
AC 2011-2671: IMPACT OF REGIONAL CENTERS FOR NEXT GENERATION MANUFACTURING

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Karen Wosczyzna-Birch, a national award winning Professor of Chemistry, is the statewide director for Connecticut's College of Technology, which includes all 12 Connecticut community colleges, six universities and partner high schools including the technical high school system. She is also the executive director of the Regional Center for Next Generation Manufacturing, a National Science Funded Advanced Technology Center, where she provides leadership for the advancement of manufacturing and related engineering and technologies. Karen also has expertise in providing professional development that includes strategies for the engagement and persistence of under represented populations in STEM disciplines. She has received awards from several organizations including the American Association for University Women (AAUW) for her work in addressing the need to increase females in engineering and technology fields as well as for her work in educating students with the skills required for the 21st century workforce.

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Dr. Marilyn Barger is the Principal Investigator and Executive Director of FLATE, the Florida Regional Center of Advanced Technological Education, funded by the National Science Foundation and housed at Hillsborough Community College in Tampa, Florida since 2004. FLATE serves the state of Florida as its region and is involved in outreach and recruitment of students into technical career pathway; curriculum development and reform; and professional development for technical teachers and faculty. She earned a B.A. in Chemistry at Agnes Scott College and both a B.S. in Engineering Science and a Ph.D. in Civil Engineering (Environmental) from the University of South Florida, where her research focused on membrane separation science and technology for water purification. She has over 20 years of experience in developing curricula for engineering and engineering technology for elementary, middle, high school, and post secondary institutions, including colleges of engineering. Dr. Barger serves on several national panels and advisory boards for technical programs, curriculum and workforce initiatives, including the National Association of Manufacturers Educators' Council. She is a registered professional engineer in the State of Florida, a Fellow of the American Society of Engineering Education, and charter member of both the National Academy and the University of South Florida's Academy of Inventors. Dr. Barger is a licensed professional engineer in Florida.

**IMPACT OF REGIONAL CENTERS FOR NEXT
GENERATION MANUFACTURING**

Introduction

Through funding from the National Science Foundation, this paper will present the promising practices that two Advanced Technology Manufacturing Centers have implemented in order to create and strengthen their manufacturing programs. Although the two Centers are located in different parts of the U.S., the authors of this paper have collaborated on a number of initiatives that have increased enrollments in manufacturing programs and in the process, addressed workforce needs for manufacturing engineers and technicians. This paper will address the impact of two National Science Foundation funded advanced technology centers on increasing and developing new programs that are contributing to a 21st Century workforce in advanced manufacturing.

Background

Today's global-market has contributed to significant advancements in the areas of science and technology. The demand for innovative products and designs has led to new challenges in manufacturing. Engineers and technicians must be prepared to address future manufacturing needs for integrating material properties and processing technologies. In order to meet these challenges, Connecticut's Community Colleges in Y and Florida, with the assistance of grant funding from the National Science Foundation's Advanced Technology Education (ATE) program, have established regional ATE Centers that have implemented educational pathways supporting manufacturing. The Centers have spearheaded marketing campaigns in order to change the image of manufacturing. They have created model programs of how community colleges can effectively engage educational partners, business and industry and government agencies in the education of technicians and engineers for the new workforce of the 21st Century. This paper will highlight the educational pathways implemented and marketing strategies used for the recruitment and retention of students in the manufacturing and related disciplines.

Statewide Educational Pathways:

The Regional Center for Next Generation Manufacturing (RCNGM) operates under the umbrella of the College of Technology, which is a statewide initiative that provides career pathways for students to earn certificates, Associate of Science and Bachelor of Science degrees in Engineering and Technology disciplines. In order to facilitate this statewide initiative, the College of Technology, a "*virtual college*" consists of all of Connecticut's twelve public community colleges and six public and private partner universities (figure 1). The College of Technology was established under Connecticut's public law 95-04 creating a "*virtual college*" and its governance in 1995. This unique infrastructure provides a seamless articulation between the community colleges and the four-year partner universities through offering multiple points of entry for completion of degrees. Students also have the option to select from two pathways at the community college that provide seamless transition to the four-year partner universities- Technology Studies and Engineering Science.

The Technology Studies pathway is an applied major with an innovative curriculum that includes five industry driven electives. These electives are designed to respond to workforce needs that align with national skill standards. The Engineering Science pathway follows a traditional engineering curriculum with calculus-based coursework.

The College of Technology's unique infrastructure provides seamless career pathways with multiple points of entry and exit that culminate in Bachelor's degrees, Associate's degrees and credit certificates in engineering and technology. There are two pathway programs at the community colleges: Technology Studies and Engineering Science that seamlessly articulate to the 4-year partner universities. The Technology Studies pathway has an innovative curriculum that includes five industry driven technology electives. These electives are designed to respond to workforce needs that align with national skills standards such as National Institute for Metalworking Skills (NIMS) and National Occupation Competency Testing Institute (NOCTI) and are used to create program options and certificates.

The Florida Advanced Technological Education Center, FLATE, reviewed and reformed the statewide Curriculum Frameworks and has redefined the manufacturing and related curriculum in Florida at the state level and deployed it regionally in 11 colleges across Florida. FLATE, working with the Florida Department of Education's Career and Technical Education team, Florida community colleges, and Florida industries has recently completed the first phase of this project. A new A.S. / A.A.S. degree program in Engineering Technology (ET) with 8 specialization tracts and 14 specialization certificates was approved by the Florida Department of Education (FL DOE) in March 2007.

The premise of this degree is a "one-plus-one" approach where in year-one a student takes general education courses and a technical core curriculum that aligns with the Manufacturing Skills Standards Council (MSSC) Certified Production Technician (CPT) credential. The 18 credit hour "ET Core" covers introductory computer aided drafting, electronics, instrumentation and testing, quality, safety, and processes and materials. Year-two of the ET degree focuses on a specialization tract, each of which has some required and some elective topics. Each community college is free to adopt any or all of the specialization tracts and certificates depending on their local industry needs. The currently approved tracts are: Advanced Manufacturing, Advanced Technology, Alternative Energy, Electronics, Mechanical Design & Fabrication and Quality, Digital Design and Modeling, Biomedical Systems. Ten colleges have adopted the new degree as of March 2011, and several others have recently started their own internal curriculum processes to get the degree program approved for offering in 2011.

This community college Engineering Technology degree is part of a much larger statewide unified curriculum project that reaches the high school technology programs and career academies, incumbent worker training and bachelor degree programs. Embedding the MSSC Skill standards into the ET Core provides an industry-relevant articulation pathway from secondary programs that address these same industry skills. It also provides a pathway for incumbent workers to gain college credit by experience through certification. To accomplish these articulations, FLATE has crafted the first-of-its-kind Statewide Articulation Agreement based on Industry Certification. This agreement has been ratified by the community college partners and was approved by the FLDOE. This statewide agreement based on industry

certification has become the model for other career programs in Florida as well as across the country.

To ensure the success of this unified curriculum plan, FLATE, in partnership with the FLDOE, has drafted a new curriculum framework for secondary and PSAV programs that also aligns with the MSSC CPT. This framework was approved in January 2009 and is now available for adoption by Florida high schools and Tech Schools. In the next phase of the project, FLATE will develop needed curriculum for the ET Core and provide professional development for high school teachers and community college faculty to ensure that students wishing to become MSSC certified are successful. This Florida ATE Center has also aligned existing secondary frameworks for pre-engineering programs in the state with the MSSC Certifications. FLATE also provides ongoing support for colleges during their institutional implementation phase, as well as providing the foundation and individual college support of a statewide promotional campaign for the unified curriculum aimed at educational communities (student, parents, counselors, teachers, etc.) and manufacturing industries.

All Engineering Technology Associate in Science (A.S.) Degree holders can transfer seamlessly to a number of Bachelor of Applied Science (B.A.S.) Degrees offered in the state universities, state colleges and community colleges. The 2 + 2 agreements apply 60 credit hours of an A.S. Degree directly to the 4-year bachelor’s degree. The number of B.A.S. degree offerings across the state is growing rapidly. Alternatively, A.S. degrees in Engineering Technology will articulate to the B.S.A.S. in Operations Management at USF Polytechnic in Lakeland. This degree is a gateway to post baccalaureate degrees, requires additional general education and has technical prerequisite courses that may require an additional semester to complete. A third option is for graduates to transfer to a B.S.E.T. degree granting institutions. Several opportunities for degree specializations are available at each university. To transfer to a B.S.E.T. degree may require additional general education as well as technical prerequisite courses.

A.S. / A.A.S. Engineering Technology Degree Specializations and related Certificates (2010)

SPECIALIZATION	CERTIFICATES
Advanced Manufacturing	Automation (12 credit hours) Lean Manufacturing (12 credit hours) Pneumatics, Hydraulics & Motors for Manufacturing (12 credit hours)
Advanced Technology	Applied Technology Specialist (16 credit hours) Composite Fabrication and Testing (12 credit hours)
Alternative Energy Systems	Alternative Energy Systems Specialist (18 credit hours)
Biomedical Systems	Medical Quality Systems (12 credit hours)
Digital Design and Modeling	Computer Aided Design and Drafting (12 credit hours)
Electronics	Electronics Aide (12 credit hours)
Mechanical Design & Fabrication	CNC Machinist (12 credit hours) Computerized Woodworking (12 credit hours)
Quality	Lean Six Sigma Green Belt (12 credit hours) Six Sigma Black Belt (12 credit hours)
Non-specific:	

ET Core (MSSC CPT aligned)	Engineering Tech. Support Specialist (18 credit hours)
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Although the Centers are located in different states and regions of the United States, their ability to implement programs that include a common curriculum with specializations that address workforce needs, provides a model that successfully creates the critical mass needed for these programs to survive and in fact prosper.

For The Regional Center for Next Generation Manufacturing, the partner community colleges have reported an increase in enrollments from the original NSF grant award of 101% . It is especially noteworthy that enrollments in under represented populations have increased over the course of the NSF funding by 42%.

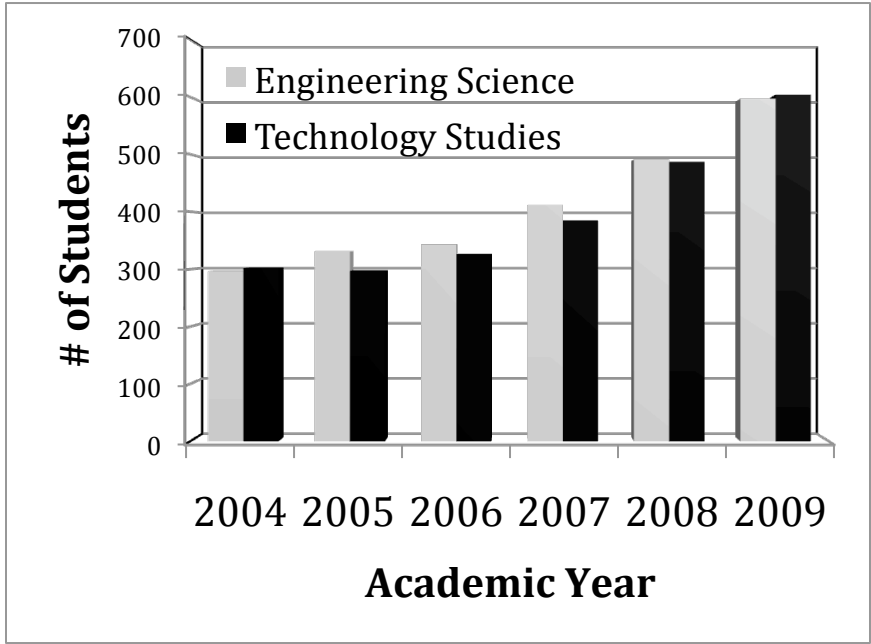


FIGURE 1 Enrollment in The Regional Center for Next Generation Manufacturing ’s Programs

The enrollments in Connecticut’s Manufacturing Programs have increased significantly since the receipt of the National Science Foundation funding to establish the Regional Center for Next Generation Manufacturing. As illustrated in Figure 1, the increase in enrollments from 2004 to 2009 were as follows:

- **101%** increase in Engineering Science
- **103%** increase in Technology Studies

Similar enrollment increases has been documented in Florida colleges over the past 3 years, with enrollment increases in the new FLATE programs increasing over 120% over the last 2 years in credit programs.

Of particular interest, is the increase in the enrollments of under represented populations, where from 2004 to 2009, there was a 42% increase in the enrollment of minority students in The

Regional Center for Next Generation Manufacturing 's technology programs with a 34% increase in minority females and a 59% in minority males. The recruitment initiatives implemented by both Centers clearly have successfully increased the enrollments in the two-year technology programs.

Recruitment and Outreach Initiatives

In addition to the ATE Centers involvement in the redesign and implementation of manufacturing programs that address workforce needs, both Centers have been involved in implementing aggressive recruiting and marketing strategies. Examples include statewide expositions where industry has been a partner in the delivery of the workshops and exhibits. For The Regional Center for Next Generation Manufacturing, the expos have engaged over 8000 students who have participated in hands-on simulations of a manufacturing process. FLATE has taken over 3,000 secondary students into over 50 different manufacturing facilities since 2006 and continues to engage in this activity. The tours carefully match school programs and companies for high impact taking school programs focused on design into designed focused technology or manufacturing facility or maritime program into high tech boat building facilities. Student tour surveys indicate significant increase in students considering careers in manufacturing than they did before the tours. The tours also serve as a seed for extended partnerships between the school programs (including teachers and faculty) and local companies.

Both Centers have also developed a robust marketing campaign that includes materials that highlight the new manufacturing environment and strong, consistent branding. In particular, both FLATE and the RCNGM have produced videos that showcases graduates of their programs working in high tech companies that are modern in design and have clean, computer-integrated facilities. In addition, the Centers have addressed the need to develop social media that advertises their Centers including the design of interactive websites, the establishment of Facebook pages and the use of blogs and twitter.

Finally, the Centers have strengthened the pipeline from high school to higher education through the after school and summer programs that have students working in teams on real world applications for students.

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