INDUSTRIAL DATA PROCESSING APPLICATIONS REPORT

Applications	Integrated Computer Control System
Type of Industry	Steel
Name of User	Park Gate Iron and Steel Ltd. Rotherham, England

Equipment Used	Three English Electric-Leo-Marconi KDN2 Computer Systems One English Electric-Leo-Marconi KDF6 Computer System Friden Flexowriter Creed Paper Tape Punches and Verifiers

Synopsis

Park Gate Iron and Steel Limited is presently operating with an integrated computer control system supplied by English Electric Company Limited. The system initially comprised three English Electric-Leo-Marconi KDN2 computer systems; the first for off-line production planning, the second for on-line coordination of production in the primary mill and the third for control of billet shearing to give improved yield.

In order to give extra capacity for the development of an integrated planning and accounting system, an English Electric-Leo-Marconi KDF6 computer has been added.

The coordination system has enabled the quarter-mile long primary mill to be controlled as a single production unit and has contributed significantly to a build up of production.

The integrated computer control system at Park Gate Iron and Steel in Rotherham, England, was supplied by English Electric Company Limited. The system automatically controls operations ranging from the receipt of incoming orders to the step-by-step setting of the primary mill.

The wide range of control is provided by three computers, each having specific fields of operation but all closely interconnected to provide coordinated control.

This development, started in 1961 by the Park Gate Iron and Steel Company, has doubled its manufacturing capacity by the introduction of new steelmaking facilities, a new primary mill and a narrow strip mill. These supplement the existing open hearth steel-making furnaces and various bar and section mills.

At an early stage of this development Park Gate decided that the new works should be designed to exploit the newest techniques of automation including the use of computers wherever it could be shown that these would provide real advantages to its operations. To implement this, Park Gate and English Electric participated in joint studies to investigate all areas in which automation might be applied and to make recommendations for suitable specific applications.

Following reports by study teams it was decided to install a three-computer system which would cover production planning from steelmaking to finishing mills, minute-by-minute production control through the primary mill area and fully automatic control of the bloom mill and billet shear.

THE SYSTEM

Production Planning

The production planning system is responsible for all off-line aspects of production control from the steelmaking plant to the finished steel dispatch. The system is designed around an English Electric-Leo-Marconi KDN2 computer. Data preparation equipment is also included in the system and consists of Creed Keyboard tape punches and verifiers and a Friden Flexowriter.

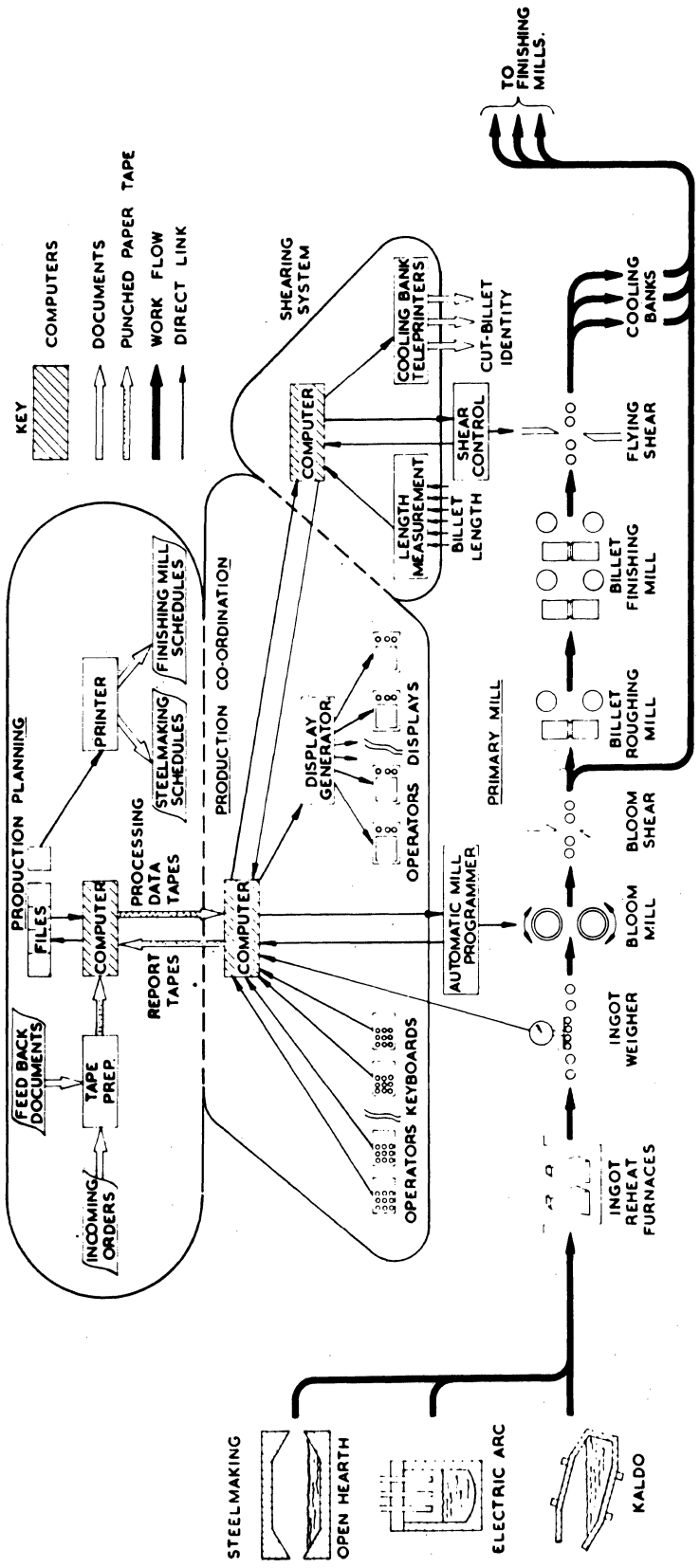
The main duties of the system are:

1. The grouping of incoming orders into suitable quantities for steelmaking while allowing for steel analysis, furnace availability, mill set-up requirements, delivery commitments and other factors.
2. The issuing of appropriate working schedules to the various production departments.
3. The control of the progress of individual order items to ensure that specifications and delivery requirements are met.

These are essentially off-line duties and the system is arranged so that all relevant data on orders and work in progress is held in files which are processed and updated in periodic computer runs. The English Electric-Leo-Marconi KDN2 computer used for production planning has 24,576 characters of memory. In addition, an English Electric KDF6 computer has been added. The production planning system also uses magnetic tape units, high-speed and low-speed paper tape readers and punches and a high-speed line printer.

Incoming orders are transcribed on punched paper tape, on keyboard punches and verifiers, and organized into production schedules taking into account steel analysis, dimensions and the dates required. Orders, stock lists, etc., are stored on magnetic tape files. The system output is either in the form of printed schedules and progress cards, produced by the line printer, or as punched paper tape for transfer to the production control computer.

Detailed instructions for the primary mill use ingot data which is available only a few hours before rolling and are therefore issued as "pit tapes" up to 12 times a day. These "pit tapes" are



INTEGRATED INFORMATION SYSTEM AT PARK GATE IRON AND STEEL LTD.

read into the production control computer and define all operations to be performed in the primary mill area.

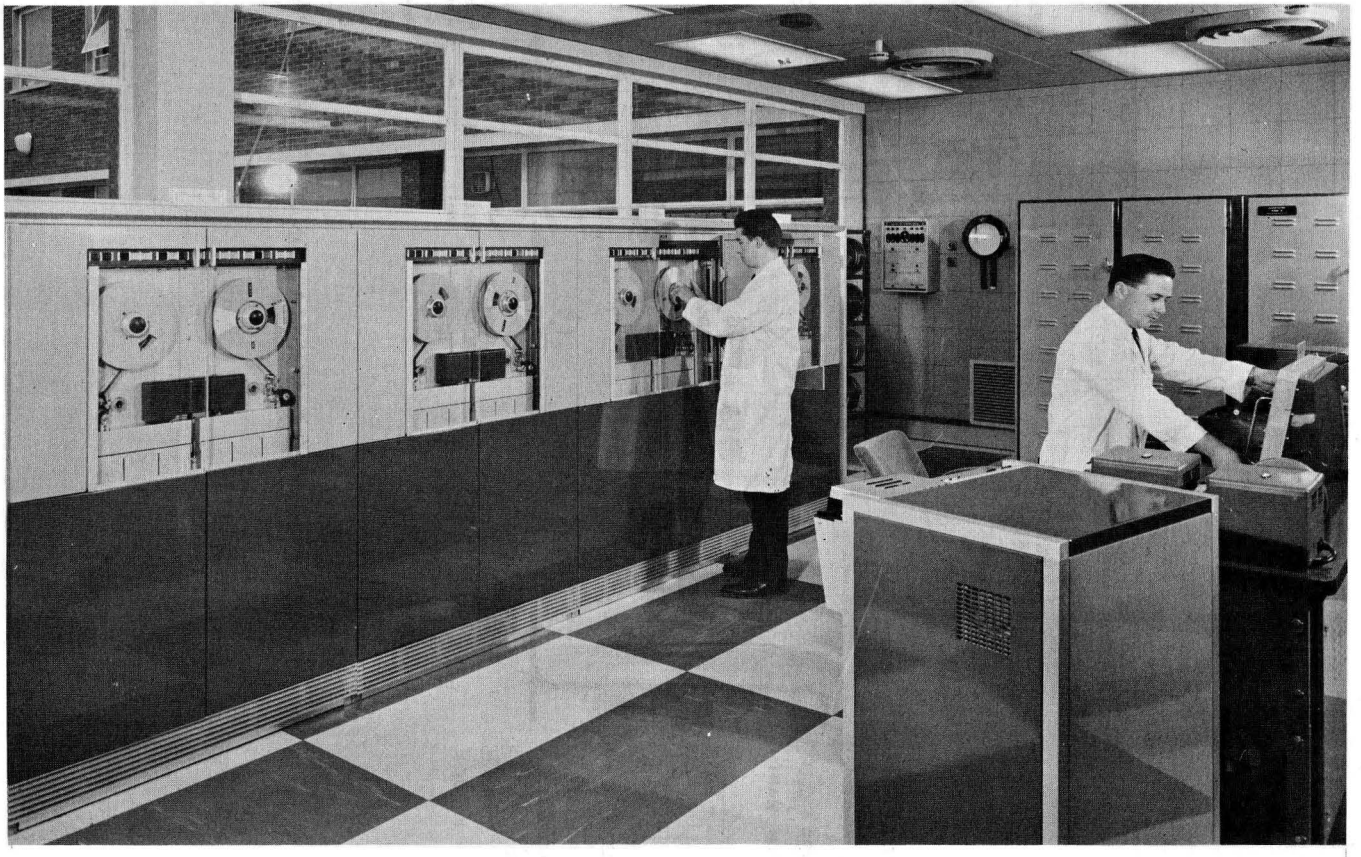
Production Control

The production control system is provided to implement the production plan in the primary mill area. A production controller works in conjunction with the computer to supervise operations.

The production controller supervises operation and attends to emergency or exceptional conditions while the computer automatically deals with routine situations, collects feedback data, controls a special memory tabular display equipment having a central character generator and ten cathode-ray tubes which display essential data, and issues working instructions. In this way the computer relieves the controller of time consuming routine duties leaving him free to concentrate on exceptional situations. It further helps by informing the controller of the up-to-the-minute detailed production situation and providing at his finger tips means to address the process operators.

Specifically, the computer accepts "pit tapes" produced by the planning system and identifies each ingot drawn from the reheating furnace with an order requirement. Where processes are operator controlled it displays working instructions on tabular displays; where processes are automatic it gives the necessary instructions to the appropriate process controls; e.g., bloom mill programer or shear computer. Finally, it collects feedback data on operations completed, weights of ingots and lengths of blooms cut, and uses this data to amend displays and to prepare a report tape for the planning system.

The computer used here is also an English Electric-Leo-Marconi KDN2. In this case the computer is arranged for on-line operation with a special purpose input/output unit as well as the



PRODUCTION PLANNING COMPUTER.
THE ORDER BOOK, STOCK LISTS, ETC., ARE STORED ON MAGNETIC TAPE FILES.

PRODUCTION CONTROL CENTER AT PARK GATE. THE OPERATOR CAN GIVE INSTRUCTIONS TO THE COMPUTER OR TALK TO MILL CREWS THROUGH MICROPHONE.

standard 1,000 and 20 character per second paper tape reader, 110 and 20 character per second paper tape punches, monitor, typewriter, etc.

The input/output unit is arranged in data gates, registers, etc., to enable the computer to interrogate the various keyboards and rotary switches at the operator's control stations and to exchange data with the shear computer and bloom mill programer.

A significant feature of the installation is the use of a tabular display to present working information to the operators. This display, developed by the Marconi Company Ltd., uses a special character generator linked to the computer to present data as messages written by an electron beam on a cathode-ray tube. This display is under direct control of the computer. Four displays show instructions to the bloom mill operators while an additional four show the billet mill instructions.

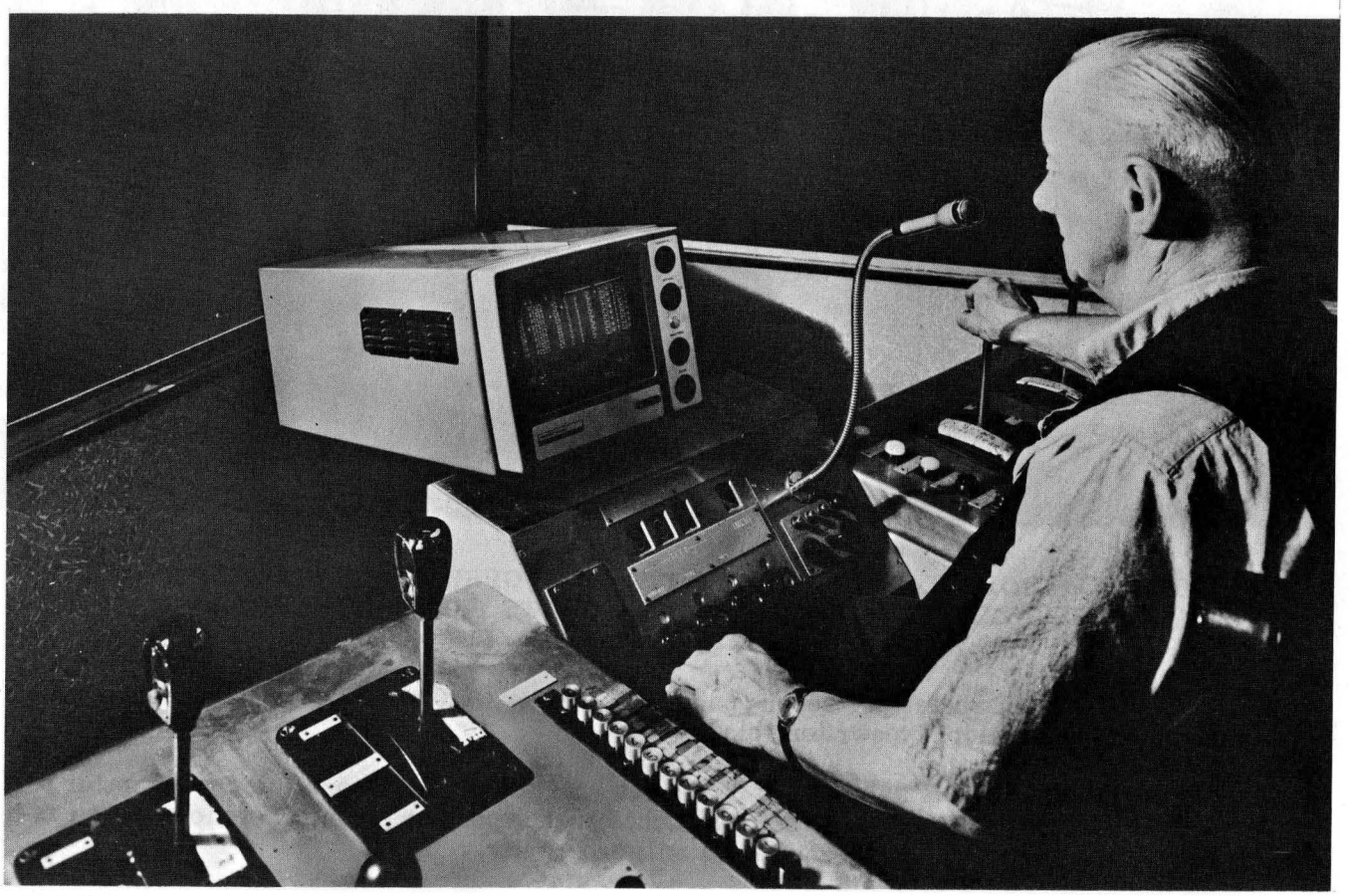
The production controller is also provided with a special console on which he has repeats of the bloom and billet mill tabular displays, a full set of audio communication equipment and a series of message keys and data input switches with which he is able to address the computer directly so that special messages may be relayed to the operators through the tabular display.

Bloom Mill Programer

While it is not strictly a computer, the bloom mill programer uses a number of computer techniques and is closely linked to the production control system.

In the bloom mill the cast ingots are rolled to bloom or slab section by a specific program of passes through the mill related to the product required. The automatic programer stores up to 100 of these programs, each capable of defining up to 25 passes through the mill. For each pass the roll separation, manipulator position, mill and table speeds are stored and these are applied to the appropriate drive controls as required.

Hot ingots are withdrawn as required from the ingot reheating furnaces and placed on to an ingot cart. An English Electric control system automatically positions the cart adjacent to the particular furnace being discharged and delivers the ingot to a weighing station under control of the system, and the ingot weight is recorded by the production control computer. The ingot is then transferred to the bloom mill on the in-going roller tables.

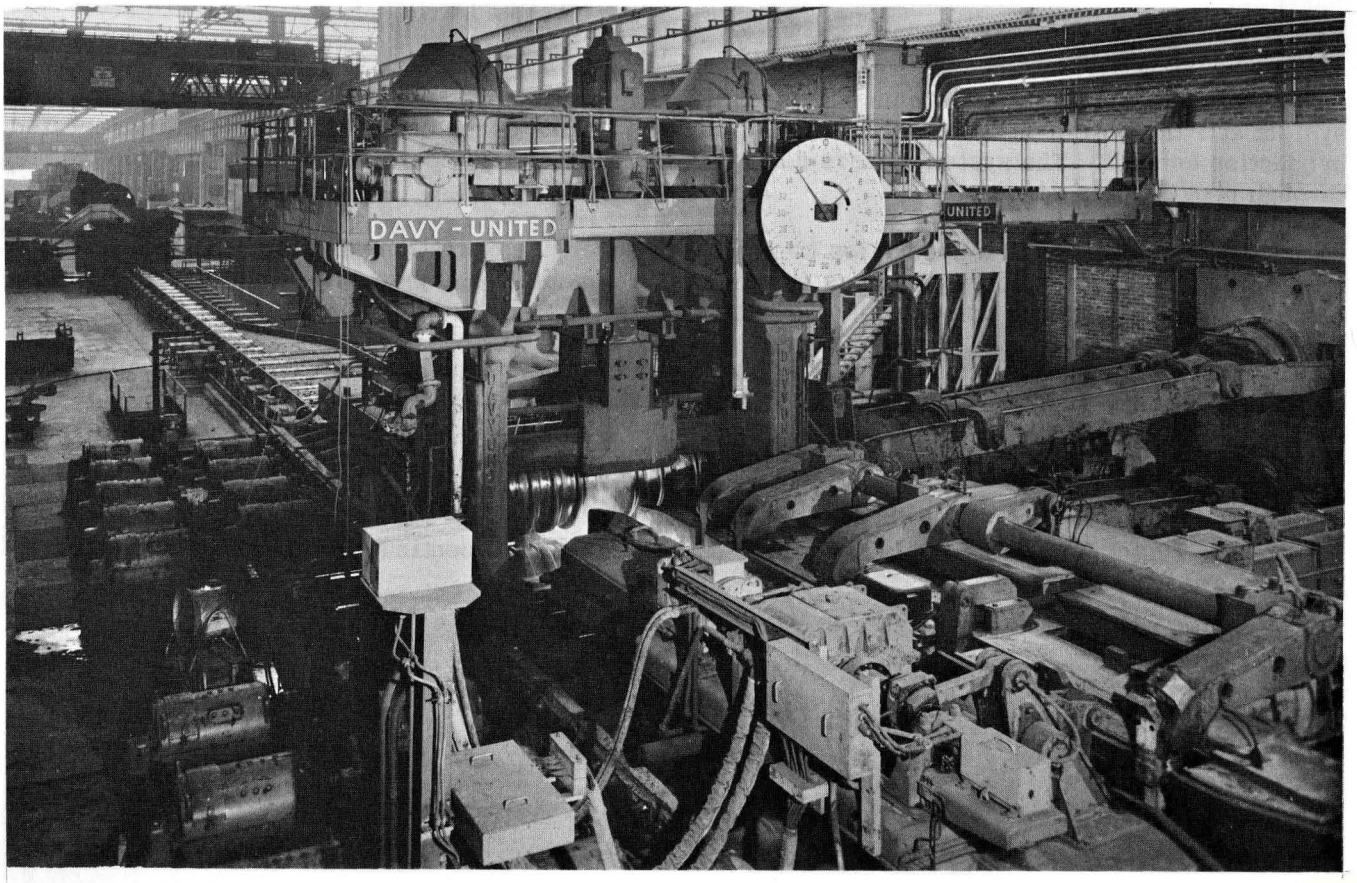


THE BLOOM SHEAR OPERATOR RECEIVES INSTRUCTIONS FROM A TABULAR DISPLAY SCREEN AND SETS SWITCHES TO REPORT HIS ACTIONS TO THE COMPUTER

The bloom mill programer uses ferrite cores for the main storage and solid state logic elements for the appropriate addressing and input/output circuits. These include a link to the production control computer for automatic program selection. In general, the bloom mill programer is a special purpose storage device with associated equipment.

The Billet Shearing System

The billet shear computer performs two important tasks. First, it reduces significantly the tail-end waste at the shear and secondly, it defines each group of billets on the cooling banks. It also completes the automatic chain which starts with the receipt of a customer's order and extends through production systems to the actual cutting of that order.



THE BLOOM MILL ROLLS RED-HOT FIVE TON INGOTS INTO BLOOMS OR SLABS

Normally, rolled billets have a random variation in length which can only be measured after they have been sheared. Billet users accept some tolerance in cut length and if the total rolled length can be predicted optimum lengths can be chosen which leave the minimum tail-end waste.

The computer system measures the length of the intermediate billet as it enters the finishing mill by means of special infra-red sensitive photocells. It next measures the elongation with a pulse counter in the mill as the front end leaves and uses these two measurements to calculate the total outgoing length. From this the cutting lengths that will leave minimum waste are calculated and transmitted to the shear control.

After cutting, each group of billets is directed on to one of the cooling banks. As soon as the bank is selected, the shearing computer causes a teleprinter adjacent to the appropriate bank to print out all data necessary to identify the group of billets.

The shearing computer is also an English Electric-Leo-Marconi KDN2. Like the production control system, it is arranged for on-line operation with a special purpose input/output unit and with 20 character per second tape readers and punches. Special features of the system include an array of infra-red sensitive photocells arranged for length measurement and specially protected teleprinters for billet identity print out.

A special two-way data link provides exchange of data between the production control and shearing computers. Order details and cutting requirements are passed to the shearing computer, which reports back to the production control. This link completes the automatic chain of control which starts with the receipt of a customer's order and extends through the production planning and control computers to the shearing system.

RESULTS AND FUTURE PLANS

While the individual systems provide benefits in their own areas, the greatest benefit of the system at Park Gate Iron and Steel has come from the linking of the computers to provide integrated production control. The system covers all aspects of Park Gate's operation from production planning through production control.

The system allows a production controller to supervise operations and attend to emergency situations while the computer performs routine tasks. In addition, up-to-the-minute production information is available for updating the planning system.

The coordinated system has proved invaluable in its key function of controlling the quarter-mile long primary mill. It has also contributed significantly to the build up of production.

The billet shear computer has paid for itself by reducing the amount of scrap at the billet shear.

The system at Park Gate is still being developed and will continue to evolve for a number of years in the future.