

AC 2007-1027: THE STATE OF MANUFACTURING ENGINEERING TECHNOLOGY EDUCATION

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The State of Manufacturing Engineering Technology Education

Abstract

In response to a need identified by the Society of Manufacturing Engineers' Education and Research Technical Community, a survey was conducted to assess the health of ABET-accredited manufacturing engineering technology programs in the spring of 2005 and 2007. In 2005, thirty-eight programs received the survey via email and twenty-two programs provided a response. Survey questions focused on enrollment issues, laboratories, regional manufacturing industrial base, graduate success, and student recruiting resources. Now, the survey has been updated and all programs currently listed on the ABET website have been contacted in early 2007. This paper will present the original results of the survey as well as results from the spring 2007 survey. Thus the paper helps establish overall national trends for, and, when possible, within manufacturing engineering technology programs. These results provide information regarding manufacturing engineering technology program health. Thus, inferences are drawn regarding the state of manufacturing engineering technology education across the nation.

Introduction

Several years ago, the Society of Manufacturing Engineers (SME), as a part of an internal reorganization, formed the Manufacturing Education & Research Community, recognizing that manufacturing research and education are inherently linked. The Community focused on education, excellence in academic programs and professional credentialing, all areas that address the diverse needs of manufacturing enterprises. One of the Technical Groups originally formed, as a part of the Manufacturing Education & Research Community, was the Manufacturing Technology Programs Tech Group. It was to monitor manufacturing technology programs, including ABET-accredited, NAIT-accredited, or non-accredited programs, with goals of identifying industry needs in manufacturing education, and foster communication among educational programs and other groups interested in building manufacturing strength in the United States¹.

As a part of implementing this mission, the Chair of the Manufacturing Technology Programs Tech Group implemented a survey of all ABET-accredited manufacturing engineering technology programs in 2005. This effort paralleled another survey being done at the same time of the ABET-accredited manufacturing engineering programs in the US. Now, in 2007, the manufacturing engineering technology survey is being repeated, with several additional questions. These surveys were intended to provide understanding about the health of manufacturing engineering technology programs within the United States.

These programs are functioning within a complex environment—one that is a blend of both pessimism and opportunity. It is also worth noting that, within engineering education, there are more manufacturing engineering technology programs (baccalaureate) than there are manufacturing engineering programs. Thus, a large portion of the manufacturing-focused Bachelor of Science degrees granted within the US is from engineering technology programs.

According to Jack's 2005 survey on ABET-accredited manufacturing engineering programs², there is a shortage of manufacturing students due to the poor public perception of manufacturing. This leads to a shortage of manufacturing engineering graduates (and here we combine engineering and engineering technology graduates, as does the National Bureau of Labor Statistics). This shortage has led to a large demand for new graduates from manufacturing engineering education programs and corresponding high starting salaries. This is occurring at Arizona State University where out-of-state manufacturers such as HR Textron and Proctor & Gamble are visiting the campus to search for manufacturing engineering technology (MET) graduates to fill manufacturing engineering positions within their companies.

Despite the excellent job prospectus and impressive starting salaries, many MET programs have reported that students are hard to recruit and retain in manufacturing engineering technology programs. National news articles portray manufacturing in the US as in decline, as they proclaim that most US manufacturers are moving their manufacturing operations offshore. This pessimism influences potential students and their parents in their choice of educational program. However, despite the public's poor perception, some institutions have been able to attract a large number of students to their programs.

This paper compiles data from manufacturing engineering technology programs around the U.S. and provides insight into MET program trends. We hope that this information will ultimately help interested individuals understand the national status of manufacturing engineering education as they work towards maintaining an important part of the US economy.

Methodology

The manufacturing engineering technology surveys were sent to the head/director/chair of manufacturing programs accredited by ABET as Manufacturing Engineering Technology programs. These ABET-accredited programs were determined using the list of accredited programs published on the ABET website. Appendix B contains a list of all 41 programs surveyed during this effort. The MET programs providing a response to the 2005 surveys are listed first, along with the location of the program, followed by programs responding to the 2007 survey.

2005 Survey Respondents

Arizona State University, Mesa, AZ
Ball State University, Muncie, IN
Brigham Young University, Rexburg ID
California State University, Long Beach, CA
Marshall Community & Technical College, Huntington, WV
Middle Tennessee State University, Mufresboro, TN
Midwestern State University, Wichita Falls, TX
Naugatuck Valley Community College, Waterbury, CT
Oregon Institute of Technology, Klamath Falls, OR
Pellissippi State Technical College, Knoxville, TN
Pittsburg State University, Pittsburg, KS
Purdue University Calumet, IN
Purdue University, W. Lafayette, IN

Southwestern Oklahoma State University, Weatherford, OK
Texas A & M University, College Station, TX
University of Memphis, Memphis, TN
University of Nebraska, Omaha, NE
Weber State University, Ogden, UT
Wentworth Institute of Technology, Boston, MA
Western Carolina University, Cullowhee, NC
Western Michigan University, Kalamazoo, MI
Western Washington University, Bellingham, WA

2007 Survey Respondents

Arizona State University, Mesa, AZ
Brigham Young University, Provo, UT
California State University, Long Beach, CA
Chattanooga State Technical Community College, Chattanooga, TN
Essex County College, Newark, NJ
Farmingdale State College, Farmingdale, NY
Oregon Institute of Technology, Klamath Falls, OR
Rochester Institute of Technology, Rochester, NY
Southwestern Oklahoma State University, Weatherford, OK
University of Memphis, Memphis, TN
Weber State University, Ogden, UT
Western Michigan University, Kalamazoo, MI

The 2005 Manufacturing Engineering Technology survey went to thirty-eight ABET accredited programs via email. The survey participants were given two reminders to complete the survey over the next three to four months. The data from this survey were compiled and shared in 2005 with the SME Manufacturing Education & Research Community steering committee and survey participants.

A revised 2007 Manufacturing Engineering Technology survey was sent to thirty-four ABET accredited programs via email. The new survey contained questions pertaining to the program's perceptions of strengths and weaknesses. The survey participants were given two additional reminders over the next two months to fill out and return the survey. Twelve out of the thirty-four programs, 35%, provided a response. After the two-year span, seven of the original 2005 programs were no longer ABET accredited and three programs have become newly accredited. Appendix B contains a list of newly ABET-accredited MET programs and programs no longer ABET accredited.

The survey data are analyzed and condensed below. The 2007 manufacturing engineering technology survey data follows the 2005 data. These data provide insight into trends occurring in manufacturing engineering technology programs around the U.S. Finally, a conclusion on MET trends over the past two years is provided.

Spring 2005 Manufacturing Engineering Technology Survey Results

The following data reflects the status of ABET-accredited manufacturing engineering technology (MET) programs in 2005. This information was generated from the 2005 survey, shown in Appendix A. The survey was returned, with varying levels of completeness, by twenty-two programs, a 57% participation rate (percentages have been rounded). Of the twenty-two respondents, six institutions or 27%, replied that they were being, or had, shut down their program. One of the six institutions implied that they no longer had a MET degree but that they still offered some manufacturing classes. Another of the six institutions replied that they were phasing out both their MET and Industrial Engineering Technology degree due to budget constraints. Thus much of the 2005 MET survey results are derived from 16 different institutions. However, for some questions, all twenty-two respondent's answers are present so some data reflect the impact of MET programs that have closed down. In addition, some programs did not complete all the questions, thus some data sets are based on less than 22 responses. Data where not all sixteen participants answered are clearly noted.

The twenty-two institutions responding to the survey were located across the U.S. These respondents were divided into three sections of the country; East Coast, Central, and West Coast. This aids in establishing region-specific trends for MET programs around the US. The geographic distribution of all twenty-two participants is listed below and shown in Figure 1. Programs in brackets indicate that the program was, or was going to be, shutdown.

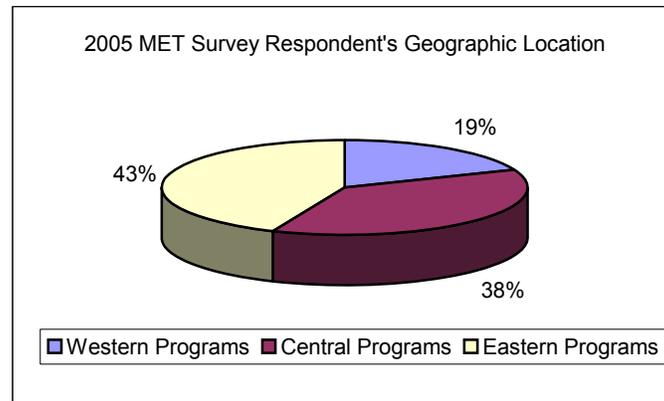


Figure 1. 2005 Geographic Distribution of 2005 Survey Respondents

<u>Western Programs</u>	<u>States</u>
6	CA, OR, UT, AZ, WA, [ID]
<u>Central Programs</u>	<u>States</u>
12	TX, TX, KS, OK, MI, TN, TN, IN, IN, [IN], [TN], [NE]
<u>Eastern Programs</u>	<u>States</u>
4	CT, WV, [NC], [MA]

Using the information from the sixteen healthy MET programs, most of the programs are offering baccalaureate degrees. Two programs did not provide a response to this question, omitting them from the following statistics. Eleven of the fourteen institutions, 79%, offered baccalaureate level MET degrees. Two schools, or 14%, offered a MET master's degree along

with the bachelors degree. One school, or 7%, offered an associates degree along with the bachelor's degree. Finally, two of the 14 respondents, or 14%, offered a MET associates degree only.

The second question in the 2005 MET survey asked if the programs planed on maintaining their ABET accreditation with all sixteen MET programs, 100%, indicating that they planned to do so. All of these programs indicated that ABET accreditation is a very important aspect of a Manufacturing Engineering Technology degree. Therefore, ABET accreditation is an important aspect of both two and four year MET degrees. Of course, this is a biased group as all currently maintain ABET accreditation. If surveys were completed of NAIT and un-accredited manufacturing programs, more general conclusions about accreditation could be drawn.

Question three asked participants to complete a data table indicating their student FTE numbers, total enrollment headcount, and number of graduates by year. Respondents were instructed to use an estimate, if exact numbers were not available. If no data for these items were available, an estimate of enrollment trends was requested. The results are shown below in Table 1. The survey indicated that there are bright spots in the country but most of the country is experiencing a decline in manufacturing engineering technology enrollment.

Table 1. Manufacturing Engineering Technology Enrollment Trends

<i>Academic Year</i>	<i>Total Enrollment</i>		<i>Number of Graduates</i>	<i>If you don't have numbers, please indicate the trend of enrollment</i>
	<i>FTE</i>	<i>Headcount</i>		
2004-5	365	701	128	117
2003-4	341	724	162	63
2002-3	339	792	176	62
2001-2	325	841	149	145

The survey asked if the program's enrollment was increasing. If yes, the institution was asked to indicate what they believed to be the key in attracting students. Two of the sixteen institutions, or 13%, replied that their growth had remained steady for the last five years with three of the sixteen programs, or 19%, reporting student enrollment growth. The three schools reporting growth all indicated that close ties with industry and working closely with high school counselors were the reasons their program had been growing. The remaining eleven of the sixteen programs, or 69%, reported their enrollment to be decreasing. Figure 2 illustrates the 2005 growth trends for the responding ABET-accredited manufacturing engineering technology programs in the US.

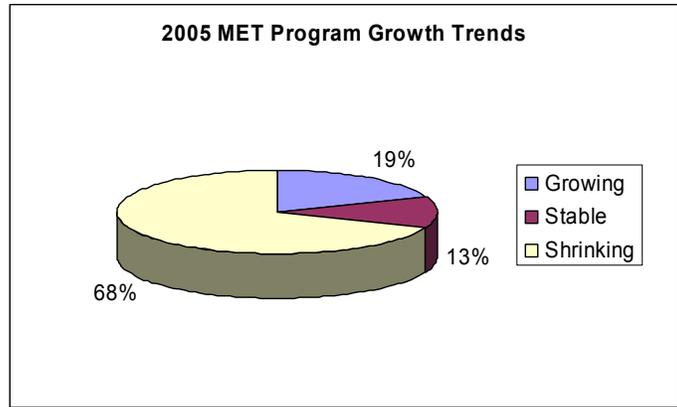


Figure 2. Manufacturing Engineering Technology Growth Trends in 2005

The next survey question focused on the number of faculty spending a majority of their time teaching manufacturing courses. All sixteen institutions answered this question. One program, or 6%, had one full-time MET faculty member teaching courses. Four out of sixteen institutions, or 25%, had two faculty members. Four programs, or 25% had three full time faculty members, while two programs, or 13%, had four faculty members spending a majority of time teaching manufacturing courses. Three programs, or 19%, had five faculty members and one, or 6% had six faculty members primarily teaching manufacturing courses. Finally, one institution, or 6%, had ten full-time MET faculty members. Thus, most MET programs had at least three faculty members teaching classes. The average number of full-time MET faculty members between all sixteen MET programs was 3.7 faculty members with a high of ten and a low of one faculty member. Figure 3 shows a breakdown of the number of faculty members for the responding institutions.

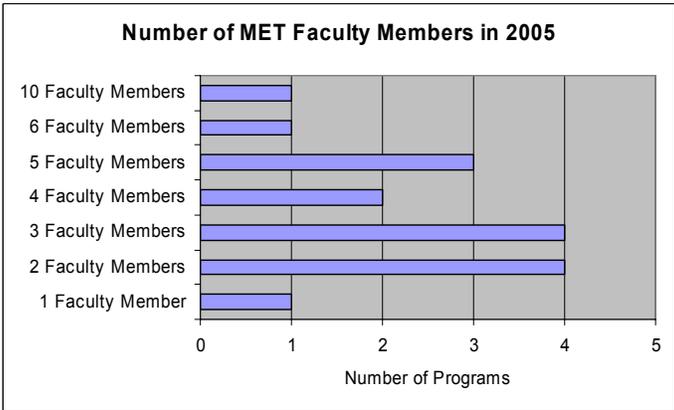


Figure 3. Number of MET Faculty Members in 2005

The average number of MET laboratories devoted to manufacturing topics varied between two and fourteen laboratories with all sixteen respondents reporting on this question. The average number of laboratories was five. Only one program, or 6%, had only two labs devoted to their MET program. Twenty-three percent of the programs had three laboratories and another 23% percent had four laboratories. Two out of sixteen programs, or 13%, have five manufacturing laboratories. One program had fourteen laboratories devoted to their MET program. The

remaining five MET programs, or 31%, had between six and ten laboratories devoted to their program. Ninety-four percent of the respondents had at least three laboratories devoted to the manufacturing program. Most engineering technology educators would believe that such laboratories are necessary for MET programs to survive. Hands-on engineering education is the backbone of an engineering technology program's educational offerings, making multiple laboratories and space for equipment essential for Manufacturing Engineering Technology programs to grow and thrive. Figure 4 shows a bar chart depicting the average number of MET labs among responding institutions in 2005.

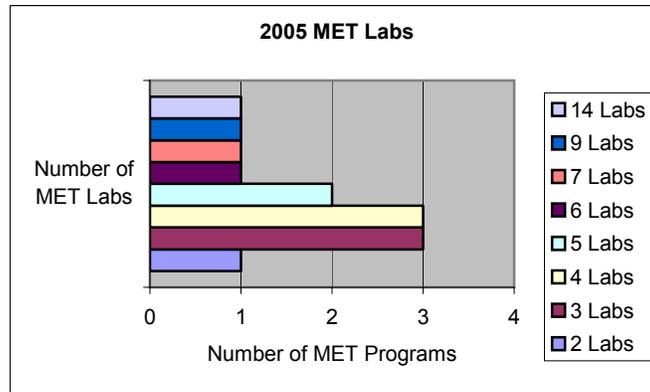


Figure 4. Average Number of MET Labs in 2005

There was an average of 13.6 new MET students in 2005 amongst the responding MET programs. One of the sixteen survey participants did not answer so the following data are from fifteen MET programs. One program, or 7% of the sample, had the largest new MET student population had 80 new MET students in 2005, with fifty more new students than any other program. The smallest number of new students occurred in two schools, 13% of the sample, with only two new students each. One of the lowest new enrollment numbers came from a program that indicated that most of their students transferred with college credit and they did not count such transfer students as new students. Nine of the fifteen programs, or 60% of the sample, had between twelve and thirty new students in 2005. There did not seem to be any direct correlation between the location of the school and the number of new students in these 2005 data.

Twelve of the sixteen programs, 75% of the sample, reported their local manufacturing industries were stable. Three of the sixteen programs, 19% of the sample, reported their local manufacturing industries were slightly shrinking. One program, 6% of the sample, reported that their local manufacturing industries to be slightly growing.

Fifteen of the sixteen participants, 94% of the sample, implied their graduates are finding appropriate professional employment. One of the sixteen participants, 6% of the sample, did not reply. The second part of the question asked the programs what the average salary of their MET graduates was. Only fourteen programs, 88% of the sample, reported on their graduate's average salary. In 2005, the average salary of MET graduates was \$43,047.00. One program, 7% of the sample, reported their lowest salary at \$30,000. Two programs, 14.25% of the sample, reported the highest salary at \$55,000 or higher. The positive employment responses imply an MET

degree is a lucrative degree. Graduates typically obtain a starting annual salary ranging from the mid \$40s to the mid \$50s. Figure 5 shows bar chart of the MET graduate salary data.

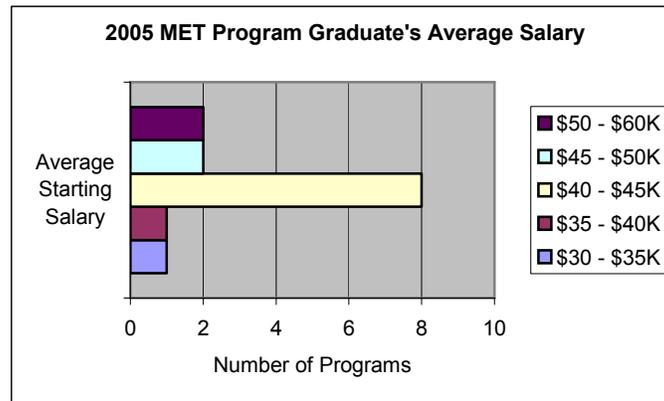


Figure 5. 2005 MET Graduate Average Salary Data

The industries influencing MET programs vary widely as judged by the question asking programs to list their predominate, influencing industries. Nine out of the sixteen participants, 56% of the sample, listed the automotive industry as one of the most important industries. Eight of the sixteen programs, 50% of the sample, listed the aerospace industry as an influential industry. The third largest industry reported to be influential was medical manufacturing with four out of sixteen programs, 25% of the sample, reporting it. The rest of the industries reported to be influential varied from automation to nuclear. A list of all of the influential industries the MET programs deemed predominate and influential is in Appendix C.

One hundred percent of the programs responding indicated what resources would help make their MET program more attractive to students. Eight of the sixteen programs, 50% of the sample, stated that a modern, larger facility with organized and well-equipped labs would aid in attracting students. Furthermore, five of the sixteen programs, 31% of the sample, felt that more publicity and recruitment efforts were needed to attract new students. The other items the programs indicated as helping attract students are listed in Appendix C.

Finally, the programs were asked how they thought the SME could help recruit, retain and graduate manufacturing engineering technology students. One program did not answer this question but the remaining fifteen programs provided a plethora of responses. Four of the fifteen programs, 27% of the sample, wanted SME to provide a message to the press about the positive outlook for manufacturing engineering jobs. Three out of the fifteen participants, 20% of the sample, would like to see more SME Foundation grants for this purpose. The other answers range from more PLC courses to a Certified Manufacturing Engineering Technologist exam for two-year MET graduates. All participant responses to this question are listed in Appendix C.

2007 Manufacturing Engineering Technology Survey Results

This section characterizes the status of the ABET-accredited Manufacturing Engineering Technology programs in 2007 and was generated from responses to the spring 2007 MET survey. The 2007 MET survey added four additional questions to the 2005 survey. One of the

additional questions asked MET programs to list their perceived strength(s), particularly those strengths attracting new students. We hope these strength data provide information about what type of manufacturing curriculum attracts students to MET programs. A question pertaining to graduate level degrees was also added to the survey, as the 2005 survey did not specifically ask programs if a M.S. in Manufacturing Engineering Technology was offered.

The graduate starting salary question was modified from a two-part question where a yes/no question was followed by a salary range question (some participants stopped at the first part of the question). The salary range question is now a stand-alone question in hopes of obtaining more responses. The last question added, asked the participants to provide any additional comments with respects to the state of the manufacturing program; including changes, challenges and successes. This gives the survey participants an open-ended forum to explain any problems or successes pertinent to their program.

The following information was generated from the completed 2007 survey, shown in Appendix A. The surveys were returned, with varying levels of completeness, by twelve programs, a 35% participation rate. Some programs did not complete all the questions, thus some data sets are based on less than twelve responses. Data where not all twelve participants answered are noted.

The twelve institutions responding to the survey were located across the United States. As in the 2005 survey, the respondents were divided into three sections of the country: East Coast, Central, and West Coast. The geographic distribution of all twelve participants is listed below. None of the programs indicated the program was, or was going to be, shutdown, contrary to the 2005 survey data! Figure 6 shows a pie chart of the respondent's geographic location.

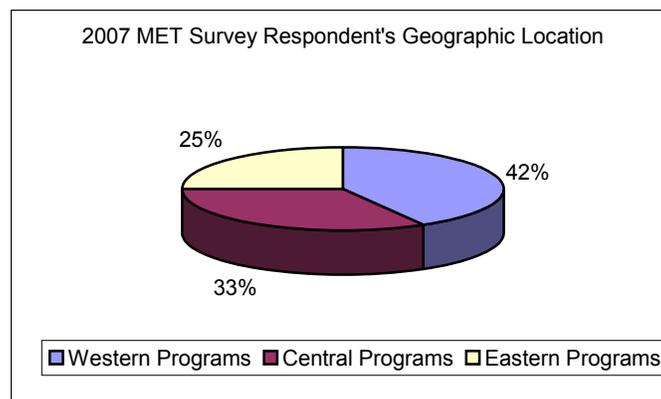


Figure 6. 2007 Survey Geographic Distribution

<u>Western Programs</u>	<u>States</u>
5	AZ, CA, OR, UT, UT,
<u>Central Programs</u>	<u>States</u>
4	MI, OK, TN, TN
<u>Eastern Programs</u>	<u>States</u>
3	NJ, NY, NY

Using the information from the twelve responding MET programs, most of the programs are offering baccalaureate degrees. Ten of the twelve institutions, 83% of the sample, offered baccalaureate level MET degrees. Five schools, 41% of the sample, offered a MET masters degree along with the bachelor's degree. Two schools, 16%, offered an associates degree along with the bachelor's degree. Finally, two of the twelve respondents, 16%, offered a MET associates degree only.

The second question in the 2007 MET survey asked if the programs planned on maintaining their ABET accreditation with all twelve MET programs, 100%, indicating that they planned to do so. One program indicated the ABET accreditation criterion for A.A.S. degrees was almost the same as the B.S. criterion, making it "impossible and impractical for A.A.S. degree programs to meet the criteria."

Participants were asked to complete a data table indicating their; student FTE numbers, total enrollment headcount, and number of graduates by year. Respondents were instructed to use an estimate, if exact numbers were not available. If no data for these items were available, an estimate of enrollment trends was requested. Four of the twelve respondents, 33%, gave FTE numbers on top of the headcount and graduate numbers. None of the respondents estimated enrollment trends and one respondent did not answer this question. This leaves eleven out of twelve respondents, 91%, whom estimated the total enrollment headcount and number of graduates. The results from the eleven respondents are shown below in Table 2. The 2007 survey indicated that most of the country is experiencing steady to slightly declining numbers in manufacturing engineering technology enrollment while three schools out of eleven, 27%, indicated that enrollment is increasing.

Table 2. Manufacturing Engineering Technology Enrollment Trends

<i>Academic Year</i>	<i>Total Enrollment</i>		<i>Number of Graduates</i>	<i>If you don't have numbers, please indicate the trend of enrollment</i>
	<i>FTE</i>	<i>Headcount</i>		
2006-07	181	809	145	No Answer
2005-06	164	826	164	No Answer
2004-05	67	813	162	No Answer
2003-04	62	890	171	No Answer

Next, the survey asked if the program's enrollment was increasing. If yes, the institutions were asked to indicate what they believed to be the key in attracting students. Four of the twelve institutions, 33%, replied that their growth had remained steady for the last five years. One of the schools, with steady growth indicated aggressive recruitment strategies were the only reason why they have remained stable. Three of the twelve programs, 25%, reporting student enrollment growth. The three schools reporting growth all indicated that close ties with industry, extensive community college recruiting and high school articulations were reasons their program

had been growing. The remaining five of the twelve programs, 41%, reported their enrollment to be decreasing. Figure 7 illustrates the responding 2007 MET program's growth trends.

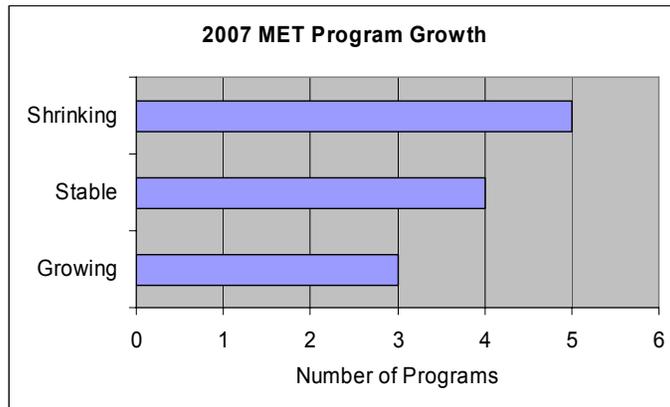


Figure 7. 2007 MET Program Growth

Question five asked respondents to indicate the number of faculty spending a majority of their time teaching manufacturing courses. All twelve institutions answered this question, shown in Figure 8. One program, 8%, had one full-time MET faculty member teaching courses. Three out of twelve institutions, 25%, had two faculty members. Two programs, 17% had three full time faculty members, while one program, 8%, had four faculty members spending a majority of time teaching manufacturing courses. Four programs, 34%, had five faculty members and one, 8% had six faculty members primarily teaching manufacturing courses. In 2007, the responding MET programs had an average of three and a half faculty members teaching classes, with a high of six and a low of one.

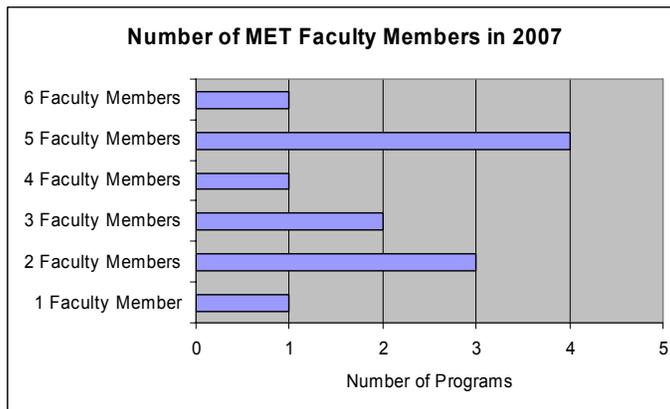


Figure 8. Number of Full-Time MET Faculty Members in 2007

The average number of MET laboratories devoted to manufacturing topics varied between two and eight laboratories with all twelve programs responding to this question. The average number of laboratories between the twelve programs was seven. One program, 8%, had only two labs devoted to their MET program and one program, another 8%, had three labs. Twenty-five percent of the programs, three out of twelve, had four laboratories while 33% of the responding MET programs had five laboratories. Finally, two out of twelve programs, 16%, have five manufacturing laboratories. Ninety-one percent of the respondents had at least three laboratories

devoted to the manufacturing program. Again, as we saw in the 2005 survey, laboratories have proven to be the backbone of an engineering technology program. Figure 9 shows a bar chart of the number of labs devoted to MET.

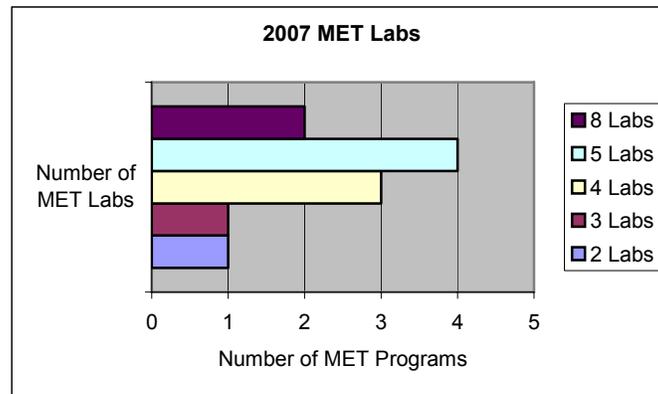


Figure 9. Average Number of MET Labs in 2007

There was an average of 22.75 new MET students in 2007 amid the responding MET programs. Four of the 12 survey participants, or 25%, did not respond; thus, the new student data are derived from eight MET programs. The 2007 data implies a 57% growth in new MET students since the 2005 survey. One program, 12% of the sample, had the largest new MET student population with 80 new MET students in 2007. That particular program had sixty more new students than any other program. The smallest number of new students occurred in one school, 12% of the sample, with only three new students. Six of the eight programs, 75%, had between fifteen and eighty new students in 2007. As in the 2005 data, there did not seem to be any direct correlation between the location of the school and the number of new students.

Five of the twelve programs, 41%, reported their local manufacturing industries were stable. Two programs, 16%, reported that the industry is growing in some areas and staying stable in other areas. Five of the twelve programs, 41%, reported their local manufacturing industries were shrinking. Figure 10 shows a breakdown of growing, stable and shrinking manufacturing industries as reported by the participants in the 2007 MET survey.

Ten of the twelve participants, 83%, implied their graduates are finding appropriate professional employment. One of the twelve participants, 8%, did not reply. The second part of the question, in the 2007 survey, asked what percentages of graduates enter careers or graduate programs in manufacturing. Only three programs, 25%, reported on the second part of this question. Of those three programs that answered the second part of the question, one program, 8%, indicated 90% of their graduates enter into graduate programs. Another 8%, one program, implied that 40% of their graduates get “manufacturing” related jobs and they did not imply how many graduates go to graduate school. Finally the remaining program, 8% indicated that 10 – 15% of their graduates enter into a graduate program, not answering how many go to graduate school.

Question number ten in the 2007 survey asked the institution’s average starting salary for manufacturing engineering technology graduates. In 2007, the average salary of MET graduates was \$48,556.00. The 2007 average salary data were \$5,500 higher than the 2005 figures. Three

programs, 25%, did not answer this question making the numbers derived from eight MET programs around the US. One program, 8%, reported their lowest salary at \$45,000. Three programs, or 25%, reported the highest salary at \$50,000 or higher. This data indicates manufacturing graduates are still in demand. In 2007, the MET graduates typically achieve starting annual salaries ranging from the mid \$40s to the mid \$50s. Despite the higher average salary data in 2007, these figures are still in the range of the 2005 data. The salary data are reported in Figure 10.

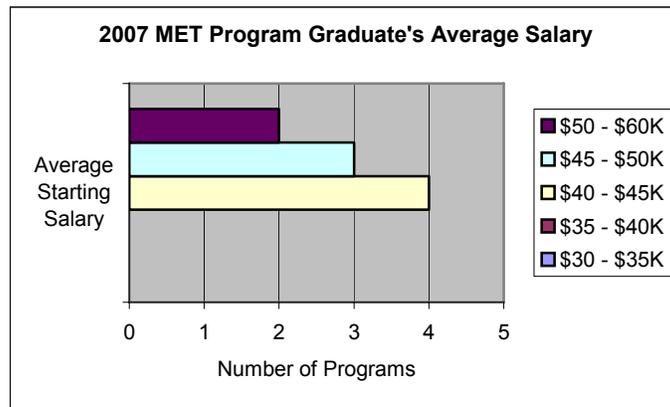


Figure 10. MET Graduate Average Salary 2007 Data

The industries influencing MET programs vary widely as judged by question eleven in the survey. Question eleven asked programs to list the predominate industries influencing their program. Only one out of twelve respondents, 8% did not give a reply this question. Four out of the eleven participants, 36%, listed the aerospace industry as one of the most important industries. Three out of eleven programs, 27%, listed the automotive industry as an influential industry. The third largest industry reported to be influential was medical manufacturing with two out of eleven programs, 18%, reporting it. One program, 9%, indicated that there were no predominate industries at the B.S. level. The rest of the industries reported to be influential varied from automation to oil and gas industries. A list of all of the influential industries the MET programs deemed predominate and influential is in Appendix C.

Question 12 asked the institutions if they offered an M.S. degree in Manufacturing Engineering Technology. Almost half of the schools responding to this survey had a master's degree program. Five institutions, 41%, offer a M.S. in manufacturing while the other seven programs, 59%, do not offer a M.S. degree. However, one of the seven programs currently not offering an M.S. degree implied they are working on a joint agreement with a major state university to get an M.S. degree accessible to their MET students.

Ten out of twelve of the programs, 83%, indicated what resources would help make their MET program more attractive to students. As seen in the 2005 survey, five of the ten programs, 50%, stated that more money to build a modern, larger facility with organized and well-equipped labs would aid in attracting students. Two of the ten programs, 20%, felt that more recruitment efforts and media were needed to attract new students. Finally, all of the items programs indicated as helping attract students are listed in Appendix C.

Next, in question fourteen, the programs were asked how they thought the SME could help recruit, retain and graduate manufacturing engineering technology students. Two programs did not answer this question but the remaining ten programs provided an overabundance of responses. Five of the ten programs, 50%, wanted SME to provide a message to the press about the positive outlook for manufacturing engineering jobs. Three of the ten programs, 30% would like SME to provide more grants and scholarships to manufacturing students, including high school students. Two of the ten programs, 20%, want SME to lobby or provide a message to the press about the positive outlook for manufacturing engineering jobs in the United States. The rest of the answers ranged from advertise their program to advertising about the career opportunities in the field of manufacturing. All of the ten participant responses to this question are listed in Appendix C.

Question 15 asked the respondents if they have any particular strength in their manufacturing program. Two out of twelve respondents, 16% did not answer this question. Of the ten programs that responded, there was an underlying theme between the labs and the faculty. Six out of ten programs, 60% attributed the hands-on laboratories as their strengths. Four out of ten institutions, 40%, replied that hands-on faculty with industry experience greatly aids in a manufacturing engineering technology program. There were other responses such as leadership, globalization and specialized production process however all of the ten respondents implied that the faculty and labs were a key part of their manufacturing engineering technology curriculum.

Finally, question sixteen asked the programs to provide any additional comments they had with respect to the state of the program. This can include challenges, changes and successes. One out of twelve respondents, 8%, did not answer this question. The remaining eleven programs provided numerous responses. The challenges listed the most frequently were recruiting students into “manufacturing” programs. One institution reported changing their curriculum to a motorsports based curricula helped them recruit more students. Finally, the successes were attributed to having well equipped facilities and knowledgeable hands on faculty. All of the eleven participant’s responses are listed at the end of Appendix C. The underlying subject matter found in the responses from this question seems to be student recruitment in MET programs. Despite great job opportunities for manufacturing engineering technology graduates getting them into the programs poses the biggest challenge for the 2007 responding MET programs.

Conclusions

In spring 2005, all ABET-accredited Manufacturing Engineering Technology programs were sent a survey that asked questions pertaining to the health of the program. Twenty-two programs provided some sort of response to this survey, providing a 57% response rate. Six of the responders indicated that they had or were in the process of shutting down their manufacturing programs. Respondents were spread across the US, but a majority was from the central region. The 2007 survey was sent to 33 ABET-accredited Manufacturing Engineering Technology programs. Twelve programs provided some sort of response to the survey, 35% of the programs, evenly distributed across the US.

During the two years between surveys, seven programs had dropped ABET-accreditation and three programs were newly accredited. Thus, the total number of ABET-accredited manufacturing engineering technology programs in the United States is decreasing.

There were seven associate degree programs contacted in 2005 and four responded to the survey in some fashion. In the 2007 data, there were four associate level programs respondents, but two of these associate programs also offer a Bachelor of Science degree. The rest of the twelve 2007 survey participants represented of Bachelor of Science degrees with five of those programs also offering a Master of Science degree program.

In both 2005 and 2007, all programs continuing their manufacturing program plan to maintain their ABET accreditation. While there are some programs increasing their enrollment, it appears that total manufacturing engineering technology enrollment is in a decline. Manufacturing graduates appear to be decreasing after a peak in the 2002-2003 academic year. There were three programs reporting enrollment growth in both survey data sets. Since the 2007 data are based on fewer reporting programs, it is possible that more programs are experiencing enrollment growth so a positive total enrollment trend could be beginning. Survey data for new students entering programs reinforce this idea with the 2007 data averaging of 23 new students per program as compared to the 13.6 students per program in 2005.

The number of full time faculty primarily teaching manufacturing courses declined slightly over the two surveys, from an average of 3.8 per program in 2005 to 3.6 per program in 2007, or a decrease of 5%. The number of laboratories devoted to manufacturing stayed essentially stable over the surveys, with an average 4.3 per program in 2005 and 4.4 per program in 2007.

Industry ties or an industry focus were reported as a key to enrollment increases. The manufacturing industrial base in the each program's area of influence was reported as essentially stable. The primary industries influencing MET programs were reported to be automotive, aerospace, medical and defense. The resources that programs felt were most helpful in making the program attractive to students were modern, large facilities and well equipped laboratories (by almost half of the respondents) and getting publicity about their program and its successful students.

Programs identified a number of things that the SME can do to help recruit, retain, and graduate students. The most mentioned were:

1. Publicity about the positive outlook for technical engineering jobs in manufacturing,
2. SME Education Foundation grants,
3. Scholarships,
4. Promote engineering technology as a good education choice/career, and,
5. Help programs understand national and regional trends in available jobs, employer requirements, and pay scales so programs can be tailored to region.

Bibliography

1. Society of Manufacturing Engineers (2007). Found at http://www.sme.org/cgi-bin/communities.pl?communities/education/edu_community_hp.htm&&&SME&, accessed on January 12, 2007.
2. Jack, Hugh. (2005). The State of Manufacturing Engineering Education. *Society of Manufacturing Engineers*. Tech. Rep. No. TP05PUB209.

Appendix A –Manufacturing Engineering Technology Survey

2005 Manufacturing Engineering Technology Survey

1. Program and contact information:

Name of school/college and university:

Name of department or name of program within a department:

Associate or bachelor degree program?

Accreditation status (last ABET visit – next visit):

Program Contact information

Name:

Title:

Address:

City/State/Zip:

Phone:

Fax:

E-mail:

2. Do you plan to maintain manufacturing program ABET accreditation?

3. Manufacturing enrollment by year (if exact numbers are not available, please provide your best estimate, or an indication of enrollment trends.)

<i>Academic Year</i>	<i>Total Enrollment</i>		<i>Number of Graduates</i>	<i>If you don't have numbers, please indicate the trend of enrollment</i>
	<i>FTE</i>	<i>Headcount</i>		
2004-5				
2003-4				
2002-3				
2001-2				

4. If your enrollment is increasing, what do you believe is the key to attracting students?

5. Number of faculty spending a majority of their time teaching manufacturing courses?

6. Number of laboratories devoted to manufacturing topics?

7. Number of new students in the manufacturing program in the past year?

8. Is the manufacturing industry in your area growing, staying stable, or shrinking?

9. Are your manufacturing graduates finding appropriate employment?

Average starting salary?

10. What are the predominant industries influencing your program?

11. What resources do you feel would help make your manufacturing program more attractive to students?

12. How do you think SME can help you recruit, retain and graduate manufacturing engineering technology students?

Additional 2007 Survey Questions

13. Do you have a specific strength(s) in your manufacturing program?

14. Does your school offer an M.S. degree in manufacturing?

15. Please provide any additional comments you may have with respects to the state of your program including changes, challenges and successes.

16. What is the average starting salary for your manufacturing graduates?

Appendix B – List of Survey Participants

List of all of the MET institutions that were sent both surveys

Arizona State University, Mesa, AZ
Ball State University, Muncie, IN
Bradley University, Peoria, IL
Brigham Young University, Provo, UT
California State University, Long Beach, CA
Central Connecticut State University, New Berlin, CT
Dayton University, Dayton, OH
Essex County College, Newark, NJ
Indiana University Purdue University Indianapolis, Indianapolis, IN
University of Cincinnati, Cincinnati, OH
Lake Superior State University, Sault Ste Marie, MI
The University of Memphis, Memphis, TN
Midwestern State University, Wichita Falls, TX
Minnesota State University, Mankato, MN
Naugatuck Valley Community College, Waterbury, CT
New Hampshire Technical Institute, Concord, NH
New York State University, Farmingdale, NY
North Texas University, Denton, TX
Northern Kentucky University, Highland Heights, KY
Oregon Institute of Technology, Klamath Falls, OR
Pellissippi State Technical Community College, Knoxville, TN
Pittsburg State University, Pittsburg, KS
Purdue University, West Lafayette, IN
Rochester Institute of Technology, Rochester, NY
Southwestern Oklahoma State University, Weatherford, OK
Texas A&M University, College Station, TX
Three Rivers Community College, Norwich, CT
Weber State University, Ogden, UT

List of MET programs no longer accredited in 2007

Brigham Young University, Rexburg, ID
Central Piedmont Community College, Charlotte, NC
Marshall Community & Technical College, Huntington, WV
Middle Tennessee State University, Murfreesboro, TN
University of Nebraska, Omaha, NE
New Jersey Institute of Technology, Newark, NJ
Wentworth Institute of Technology, Boston, MA

List of newly-accredited MET institutions since 2005 survey

Chattanooga State Technical Community College, Chattanooga, TN
East Tennessee State University, Johnson City, TN
Northern Illinois University, DeKalb, IL

Appendix C – Partial Detail of MET Survey Responses from 2005 and 2007 Surveys

The following is a list of the predominate industries influencing MET programs around the country. The number next to the industry indicates how many of the sixteen responding programs listed that industry as influential.

2005 MET Survey Responses

Automotive - 9
Aerospace - 7
Manufacturing Medical - 4
Manufacturing - 3
Automation - 3
Defense/Military - 3
Manufacturing Plastics - 2
Small Industries/Business - 2
Electronics - 2
Oil Industry - 1
Quality - 1
Retail Business - 1
Safety Devices - 1
Office Furniture - 1
Metal Working - 1
Nuclear - 1
High Tech - 1
Job Shops - 1
Chemical - 1
Composites Manufacturing - 1
Investment Casting - 1
Industrials - 1

2007 MET Survey Responses

Automotive - 3
Aerospace - 4
Detail Parts Manufacturer - 1
Wood Products - 1
Oil and Gas - 1
Manufacturing Subcontractors - 1
Furniture - 1
Medical Devices - 1
Automation - 1
Welding - 2
Distribution and Logistics - 1

The topics below are items that MET programs would like in order to recruit more students.

2005 MET Survey Responses

More audio visual aids
After Hour classes/on line classes
Solid text books – less expensive
Solid links to prospective employers
State of the art equipment & software
Modern, larger facility - 7
Well organized and funded labs - 7
More publicity/recruitment - 4
Outreach to high schools/Undecided majors
More student centered faculty
Additional faculty
Positive media input

2007 MET Survey Responses

Program advertisement - 1
More labs - 1
Newer lab equipment - 3
Project Lead the Way (PLTW) - 1
Scholarship Programs - 1
Additional Funding - 2
Stop bad manufacturing press - 1
More sophisticated computing tech. - 1
More local mfg. for more jobs - 1

General funding
More elective courses
Well-equipped labs
Good faculty
More manufacturers
Image improvement

The topics below are items that MET programs would like SME to do in order to in order to recruit, retain and graduate more manufacturing engineering technology students. The topics are listed in order of importance

2005 MET Survey Responses

Message to press for positive outlook for technical, technologist and engineering jobs – 4
SME Grant Proposals – 3
Promote engineering technology discipline as career – 2
Offer scholarships – 2
Help in understanding national and/or regional trends in available jobs, employer requirements, pay scales so programs can be appropriately tailored - 2
Work with industry/government to increase manufacturing in US – 1
Increased financial support/industrial partnerships w/reduced cost
Develop CMfgT Exam for 2 yr programs/add guidelines for TAC/ABET, reduce cost of exam – 1
Introduce more PLC courses – 1
Provide more/less expensive audio visual aids/solid text books for the real world in today's world of manufacturing. – 1
Provide a mechanism for job seeking college students to find jobs locally, regionally, nationally and globally. – 1
Show students there is a viable, solid and lucrative career in MET thru articles, events, career counseling – 1
Lobby university administrations/state legislatures to increase level of resources – 1
Provide guest speakers and presenters – 1
No Answer – 1

2007 MET Survey Responses

Continue emphasizing the importance and challenging nature of manufacturing – 1
Beat the drum about the opportunities as a career field – 1
Short of a scholarship for every student entering the program, getting after the negative press coverage would certainly help. – 1
Encourage programs like Project Lead The Way in high schools – 1
Funding of technology courses in the regional high schools to encourage manufacturing engineering among minorities, women, etc.; offering scholarship to high school graduates who plan to attend a manufacturing engineering degree programs – 1

Return to the old system of grants. We used to do very well each year. The new system tends to favor larger programs – 1

More funding support for SME student chapters – 1

SME could help in recruitment and provide internship and other learning opportunities, the students will be retained and graduate – 1

Lobbying for keeping manufacturing jobs in the U.S. – 1

Help us with grants to enhance our labs (we have problem with matching funds to bid on many contracts), develop new areas in manufacturing, and advertise our program – 1

No Answer – 2

The topics below items that MET programs perceived as their specific strengths in their manufacturing program.

2005 MET Survey Responses

The question was not asked during the 2005 survey.

2007 MET Survey Responses

Leadership and globalization – 1

Laboratories, metal cutting capability, faculty – 1

Hands-on applied with faculty with industrial experience – 1

Expertise of instructor, pretty up-to-date labs – 1

Updated laboratories, updated manufacturing various types of software

surface mount electronics manufacturing ; electronics packaging; plastics manufacturing – 1

Machining and Welding – 1

Qualified faculty and state-of-the-art equipment – 1

Our program is an engineering technology program and has many applied classes. These classes are very attractive to the students who in turn become very good product and process engineers. – 1

No Answer – 2

The topics below are additional comments that MET programs had with respects to the state of their program. These topics can include changes, challenges and successes.

2005 MET Survey Responses

The question was not asked during the 2005 survey.

2007 MET Survey Responses

The name ‘manufacturing’ seems to be a problem in attracting high school students.

Have started a motorsports concentration because of young students interests. Also this will allow us to recruit graduates of the college's vocational oriented programs.

PLTW has courses stressing engineering design and CIM

Better articulation with the CC seems to be helping.

Great facilities and faculty

In the past two years we updated our laboratories and purchased new software and upgraded the existing ones. However, even if we had aggressive recruitment efforts, we are not able to attract new students to our program.

The program enrollment is continuously decreasing and if the current trend continues, we will not be able to offer all the scheduled manufacturing courses due to lack of enrollment and forced to close the program.

Students have been doing very interesting entrepreneurial capstone projects that generate ongoing interest in the Mfg ET program from employers and prospective students

Our graduates are in high demand. Most are getting multiple offers at graduation. We have done very well as far as keeping our laboratory equipment reasonably current. Like most State institutions, our funding is either being cut or remains flat, while costs continue to rise. Without the support and donations from local industry, our program would die.

Major challenges are recruiting students and qualified faculty. Our successes are our students and their accomplishments after graduation.

The ABET accreditation criteria for the A.A.S. and B.S. degrees are almost the same for the manufacturing engineering technology program, making it impossible and impractical for the A.A.S. degree programs to meet the criteria. Furthermore, due to the change of economies during the past decades, job opportunities for graduates with A.A.S. degrees are rare. Therefore, ABET should revise its accreditation criteria for the A.A.S. degrees program in manufacturing engineering technology (making the criteria similar to a pre-engineering program), based on the fact that most of the graduates transfer to four-year universities, rather than employments.

We have maintained a fairly solid enrollment over the past several years. We feel that it is due somewhat to the management minor that students are able to get together with their technical degree.

No Answer – 1