AC 2007-645: SUSTAINING MANUFACTURING WITH INNOVATIVE RECRUITMENT STRATEGIES

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Sustaining Manufacturing with Innovative Recruitment Strategies

Abstract

San Diego City College (SDCC) has been partnering with different organizations in the state of California to increase the quantity and quality of manufacturing engineers and engineering technicians available to the workforce. In this paper, the authors discuss different recruitment strategies to attract students into engineering technology programs, specifically, the manufacturing engineering technology field. Three main factors that led us to a successful program implementation are local news publications, active industry partnerships, and campus events for students. This paper describes in details our publication effort through six different news communication channels, targeting both manufacturing companies and the general public. SDCC has strong industry partnerships through a number of advisory boards, grant and project collaborations over the years. Many of our new students were recruited through these industry partners who believe in the values and integrity of our academic programs. Last but not least, the paper writes about various campus events, sponsored by different organizations, that the Engineering and Technologies Department at SDCC used to promote students' interest in engineering and engineering technology. These events include engineering and engineering technology academic and career fairs during National Engineers Week, engineering technology open houses, campus orientations, technology workshops, and summer academies. Current outreach efforts at high schools are also discussed in the paper. Different strategies are currently used to educate high school students and parents about engineering/engineering technology, and to train high school teachers and counselors (both college and high school levels) on modern perspective and practices in manufacturing. The paper emphasizes special efforts in recruiting females and Latinos into manufacturing, which involve several activities such as industry-sponsored workshops, robotic competition for girl teams, and mentoring program. At the end, the paper describes challenges of student recruitment along with some continuous improvement strategies that the Engineering and Technologies Department at SDCC plans ahead.

Current Status of Manufacturing Industry and Workforce

According to the 2005 Skills Gap Report, over 80% of the 800 surveyed American manufacturers experience a shortage of qualified workers overall, which in turn impacts the companies' ability to serve customers. See Figure 1 below.

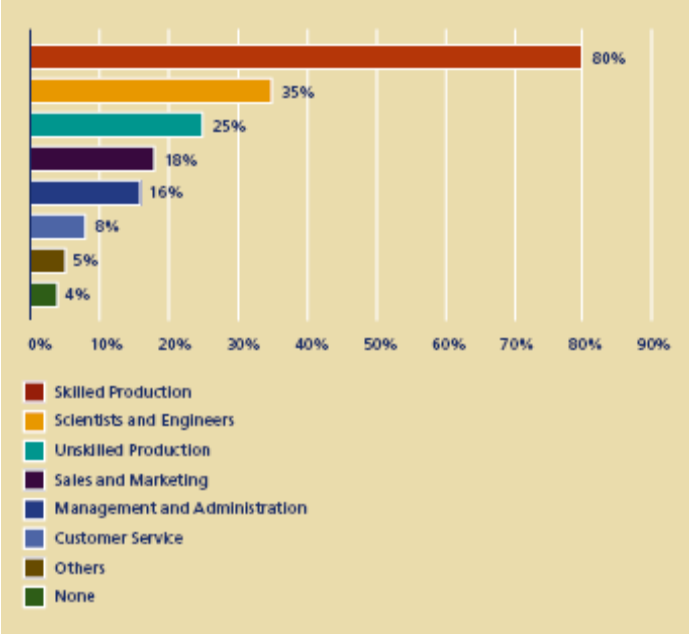

Figure 1. 2005 Skills Gap Report survey question:
What types of employees are expected to be in short supply over the next three years? (1)

These surveyed companies also indicated that the "most important driver of future business success" is a "high-performance workforce." Companies emphasized that in order to be "ahead of the pack", the workforce needs to be not only "high-performing, innovative, but lean." Survey results appear in Figure 2 below.

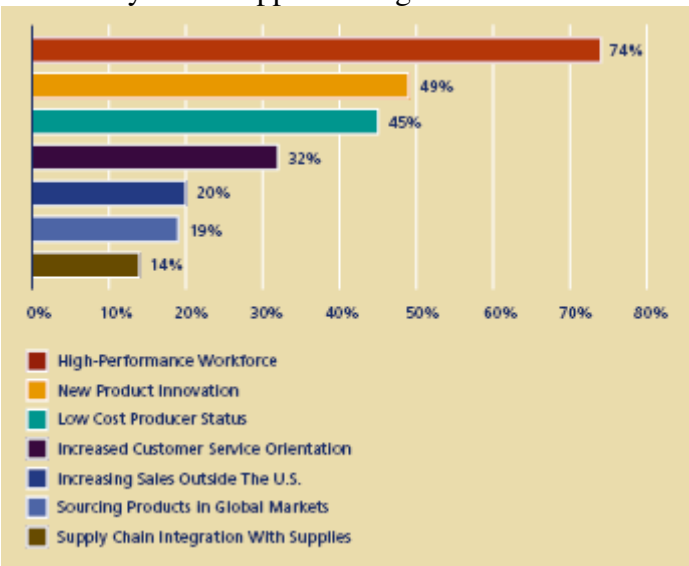

Figure 2. 2005 Skills Gap Report survey question:
Given changes in the economy and business environment, which of the following will be most important to your company's future business success over the next three years? (1)

The current shortage of skilled workers, as discussed in an article published in USA Today in December 2006, are consequences of several factors. The article stated that one of the major reasons is that "manufacturing in the USA is becoming more high-tech and

skill-based as the more repetitive, less-skilled work is moving abroad" [(2)]. Because the new manufacturing sector has become "more specialized with a greater focus on technology," workers are required to be trained with special technical expertise and work skills. This labor gap is projected to grow to over 15 million workers in 14 years as the Baby Boomers with years of experience retire [(3)]. In addition, younger folks are bypassing factory jobs, viewing them as "repetitive, dirty and without much opportunity [(2)]. Moreover, the headlines about manufacturing jobs moving to India, Mexico, or China have stopped high school graduates pursue a manufacturing career.

Manufacturing Engineering Technology Program at San Diego City College

San Diego City College (SDCC) has been partnering with different organizations in the State of California to increase the quantity and quality of manufacturing engineers and engineering technicians available to the workforce. In November 2004, the Engineering and Technologies Department at SDCC teamed up with local industries to create an advanced Manufacturing Engineering Technology (MFET) program that provides students the opportunity to acquire highly valued skills in an innovative, hands-on learning environment. The new MFET program replaces the old MAFG (Manufacturing Technology) program that was terminal and no longer meets current industry standards. MFET program was first launched in September 2006 at the College, and is the only one across San Diego and Imperial Counties.

The new MFET program not only meets industry standards but also is transferable to 4-year colleges/universities. The program uses an innovative approach where faculty from different departments, including math, English, science, engineering and technology, work together to build curriculum and employ training pedagogies that work for the student population and improve students' employability after graduation. MFET program features cutting-edge technologies and modern practices such as rapid prototyping, computer integrated manufacturing, latest programmable logic control technology, lean manufacturing and quality control techniques. STEM (Science, Technology, Engineering and Math) skills are incorporated throughout the curriculum to improve students' employability skills and prepare them properly for the highly competitive economic world. The program uses project-based approach, integrating experiences through which students participate in all aspects of a manufacturing enterprise, from materials and processes to safety, design, automation, quality and lean manufacturing. Armed with these skills, MFET graduates can pursue rewarding, growth-oriented careers in such diverse industries as plastics, automotive, biomedical, electronics, aerospace, machining and other high-value manufacturing sectors.

Issues with Student Enrollment

Like many other community colleges across the nation, San Diego City College faced many challenges in student enrollment. SDCC is a Hispanic-serving institution where our student population is made up of 31% (Fall 2006 data) Latinos, whose course completion rate fell below 60%. SDCC average annual enrollment is just below 15,000 students.

Specific to the old MAFG courses (a total of three courses – Print Reading, Processes, and Materials, run independently before the new MFET program started in Fall 06), SDCC had an average of 28 students as total enrollment per semester between Fall 03 and Fall 05, with an average of 3 female students per semester. See Table 1 for more details on student enrollment and performance statistics:

Table 1. Student enrollment and performance statistics for Manufacturing, 2003-2005

		N					SUCCESS						
GENDER	ETHNICITY	Fall 03	Spr g 04	Fall 04	Spr g 05	Fall 05	Fall 03	Spring 04	Fall 04	Spring 05	Fall 05	Total N	Total SUCCESS
Female	Latino	1	1	1	--	--	100%	0.0%	100%	--	--	3	67%
	White	3	7	1	--	--	100%	66.7%	0%	--	--	11	70%
	Decline	1	--	--	--	--	100%	--	--	--	--	1	100%
Female Total		**5**	**8**	**2**	**0**	**0**	**100%**	**57.1%**	**50.0%**			**15**	**71%**
Male	African-American	4	4	2	1	3	100%	100%	0%	--	--	14	88%
	Asian-Pacific	1	3	3	10	2	100%	100%	66.7%	100%	100%	19	90%
	Latino	1	16	2	3	12	100%	91.7%	0%	0%	43%	34	65%
	White	5	11	8	9	3	75%	87.5%	85.7%	80%	50%	36	81%
	Other	--	--	--	--	6	--	--	--	--	60%	6	60%
	Decline	7	4	--	2	5	100%	100%	--	50%	25%	18	77%
Male Total		**18**	**38**	**15**	**25**	**31**	**94%**	**93.1%**	**61.5%**	**70.0%**	**50.0%**	**127**	**76%**
MAFG Total		**23**	**46**	**17**	**25**	**31**	**95.5%**	**86.1%**	**60.0%**	**70.0%**	**50.0%**	**142**	**76%**

Due to low student enrollment, the program received little instructional support and recognition from the institution and college faculty. With tremendous departmental effort, the faculty developed the new MFET program to replace the obsolete MAFG courses, sought outside funding support for equipment, materials and supplies purchases and building laboratory. Program structure had been established; however, it was not known by the public. Since the MFET program is new and due to lack of integration between the counseling and Engineering and Technologies departments, many SDCC counselors were not even aware that the new MFET program existed. As a result, students were not given full options of career choices and were misguided in some cases.

Student Recruitment Strategies

Recognizing the problems and challenges faced by the Manufacturing program, the Engineering and Technologies department consulted with the school Dean and other experts on student recruitment strategies. The faculty decided to target three different student populations: current workforce, incumbent workers, and current high school students with special emphasis on females and Latinos. Aggressive recruitment started Spring 2006 and has continued to the current day, led by the Engineering and

Technologies department at SDCC. Our recruitment efforts have been carried out employing the following strategies:

1. Use of local media
2. Partnerships with local industries
3. College events
4. High school outreach

Each of the recruitment strategies is discussed in details in the following sections:

1. **Use of local media**: The Engineering and Technologies department first worked with SDCC Communications Officer and generated a press release for the media on MFET program. This press release was posted on the school web site in summer 2006. This summary article was sent to three different local newspapers and magazines advertising the new program. Two publications contacted the department and published their own articles about our new MFET program. Following these first publications, the college newspaper, the San Diego Community College District newsletter and The Diversity Works! Magazine by Urban League had interviewed faculty and published their own articles later in Fall 2006. In early December 2006, USA Today published an article about current shortage of skilled workers which negatively impacts manufacturing industries [(2)]. This article fell in line with SDCC's new MFET program which was built to address the current skilled worker shortage. Local KPBS news station in San Diego picked up on this alignment and contacted the department to talk about the new Manufacturing program. The segment was aired on both radio and television and caught the attention of many news listeners and viewers.

2. **Partnerships with local industries**: The MFET program at SDCC has been receiving strong support from local industries. The MFET Advisory Board members played an integral part in the development of this advanced manufacturing program. Curriculum is based on program competencies and program outcomes established and approved by key executives, managers and engineers from local manufacturing firms. SDCC MFET industry advisory board consists of executives, managers and engineers from Goodrich Aerostructures, Delta Design, Kyocera, Sony, Jabil Circuit, Northrop Grumman, Raytheon, Remec, Nokia, Solar Turbines, NASSCO, GKN Chem-Tronics and Johnson Matthey. The board has been assisting the Engineering and Technologies Department with program advertisement at their own companies. For example, Goodrich Aerostructures and GKN Chem-Tronics have published articles about MFET program in their company's internal newsletters, explaining how MFET program can help improve knowledge and skills of the current workers. As a result of industry support, almost 50% of our students enrolled in the program are current engineers and technicians at many of the companies represented in our industry advisory board. As the program grows the Engineering and Technologies Department expects to increase student enrollment drawing from the current workforce. To accomplish this goal the department lead faculty will visit different company sites and discuss with employees the career and academic options of the

MFET program. The department will kick off this effort starting Spring 2007. These industry visits will not only advertise the program, but also strengthen relationships with local industry.

3. **College events**: As mentioned above, MFET program was not very well known and advertised within San Diego City College. The Engineering and Technologies Department started the internal recruitment effort through SDCC Counseling office. The department held a one-day orientation for the college counselors, taking them through different labs and classroom areas, introducing various curricula and degree/certificate programs. In addition, the faulty also developed program help sheets and flyers to better assist counselors with student guidance. In addition to working with the college Counseling office, lead MFET faculty has been working to organize and conduct several on-campus events to promote students' interest in engineering and technology fields, especially manufacturing. For example, the School of Math, Engineering & Technologies, joint with the Center for Applied Competitive Technologies (CACT) had held two career fairs in 2006, once during National Engineers Week and another in Fall semester. Fifteen to twenty local companies from different engineering and technology fields had participated in these fairs, showcasing company's products and processes. Along with industry, the Manufacturing program had a booth at these fairs advertising the program and demonstrating use of the rapid prototyping machine. Fair visitors are usually college students, faculty, staff, and high school students. By actively participating in these fairs, the department is able to increase MFET program awareness among not only students, faculty, staff, but also local industries. Another on-campus activity that we have conducted involves summer technology workshops. Each summer the Engineering and Technologies Department holds a four-day technology workshop for Price Scholars who are sponsored by the Sole Price Scholarship Foundation. Price Scholars are either high school students or college freshmen. For past summers, one day was reserved for Manufacturing workshop in which students learned about manufacturing academic and career options through hands-on activities and team work. Starting summer 2007, the department will place more emphasis on manufacturing and extend the program workshop to three days. In this workshop, students will learn about the manufacturing career options, explore the academic program at the college, and interact with engineers and/or technicians who are currently working in the field. Students will have the opportunity to work in teams to build a certain product to meet customer's requirements. At the end of the workshop, students will be taken on a field trip to a local manufacturer where they will experience the actual working environment, witness the greatest and latest technology and learn about different manufacturing practices. Moreover, students attending this summer workshop will receive one college credit that is transferable to California State Universities and can be used towards manufacturing major at the college. The department and the Price Scholarship program believe that by conducting the workshop this way, students will not only learn more about career opportunities in manufacturing but also see first hand how manufacturing works in the real world.

4. **High school outreach**: Knowledge of modern manufacturing still has not quite reached the high school population, including teachers, counselors, students and parents. Manufacturing is still considered manual, hard-labor and boring work, even though the advancement of technology along with the new phase of world economy have transformed manufacturing into a high-skilled, challenging field. As a consequence of this misconception, no recent high school graduates have enrolled in the manufacturing program. Recognizing the situation, the Engineering and Technologies Department has implemented several outreach strategies to high schools focusing on teachers, counselors, students and parents. For example, each semester we participated in an open house event hosting two to four different high schools at one time, talking to them about the MFET program, showing them the laboratory, and running some equipment demonstrations. Other outreach activities include holding an open-house event for high school teachers, counselors and parents once a year in Spring, conducting semi-annual, technical seminars for both high school and college faculty on a cutting-edge manufacturing-related topic. With the current state funding support, the Engineering and Technologies Department developed seven project-based manufacturing modules (one to one-and-a-half unit per each module) for implementation at high schools in several school districts. Faculty structure the modules to be taught in conjunction with Project-Lead-The-Way (PLTW) courses currently instructed at these schools. Moreover, these manufacturing modules, along with some PLTW courses, articulate to the current MFET courses that are part of the Associate Degree and Certificate requirements at the college. With this joint effort, high school students can jump start career preparation, become familiar with the work environment and can interact with engineers and technicians in industry. Also, by taking classes while in high school, they will experience a smoother transition into SDCC's MFET program and shorten the time toward college graduation. Several high schools will be first to implement the modules in Fall 2007.

Recruiting Strategies for Special Populations

SDCC Engineering and Technologies department's goal is to increase student enrollment in general, but with special emphasis on recruiting female and Latino students. The department has established relationship with several high schools in Sweetwater Union School District which extends to the California-Mexico border. The student population is mostly Latino. SDCC faculty started working with these students by introducing them to rapid prototyping which initiates their manufacturing skills while studying engineering design. Faculty will also start implementing the manufacturing modules mentioned above at these schools Fall 2007. With the current state funding support, SDCC faculty also plan to provide theses students with industry summer internships, job shadowing and field trips to local manufacturers starting Summer 2007.

The Women In Engineering Technology (WIET) Board was formed at SDCC in early 2006 with the vision to increase the enrollment and retention of women in the

Engineering Technology curriculum at the college, leading to job placement in the local industrial community. This board consists of community college and university faculty, administrators, industry representatives, active engineers and technicians from various companies in two local counties. The Manufacturing program, with its lead faculty being an active WIET member, has joined with the WIET to sponsor and conduct several activities to promote women's interests in the manufacturing field. For example, during SDCC career fair at 2006 National Engineers Week, the WIET board conducted special workshops for female students in which students interacted directly with engineers and technicians from industry to share experience and seek career guidance. The faculty will also offer mentorship to these students to help them with academic and career preparation. In Spring 2007, the department will be holding the first robotics competition for female students under MFET program grant funding. Ten teams of combined community college and high school students will build robots and compete for college scholarship prizes. The scholarships are fully sponsored by different companies and foundations; mentors and judges are volunteer engineers and technicians from local industries. Though 2007 is the first year for this event, the Engineering and Technologies department plans to continue the effort in the future with support from the WIET Board and local industries.

Implementation Results

With the new MFET program launching in Fall 2006 at SDCC and recruitment effort starting Spring 2006, student enrollment increased significantly for Fall 2006 semester in all of the MFET classes with a total of 84% increase from Fall 2005. Almost 50% of our students enrolled in the program are current engineers and technicians at many of the companies represented in our manufacturing industry advisory board. Although this data shows evidence of our effective industry partnership, other program advertisement venues has also contributed significantly to the increase in enrollment.

Fall 2006 data shows that students enrolled in MFET program include 32% Latinos and 21% females. Several factors have led to these results: recruitment by WIET industry members at their own sites; female faculty presence in MFET program; recruitment effort targeted industries with highly populated Latino workers. In addition to increased student enrollment, we also recruited new industry partners and improved program awareness in the general public, including faculty and staff in different community college districts throughout California.

Although these results are preliminary, they indicate success of our initial effort. Based on feedbacks from our students and industry, the Engineering and Technologies department at SDCC constantly seeks for ways to improve recruitment strategies, increase student diversity and update the MFET program to keep up with technology and industry expectations.

Project Evaluation Plan

As students enter the program, they are surveyed with the information such as how

student first heard about the program and what student career interest is. After completing the first Introduction class, MFET 101, students are then asked again about their long-term career plan. As Fall 2006 data shows, student interest in manufacturing careers doubled after completing the Introduction to Manufacturing Engineering Technology class.

In the next step, the Engineering and Technologies department plans to develop pre- and post-surveys regarding engineering or technology career interests for student participants in workshops, field trips, job shadowing and other related events. Besides, student enrollment and student equity data will be collected, analyzed and kept in records every year over the next five years to evaluate the impact of current recruitment efforts and to be used as basis for determination of new strategies.

Conclusions

In summary, the paper discusses several recruitment strategies that have been implemented at San Diego City College to increase student enrollment in the Manufacturing Engineering Technology program since Spring 2006. The MFET program, featuring innovative curriculum and cutting-edge technology, was created and launched in Fall 2006 to address the shortage of highly-skilled workers in manufacturing industry. With initial efforts focusing on media advertisement, industry partnership and college events, MFET program has been able to attract a diverse student population from local areas. Student enrollment in the Manufacturing program was increased by 84% in Fall 2006 compared to the previous year. Student population in the program consists of 21% females and 32% Latinos. SDCC Engineering and Technologies department is currently working with high schools to develop a 2+2+2 manufacturing educational model for the state of California. With this K-12 outreach effort, the department hopes to change the perception of the new generation on modern manufacturing careers and create some interests in the field among the youngsters. Although the initial results were promising, the recruitment effort should be a continuous improvement project. Student enrollment and equity data statistics are kept in records for each semester, and recruitment strategies are continuously revised and improved. In addition, the Engineering and Technologies Department at SDCC continues to 1) seek more industry partners to support the program and the students, 2) seek funding support for ongoing on-campus events and competitions, and 3) keep the college administrators, faculty and staff up-to-date on the program scope and progress. This project is currently supported and joint efforts with several other organizations including the Center for Applied Competitive Technologies, Women In Engineering Technology and Project-Lead-The-Way groups. Moreover, with strong industry support and highly enthusiastic MFET faculty, we believe that the MFET program at SDCC will grow stronger and broader in scope along with our student population for the years to come.

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