INDUSTRIAL DATA PROCESSING APPLICATIONS REPORT

Applications	Engineering Drawings Control and Reference
Type of Industry	Electronics Manufacturer
Name of User	Marconi Co. Chelmsford, England

Equipment Used	Xerox Reprography Equipment Closed-Circuit Television Tape Recorders

Synopsis

Batch, rather than mass production of specialized electronic goods predominates at Marconi Co., Chelmsford, England. This influences the company's approach to engineering drawings requirements as design modifications may well occur between manufacture of two batches of the same item. To ensure that the latest drawings are always on hand and available from one central source, Marconi has installed a centralized microfilm system in its drafting section for filing and reproducing engineering documents. The system, based on Xerox reprography units permits a three-hour service of prints from half-a-million drawings on file, meeting an average demand of about 5,000 copies a day.

System procedures begin at the drafting board where the draftsman uses a standard range of paper, pens, pencils and free-flowing ink to ensure compatibility of linework filming density. Completed drawings are microfilmed and mounted on aperture cards in several copies. One copy goes to the main reference library, another provides a master from which prints are produced. Additional copies are distributed to other factories, and where applicable, to companies abroad.

Simple information on any drawing can be obtained by a telephone call to the company reference library. There, the proper card is inserted into the viewer by a librarian who answers the inquiry. In addition, at Marconi's Basildon factory, shop personnel can view production drawings at one of five closed circuit television monitors on the plant floor. They are linked to a master station in the print room. The camera is equipped with remote zoom lens control to permit magnification of drawing sections for closer scrutiny.

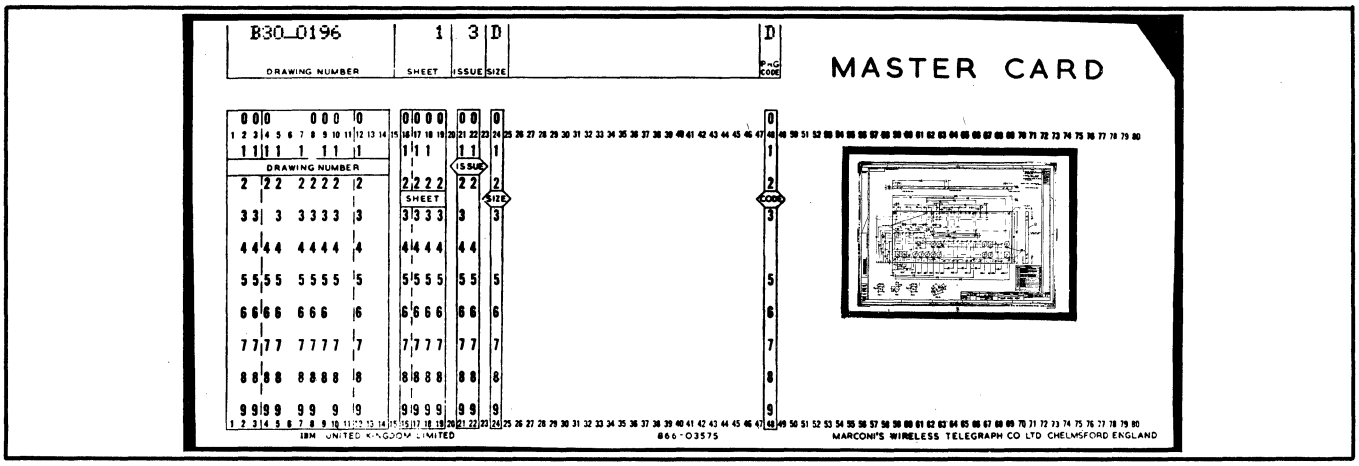
To catch up with the backlog of old drawings to be microfilmed, Marconi uses tape recorders to list identifying details. The operator then works directly from the tape.

While microfilm is still one of the most efficient and economical means of storing records ever conceived, it is fast emerging from its passive role in the storage vault to an active role in business and industrial communications and data processing systems. This trend is examplified by the widespread use of microfilmed engineering records made by the Marconi Co., Chelmsford, England. In addition to microfilm, which it routinely employs for its business procedures, Marconi Co. uses telephones, closed circuit television and tape recorders also, to aid information retrieval and recording of engineering drawings.

The Marconi Microfilm System

One of Europe's best-known names in electronics, Marconi manufactures an extensive range of products. Since batch production of specialized items predominates, rather than mass production, the company's overall approach to engineering drawing requirements has naturally been influenced. Between the manufacture of one batch and the next of the same item there may well have been design modifications, so it is always important that the latest drawing always be on hand, preferably at one central source.

In the early 1960's, Marconi first installed a centralized microfilm system in its drafting department for filing and reporducing engineering documents. Since then, the company has organized a three-hour service of prints from the half-million drawings on file, meeting an average demand of 5,000 copies per day.



MICROFILM ENGINEERING DOCUMENTS provide information for all Marconi production departments.

Through this centralized scheme, simple information on any drawing can be obtained by a telephone call to the company reference library, where one of the staff inserts the relevant cards in a viewer and answers the inquiry. At Marconi's Basildon factory in Essex, personnel on the shop floor can view production drawings at one of five closed circuit television monitors, located at key points in the building. The monitors are linked to the master station in the print room, where the drawing is placed under a camera equipped with remote zoom lens control. This allows sections of the drawings to be magnified for closer scrutiny. To catch up with the backlog of old drawings to be microfilmed, Marconi uses a tape recorder to list identifying details. The operator then works directly from the tape.

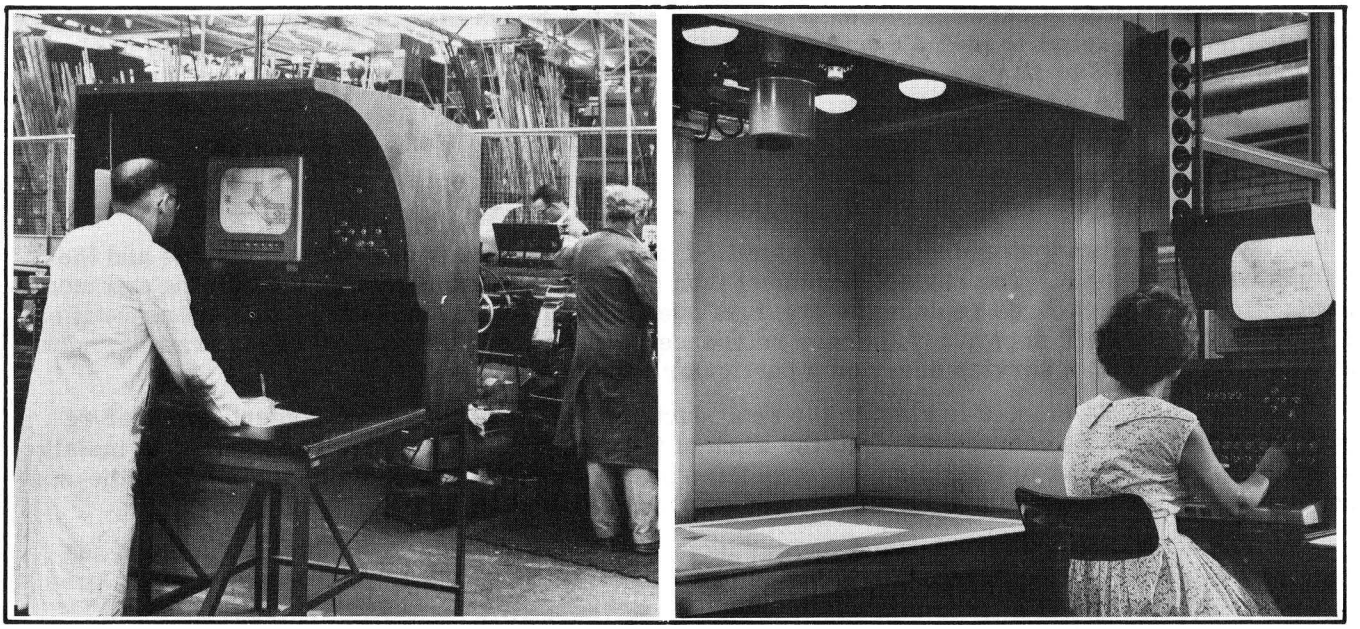
The basic structure of the Marconi system is a simple one. Drawings are photographed on 35mm film and mounted on standard aperture cards. From this point, every drawing is used only in its microfilmed version; the original is put into safe storage and brought out only for modification and subsequent refilming. Original drawings are destroyed after a five-year "change hazard" period.

Procedures

When plans were made to centralize reproduction, so as to provide efficient service to Chelmsford and its other centers, the company was anxious to avoid the inflexibility which sometimes result from centralization. A well-organized system of drafting room procedures, adoption of unitized cards, facilities for reference viewing and a simple print ordering routine all were designed to help avoid this danger. Cards are filed centrally so that copy prints can be produced quickly, with duplicate sets at each factory for reference and local printout.

Several microfilm copies are made of each drawing. One copy goes into the main viewing reference library, and another into the printing section as a master from which prints are produced. Additional copies are distributed to other factories to update their files and, where applicable, to companies abroad.

In order to ensure compatibility of filming desnity between pen and pencil linework, a standard range of paper, pens, pencils and free-flowing ink is used by all of the drafting staff. In addition, drawing boards are covered with linoleum, which gives them a hard surface. In this way possible indentation of the paper by pencil pressure (which would affect line density) is avoided.



CLOSED-CIRCUIT TELEVISION MASTER STATION (at left) provides visual production drawing information to shop personnel at plant floor CLOSED-CIRCUIT TELEVISION MONITORS (at right).

Working on 90-gram Gateway tracing paper, the draftsman uses a 2H pencil for linework and a fountain pen for figures and letters. On completion, any prints required immediately are made at that time on a local dyeline machine and the original is sent to the reporduction unit at Chelmsford. From that time onwards, no alterations are allowed without formal notification. This avoids the risk of out-of-date documents remaining in circulation.

While a drawing is filmed on the Lumoprint camera (the reduction rate depends on the size of the original), the required number of aperture cards are punched with the essential information as supplied by the draftsman. A record card for the drawing (without aperture) is also prepared, on which additional data can be punched for data processing purposes.

Each roll of 35mm microfilm takes about 540 exposures with fine resolution charts on the first and last frames. After processing, the roll is checked with a densitometer, and submitted to visual and chemical tests for archival quality. From start of filming to completion of drying takes about two and one-half hours.

After sets of cards have been checked on the verifier, the operator views the first frame of each roll, inserts the corresponding card in a semi-automatic 3M mounter and positions the microfilm in the aperture. On completion of each batch, the cards are separated into packs for their different destinations. As a timesaver for later filing, the cards are automatically sorted into numerical order for the main reference and printing files. The sorter has been modified to avoid "brushing" the mounted film."

To requisition prints, simple order forms are made out. These are manually sorted into numerical order and the cards are pulled accordingly from the printing file. The reference set is kept handy in the adjoining room for viewing.

The selected cards are programed into convenient batches, keeping together all print requirements of the same size, then subdivided into sets according to the number of copies required from each card. Batching is done quickly by means of a simple set of pigeon holes, coded along the top by the number of prints required and down the side by the printing paper width.

As each batch of cards is placed in the hopper of the Xerox Copyflo printer, paper "flags" are inserted between groups to indicate fresh instructions to the machine. In this way, a single day's work is handled in 8 to 10 runs at a constant speed of 20 feet per minute on rolls of ordinary unsensitized paper and is cut on-line.

The final stage in each requisition is to match the print with the corresponding request form for dispatch. Frequent delivery truck service exists between Marconi's various plants and the drafting rooms.

When an existing drawing must be modified, the original is withdrawn from the file and the alterations carried out. The revised document then goes through the normal microfilming and mounting routine. The new cards replace the previous ones in the printing and each of the reference files. The old cards are kept separately, in case reference must be made to the unmodified drawing, such as when dealing with a service query on a particular model.

A Xerox 1824 printed is used in the reproduction unit for fulfillment of urgent, or other requests which do not fit conveniently into the work of the larger Copyflo unit. It is planned to install additional printers next to the card reference files in the various drafting rooms to meet on-the-spot requirements. The central unit, however, will continue to handle bulk reproduction work.

The daily throughput of 1,100 drawings include new and modified drawings and some of the backlog. After the system was introduced, all new work was put on film. At the same time, a program was initiated to deal with earlier documents -- working backwards in time from the most recent. In this way, the bulk of the most recent active drawings were quickly absorbed into the system.

Results

Before installation of the present system, space was the most pressing problem in the Chelmsford drafting section. The file of active drawings occupied a large area and, in addition, extensive print files had to be maintained. Now, the complete active file, mounted on unitized cards, is contained in a compact bank of cabinets and the files have been eliminated. At the same time, a 25 percent reduction in cost, which amounts to a substantial figure on the present annual volume of one and a quarter million prints is being achieved. Other companies and associates in Canada, Australia and Italy also benefit when they exchange information with Marconi. The lightweight cards are easier to handle and are cheaper to mail than the bulky drawings.

Marconi has pioneered the application of this system in Great Britain. A great deal of the success of this application is attributed to meticulous planning and research. At the planning stage, the drafting section supervisor and chief of the O & M (Operations and Methods) visited the U.S.A. and studied systems operated by leading U.S. engineering firms. Systematic quality control and constant attention to improving and simplifying the operation have contributed to its success.