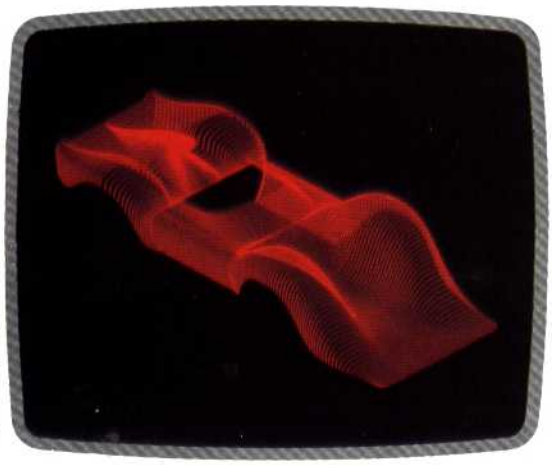
CAD/CAM

Computer aided design and *computer aided manufacturing* are both terms that are more commonly referred to by their initials, and are frequently considered together as a single concept. In this context, the word 'design' generally refers to engineering or functional design, rather than aesthetic design — though computers are now making inroads into that field as well.

There are three main advantages of using computers to aid in design. The first advantage concerns the whole area of graphical visualisation of the product being developed. Most CAD systems feature both a high resolution screen display and a full colour plotter for hard copy



COURTESY OF INTERGRAPH

print-outs. The software used by such a system is really the graphical equivalent of a word processor package, permitting parts of an image to be amended, deleted, moved around or called up from a disk library of standard components. The more advanced models, which 'think' in three dimensions, allow a design to be viewed from any direction or angle.

Secondly, a computer can perform all the tedious and time-consuming calculations required in the background, leaving the designer free to concentrate on the higher level decisions. Such calculations might include checking for clearance and stress, or evaluating the functions that define a curve used in the projected design.

The third benefit involves taking this a stage further — using the computer to find the optimum design within given constraints. This may be optimising for weight, size, strength or cost. In many cases there is no formula for the optimal solution, but the computer can perform trial and error calculations thousands of times faster than an engineer.

Computer aided manufacturing is a very broad term, arguably encompassing the whole field of robotics. There is now a general trend in industry away from fixed production lines towards flexible manufacturing systems (FMS), which can be easily re-programmed. This allows for the production of goods to be more closely related to sales. Another important aspect of CAM is CNC — *computer numerically controlled* machine tools. A single CNC machine can replace dozens of fixed-position drills on a production line.

C

CAI/CAL

The use of computers in education is a controversial subject, even among those who support their introduction into schools. The debate centres on whether computers are best employed as aids to either teaching or learning. This distinction is made clearer by considering the differences between CAI and CAL.

Computer aided instruction (CAI) can be defined as applying the computer to traditional methods of instruction. The computer is regarded as a combination of electronic textbook and electronic tutor. Typically, the student will work through a program on his or her own. The computer breaks down each lesson into modules, perhaps using graphics, animation or sound to make the material more interesting than it would be in a textbook or on a blackboard. At the end of each module, the computer tests the student using multiple-choice questions to find out how well the material has been understood. It allows each child to progress at his or her own pace, can backtrack when appropriate, and can keep a record of the child's progress for the teacher to study.

Proponents of *computer aided learning* (CAL), however, argue that for the first time the microcomputer allows us to place the emphasis on learning rather than on being taught, which may have been the only practical approach in the past owing to limited resources. CAL applications use the processing power of the microcomputer to create an environment in which the child can explore and learn — in much the same way as very young children learn about the world from playing with sand and water.

There can be little doubt that computer aided learning results in a better understanding on the part of the child, but it must be remembered that CAL applications require a great deal of imagination and considerably more sophisticated programming than their CAI counterparts.

CALL

CALL is a programming keyword that instructs the computer to invoke another routine. Your computer may not feature this word in its dictionary, but it will certainly have an equivalent command. GOSUB is a form of CALL, as are the commands: PROC, SYS and USR. Another common use of this keyword is to mean 'go into machine code from this point'. Effectively, the programmer is calling up another subroutine, but this one is written in machine code.

The term originates from the early days of programming, when most programs were assembled by stringing together subroutines from a large library of functions called a 'macro library'. When the CALL instruction was encountered, the computer literally had to 'call up' the lines of the appropriate subroutine from a disk file.