familiar green boards with metal stripes to link the electronic components.

Even the design of the board itself is subject to manufacturing cost constraints. It is possible to have multi-layer boards made, where several layers of metal are deposited with layers of insulation between them. However, this is expensive and is avoided by designers. Instead, a system of plated-through holes, in which holes for all wires are metal-plated inside to improve electrical contact, is always specified for computer boards because of the reliability this gives the finished product.

The power supplies, television modulators, connectors, keyboards and other components are bought in from all over the world, with cost being the main consideration. These parts then go to another sub-contractor, often overseas, for final assembly. Even the plastic case, which is made with expensive moulding machinery, comes in from yet another sub-contractor.

The final assembly of a computer can be done in two ways; either by highly automated means, or by a large number of cheap labourers doing the work by hand. The first option is generally the practice in the USA, Europe and Japan, while the second is common in Hong Kong, Singapore and Korea.

The automated assembly lines use robots to fit each component to the circuit boards. The robots are fed with bandoliers of components, ranging from capacitors to memory chips. All the operators need to do is to replace the bandoliers as they run out.

Whichever system is used, the boards are 'stuffed' with the appropriate chips and other components, with their leads protruding below the printed circuit board. The boards are then passed through a 'flow-soldering' machine that coats the protruding leads with solder. The solder is drawn up through the plated holes in the board and solidifies to give a reliable connection.

The completed boards are then tested, fitted into the cases, packed and shipped off to the warehouses for distribution, marketing and sale to the customers. This may sound simple, but every stage of the process has its own inherent problems.

SUPPLY LINES

The first problem is one of timing. All the components, from their various sources, must arrive in one place ready for assembly. The person responsible for this operation, the parts buyer, is one of the most vital links in the chain. He must have the ability to make a sharp business deal to