Journal of
INDUSTRIAL
TECHNOLOGY

Volume 24, Number 4 - October 2008 through December 2008

Developing Maximum Career Potential in Manufacturing Technology Curricula

By Dr. R. Neal Callahan, Dr. Martin Jones, and Mr. Rathel R. Smith

Peer-Refereed:
Applied Papers

KEYWORD SEARCH

Lean Manufacturing
Management
Manufacturing
Six Sigma

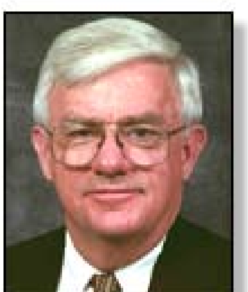
The Official Electronic Publication of the National Association of Industrial Technology • www.nait.org

Developing Maximum Career Potential in Manufacturing Technology Curricula

By Dr. R. Neal Callahan, Dr. Martin Jones, and Mr. Rathel R. Smith

Dr. R. Neal Callahan is an Associate Professor in the Department of Technology and Construction Management at Missouri State University. His research and teaching interests include computer integrated manufacturing and quality systems. Dr. Callahan received his Ph.D. in Engineering Management from the Missouri University of Science and Technology.

Dr. Martin P. Jones is an Assistant Professor in the Department of Technology and Construction Management at Missouri State University. He has over 15 years of professional experience as an engineer in both industry and government. In recent years, he has taught at high school, community college, and university levels. His expertise is in nondestructive evaluation of materials ultrasonic and radiographic methods. Dr. Jones has a B.S. from University of Maryland and a M.S. and a Ph.D. from The Johns Hopkins University.



Mr. Rathel R. (Dick) Smith is an Assistant Professor in the Department of Technology and Construction Management at Missouri State University. Mr. Smith is also an active consultant to the manufacturing community, specializing is quality systems and ISO 9000.

Abstract

This contribution reports the results of a national survey of manufacturing professionals concerning trends and educational needs in the competitive manufacturing environment. A variety of manufacturing professionals responded to questions relating to demographics, technology trends, and needed training. The survey explored the various manufacturing technologies and methods currently identified as being prominent and those expected to increase over the next decade. The study also included an analysis of the needs in continuing education for those currently working as manufacturing professionals. This article provides insights into curricular changes and strategies necessary to improve the competitiveness of manufacturing technology graduates. Recommendations for changes to academic courses, NAIT accreditation, and NAIT certification are included as methods for strengthening process improvement and efficiency skills. The survey and literature review also provide insight into the opportunities and advantages of technology programs and how these advantages can be used to maximize the career potential of graduates.

Introduction

Industrial Management and Manufacturing Technology disciplines in higher education face great challenge and opportunity as they look toward the second decade of the 21st Century. Graduates of these programs are constantly challenged to meet the demands of a rapidly changing business and technological environment that requires broadened skill sets. As an early proponent for broadened skill sets, Termini (1996) envisions "the new manufacturing engineer will be a people-oriented facilitator capable of listening to diverse opinions" (p. 2). Termini does not explicitly explain how this skill and others are to be learned. However, he does recommend that the manufacturing engineer have the ability to function as an "educator and trainer" (p. 2) to others within an organization. He also recommends that organizations "utilize training professionals who can bring real-world experience" (p. 160). The above recommendations indicate that Termini considers the continuing education and training of manufacturing engineers and technologists to be primarily accomplished through in-house experts and external consultants. He does not specifically address the role of engineering and technology schools in the initial or continuing education of manufacturing professionals. The present paper explores the potential of these schools to provide initial or continuing education that is in better alignment with the rapidly changing needs of manufacturing professionals and organizations. While the use of consultants and in-house trainers are effective in achieving the specific goals of a manufacturing organization, additional and relevant academic education and training can provide a broader foundation for the development of the manufacturing professional's career.

Changing and emerging technologies along with the ever increasing competition brought by globalization have altered and added to the required skills of the manufacturing professional (Lucena, 2006). Among the curricular proposals by Lucena are courses "developed to educate engineering students to understand and deal with the complexities of organizational change" (p. 334). To meet the expectations of employers, graduates must draw on a broad range of knowledge that often requires a blend of management and technical abilities (Bergendahl, 2005). Even if an engineer's job title does not include manager, Bergendahl states "they must be able to interact with and manage many different types of engineers" (p. 259). Industrial technology programs, with their well established tradition of blending these two areas, are well suited for the challenge. This ability may even provide an advantage over engineering graduates who tend to emphasize theory and have more narrowly focused analysis skills.

The skill set needed for success tends to change with the evolving competitive pressures of the industrial environment (Pascail, 2006). To maximize success for engineers over their entire career, Pascail advocates a broad skill set. Technology education should not only prepare students for the expectations placed upon them as they enter their profession, but also develop an expanded skill set that enables them to maximize their opportunities in a changing industrial environment. This paper reports the results of an industry survey relating to career-needed skills for manufacturing professionals. Through this process, the role of the technology educated professional in industry along with the unique opportunities available are highlighted and discussed. Based on survey results, recommendations are made for curricular improvements at the college level.

Background

As globalization accelerated over the past decade numerous manufacturing jobs left the United States for cheaper labor markets in developing areas such as Asia and the Pacific Rim. As those jobs left, some were replaced by positions in smaller start-up companies. Those smaller organizations, along with the remaining traditional manufacturers, face strong global competition as they strive to survive and grow.

Although fewer people are working in manufacturing in the United States, this sector still accounts for about 22-25% of the gross domestic product as it has for the past 50 years (Shinn, 2004). The remaining manufacturing professionals such as manufacturing technologists and manufacturing engineers play an increasingly important role in improving the efficiency and competitiveness of companies. Manufacturing professionals in the United States are increasingly asked to perform new and different tasks. It is no longer acceptable to only understand the technical components of the operation. A broader understanding of the overall business environment, competitive forces, and trends is necessary in order to properly apply technical knowledge (Sinn, 2004).

Various continuous improvement tools are widely used in industry today as a means for meeting the additional expectations placed upon manufacturing professionals. Lean and Six Sigma methodologies are prominent examples of these tools which strive to eliminate waste, improve quality and reduce production time. Implementing these programs can improve value for the customer while increasing profits for the company (Summers, 2007). According to one recent survey conducted by Industry Week and the Manufacturing Performance Institute, 40% of manufacturers have implemented some form of lean manufacturing program. Another 12% have implemented a combination of Lean and Six Sigma (Katz, 2007). Some companies considering outsourcing have found that they can stay competitive and meet financial goals by implementing lean concepts while remaining in the United States. Small to mid-sized companies in particular may be better off implementing lean concepts rather than migrating offshore (Langer, 2007).

While the methodologies of continuous improvement, Six Sigma, and similar techniques have steadily marched into the manufacturing professional's arena in industry, advances in technical education may not be keeping pace. Engineering programs struggle with the issue of integrating manufacturing and efficiency skills into their programs. Florman (1990) expresses concern over an increased emphasis on manufacturing in engineering programs and cautions "it comes too close to that hazardous no-man's land that lies between professional school and trade school" (p. 36). Although this sentiment may not be universal, it demonstrates a resistance to incorporating applied skills into engineering curricula. Ferguson (2005) indicates that traditional engineering education focuses on the analysis of design. He also cautions against compromising the traditional engineering knowledge base and analytical skills for the new applied focus. The resistance to incorporating more applied skills may be in part due to rigid curricula requirements for accreditation and professional engineer registrations. As competitive pressures focus on process improvement and efficiency, many degreed engineers are forced to learn these management and process skill sets.

Technology based programs have traditionally included a substantial applied component. Courses in manufacturing methods and management can be updated to include management and process skills such as Six Sigma and continuous improvement with relative ease. In comparison to engineering programs, technology programs can be much more agile in adjusting to the competitive forces of modern industry (Jones, Scott, Bolton, Bramley, and Manske, 2000). Based on employer input, Jones, et al. suggest engineers' "undergraduate education and training are inadequate for the needs of modern industry, lacking the business techniques or commercial and managerial understanding needed by today's firms" (p. 6).

Rapidly changing technology is also a factor in educating the manufacturing professional. New high tech industries are developing and expanding as a result of advances in material science, health care, and electronics. Microtechnologies and nanotechnologies typify the trend toward converging technologies where several disciplines such as material science, biology, chemistry, engineering, and physics are all critical in the development and manufacture of a product (Kalpakjian and Schmid, 2006). These new and developing industries require the same process improvement and efficiency skills as traditional manufacturing organizations. Examples of products currently being developed around the convergence of disciplines include microsensors for healthcare testing, automation applications using intelligent software, and high performance materials using carbon nanotubes (McCann, 2006). These new industries and technologies bring expectations and challenges to skilled professionals that must be addressed by both continuing education and traditional college degrees. Plaza (2004) proposes developing some core college technology courses around a topic involving several disciplines and instructors. This integrative approach could be particularly helpful at the introductory or capstone level in demonstrating the importance and application of the convergence of technology. Continuing education may also play an important role in updating the working professional with new technologies and applications.

Advances in software and internet applications can play an important role in the success of a manufacturing organization. Software to support lean concepts that required a major investment in the past is now available incrementally in much more affordable packages. Internet-enabled software is also now available in specialized segments allowing cash-strapped companies to purchase only what they presently need as they begin to implement a lean or continuous improvement program (Peake, 2003). Knowledge of these tools along with the training and skills needed to use them can provide companies with a significant competitive edge.

It is recognized that schools of technology and engineering should partner with manufacturers to integrate programs like lean manufacturing and Six Sigma into curricula. For example, Cebeci (2003) recalls his experience in such an educational partnership:

> *Boeing knew its engineers needed to work more effectively in a team environment to incorporate lean manufacturing, supply chain management, and integrated product development. As an academic partner with Boeing at the time, I worked with my colleagues at Cal State on a program to help engineers develop the required competencies. (p. 16)*

Jones and Chung (2008) more recently recognize the need to include such programs in curricula through special topics courses by suggesting "Advanced topics such as total quality management using Six Sigma techniques may provide modernized project execution skills" (p. 30).

By understanding the expectations of industry and beginning their careers with these needed skills, entry level manufacturing professionals are positioned to excel in their careers. Cebeci (2003) concludes that " To be successful, today's manufacturing professionals need to know how to implement lean manufacturing processes, how to manage the supply chain efficiently, and how to work efficiently as team members" (p. 16).

The goal of the present paper was to quantify and analyze what specific topics manufacturing professionals identify as needed in curricula so as to maximize their career potential.

Methodology

To better understand the current and future educational requirements for manufacturing technology programs, a unique survey was administered to a wide range of manufacturing professionals working in a variety of manufacturing and process-related industries in the United States. The e-mail addresses were supplied by the Society of Manufacturing Engineers (SME) and were selected from a database that consisted of both member and nonmember participants in SME events. This database generally represented manufacturing professionals who often have a technical component associated with their jobs. The survey was e-mailed to approximately 5200 individuals, with 261 responding for a response rate of about 5%. Although a 5% response rate has traditionally been considered low, there are additional factors to consider that do support validity.

Based on findings from Sheehan (2001) and Kent and Brandal (2003), response rates for e-mail surveys have fallen significantly over the past two decades and currently average about 5%. Tanner (1999) argues that an e-mail response rate of 5% is reasonable and workable in many cases. Wiseman (2003) echoes this conclusion saying "In fact, non-response error is only a problem if a low response rate is achieved and respondents differ from non-respondents on one or more of the variables of interest" (p. 2).

As the survey results indicate, the demographic profile of the respondents was compatible with the technical and managerial make-up that was being sought. According to Tanner (1999), knowledge about the population from which the information was drawn can help support validity. The survey population consisted of SME members and others with similar interests. A demographic study of SME members indicates that approximately 40% are engineers, and 30% are managers. Engineers and managers respectively were the two largest groups by far for both the SME population and the respondents with all other groups smaller that 10%. This supports a reasonable level of compatibility between the SME demographics and the respondent demographics and indicates a proportionate representation of all job function types. Although pre and post survey messages would have increased the response rate, this was not possible with the given arrangement with SME. The compatibility of demographics between SME membership and the respondents supports the validity of the survey.

There are several other methods to support the validity of a survey (Suskie, 1996). Among those methods, Suskie suggests using a focus group for comparison to the responses of the survey participants. The survey was developed by an eight member task force consisting of practicing manufacturing professionals, researchers, and educators. Those members provided a broad background of manufacturing experience and most had been active in SME for over twenty years. Since the response of the participants is similar to that expressed by the developers (a focus group), the survey is further validated.

Additional support of the survey's validity was drawn from the comparison of similar surveys that addressed the education and skills needed by manufacturing professionals. While the data collection techniques and specific questions differed among the previous surveys and the present survey, the underlying goal to help better align curricula with the professional's needs was fundamentally the same. For example, Markes (2006) surveys "the existing literature with a particular emphasis on those skills required by engineering and manufacturing employers" (p. 637). She recognizes "the need to enhance students' employability" (p. 637) but is unable to identify specific skills because the literature uses "different terminologies, which makes it impossible for meaningful comparisons to be conducted, meaningful conclusions to be drawn and meaningful assessments to be carried out." (p. 647).

The present survey was designed to account for other terminologies with which respondents might have been more familiar than those listed as choices in each question. For example, in Table 1, an insignificant percentage of respondents selected "other" with respect to job function. For the other tables, respondents had similar choices such as "none of the above". Very few selected responses like "other" and therefore were not listed in the tables. Because the respondents almost always selected the listed choices, it further supports the validity of the survey in that the terminology was familiar to the respondents (Suskie, 1996).

Results and Discussion

Educational Needs of Manufacturing Professionals

The survey initially addressed the role of the respondents by asking them to identify their current job function. Table 1 summarizes this data.

This information indicates that most of the respondents are placed in an engineering role while only 5% consider themselves technologists. At first glance this would seem to indicate that manufacturing professionals with a technology education have a very limited presence in industry. However, a closer look at the data revealed a much different conclusion. Participants were also asked to list their highest level of education. Twenty seven percent indicated either a two or four year technology related degree and 26% indicated a 4-year engineering degree. Only 5% of participants responded as being in technologist positions, indicating that most of the respondents with technology degrees have actually been working in engineering related positions. The data also indicates that the pool of manufacturing professionals is roughly made up of equal numbers of engineering and technology educated individuals. This clearly reflects the major contribution and position of technology educated graduates.

The survey also asked participants which technologies they were currently required to use. Lean process improvement tools, CAD/CAM, flexible manufacturing, integrated manufacturing systems, Six Sigma and automation were the top answers. These skills all relate to better efficiency and process improvement and have been utilized in industry for some time. Technology and engineering students are typically exposed to CAD and automation topics, but often see less exposure to lean concepts and Six Sigma methods. These process improvement related skills are often taught through employee training initiatives on the job or through seminars and special classes (Becker, 2006). The survey reported that lean process improvement tools are the most commonly required skill in today's industrial environment.

The survey addressed the issue of future trends. Participants were asked to indicate the tools and technologies they believed would increase in importance in the future. Multiple responses were allowed for this question as participants were asked to mark all that apply. Again, lean process improvement tools led the responses. Six Sigma, integrated manufacturing, sensor technology, flexible manufacturing and CAD were also prominent selections. The results for this question are shown in Table 2.

Continuing Educational Needs

Recognizing that the rate of change in technical knowledge is significant and that manufacturing professionals

Table 1. Job Function Data From Survey

What best describes your job function?	
Engineer	64.0%
Management	21.1%
Technologist/Technician	5.0%
Foreman/Group Leader/Supervisor	3.1%
Not listed	2.3%
Owner/CEO/Executive	1.9%
Machinist/Machine operator/Other Skilled Trades	1.5%
Other	0.8%

often need to update their education after they have entered their careers, the survey also sought to gain information with regard to continuing education. The participants were asked to identify areas of training or continuing education that are important in today's industrial environment and which areas are expected to be important over the next ten years. The results for this question are listed in Table 3. Again, participants were asked to select all that apply.

The data indicate that lean manufacturing concepts are a major factor in continuing education now and will also be important in the future. Process and efficiency improvement efforts typically include a variety of tools including lean manufacturing, Six Sigma, and statistical analysis. A majority of survey participants identified these methods as an important area for continuing education both now and 10 years into the future. New technologies and materials also ranked high in the response to this survey question. Approximately 80% of respondents identified new processes and technologies and over 50% identified new materials as important areas for continuing education.

Topics where employees lack exposure or depth of knowledge, even after their formal education, can be addressed through continuing education. Some areas requiring additional training may have developed after individuals finished college such as new materials, new methods, and continuous improvement tools including lean manufacturing and Six Sigma. In these situations employers may develop an in-house training mechanism or send employees to specialized training elsewhere. Another possibility is to fund additional formal education such as completing a two or four year degree or even completing a degree on-line. Training and assisting with formal education are expensive activities for employers. They are willing to absorb these expenses realizing that an even bigger reward will be realized through improved performance and efficiency. Continuing education activities are a major factor now and are expected to remain so in the future. The survey addressed this issue by asking how much time employers should devote to training manufacturing professionals over the next ten years. The response to this question is summarized in Table 4.

The survey indicates that about 52% of respondents predicted that time spent on continuing education will increase over the next 10 years and only 13% predicted it will decrease. This result demonstrates the emphasis companies place on continuing education now and the expectation that it will continue into the future.

Conclusions

More than ever, the rapidly changing global manufacturing environment places demands on manufacturing professionals. Advances in technology and ever increasing competition require expertise in business, efficiency, and

Table 2. Tools and Technologies Expected to Increase Over the Next 10 Years

In your opinion, which technologies do you see increasing in importance over the next ten years? (% of all participants)	
Lean Process Improvement Tools	63.8%
Six Sigma	51.5%
Integrated Manufacturing Systems	51.5%
Sensor Technology, Vision Systems, etc.	51.5%
Flexible Manufacturing Systems	50.8%
CAD, CAE, CAPP, or CAM	49.2%
Advanced Inspection Technologies	44.6%
Automated Material Handling	43.1%
Expert Systems, Artificial Intelligence	42.9%
Simulation	40.8%
Laser Applications	38.9%
Design of Experiments	30.8%
Composite Materials	24.5%

Table 3. Continuing Education Requirements

What areas of continuing education or training are important to the manufacturing professional in today's environment and over the next 10 years? (% of all participants)	Today	Next 10 years
Lean Manufacturing	82.0%	77.8%
New Processes or Technologies	80.8%	79.7%
CAD or Modeling	65.1%	52.5%
Six Sigma	63.6%	56.3%
Statistical Analysis	55.2%	46.0%
New Materials	52.5%	54.8%
Quality Management	49.8%	46.7%
Leadership or Supervision	48.3%	41.0%
Facilitator/Train the Trainer	34.5%	26.0%

innovation. With a significant number of manufacturing professionals being supplied by two and four-year technology programs, these institutions play a significant role in educating future leaders to meet the challenges of modern industry.

This paper provided an original approach to understand the skills needed by manufacturing professionals to maximize their career potentials. The use of the SME e-mail database provided a unique opportunity to survey a broad range of manufacturing professionals and receive valuable input for curricular change in support of the manufacturing industry. The participants' survey responses described in this paper identified critical skills and knowledge needed by manufacturing professionals. Lean process improvement tools and Six Sigma methods topped the list as major areas of importance both now and in the future. Based on this information, technology programs should emphasize these topics wherever possible in their curricula. Production management and quality courses often include components of these continuous improvement methods; however, additional and more in-depth coverage should be considered. Based on the level of the survey participants' interest shown concerning these topics, perhaps an additional course or courses should be offered that focus primarily on continuous improvement and efficiency methods.

NAIT can provide leadership and support for achieving a stronger focus on the methods indicated by this study. NAIT Standards for Accreditation for the baccalaureate degree program (NAIT Accreditation Handbook, 2006) currently includes 12-24 semester hours of Management, 24-36 semester hours Technical, and additional requirements for the more general educational areas. NAIT should emphasize the importance of process improvement and efficiency by including this area as a major foundation requirement. Reducing both the Management and Technical headings by 3-6 semester hours would allow the establishment of a Process Improvement and Efficiency heading. This would not disrupt the curricular balance because the Management and Technical headings currently contain provisions for efficiency and process improvement in more general terms such as Total Quality Management, teaming, production planning and control, and computer integrated manufacturing. Establishing a process improvement and efficiency heading with specific areas such as lean manufacturing, Six-Sigma, technology integration, and other specific process improvement methods would insure that accredited programs were addressing the applied skills indicated by this study. Similar changes could also be incorporated into associate level programs.

Table 4. Quantity of Training Required Over the Next 10 Years

In your opinion, over the next 10 years, the amount of time devoted to training for a manufacturing engineer/technologists will:	
Increase dramatically	15.7%
Increase somewhat	36.0%
Stay about the same	33.3%
Decrease somewhat	8.4%
Decrease dramatically	4.6%

NAIT certification can also play an important role in promoting process improvement and efficiency methods. The NAIT Industrial Technologist and Manufacturing Specialist exams currently include questions concerning management and supervision, planning and control, and production (NAIT Certification Policy, 2008). More specific study headings and exam questions should be added that clearly cover process improvement and efficiency methods. These changes would be complimentary to the proposed changes to the accreditation model.

New processes and materials were also indicated as a major concern both now and over the next 10 years. Including these topics in technology curricula is critical in preparing manufacturing professionals to enter the workplace. Adding an emerging technologies component to traditional manufacturing materials and processes courses could help instill this knowledge. Based on the trend toward converging technologies, creating a multidisciplinary capstone course that includes several areas such as technology, physics, materials, and biology may prove beneficial.

Continuing education will also play an important role in preparing manufacturing professionals to meet the ever-changing demands of industry. Lean manufacturing, new processes or technologies, CAD, and Six Sigma topped the list as needed areas for continuing education. Since terms such as "Six Sigma" and "lean" show a high selection rate among the respondents, courses might be more attractive to manufacturing professionals if so named or identified in the course description. Technology programs can help meet this need by offering completion degrees, and certificate programs that emphasize these skills. In addition, internet courses that address continuous improvement and new technologies can be a valuable resource for those working full-time and unable to attend live courses.

Two and four-year technology programs play a key role in preparing manufacturing professionals for current and future challenges. Given their tendency toward applied knowledge and the flexibility of their curricula, technology programs are in a unique position to respond to competitive challenges. By adjusting curricula to further emphasize continuous improvement skills and new technologies, technology programs will provide a major resource for competing in the global manufacturing economy.

This paper is limited to input from industry concerning needed skills and trends for manufacturing professionals. Additional research is needed to determine the practice and trends in academia concerning needed manufacturing skills. A comparison of these two perspectives could help identify areas of progress and opportunity for additional adjustments.

References:

Becker, F. (2006). Globalization, curricula reform and the consequences for engineers working in an international company. *European Journal of Engineering Education*, 31(3), 261-272.

Bergendahl, J. (2005). Toward a Broader Technical Education for Engineers. *Journal of Professional Issues in Engineering Education and Practice*, 131(4), 257-262.

Cebeci, T. (2003). Broadening the manufacturing practitioner's education. *Manufacturing Engineering,* 130(1), 16-17.

Ferguson, C. (2006). Defining the Australian mechanical engineer. *European Journal of Engineering Education*, 31(4), 471-485.

Florman, S. (1990). Producing engineers for the real world. *Issues in Science and Technology*, 6(3)**,** 34-37.

Jones, B., Scott, P., Bolton, B., Bramley, A., & Manske, F. (2000). The British engineer problem: a comparison of careers, employment and skills. *Policy Studies*, 21(1), 5-23.

Jones, E., & Chung, C. (2008). Education in modern solutions. *Industrial Engineering*, 40(8), 29-33.

Kalpakjian, S., & Schmid, S. (2006). *Manufacturing engineering and technology.* Upper Saddle River, NJ: Prentice-Hall.

Katz, J. (2007). Back to school. *Industry Week*, 256(5), 14.

Kent, R., & Brandal, H. (2003). Improving e-mail response in a permission marketing context. *International Journal of Market Research*, 45(4) 489-503.

Langer, F. (2007). Lean manufacturing challenges outsourcing. *Machine Design*, 79(4), 71.

Lucena, J. (2006). Globalization and organizational change: engineers' experiences and their implications for engineering education. *European Journal of Engineering Education*, 31(3), 321–338.

Markes, I. (2006). A review of literature on employability skill needs in engineering. *European Journal of Engineering Education,* 31(6), 637–650

McCann, J. (2006). The next economy. *BizEd*, 5(3), 40-44.

NAIT Accreditation Handbook (2006). Retrieved August 5, 2008 from http://www.nait.org/accred/2006accreditationhandbookcomp.pdf

NAIT Certification Policy (2008). Retrieved August 5, 2008 from http://www.nait.org as CITExamStudyGuide.pdf.

Pascail, L. (2006). The emergence of the skills approach in industry and its consequences for the training of engineers. *European Journal of Engineering Education*, 31(1), 55–61.

Peake, A. (2003). Preparing for the next generation. *Manufacturing Engineer*, 82(3), 14-17.

Plaza, O. (2004). Technology education versus liberal arts education. *The Journal of Technology Studies*, 30(1), 16-19.

Sheehan, K. (2001). E-mail survey response rates: a review. *Journal of Computer-Mediated Communication*, 6(2), 1-18.

Shinn, S. (2004). What about the widgets? *BizEd*, 4(1), 30-35.

Sinn, J. (2004). Electronic delivery in higher education: promise and challenge. *The Journal of Technology Studies*, 30(1), 39-45.

Summers, D. (2007). *Six Sigma basic tools and techniques.* Upper Saddle River, NJ: Pearson Prentice Hall.

Suskie, L. (1996). *Questionnaire survey research: What works.* Tallahassee, FL: Association for Institutional Research.

Tanner, J. (1999). Organizational buying theories a bridge to relationships theory. *Industrial Marketing Management*, 28(3), 245-255.

Termini, M. (1996). *The new manufacturing Engineer: Coming of age in an agile environment*. Dearborn, MI: Society of Manufacturing Engineers.

Wiseman, F. (2003). On the reporting of response rates in extension research. *Journal of Extension*, 41(3), 1-5.