Making a Partnership Work: Outcomes Assessment of the Manufacturing Engineering Education Partnership

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Abstract

This paper describes the ***summative assessment strategy*** of the ***Manufacturing Engineering Education Partnership (MEEP)***. 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 reviewing 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.

I. Introduction

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 - Pennsylvania State University, 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 [2]**.** The program calls for the development of a new practice-based curriculum and physical facilities for product realization and manufacturing. The major objective is to provide an improved educational experience that emphasizes the interdependency of manufacturing and design in a business environment. The goal is to graduate better engineering professionals who possess 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 and laboratory, academia and 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. In 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 [1]. 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 institutions found it difficult to design and implement a strong project-wide assessment program to measure the impact of their curriculum experiments. Therefore, outcomes assessment, which is required by many granting agencies, also seems to play an important role in ensuring success. 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 project 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 describes MEEP's tasks and deliverables and presents the outcomes assessment strategy for the project. It also presents and discusses results. Further information on MEEP and the Learning Factory concept and the curricular materials developed can be found in reference 2 and in the following web sites: http://lfserver.lf.psu.edu/ and http://www.me.psu.edu/lamancusa/welcome.htm

II. MEEP's Goals and Tasks

As mentioned before, MEEP's major goals were the development of a practice-based curriculum and physical facilities for product realization and manufacturing that responded to constituents' needs, and, to graduate better engineering professionals who possess the knowledge and skills needed to succeed in the highly competitive world of today and tomorrow. These goals were achieved through four major tasks, namely:

Curriculum Development: to develop a practice-based undergraduate engineering curriculum which balances analytical and theoretical knowledge with product realization and manufacturing, design, business realities, and professional skills;

Integrated Learning Factory: to develop a "Learning Factory" at each partner institution, integrated with the curriculum, to provide facilities for hands-on experience in design, manufacturing, and product realization;

Industrial Partners: to develop strong collaboration with industry; and

Outreach: to share the project's deliverables with other academic institutions, government and industry.

This program - a series of courses designed as an option or minor at the three participating institutions - offers a new paradigm for engineering education, providing a balance between theory and practice and emphasizing the development of basic skills in the student. The students learn by doing through non-traditional educational activities integrated into the curriculum. For example, students work in teams to dissect a product in the Learning Factory, engineering experts are brought to the classroom, and real-life problems are solved in the capstone design course. MEEP's courses' syllabi not only include the knowledge base the student has to learn, but also the desired skills to be developed, for example, communication, teamwork, business concerns and project management.

More than 100 corporate partners covering a wide-spectrum of US industries and government, and more than 40 faculty members from three institutions teamed for three years to achieve these goals.

III. Outcomes Assessment Strategy

There are numerous resources available for the development and implementation of outcomes assessment plans. For example, Rogers and Sando have prepared a user friendly, step by step booklet that presents eight steps in developing an assessment plan [4]. Either prompted by the Accreditation Board for Engineering and Technology (ABET) new criteria or by the desire to improve quality standards, engineering programs have started to gather data for use in appraisal and improvements efforts in their institutional programs. For example, the College of Engineering of Auburn University has developed a plan to assess the quality of their instructional programs, designing various assessment tools for that purpose [5]. But regardless of how the assessment plan is developed, an effective plan must start with the identification of specific goals and objectives, definition of performance criteria, followed by the data collection methods and tools and, finally, the elaboration of feedback mechanisms. Data collection requires the development of assessment instruments or tools focused for appropriate audiences.

Developing MEEP's assessment strategy proceeded rather easy because the project's goals and objectives had been clearly defined in the project's Strategic Plan. An assessment team was formed and the strategy discussed and shared with all the constituents (faculty, students, and industrial partners). The team, composed of one representative from each institution was in charge of the design and implementation of the assessment process and 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.

It was agreed that in order to have comprehensive and valid results the assessment plan should have the following elements:

- Internal (self-assessments)

- External (outside the partnership)
- Multiple criteria (variety of modes and viewpoints)
- Holistic (integrated)
- Qualitative and quantitative components.

MEEP's assessment strategy had both *qualitative* as well as *quantitative* components intimately linked to the project's goals. Because the granting agency (NSF) was specific about the quantitative data to be gathered, the assessment strategy focused on the qualitative aspects of the program. The quantitative data collected by each institution is shown in Table 1.
This paper focuses on the strategy for gathering qualitative data to evaluate the project's outcomes. The following methodology was used [6]:

1. Outline the project's goals, tasks, expected outcomes and metrics, as per the Strategic Plan.
2. Develop specific criteria and assessment tools.
3. Establish assessment schedule.
4. Conduct assessments.
5. Analyze results.
6. Report.

Once the project's goals were outlined, four matrices were developed (one for each of the project's tasks) which contained general and specific questions we thought the project's constituents wanted to be answered. These matrices helped the assessment team develop the data collection approach and design the assessment instruments/ tools for the different audiences. Some of the tools used are presented in the next section.

IV. Assessment Tools

The most critical phase of the assessment strategy was the development of the qualitative outcomes assessment tools [4,7]. Faculty, students and industrial partners participated actively in the design of the following tools:

A. 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 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 2 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. Since this was a final outcomes assessment, tools were mostly utilized at the conclusion of the project. Table 3 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 industry survey appears in Table 4. 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.

B. 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.

C. 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.

V. Implementation Scenario

During the first semester of academic year 1996-97, all stakeholders within the institutions involved were surveyed, including faculty, students, industrial partners and other evaluators at other institutions. One hundred eighty one (181) surveys were returned. Focus group discussion was carried on during a partnership meeting and via email. And, as mentioned before, external evaluators provided feedback through various means. Highlights of the results follow.

VI. Evaluation Highlights

A. Overall Quantitative Accomplishments

Upon completion of the project, new minors and formal options in Product Realization and Design/Manufacturing had been started at each academic partner. During year two of the 2-year project more than 1300 students had participated in MEEP courses and projects. A total of 43 faculty participated either in program management, course design, Learning Factory development or industrial advisory board coordination, and over 100 industry partners provided $2.3 million in cash and in-kind services. Currently, Learning Factory facilities are operational at each academic partner with nearly 15,000 ft^2 of new or remodeled space. Curricular materials have been disseminated to at least 20 institutions and workshops and seminars on the Learning Factory model are being offered nationally and internationally.

B. Qualitative Assessment Results

The quality of the MEEP program and the project implementation effectiveness was measured by means of various instruments, as previously described. This section summarizes qualitative assessment results.

1) Surveys. Table 5 describes the distribution of the survey responses. What follows is a summary of the surveys' responses to the various issues associated with the goals and objectives of the project. Numbers refer to percentage of respondents who ***strongly agree*** or ***agree*** with a particular issue.

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

- 100% of industry partners (IP) and faculty believe real life problems were provided.
- 89%, 71% and 80% of IP, faculty and students believe communication skills were emphasized.

- 93%, 93%, 97% of IP, 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.

Issue: 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.

Issue: 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 industry partners 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.

Issue: 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 they 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 a contributing factor for their promotion/tenure.

Issue: 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.

Some of the written comments of the surveys by stakeholders were as follows:

Industry 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 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."

2) 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's Principal Investigators
- Clear vision and goals from the beginning
- Consensus of all participants
- Focus on early and continuous teaming of participants through exercises and meetings
- Frequency of communication and follow up of tasks
- The existence of an effective and realistic strategic plan
- Clear, focused and achievable deliverables
- Well defined organizational structure
- Equitable distribution of responsibilities and 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)
- Compatible personalities and motivation of the faculty involved
- Diversity: cultural, institutional, and professional of those involved
- Healthy student involvement at all levels
- Strong industrial commitment and support
- The ability to work and have fun!

3) 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."

VII. Unexpected Outcomes

In addition to the expected project outcomes, there were some unexpected consequences as a direct result or perhaps, in spite of, this project.

1. Thirteen faculty members 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 who were promoted to dean, and one to associate dean.
2. The number of papers and presentations about MEEP (28 at this time) exceeded expectations.
3. Our efforts have been documented in local and national news media, including the New York Times [8], and ASEE PRISM [9].
4. Industrial support - the number of companies, the number of student projects, and financial contributions, exceeded expectations.
5. There have been several spin-offs and examples of leveraging. For example, some of the partners have received complementary grants from other Foundations (e.g., a Procter and Gamble grant to UPRM to expand MEEP into Chemical Engineering), and all institutions received internal grants for infrastructure development.
6. Our universities are featuring the Learning Factories to recruit incoming students as well as to attract benefactors.

VIII. Conclusions and Recommendations

A fundamental difference between this curricular reform and others is the strong partnership that was created between participating institutions and between industry and academe. The curriculum reform involved representatives from nearly 100 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 by students in the MEEP Partnership.

From the assessment data we may conclude that there is a high degree of acceptance and satisfaction of the MEEP program by all stakeholders and that the proposed goals have been achieved with success. According to assessment results, we can reach the following conclusions:

1. The MEEP program provides real life experience, including development of communication and teamwork skills in students.
2. The MEEP program's quality is superior to other programs.
3. Industries are more likely to hire students that have taken MEEP courses.
4. Goals and objectives of the partnership were achieved through good teaming efforts among participating institutions.
5. Industrial participation played an important role in program development, support, implementation and assessment, and provided strategic guidance.
6. Although MEEP courses are more motivating, they seem to require more time and effort from students.
7. Learning Factory facilities seem to be providing the appropriate learning environment for the students.
8. Outreach to other institutions should be increased.

9. Faculty perceptions about the relevance and impact of MEEP in their professional careers do not match outcomes (awards, promotions).
10. MEEP faculty perceive that administrators do not give proper recognition or importance to educational projects compared to traditional research activities.

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 for peers and students, in addition to continuing the assessment of current and future activities.

Furthermore, it is critical 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 quantitatively 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 implementing a longitudinal study of the project's outcomes.

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Table 1. Quantitative Measures of Project Success

CURRICULUM DEVELOPMENT	INTEGRATED LEARNING FACTORY (ILF)	INDUSTRIAL PARTNERS	OUTREACH
number of new courses developed	resource acquisition /donations	number of industrial partners in the Industry Advisory Board	number of courses developed suitable for transfer or distance learning
number of existing courses modified to use the Learning Factory	student usage	number of program graduates recruited by industrial partners	number of outreach institutions
number of students choosing to take new courses	projects or process activities	number of courses/hours provided to partners in continuing education	number of courses utilized by other institutions
number of faculty and staff involved in the project	shared use within the institution	number of hours that industrial partners participate in education programs	number of students participating in outreach activities
number of placements	training activities	number of students enrolled in internship programs	number of journal papers and presentations
number of industrial projects integrated into the capstone design course		number of industrial projects	number of participants in annual workshops
number of "engineers in the classroom", seminars and lectures by visiting professionals		number of co-authored papers between faculty and industrial partners	outreach activities in the Learning Factory
number of courses or modules transferred internally			
number of requests for information or course modules by other institutions			

Table 2. Overall Assessment Design Matrix

TASK	GOALS AND OBJECTIVES	STAKE-HOLDERS		
		Student	Faculty	Industry/ others
	• Develop a new interdisciplinary, practice-based curriculum which emphasizes the interdependency of manufacturing and design in a business environment	X	X	X
Curriculum Development	• Develop a new paradigm for coalition-wide course development, sharing and exporting 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
	• Implement the Integrated Learning Factory (ILF) to support curriculum activities locally and across the partnership	X	X	X
Integrated Learning Factory	• 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

	• Establish a local Industrial Advisory Board		X	X
	• Create a liaison that will interact with the coalition task leader for Industrial Partnership		X	X
Industrial Partners	• Expand the industrial sponsor base	X	X	X
	• Coordinate the development of industrial based projects for undergraduate students and exchange programs 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 3. Curriculum Development Matrix (sample)

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	Respondent (students, faculty, industry)	Schedule*
1a. Did the program allow students to practice their engineering science fundamentals in the solution of real problems?	Questionn-aire (Q) or Focus Group (FG) Samples	S, F, I	
1b. Are professional communication and team skills taught and learned?	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 students take courses with students from disciplines other than engineering?	Q or FG	S	
1g. Did faculty 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 in curriculum development?	Q or FG Samples	S, F	
2d. Did you participate with partnership professors to develop course materials? How effective?	Q or FG	F	

***** assessments all carried out at the conclusion of the project

Table 4: 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 University, 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 (Not Applicable) circle.

5 - Strongly Agree 4 - Agree 3 - Neutral 2 - Disagree 1 - Strongly Disagree N/A

The program allowed students to practice engineering science fundamentals in the solution of real problems.	5	4	3	2	1	N/A
Professional communications skills were enhanced.	5	4	3	2	1	N/A
Teamwork skills were enhanced.	5	4	3	2	1	N/A
The partner schools learned from each other's experience.	5	4	3	2	1	N/A
Resources and ideas were shared, avoiding redundant efforts.	5	4	3	2	1	N/A
Real life problems were provided.	5	4	3	2	1	N/A
New technologies for communication were utilized on curriculum content.	5	4	3	2	1	N/A
The local Industrial Advisory Board (IAB) provided quality strategic and operation guidance to the local institution.	5	4	3	2	1	N/A
The local IAB supported MEEP's activities providing financial and/or non-financial resources.	5	4	3	2	1	N/A

There was good communication between industrial sponsors and the institution.	5	4	3	2	1	N/A
Each institution provided the IAB the right information in a timely fashion.	5	4	3	2	1	N/A
The MEEP's Industrial Advisory Board (IAB) evaluated the overall progress of the program.	5	4	3	2	1	N/A
The partnership reported progress and activities related to participation in curriculum development.	5	4	3	2	1	N/A
The MEEP's IAB provided support in actions/activities that are relevant to the program.	5	4	3	2	1	N/A
The partnership reported progress and activities related to participation in the classroom teaching.	5	4	3	2	1	N/A
Students completing the MEEP program are more useful to our industry.	5	4	3	2	1	N/A
My industry and company is more likely to hire a MEEP trained student than a traditionally trained student.	5	4	3	2	1	N/A

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

What can be improved with MEEP?

Comments:

Table 5. Survey Participants

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 faculty evaluators • 1 Sandia National Labs	3
TOTAL	**181**