AC 2012-3599: IMPLEMENTATION OF ADVANCED TECHNOLOGY TRAINING IN SOUTH TEXAS

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Implementation of Advanced Technology Training in South Texas

Abstract:

The manufacturing industry is undergoing a dramatic transformation in terms of the technology being used, the market dynamics, the workforce demographic, and skills needed to work in advanced manufacturing environment. The rate of technology adoption and the ability to use technology to remain competitive and add value to the manufactured parts defines the degree of advanced manufacturing adoption by industry. The transformation of manufacturing has major implications for the current manufacturing workforce and for the new workers the industry requires.
In order to train qualified technicians in the South Texas area who are able to perform well in high-tech manufacturing, advanced manufacturing concepts should be implemented in the South Texas technical colleges. This is possible by providing South Texas technical colleges with teaching materials, faculty workshops, appropriate software, equipment and online training/educational resources.

Introduction:

In order to operate a modern production facility, manufacturers require workers with advanced skills. Rather than hiring a worker to perform a specific task, employers increasingly need workers who are continually focused on innovation of both products and processes[1]. Modern manufacturing workers require advanced academic and technical skills to enable their employers to stay competitive. All manufacturing workers need adequate foundational competencies in math, science, reading comprehension, and technical writing[2].Technical workers need strong work related competencies such as computer literacy, teamwork, and critical thinking as well as strong technical competencies in quality and process control, production philosophies including lean, Just-In-Time, and integrated production systems in order to be successful in their careers.

Not enough high school graduates consider an advanced manufacturing career as an option and are not aware of the skills needed to work in this environment. A survey by the National Association of Manufacturers stated that 80 percent of respondents reported a moderate to serious shortage of qualified job applicants[3].It is obvious that the K-12 system does not provide students with these skills or provide educational experience for them to be familiar with advanced manufacturing career opportunities[1].

In order to train qualified technicians in the South Texas area (Figure 1) who are able to perform well in high-tech manufacturing, advanced manufacturing concepts should be implemented in the South Texas technical colleges. There are six technical colleges in South Texas offering an Associate of Applied Science (A.A.S.) degree in machining technology and/or computer drafting and design technology. All six technical colleges share the same student demographics; South Texas is a region where more than 65% of the population is Hispanic. It is transitioning from a historically under-served region to one where major efforts are underway to build an educational and economic infrastructure. Despite the declining of manufacturing units in most part of the U.S. several manufacturing industries have been able to retain jobs in the South Texas region.

The region's geographic proximity to Mexico makes industrial allied with international trade extremely important.
Due to the composition of the target student population for the project, implementing advanced technology training will have a significant impact on the education and the development of the skills of an under-representative minority group.

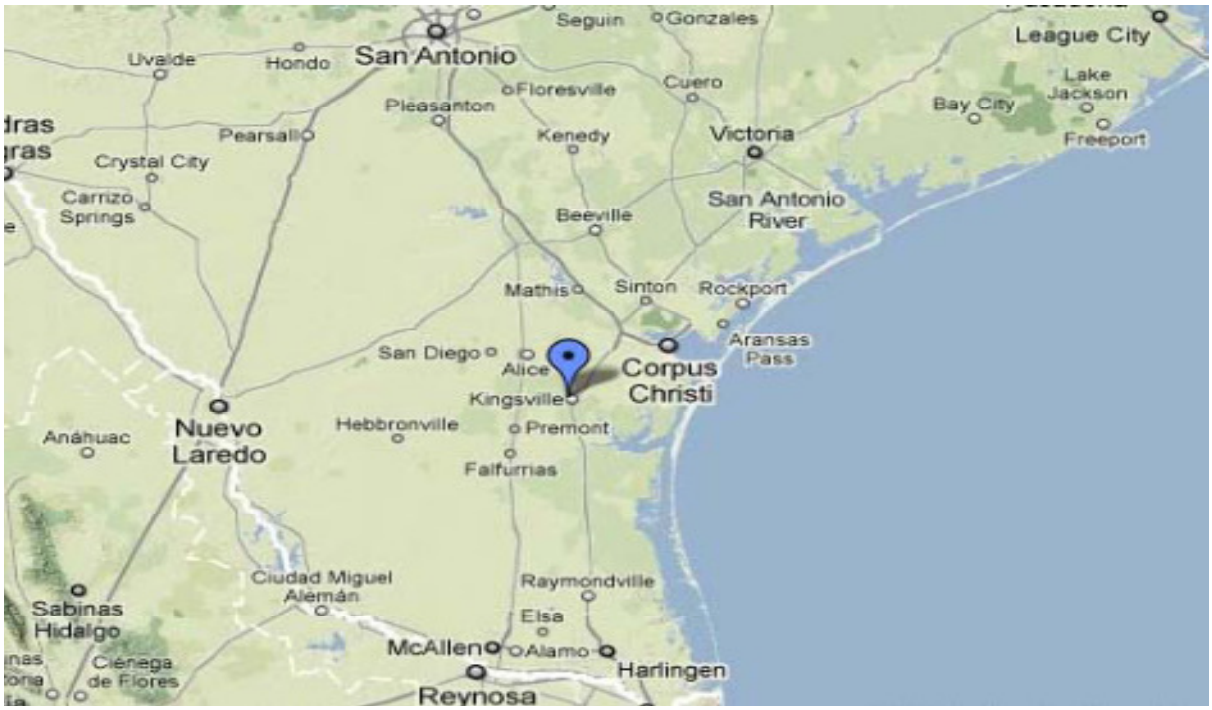

Figure 1: South Texas Region

Project Goal:

Cooperation between South Texas College (STC), the Department of Industrial Technology at Texas A&M University-Kingsville and local manufacturing industries which have successfully implemented advanced technology in their production is the foundation of a collaboration to employ advanced manufacturing training for South Texas technical colleges (Table 1). The South Texas College (STC) students majoring in precision manufacturing technology or computer aided drafting and design will be provided with the state of the art teaching materials related to 3D modeling, CAD/CAM/CNC processes, as well as principles of material handling in a plant, system integration, and production scheduling concepts. After the curriculum is delivered to STC students the instructors will share their experience with the rest of the South Texas technical college instructors to promote advanced manufacturing in South Texas.

The Department of Industrial Technology is providing the needed support and educational materials and graduate students support for both STC and South Texas technical colleges to assist them with this task. This include faculty training, updated software, online training, resources needed to train qualified manufacturing technicians, and recruiting and promoting advanced manufacturing careers as an attractive option to high school seniors.

Technical College	City	Degrees Offered	Degree Plan	Total College Enrollment
Texas State Technical College	Harlingen	Machining Technology Computer Drafting & Design Technology	72 Credit Hours 72 Credit Hours	9, 190 Students
South Texas College	McAllen	Precision Manufacturing Technology Computer Aided Drafting & Design	69 Credit Hours 70 Credit Hours	18, 466 Students
Del Mar College	Corpus Christi	Industrial Machining Applied Technology Architectural/Drafting Technology	69 Credit Hours 67 Credit Hours	25, 761 Students
Texas South-most College	Brownsville	Machining Technology Computer Aided Drafting Technology	66 Credit Hours 62 Credit Hours	28, 322 Students
Coastal Bend College	Alice/Beeville	Machinist Program (Alice) Drafting & Design Technology (Beeville)	62 Credit Hours 69 Credit Hours	8, 016 Students
Laredo Community College	Laredo	No Machining Program Computer Drafting & Design Technology	72 Credit Hours	18, 492 Students

Table 1: South Texas Colleges

As the result of this project the following objectives will be achieved to implement advanced manufacturing training in South Texas:

- Introduce the advanced manufacturing processes to South Texas technical college students.
- Create and implement curriculum for innovative application of technologies, processes, and methods of production.
- Provide students with manufacturing practices that result in rapid transfer of science and technology into manufacturing products and processes.
- Present high school students in South Texas with the Science, Technology, Engineering, and Mathematics (STEM) Education.

Strategies to achieve these objectives include:

- Incorporate design and 3D modeling in all South Texas technical programs.
- Improve the teaching of CAD/CAM/CNC process and 3D simulation related to that process for all South Texas technical programs.
- Introduce advanced material handling processes, system integration, and production scheduling used in conjunction with advanced manufacturing processes in a plant.
- Introduce the concept of lean, green, and Just-In-Time philosophy as it relates to the operation of advanced machine tools in a manufacturing plant.
- Encourage the instructors at South Texas colleges to reduce the number of courses related to manual machining in their programs and replace them with skills to run Computer Numerical Control (CNC) courses.

- Encourage high school students in South Texas to consider advanced manufacturing as a career by visiting high schools and presenting technical demonstration of advanced manufacturing processes related to the Science, Technology, Engineering, and Mathematics (STEM) education.

Project Description:

Advanced manufacturing incorporates many high tech computer controlled production tools that are developed for and used in the manufacturing field, including high tech products and processes to produce parts and lean, green, and flexible manufacturing methods to perform the production process[1]. Advanced manufacturing involves the use of technology to improve or upgrade the existing process, with the relevant technology being described as innovative or cutting edge.

Advanced manufacturing products are characterized as products with a high level of design, technologically complex products, innovative products, and high performing products. The manufacturing process technologies under advanced technology are high performance computing for modeling, simulation, and analysis as part of the production process.

The roles of technical colleges are becoming more active in the technology based economic development era of the present time. Technical colleges are becoming the key institutions to train highly skilled and technically capable workers[4]. At the same time the need to identify appropriate instruction and technologies to train skilled workers to perform well in industry is becoming more important. The technical colleges bridge the gap between education and training and act as a technology intermediary[5]. Technical colleges wish to meet the educational and training needs of their manufacturing community but are unable to sustain manufacturing related courses beyond a common curriculum core[6].

An Employment Training Administration (ETA) report defines advanced manufacturing as implementing process improvement, increasing quality controls, installing advanced robotics and other intelligent production systems[1]. Along the same lines advanced manufacturing must entail high-performance computing for modeling, simulation, and analysis. Manufacturing is becoming increasingly dependent upon the use of high-tech equipment that involves integrated systems. Companies that implement advanced manufacturing are the ones that succeed in today's competitive environment.

An Associate of Applied Science (A.A.S.) in advanced manufacturing is earned upon successfully completing both required general education and core technical coursework. Job opportunities as a CAD designer or 3D solid modeler, CNC or CAM programmer, CNC operator, or a combination of these technologies are available upon completion of an advanced manufacturing degree. Advanced manufacturing graduates are also ready to transfer to a bachelor's degree program in technology or engineering to continue their education.

Leading technical colleges reference CAD/CAM/CNC programs as advanced degree plan manufacturing programs. Student success depends on their ability to demonstrate mastery through all coursework required in a degree plan. Table 2 delineates earned credit hours for each

course in this degree plan (Northwestern Michigan College, 2010). The degree plan consists of 64 total credit hours to include 18 credit hours of drafting and design, 6 credit hours of manual machining, 6 credit hours of CNC and CAM, and 12 hours of other related technical courses. The remaining 22 credit hours are allotted to general education coursework.

Associate in Applied Science Degree (A.A.S.) Advanced Manufacturing Program		
General Education Requirements		22 credit hrs
Supporting Fields for Machining Technology		
Print Reading Sketching	3 hours	
Basic Metallurgy	3 hours	
Math for Manufacturing	3 hours	
Advanced Manufacturing Project	3 hours	
		12 credit hrs
Manual Machining requirements		
Machining I	3 hours	
Machining II	3 hours	
		6 credit hrs
2D and 3D CAD requirements		
Computer Aided Drafting	3 hours	
Mechanical Drafting	3 hours	
Detail Drafting	3 hours	
Geometric Dimensioning & Tolerance	3 hours	
Part and Assembling Modeling	3 hours	
Advanced Part & Assembling Modeling	3 hours	
		18 credit hrs
CNC and CAM requirements		
CNC Programming	3 hours	
Computer-Aided Machining	3 hours	
		6 credit hrs
Program Requirements		64 credit hrs

Table 2: CAD/CAM/CNC or Advanced Manufacturing Program Degree Plan

There are six technical colleges in South Texas offering an Associate of Applied Science (A.A.S.) degree in machining technology and/or computer drafting and design technology. Each technology degree is independent of each other and classified under different technology departments. In some cases they are housed in different buildings. Technical colleges included in this project are: Texas State Technical College in Harlingen, South Texas College in McAllen, Texas South-most College in Brownsville, Laredo Community College in Laredo, Coastal Bend College in Alice and Beeville and Del Mar College in Corpus Christi. These colleges prepare students for industrious employment with drafting and machining careers in South Texas. The demographic information and programs offered are shown in Table 2. Machining technology, computer drafting, and design degrees are offered at all six colleges. Degree plans were evaluated to identify the present status of CAD/CAM/CNC training in the South Texas technical

colleges. Evidence suggests the directional goals of six South Texas technical colleges are to establish technology programs offering advanced training in conventional shop machinist and maintenance machinist for local industries. South Texas College (STC) in McAllen is the only technical college in South Texas offering Computer Aided Design / Computer Aided Manufacturing, Drafting for Special Occupations, and Machine Drafting[9]. The STC degree plan analysis clearly demonstrates an evolutionary attempt to meet industry demands toward advanced manufacturing training.

Technology coursework amongst all six South Texas Technical College degree plans reflects a strong emphasis in manual machine tool training. Texas State Technical College, South Texas College, Del Mar College, Texas South-most College, and Coastal Bend College offer 24 credit hours, 11 credit hours, 42 credit hours, 24 credit hours, and 23 credit hours respectively in manual machine tool training[9]. The number of credit hours related to manual machine tool training are significantly different nationwide with a typical advanced manufacturing program at 6 credit hours. Table 3 compares percentage of manual machining coursework and supporting fields to the total degree requirements of all coursework. The data presents a significant difference between South Texas Colleges to Northwest Michigan College, a leading school in advanced manufacturing.

Technical College	City	Percent of Courses Related to Manual Machine Training & Supporting Fields Compared to the Total Program Requirements
Texas State Technical College	Harlingen	62%
South Texas College	McAllen	60%
Del Mar College	Corpus Christi	70%
Texas South-most College	Brownsville	64%
Coastal Bend College	Alice/Beeville	55%
Northwestern Michigan College	Traverse City	28%

Table 3: Percentage of Manual Machining Courses

The lack of computer aided design, 3D modeling and assembly drawing is evident in all the South Texas machine technology programs[10]. In an advanced manufacturing program, a minimum of 18 hours of drafting and design courses are included in the degree plan. South Texas College in McAllen is the only technical school in South Texas that requires DFTG 1313 Drafting for Special Occupations and DFTG 2402 Machine Drafting.

The collaboration between South Texas College (McAllen, TX), Dixie/MSI Company (Alice, TX) and the Department of Industrial Technology at Texas A&M University-Kingsville will be established to implement advanced manufacturing training to South Texas Technical colleges. Implementing required technology coursework in advanced manufacturing programs in South Texas technical colleges will significantly improve educational standards and career opportunities for students in South Texas.

Technology skills gained by students in CAD/CAM/CNC, material handling, system integration, production scheduling, and drafting coursework should be evident in students' ability to understand and demonstrate mastery with these technologies. Rewarding careers are available for trained students in advanced manufacturing programs. Students may seek jobs opportunities as a CAD drafter or 3D model designer, CNC or CAM programmer, CNC operator or a composite of these technologies.

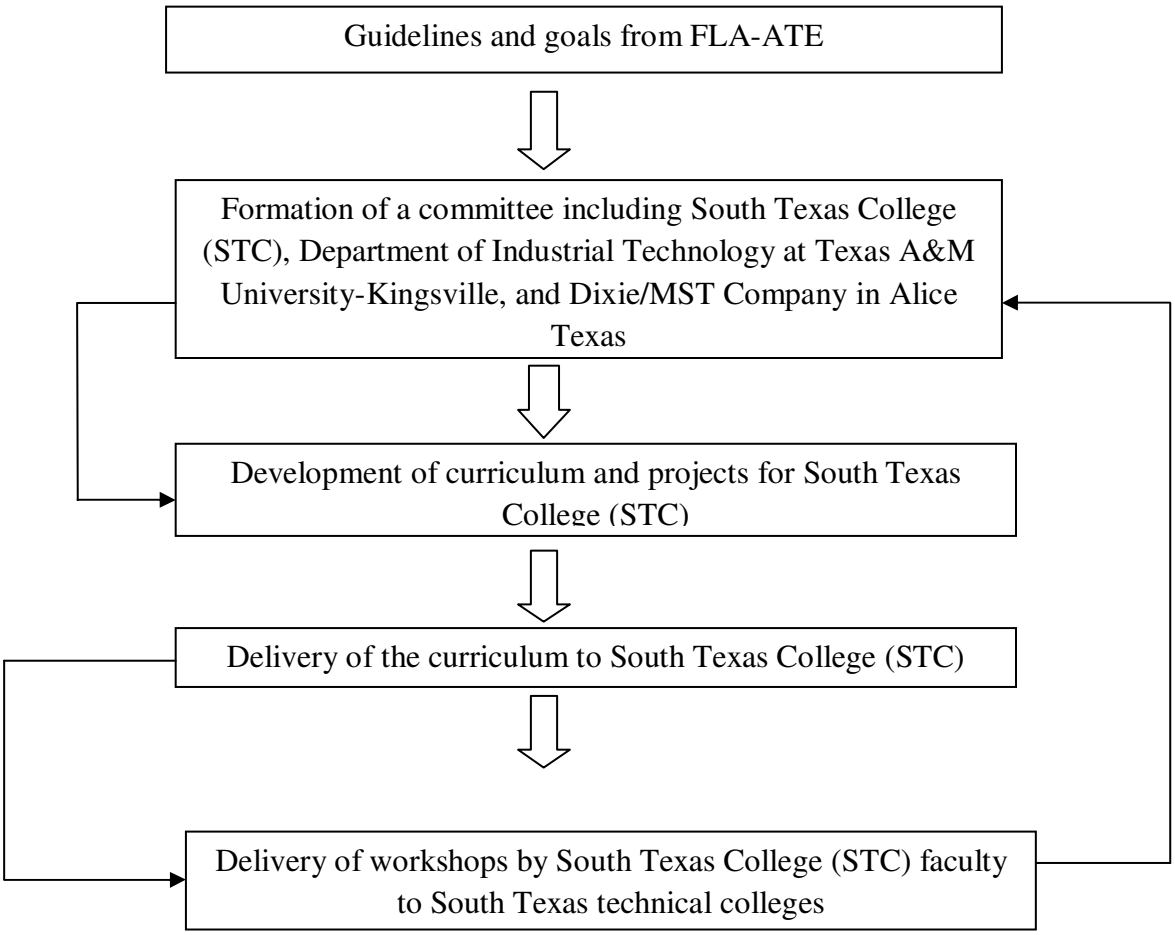

Figure 2: Project Implementation Plan

Conclusion:

As the result of this project following goals will be achieved:

- Create and implement curriculum for innovative application of technologies, processes, and production methods.
- Provide students with manufacturing practices that result in rapid transfer of science and technology into manufacturing of products.
- Train qualified technician for South Texas industry and production plants.
- Improve student enrollment and retention in tow-year colleges.

The long term impact of integrating advanced manufacturing programs with CAD/CAM/CNC training will increase both science and technology literacy, while increasing standards of living and improving the quality of South Texas technical education.

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