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A Preliminary Manufacturing Competencies Study of Small and Medium-Sized Manufacturers in Illinois

by Dr. Kenneth W. Stier

Dr. Kenneth Stier is a professor and Certified Manufacturing Engineer (CMfgE) in the Department of Technology at Illinois State University (ISU). He is the sequence coordinator for the Integrated Manufacturing Systems Sequence and teaches materials technology, manufacturing processes, and manufacturing organization and management.

Introduction and Background

Program assessment has become an important element of the accreditation process in higher education today (Boser & Stier, 2005). As part of the assessment process competencies, program goals and learning outcomes are identified. Usually this is done through the assistance of an advisory board. Competencies and learning outcomes should address, and be limited to, the enduring understandings of the program (Wiggins & McTighe, 1998). In other words, what are the essential knowledge, skills, and/or competencies that the students in your program should know and be able to do by the time they graduate? In addition, the level or degree of performance expected for each outcome should be established (Weber State University, 2000).

Other sources for identifying outcomes, in addition to advisory boards, are accreditation agencies and professional organizations (Duff, 2004). With regard to manufacturing, the Accreditation Board of Engineering Technology (2003) has provided a generic list of program outcomes. This list addresses the outcomes of a manufacturing program in a broad sense. They include such competencies as mastery of manufacturing knowledge, techniques, skills and modern tools of ones discipline, the ability to apply current knowledge and adapt to emerging applications of mathematics, science, engineering and technology, and the ability to apply experimental results to improve processes, to name a few.

Professional organizations, such as the National Association of Manufacturers (NAM) and the Society of Manufacturing Engineers (SME) have conducted studies (NAM, 2001 & SME, 2003) to stimulate the academic community to help improve the competencies of the manufacturing workforce. The NAM conducted a study on workforce issues in the manufacturing industry at the beginning of the 21st century (NAM, 2001). The study showed that more than 80% of the manufacturers surveyed reported a "moderate to serious" shortage of qualified job applicants at a time when manufacturers were downsizing (NAM, 2003b). The study noted that there was a mismatch between the competencies that employers were searching for in job applicants versus what current employees and job applicants had to offer. The NAM has published two papers (NAM, 2003a & NAM, 2003b) since the 2001 study was conducted, indicating the need for an appropriately prepared workforce to help keep the United States manufacturing companies competitive in the global marketplace. The NAM has done a good public awareness campaign for the need for a highly skilled generation of employees in our domestic manufacturing sector and reinforced the idea of matching an educational program's competencies with employer needs.

The SME Organization has used its competency gaps study as the basis of the Foundation's grant proposals. The focus of the SME study was on closing competency gaps between what the industry needs in new employees and what educational programs provide. The competency gaps identified in the SME study included: communication skills, teamwork, personal attributes, manufacturing principles, reliability, project management, manufacturing processes, business skills, quality, change management, statistics and probability, ergonomics, materials, and continuous or lifelong learning (SME, 2003). A more detailed explanation of each of these gaps is given in the SME literature.

The literature supports many of the SME competency gaps that were identified. Hall (2005) sighted the need for academia to improve its delivery of education with regard to quality, just-in-time manufacturing, problem solving, teamwork, and, most importantly, lean manufacturing. Green (2002) and Levinson (2002) further reinforce the importance of lean manufacturing and how these principles will help domestic companies survive in the global marketplace.

Driving the need for lean manufacturing and other competencies identified in the SME study was the rapid change that had taken place in the manufacturing industry in the six years prior to this study. Globalization of U.S. manufacturing companies and the appearance of a mass exodus of domestic production were two major changes that took place from the late 1990s to the present (McClenahen, 2003). China has been the country most frequently associated with the later of these changes (McClenahen & Panchak, 2003). Enough concern was raised with regard to globalization and exiting manufacturing companies that a study was conducted on the impacts of international trade with China on Illinois manufacturers (Weinstein, Lewis and Bergeron, 2003).

Consequently, the rapid change experienced in the manufacturing industry suggested the need for a preliminary study to enable the Integrated Manufacturing Systems (IMS) Program in the Department of Technology at a Midwestern University (MU) to benchmark its current competency listing with the feedback from small (those with less than 100 employees) and medium-sized (those with 100-500 employees) manufacturers in Illinois (Krejcie, 1970). It was considered important to conduct a study before undertaking a major capital equipment project at the MU to gain some sense of what small and medium-sized employers were indicating were important competencies, given the changes that had occurred in the manufacturing industry. Accordingly, this study was designed to identify the competencies that are needed by new graduates that are employed in small and mid-sized manufacturers in Illinois. The study provided baseline information for the development of a high end, integrated manufacturing laboratory for the Department of Technology. Funding for this project was the result of a major capital campaign drive at the MU.

Objectives of the Study

The purpose of the study was to identify the competencies desired of manufacturing engineering and technology graduates as specified by small and medium-sized manufacturers in the electronics, metals and plastics products companies in Illinois. The specific objectives of the study were to:

a. investigate if there were competency gaps with regard to basic personal skills, technical skills, and business/professional skills between manufacturing engineering and technology graduates and those required by small and mid-sized Illinois electronics, metals and plastics products manufacturing companies.
b. investigate if the competency gaps in manufacturing engineering and technology graduates in Illinois electronics, metals and plastics products manufacturing companies that employ the MU manufacturing graduates are different than those of the companies that have not.
c. investigate the need for curriculum change and improvements in laboratory instrumentation and processing equipment in the IMS Program at the MU.

Upon completion of this study the following research questions were to be answered.

1. What are some of the demographic variables of small and medium-sized electronics, metals and plastics products manufacturing companies in Illinois?
2. Did the selected small and mid-sized Illinois electronics, metals and plastics products manufacturing companies in this study perceive competency gaps in new manufacturing practitioners who they have hired within the last three years with regard to basic personal skills, technical skills and business/professional skills?
3. To what extent were the perceived competencies the same or different from those identified by the manufacturing program at the MU?
4. Was there a significant difference between the responses of small and medium-sized electronics, metals and plastics products manufacturers that did hire graduates from the MU program versus those that did not?

Methodology

By using the *Illinois Manufacturers Directory* (2004), small electronics, metals and plastics products manufacturing firms and medium-sized manufacturing firms were identified from the state. The population for this study consisted of approximately 3,000 companies in the electronics, metals and plastics products listing. These three types of companies were used for the population for this study because they align quite closely with the three options in the IMS Program at the MU.

The companies were surveyed by mail and asked to respond to a questionnaire that focused on the research questions. The questionnaire used a five-point Likert-type scale that focused on research questions in four major areas: (a) general demographic information, (b) basic personal skills, (c) technical skills, and (d) business/professional skills. A place for additional comments at the end of the questionnaire gave respondents an opportunity to elaborate and explain their previous answers, as well as include skills that were missing (see Appendix for complete questionnaire).

The return rates in the four categories of companies were: (a) 77.8% return rate with the small companies that hired manufacturing graduates from the MU, (b) 50% return rate with medium-sized companies that hired manufacturing graduates from the MU, (c) 3.3% return rate with the small companies that did not hire manufacturing graduates from the MU, and (d) an 11.3% return rate with the medium-sized companies that did not hire manufacturing graduates from the MU.

The data were subjected to quantitative and qualitative analysis. In the quantitative analysis, descriptive statistics were prepared using SPSS 12.0 for Windows. In the qualitative analysis, the open-ended responses were studied for any major themes that might emerge.

Discussion of return rate

The author was not pleased with the rate of return, especially for the companies that did not hire graduates from the MU program. However, several considerations are worth mentioning. First, a total of 122 responses (sample size of 306) were received from the small companies that did not hire graduates from the program. This was a 40% return rate, but many of them could not be used because they responded by saying they did not hire manufacturing engineers or technologists, or they were not interested in the study. Consequently, they left the questionnaire blank. This may have been due to the fact that these companies were too small to allocate a full-time position to this area. Instead, these duties may have been part of someone's overall job responsibilities. The medium-sized companies that did not hire graduates also had responses that were not included for the same reasons. Seventeen percent of the questionnaires in this category were received, but only 11.3% were used.

Second, the 2004 *Illinois Manufacturers Directory* was used to identify the sample. Some of the companies listed in it may have changed locations or gone out of business since the address data was collected. Some of the mailings came back marked "return to sender." In addition, the titles of the contact people listed in the directory varied widely. Some of these people may have most of their responsibilities in other areas of the company and did not have any desire to become concerned with a questionnaire on manufacturing.

Third, the return envelopes were numbered so that the author could identify non-respondents for follow-up. Some of the people receiving the questionnaire may have decided not to complete and return it because they were concerned that they would have been identified with their responses.

Feedback from the Advisory Board

Once the questionnaires had been received and tallied from the Illinois companies in the study, the advisory board members for the Manufacturing Program at the MU were asked to become involved with the study. They were split into two groups and asked to respond to the three skills sections. Ten advisory board members were asked to think as if they were a small or mid-sized electronics, metals or plastics manufacturer who hired graduates from the program and guess how the study turned out. Ten other advisory board members were asked to think as if they were a small or mid-sized electronics, metals or plastics manufacturer who did not hire graduates from the program and guess how the respondents answered. The return rate was six out of the 10 advisory board members and seven out of 10 respectively.

The data were subjected to quantitative analysis using descriptive statistics in SPSS 12.0 for Windows. The independent variables were either hiring or not hiring graduates from the manufacturing Program at the MU. The dependent variables were the list of skills in questionnaire. A one-way ANOVA was used to analyze the data. A Levene's test for equality of variances and t-test for equality of means were used to generate data. Significance was determined at the 0.05 level as to whether there were substantial differences with regard to how the advisory board and company groups responded.

Quantitative Analysis of Data

Employer Data

For the questionnaires that were returned from the employers and could be used as part of this study, the author created a Microsoft Excel spreadsheet for ease of entry. Then the data were transferred into SPSS 12.0 for Windows, PC version. Descriptive statistics were calculated and graphics were prepared. The data were analyzed in terms of (a) demographic variables, (b) basic personal skills, (c) technical skills and (d) business/professional skills.

Demographic variables

The first five questions addressed demographic variables of the respondents (see Tables 1-5). All the following information with regard to demographic variables is based on those questionnaires which were returned and were included in the results of the study. The author found the average company age for (1) small companies who hired manufacturing graduates to be 35 years, (2) for medium-sized companies who hired manufacturing graduates to be 64 years, (3) for small companies who did not hire manufacturing graduates to be 36 years and (4) for mid-sized companies who did not hire manufacturing graduates to be 47 years (see Table 1). The average age of all the companies combined together was 49 years. This

Table 1. The Mean Age of Companies

Company Category by Size	Mean Age (years)
Small Companies That Do Hire	35
Mid-sized Companies That Do Hire	64
Small Companies That Do Not Hire	36
Mid-sized Companies That Do Not Hire	47
Average Age of All The Companies	49

suggests that the respondents were from stable enterprises with relatively long track records of success.

Table 2 shows the average number of manufacturing engineers hired by each category of company, which were (1) five for small companies that hired manufacturing graduates, (2) eight for medium sized companies that hired manufacturing graduates, (3) two for small companies that did not hire manufacturing graduates and (4) 22 for medium-sized companies that did not hire manufacturing graduates. Table 2 shows that medium-sized companies hired more manufacturing engineers than small companies. In addition, table 2 also shows that there are employment opportunities for manufacturing graduates in medium-sized companies which had not been hiring students or graduates from the MU program.

Table 3 shows the average number of employees involved in production for the different sized companies: (1) 45 for small companies who do hire manufacturing graduates, (2) 323 for medium-sized companies who do hire manufacturing graduates, (3) 21 for small companies who do not hire manufacturing graduates and (4) 326 for medium-sized companies who do not hire manufacturing graduates. It should be noted that small companies who did not hire manufacturing graduates from the MU program only averaged 21 employees being involved in production. This could be the reason for the lack of interest in this group of companies in the questionnaire and hiring manufacturing engineers or technologists. They simply do not appear to be big enough to have a need for hiring someone specifically for that position.

Company Category by Size	Number Hired
Small Companies That Do Hire	5
Mid-sized Companies That Do Hire	8
Small Companies That Do Not Hire	2
Mid-sized Companies That Do Not Hire	22

Table 2. The Average Number of Manufacturing Engineers Hired by Each Type of Company

Company Category by Size	Number of Employees
Small Companies That Do Hire	45
Mid-sized Companies That Do Hire	323
Small Companies That Do Not Hire	21
Mid-sized Companies That Do Not Hire	326

Table 3. The Average Number of Employees Involved with Production

	Mean Scores			
Listing of Basic Personal Skills	Company Category by Size			
	1	2	3	4
Oral communication skills	4.4	4.3	4.4	4.2
Written communication skills	4.1	4.1	4.3	4.5
Computer skills	4.4	4.3	4.1	4.7
Work effectively in teams	4.4	4.6	4.6	4.7
Solve technical problems	4	4.4	4.5	4.2
Anticipate or plan for the unexpected	4.2	4.4	4	3.7
Know what's happening around them	4.1	4.4	3.9	4
Leadership and willingness to take initiative	4.1	4.5	3.9	4
Willingness to learn and improve	4.7	4.3	4.3	4.7

Note: Below are the company categories by size.

1 = Small Companies That Do Hire
2 = Mid-sized Companies That Do Hire
3 = Small Companies That Do Not Hire
4 = Mid-sized Companies That Do Not Hire

Table 4. The Mean Responses for the Listing of Basic Personal Skills

The data for the last demographic question asked to what extent the company representative felt the company was a low run production shop, high run production shop, or job shop. The respondent had to rate each of the three types of shops on a likert scale from one to five, with five being a strong identifier as to the type of facility the company operated. The average for all the companies that responded was 2.32, 3.82, and 2.56 respectively. The averages show that the majority of the respondents felt their company ran a high run production shop.

Basic personal skills

Questions 6-14 on the questionnaire focused on basic personal skills that would be needed by a manufacturing engineer or technologist. The respondents were asked to what extent they felt it was important for newly hired manufacturing engineering or technology graduates to possess the basic skills listed. They had to respond to a five-point likert scale with one being low importance and five being high importance. Table 4 shows the mean responses for small and medium-sized companies. All these skills were rated highly by the respondents. 'The ability to work effectively in teams' had the highest overall rating and was followed by 'a willingness to learn and improve their knowledge and skills'.

Technical skills

Items 15 to 20 on the questionnaire dealt with technical skills that would be needed by a manufacturing engineer or technologist. The respondents were asked to what extent they felt it was important for newly hired manufacturing engineering or technology graduates to possess the technical skills listed.

Table 5 depicts the mean responses to these items. The ability to read and interpret manufacturing documentation such as blue prints, technical drawings and diagrams, production plans, tooling plans, quality plans, and safety plans was rated the highest by the respondents. The small manufacturers who hired graduates from the MU program gave it the highest rating possible, as did medium-sized manufacturers who did not hire graduates from the program. The ability to monitor and control manufacturing processes or other industrial systems had the second highest overall mean score ratings. The manufacturers that did hire graduates from the MU program rated it higher than those companies that did not hire them.

Business/professional skills

Items 21 to 27 on the questionnaire dealt with business and professional skills that would be needed by a manufacturing engineer or technologist. The respondents were asked to what extent they felt it was important for newly hired manufacturing engineering or technology graduates to possess the business and professional skills listed. The same five-point likert scale was used.

Table 6 shows the responses to these items. Understanding quality systems was rated the highest by the respondents. All the mean values for this item were a 4.0 and above. The next highest ranked skill was understanding how to manage projects. The means

	Mean Scores			
Listing of Technical Skills	Company Category by Size 1	2	3	4
The ability to interpret and apply basic concepts of materials science	3.1	3.8	3.1	3.5
The ability to analyze and apply basic electricity and electronic principles	3.3	3.8	2.9	3.3
The ability to monitor and control manufacturing processes or other industrial systems.	4.2	4	3.8	3.7
The ability to select appropriate manufacturing processes for product production applications	4.1	3.7	3.8	3.8
The ability to utilize 2-D and 3-D computer-aided design systems	3.7	3.4	3.6	4.3
The ability to read and interpret manufacturing documentation	5	4.5	4	5

Note: Below are the company categories by size.

1 = Small Companies That Do Hire
2 = Mid-sized Companies That Do Hire
3 = Small Companies That Do Not Hire
4 = Mid-sized Companies That Do Not Hire

Table 5. The Mean Responses for the Listing of Technical Skills

	Mean Scores			
Listing of Business/Professional Skills	Company Category by Size 1	2	3	4
An understanding of how to manage projects	4.1	4.3	4.1	4.5
An understanding of lean manufacturing	3.7	4.3	3.7	4.3
An understanding of ergonomics	3.1	3.9	3.2	3.7
An understanding of quality systems	4.6	4.3	4	4.5
An understanding of statistics and probability	3.5	3.6	3.7	3.2
An understanding of supply chain management	3.6	3.7	3.3	3
An understanding of global economics	3	3	3.2	2.7

Note: Below are the company categories by size.

1 = Small Companies That Do Hire
2 = Mid-sized Companies That Do Hire
3 = Small Companies That Do Not Hire
4 = Mid-sized Companies That Do Not Hire

Table 6. The Mean Responses for the Listing of Business/Professional Skills

for this cluster were consistently high for all the groups that responded. The least valued skill by the respondents was having an understanding of global economics. This was somewhat of a surprise to the author since many of the companies that were surveyed operate in a global marketplace today.

Advisory Board Data

The goal of having the advisory board members fill out the questionnaire and try to second guess the company responses was to identify if there were differences between the perceptions of the advisory board members and the employers with regard to how they viewed the level of importance of the basic personal skills, technical skills and business/professional skills listed on the questionnaire. If there were major differences, then the data would then be used to foster discussion with the advisory board members.

Two skills were found to be significant at the 0.05 level for the responses by the advisory committee members and the employers that did hire the MU manufacturing graduates. The first one was a personal skill, item number 12 on the questionnaire "The ability or motivation to know what's happening around them (perception). The second skill with a significant difference was item number 19 which is the ability to use 2D and 3D computer-aided design (CAD) systems. Employers who hired graduates rated 'perception' higher than the advisory committee members. The opposite was true with regard to graduates being able to use 2D and 3D CAD systems. In other words, the advisory committee members surmised that the employers would rate them differently.

No skills were found to be significant at the 0.05 level for the responses by the advisory committee members and the employers that did not hire the MU manufacturing graduates. The lack of significance would indicate that both groups responded relatively the same and that the advisory committee members had a good perception as to how employers valued the different skills listed on the questionnaire.

Qualitative Analysis of Data

The employer respondents were encouraged to write comments beneath each of the four sections of the questionnaire. There was also an open-ended section at the end where they were asked for additional comments. All the comments that were written were found in the section at the end of the questionnaire. The feedback from the respondents was studied to determine to what extent there were identifiable themes or trends, if there were major areas of consensus among respondents, and if the comments were consistent with the responses to the quantitative items. A total of nine questionnaires contained comments. Preliminary analysis showed the comments to be diverse. Some reiterated and supported skills that were listed in the three previous sections (i.e. "The most important skill that a new grad should possess is the drive and ability to learn. Motivation is the key!"). Others made comments about what they did at their facility (i.e. "Interact with job shops and manufacturers"). The comments are best used as "food for thought," because there did not appear to be any additional trends related to manufacturing skills issues.

Conclusion and Discussion

In terms of demographics, the largest number of companies that responded was medium-sized companies that hired graduates from the Manufacturing Program at the MU with 100 to 500 employees involved in production. All the companies that responded seemed to be stable concerns with long-term track records and they tended to be high-run production or job shop facilities. The average number of manufacturing engineers or technologists hired over the years by the companies that responded was nine. Interestingly, medium-sized companies that did not hire manufacturing engineers or technologists from the MU program had hired the most number of these people in the past. Small companies that responded hired very few manufacturing engineers or technologists.

All the basic personal skills were rated highly by the respondents. No group rated any of these skills below a 3.5 on a five point scale. Most of the items were rated at a mean score of 4 or above by the four different categories of companies. 'The ability to work effectively in teams' and 'a willingness to learn and improve their knowledge and skills' were the two skills that were rated the highest by the respondents. There did not appear to be any skills that were more desired by one category of companies or less desired. All of the mean scores were very consistent from one category to another.

The ability to read and interpret manufacturing documentation such as blue prints, technical drawings and diagrams, production plans, tooling plans, quality plans, and safety plans was rated as the highest desired technical skill by the respondents. The overall rating for this skill was a 4.5 on a five point scale. The other skills were primarily rated between a 3 and a 4 mean score by all four categories of companies. Thus, the author observed that the respondents rated the basic personal skills slightly higher than the technical skills when comparing the mean scores.

Consistent with the literature (Green, 2002; Heizer & Render, 2004; Levinson, 2002; Preuss, 2002; Steinburg, 1998), respondents indicated that having an understanding of quality systems, managing projects, and lean manufacturing are the three highest desired business/professional skills for manufacturing engineering and technology graduates. The order of importance is in their respective order, with the average mean score for all the companies being above a 4 on a 5 point scale for each of the three skills. The least amount of importance was placed on understanding global economics by the respondents.

The skills listed in the three categories on the questionnaire were consistent with the competencies used by the manufacturing program at the MU. No new competencies or trends were discovered from the study. If anything, this study re-affirmed what the program was doing.

There was no significant difference between the responses of the companies that did hire graduates from the MU program and those that did not. Given the low return rate it is difficult to draw any concrete conclusions in this regard. Further study is recommended to verify the results on this item.

There are some implications for manufacturing engineering and technology programs that can be drawn from the study. If the results apply to other geographic regions of the United States, and the author feels they might, there seems to be an indication that small electronics, metals, and plastics manufacturing companies (those with less than 100 employees) generally do not allocate a separate position to this responsibility. While this is a large constituency within the manufacturing industry, this group of companies may not provide much opportunity for graduates in manufacturing engineering or technology programs. Medium-sized electronics, metals and plastics manufacturing companies offer more opportunity for gainful employment, but there are not as many of these companies in the industry. Often these companies produce parts and subassemblies for large companies. The large companies demand that smaller concerns have employees with similar skills. Both categories of companies are more likely to allocate full time positions that would be a good match for manufacturing engineering or technology graduates.

Faculty in manufacturing engineering and technology programs are well positioned to address the skills that were identified in this article. With the applied or hands-on approach that has always been the mainstay of this discipline, manufacturing faculty have many opportunities to provide the students with these skills in an appealing manner. At the same time, faculty and graduates can make a contribution to the continued economic viability of this nation.

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APPENDIX on page 9

Appendix

Questionnaire That Was Used in the Study

Illinois State University
Department of Technology
Competencies Needed for Manufacturing Engineering and Technology Graduates

I. DEMOGRAPHIC INFORMATION

1. What is the age of your company? __________ years
2. Have you ever employed manufacturing engineering or technology graduates? Approximately how many?
3. How many manufacturing engineering or technology graduates do you currently employ?
4. How many of your plant employees are directly related to production? ____
5. To what extent do you feel that you are a:

	Low				High
a. Low run production shop	1	2	3	4	5
b. High run production shop	1	2	3	4	5
c. Job shop	1	2	3	4	5

II. BASIC PERSONAL SKILLS

To what extent do you feel it is important for newly hired manufacturing engineering or technology graduates to possess the following basic personal skills:

	Low				High
6. Oral communication skills	1	2	3	4	5
7. Written communication skills	1	2	3	4	5
8. Computer skills	1	2	3	4	5
9. The ability to work effectively in teams	1	2	3	4	5
10. The ability to solve technical problems	1	2	3	4	5
11. The ability to anticipate or plan for the unexpected (urgency)	1	2	3	4	5
12. The ability or motivation to know what's happening around them (perception)	1	2	3	4	5
13. Leadership and willingness to take initiative	1	2	3	4	5
14. A willingness to learn and improve their knowledge and skills.	1	2	3	4	5

III. TECHNICAL SKILLS

To what extent do you feel it is important for recently hired manufacturing engineering or technology graduates to possess the following technical skills:

15. The ability to interpret and apply basic concepts of materials science such as strength of materials, structural properties, conductivity, and mechanical properties. Perform various non-destructive and destructive materials testing procedures.

Low				High
1	2	3	4	5

16. The ability to analyze and apply basic electricity and electronic principles within the various manufacturing environments and applications such as industrial robots, controls, and other such systems.

Low				High
1	2	3	4	5

17. The ability to monitor and control manufacturing processes or other industrial systems.

Low				High
1	2	3	4	5

18. The ability to select appropriate manufacturing processes for product production applications such as forming, molding, separating, conditioning, joining, and finishing.

Low				High
1	2	3	4	5

19. The ability to utilize 2-D and 3-D computer-aided design systems to create drawings and models for products, machines, jigs, fixtures, and other mechanical devices used in manufacturing environments.

Low				High
1	2	3	4	5

20. The ability to read and interpret manufacturing documentation such as blue prints, technical drawings and diagrams, production plans, tooling plans, quality plans, and safety plans.

Low				High
1	2	3	4	5

IV. BUSINESS/PROFESSIONAL SKILLS

To what extent do you feel it is important for recently hired manufacturing engineering or technology graduates to possess the following business/professional skills:

	Low				High
21. An understanding of how to manage projects	1	2	3	4	5
22. An understanding of lean manufacturing	1	2	3	4	5
23. An understanding of ergonomics	1	2	3	4	5
24. An understanding of quality systems	1	2	3	4	5
25. An understanding of statistics and probability	1	2	3	4	5
26. An understanding of supply chain management	1	2	3	4	5
27. An understanding of global economics	1	2	3	4	5

Please use the area below to make any comments you feel are appropriate.

THANK YOU FOR COMPLETING THIS SURVEY!