Visit to IBM Fujisawa Plant, Sept 9, 1991

Background

My hosts were Mr. Sawada from the Tokyo Research Lab, Mr. Tsunoda of Manufacturing Engineering, and Dr. Koda also from TRL. This visit was mostly a plant tour to see manufacture of hard disk drives (HDD) for PC's.

Product and Factory Design

A disk drive is designed by a team of about 30 designers. This total includes all support people, such as draftsmen, of whom there are few or none. Design is done at another plant in Yokohama about 10 miles away. The HDD assembly system is almost totally automatic, comprising many class 100 clean rooms, robots, conveyors, stacker cranes, and test equipment. IBM and its vendors took 9 months to design, build and install this large system. In the future, Mr Tsunoda notes, they must reduce the time to 6 months.

The decrease in time to produce the factory coincides with the faster pace of new product introductions. Only parallel development of product and processes will be capable of sustaining this development. This is Concurrent Engineering, according to Mr Tsunoda, who did most of the talking during this discussion and appeared not able to answer my questions easily.

A possible reason emerged later in discussions with younger engineers. I was shown a promotional videotape that first described IBM's software vision of CIM, then showed how it has been implemented at Fujisawa. The icon of this video is a set of three concentric rings. Each ring is segmented into activities: on the outside are the factory's activities (engineering, marketing, etc.), then inside are the common support elements like computers and displays, and on the innermost ring are the architectural elements like communication, databases, and presentation software.

Ths icon has been associated with IBM's CIM publicity for about 10 years and it gives the impression that if one has the right software one has CIM. The video confirms this by listing all the IBM products or VAR items that make up the system (CATIA, EDCS, VALISYS, COPICS, MRP, DB2, SNA,RIC, AS, QMF, SMART, AND AD/Cycle) omitting explanations of what they stand for.

It is clear however that behind the acronyms there are problems because in fact the communciation channels between people are not as open as they should be. HDD's are very hard to design, especially high performance ones (not shown to me). IBM is not the only company I know where the design is passed on to the manufacturing system people without their being able to comment on it, much less get a head start on their system design.

The method consists of product designers at one facility making the design, passing it on to another facility where process specs are designed, then to a third group at the second facility where the equipment is designed or specs are written, and finally giving vendors the specs for fabrication and installation of the equipment. For example, no IBM robots are among the 10 used for HDD assembly, test, or material handling.

This method is very much in the American style. This style prevents the typical Japanese method of bottom-up automation from occurring. The technology belongs to the vendors. Each department is a specialist. "We Japanese learn by trying, not by buying. The Japanese maker's treasure is his factory." "So IBM Japan is an American company with Japanese employees?" "Yes."

Plant Tour

This is a truly integrated factory for HDD assembly. (Procuring and installing it in 9 months was clearly quite an achievement.) Incoming parts are stocked in an automated warehouse in boxes or bins. They are called out by the assembly equipment as the need arises. This is called "Auto Pull Mode," an automated version of the Kanban system. Parts are first sent by automatic conveyor to a cleaning machine which presently soaks them in a swirling Freon bath. This bath will soon be replaced by one that uses just water. Then they travel by conveyor to the assembly area.

The mechanical portion of the product consists of about 16 parts plus 4 vibration isolators and 5 screws. Unidirectional assembly is used. A line of 10 robots builds it up, starting from a kit of parts (base-motor-spindle, head package, set of platter spacers) manually loaded into the pallet. The robots take the platters from a feeder magazine, where they sit upright, and put them gently on the drive spindle, then insert a spacer, then another platter, and so on. Finally a cap and screws are installed. Each drive then gets servo marks written and a 10 minute test. It it passes this test, an elastic seal gasket and the lid are installed using more screws, and the drive is leak tested. If it passes, it leaves the clean room for more electrical tests, addition of the logic board, still more tests, and finally packaging. Some of the equipment in this second line, especially the screw feeding and installing parts, seemed very elaborate and complex. The tour was so rushed that I could not ask about any of the details.

Only a few of these steps requires human intervention. One of these is the place where TRL's force-controlled robot is supposed to plug the test connector into the drive. A second feeder robot was broken so the whole station is down. This robot uses a low insertion force connector invented by IBM. It reduces the insertion force by about half by recessing half the contacts part way in the insertion direction. Half the males and females mate early in the insertion process while the other half mate later. The insertion force history therefore has two small peaks rather than one large one.