

MANUFACTURING EDUCATION FOR THE **21ST** **CENTURY**

*Volume I:
Curricula 2002 Report*



Sponsored by the
Society of Manufacturing Engineers

Editor: David L. Wells, CMfgE

Published by the
Society of Manufacturing Engineers
One SME Drive, P.O. Box 930
Dearborn, Michigan 48121 U.S.A.

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DEARBORN, MICHIGAN 48121-0930

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International Standard Book Number: 0-87263-463-9

Manufactured in the United States of America

Chapter 2: Associate Education in Manufacturing Engineering Technology

Edward Nagle; Tri-State University [Panel Moderator]
John DeFilippo; Capital Community Technical College
Harold Jones; Sinclair Community College
George MacRitchie; Owens Technical College
Daniel McCarthy; Naugatuck Valley Community Technical College
Harry Ogden; Three Rivers Community Technical College
George Timblin; Central Piedmont Technical College

2.1 Objectives ...

The associate degree¹⁶ panel established its purpose as three-fold ...

- To articulate the positioning of the associate degree in the overall spectrum of professional manufacturing education;
- To clearly describe what the associate degree level should mean in terms of attained competencies;
- To articulate how this attainment differs from that of graduates of the next higher level.

In order to achieve these objectives, the panel first articulated a vision of the characteristics which should be displayed by a fully competent graduate of an associate degree¹⁷ program in this discipline. It is generally intended that graduates of associate degree programs in Manufacturing Engineering Technology will enter careers as manufacturing engineering technicians. The panel, therefore, delineated the common characteristics of those career fields.

The learning objectives for associate degree programs in Manufacturing Engineering Technology are depicted in the Cartesian space developed in Chapter 1¹⁸, and are shown in relationship with the other modes of manufacturing education.

¹⁶ Normal practice is to title these degrees as "Associate of Applied Science". There are, however, several variants in use -- "Associate of Science", "Associate of Engineering", "Associate of Engineering Technology", "Associate of Manufacturing Engineering Technology" and other similar titles.

¹⁷ Associate degree programs in the United States are commonly understood to be comprised of two academic years of full-time study. This is half of the norm for a bachelor's degree. An "academic year" is typically divided into either two sixteen-week semesters or three eleven-week quarters.

¹⁸ Figure 1.4, page 9.

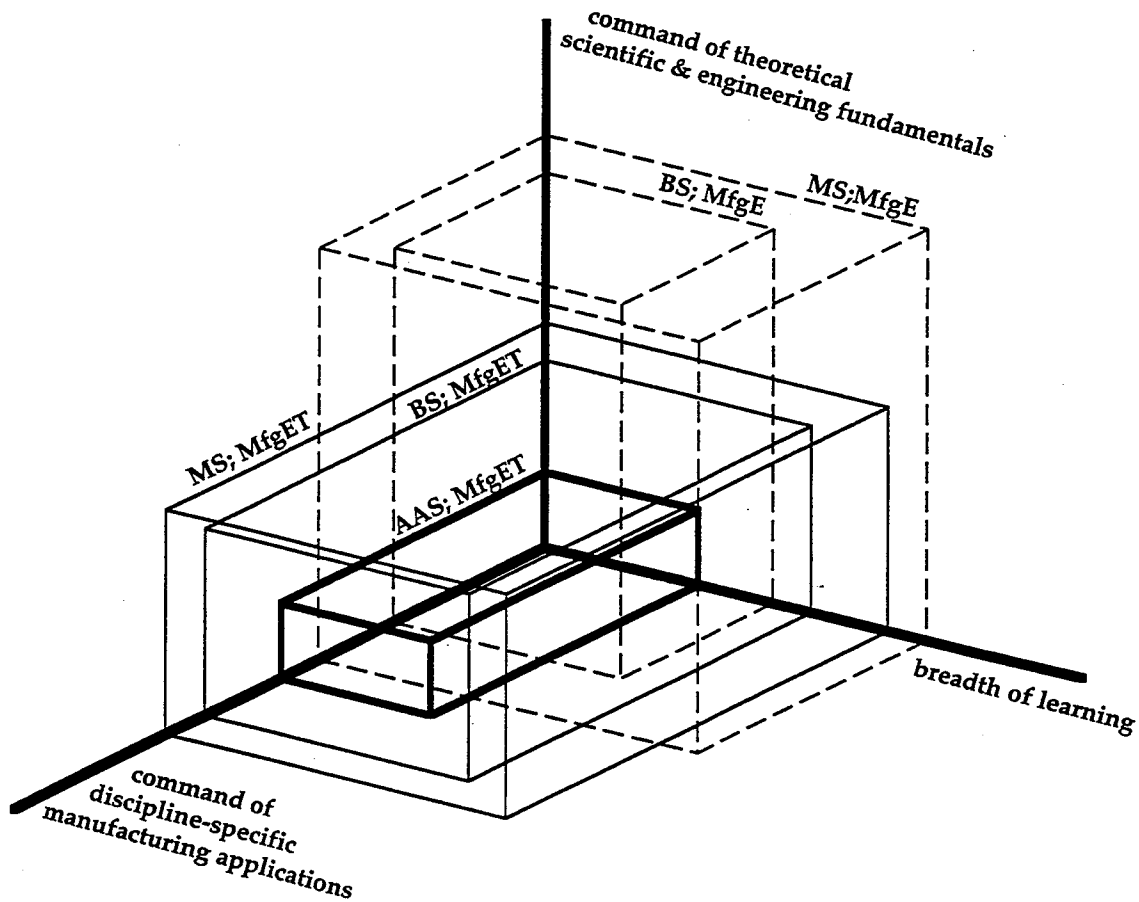


Figure 2.1: Learning Objective Coordinates for Associate Degree Programs in Manufacturing Engineering Technology

2.2 Vision of a Manufacturing Engineering Technician ...

The manufacturing engineering technician is a flexible, adaptable team member within the evolving technological manufacturing environment. Graduates of associate programs in Manufacturing Engineering Technology are prepared for immediate productive employment or, equally, for transfer to a bachelor's degree program in Manufacturing Engineering Technology or a different engineering technology discipline -- or, perhaps, another baccalaureate program. When entering a career field upon associate graduation, these technicians are able to apply state-of-the-art manufacturing skills and knowledge.

In addition to technical skills and knowledge, associate graduates in Manufacturing Engineering Technology will have acquired the capability to ...

... rapidly respond to a changing dynamic environment;

- ... function as a team player;
- ... learn quickly the changing technological skills;
- ... demonstrate competency in mathematics, basic sciences, communications and multicultural human interaction;
- ... exhibit competence with skills necessary for integration of manufacturing operations.

2.3 Characteristics of Associate Program Graduates ...

An associate degree program in Manufacturing Engineering Technology supports the vision of the career path for a manufacturing engineering technician by providing an educational platform which equips graduates to ...

- ... be immediately employable in the manufacturing enterprise;
- ... function effectively in an agile manufacturing environment;
- ... transfer into baccalaureate study for Manufacturing Engineering Technology or other appropriate degree programs;
- ... perform in a responsible and ethical manner.

In terms of the initial planning taxonomy for manufacturing education adopted for the preparations for this project¹⁹, associate degree holders in Manufacturing Engineering Technology will possess a solid core of technical competence, strengthened by a blend of human and introductory business skills. Expectations for competency levels in associate program graduates can be summarized as follows:

1. Liberal Studies and Communications:
 - Demonstrate team-oriented human skills that permit effective participation in multicultural work and social environments.
2. Scientific Fundamentals:
 - Apply appropriate mathematical and scientific principles to manufacturing applications.
3. Engineering Fundamentals:
 - Demonstrate proficiency in engineering fundamentals to analyze manufacturing engineering problems and make appropriate decisions.
4. Design for Production:
 - Assist in the design process to meet effective production objectives.
5. Engineering Materials:
 - Possess knowledge of engineering materials and be able to demonstrate competency in selection and utilization of materials.

¹⁹ See Figure 1.5, page 12.

6. Manufacturing Processes:
 - Apply knowledge and skills to develop, interpret and select appropriate manufacturing processes.
7. Manufacturing Systems:
 - Demonstrate ability to analyze manufacturing engineering problems, make appropriate decisions, and design and implement sub-systems for monitoring, controlling and optimizing production.
8. Physical Controls of Manufacturing Systems:
 - Maintain a practical knowledge of state-of-the-art hardware and software for manufacturing systems.
9. Information Controls in Manufacturing Enterprise:
 - Be aware of and utilize available information and data sources in support of the manufacturing enterprise.
10. Manufacturing Management:
 - Apply skills and knowledge to effectively and efficiently plan, organize, implement, measure and control manufacturing processes.

While it is considered imperative that associate graduates acquire competencies in the full range of the manufacturing discipline, it is clear that skill and knowledge attained in two years of full-time study will be less extensive than will be the case for more advanced degree holders. It is, therefore, necessary that the depth and breadth of capability expected in associate graduates be described. The matrix diagram employed in Chapter 1 is applied to this purpose²⁰ -- with slightly altered format to show specific associate graduate characteristics more clearly. This is shown as Figure 2.2 on the next page.

The associate panel defined the terms employed to describe the extent of capability, or competency, in Figure 2.2 as follows:

Awareness:

- Informed of the terms and language.

Knowledge:

- Familiar through both actual experience and formal instruction.
- Capable of dealing with specific definitions and terms.

Understanding:

- Comprehensive grasp and appreciation of primary concepts and relationships.

Applications:

- In command of fundamental mathematical, scientific and technical skills necessary to perform tasks.

²⁰ See Figure 1.8, page 16.

Skill Taxonomy for Manufacturing Engineering Technology	Measures of Depth of Learning						
	Awareness	Knowledge	Understanding	Applications	Synthesis	Evaluating	Judging
1. Technological Skills							
1.1 Design for Production	■	■	■				
1.2 Engineering Materials	■	■	■	■	■		
1.3 Manufacturing Processes	■	■	■	■	■	■	■
1.4 Manufacturing Systems	■	■	■	■	■	■	■
1.5 Control of Machines	■	■	■	■	■	■	
1.6 Quality and Manufacturing Information	■	■	■				
2. Humanistic Skills							
2.1 Communications Skills	■	■	■	■			
2.2 Computer Skills	■	■	■				
2.3 Information Technology Skills	■	■	■				
2.4 Globalism/Multiculturalism	■	■	■				
2.5 Teamwork Skills	■	■	■	■			
3. Business Skills							
3.1 Marketing	■	■					
3.2 Material Management	■	■	■				
3.3 Finance	■	■					
3.4 Human Resources	■	■					

Figure 2.2: Achievement Matrix for Graduates of Associate Programs in Manufacturing Engineering Technology (*enhanced*)

Synthesis:

- Capable of combining concepts.

Evaluating:

- Able to measure existing systems against appropriate criteria.

Judging:

- Able to assemble and balance facts, ideas and propositions, and to make informed decisions and recommendations.

In Figure 2.2, the solid bars indicate a high level of proficiency . Diagonally-striped bars indicate a medium level of proficiency, while vertically-striped bars represent introductory [low] level proficiency. The depth of the bars on the chart depict the depth of coverage of the subject at the indicated depth of competency. Thus, in the area of quality and manufacturing information [Skill 1.6 in Figure 2.2], the typical associate graduate in Manufacturing Engineering Technology can be expected to have attained a high level of proficiency in 'awareness' at substantial depth, an equally high proficiency at a lesser depth in 'knowledge', and an introductory proficiency at moderate depth in 'understanding' of this topical area. In each case, the extent terms are interpreted as described above.

2.4 Summary ...

Associate degree Manufacturing Engineering Technology programs prepare graduates for immediate employment as manufacturing engineering technicians. The same education prepares the associate graduate for direct continuation in a baccalaureate program in Manufacturing Engineering Technology. If the associate graduate should elect to continue education in another field, he/she will have attained the capability to transfer into and succeed in a baccalaureate program in another engineering technology discipline.

In the event that an associate Manufacturing Engineering Technology graduate should elect to continue education in Manufacturing Engineering or another engineering discipline, it is to be expected that significant time will be lost. The competencies gained during the two years of the associate engineering technology program will not be a good match with the expectations of the first two years of an engineering program. The engineering technology learning style relies much more on hands-on laboratory experience, provides less depth in mathematics and scientific fundamentals, integrates basic fundamentals with applications of the discipline much earlier in the educational process, and is, in general, a more discipline-

specific program. These characteristics will apply regardless of how closely matched are the specific disciplines.

Transfers to bachelor of science or bachelor of arts programs in non-engineering fields are also possible for graduates of associate programs in Manufacturing Engineering Technology. However, any transfer between disparate disciplines always results in some loss of time. In transfers to less technological disciplines, it can usually be expected that only the basic general education component of the associate program would be applicable.

The fundamental purpose of the associate program remains as the preparation of manufacturing engineering technicians for immediate productive employment. Associate graduates in Manufacturing Engineering Technology will possess skills and knowledge to contribute to and support the technological, human and business functions of the manufacturing enterprise.

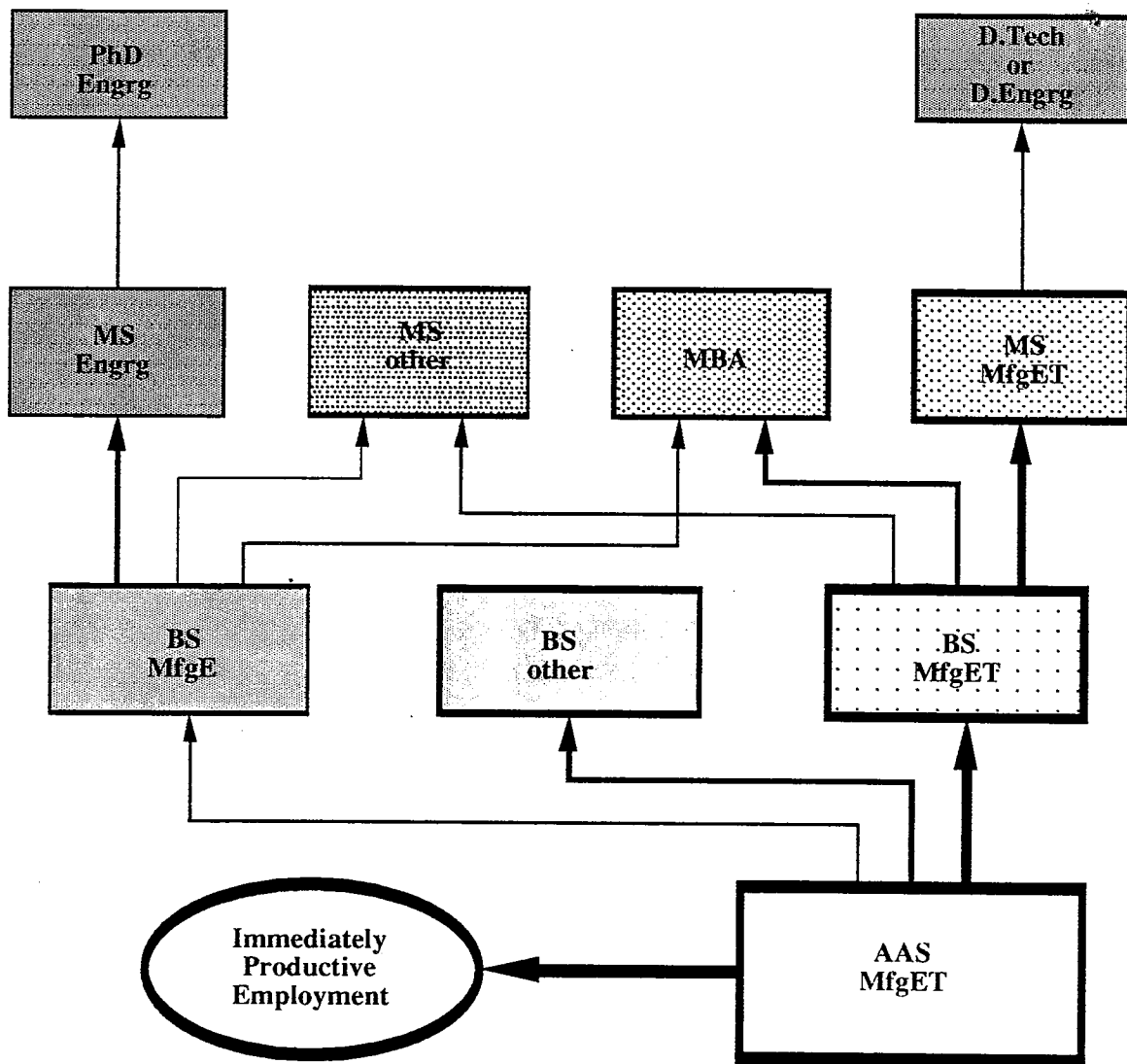


Figure 2.3: Educational and Career Flow Path from the Associate Degree in Manufacturing Engineering Technology *(enhanced)*