goals were summarized in the Design Matrix, four sets of matrices - one for each individual task - were developed, which included the following: general evaluation questions, evaluation instruments and approaches, who the respondents were and the data collection schedule[8]. Table 2 presents the Curriculum Development Matrix.
3. Surveys: Four surveys were designed with questions from the individual task matrices and distributed among the principal stakeholders (students, faculty, industrial partners and other institutions). A copy of the student and industry surveys are shown in Table 3. Issues pertaining to courses, skills developed, use and integration of the Learning Factory, industrial partners involvement and outreach are included in these surveys. A five point scale was used for all questions (strongly agree, agree, neutral, disagree or strongly disagree). ***Survey Pro Software 2.0 (Apian Software)*** was used to create and manage surveys, as well as to generate reports.

- FACULTY/INDUSTRY FOCUS GROUP**.** Seven faculty members and industrial partners from the three institutions discussed their experiences and their perceptions as to what made the partnership a success.

- EXTERNAL EVALUATORS**.** External evaluators - who either had experience in manufacturing engineering, or were familiar with our work or with similar partnerships/ learning goals - evaluated the project's deliverables. They participated in partnership meetings, visited the Learning Factory, completed the survey, or browsed course materials in national conferences and meetings.

IMPLEMENTATION SCENARIO

All stakeholders within the institutions involved were surveyed: faculty, students, industrial partners and other institutions. At the time of the writing of this paper, 181 surveys had been completed. Highlights of the results follow.

EVALUATION HIGHLIGHTS

OVERALL QUANTITATIVE ACCOMPLISHMENTS

- New minors and formal options in Product Realization and Design/Manufacturing have been started at each academic partner.
- 1333 students participated in MEEP courses and projects during year 2 of the 2-year project.
- 43 faculty participated.
- Nearly 90 industry partners have provided $2.3 million in cash and in-kind services

[8] Since this was a final outcomes assessment, tools were mostly utilized at the conclusion of the project.

- Learning Factory facilities are operational at each academic partner with nearly 15,000 ft^2 of new or remodeled space.
- Curricular materials disseminated to other institutions.

QUALITATIVE ASSESSMENT RESULTS

The following table summarizes the respondents profile of the surveys:

Faculty • 57% involved in course development • 50% currently teaching a course • 21% female	14
Students • 96% undergraduates • 73% taken one course • 24% taken two courses	122
Industrial Partners • 69% Industrial Advisory Board members • 52% involved in student projects	42
Other institutions • 2 external evaluators • 1 Sandia National Labs	3
TOTAL	**181**

The following section is a summary of the responses to the various issues associated to the goals and objectives of the project. [Number refer to percents of respondents who ***strongly agree or agree*** to a given issue]:

RE: MEEP courses/program and the Learning Factory (LF)

- 100% of IP's and faculty believe real life problems were provided.
- 89%, 71% and 80% of IP's, faculty and students believe communication skills were emphasized.
- 93%, 93%, 97% of IP's, faculty and students believe teamwork skills were emphasized.
- 72% of faculty think the quality of the program is superior to other typical courses at their institutions.
- 57% of faculty think the LF provided an activity center for the creation and implementation of products and processes.
- 71% of faculty feel the LF is well equipped to give students real life experiences in state-of-the-art processes.

Student responses:

- 88%say the program allowed them to practice engineering science fundamentals in the solution of real life problems.
- 82% say MEEP courses are more fun than typical engineering courses.
- 78% believe they now have a better understanding of engineering, and feel more confident in solving real life problems.
- 80% feel more confident in their ability to teach themselves.
- 93% believe their MEEP instructors to be superior.
- 82% believe active learning activities were extensively used in the program; 17% say they learn better from lecture than from hands-on experience.

RE: Teaming among institutions:
Faculty responses:

- 85% believe that partner schools exchanged information to learn from each other's experiences.
- 64% feel they were greatly involved during course development, while 57% think they were effective participants in course development and felt like full partners in the teaching team.

RE: Industrial Advisory Board (IAB):

- 68% of industrials think that the local IAB provided strategic and operational guidance to their respective local institutions.
- 79% and 90% of industrials and faculty, respectively, believe that the IAB provided support (financial and non-financial) to MEEP activities.
- 95% of industrials consider that MEEP students would be more useful to their respective industries, and 79% are more likely to hire a MEEP student over a typical student.

RE: Faculty issues

- 71% of faculty received release time for the project.
- 50% of faculty understand that their participation in MEEP was beneficial to their careers; 62% were provided with positive feedback from their supervisors.
- 14% received better student evaluations compared to regular courses.
- 64% said the had a better experience with MEEP courses, compared to regular courses.
- 57% believe that their participation in MEEP was an element for teaching/education awards and recognition; but only 10% think that their participation in MEEP was an element for their promotion/tenure.

RE: Outreach

- 36% of faculty believe their institution helped implement a manufacturing program in other institutions.
- 29% of faculty think that the partnership has helped in the design of similar courses in other institutions.

SURVEY COMMENTS

Industrial Partners:

- "... company has impact on curricular developments, students and faculty... and they have an impact on our company."
- "... provides access to a pool of engineers for potential hiring."
- "... helps students bridge academic and professional careers... more mature and better prepared students."
- "... it opens the opportunity to solve real life problems and provides the means to meet other business people and faculty."
- "MEEP provides education beyond the books and the labs."
- ".... real day to day engineering, teaching the student how to apply what they have learned in the compressed time frame of real industry."
- "All students should be involved."
- "Industry is served by investing in academics."
- "MEEP provides a cost-effective consulting engineering sources to help solve manufacturing problems."
- "... tremendous impact on engineering education (engineering skills and teamwork), plus many side benefits (communication skills, visibility with companies/students)."
- "It is a good opportunity to share knowledge. It gives the university an idea of how industry is doing so that they can adjust their curriculum. The overall benefit is that industry will get a better trained employee, with exposure to current manufacturing processes."
- "This should be leading formal and informal education... a win-win relation..."

Students::

- "The hands-on experience is helpful and necessary."
- ".... definitively an excellent learning experience."
- "My MEEP course requires far too much busy work..."
- "...liked case studies where discussions were more intense... Allowed me to look at things in a new different way...."
- Thanks to MEEP and the experience acquired through the LF, I have developed professional skills needed to be successful in my career as an engineer. I think the effort should be institutionalized so that more students can benefit from it."

Faculty:

- "I am very proud of what we have accomplished over the past few years... The greatest benefit that I received from participating in MEEP was the great number of friends that I established..."
- " I think MEEP is successful primarily because of the kind of people involved ...who care about what education the student should get, and what will make them more successful once they graduate."
- "... having everyone participate and contribute - from students to administrators - has made a difference."

External Evaluators:

- "The text on Product Dissection is very good. I will use parts of it in my Freshman ME Design course."
- "... the discussions about competency-based design education influenced the way I've gone about creating a course."

FACULTY/INDUSTRY FOCUS GROUP:

The focus group consisted of eight faculty members and two industrial partners from all of the institutions, and centered in the question: ***Why has this partnership worked?*** Below is a list of issues and elements identified as key indicators of the success of this partnership:

- A strong leadership provided by project PI's.
- Clear vision and goals from the beginning.
- Consensus of all participants.
- Focus on early and continuous teaming of participants through exercises and meetings (virtual or real).
- Frequency of communication and follow up of tasks, be it by meetings, e-mail, or telephone conferences.
- The existence of an effective and realistic strategic plan:
    - clear, focused and achievable deliverables
    - project organizational structure and equitable distribution of deliverables among participating institutions
        - optimum number of people involved in tasks - teams of 3-4 at any given time
        - optimum number of schools involved (3)
- Personalities and motivation of the faculty involved.
- Diversity: cultural, institutional, and professional of those involved.
- Healthy student involvement at all levels.
- Strong industrial partners commitment and support.

- The ability to work and have fun!

EXTERNAL EVALUATORS

The following table lists the pool of external evaluators and their respective assessment participation:

Name	**Position**
Dr. Ed Hensel	Director of the Advanced Manufacturing Center, New Mexico State University • participated in partnership meeting, hosted visits to his institution, provided feedback, completed survey
Dr. Bopaya Bidanda	Associate Professor, IE Department, University of Pittsburgh • participated in partnership meeting, provided feedback
Dr. Christina Amon	Associate Professor, ME Department, Carnegie Mellon University • participated in partnership meeting, provided feedback
Dr. Linda Schmidt	Assistant Professor, ME Department, University of Maryland • participated in partnership meeting, provided feedback
Dr. Charlie Martin	Director, Engineering and College Liaison Programs, Raytheon and member of the New England Manufacturing Coalition • participated in partnership meeting, provided feedback
Others	Dr. Wayne Helmer, ME, Southern Illinois University Dr. Vincent Wilczynsku, US Coast Guard • Reviewed materials and video • interviewed at ASEE 1996 Conference

EXTERNAL ASSESSORS COMMENTS:

- "The participating institutions and team did a very good job."
- "The Learning Factory concept and implementation, and new coursework and manufacturing program were very successful."

UNSUSPECTED OUTCOMES

In addition to the expected project outcomes, we had some unsuspected consequences, that may or may not have resulted exclusively from MEEP.

- First, thirteen faculty members from all institutions received awards or recognition for their work in MEEP and in teaching. Seventeen people received promotions and/or tenure during the project, including three faculty promoted to deans and one to associate dean.
- Second, the number of papers and presentations about MEEP that have been carried and are currently being accepted for presentation and publications exceeded expectations. For example, this assessment paper has been accepted this year in six different conferences.
- Third, the industrial partners support, the number of companies and financial help, exceeded proposed amount.

- Fourth, there have been several institutional impacts and spin-offs that were not expected initially. For example, some of the partners received complementary grants by other Foundations (e.g., a Procter and Gamble grant to UPRM to expand MEEP into Chemical Engineering), and all institutions received grants for infrastructure development.
- Fifth, this project has generated books by inter-institutional teams of faculty (Technology-based Entrepreneurship and Concurrent Engineering course material).
- Sixth, there were enhanced employment opportunities for students.
- Seventh, cultural, gender and professional barriers were overcome to achieve results.

CONCLUSIONS

A fundamental difference between this curricular reform and others is the strong partnership which was created between industry and academe. The curriculum reform involved representatives from nearly 90 companies, both large and small who have taken significant responsibility in assuring that the topics and the focus of the new courses are relevant and germane to companies in both the civilian and defense sectors. Faculty have consulted with our industry partners about the roles of concurrent engineering, industry experts have visited the academic partners to advise about entrepreneurial issues, and many industrially-based senior design projects have been tackled in Year 2 by students in the MEEP Partnership.

From the assessment data that has been analyzed to date, we may conclude that there is a high degree of acceptance and satisfaction of the MEEP program by all stakeholders. According to assessment results, we can reach the following specific conclusions :

- The MEEP program provides real life experience, including communication and teamwork skills to students.
- The MEEP program's quality is superior to other programs.
- Industries are more likely to hire MEEP students than non-MEEP students.
- Goals and objectives of the partnership were achieved through good teaming efforts among participating institutions.
- Industrial participation played an important role in program development, support, implementation and assessment, and provided strategic guidance.
- Although MEEP courses are more fun, they seem to require more time and effort from students.
- Learning Factory facilities seem to be providing the appropriate learning environment for the students.
- Outreach to other institutions needs to be increased.
- Faculty perceptions about the relevance and impact of MEEP in their professional careers do not match outcomes (awards, promotions).
- MEEP faculty perceive that administrators do not give proper recognition/importance to educational projects compared to traditional research.

ACTING ON ASSESSMENT RESULTS - FUTURE WORK

The results of the assessment demonstrate a high degree of acceptance and satisfaction. They also show that key tasks such as development and use of the Learning Factory, the Industrial Partnership, and renewal/development of courses using a more practice-based method, are of extreme importance. Therefore we must maintain and expand our dissemination efforts by transporting this integrated effort to other areas applicable in engineering and science, as well as maintain a high commitment from both, academic administrators and the industrial sectors. This translates to continually working with the Industrial Advisory Boards, to make sure that Deans and Department Heads continue to support the effort, and conducting orientation workshops to peers and students, in addition to continuing the assessment of current and future activities.

Furthermore, it is critical that to influence the tenure and promotion process for faculty so that efforts like this are recognized, particularly in departments and universities where the prevalent culture has been to stress recognition of research activities, leaving academic reform activities in a distant second place. Working in an integrated manner with the aforementioned aspects will promote a permanent institutionalization of the effective efforts of MEEP and will truly promote continuity in improving the educational development of the professional careers of our students and faculty.

Finally, we are aware that it is too early to evaluate this project's potential to impact students, faculty, participant organizations and employers. Therefore, it is important to continue our assessment efforts. We believe these surveys should be repeated in the future, with the possibility of carrying a longitudinal study of the project's outcomes.

BIOGRAPHICAL INFORMATION

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Table 1. MEEP's Overall Assessment Design Matrix

Task	Goals and Objectives	Stakeholders		
		Student	Faculty	Industrials/others
Curriculum Development	• Develop a new interdisciplinary, practice-based Curriculum which emphasizes the interdependency of manufacturing and design, in a business environment	X	X	X
	• Develop a new paradigm for coalition-wide course development, sharing and export to the academic community at-large		X	X
	• Integrate these new courses into the permanent academic programs of the respective universities	X	X	X
	• Facilitate and encourage the inclusion of more design/manufacturing content into existing courses	X	X	X
Integrated Learning Factory	• Implement the Integrated Learning Factory (ILF) to support curriculum activities locally and across the partnership	X	X	X
	• Initiate the capstone design project course with industrial support	X	X	X

	• Establish linkages to
	  • partnership school facilities and activities
	  • local industry and community colleges
	  • national industry, universities, and research institutions.
		X	X	X

Industrial Partners	• Establish a local Industrial Advisory Board		X	X
	• Create a liaison that will interact with the coalition task leader for Industrial Partnership		X	X
	• Expand the industrial sponsor base	X	X	X
	• Coordinate the development of industrial based projects for undergraduate students , and exchange progams to support the curriculum	X	X	X
	• Identify strategies to amplify the effectiveness of the Learning Factory	X	X	X
Outreach	• Develop a process for the members to fully share instructional, laboratory, and manufacturing facilities.	X	X	X
	• Develop a process for external institutions to participate in the MEEP educational program.	X	X	X

Table 2. Curriculum Development Matrix

Question 1: Was a new interdisciplinary, practice-based curriculum which emphasizes the interdependency of manufacturing and design, in a business environment developed?			
Subquestions	*Data Collection Approach*	*Respondents*[9]	*Schedule*[10]
1a. Did the program allow students to practice their engineering science fundamentals in the solution of real problems?	Questionnaire (Q) or Focus Group (FG) Samples	S, F, I	
1b. Are professional communication and team skills emphasized?	Q or FG Samples Interviews	S, F, I	
1c. Are case studies, active learning techniques, and computer technologies extensively used in the classroom?	Q or FG Samples	S, F	
1d. Did the program provide previously unavailable opportunities for hands on engineering experience in the Learning Factory?	Q or FG	S, F	
1e. Did the partner schools exchange information and learn from each other's experiences?	Q or FG	S, F, I	
1f. Did you take courses with students from disciplines other than engineering?	Q or FG	S	
1g. Did you develop or modify courses to accommodate multiple engineering disciplines?	Q or FG	F	
Question 2: Was a new paradigm for coalition-wide courses development, sharing and export to the academic community at-large developed?			
Subquestions	*Data Collection Approach*	*Respondents*	*Schedule*
2a. Were resources and ideas shared, avoiding redundant efforts? Were new technologies for communication utilized, achieving consensus on curriculum content?	Q or FG Samples	S, F, I	
2b. Were jointly developed curriculum materials easily transported among the MEEP partners, and exported to the academic community at large?	Q or FG	S, F	
2c. Were computer technologies, multimedia and electronic communications used?	Q or FG Samples	S, F	
2d. Did you participate with partnership professors to develop course materials? How effective?	Q or FG	F	

[9] S: students; F: faculty; I: industrial partners; O: others [e.g., other institutions outside the partnership]
[10] Assessments all carried out at the conclusion of the project.

Table 2: Cont. Curriculum Development Matrix

Question 3: Were these new courses integrated into the permanent academic programs of the respective universities.			
Subquestions	*Data Collection Approach*	*Respondents*	*Schedule*
3a. Is the interdisciplinary curriculum available as minor or a degree option at the participating schools?	Q or FG	S, F	
3b. Were the institutional changes approved by the faculty at the departmental, college and university levels?	Q or FG	F	
Question 4: Was the inclusion of more design/manufacturing content into existing courses facilitated and encouraged?			
Subquestions	*Data Collection Approach*	*Respondents*	*Schedule*
4a. Did the partnership develop courses with more, the same or less an industrial focus than other courses at your institution?	Q or FG	S, F, I	
4b. Were real-life problems provided by industry?	Sample of students projects	S, F, I	
4c. What was the impact of MEEP (courses, the LF, Industrial Partnership))on other courses, programs, projects, etc. at your institution?	Q or FG	F, O	

Manufacturing Engineering Education Partnership
MEEP
INDUSTRY SURVEY

The Learning Factory is a new practice based curriculum and physical facilities for product realization that has been developed at three institutions: Penn State, the University of Washington, the University of Puerto Rico at Mayagüez in collaboration with Sandia National Labs. Its goal is to provide an improved educational experience that emphasizes the interdependency of manufacturing and design in a business environment. The key element in this approach is active learning - the combination of curriculum revitalization with coordinated opportunities for application and hands on experience.

This questionnaire has been designed to assess the performance and products of this program. Please answer it to the best of your knowledge.

Name:

_____

Company:

_____

Partner University:
[ ] UPR-M [ ] PSU [ ] UW [ ] Other_____

Your Involvement with the program:
[ ] Member of Industrial Partner Board [ ] Expert in the classroom [ ] Involved with students projects
[ ] Other_____

Instructions:

The following items reflect some of the ways in which the Manufacturing Engineering Partnership (MEEP) can be described. Please fill in the numbered circle which indicates THE DEGREE TO WHICH YOU AGREE that each item is descriptive of the experiences you were exposed to and provided by the program. If you have no information or feel an item does not apply, please fill in the N/A circle.

The program allowed students to practice engineering science fundamentals in the solution of real problems.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

Professional communications skills were enhanced.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

Team work skills were enhanced.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

The partner schools learned from each other's experience.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

Resources and ideas were shared, avoiding redundant efforts.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

Real life problems were provided.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

New technologies for communication were utilized on curriculum content.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

The local Industrial Advisory Board (IAB) provided quality strategic and operation guidance to the local institution.

[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

The local IAB supported MEEP's activities providing financial and/or non financial resources.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

There was good communication between industrial sponsors and the institution.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

Each institution provided the IAB the right information in a timely fashion.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

The MEEP's Industrial Advisory Board (IAB) evaluated the overall progress of the program.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

The partnership reported progress and activities related to participation in curriculum development.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

The MEEP's IAB provided support in actions/activities that are relevant to the program.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

The partnership reported progress and activities related to participation in the classroom teaching.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

Students completing the MEEP program are more useful to our industry.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

My Industry and company is more likely to hire a MEEP trained student than a traditionally trained student.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

Would you encourage other companies to participate in the program and coalition? Why?

_____

What can be improved with MEEP?

_____

Comments:

_____

Manufacturing Engineering Education Partnership
MEEP
STUDENT SURVEY

The Learning Factory is a new practice based curriculum and physical facilities for product realization. Its goal is to provide an improved educational experience that emphasizes the interdependency of Manufacturing and design in a business environment. The key element in this approach is active learning - the combination of curriculum revitalization with coordinated opportunities for application and hands on experience.

University:
[ ] UPR-M [ ] PSU [ ] UW [ ] Other_____

Major:
[ ] Mechanical Eng. [ ] Chemical Eng. [ ] Industrial Eng.
[ ] Other_____

[ ] Graduate student [ ] Undergraduate student

Involvement with MEEP:
[ ] Taken 1 course [ ] Taken more than 1 course [ ] Research Assistant
[ ] Other_____

The program courses at your institution were offered as: (Check all that apply)
[ ] as part of a minor [ ] as electives [ ] as part of a degree option [ ] required for the major
[ ] Other_____

The courses were:
[ ] interdisciplinary [ ] engineering students only [ ] students from only one department

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Instructions:

The following items reflect some of the ways in which the Manufacturing Engineering Partnership (MEEP) can be described. Please fill in the checkbox which indicates THE DEGREE TO WHICH YOU AGREE that each item is descriptive of the experiences you were exposed to and provided by the program. If you have no information or feel an item does not apply, please fill in the N/A checkbox.

The program allowed you to practice engineering science fundamentals in the solution of real problems.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

Professional communications skills were emphasized.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

Team work skills were emphasized.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

Case studies were extensively used in the courses.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

Active learning activities were extensively used in the courses.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

Computer technologies were extensively used in the classroom.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

Hands-on engineering experiences were extensively used in the classroom.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

The courses were set in an industrial like setting.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

The MEEP courses you took had more design/manufacturing content than other similar courses at your institution.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

The Learning Factory (LF) provided you with a fully integrated activity center for the creation and implementation of products and processes.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

The LF facility was well equipped to give me real life experience in "state of the art" processes.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

The LF facility was professionally staffed to allow me to experiences the product/process realizations.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

I feel that my participation in the MEEP Program has improved my career opportunities.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

I learn better from classroom lecture then hands-on laboratory experience.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

The MEEP courses provided more to my professional development than typical courses.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

My MEEP course(s) were more fun than my typical engineering courses.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

Because of the MEEP courses, I have a much better understanding of what engineering is.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

As a result of this course, I am more confident in my ability to solve real-life problems.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

As a result of this course, I feel more confident in my abilities to process information, and teach myself new things, without the aid of an instructor.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

The MEEP instructors were superior to my typical university instructors.
[ ] Strongly Agree [ ] Agree [ ] Neutral [ ] Disagree [ ] Strongly Disagree [ ] N/A

COMMENTS: