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## **AC 2011-1723: WHAT IS CURRICULA 2015?**

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## WHAT IS CURRICULA 2015:

### Abstract

The Curricula 2015 report has been in development by the Society of Manufacturing Engineers – Manufacturing Education and Research Community since 2008 with the involvement of hundreds of people from businesses, organizations, and academia. The report examines the state of manufacturing education and industry, emerging issues, and opportunities for improvement. The document includes numerous recommendations and actions for building a stronger manufacturing education system; to keep manufacturing a vital part of our future.

### Introduction

The manufacturing discipline has existed for over 60 years and has interfaces with several other programs, most notably Mechanical Engineering and Industrial Engineering. The first known program was a Manufacturing Technology associates degree started at the University of Houston in 1951. Since then the number of programs has grown and as of 2011 there were 73 manufacturing related programs accredited by ATMAE (Association for Technology, Management, and Applied Engineering), and under ABET, Inc. (Accreditation Board for Engineering and Technology) there are 33 manufacturing technology and 23 manufacturing engineering programs. There is a very large number of groups supporting manufacturing industry and education including the SME (Society of Manufacturing Engineers), ASME (American Society of Mechanical Engineers), IIE (Institute of Industrial Engineers), IEEE (Institute of Electrical and Electronics Engineers), NSF (National Science Foundation), and many others.

For the purpose of brevity the authors will assume that the reader understands the critical importance of manufacturing to a healthy economy and society. Manufacturing educators are avid supporters of manufacturing industries, and likewise, manufacturers value well educated graduates. However, given the different nature of industry and academia there is a constant process of assessment and improvement for all. For academics we prepare our curriculum and offer it to students. Once they graduate into a profession we are able to assess our programs and make changes. The process of continuous improvement has two elements i) a desire to improve what we do, and ii) to revise the curriculum with an eye to current demands from industry and emerging needs.

To deal with continuous improvement issues, groups such as the ASEE Manufacturing Division and the SME Manufacturing Education & Research Community have been formed and actively discuss manufacturing education. Beyond regular activities there is a long standing tradition of a major review of manufacturing education every few years. The outcomes of these reviews are

developed using the content of these documents and input from many other sources to promote improvement of not only manufacturing-named curricula, but also to encourage other disciplines whose graduates enter manufacturing-related careers to enhance the content of manufacturing topics in their curricula.

- Countdown to the Future: The Manufacturing Engineer in the 21st Century: Profile 21, Dearborn, MI: Society of Manufacturing Engineers, 1988.
- Ideal Models in Manufacturing Education – Proceedings of the Curricula 2000 Workshop, Dearborn, MI: Society of Manufacturing Engineers, 1990.
- Manufacturing Education for the 21st Century – Volume I: Curricula 2002 Report, Dearborn, MI: Society of Manufacturing Engineers, 1995.
- Manufacturing Education Plan: Phase I report: industry identifies competency gaps among newly hired engineering graduates: the next step-partnerships with schools. Manufacturing Education for the 21st Century, v. 4. Dearborn, MI: Society of Manufacturing Engineers, 1997.
- Manufacturing Education Leadership Forum: Vision for Progress, Society of Manufacturing Engineers, Robert Morris University, 2008.
- Manufacturing Education Leadership Forum; Moving Forward, Society of Manufacturing Engineers, Farmingdale State College - SUNY, 2008.
- Manufacturing Education Transformation Summit 2009, Society of Manufacturing Engineers, Austin, TX, 2009.

The curriculum of manufacturing-named baccalaureate degree programs has been adjusted since those studies were completed for consistency with the documents from the 1990s. Accreditation criteria promulgated by the Accreditation Board for Engineering and Technology (ABET, Inc.) for such programs have similarly been adjusted for both Manufacturing Engineering and Manufacturing Engineering Technology programs. The body of knowledge covered by SME certifications for the manufacturing engineer (CMfgE) and the manufacturing technologist (CMfgT) have also been adjusted.

## **The Issues**

The list below indicates the major issues examined in Curricula 2015. Each of these has been explored in depth and the following recommendations are a blend of the opinions, suggestions, and plans developed by many professionals and groups.

***Emerging Sectors, Technologies and Methods*** - Educators look to industry to tell us what degree programs they will need, such as nanotechnology, what technologies we should teach in the classroom, such as electronics manufacturing, and what methods are important, such as Lean manufacturing, sustainability, and energy.

***Globalization*** - The issues of off-shoring and global competition continue to grow and companies

individuals who are comfortable working across multiple disciplinary boundaries. For manufacturing professionals this must include, as a minimum, an awareness of business practices.

**Research** - Corporations need both the outcomes of fundamental research to develop new technologies, but they also need graduates who are able to do higher level design, research, and development work.

**Pipeline and Image** - The evolution of industries from labor intensive to intellect intensive continues. However the public has focused on the loss of low skill jobs as a sign that manufacturing is dying. The truth that manufacturing graduates are in very high demand does not yet translate to incoming students that elect manufacturing education programs.

**Curriculum** - As manufacturing becomes more established as a discipline it is necessary to work towards a strong yet flexible core curriculum. There is a need for a consistent model that can be used by all to design and assess programs. These can also guide the accreditation processes.

**Support** - The image issues and low student enrollments have impacted how manufacturing programs are perceived and funded. In some cases well known programs have been closed.

**Credentials** - Industry needs a wide spectrum of professionals in terms of knowledge, skills, and depth. Currently this means degrees from two year, four year, and graduate schools. It can also mean certifications such as the SME CMfgT and CMfgE. There is also a question of how manufacturing education for students in non-manufacturing disciplines can be improved.

**Education Methods and Tools** - New methods impact how manufacturing can be taught, as opposed to what is taught. In particular there is substantial discussion about hands-on and distance education along with effective use of the Internet, electronic books, and other computer aided engineering and manufacturing software.

## Now?

At the time this paper was written the report was still in draft form. However the report will now be available through the SME website, or it can be obtained from one of the authors in PDF format. In brief the majority of the recommendations for the report fall within one of the five areas below.

**Four Pillars** - The Four Pillars of Manufacturing Engineering concept was developed as a separate initiative from the Curricula 2015 report through the SME Center for Education. This concept provides a reference structure for manufacturing education, which needs to be used to

of materials and practices that can be used at all schools and by all relevant disciplines. This will help authors develop materials that can be used anywhere, and will help industry understand the manufacturing knowledge set.

**Image and Recruiting** - A consistent and powerful image for manufacturing must be created and used for the general public, government, students, professionals, and more.

**Financial Support** - Funding has become a critical issue for educators and students. Securing funding will allow more students to pursue manufacturing and other relevant degrees.

**Cooperation** - Academia, Industry, and Service groups must work together to keep the programs and practices up to date, develop new technologies, and develop other win-win strategies.

The audience for the report includes academics, manufacturers, policy makers, and other professionals. For each of the recommendations there are multiple actions suggested with stakeholders identified. It is expected that educators, industry, and service groups will improvise and develop new approaches as needed.

After all is said, manufacturers need our help to succeed, and what we can offer is high quality education.

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