An Application of the SME Four Pillars of Manufacturing Knowledge

Prof. Paul Nutter, Ohio Northern University

Paul Nutter, LSME, CMfgE, CQE, CQA, is an Associate Professor in the Department of Technological Studies at Ohio Northern University. He has been teaching manufacturing technology since 2000, and has 26 years of experience in industrial and manufacturing engineering, primarily with Rockwell Automotive. Nutter is active in the Society of Manufacturing Engineers as faculty advisor for SME Student Chapter S186, and is chair for the SME Manufacturing Knowledge Base WIKI committee. He previously served as 2011 chair of the SME Technical Community Steering Committee, chair of the 2009 & 2010 Automated Manufacturing and Assembly Community, chair of the 2007 & 2008 Simulation Technical Group, on the 2006 Member Council, chair of the 2005 Student Relations Subcommittee, and on the 2005 SME Youth Program Task Force. He has also served multiple times on the SME nominating committee, and participated on various committees for annual conferences. Nutter received the 2009 national SME Award of Merit.

Dr. Hugh Jack, Grand Valley State University

An Application of the SME Four Pillars of Manufacturing Knowledge

Introduction

The Society of Manufacturing Engineers (SME) published a detailed study of manufacturing educational needs entitled “Curricula 2015: A Four Year Strategic Plan for Manufacturing Education”. A principle component of the study is the organization and visual representation of the key topics for manufacturing education into a graphical form that has been designated the "Four Pillars of Manufacturing Knowledge". (See Figure 1 below)

To assist in program and curriculum improvement of manufacturing engineering or technology programs, a survey was conducted of a broad audience including industry practitioners, managers, company owners and educators. The topics identified in the Four Pillars of Manufacturing Knowledge were specified along with a few others. Respondents were asked to indicate (in their opinion) how important each topic is for graduates of these programs.

This paper and poster provides a model of how the results of the survey can be utilized to assist in appropriate curriculum revisions to fulfill the needs/expectations of manufacturing industries.

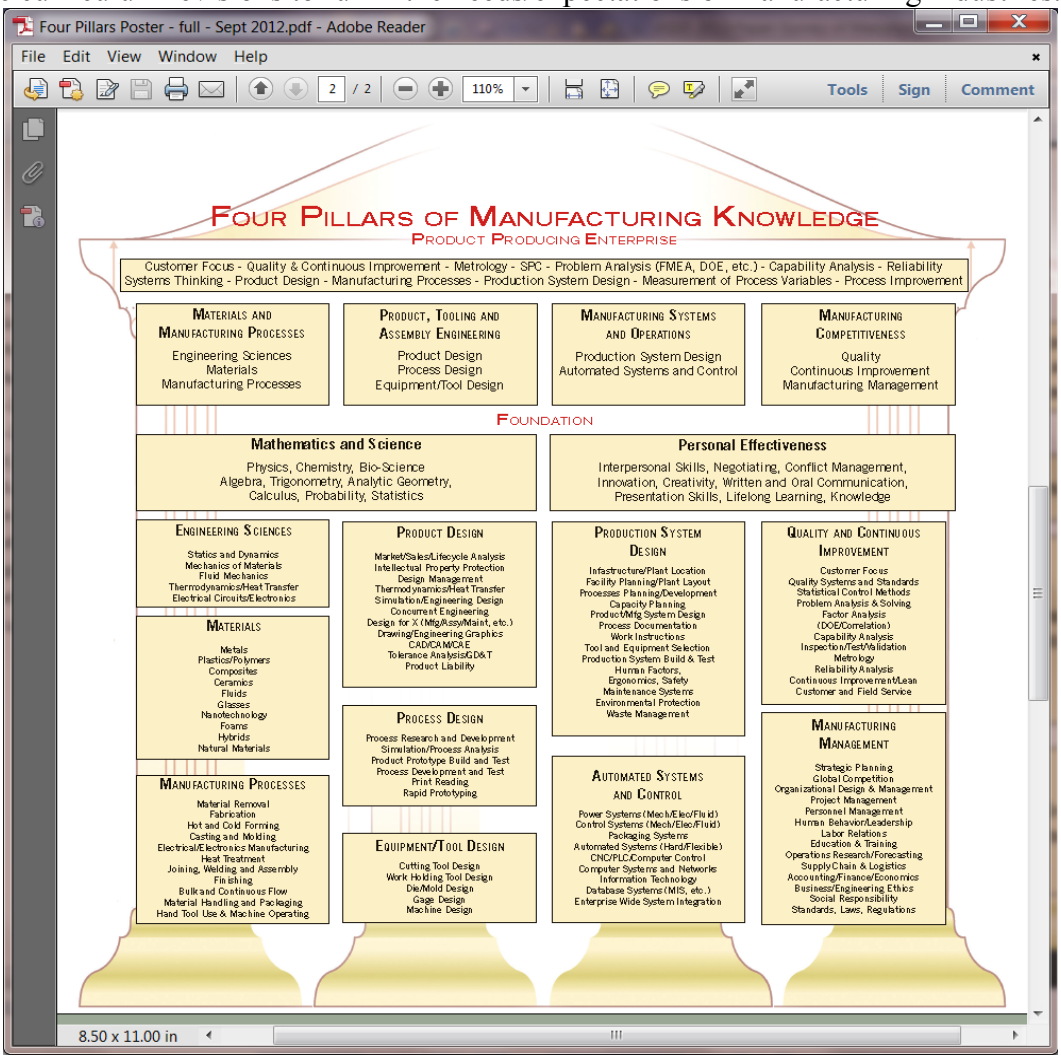

Figure 1. Graphic Representation of the Four Pillars Model.
For a PDF and details of the above go to www.sme.org/fourpillars

Survey Objectives and Instrument

A primary objective of this survey was to provide input to the decision making by educators in manufacturing programs for curriculum improvements. What content and relative emphasis should be placed on the topics that make up the field of manufacturing? The following demonstrates one mechanism to assist in application of these insights

The survey was created in Survey Monkey, and distributed as an email to a significant number of industry practitioners and educators through SME and ASEE distribution and list serves.

1. Responders were asked for which kinds of academic programs they are primarily responding. Multiple responses were permitted. Six options were provided:
   Bachelor Degree in Engineering (BS-Engr.)
   Associate Degree in Engineering Technology (ASET)
   Bachelor Degree in Engineering Technology (BSET)
   Associate Degree in Industrial Technology (ASIT)
   Bachelor Degree in Industrial Technology — Management Track (BSIT-Mgt)
   Bachelor Degree in Industrial Technology — Technical Track (BSIT-Tech)

2. A total of 99 topics were included in eleven sets of topics, derived primarily from the Four Pillars model. Responders were asked to indicate how well prepared graduates should be on each topic on a five-point Likert scale.

3. Survey responders were also asked to identify their primary background: Manufacturing management (Industry), Manufacturing engineering (Industry), Manufacturing education (Academia), or Professional or Academic administration. Multiple responses were permitted for those whose careers spanned more than one area to a significant degree.

An Application of the Survey Results

A primary objective of this survey was to identify the topics of highest value to manufacturing companies, and also those of significantly lower value. Although it is understood that various institutions and industries will have different priorities, this does offer the opportunity to consider which ones might be appropriate for emphasis. Alternatively, those considered less important might be reviewed to see if they represent a disproportionate component of an existing curriculum. If some topics were to be added or expanded, others may need to be reduced.

The following chart shows the top 20 topics as rated by the respondents, and the bottom 20 topics. These are in ranked order with the #1 topic being the highest rated. Beside each topic are three columns:

1. Column #1 asks if the topic is core to the objectives of the academic program making the evaluation. An ‘A’ indicates it is considered Essential for their majors; ‘B’ indicates it is Important; ‘C’ indicates it is Good to include; and ‘D’ indicates it is Not significantly important.
2. Column #2 estimates the number of hours students are presented or work with that topic area. This indicated the current state condition.

3. Column #3 indicated if there appears top be a need to increase or reduced emphasis and time commitment to that topic to achieve the objectives of the program.

Ranked Order of Survey Topics by Respondents—Top and Bottom 20 Topics

Rank Order	Top 20 Topics	Core for our Program? A-B-C-D*	Current # hrs on topic?	Priority for revision
1	Problem Analysis and Solving	A	100+	Same
2	Fabrication	A	20	Same
3	Print Reading	A	10	Increase
4	Metals	A	10	Same
5	Drawing/Engineering Graphics	A	20	Same
6	CAD/CAM/CAE	A	100+	Same
7	Continuous Improvement/ Lean	A	30	Same
8	Material Removal	A	20	Same
9	Tolerance Analysis/GD&T	A	6	Increase
10	Project Management	A	12	Increase
11	Product Prototype Build and Test	A	45	Same
12	Plastics/ Polymers	B	12	Same
13	Process Development and Test	A	30	Same
13	Customer Focus	A	10	Same
15	Joining, Welding & Assembly	A	20	Same
16	Design for X (Mfg/Assy/Maint.,etc.)	B	4	Same
17	Process Documentation	A	12	Same
18	Tool and Equipment Selection	B	8	Same
19	Statistical Control Methods	A	4	Increase
20	CNC/PLC/Computer Control	A	8	Increase

Rank Order	Bottom 20 Topics	Core for our Program? A-B-C-D*	Current # hrs on topic?	Priority for revision
80	Marketing/Sales/Lifecycle Analysis	C	4	Same
81	Organizational Design & Management	B	6	Same
82	Global Competition	B	3	Same
83	Thermodynamics/Heat Transfer	C	3	Same
84	Intellectual Property Protection	D	1	Same
85	Database Systems (MIS, etc.)	B	30	Reduce
86	Enterprise Wide Systems Integration	C	3	Same
87	Nanotechnology	C	1	Same
88	Accounting/Finance/Economics	B	2	Same
89	Packaging Systems	C	2	Same
90	Operation Research/ Forecasting	C	2	Same
91	Natural Materials	C	4	Same
92	Infrastructure/Plant Location	C	2	Same
93	Labor Relations	B	4	Reduce
94	Thermodynamics/Heat Transfer	C	1	Same
95	Glasses	C	1	Same
96	Hybrids	C	1	Same
97	Foams	C	1	Same
98	Auto ID Technologies/ Radio Frequency ID	C	4	Reduce
99	Can speak any foreign language	D	0	Same

* A = Essential for our majors; B = Important; C = Good to include; D = Not significantly important

Conclusion

This paper and poster provides one approach to using the information gather from a survey to assist in the development of a future state of their curriculum. By basing the survey on the Four Pillars of Manufacturing Knowledge and asking industry practitioners and educators in manufacturing fields this approach recognizes the “Voice of the Customer” to better prepare graduates of these programs.