

AC 2007-2749: OPPORTUNITIES AND CHALLENGES FOR MANUFACTURING ENGINEERING

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Opportunities and Challenges for Manufacturing Engineering

Abstract

During the decades of the 1980's and 1990's, the development of undergraduate and graduate manufacturing engineering programs advanced and legitimized the manufacturing engineering discipline. With recent perceived loss of manufacturing production to overseas locations and the continued public perception of manufacturing being a dirty and non-technical career, all manufacturing related education programs have experienced difficulty in recruiting students to their programs¹. Additionally, manufacturing's increasingly technical methods, required innovativeness, and the emergence of advanced manufacturing technologies have necessitated continuous improvement of manufacturing engineering programs. Succumbing to these pressures, some undergraduate manufacturing engineering programs have even begun to close, despite the high demand for the graduates of these programs. This paper will examine strategies that the University of Wisconsin-Stout has deployed to keep its manufacturing engineering program one of the largest and most vibrant in the face of these challenges.

Current State of Manufacturing Engineering Education

Shortly after 9/11, the University of Wisconsin-Stout Manufacturing Engineering Program experienced a dramatic downturn in enrollment, shrinking by over 40% from historic highs in only a few short years (Figure 1). This dramatic downturn was met by alarm throughout the university, and it raised serious questions about the program's future. Some pundits predicted the rapid decline of manufacturing in the United States and its movement to offshore competitors. An avalanche of plant closings and layoffs in the ensuing months seemed to confirm these dire predictions and, at least for the moment, prospective students began to look away from manufacturing related careers for opportunities having what they perceived as more promising futures.

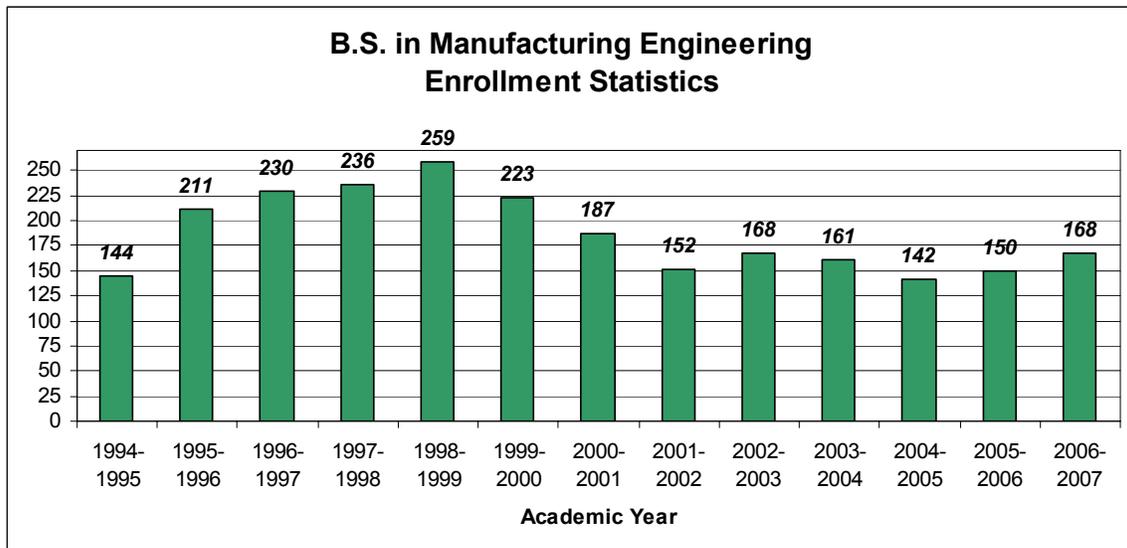


Figure 1. Historic Program Enrollment for B.S. in Manufacturing Engineering at the University of Wisconsin-Stout .

All levels of post-secondary manufacturing education have experienced declining enrollments over the past decade. As noted in “The State of Manufacturing Engineering Education,”¹ the trends in undergraduate manufacturing engineering education have shown declining enrollments and directly related to that, declining graduation rates. Table 1 depicts the national trend in manufacturing engineering programs. At the University of-Stout, a similar trend in dropping enrollments and decreasing number of degrees awarded is noted. These trends, again depicted in Table 1, indicate that the drop in overall enrollment began more quickly than the national trend indicates. A positive note seen in recent enrollment and graduation rates at the University of Wisconsin-Stout is that enrollments appear to be rebounding over the past 3 years, whereas the national trends may still be declining. In recent years, several large manufacturing engineering programs have closed.¹ This indicates the national downward trend in manufacturing engineering program support and enrollment may not have yet reversed itself. For the date range listed in Table 1, the University of Wisconsin-Stout has enrolled on average 25% of the overall Manufacturing Engineering students and awarded on average 25% of all Manufacturing Engineering undergraduate degrees in the United States.

Table 1. National and University of Wisconsin-Stout enrollment and graduation statistics for manufacturing engineering programs.

	SME Manufacturing Engineering Programs Survey ¹ [13 of 21 Programs Response]		University of Wisconsin-Stout	
	FTE Enrollment	Graduates	FTE Enrollment	Graduates
1999-2000	667	148	223	42
2000-2001	665.5	131	187	45
2001-2002	675.5	125	152	39
2002-2003	695.5	135	168	22
2003-2004	658	142	161	28
2004-2005	641.5	88	142	18
2005-2006	--	--	150	22
2006-2007	--	--	168	--

Similarly, a national survey of manufacturing engineering technology programs, conducted by the Manufacturing Education and Research Technical Community of the Society of Manufacturing Engineers (SME), indicates a similar downward trend in headcount and graduations.² Table 2 depicts this national trend in data on manufacturing engineering technology programs. It is interesting to note that the FTE enrollment for these technology programs has slightly increased whereas the actual student headcount has dramatically decreased during the period of the study.

Table 2. National enrollment and graduation statistics for manufacturing engineering technology programs²

	SME Manufacturing Technology Programs Survey ² [17 of 38 Programs Response]		
	FTE Enrollment	Headcount	Graduates
	2001-2002	325	841
2002-2003	339	792	176
2003-2004	341	724	162
2004-2005	365	701	128

As clearly indicated in these statistics, interest by young adults in manufacturing careers is dwindling. Despite ongoing high demand for manufacturing engineering and manufacturing engineering technology graduates, as indicated by Jack¹ and Danielson², the surveys show a continued decline in enrollment and interest in pursuing a manufacturing career. There are variety of reasons for this, but it is believed that the primary drivers of disinterest in manufacturing careers is derived from 1) the negative news regarding manufacturing, 2) a perceived “dirty” image of manufacturing, and 3) a lack of understanding how technically challenging and advanced manufacturing really is.

Like many other states, the Wisconsin state budget was in deficit and budget reductions translated into program resource reductions that further threatened the manufacturing engineering programs future at the University of Wisconsin-Stout. The situation raised many serious questions about both the future of manufacturing and, correspondingly, the future of manufacturing related education programs across the country.

In recent years, the University of Wisconsin-Stout developed and implemented numerous recruiting and outreach activities to interest more young students in manufacturing engineering and engineering careers. Additionally, the leadership at the University of Wisconsin-Stout has become involved in regional and national efforts to improve the image of manufacturing. Regionally, the University has become a leader in efforts to promote all levels of manufacturing careers through a regional manufacturing promotion group called Manufacturing Works. And nationally, the University has become a leader in efforts to promote manufacturing careers through SME. This effort is “Our Future in Manufacturing” Technical Group and is a direct result of the regional Manufacturing Works efforts. All of the activities discussed in this paper have have directly influenced the manufacturing engineering enrollment growth with an increase by 17.8% in the last three years (see Figure 1).

Importance of Manufacturing

Manufacturing Engineering programs are a recent phenomenon within engineering schools across the United States. As stated by Jack¹, the age distribution of the surveyed manufacturing engineering programs is listed in Table 3. These programs were driven to respond to industrial needs for highly technical and competent manufacturing engineers. This need continues¹ and far

surpasses the ability of the remaining manufacturing engineering programs to provide competent graduates.

Table 3. Year manufacturing engineering programs started

<i>Year Manufacturing Program Started</i>	<i>Number of Programs</i>
1970-79	1
1980-89	5
1990-99	12
2000-	7

As noted in Table 3, manufacturing engineering programs were developed across the United States in response to industrial needs. These needs directly reflected the industry needs to manufacture efficiently, produce high quality products, and develop automation where needed. The developers of these manufacturing engineering programs understood the importance of manufacturing. But how important is manufacturing to our national economy?

According to the U.S. Bureau of Statistics³, there were 378,142 U.S. manufacturing enterprises in 2004. In 2006, these U.S. manufacturing enterprises employed 14.2 million employees⁴. On average, a manufacturing worker is paid \$64,854, which includes wages and benefits, whereas the national average compensation for all jobs is \$52,533⁵. These statistics are strong indicators of the value of a manufacturing career. While not specific to a manufacturing engineer, the higher standard of living that a manufacturing career in general provides is clear.

In 2005, the U.S. Gross Domestic Product, or GDP, was \$12.487 billion⁶. The U.S. manufacturing portion of the GDP was \$1.497 billion, or 12% of the nation's GDP. This makes manufacturing the largest sector contributor to our nation's economy. If the U.S. manufacturing economy were to stand on its own, it would represent the fifth largest economy in the world. The U.S. manufacturing portion of our economy is larger than France's, China's, and the combination of Canada and Mexico. While these statistics are not often noted, it is important to understand the enormous impact manufacturing has on our national economy.

In the direct region served by the University of Wisconsin-Stout, it is important to understand the contribution of manufacturing to these regional economies. In Wisconsin, the State GDP is \$43 billion and the manufacturing sector makes up 25% of the State's economy. In 2001, there were 560,000 manufacturing employees in the state. In Minnesota, the State GDP is \$32 billion and the manufacturing sector makes up 18% of the State's economy. In 2001, there were 378,000 manufacturing employees in the state⁷.

Another interesting comparison to make is the contribution of U.S. manufacturing with U.S. agriculture to the overall exports overseas. In 2005, U.S. manufacturing exported \$782 billion of goods, which accounted for two-thirds of all U.S. exports during that year. During this same period, U.S. agriculture exported roughly \$50 billion. U.S. manufacturing contributed more than the annual agricultural export monthly⁸.

In addition, nearly two-thirds of the United States private research and development is funded by manufacturing (roughly \$200 billion). Manufacturing also accounts for 90% of the patents awarded annually⁹. Research and development has long been heralded as a key link between technology development and the economic growth that results in job creation. Research and development also plays a prominent role in national defense and national security. It is therefore obvious that manufacturing is of strategic importance to the health of the nation and our economy. As reported in NAM's Labor Day Report (2005)¹⁰, "Our economy's ability to compete in the 21st Century will not be influenced by past performance. Success or failure will be determined primarily by our capacity to invent and innovate,"

The Need for Manufacturing Workers

There is a growing need for both manufacturing engineers and highly skilled manufacturing related workers. There are two dynamics that are driving this increase. First, low skill manufacturing that is labor intensive is moving off shore. To remain competitive in this environment, manufacturers and the manufacturing workforce in the United States has become much more productive and sophisticated. Second, the existing pool of manufacturing engineers and skilled technicians is aging and nearing retirement. In the area of northwest Wisconsin directly served by the University of Wisconsin-Stout, for example, there is a decline in the number of high school graduates over time and an increase in workers nearing retirement age¹¹, as demonstrated in Figure 2.

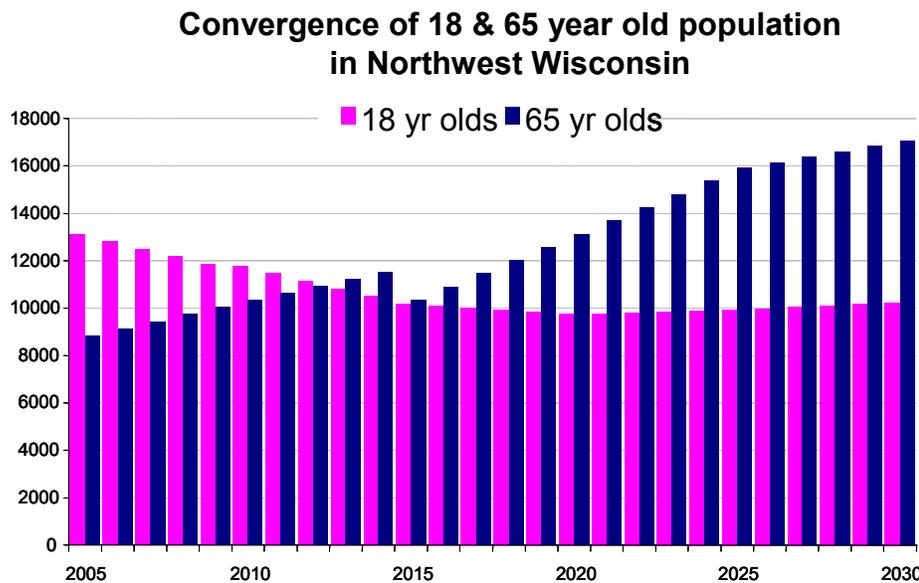


Figure 2. Convergence of 18 and 65 year old population in NW Wisconsin.¹¹

This demographic combination is prevalent throughout the state and is already being felt by Wisconsin manufacturers. Corporate Report Wisconsin¹² reported that despite post-9/11 downturns in manufacturing related employment, Wisconsin manufacturing has rebounded. Over 46% of manufacturers reported increases in hiring in the first quarter of 2006. But more than half were having trouble finding employees and nearly 40% reported having difficulty hiring employees with the proper level of technical skills.

On the national landscape, the demographics mirror Wisconsin with more than half of the current science and engineering workforce over 40 years of age. As reported in Time Magazine (May 6, 2002), 76 million “baby boomers” are headed for retirement over the next two decades with only 46 million “Gen Xers” to take their place in the workforce. Despite the escalation of the retirement age, labor-saving technology, and immigration, Time Magazine predicts a shortage of 4 million to 6 million workers by 2010. A 2005 survey of small manufacturers by the National Association of Manufacturers notes that companies are already having trouble finding qualified workers, both skilled technicians and engineers as summarized in the charts below:

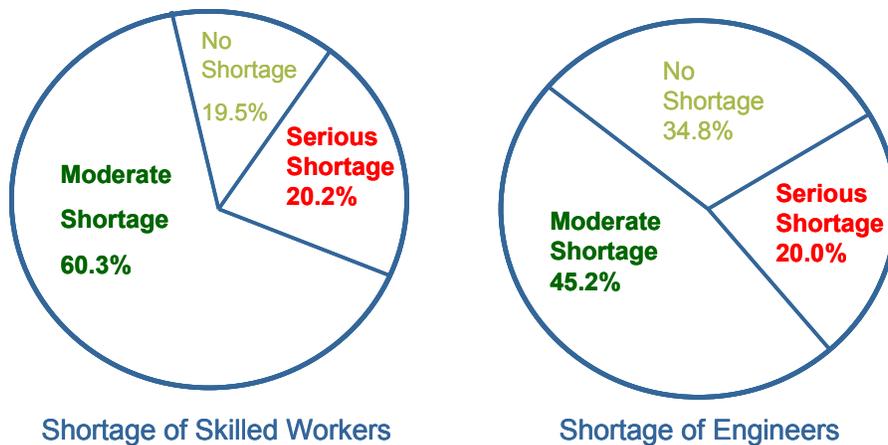


Figure 3. Shortages of skilled manufacturing workers and engineers.¹³

The need for engineers was best summarized by William Wulf, President, National Academy of Engineering, when he stated, “We will need a million entry level engineers in the next decade. Our colleges are producing 65,000 engineers per year. With retirements we’re going to be short 350,000 engineers.”¹⁴ And Joel Houlton (VP of Operations at Honeywell) agrees with Wulf pointing out that, “This is consistent with our view of the future, we are struggling to grow our engineering work force today.”¹⁴ In a 2005 IW/MPI Census of Manufacturers Report¹¹, it was noted that the “upward pressure on the labor pool now appears to be affecting plant ability to retain employees, as measured by annual turnover rate”.¹⁵ The census reported that the median annual labor turnover rate had risen in 2005 to 8% from 6% the previous two years.

Dan Conroy (HR Director, Nexen Corp.) adds that “even when labor-intensive manufacturing goes offshore, the need for engineering talent does not diminish; in fact, it may even increase. One of our greatest resources in the new economy is brainpower”.¹⁴ If we are going to compete internationally, we will need to attract more students into engineering careers. Currently, 6% of the nation’s undergraduates are pursuing engineering degrees which ranks 23rd internationally. Only 10% of U. S. graduate degrees received are in engineering fields, ranking 20th internationally. Perhaps David Heenan, author of *Flight Capital* has it right when he states “forget terrorism and weapons of mass destruction, the next global war will be fought over human talent – and America’s already losing”.¹⁶

Changing the Image of Manufacturing

Often, we hear and see very negative images of manufacturing in the media. It is not uncommon to see front page news headlines bemoaning the latest industrial closure. It is also not

uncommon to see news headlines noting a manufacturing firm’s movement to an Asian rim location. But, how often do we see headlines proclaiming the successes of a manufacturing expansion or new facility? Why are the front page headlines negative whereas the manufacturing successes are buried in the business pages, if covered at all?

In order to attract more students into manufacturing engineering and other manufacturing related careers we will need to change the image of manufacturing. As stated in *Keeping America Competitive: How a Talent Shortage Threatens U. S. Manufacturing*¹⁷:

“Unless industry finds a compelling way to communicate a positive image and address education and training issues effectively, manufacturing could experience a shift from merely having a talent shortage to facing a serious labor crisis. This could foreshadow a significant decrease in manufacturing’s competitiveness and accelerate the movement of American productive capacity and well-paid manufacturing jobs overseas. These events could deliver a decisive blow to an already fragile economy and even undermine national security”.

Although the above quote is correct, it is important to note that industry is not the only group obligated to change the image of manufacturing careers. In addition, members of the educational community need to be actively engaged in these activities. To understand these perceptions, consider student perceptions of manufacturing careers versus aspirations¹⁷ as shown in Table 4.

Table 4. Student respondent perceptions of manufacturing careers vs. aspirations¹⁷.

Perceptions of Manufacturing Careers	Desired Career Characteristics
Assembly Line	Interesting
Repetitious/Boring/Tedious	Creative/Non-Cookie Cutter
Not Something You Dream About	Emotionally Rewarding
Not Ambitious/Settling for Less	
Serving a Life Sentence	Good Quality of Life
Chain Gang/Slave/Torture	Freedom to Choose
Dangerous/Dark/Dirty	
Hard Work/Long Hours	
Low Pay	Prestige
No Benefits	Financially Rewarding
No Chance for Promotion/Dead End	Opportunities for Growth/Advancement
Sector in Decline	Stable, High-Growth Sector
Jobs Leaving the Country	Ample U.S.-based jobs

It is imperative that actions be taken to directly address the manufacturing skills gap already developed and getting worse. Locally, the University of Wisconsin-Stout has successfully initiated regional partnerships and actions to address a declining interest in manufacturing careers. Nationally, the Society of Manufacturing Engineers and the National Association of Manufacturers have initiated actions to address the decline as well. Each region, state, and

national group can do a small part and make significant impacts on turning around the declining interest in manufacturing careers at all levels of education.

Actions to Recruit Manufacturing Engineers

Increasing enrollments into manufacturing engineering and other manufacturing post secondary education has driven the actions of the University of Wisconsin-Stout over the past decade. Several local, regional and national activities are contributing to a continued and increasing enrollment in the manufacturing engineering program. These efforts are also beneficial to recruiting into other manufacturing post secondary education.

Local Actions to Recruit Manufacturing Engineers

The University of Wisconsin-Stout has developed many actions that are directly or indirectly designed to reverse the declining interest in and promote a positive image of manufacturing. The local programs supported and developed include Engineering and Technology Career Days, FIRST LEGO League Regional Tournaments, Project Lead the Way Affiliate, SkillsUSA, and STEPS (Science, Technology & Engineering Preview Summer Camp) for Girls. These local, regional, and statewide efforts are putting the University of Wisconsin-Stout forward as a champion for manufacturing, technology, and engineering careers.

A primary recruiting program, implemented in 2001 is the Engineering and Technology Career Day events. These day-long events are for high school students to come onto our campus to explore career options at the University. The hands-on sessions allow students to get into actual lab facilities associated with the programs and see firsthand the exciting things possible in a variety of careers. Programs highlighted in these events include: manufacturing engineering, engineering technology, packaging, construction, information technology management, applied mathematics and computer science, applied science, and graphic communications management. The fall Career Day is for high school juniors and seniors and the spring Career Day is for high school freshmen and sophomores. Since its creation, 2,200 high school students have attended the Engineering & Technology Career Days. New College of Technology, Engineering, and Management (CTEM) student surveys indicate that on average 15 percent obtained information on UW-Stout and the programs offered from on campus events such as the Engineering and Technology Career Days.

The FIRST LEGO League (FLL)¹⁸ Regional Tournament is a 2005 addition to the outreach offerings and programs supported by the University of Wisconsin-Stout. FLL is a dynamic sport for the mind tournament style event that draws 9 to 14 year olds into engineering and technology. While not specifically focused on manufacturing engineering, the College supports this event as it interests youth in engineering in fun and exciting ways. Current themes are utilized along with the LEGO Mindstorms robotics technology. The faculty and students have embraced this event as a great way to perform K-12 outreach.

Project Lead the Way (PLTW) is a structured pre-engineering program for high schools and a technology exploration program for middle schools. In 2004, the University of Wisconsin-Stout became involved in supporting the growth of PLTW within the State. The University has become a PLTW Affiliate and consults with middle and high school instructors to develop their

pre-engineering curricula. We are aspiring to be a training site for PLTW instructors. In addition, recent efforts to incorporate PLTW into the B.S. in Technology Education program curriculum have resulted in a pre-engineering education concentration within the program.

The University of Wisconsin-Stout has sponsored a SkillsUSA Leadership and Skills Contest for 24 years on campus. This dynamic event brings 425 students to campus annually. There are six leadership and 21 skills contests for high school students and three skills contests for middle school students. This is an exceptional program bringing a large number of students on campus for programmatic awareness. As indicated previously, the more times a student come to a campus, the more likely they are to come to a program at that university. This emboldened marketing approach presents a friendly and welcoming atmosphere.

Probably the most successful outreach activity on the University of Wisconsin-Stout campus is the Science, Technology & Engineering Preview Summer Camp for Girls (STEPS for Girls).¹⁹ It was developed and created by the University of Wisconsin-Stout and is now nationally promoted by the Society of Manufacturing Engineers. STEPS for Girls is a one-week summer camp initiated in the summer of 1997.²⁰ The purpose of STEPS is to introduce young 7th grade women to career opportunities in engineering, technology, and science and to inspire them to prepare for these careers by selection of appropriate math and science courses in middle and high school. With the completion of the 10th year camp in 2006, 1600 young women have manufactured the components for and assembled their own radio-controlled model airplanes. A recent survey of early STEPS campers has revealed this summer camp has made significant impacts on their career pursuits. A young woman attending STEPS is 9.6 times more likely to pursue an engineering or technology degree and is 4.8 times more likely to pursue a natural science degree than her contemporaries.²¹

Regional Actions to Recruit Manufacturing Engineers

Since its creation in 2005, the University of Wisconsin-Stout has been a founding and leading partner in a regional manufacturing careers promotional group called Manufacturing Works. Manufacturing Works was formed when a group of manufacturers, regional Technical Colleges, and the University of Wisconsin-Stout realized they all had a stake in recruiting students into manufacturing educational programs. The Dean of CTEM is now the co-chair of Manufacturing Works. The groups stated purpose is to improve the image of manufacturing career opportunities in the Chippewa Valley. The group has been extremely active in doing activities for the two target market groups of K-12 students and staff and 19-45 year old workers caught in “accidental careers.”

Many activities have been completed to date. A summary of all the activities initiated to date is shown in Table 5.

Table 5. Manufacturing Works summary of activities.

<u>Summary of Activities for Manufacturing Works</u>
<ul style="list-style-type: none">• Print Ads – schools/businesses• Radio Ads – business/alumni• Movie Theater Trailers• Bus/Truck Signs• www.goldcollarcareers.com website• Career Fairs – promoting business and education• Regional Career Day for High School Students• Presentations to Students• Newspaper Articles on Manufacturing Careers• Call in to Public Radio on Manufacturing Careers• Meeting with State Legislators• Bringing High School Teachers on Campus• Presentations to Civic Groups• Presentations to Job Placement Agencies• Raised \$25,000 from Local Industry for the Effort

Manufacturing Works has clearly defined expectations for both the manufacturing community and the education community. Manufacturing Works recognizes that promoting manufacturing is not a spectator sport, which all parties involved need to participate, that participation is not to be passive and needs to be done creatively. All parties need to be actively involved in preparing workers for today and tomorrow.

For the manufacturing community, Manufacturing Works expects participants to proclaim the vitality, career potential, and economic importance of manufacturing in Wisconsin. Participants need to support technology education and pre-engineering instruction in the K-12 school systems. Manufacturers should also get into the K-12 classrooms to help youth realize the potential within high demand manufacturing careers. They should also be acutely involved in local school boards to make sure the boards are aware of regional and national manufacturing needs. Additionally, the manufacturing community needs to demand more promotion from colleges and universities and assist them in achieving their manufacturing promotions.

For the education community, Manufacturing Works expects participants to promote manufacturing at all levels of the education spectrum. The K-12 school systems need to keep technology education programs vibrant by funding and staffing the programs, by keeping the curriculum crisp, interesting, and relevant, and by publicizing and broadcasting the programs successes. Manufacturing Works believes that the K-12 school systems need to stop keeping the successes of technical education a secret. School boards need to be keenly aware of the urgent nature of promoting manufacturing to students. The education community needs to have active partnerships with manufacturers through advisory boards, continual plant tours, and industry

group involvement. All levels of education need to participate in exciting events such as STEPS for Girls, FIRST LEGO League, SkillsUSA, Project Lead the Way, Super Mileage Vehicle, Rube Goldberg Contests, Science Olympiad, etc. on a continuous basis. Universities and Colleges must ensure that these events are available and K-12 school systems need to provide the opportunity for all levels of students to participate.

One company involved in Manufacturing Works is Nexen Corporation in Webster, WI. Nexen, through the leadership of Human Resources Director Dan Conroy, has been at the forefront in the manufacturing community promotion of manufacturing. Table 6 lists some of the Nexen partnerships they have forged.

Table 6. Example of one Manufacturing Works member promotion of manufacturing careers.

Nexen Corporation Partnerships with Education

- K-16 Education
- Plant Tours
- Education for Employment
- Teacher In-Services
- Guidance Counselor In-Services
- Career Fairs
- Classroom Presentations
- Student Internships
- Scholarships
- Equipment and Cash Donations
- Advisory Committees
- Staff Training
- Job Shadowing
- STEPS for Girls Donor
- FLL Team Sponsorship and Mentoring
- Manufacturing Engineering Capstone Projects

Manufacturing Works is an extremely effective grassroots style organization, and this type of effort should be considered regionally throughout the United States. The leaders of Manufacturing Works have had direct contact with 763 high school students, 240 educators of these students, and 297 business leaders in the region of Northwest Wisconsin and East Central Minnesota. It is making a significant impact on the decisions of students to enroll in manufacturing careers, as evidenced by increasing enrollments in the manufacturing based two year technical college degree programs at Chippewa Valley Technical College.

National Efforts

The University of Wisconsin-Stout is involved in national efforts to promote manufacturing with the Society of Manufacturing Engineers (SME). In 2005, members of the Manufacturing Works presented at the SME Summit in Oconomowoc, WI. The interest generated at this presentation

was extreme and it became apparent to leaders of the Manufacturing Education and Research Technical Community this effort needed to expand to a national SME effort. As a result, the “Our Future in Manufacturing” Technical Group (TG) was born. Since then, leaders of the Manufacturing Works group have co-chaired the Our Future in Manufacturing TG and have helped create a framework for SME membership involvement in promoting manufacturing careers. The Our Future in Manufacturing Tech Group’s vision and mission are clearly defined.

SME Our Future in Manufacturing Technical Group Vision:

The field of manufacturing careers will be considered to be attractive to talented young people and all who wish to contribute to enhancing industrial competitiveness.

SME Our Future in Manufacturing Technical Group Mission:

To enhance the image of manufacturing to all of our current and future stakeholders.

Clearly, this Technical Group has a big task and SME will not achieve the vision alone. It is important for this group to broadly disseminate accurate, positive manufacturing information so that the field of manufacturing engineering and related functions will be highly regarded locally, nationally, and internationally. This recognition needs to occur within manufacturing enterprises, governmental agencies, K-12 education, post secondary education, and by the public at large. There are 267 professional and student members currently signed up as members of Our Future in Manufacturing Tech Group.

Our Future in Manufacturing Tech Group has developed an extensive list of action items that will move toward achieving the mission and vision. Table 7 lists the action items for the group. More detail on this group’s activities and getting involved with them can be found through the SME website at www.sme.org and going to the Manufacturing Education and Research Technical Community page.

Table 7. Our Future in Manufacturing Technical Group Action Items.

Our Future in Manufacturing Action Items
1. Emulate the success of the STEPS program to enhance the awareness of young people to pursue careers in manufacturing and other engineering, technology, and science fields.
2. Develop off the shelf “Image Enhancement Kits” to share for free.
3. Prepare an inventory of resources that currently exist.
4. Conduct a major national campaign to promote manufacturing career.
5. Develop hands-on manufacturing experiences for students.
6. Develop and promote campaigns that recognize manufacturing engineers and technical staff for their innovations and accomplishments.
7. Promulgate an ‘Employer Call to Action’ list.
8. Create a website for Our Future in Manufacturing Technical Group that includes resources that SME members can use to accomplish many of the action items.
9. Work with SME Education Foundation to upgrade and update the ‘Manufacturing is Cool’ website.

Conclusions

This paper has demonstrated that concentrated efforts have helped enrollments at the University of Wisconsin-Stout rebound. Nationally, there is an urgent need to fill the education pipeline with students for all types of manufacturing careers. Actions to promote manufacturing careers need to occur locally, regionally, and nationally. Several activities at the University of Wisconsin-Stout have been discussed, including Engineering and Technology Career Days, FIRST LEGO League, Project Lead the Way, SkillsUSA, and STEPS for Girls. Regionally, actions of Manufacturing Works have been discussed. These actions are targeted to both manufacturing and educational community involvement in the promotion of manufacturing careers. Finally, national manufacturing promotion efforts by the Our Future in Manufacturing Technical Group within the Society of Manufacturing Engineers have been detailed. While just getting started, this group has the potential to be a leading voice in the change in the image of manufacturing. A positive image of manufacturing will present manufacturing careers as a viable, high demand, technical career choice.

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