MANUFACTURING EDUCATION - THE INDUSTRY INTERFACE

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ABSTRACT

This paper highlights the need for teaching manufacturing technology in a practice oriented environment. It draws attention to some of the changes that have taken place and presents some ideas for future implementation. These include changes of teaching style and methodology, a programme of industrial visits, application of CAD-CAM technology and implementation of a 'teaching factory' concept.

INTRODUCTION

Manufacturing processes involving metals are considered as 'base industries' in any country and are often a measure of economic stability and growth. The teaching/training of students in Manufacturing Technology and related topics therefore occupies a key position in a mechanical engineering curriculum. With the developments in materials technology, rapid changes and advances in processing techniques have taken place resulting in a proliferation of processes. In view of this, the teaching of Manufacturing Technology within a general mechanical engineering curriculum needs careful identification of breadth and depth of topics.

The practice of teaching workshop technology with hands-on experience on conventional machines in a first year engineering curriculum may no longer be possible, or necessary considering the rapid technological advances made in the manufacturing sector. Even if one considers this as the correct approach, in an era of high-tech applications, the students are likely to be de-motivated by such a scheme. However a basic understanding and appraisal of the principal manufacturing processes executed in the conventional style is very important and this is best communicated to the student through well formulated workshop demonstration sessions and visual methods such as video clips.

Laboratory scale manufacturing equipment is expensive and therefore industry type state-of-the-art teaching laboratories are not common even in the industrialized countries. The larger companies have their own in-house sophisticated R & D facilities and major research work is carried out in these laboratories, in collaboration with universities. In Sri Lanka there are very limited such opportunities for students to be trained. However, on a more positive note, there are several companies of relatively recent origin, particularly in the BOI sector, which practice state-of-the-art technology.

INDUSTRIAL VISITS BUILT-IN TO THE TEACHING PROGRAMME

A well coordinated and intelligently executed programme of industrial visits is one mechanism through which the students will come to appreciate the vital nature of manufacturing engineering as an area that is exciting and challenging. No manufacturing teaching programme will be successful unless the industry interface is vividly shown to the student. These industry sessions normally commence with an in-house introductory presentation by the company officials and following the visit to factory, end with a discussion session where views are exchanged and problems clarified.

There are many benefits that can be achieved through such a programme. The teaching faculty must essentially accompany the students on such visits to add value to the programme even from the students' point of view. Apart from this, the teaching faculty and the industry will mutually benefit from the interaction. Periodic visits (not just one-off) will establish a working relationship between university and industry. Not only students but technical staff of a department at all levels should also be exposed to industry environment through these visits. Some other benefits would be identification of good industrial training places and employment opportunities, orientation of the students towards a future career, identification of research projects and areas for collaboration and above all, developing mutual trust.

From the student learning and assessment point-of-view, following a visit the students are guided to read about the technical and broader aspects of the processes they witnessed and the style of examination questions changed to reflect real-world problems and practical aspects. In order to support this approach, there are a few state-of-the-art core teaching texts which give a balanced coverage of fundamentals and real-world practices (eg. Ref. 1). This approach is proving to be successful and the student response towards industrial visits has been very positive. The opportunity to see their predecessors, often the past alumni, performing successfully in industry has motivated the students.

APPLICATION OF CAD-CAM TECHNOLOGY

The 1990^s saw an increasing use of and awareness in CNC technology in the local manufacturing industry. Computer graphics is widely used but complete CAD-CAM systems are in place only in a very limited number of manufacturing organizations. This decade will see accelerated application of CNC technology and CAD-CAM implementation in industry. The required higher level manpower inputs necessary will have to come from the universities and not the apprentice training institutions. The latter level inputs are currently being sought and appreciated by many local industries using these technologies only because their immediate needs are in the production function and not in technology implementation. This situation is often mis-represented and mis-quoted as the requirement of the industry.

Manufacturing Engineering activity certainly would necessarily be the next stage of development.

Beginning with computer graphics, through computer-aided design and culminating with CNC programming and manufacturing, the CAD-CAM route provides an alternative solution to conventional Engineering Drawing and Workshop Practice oriented teaching. Whilst most of the learning will be computer-based, it is essential that the students gain hands-on experience in CNC machining and on other advanced manufacturing machinery available. The engineer needs this practical feel and confidence, which cannot be achieved through computer simulation.

THE TEACHING FACTORY CONCEPT ?

The teaching factory concept widely practiced by institutions such as those coming under the Economic Development Board (EDB) of Singapore (Ref. 2), embody the principle of training students through project work with industry. These are mainly apprentice level training institutions, but the concept could perhaps be extended to the universities in a completely modified form. Structured like a company and staffed with a multi-disciplinary team of full-time project engineers and designers, these institutions provide a platform for both staff and students to work on real-life projects.

Engineering Design Centres

Here a parallel could be drawn with the Engineering Design Centre (EDC) concept (Ref. 3) recently promoted in local engineering faculties and research institutions. The EDCs have a somewhat similar objective, but for design implementation there are no clear avenues. Can facilities like the CAD/CAM Centre in the author's department serve as a manufacturing arm of the EDC ? Only in limited circumstances. Let's suppose the center has extended manufacturing facilities such as several CNC machining centers, CNC lathes, EDM die-sinking and wire-cut machines. – Who will man these? Certainly the undergraduates cannot be expected to perform this role as their training is at a different level.

Trainee Apprentices as Effective Manpower

A university CAD-CAM Centre with extended facilities could be a good training ground for apprentices from Apprentice Training Institutes (ATIs) who can be used on industry projects after an initial training phase. The design inputs will come primarily from EDC staff and undergraduates and the manufacturing will be performed mainly by apprentices under the guidance of a few senior technical staff. This way both groups of students will benefit although the training objectives and training levels are completely different. Such an in-house manufacturing center with live activity will provide the required factory atmosphere.

An ultimate example of University – Industry collaboration may be found at the University of Warwick, UK. The Warwick Manufacturing Group, which includes Advanced Technology Centre and the International Manufacturing Centre, has a strong tradition of multi-disciplinary research

in close cooperation with industry. The concept has been to create a flexible environment where company staff and university staff can work together and share facilities.

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