AC 2012-5551: MANUFACTURING WORKFORCE: REPORT ON NSF-ATE PROJECT PERTAINING TO MECHATRONICS TECHNICIAN DEVELOPMENT

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Mr. Aco Sikoski, Ivy Tech Community College

Aco Sikoski completed his bachelor's of science in electrical engineering in June of 1990, majoring in industrial control. After completing his course work at the University of Kiril I Metodi, Skopje, Macedonia, he transferred to the United States in 1991, where he continued his engineering education at Purdue University. He obtained a master's of science degree in engineering in 2003. In the meantime, he worked as a project engineer for an engineering consulting company and as an adjunct faculty at Ivy Tech Community College. Intermittently, Sikoski has performed consulting for various institutions and organizations. In 1997, he started his career at Ivy Tech Community College, where he stayed until present. First, he started as an instructor in design technology and then as a Dean of the School of Technology. Sikoski has worked with NSF grants and projects as a Co-PI. Sikoski also served as an ATMAE Evaluator.

Mr. Branislav Rosul, College of DuPage

Branislav Rosul completed his bachelor's of science in mechanical engineering in Feb. of 1984, majoring in control systems. Soon after, he started to work as an instrumentation engineer in Teleoptic, Belgrade, where he stayed for three years working on the instrumentation design and as a Project Engineer. During that time, he worked on instrumentation and technology development of various industrial processes, from food to petrochemical and still industry. Academically, he continued on toward the master of science in electrical engineering at University of Belgrade. After completing his course work at the Belgrade University, he transferred to the United States in 1987, where he continued his work in the Controls area and robotics at the University of Illinois in Chicago. He obtained a master's and then a doctorate in the area of robot control and modeling of multibody systems in 1997 at the same school. In the meantime, he worked as an instructor at Oakton Community College and the University of Illinois. Occasionally, Rosul has performed consulting for various institutions and organizations. In 1992, he started his career at the College of DuPage, where he stayed until present. First, as an instructor in electro-mechanical technology and manufacturing technology and then as a coordinator in electronics technology. In addition to practical engineering experience, Rosul has significant teaching and research background. As a PI and Co-PI, Rosul has extensively worked with NSF on several grants and projects. Currently, Rosul serves as an ABET evaluator for IEEE society.

Manufacturing Workforce - Report on NSF-ATE Project Pertaining to Mechatronics Technician Development

Introduction

The National Science Foundation (NSF) has awarded an Advanced Technical Education (ATE) grant to three partnering institutions in two states, Illinois and Indiana, for the project, *"Meeting Workforce Needs for Mechatronics Technicians."* These institutions are: Ivy Tech Community College-Northwest Region (Ivy Tech), IN; College of DuPage (COD), IL, and Purdue University Calumet (PUC), IN. The lead institution for this ATE project is PUC in Hammond, Indiana, an area known for having several heavy industries, such as steel companies and oil refineries. All three institutions are conveniently located within 50 miles of each other, thus augmenting faculty interaction and student participation. The student enrollments at these institutions are: over 10,000 at PUC, over 8,000 at Ivy Tech, and more than 28,000 at COD.

The NSF-ATE project goals are: 1) augment and reorganize existing electrical and mechanical engineering technology courses into thirty-two enhanced modules at three different tiers, 2) incorporate experiential learning in each module level so that the modules are meaningful and practical, and 3) incorporate innovative delivery of lecture and laboratory materials.

The innovative aspects of this project are: a) meet student learning needs based on their diverse educational background, b) provide multiple delivery options, c) complete modules (rather than courses) to receive college credit(s) or certificate(s), and d) provide seamless transition among partnering institutions in their respective degree programs. The major focus of the project are in two areas: 1) augment and enhance existing courses in modular forms at various tiers and disciplines, with majority of the material being already available from existing courses, and 2) develop and implement a continuous improvement plan based on assessment and evaluation of learning outcomes for each module.

Expected deliverables from the project are: Thirty-two, 2- or 4-week modules that carry crossover concepts among electrical, mechanical, and computer topics. The modules are to be progressive in level of difficulty and transferable from one discipline to another. At least fifty percent of these modules are to have experiential learning components. The innovative delivery methods of the modules include: remote interactive delivery, synchronous online delivery, remote laboratory functions, asynchronous delivery, and delivery using virtual classroom with students having 24/7 remote access anytime, anywhere, and on any platform.

This paper describes the progress made in the project's first 16 months in terms of innovation, module development, level of participation, industry partnership, experiential learning, and college credits for participants. It also describes the outcomes related to the project goals through formative measures, and subjective assessments.

Background and Rationale for the Project

There is a large gap between student preparedness and regional opportunities in engineering/manufacturing technology. The need for multi-disciplinary programs addressing the industry need for graduates who can be multi-task oriented and understand the whole system is increasing as technology improves. Furthermore, many workers in the largest manufacturing industries in Northwest Indiana and greater Chicago region are retiring. These industries have been in serious need for engineering technicians who understand their systems better and are prepared to perform from the first day on the job. Additionally, a large number of packaging companies in this region have expressed a desperate need for graduates who can understand Mechatronics systems.

United States Department of Labor has acknowledged the importance of mechatronics to the packaging industry and to the US economy by publishing a hybrid-industry, packaging-oriented mechatronics competency model on the Career One Stop website (US DOL, 2009). "The National Council on Competitiveness estimates that 100 million new jobs will be created in the 21st century at the intersection of disciplines rather than in individual disciplines (Vanston et. Al., 2007)." Mechatronics is such a discipline-it integrates topics from mechanical, electrical, computers, and controls as applied to the manufacturing environment.

One of the focus areas of this project is to target the underrepresented population (Hispanics, Asian, and African American) of Northwest Indiana and the greater Chicago area. Currently, 33% of PUC students are in this group, and 57% of the student populations are female. Enrollment at the COD consists of 32% underrepresented population and 55% of total enrollment is female. Ivy Tech has 59% female students and 34% of Hispanics and African American. Additionally, 54% of Ivy Tech students receive Pell Grants that mirror the poverty of the area.

Many students leave college to pursue the reward of immediate income-producing employment, forgoing the long-term gains of higher education. Also, many of these students encounter family pressures to go to work. For the first generation college students, and to increase the retention rate, there needs to be explicit rewards over and beyond those of learning for its own sake. Therefore, there is need for a program that presents an opportunity for both career-enhancing work and education. The NSF-ATE project with an experiential learning component and certificate of completion at the beginner, intermediate, and advanced levels provides such rewards.

Electro-mechanical, manufacturing, and Mechatronics fields are often perceived as unappealing, and the reality of today's manufacturing environment is a surprise to students who encounter the clean and technology-driven environments through field experiences. "Student support" can mean, among other things, providing students with these first-hand experiences, as they cannot easily gain such experience on their own. Contemporary engineering/manufacturing technology education also demands that instructors interact with local industry and government to know what resources are available, and to remain current as their field evolves. This project provides and facilitates such opportunities.

Modularization of course and benefits of industrial partnership

Modularization of course materials is desirable for industry professionals who may not need all the topics covered in a course. Traditional students also benefit from modularized delivery because each module usually has a smaller number of learning activities and learning outcome expectations compared to a semester-long course. Modular courses are assessed, evaluated and modified for continuous improvement during and at the end of the delivery of each module. Such assessment and evaluation would clearly indicate if the learning outcomes are met for each module. Also, modules are sequential, and thus ensuring each student's preparation for taking the next module. For traditional students, *"Modularization of course content may allow students to earn variable credit based on how many modules they successfully complete by the close of the term, thus reducing the number of course repetitions. Students complete the remaining modules in the next term."* (RPI, 2009) Furthermore, the modules are focused on topics, thus students will benefit from faculty expertise in that focused area.

Benefits of the industry partnership are: 1) well-educated workforce specific to industry needs, 2) experiential learning opportunities for students at the industrial facilities, 3) employment of students at different competency levels as determined by the level of certificates, 4) paid internships for participating students, 5) gift-in-kind support for laboratory enhancement, 6) advisory support in module development, and 7) support for faculty professional development

Project progress in first 16 months

The module delivery schedule for the first year of the project is shown in Table 1a. Table 1b shows the number of participants taking different modules. The innovative aspects of the modular curriculum and first year outcomes are shown in Table 2. Five students (from Ivy Tech, and three students from PUC who have completed module 1-1 and module 1-2 during the first year have received college credit as indicated on their transcripts.

Module	Module Title	Contact hours percent		Responsibility
		Lect	Lab	
1-1	DC Electrical systems	50	50	Ivy Tech
1-2	AC Electrical Systems	50	50	Ivy Tech
1-3	Analog Electronics	50	50	COD
1-4	Digital electronics	50	50	COD
1-5	Fundamentals of Hydraulics and Pneumatics	60	40	Ivy Tech
1-6	Fluid Circuits w/o Elec. Control	50	50	Ivy Tech
1-7	Introduction to Mechanics I	100	0	Ivy Tech
1-8	CAD	30	70	COD
1-9	Blue Print Reading (Elect & Mech)	40	60	COD
1-10	Programmable Logic Controllers (PLC) Architecture	50	50	PUC
Internships (Experiential		0	100	Ivy Tech

Table 1a**.** Module delivery schedule for the first year

Module	COD	Ivy Tech	PUC	Total
1-1		20	10	30
1-2		16	9	25
1-3	1		9	10
1-4	1		8	9
1-5	1	7	2	10
1-6	1	6	2	9
1-7	4	14	10	28
1-8	1			1
1-9	1			1
1-10	Being offered in Spring 2012			

Table 1b**.** Number of participants taking different modules
Note: The Table 1b. represents data from the inception of the project through 12/31/2011

Organizations that have been involved as partners with the project during the first year are: UGN Inc., KSM Inc., Oystar RA Jones, Morrison Container Handling, Rockwell Automation, Mitsubishi Electric Automation, ARPAC, and Triangle Packaging. Project progress is shown in terms of each goal and corresponding objectives in the Table 3a,3b,3c,and 3d.

Innovative aspects	*Outcomes in first year*
I. Meet student learning needs based on their diverse educational background	• Student participants in the projects have academic background in *Electricity, Print reading, and CAD systems*
II. Provide multiple delivery options	• Polycom Technology, DVD's , PowerPoint presentations
III. Complete modules (rather than courses) to receive credit or certificate(s)	• Six participants from Ivy Tech Community College have already received college credits after completing the modules
IV. Provide seamless transition among partnering institutions in their respective degree programs	• Articulation agreements are being processed among Purdue University Calumet, College of DuPage, and Ivy Tech Community College for Mechatronics Engineering technology Program

Table 2**.** Innovative aspects of the modular curriculum and first-year outcomes

Example of assessment and improvement of modular delivery and modules

The NSF-ATE project requires: 1) tracking course quality for continuous improvement and 2) assessing project staff member's performance related to module delivery. Following are the

assessments, improvement actions, and results for Analog Electronics (Module 1-3) and Digital Electronics (Module 1-4).

The above modules were delivered by faculty members at COD and made available over the Internet to COD students, IVY Tech students and PUC students. Modules 1-3 and 1-4 were taught twice from COD in 2011 (*following the sequence behind modules 1-1 and 1-2, which were taught from Ivy Tech*). Each of these four modules (1-1 through 1-4) consisted of four class meeting times. Each class meeting consisted of two hours of lecture (video) followed by two hours of lab (overseen by a local lab assistant). In Spring 2011, module 1-3 was taught on four consecutive Fridays beginning March 18, 2011, and module 1-4 was taught on four consecutive Fridays beginning April 22, 2011. In Fall 2011, module 1-3 was taught on four consecutive Wednesdays beginning October 19, 2011. Module 1-4 was also taught on Wednesdays: Nov. 16, Nov. 30, Dec. 7, and Dec. 14, 2011.

The modules delivered in the Spring session utilized COD's existing television studio equipment and the modules delivered in the Fall session used the Polycom technology. The Spring session was physically taught from two locations at COD: the main studio and the library. Although, there was a good support from COD's television department, it was difficult to present the course because no computer (with appropriate software) was available and equipment, such as oscilloscopes, had to be transported. However, in the Fall, modules 1-3 and 1-4 were taught using Polycom technology that was placed in one of COD's electronics classrooms. This was indeed a great improvement. The Polycom technology enabled the following during the module delivery, 1) move among 3 preset camera positions, 2) PC output (Internet and electronics software use), 3) overhead projector use, and 4) video segments from DVD. Although, the multiple camera shots, video DVD segments, and overhead were used in the Spring session, it was much more convenient using the Polycom technology in the electronics classroom/lab area.

The Co-PI (a faculty member at COD) of the project had suggested that the students would prefer a "project" rather than the traditional lecture/lab, so in the Fall session, the instructor (*who delivered module 1-4*) incorporated project-based learning in Digital Electronics (Module 1-4). For example, a project using Field Programmable Gate Arrays (FPGA) allowed students to learn the basic concepts of digital electronics. Students were exposed to state-of-the-art technology while learning the basic concepts with TTL/CMOS chips. Based on this experience, the instructor plans to include projects in both Module 1-3 and Module 1-4 in the future. For the digital course (Module 1-4), the plan was to enable the project to be constructed either using FPGA software and hardware or traditional TTL/CMOS breadboard setups. This way the students and lab instructors at the remote locations could determine and pick (*one of the two options*) based on the particular need/interest of the students at their locations. This was possible because the instructor used the graphical/schematic entry form of the FPGA software (i.e. used traditional 7400 series chips emulated in software). During the Spring session, the instructor received good interaction from both the local COD students, as well as the students at the remote locations, Ivy Tech and PUC.

Dissemination through Conference Presentation and Conference Proceedings Article

NSF-ATE projects require dissemination of information pertaining to the project. The following two articles related to the NSF-ATE project were presented and published in the conference proceedings during the first year of the project:

- *Latif, N.*, Wilson, N., (2011). "Industry Education Partnership: Mechatronics Engineering Technology Program Development"[CD-ROM]. Proceedings of the Annual Conference of the American Society for Engineering Education,Vancouver, BC., Canada
- *Latif, N.*, Zahraee, M., Sikoski, A., Rosul, B., (2011)"Modular Curriculum Development for Mechatronics Technicians" [CD-ROM]. Proceedings of the Annual Conference of the American Society for Engineering Education,Vancouver, BC., Canada

References

1. College of DuPage (2008) http://www.cod.edu/Academic/AcadServ/AQIP/overview.pdf
2. Purdue University Calumet (2008) http://webs.calumet.purdue.edu/strategicplan/
3. Ivy Tech State College (2008) http://www.ivytech.edu/institutional-research/Profiles/Region_1_Fall_EOT_Trends_Complete.pdf
4. US Department of Labor DOL (2009) http://www.careeronestop.org/CompetencyModel/pyramid.aspx?ME=Y (Competency model website)
5. RPI (2009) http://www.center.rpi.edu/Workshops/Generic/Workshop%20I%20Packet%20(Generic).pdf
6. Vanston, J.H., Elliott, H, Brazell, J, Evans,E, Irwin, J, and Bettersworth, M.(2007). Mechatronics –A Technology Forecast. *Texas State Technical College, July 2007*

Table 3a. Goal and outcomes for corresponding objectives (first-year of project)

FORMATIVE MEASURES **Evaluation Matrix by Objectives**						
Activity Objectives	Measure	Responsible Personnel	Prescriptive Actions	Expected Outcome	Objectives Met/Not met	**Outcomes**
Goal one: Augment and reorganize six to eight existing electrical and mechanical engineering technology courses into thirty enhanced modules at three different tiers. Completion of all modules at each level will allow them to receive a certificate of completion at levels I, II, and III.						
Objective 1: Form an advisory board including all constituencies within to help with input towards development of modules. This board should include membership from faculty of both Ivy Tech and PUC, all companies and industry which have committed to internship and experiential learning, and other regional companies that are deemed to benefit from this project. This board should meet twice per year.	1. Number of Advisory board members 2. Representative number of companies and educational institutions	Principal Investigator and other project team members	Meet with representatives from constituencies (educational institutions and industries hiring interns) and invite key individuals to be on the advisory board Communicate with the advisory board members on a continuous basis and at least formally twice per year	1. at-least a 15 member advisory board to be formed within the first three months. 2. At least three industry representative, three community college representatives, and two H.S. representatives to be on board within the first year. This number to be maintained over the life of the project.	1. This objective has been met. 2. This objective has been met.	1. An advisory board with 16 members has been formed . PUC, IvyTech and COD participated in forming the advisory board 2. Nine industry representatives, three community college representatives, two high school representative.
Objective 2: Develop 8 to 12 modules per year, starting from level-one (beginner's level) modules.	1. Number of modules developed	Individual faculty in charge of modules	Decide the modules to be developed and existing courses from which the module will be created from Faculty to develop the modules to enhance the existing course(s) and modularize the	At least 8 modules to be developed per year.	1. This objective has been met.	Module 1-1, 1-2, 1-3, 1-4, 1-8,1-9, have been developed Module 1-5, 1-6, 1-7, 1-10 are being developed in Summer 2011 to delivered in Fall 2011

Table 3b. Goal and outcomes for corresponding objectives (first-year of project)

Objective 3: Deliver nine modules in year one, followed by ten modules in year two and eleven in year three. Delivery of modules may lag the development by a few months	1. Number of modules delivered 2. Number of students using the modules	Principal investigator, assessment coordinator, and project evaluator	Track the number of modules and number of student in modules.	1. At least 8 modules in first year and at least 10 modules each in years two and three to be delivered. 2. A reasonable number of students to take these modules to ensure sustainability of the project.	1. This objective is partially met 2. This objective is partially met	• Four modules have been delivered. 1-1, 1-2 from IvyTech; 1-3,1-4 from College of DuPage • Module 1-8 and 1-9 have been delivered from College of DuPage *The grant was received on August 1, 2010; a-month later than the scheduled starting date in the proposal. Therefore, out of nine modules, six modules were delivered*

Table 3c. Goal and outcomes for corresponding objectives (first-year of project)

***Goal Two*: Incorporate *experiential learning* in each module level so that the modules are meaningful, practical, and interesting to students and professionals.** *Note: Assessment and evaluation of experiential learning will follow the guidelines established by the National Society of Experiential Education (see details under assessment section)*						
Objective 1: To provide 10 internship opportunities in industry in year one, 15 in year two, and 20 in year 3 of the project.	1. Number of internships and other means of employment and experiential learning for students 2. Satisfaction of interns 3. Satisfaction of employers	PI and Co-PIs Faculty delivering the modules PUC and Ivy Tech offices of student employment and activities Advisory Board members representing industry	Meet with industry representatives within the region to develop partnerships. Through the office of student employment and activities, monitor the internships. Develop and conduct evaluation of the internship experience and assess the internship by surveying students and employers	1. 10 internship opportunities in first year, 15 in second year, and 20 in third year of the project. 2. Survey all interns at the end of each internship period. The outcomes should pass the 70% satisfaction rate 3. Survey all employers at the end of each internship period. The outcomes should pass the 70% satisfaction rate.	1. This objective is partially met 2. Not applicable at this time 3. Not applicable at this time	• One internship through IvyTech Community College in the company UGN Inc. • One internship through College of DuPage in the company KSM Inc. • One internship through Purdue University Calumet in the company Oystar Jones company.
Objective 2: To expand the companies supporting internship and hiring interns from at-least three companies in year one to at-least 5 companies in year two and 7 companies in final year of the project.	1. Number of companies hiring interns	PI and Co-PIs Office of student employment and activities	Invite industry representatives to an annual open house, present the program, its outcomes and objectives, and ability of its graduates. Develop a brochure, highlighting the program, its graduates, and program outcomes	1. At the end of the first year, three companies should be providing internships. 2. At the end of second year, employing companies should be at least five and this number should be at least seven at the end of third	1. This objectives have been met 2. Not applicable at this time	

Table 3d. Goal and outcomes for corresponding objectives (first-year of project)

Goal Three: Incorporate ***innovative delivery*** of lecture and laboratory material. This includes: remote interactive delivery, synchronous online delivery, remote laboratory functions, asynchronous delivery, and delivery using virtual classroom with students having 24/7 remote access anytime, anywhere, and on any platform.						
Objective 1: To deliver each module using one of the delivery methods mentioned after piloting the module	1. Number of modules using innovative delivery approach 2. Number of students using the aforementioned delivery approach.	PI and Co-PIs Faculty in charge of module Academic and/or industrial advisors	Faculty needs to incorporate non-conventional delivery approach into each module Academic advisors need to advice students to take advantage of the modularized courses	At least 50 % of the delivered modules in each year should be using the innovative delivery approach.	1.This objectives have been met. 1.This objectives have been met.	1. Four modules have been delivered using the Polycom technology 2. Following number of students participated 1-1 Ten students 1-2 Nine students 1-3 Nine students 1-4 Eight students
Objective 2: Implement the delivery of these modules from the source institution to other partners with reasonable rate of increase of modules being delivered in multiple ways. This rate will be decided after the first year	1. Number of modules delivered outside each responsible institution. 2. Number of students outside the responsible institution.	Assessment Coordinator PI Academic and/or industrial advisors	Data to be collected at the end of each module.	1. These targets to be developed after an initial baseline and an expected target is established at the conclusion of the first year.	1. Not applicable at this time	
Objective 3: Market and offer a reasonable number of basic modules to area high school students using at least one innovative delivery method	1. Number of modules delivered to high schools each year. 2. Number of HS students taking these modules and getting	Academic Advisors	Academic advisors and recruiters should highlight the advantage of modules in their recruitment events.	Baseline to be established after the first year.	1. Not applicable at this time 2.Not applicable at this time	

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FORMATIVE MEASURES Table VI: Evaluation Matrix by Objectives						
Activity Objectives	Measure	Responsible Personnel	Prescriptive Actions	Expected Outcome	Objectives Met/Not met	**Outcomes**
Goal one: Augment and reorganize six to eight existing electrical and mechanical engineering technology courses into thirty enhanced modules at three different tiers. Completion of all modules at each level will allow them to receive a certificate of completion at levels I, II, and III.						
Objective 1: Form an advisory board including all constituencies within to help with input towards development of modules. This board should include membership from faculty of both Ivy Tech and PUC, all companies and industry which have committed to internship and experiential learning, and other regional companies that are deemed to benefit from this project. This board should meet twice per year.	1. Number of Advisory board members 2. Representative number of companies and educational institutions	Principal Investigator and other project team members	Meet with representatives from constituencies (educational institutions and industries hiring interns) and invite key individuals to be on the advisory board Communicate with the advisory board members on a continuous basis and at least formally twice per year	1. at-least a 15 member advisory board to be formed within the first three months. 2. At least three industry representative, three community college representatives, and two H.S. representatives to be on board within the first year. This number to be maintained over the life of the project.	1. This objective has been met. 2. This objective has been met.	1. An advisory board with 16 members has been formed . PUC, IvyTech and COD participated in forming the advisory board 2. Nine industry representatives, three community college representatives, two high school representative.
Objective 2: Develop 8 to 12 modules per year, starting from level-one (beginner's level) modules.	1. Number of modules developed	Individual faculty in charge of modules	Decide the modules to be developed and existing courses from which the module will be created from Faculty to develop the modules to enhance the existing course(s) and modularize	At least 8 modules to be developed per year.	1. This objective has been met.	Module 1-1, 1-2, 1-3, 1-4, 1-8,1-9, have been developed Module 1-5, 1-6, 1-7, 1-10 are being developed in Summer 2011 to delivered in Fall 2011

			the course for mechatronics curriculum			
Objective 3: Deliver nine modules in year one, followed by ten modules in year two and eleven in year three. Delivery of modules may lag the development by a few months	1. Number of modules delivered 2. Number of students using the modules	Principal investigator, assessment coordinator, and project evaluator	Track the number of modules and number of student in modules.	1. At least 8 modules in first year and at least 10 modules each in years two and three to be delivered. 2. A reasonable number of students to take these modules to ensure sustainability of the project.	1. This objective is partially met 2. This objective is partially met	• Four modules have been delivered. 1-1, 1-2 from IvyTech; 1-3,1-4 from College of DuPage • Module 1-8 and 1-9 have been delivered from College of DuPage *The grant was received on August 1, 2010; a-month later than the scheduled starting date in the proposal. Therefore, out of nine modules, six modules were delivered*
Goal Two*:** Incorporate ***experiential learning in each module level so that the modules are meaningful, practical, and interesting to students and professionals. *Note: Assessment and evaluation of experiential learning will follow the guidelines established by the National Society of Experiential Education (see details under assessment section)*						
Objective 1: To provide 10 internship opportunities in industry in year one, 15 in year two, and 20 in year 3 of the project.	1. Number of internships and other means of employment and experiential learning for students 2. Satisfaction of interns 3. Satisfaction of employers	PI and Co-PIs Faculty delivering the modules PUC and Ivy Tech offices of student employment and activities Advisory Board members representing industry	Meet with industry representatives within the region to develop partnerships. Through the office of student employment and activities, monitor the internships. Develop and conduct evaluation of the internship experience and assess the internship by surveying students and	1. 10 internship opportunities in first year, 15 in second year, and 20 in third year of the project. 2. Survey all interns at the end of each internship period. The outcomes should pass the 70% satisfaction rate 3. Survey all employers at the end of each internship	1. This objective is partially met 2. Not applicable at this time 3. Not applicable at this time	• One internship through IvyTech Community College in the company UGN Inc. • One internship through College of DuPage in the company KSM Inc. • One internship through Purdue University Calumet in the company Oystar Jones company.

			employers	period. The outcomes should pass the 70% satisfaction rate.		
Objective 2: To expand the companies supporting internship and hiring interns from at-least three companies in year one to at-least 5 companies in year two and 7 companies in final year of the project.	1. Number of companies hiring interns	PI and Co-PIs Office of student employment and activities	Invite industry representatives to an annual open house, present the program, its outcomes and objectives, and ability of its graduates. Develop a brochure, highlighting the program, its graduates, and program outcomes	1. At the end of the first year, three companies should be providing internships. 2. At the end of second year, employing companies should be at least five and this number should be at least seven at the end of third year.	1. This objectives have been met 2. Not applicable at this time	
Objective 3: To assure that at least 50% of developed modules include an experiential learning component	Number of modules having experiential learning components	Faculty developing each module.	Faculty should be in continuous communication with advisory board members and other industry representatives to assure the existence of meaningful practical experiences within each module.	At least 50% of all modules will have an experiential learning component built into them.	1. This objectives have been partially met	
Goal Three: Incorporate ***innovative delivery*** of lecture and laboratory material. This includes: remote interactive delivery, synchronous online delivery, remote laboratory functions, asynchronous delivery, and delivery using virtual classroom with students having 24/7 remote access anytime, anywhere, and on any platform.						
Objective 1: To deliver each module using one of the delivery	1. Number of modules using innovative delivery	PI and Co-PIs Faculty in charge of	Faculty needs to incorporate non-conventional delivery	At least 50 % of the delivered modules in each year	1.This objectives have been met.	1. Four modules have been delivered using the Polycom technology

methods mentioned after piloting the module	approach 2. Number of students using the aforementioned delivery approach.	module Academic and/or industrial advisors	approach into each module Academic advisors need to advice students to take advantage of the modularized courses	should be using the innovative delivery approach.	1.This objectives have been met.	2. Following number of students participated 1-1 Ten students 1-2 Nine students 1-3 Nine students 1-4 Eight students
Objective 2: Implement the delivery of these modules from the source institution to other partners with reasonable rate of increase of modules being delivered in multiple ways. This rate will be decided after the first year	1. Number of modules delivered outside each responsible institution. 2. Number of students outside the responsible institution.	Assessment Coordinator PI Academic and/or industrial advisors	Data to be collected at the end of each module.	1. These targets to be developed after an initial baseline and an expected target is established at the conclusion of the first year.	1. Not applicable at this time	
Objective 3: Market and offer a reasonable number of basic modules to area high school students using at least one innovative delivery method	1. Number of modules delivered to high schools each year. 2. Number of HS students taking these modules and getting advance credit	Academic Advisors	Academic advisors and recruiters should highlight the advantage of modules in their recruitment events.	Baseline to be established after the first year.	1. Not applicable at this time 2.Not applicable at this time	