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ABSTRACT

This paper addresses the image problem facing manufacturing education which dramatically affects program growth. More specifically, remedies are presented for combating declining enrollments and misconstrued public opinion. In addition, remedies requiring limited or no new financial resources are reviewed as well as a holistic approach that effectively tripled the enrollment of an undergraduate Industrial Technology program within a period of less than five years. Private and government agencies are also reviewed for their relevancy to program support.

INTRODUCTION

Presently, manufacturing suffers from a poor public image that makes it difficult for industry to attract the new talent that is needed for the more advanced careers that are associated with future manufacturing trends (The Workforce Boards, 2004). The National Association of Manufacturers, commonly referred to as NAM (2003) noted that the manufacturing sector's image was "heavily loaded with negative connotations and universally tied to a stereotype of the assembly line" (p. 9). NAM (2009) also perceived manufacturing "to be in a state of decline" (p. 9). According to a survey of high school students reported in an online article by James Benes (2005), writer for the American Machinist, students described images associated with a career in manufacturing with phrases such as "serving a life sentence" being "on a chain gang" a "slave to the line" or even being a "robot" (para. 8). Benes (2005) also noted that the students almost unanimously saw manufacturing opportunities to be in stark contrast with the characteristics they desire in careers and that they do not plan on careers in manufacturing.

McKenney and Narvaiz (2009), from Deloitte LLP and NAM respectively, noted that their survey entitled "Public Viewpoint on Manufacturing" listed only 17% of American high school students as naming manufacturing as one of their top two industry choices to start a career and that only 30% of their parents would encourage their children to pursue jobs in manufacturing. People's perceptions of career paths in manufacturing or industrial fields have also been tainted by the media and the recent downturn in the economy.

Although most Americans have negative views on manufacturing careers, McKenney and Narvaiz (2009) noted that their survey also revealed that most Americans (81 percent) agreed that the United States manufacturing industry had a significant impact on their standard of living and was the top industry of importance to the economy.

STATEMENT OF THE PROBLEM

As previously noted, the public perception of manufacturing career opportunities has sunk to an all time low, thereby reducing the number of students who would be interested in enrolling in a manufacturing-related educational program. Although manufacturing jobs have fallen by one-third in the past decade, manufacturing output has remained roughly constant (Sherk, 2010). Technological improvements are driving this increased productivity as well as the implementation of

continuous improvement, lean, and six sigma programs. Advances in manufacturing technology have created new jobs for highly skilled workers who operate machines and improve production (Benes, 2005; Healy, 2009; McKenney & Narvaiz, 2009; and Sherk, 2010). Moreover, the average skilled worker is over 50 years old and the baby boomer generation will retire within the next 5-15 years thereby creating and estimated demand for 10 million highly skilled manufacturing workers by 2020 (Shankel, 2010). Further, according to the U.S. Department of Commerce (2004), the lack of qualified labor in the United States is the biggest issue and roadblock to continued growth. In order to provide enough highly skilled manufacturing workers, educators and recruiters from manufacturing-related and industrial technology programs need to inform the public, and more importantly, prospective students of the demand for highly skilled workers and of the "clean" job opportunities available in manufacturing.

METHOD FOR PROGRAM IMPROVEMENT

The most effective way of increasing enrollments for these programs is to change the mindset of prospective students and their parents by addressing what this author's colleagues refer to as the four P's: preparation, promotion, presentation, and placement. These four key elements are vital to a program's growth and longevity. Examples of these elements and details of their implementation at The University of Texas at Tyler are addressed as follows:

Preparation

In order to prepare a student for gainful employment in the manufacturing sector, a solid curriculum must be developed to satisfy the employer's needs. In addition, as technology changes and domestic manufacturing becomes increasingly more automated to compete with low cost overseas labor, manufacturing curricula must evolve to meet these challenges. Further, as the cost of higher education continues to escalate, potential students and their parents are now seeking viable educational programs that are capable of placing graduates in high paying positions with projected long term growth. Manufacturing programs must, more than ever, demonstrate their evolution by revising curricula to make graduates more prepared to be competitive in the workforce.

In just over a four year span, the industrial technology program at The University of Texas at Tyler revised its curricula based upon recommendations from industrial advisory board members, former graduates, and from recommendations of similar programs that had recently made changes to their curricula. Industrial advisory board members recommended that the program must focus more on "soft skills" (i.e., team work, empathy, professionalism, people skills, etc.) and give its students only a general technical education because industries will internally train new employees for their specific proprietary technical knowledge that is not available to academia. In addition, they noted that a good understanding of outsourcing and supply chain management is important to most industrial managers. Recent graduates who responded to the last post graduate survey noted that most of the industries were embracing lean principles and were hiring individuals with a background in six sigma quality.

Hung and Leon (2005) touched on many of these same points in their discussion of revising the curricula for the manufacturing and mechanical engineering technology programs at Texas A&M University. Additionally, they suggested that micromanufacturing and nanotechnology be introduced into the curricula as well as programmable logic controllers and that some basic hands-on experiences be introduced in laboratory activities to reinforce these concepts. Hung and Leon (2005) also mentioned in their paper that globalization and cross-cultural collaborative efforts should also be introduced into the curricula. Web based activities as well as diverse team projects promoting entrepreneurship, innovation, and creativity was also recommended.

The following revisions were made to the curricula of the industrial technology program at The University of Texas at Tyler to incorporate most of these suggestions:

1. The course entitled *Production Technology* was renamed *Lean Production* and was revised to cover all the major lean principles used by industry to eliminate waste.
2. A course entitled *Supply Chain Management* was added to the curriculum.
3. The course *Quality Control Technology* was renamed *Six Sigma Quality* and six sigma principles were added to the course.
4. A new course entitled *Introduction to Nanotechnology* will be added to the curriculum.
5. The course *Value Stream Management* was added to the curriculum.
6. A course in industrial maintenance was revised and is now titled *Total Productive Maintenance*.
7. Students are now allowed to take the course *International Business* as one of their electives.
8. A programmable logic controller trainer was purchased and is now part of the laboratory activities for the *Computer Integrated Manufacturing* course.
9. Human resource development courses emphasizing soft skills are now required as part of the core curriculum.
10. Micromanufacturing is now covered in the *Advanced Manufacturing Processes* course.

Additional changes are planned as two new faculty have joined the program. Industrial Advisory committee members and recent graduates have approved and welcomed these changes. Each year industry and alumni are queried so the program adequately prepares its graduates for employment. The emailed survey instrument asks respondents to rate the importance of certain educational content using a five point Likert-type scale. In addition, respondents are asked to add any addi-

tional educational content that they feel is important to the program's curriculum. The new content is then placed on a new survey instrument that only includes the new suggestions. Industry and alumni are then asked to rate the importance of this new content using the same Likert-type scale.

Promotion

The next step to generating interest in the manufacturing program is to reeducate undecided students about the latest trends in manufacturing industries. A proactive approach was implemented in order to generate new interest in manufacturing careers. The focus had now changed from dirty, smokestack factories with sweatshop conditions to clean, neat, and organized climate controlled manufacturing work environments with state-of-the-art technical gadgetry. Pictures in the brochures and departmental bulletin boards only focus on the "clean" industries associated with manufacturing. In fact, other states, such as Connecticut, have gone even further by implementing a campaign that was funded by the National Science Foundation and developed by the Regional Center for Next Generation Manufacturing (2005) entitled "Manufacturing: It's not what you think!" Their promotion also stated:

> There's a great future in Connecticut manufacturing for young people like you. And it's not your grandfather's factory job anymore. It's super clean and high-tech! Exciting jobs in manufacturing are in hot demand. And in Connecticut these jobs pay an average of $52,000 a year plus great benefits!

A website (http://www.nextgenmfg.org/dvd/jan.cfm) was also created for this program so interested students can click on job titles and view short video clips depicting clean manufacturing jobs with interviews from graduates who obtained the jobs. Similar promotions can be done with most manufacturing and industrial technology programs because many states have manufacturing advancement centers or other centers to assist manufacturers that typically offer video clips of clean and high tech industries. In addition, the Society of Manufacturing Engineers (SME) has a website entitled "Manufacturing is cool" in which users can click on various objects to learn how they were made and more. SME is trying to promote manufacturing and manufacturing education so they invite programs to link to their website. Moreover, SME allows universities and communities to form student chapters in which they provide funding and opportunities for students.

Another way of promoting a manufacturing or industrial technology program is to have links to web pages that provide statistics for what the percentage of the state's GDP is made up by manufacturing, the percentage of manufacturing jobs for the state, the need for a well educated and highly skilled workforce, etc. The Manufacturing Advancement Center (2009) does this for a six state region in the northeast and the Texas Association of Manufacturers (2009) lists important data regarding manufacturing growth and contributions to the state. In addition, the U.S. Census Bureau publishes an annual survey of manufacturers (www.census.gov) under their publications section entitled *Manufacturing and Mineral Industries* which provides important information relating to manufacturing such as trends in the number of employees, hours worked, total dollar in wages, and value added dollars.

Another big source of information is online newspapers and online news organizations such as MSNBC, CNN, NYTimes, Reuters, International Business Times, etc. These organizations provide information on all businesses and if one looks hard enough, one can always find a bright spot regarding manufacturing. For example, an article in the June 1st edition of Reuters (2010) noted that the Commerce Department reported that manufacturing in the United States has expanded for 10 straight months. In addition, it was noted in an article posted in the International Business Times that a measure of manufacturing employment recently rose to its highest level in six years and that payrolls increased by over half of a million (International Business Times, 2010).

All of the previously mentioned data sources should not only be linked to a program's web site but also be posted on bulletin boards in the building that offers the program and/or all over campus for that matter. The bottom line is that manufacturing has earned a negative sentiment with the general public so a proactive positive promotion of manufacturing and industry (i.e., clean and high tech) is one way to entice new students to enroll in manufacturing-related degree programs.

Presentation

One can promote manufacturing in a positive light as much as possible; however, when a new student visits a department and it looks like the traditional job shop or vocational lab from years past, then all these promotional activities are for naught. First impressions can make or break most deals so be sure the program's departmental offices, laboratories, hallways, and any other related rooms reflect the new image for manufacturing. A nice, clean, and organized environment that welcomes most people needs to be the norm for a program. In fact, allow the administrative assistants to make the office and laboratories look more inviting by allowing them to decorate it as shown in Figure 1. A clean, neat, and organized office should appeal to a more professional student that is interested in working in the newer "clean" manufacturing industries.

With the implementation of Lean Manufacturing at most industries, the 5 S's can also be adapted and implemented at the academic department level. Typically, there is a lot of unnecessary clutter in most departments that should be shed to give a neater appearance for first time guests. The 5 S's (Dennis, 2006) stand for: sort, set in order, shine, standardize, and sustain. This can easily be applied to any academic department, thereby; making the first impres-

Figure 1. Program office reception area.

sion of a department to a perspective student one that is neat and organized and one in which everyone knows what to do. Therefore, faculty and staff of a department must keep in mind that a prospective student may be given a tour of the department at any given time so they must keep it clean and organized. A commitment must be made by everyone in the department to follow the 5 S's just like everyone must do in industry to stay competitive. A more specific example of how each of the 5 S's that can be applied to a manufacturing or industrial technology program are as follows:

Sort: As Dennis (2006) notes, "the first principle of visual order is to sort out what you don't need" (p. 29). In academia where funding is in most cases scarce and hard to come by, faculty and staff have a tendency to hold onto items longer than their expected usefulness. Therefore, it is important that unused items be discarded or stored if necessary from the public's eye. All unused items should be placed in a storage room and tagged so all faculty and staff can determine if they ever use the item. If no one claims an item, then it should be properly removed from the department's inventory and disposed of according to university regulations. Unwanted clutter can significantly detract from a department's image.

Set in Order: Next, take a long, hard look at a department's laboratories and faculty offices and see if the equipment or furniture is positioned in the most efficient manner. For example, the most recent and impressive piece of equipment may be stuck in a corner somewhere with very little visibility and impact. Make sure offices have desks that face the person entering the room. It should be noted that having your back to a new student is not the best way to welcome that student and his or her parents to a department. People want to feel welcomed.

Shine: As noted by Dennis (2006), "Nothing raises your team's spirit like a clean, well-ordered workplace" (p. 33). Most faculty and staff would view that responsibility as that of the janitorial crew, however, their job is to clean and not sort and minimize clutter. Carefully review the department's pictures, furniture and other items to see if they appear to be dated or have faded over the years. Evaluate the appearance of the laboratories and look for rusted, or chipped up equipment that could use a coat of paint. Check to see if the safety zone lines painted on the floor around machinery are still legible. Most of these things go unnoticed because addressing these issues doesn't help most faculty with their promotion and tenure packages. At any rate, someone should coordinate these efforts so the department can maintain a clean, neat and organized appearance as another way to change the dirty and unappealing image of manufacturing. Figure 2 illustrates a well organized machining laboratory that even has a carpeted floor.

Standardize: Now that the department has been cleaned up and organized, some type of visual record (pictures, written down criteria) should be kept so everyone knows who is responsible for maintaining what, how it should be done, and when it should be done. It is much easier to keep things organized and looking good if it is maintained periodically throughout the semester.

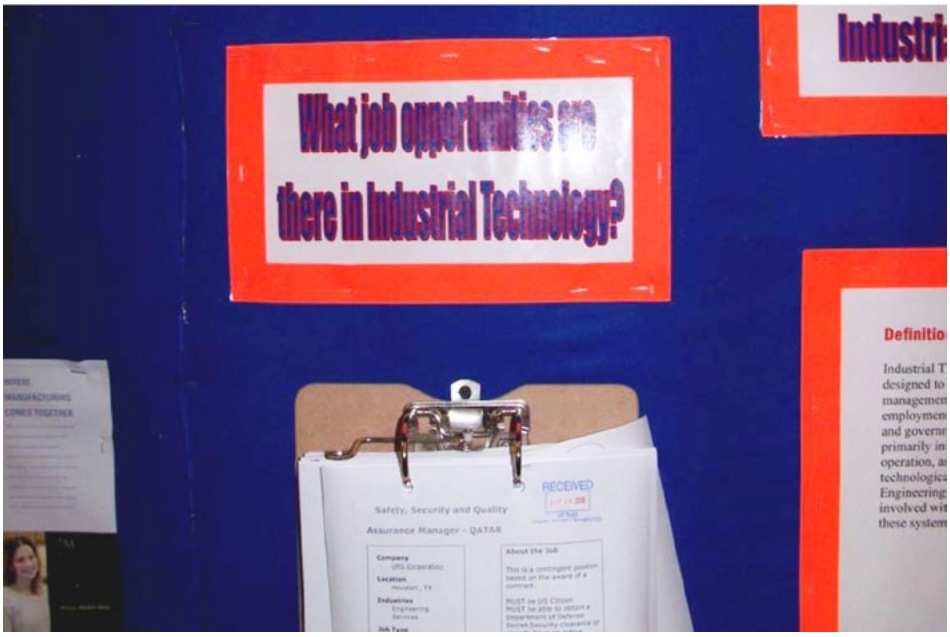
Sustain: Although everyone may be responsible for a certain area and been assigned duties that does not necessarily mean that they will continue to maintain their area. Faculty and staff must be recognized for their efforts, whether it is in their annual reports or through an employee of the month recognition effort. As budgets are cut as the economy continues to decline, additional responsibilities assigned to existing employees can overwork them to the point that they run out of time to focus on the 5 S's. Leaders in the department must make this a priority and sustain the effort to keep the department looking good to prospective students.

Placement

When enrollments decline, administrators and faculty must focus on recruitment and retention of students. Placement of graduates is a vital component to the strength of any program. Word of mouth advertising from content graduates with successful careers is a

Figure 2. Clean, neat, and organized machining laboratory.

Figure 3. Bulletin board in the main hallway where job postings are listed daily for Industrial Technology majors.



good way to attract more students to a program.

It is imperative that faculty and staff maintain job boards in hallways with the latest job postings so students can see the demand for people with this major (refer to Figure 3). Prospective students can also see the demand for these majors and will feel more comfortable investing their time and money to this degree.

If faculty and staff are too busy with other duties, then departmental student workers need to be trained to find job announcements and post them on the bulletin boards and/or program websites. There is nothing worse than a job board with job announcements posted from prior semesters. For example, this author learned from students that some of the department's majors had changed majors when they saw that no more jobs were being posted on the job boards.

As the economy continues to decline and jobs become even scarcer, post optimistic articles that note encouraging trends for job growth in manufacturing. For instance, post, "Make it in America: The Apollo Green Manufacturing Plan" which can be found at the www.apolloalliance.org web site. The two page brief by Gordon (2009) discusses all the new clean energy manufacturing or "green" jobs that will be available through the billions of dollars spent on the government's stimulus package. In fact, it has a quote by President Barack Obama that states, "I do not accept a future where jobs and industries of tomorrow take root beyond our borders – and I know you don't either. It is time for America to lead again." What can be more encouraging to a new student then knowing that they may be placed in a clean and green job that even has the endorsement of the President?

Other articles that may be placed on the job board should not only note the future job growth, but also portray manufacturing in a different light. Weldon (2007) in an article entitled "Making Manufacturing Glamorous" notes that NAM has partnered with Skills USA to undertake a major marketing and training program to champion the personal and professional rewards to the field of manufacturing through the program "Dream It. Do It." It states in the article that even though manufacturing jobs are on the decline, many of the so-called Baby Boomers are within a few years of retirement and there will

be a huge shortage of skilled workers for manufacturing industries.

RESULTS

Over the years, The University of Texas at Tyler undergraduate Industrial Technology program's enrollment had steadily declined until its numbers barely justified the need for the faculty member who coordinated it. The comprehensive plan previously stated to increase enrollment was developed and gradually implemented over the past five years to counter act this declining enrollment. During this time period, and while the economy slipped into a recession causing massive layoffs in the manufacturing sector, the enrollment for the program has almost tripled. Moreover, although there is currently a hiring freeze at the university, the administration approved the appointment of two new faculty members to assist with the program's growing enrollment. Every department that follows the comprehensive plan that was implemented at this author's university may not have the same outcome due to other factors affecting a specific geographic region. However, most of these suggestions have worked at all of the institutions this author has been associated with.

CONCLUSION

Marketing is the key to selling most products and that is the reason why there are so many advertisements on the television, radio, internet, and in the newspaper. Although marketing is an important aspect of our lives, most faculty have had little or no educational training in it. Faculty in university programs that service all the other programs on campus, such as English, History, Political Science, may not feel the need to attract majors, however, programs that do not offer service courses have to attract majors to stave off elimination. Therefore, it should be noted that a coordinated, team effort by departmental employees must be implemented to increase enrollments.

This paper illustrates the importance of departmental personnel in creating good first impressions, changing people's perceptions about manufacturing, and staying vigilant with lean tools such as the 5 S's to maintain a program's viability. In addition, recruitment efforts must be followed by departmental placement services or retention rates will suffer. Finally, the curriculum is the foundation of a solid program which enables graduates to be sought after by employers. The curriculum must stay abreast of new manufacturing trends and must reflect this through appropriately named course titles and course descriptions. A manufacturing program must capture the contemporary methods of manufacturing that stress clean, green, and highly automated industries that are globally competitive. These points will incite interest in new students and persuade them to seek degrees in manufacturing-related programs.

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