Essential issues related to the purchase of automated machinery that play a vital role in providing real world (industrial) applications to students

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Abstract

Colleges and Universities purchasing automated equipment particularly CNC machinery and robotics have the choice of either purchasing smaller machineries made specifically for educational applications or buying small to medium size industrial machines. The decision to go either way not only effects what type of machinery is purchased but also influences a wide array of other issues such as, the relevancy of the CNC programming language presented by the machine compared with what is being used in industry, topics that can be included in the curriculum, maintenance problems related to the upkeep of the machine, cost factors compared to the technology purchased, etc.

This article evaluates the advantages and disadvantages of selecting either kind of equipment by comparing features and capabilities, cost, limitations and capabilities of these machines in material processing and operations. Other issues such as resale value and cost of maintenance will be discussed providing current data and information useful to the institutions deciding to upgrade or purchase new equipment.

I. Introduction

Advancement in the field of manufacturing is so rapid that major machine makers and manufacturers have a hard time competing with the technological breakthroughs. Among the most notable technological advances on machine controls are pc-based controls/fusing technologies, machining simulation, CAD/CAM capabilities, on-line maintenance, and diagnostics. These are the results of the global customer's need for better and increasingly more customized equipment, in an era in which customizing is not cost-efficient. According to Teruyuki Yamazaki, president of Yamazaki Mazak, at EMO (The international machine tool show held in Paris) different industries have different priorities. Some automotive manufacturers want to go faster, small manufacturers want to be more flexible, whereas aerospace industry wants to hog out parts at a faster pace[3].

As educators we may not need the large table travel that some of the industrial machines provide but we need to be able to teach the technical know-how of modern manufacturing methods available on the market today[2]. Additionally, "learning the latest technologies in machine tool operation requires hands-on training one can only get by actually using today's modern machines[5]."

Today, institutions spearheading the effort to provide the latest and best training and education to their students are reaping the reward by high graduate success rates and by being nationally recognized by prominent national organizations. Pennsylvania State University (Penn State) is one of these institutions that has been awarded the (LEAD) award for excellence in the Application and Development of Integrated Manufacturing[1]. Penn state has constructed a new 10,210 square feet facility called "Factory for Advanced Manufacturing Education (FAME), a state-of-the-art laboratory that represents all the elements of a real manufacturing facility. The goal of the lab is to provide the hands-on experience needed for students to work in an advanced integrated facility. One of the innovative teaching aides used at the facility is a portable multimedia-broadcasting cart that allows an instructor to lead a class session using video camera from the CNC machine. Using this method students verbally interact with the instructor while viewing the details of operations taking place at the machine[5].

II. Maintenance and Support

Considering the maintenance and support provided by the industrial size CNC machine builders, it is obvious that one of the areas these companies take pride in, is providing the best support in the shortest amount of time. If the machine purchased has the capability of online diagnostics and maintenance, it can eliminate the need to modify class curricula during the semester when the CNC machine goes down. Many of these companies have twenty-four hour customer support lines where clients can receive technical assistance or focused training for different operations such as, programming, preventive, electrical, or mechanical maintenance. These companies also strive for better diagnostics and shorter repair time in order to reduce machine downtime. Among other services, on-site classes are offered for greater flexibility and to accommodate unique needs for custom programming and operation sessions. Based on Cincinnati Plus[2] machine tools these support services results in:

- Increasing efficiency and machine availability
- Increased productivity
- Increased retention of class material via hands on experience
- Lower total cost of ownership[8]

II. Cost Factor

Looking at this issue economically, there are smaller size machines (semi-industrial) on the market that present some of the advanced technological features mentioned above at an affordable price. Institutions can save on different fronts, purchasing such machines. First, these machines are priced based on a world wide competitive market. Second, savings are gained on maintenance, upkeep and upgrade of the equipment. Third, the resale of older equipment is also beneficial.

IV. Advantages and disadvantages of selecting semi-industrial size equipment versus machineries manufactured for education use

There are different advantages associated with using small size industrial equipment. Some of the features provided by advanced control technologies are:

- Programming capabilities – advanced programming methods allow programmers to take advantage of the cutting edge technologies, write accurate and efficient programs, and use the machine to it's full potential capabilities.
- Power, speed, accuracy and resolution – According to Jean-Paul Bugaud the machines of tomorrow will be more productive than today's machines[3.] To be more productive machine makers are packing extra axis and more power, feed, and spindle speeds into the machines.
- PC-based control fusion technologies – Advanced features of CNC control systems is coupled with the increasing capabilities of PC technology. This has resulted in a real-time feedback from machine to the control resulting in much better accuracy, repeatability, and tolerances.[7]
- Machining simulation, and CAD/CAM capabilities – Modern controls are capable of simulating tool-paths, generate CAD models, and create 3D solid models transferable to CAM packages for the generation of NC codes. These capabilities are similar to what is available on stand alone PCs.
- On-line maintenance and diagnostics – although remote diagnostics and maintenance have been used by machine-tool makers for a number of years, recent Internet connections have created new venues in performing these tasks better plus the availability of live sound, vision, and instructions right on the control direct from the factory, has enhanced the ease of communication and trouble shooting to an unprecedented level never experienced before. Controls are now being monitored for routine maintenance or diagnostics using either "high-speed and standard telephone dial-up connections or an Internet-based approach". Using either method has pros and cons of speed and security associated with it. "But either route gives today's manufacturers unprecedented access to their machines from anywhere in the world around the clock[5]."
- Networking and interfacing capabilities – PC-based controls allow networking using Internet. Networking via Internet provides the advantages of remote control and a worldwide integration necessary when parts are designed across the world and manufactured in many other locations where a company has setup plants for production. This has also allowed the machine control to become an integral part of the manufacturing operation by sharing data to help setup schedules for operation time, tool feasibility studies, setup of shipping schedules, and collection of data related to the overall machine uptime[6].

The increasing willingness of the CNC machine builders to form joint industrial-educational cooperation presents another advantage in buying semi-industrial machines. In this kind of ventures, the machine manufacturer supplies the institution one or more CNC machines at a reduced educational cost. For details about this type of joint cooperation refer to the www.cncmagazien.com home page.

Some of the disadvantages in acquiring semi-industrial machines are:

- The added expenses of operational costs such as utilities, and coolant usage
- Lack of lab space available in some institutions
- Lack of solid foundation for installing heavier equipment
- Lack of proper electrical voltage level, compressed air, or proper ventilation systems

V. Conclusion

The need for qualified graduates from manufacturing programs is echoed through the professional journals and commentaries written by manufacturers. As a nation we cannot stay competitive if there are not talented engineers or technologists to run the sophisticated machineries available on the market. With the rapid advances in the field of automated equipment, especially CNC controlled machinery, institutions have to be selective in their attempt to purchase or acquire suitable equipment. The type of equipment selected in turn dictates to some extent the qualification level of the students graduating from these institutions. Gordon Skatton, Director of the Rock Valley College Technology Division, notes that, "Today, companies look for fast-track, state-of-the-market education and training[9]." Tangible benefits are being shown as the result of joint cooperation between some institutions of higher education and industry.

It is obvious that compact educational machines don't provide the type of experience and know-how that industrial machineries provide. For a long time, educators were convinced to buy specially manufactured machineries for education with the perceptions that they cost less and pose fewer hazards to the unskilled students using them. Today, Semi-industrial size machines manufactured by major machine builders present far more advantages than educational machineries. Industrial machines are more reliable, more cost effective-in the long run and provide the bells and whistles needed to train qualified graduates. These machines also provide advanced programming, interfacing, precision and accuracies needed for today's manufacturing. These advantages plus the willingness of some of these machine builders to form special joint ventures with universities and colleges, make the selection of industrial machineries, over machines manufactured only for educational use, an issue to give in-depth consideration.

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