Silicon Valley's Processing Needs Versus San Jose State University's Manufacturing Systems Processing Component: Implications for Industrial Technology

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Background and Rationale

Manufacturing professionals within universities tend to view manufacturing systems from a global perspective. This perspective tends to assume that manufacturing processes are employed equally in every manufacturing enterprise, irrespective of the geography and the needs of the people in those diverse regions. But in reality local and societal needs influence the manufacturing processes employed by a region's manufacturers. To design better and more useful curricula that meet local needs, manufacturing systems professors and administrators need to understand the nature and magnitude of this issue.

Material processing is a major component of manufacturing systems (Seymour, 1995). All manufacturing programs emphasize material processing as a major component of their curricula. However, manufacturing processing needs in one geographical locality are often different from the needs in others. For example, while manufacturing companies in the midwestern and western United States may share commonalties in some processes, the differing needs of the two populations can result in companies of one locality emphasizing one or more processes more than the other, and vice versa. When such a situation exists, it is the responsibility of manufacturing educators and administrators to determine what changes are needed in their curricula to reflect local needs and what the local industry is doing. In other words, manufacturing processes employed by companies in a location are reflections of what manufacturing students in that location need to learn. This is important because most of their graduates get employed by companies located in that region. Addressing these regional differences in manufacturing process utilization constitutes the rationale for this study

To investigate how this applies to the manufacturing systems curriculum at San Jose State University (SJSU), a case study was undertaken in the spring of 2002. The results are contained in this article, which examines the processing needs of manufacturers in the Silicon Valley of Northern California and compares the findings with the contents of SJSU's manufacturing systems program.

Procedure

This study was undertaken in two phases. The first phase determined which manufacturing processes generated more activities in the Silicon Valley of Northern California, as evidenced by the frequency of their use in the commercial advertising by the region's job shop manufacturers. An underlying assumption was that the frequency of use in a major advertising publication was an indication of the need and popularity of a process. To accomplish this, a special group of manufacturers was selected as the main population. This group included all the commercial and professional job shop manufacturers who participated in the 2001 and 2002 Job Shop Shows at the Santa Clara Convention Center. This annual, three-day business-oriented event is billed by its sponsors as the Southwest's largest contract manufacturing event ever. It attracts hundreds of manufacturing-related companies each year. These companies advertised numerous manufacturing processes as services that they provided, ranging from rubber forming to stamping and machining. The companies, together with their services, are published in the Job Shop Technology magazine, a quarterly publication serving manufacturers in the Silicon Valley (Short, 2001, 2002). These advertised processes were identified, sorted, and collated to determine their frequencies to help identify the advertised manufacturing processes that generated more or less activities among the job shops in the Silicon Valley region.

A total of 42 processes, together with their respective frequency scores for 2001 and 2002, were so identified. They included: brazing (4, 4); chemical etching (1, 3); coating (3, 4); deep drawing (3, 3); die casting (8, 9); die cutting (1, 4); EDM (7, 11); electroforming (2, 3); electron beam welding (1, 1); extrusion (12, 10); finishing (3, 8); grinding (3, 5); heat treating (2, 3); hydroforming (2, 1); injection molding (7, 13); investment casting (3, 1); laser cutting/drilling (5, 9); laser etching (2, 1); laser marking (4, 5); laser welding (2, 3); machining (42, 44); mold design (6, 1); molding (0, 2); perforating (1, 1); photochemical machining (3, 9); plating (4, 6); powder coating (2, 2); punching (1, 2); roll forming (0, 1); rubber molding (9, 8); sand casting (0, 1); sheet metal fabrication (6, 3); sheet metal forming (1, 5); springs (10, 11); stamping (18, 22); thermoforming (2, 2); thread rolling (0, 1); tooling design/fabrication (2, 5); tube bending (1, 1); water jet cutting (3, 3); welding (2, 9); and wire forming (9, 5). Processes that received a score of 5 or higher were given more attention in this study

The second phase of the study determined the degree to which SJSU's related manufacturing systems processing courses addressed these advertised processes. The premise here is that whatever is practiced by the manufacturing companies (which is an indication of what the society needs) is, to some degree, a reflection of what should be taught (Obi, 1991). To accomplish this, SJSU's manufacturing systems' key material processing courses were identified. They included: Tech 20 (Computer-Aided Design); Tech 046 (Introduction to Machining Processes); Tech 103 (Industrial Materials); Tech 104 (Manufacturing: Planning and Processes); Tech 142 (Product Prototyping and Manufacturing); Tech 143 (Polymers and Composites Fabrication Technology); and Tech 144 (Computer-Aided Manufacturing). The courses were then matched with their related processes according to their respective contents. This helps in visualizing processes that received coverage and those that did not, a picture that would help professors and administrators to make appropriate corrections if need be.

Findings and Discussions

The study revealed several observations: (a) one process received too much coverage, (b) some processes were covered adequately, (c) some processes received too little coverage, (d) some processes were not covered at all in the program, and (e) some processes were not advertised but were taught in the program. These processes and comments essentially constitute the findings from this study and are discussed in the following paragraphs.

It is encouraging to note that only one process (sand casting) appeared to be receiving too much coverage in the manufacturing systems concentration at SJSU. Perhaps this was because manufacturers now increasingly employ other casting processes. In fact, some casting processes such as die casting and shell mold casting have actually gained more popularity and use in recent years than other more traditional techniques such as sand casting. Fortunately, only one course (Tech 142) has a significant sand casting content. Perhaps, SJSU's manufacturing systems professors should switch to an alternative casting process to reflect current trends and help address this problem. If this happens to be the case, then consideration must be given to such factors as cost of die casting equipment, ease of maintenance, space availability, and so forth.

It was also encouraging that the study indicated adequate coverage of 25 (or about 60%) of the 42 processes advertised, including brazing, chemical etching, coating, deep drawing, die cutting, EDM, electron beam welding, finishing, grinding, heat treating, injection molding, investment casting, laser welding, machining, mold design, molding, perforating, punching, roll forming, sheet metal fabrication, sheet metal forming, thread rolling, tooling design/fabrication, water jet cutting, and welding. However, students received significant practical experience performing grinding, injection molding, machining, sheet metal fabrication, and tooling design/fabrication in courses containing those processes. But lectures, videos, and field trip activities alone provided enough learning experience for students in courses containing processes that received low advertising frequencies, since they are not considered to be high-demand processes.

On the other hand, the study indicated that eight processes received little coverage in SJSU's manufacturing systems program: die casting, extrusion, laser cutting/drilling, photochemical machining, plating, rubber molding, stamping, and wire forming. Little coverage here means that these processes are covered only in classroom lectures, which does not match the high frequency scores received by the processes. Although the lectures often include videos and field trips, the actual performance of the process by students (a critical component of technology education) is missing. The absence of this applied component in a manufacturing systems program renders its graduates ill prepared to perform effectively when they enter the workforce. These graduates are expected to supervise working people and processes. A good familiarity with the processes that they will supervise will help equip them with the critical knowledge and skill needed in today's industrial environment.

Correcting this problem could require significant investment in equipment, space, and training, something SJSU's administrators are not willing to do because of their limited budget. But this is a problem that SJSU's manufacturing professors have to deal with in order to help meet those challenges and improve their manufacturing systems program. Therefore, some creative approach may have to be employed to address the problem. One possible idea is to help students complete their internships in companies where those processes are performed so they can learn those skills. Another idea may be to recommend that manufacturing systems students take courses containing those processes in a junior college and then transfer them to SJSU.

Of the eight processes that received no coverage at all in the program, namely, electroforming, hydroforming, perforating, plating, powder coating, spring forming, tube bending, and wire forming, only plating, spring forming, and wire forming are of major concern to the program because the rest did not receive as high scores as these three did. The processes that received lower scores can be included in lectures. But to implement plating, spring forming, and wire forming will again require significant investment in equipment, space, and training. Therefore, a possible solution here will be the industrial internship and junior college credit transfer ideas already discussed above.

The case of missing processes is the last observation to be mentioned here. These are processes that were not advertised by the participating companies but are taught in the program. Slush casting and open die forging, for example, were not advertised by the companies but are discussed in lectures at SJSU's manufacturing systems program. Such a situation may be due to a number of reasons, such as the case with a government contractor on specialized processes, a small business that cannot afford to participate in the show, a business whose process may not be needed locally, or simply a business that usually gets enough customers and does not care or want to participate in the job shop show. SJSU's professors and others in such a situation should use their judgment in configuring their curriculum to match companies' needs, especially if those same companies are also area employers.

It should also be mentioned that the view taken in this study represents only manufacturing-related entities that *actually* advertised their services in the job show. One should not interpret this group to represent all manufacturing companies in the Silicon Valley. Therefore, any major decisions made by SJSU's manufacturing systems professors and administrators from the results of this study should be made after other factors are considered. Such factors might include the robustness of the program, currency of the curriculum, enrollment trends in the program, and the general opinions about the program content as expressed by stakeholders such as students, parents, industry personnel, and other educators, especially community college instructors.

Implications for Manufacturing and Industrial Technology Programs

This case study was an attempt to determine the processing needs of Silicon Valley's manufacturers and compare them with the manufacturing systems processing component at SJSU. It also shows how the findings could be employed to reconfigure the curriculum to reflect local needs.

As has been demonstrated in the foregoing discussions, this kind of study helps educators and administrators to visualize the content matter of their programs more precisely and then determine whether they are meeting their intended goals and objectives. In other words, it acts as a tune-up whenever educators are in doubt about what they should be teaching. It also acts as a check and balance for a program. Since curriculum development is the core function of education, ensuring that essential and appropriate materials are covered in a program is critically important if manufacturing systems graduates are to be competently knowledgeable when they enter the workforce. This practice more directly affects the students and graduates of the region where the programs are located. Designing program content to reflect the industrial tasks of the area will certainly be a plus for the graduates and the manufacturing organizations that hire them when they graduate.

Also, this practice essentially makes the programs more functional in the communities that they serve. Students in such programs will more easily relate to the manufacturing jobs advertised in their locality when they see one. And program educators and job providers will tend to be working together toward a common goal, since they can now see their commonality more easily. The result is that the manufacturing programs in the region will be more robust and the graduates more educated.

Finally, this study is recommended for all manufacturing programs, not only to help visualize how different localities and economies influence the manufacturing processes of their respective locations but also to ensure that the needs of students and employers in such regions are being met. It potentially can result in stronger manufacturing systems programs that will be in business for many years to come.

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References

Obi, S. C. (1991). Manufacturing for quality: Implications for industrial technology. *Journal of Industrial Technology, 7*(4), 18-21.

Seymour, R. D. (1995). Manufacturing technology education. In *Foundations of technology education: 1995* (44th CTTE yearbook). Glencoe, NY: Council on Technology Teacher Education.

Short, M. (Ed.). (2001, October). Outsourcing solutions for product manufacturers. *Job Shop Technology* (Western ed.), *16*(4), 1-103.

Short, M. (Ed.). (2002, January). Outsourcing solutions for product manufacturers. *Job Shop Technology* (Western Ed.), *17*(1), 1-87.