

**AC 2007-1210: DEVELOPMENT OF A INDUSTRY-DRIVEN ASSOCIATE  
DEGREE IN PRECISION MANUFACTURING TECHNOLOGY**

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# **DEVELOPMENT OF AN INDUSTRY-DRIVEN ASSOCIATE DEGREE IN PRECISION MANUFACTURING TECHNOLOGY**

## **Abstract**

This paper describes the development of a unique educational program that addresses an industry need for workers trained in precision manufacturing techniques. Penn State University, Community College of Allegheny County, and MAGLEV, Inc. have partnered to develop a unique associate degree in Precision Manufacturing Technology (PMT). During their first three semesters, students will build expertise in foundational classes such as physics, statistics, algebra, and dynamics, which they take at the Community College of Allegheny County. In the final, fourth semester, students will enroll at Penn State and complete the requirements for their associate degree with specialized hands-on training at the state of the art MAGLEV Precision Fabrication Center in McKeesport. Penn State and MAGLEV have partnered to develop six courses in Advanced Laser Radar Metrology, Weld Distortion Control and Cutting Technology and Advanced Weld Robotics. These courses are taught by MAGLEV engineers under the direction and monitoring of Penn State faculty. After these courses are completed, the 18 credits are transferred to CCAC where the students are awarded an associate degree in Precision Manufacturing Technology.

A second program has been developed for students majoring in engineering at Penn State. This is a certificate program designed for students who wish to supplement their major field of study with knowledge of precision manufacturing techniques, leadership concepts, management principles and practices. The certificate consists of twelve total credits, including three internship courses taught at MAGLEV.

## **Background**

The fabrication industry in the United States is facing a twofold problem - antiquated processes that cannot compete in the global market, and a shrinking workforce. High school students are not considering fabrication a viable career option because it is seen as a dying technology. Some 64 million baby boomers are poised to retire in large numbers by the end of this decade. This group accounts for over 40 percent of the U.S. labor force. The U.S. Bureau of Labor Statistics reports that by 2010, the number of unfilled skilled worker posts will reach 5.3 million, increasing to 14 million by 2015. Rapidly advancing technology will heavily influence the trends shaping the workplace of the future. All studies that look to the education and skills needs of today's workers conclude that employers require more education and more technical skills from their employees. In today's economy, skill development and education must be a life long process as new technologies and innovations demand ever changing skill sets. As plants introduce new manufacturing processes, information technologies, and equipment in order to stay competitive, employee development has become even more critical. In addition, universities cannot afford the high cost of specialized and advanced manufacturing equipment.

Southwestern Pennsylvania is one of the finalists for a major Federal Railroad Administration project to construct the nation's first magnetic levitation ground transportation system (maglev). The 54-mile system proposed by the Pennsylvania Project links Pittsburgh International Airport to downtown Pittsburgh, Monroeville, and Greensburg. This project provides an opportunity to evaluate the feasibility of deploying a high-speed maglev ground transportation infrastructure across

the U.S. Building a maglev system will require manufacturers and steelmakers to roll out newer, faster, and more efficient technologies—and it will require a highly capable workforce.

During the past three years, Penn State University (Greater Allegheny Campus), Community College of Allegheny County (CCAC), and MAGLEV, Inc. have developed two unique programs in Precision Manufacturing Technology (PMT). The first program is an associate degree in PMT that involves Community College of Allegheny County, MAGLEV and Penn State. The second is a Precision Manufacturing Management program for four-year engineers that has been developed by MAGLEV and Penn State.

### **PMT Associate Degree**

MAGLEV, Inc., CCAC and Penn State University began the development of a unique associate degree in 2004. It was determined that each group had unique capabilities and that the optimum approach was for each organization to do what they do best. CCAC would develop the courses for the first three semesters. MAGLEV engineers would develop with Penn State faculty six PMT courses for the fourth semester. Penn State would obtain PSU Faculty Senate approval and MAGLEV engineers and Penn State faculty would teach the six courses at the MAGLEV manufacturing facility. During their first three semesters, students will build expertise in foundational classes such as physics, statistics, algebra, and dynamics, which they take at the Community College of Allegheny County. Those with the appropriate background will be able to test out of the first three semesters. The schedule of courses for the first three semesters is as follows:

#### **First Semester**

Introduction to Parametric Modeling	(3 credits)
Introduction to Electronics	(3 credits)
Engineering Seminar	(1 credit)
Mathematics for the Technologies 1	(4 credits)
Technical Physics 1	(3 credits)
<u>Technical Computing</u>	<u>(3 credits)</u>
Total Credits	17

#### **Second Semester**

Introduction to Chemistry	(4 credits)
English Composition 1	(3 credits)
History of American Labor	(3 credits)
Mathematics for the Technologies 2	(4 credits)
<u>Engineering Materials</u>	<u>(4 credits)</u>
Total Credits	18

#### **Third Semester**

Technical Communications	(3 credits)
Geometric Dimensioning & Tolerancing	(1 credit)

Statics	(4 credits)
Manufacturing Processes	(4 credits)
Programmable Logic Controllers	(4 credits)
<u>Oral Communication</u>	<u>(3 credits)</u>
Total Credits	19

All of these courses were already developed and were being taught in other Technology programs at CCAC. In the final, fourth semester, students will enroll at Penn State and complete the requirements for their associate degree with specialized hands-on training at the state-of-the-art MAGLEV Precision Fabrication Center in McKeesport. This recently established research and development production facility will give students the chance to learn some of the most advanced fabrication processes in the world, in a unique environment. Penn State and MAGLEV have partnered to develop six courses in Precision Manufacturing Technology as follows:

- 3D Modeling for Manufacturing & Software Integration
- Computer Aided Manufacturing
- Welding, Robotic Welding, Shop Procedures and Safety
- Metrology & Measurement Data Processing
- Basic Engineering Design & Welding / Fabrication Distortion Mitigation
- Precision Manufacturing Technology Capstone

Each of these courses is 3 credits and consists of two hours of lectures per week and 2 hours of laboratory experience per week. These courses have been jointly developed by Penn State faculty and MAGLEV engineers. This was a year-long process where PSU provided expertise on course organization and teaching requirements and MAGLEV engineers provided the technical content and the labs. Both groups worked to select proper textbooks. Two of the courses will be taught by Penn State faculty and Penn State will provide a program coordinator to organize and monitor all of the courses. The remaining courses will be taught by MAGLEV, Inc., engineers serving as PSU adjunct faculty. Some of the lectures will be taught at Penn State Greater Allegheny and all of the labs will be taught at the MAGLEV facility. Penn State will conduct student evaluations on the teaching effectiveness of the entire faculty. Included in the curriculum will be the Maglev technology for integrating their production robots, fit up table, and metrology systems in a fully automated fabrication process. The McKeesport facility is one of only four sites in the U.S. with a laser radar metrology system, which can accurately measure any object down to a few microns.

After the students have successfully completed the six PMT courses, the credits are transferred back to CCAC where the students are awarded the associate degree.

To summarize the PMT associate degree, the functions of the three partners are:

**CCAC:**

- Recruit students
- Deliver first three semesters of courses
- Prepare students for MAGLEV semester
- After PMT courses completed, award associate degree

**MAGLEV:**

- Develop PMT courses
- Teach PMT courses
- Prepare and conduct labs
- Help recruit students
- Help place graduates
- Sell program to industry

**PSU:**

- Develop and approve courses
- Approve and train MAGLEV faculty
- Ensure quality of instruction
- House students during the 4<sup>th</sup> semester

This is a somewhat unique and cost effective model for the delivery of a cutting edge technology degree where there is a high cost of equipment. This program was modeled after the Penn State Nanotechnology Manufacturing Technology program. The keys to this program are the collaboration between a community college and a large university and the willingness of a high tech company to become involved in the education process. It should be noted that this educational model will work with many different types of institutions delivering the first three semesters. The students would travel from across the state or across the country and stay in Penn State housing for the final semester.

**Precision Manufacturing Management Program**

A second program has been developed for students majoring in engineering at Penn State Greater Allegheny. These students normally take the first two years of the Baccalaureate Engineering degree and then transfer to State College for the final four semesters in their engineering program. MAGLEV and Penn State Greater Allegheny have developed a unique program where engineering students can obtain real world experience and at the same time receive a certificate in Precision Manufacturing Management (PMM). This is an interdisciplinary program designed for students who wish to supplement their major field of study with knowledge of precision manufacturing techniques, leadership concepts, management principles and practices. The PMM certificate consists of twelve total credits, including three different internship courses (5 credits total) all taught at MAGLEV. The student receives a hands-on experience in the technical details of precision manufacturing. The remaining courses consist of:

- Three-credit course in introductory engineering design
- Two-credit course in project management
- Two-credit course in engineering leadership

The program has been developed as a result of strong industry need for engineers who are capable leaders and managers and have a strong knowledge of precision manufacturing techniques. These engineers will be champions of PMT and will be able to promote and integrate these concepts to

companies across the state. In addition to those industrial benefits, Penn State Greater Allegheny will use this program to recruit and retain students in their engineering program.

### **Conclusions**

This has proven to be a very successful program in a very short time; over twenty-five students have enrolled in the program at CCAC. Approximately twenty students will begin the fourth semester in fall 2007. Discussions are under way with three other community colleges across the Commonwealth of Pennsylvania.

This program has brought together an industry, a community college and a university, and it has allowed them to partner and work together. The PMT program could not have been started by any of the partners by themselves. Some of the problems encountered included:

- Difference in cost between a CCAC credit and a Penn State credit
- Recruitment of students
- Transfer of credits from PSU to CCAC in a timely manner
- Training of MAGLEV engineers to be educators

All of these problems have been worked out through many meetings and discussions. Good communications are extremely important in building this partnership. This unique partnership has been a great asset in the marketing and recruitment of students to a technology program.