AC 2007-1334: ENGINEERING TECHNOLOGY CURRICULUM REFORM IN FLORIDA

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ENGINEERING TECHNOLOGY CURRICULUM REFORM IN FLORIDA

Abstract

FLATE, the Florida Advanced Technological Education Center for Manufacturing, has partnered with eight Florida Community colleges that have programs in manufacturing or related technologies to assess and reconstruct the statewide curriculum frameworks that govern these programs. Consensus has been achieved to construct a degree in Engineering Technology with seven specializations. The two-year Associate in Science (A.S.) and Associate of Applied Science (A.A.S.) will be structured in a one plus one format. College level certificates will be granted at the successful completion of the first year. The first year of the degree program will include a technical core of six courses with general education making up the remainder of the credits. The technical core courses will include skills and knowledge that are required to successfully pass the Manufacturing Skills Standards Council (MSSC) certification examinations among others. The second year of the program will include twenty-seven credit hours of technical courses in one of the specialization areas. The specializations will have their own required technical courses and some technical electives.

To facilitate this effort, FLATE has coordinated the state-wide initiative. It has reviewed many existing and old frameworks, coordinated the statewide curriculum team, hosted workshops, solicited industry input, developed the frameworks for the engineering technology core courses, and provided the required forms and paperwork for the FL DOE. Full implementation of the program in the eight participating community colleges is anticipated to be in fall of 2007.

Background

Addressing the needs for skilled workers is a required competitive and survival strategy for most manufacturers. They must choose to invest in growing their own future employees or influence how the community college system works for them in preparing new generations of technicians. This presentation explores the latter and analyzes two immediate goals: (1) the actualization of the educational frameworks that inform the curricular content of two-year technical programs (Associate of Science, A.S., and Associate of Applied Science, A.A.S.); and (2) implementation of a new degree in engineering technologies that responds to the needs of modern manufacturers.

Demand driven response to Florida's manufacturing community calls for a revision to the curricular frameworks for Engineering Technology and Manufacturing-related programs. Principally due to the following factors:

- Some of the curricular frameworks that, in principle, inform the outcomes of manufacturing related A.S. and A.A.S. degrees, which may potentially address many of the high skills required by manufacturers, are outdated, some by 15-20 years.

- Manufacturers are concerned about the lack of a qualified labor force in the State of Florida. They have voiced their concerns to the State. This is also a national crisis. "Eighty-one percent of the respondents to the 2005 Skills Gap Survey of the American Manufacturing Workforce (Deloitte and the Manufacturing Institute, 2005[1]) said they couldn't find qualified employees to fill their open positions." (Source: *Training & Development*, February, 2006[2]).
- Community Colleges are not currently addressing all of the needs of manufacturers for qualified personnel (for lack of communication, inadequate offering or inadequate timing or limited graduates).
- There is limited or, at best, inefficient communication between the manufacturing sector and the community college sector at a state-wide level on workforce education and training issues.
- It seems difficult for manufacturers to know what competencies community college graduates bring, given the nine different manufacturing related degree options, varying course names and descriptions.
- There does not appear to be clearly defined positions (and career pathways) for A.S. and A.A.S. graduates to assume in the industry, and therefore, the level of compensation for such graduates is also unclear and/or unknown.
- There are new statewide guidelines both from the Department of Education and Workforce Florida that technical programs should be tied to some national certification.

Program Definition

FLATE has addressed these issues by proposing and developing a one plus one associate degree curriculum. This concept regroups and reorganizes the diverse frameworks that have developed related to Manufacturing and various engineering technologies that address the skills and knowledge being asked for by industry. The basic premise of this approach is a core curriculum offered in year one of the A.S. (or A.A.S.) program that aligns with the Manufacturing Skills Standards Council (MSSC) Portable Production Skills Certification[3]. Seven engineering technology degrees specializations are defined under this common technical Engineering Technology core. After the core, each institution will offer one (or more) area of specialization that meets the needs of their own local community.

Currently, the specializations that are of interest to the six community colleges (Florida Community College at Jacksonville, Indian River Community College, Brevard Community College, Hillsborough Community College, St. Petersburg College, Gulf Coast Community College, and Pensacola Junior College) engaged in this joint effort are: Aerospace, Advanced Manufacturing, Biomedical Equipment, Electronics, Industrial Design, Mechanical Fabrication and Design, and Quality. Others specializations that would appropriately fit with the defined ET Core include Industrial Maintenance and Engineering Technology Management. These additional specializations will be evaluated and considered in the near future. The community colleges will also have the flexibility

to offer short technical certificates in the different specializations to meet local student and industry needs.

The Florida Department of Education Career and Technical Education Division houses the Frameworks (student proficiency outcomes and program definition) for all post secondary and community college programs including apprenticeships. Therefore, frameworks for the proposed new degree program and the specializations would have to be developed and verified by industry. All new program frameworks must comply with the specifications of the Florida Department of Education and submitted to the Division of Career and Technical Education for review and approval. Once approved at the state level, the Curriculum Frameworks for Engineering Technology will be available for any 2-year college to adopt and implement via their own internal program and course adoption processes.

Program Development

The process began with consensus building for the Engineering Technology Core and supporting Curriculum Frameworks concurrently with the definition of the specializations that would be housed under the degree. A working group of participants began working with FLATE in the fall of 2005 when FLATE hosted the first curriculum workshop. During this workshop, the one-plus-one approach evolved from discussion and was agreed upon as a viable option to meet the needs of all the schools.

The first exercise was the review of the existing curricular frameworks for the seven manufacturing-related programs. These that had been previously identified were analyzed for potentially significant overlaps in their technical skill sets. These disciplines are: Manufacturing Technology, Computer Integrated Manufacturing Technology, Aerospace Technology, Industrial Management Technology, Industrial Technology, Drafting and Design Technology, and Electronics Engineering Technology.

The MSSC (Manufacturing Skill Sets Council) manufacturing competencies were also compared to the frameworks of the disciplines above. During the review of individual programs, the combined programs and their correspondence to the MSSC competencies, similarities, differences, omissions and language were identified. Some observations from this analysis are:

1. There are some apparent core topics inserted in the frameworks, such as basic science, math skills, communication skills, employability skills and entrepreneurship, but they are not consistently present in all programs (nor they are all relevant to modern manufacturing).
2. There are some potential core topics, such as manufacturing overview, production, safety and quality, that are absent in most programs.
3. The language used to describe the learning goals is inconsistent and is not expressed in a more contemporary performance-based language. Some examples of non-performance language includes: understand, explain, read,

know and conceptualize. In contrast, MSSC uses only to terms: “demonstrate a skill in” and “demonstrate knowledge of”.

4. It is evident that the framework for Computer Integrated Manufacturing Technology was preceded by the framework for Manufacturing Education. It is possible that authors of the later framework submitted a “new” program, instead of revising the existing one. Regardless of the reasons, these two make for one framework by today’s practices.
5. The Industrial Technology framework contains some elements of the preceding frameworks. It is worth determining if it should continue to remain a separate program, as far as manufacturing is concerned. Since some colleges include programs like culinary science in this category of programs, another possibility is to clarify that “industrial” does not includes manufacturing.
6. The framework for the Industrial Management degree does not includes any practical manufacturing knowledge (e.g. manufacturing processes, quality, safety), other than a vague reference to “understand technical or industrial competencies”. In the best case scenario, graduates would need to come to the program with practical manufacturing experience in order to add any value to an employed. If this was the case, the framework would still need to be actualized to include areas such as lean manufacturing and Six Sigma. Most likely, the whole framework would need to be actualized.
7. Base on content, it seems that the Drafting and Design, as well as the Electronics Engineering do not directly support the manufacturing industry, even though, some of their basic competencies need to be included in the other frameworks (e.g. blue print interpretation, tolerance, basic circuits, etc.). Consequently, these two programs may be potentially excluded in our revision process.
8. Finally, a general comparison between the existing frameworks (with their vagueness, omissions, inconsistencies and obsolescence) contrasts sharply with the currency, precision, relevance and abundant competencies proposed by MSSC. If given a choice between the two, possibly most manufacturers would select the MSSC competencies to inform and anchor the curricular frameworks.

During the same period of time that FLATE was conducting its own internal review and comparisons, the existing frameworks were reformatted into a survey instrument and distributed to the FLATE Industrial Advisory Committee and several of the participating community college program advisory committees. Each company was asked to respond to one or more of the framework surveys as they applied to their particular business and employee needs. Some community colleges chose to review the frameworks during an Advisory Committee meeting as a group exercise. FLATE compiled all of this information and data to use as the validation for the final state curriculum framework proposal for the new degree.

The next phase required that the community colleges define the Engineering Technology core classes. These courses would be required of all the degree specializations. Additionally, it was desired that the Engineering Technology Core not only provide a strong technical background, and be exciting to new students, but that it also provide sufficient instruction in the MSSC Skill Standards that a student taking the ET Core would be well prepared to pass this Certification's exams. A schematic of the curriculum can be found in Appendix A and the core course areas are: basic introductory courses in electronics, quality, safety, computer aided drafting, materials and processes, and instrumentation.

Following the definition of the Core courses, the actual student proficiencies had to be defined in the state format for curriculum frameworks. FLATE developed a draft of the frameworks that it reviewed with the curriculum working group in October 2006. The group made suggestions that were incorporated. The revise ET Core frameworks have been reviewed again by the working group and were incorporated in the New Program Application that must be submitted to the FL-DOE. Working with the administrators in the Division of Career and Technical Education, FLATE has developed a strategy for organizing the program application in a format that will be acceptable to the FL DOE.

The next stage requires that one community college or a team of colleges prepare the frameworks for the specializations. These will be based on the input accumulated from industry for each area. The seven sets of frameworks developed will be appended to those of the ET Core in the Application package. FLATE is relying on the expertise of the different community colleges to develop these frameworks that will address the most technical aspects of the curriculum.

Finally, FLATE has also begun to facilitate and coordinate the development of the Florida Frameworks for a related high school technology program. Technology programs in Florida's high schools normally consist of 4 year-long courses, one at each grade level (9-12), focused on the technical area, e.g., manufacturing. Several high schools are participating in this effort with FLATE to develop meaningful and relevant frameworks. Industry partners of the high schools are also involved. A significant advantage of FLATE facilitating this the high school frameworks project is that it can provide the guidance necessary to shape the high school frameworks such they will articulate smoothly to the new Engineering Technology A.S. (and A.A.S) degree programs at community colleges using the MSSC skills as the conduit.

Concluding Remarks

This analysis was conducted by FLATE, a regional center of excellence for Manufacturing Education, which is housed at Hillsborough Community College and serves the entire state. Although located at HCC, FLATE is not an academic unit, i.e., it does not offer classes or host academic curriculum. There are several advantages for FLATE to take the leading role in this project. The most important advantage is that the Center can speak as one voice for the participating community colleges with the appropriate state-level offices (Career and Technical Education) and Workforce Florida.

It is void of local institutional political posturing and competition between departments, resources, etc. It has been able to focus Center resources on the project that a single institution could not afford in a timely manner. Additionally, FLATE has been able to accumulate and consolidate significant statewide industry input to support and validate the new degree program. Some industry input came from the individual community colleges themselves, and some has been collect statewide by FLATE. All the community colleges will be able to take advantage of the statewide industry data when implementing the programs locally. FLATE will also be positioned to help participating community colleges implement the new curriculum in their own college processes; assist new and emerging programs get started in a well-founded technical curriculum; and offer professional development for faculty offering the new program.

There are also a number of benefits to this change or consolidation of Engineering Technology 2-year programs in Florida. These include: 1) all Community Colleges in the State can market jointly to students and industry employers with a common degree program and certification; 2) Completion of the core creates a portable completion point that allows students to transfer within the community college system to an institution with their desired specialization; 3) MSSC certification assesses a student/worker's foundational skill and knowledge in four broad areas common to all manufacturing sectors: Manufacturing Processes and Production; Quality Assurance; Maintenance Awareness; and Safety. This certification is portable across manufacturing sectors and has been defined by industry; 4) Selecting the MSSC competencies to inform and anchor the curricular frameworks of the core allows currency, precision, relevance and abundant competencies; and, 5) Selecting the MSSC competencies to inform the curricular frameworks core also allows an articulation pathway from Technical Institutions and High School Academies that are also tying their curriculum to these same competencies, which helps create seamless articulation pathways for students in technical.

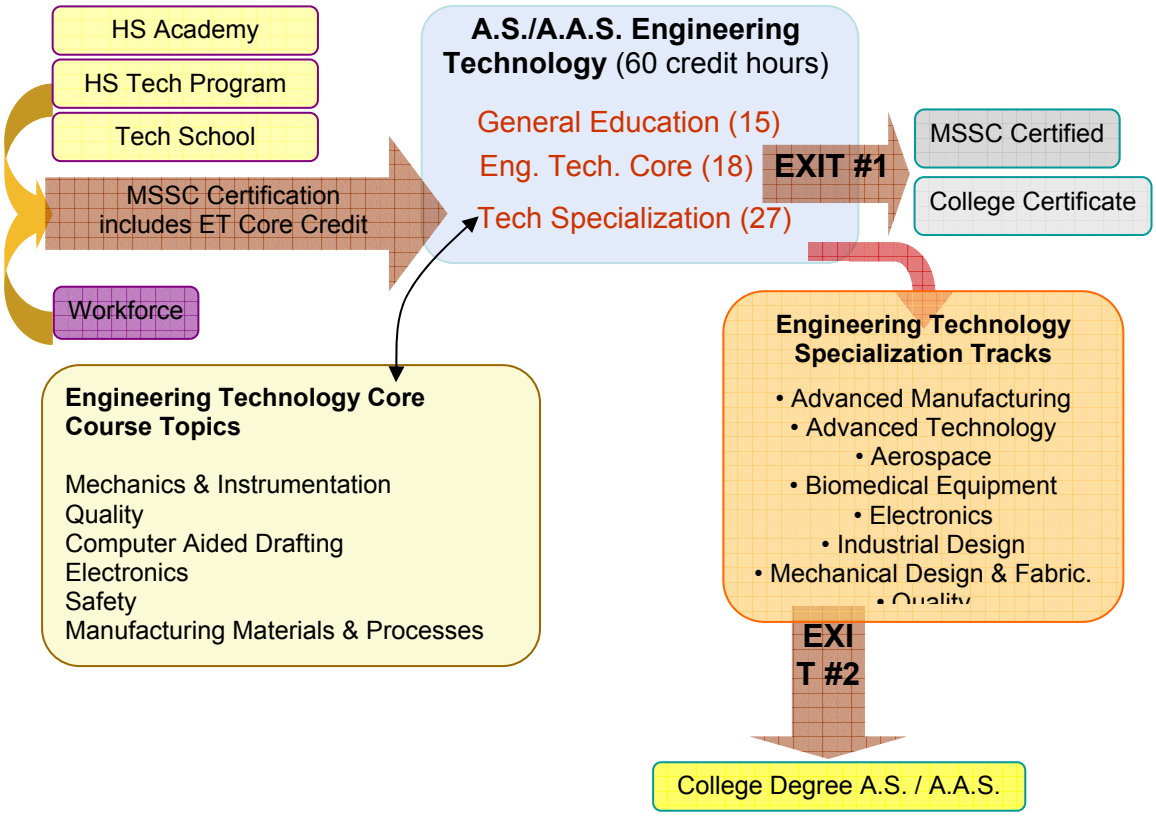
References

1. "Deloitte and the Manufacturing Institute", 2005
2. "Training and Development," 2006
3. "Blueprint for Workforce Excellence" Manufacturing Skills Standards Council (MSSC), published by MSSC, 2005.

APPENDIX A

Engineering Technology Curriculum Diagram

The Florida Engineering Technology One + One Degree Model



College Degree
A.S. / A.A.S.