Criterion Manufacturing

W.F. Buster Vice President Computer and Communication Systems
Criterion Presentation to the Financial Community Rancho Bernardo, California. May 1976

The Data Processing Division facility which you will visit today was completed in 1968. From the outset, it was designed specifically for the manufacture of general purpose data processing systems and subsystems. It was apparent at that time that material handling and control was going to be a major factor in being able to produce systems at the most optimum cost. Actually, the material content of our products have progressed to the point now where it represents 75 percent of the total cost and direct labour, not counting burden, represents only about 5 percent of the total cost. With this relationship in mind, we spent most of our effort in managing the material part of the business, where we would be able to obtain the greatest impact on reducing the total product cost. This will be apparent when you visit our facility later this afternoon.

The material handling building is highly automated, from the receiving dock through receiving inspection, storage location identification and put away. The material is moved and controlled by a series of automated conveyors and staging positions. The actual storage is divided into two areas, a relatively low density bulk storage area and an extremely high density automatic storage and retrieval system. The automatic storage and retrieval system (ASRS) is fully computer controlled and is operated from information which is transmitted by magnetic tape from the main inventory control system.

Individual components which are required for the scheduled daily production of the subassemblies are collected in shop order form. The shop orders have been previously identified by our manufacturing information system, which takes into account the final end unit schedule and the indentures of all the subassemblies required to produce the product at the required rate.

Over 7,000 part types are stored in the ASRS. During a typical day, about 1,000 line items will be picked and put into shop order form - all automatically. This operation averages about 100 line items per hour. Only sixteen people are required to run this system, where prior to the time it was installed we required 45 people for the same level of activity.

The inventory is divided into "A", "B" and "C" categories, where the "A" category, which represents 80 percent of the total inventory dollars, contains only 20 percent of the total part types. By exercising very detailed and close control on "A" type inventory, we have

been able to achieve four turns of the "A" inventory each year. This, in itself, represents a significant cost savings. When you consider that it costs approximately 30 percent of the value of inventory to control and maintain it during each year that it is on the premises, it becomes obvious that a reasonable investment and expense in obtaining a very high turn's ratio has a fast payoff rate and results in lower overall product costs. A great deal of our management effort has been spent in this area.

We have also optimized the material flow through the factory. All of the printed circuit boards have been designed on a standard grid. This allows us to automatically insert all the major components including dual in-line packages which contain integrated circuits and axial lead components which are the passive elements such as resistors and capacitors.

After assembly and inspection, the boards are subjected to a comprehensive test. They are actually exercised as they would be exercised in a performing system, and the faults are identified at the board level, which can be repaired early in the production cycle.

After the systems have been assembled, more than 95 percent of the total errors in manufacturing and faults with components have been identified and corrected, and the remaining small percentage of problems are relatively easy to identify and correct in the unit and systems test area. This process reduces the total time required to manufacture the system and verify its operation.

The Criterion is very different from the Century systems. It uses a new circuit family, ECL, which has an operation speed of about two nanoseconds. It is constructed on 11" x 14" printed circuit boards, compared to the Century 300 which was manufactured using 4" square boards. Also, the logic complexity of the circuit elements is significantly higher than those used in the Century products.

For example, the average Century integrated circuit had approximately 30 logic elements per circuit, and the Criterion has circuits with as high as 5 ,000 elements per package. This allows us to produce physically small systems which have phenomenal logic complexity and capability. The Century 300 had about 2,000 logic boards, or printed circuit boards, and the Criterion has less than 50. The total number of integrated circuits in the Century 300 was 13,000, where there are about 5,000 in the Criterion.

A startling comparison is one of just physical size. There are seven relatively large cabinets in the Century 300 with 512,000 bytes of memory. In the Criterion, we can house a million bytes of memory, along with the processor and several controllers, all in the same small cabinet.

In order to provide you with an understanding of just what the Criterion is, what its systems architecture is, and the general design objectives established for the system, Tom Elrod, who is the Director of Engineering, Data Processing Division, will describe the Criterion in some detail.