

For the second six months our average figures were:

Maintenance	22%
Available time	78%
Productive work	20%
Average serviceability	91%

The drop in the percentage of time on productive work was due to the improvements of the programs which we were able to make, when actually operating on large-scale data, from the experience gained during our first six months: in fact, in the second period, we were doing more work than in the first, which shows how misleading figures of this nature can be.

Our more recent figures show that maintenance has decreased to 20% and productive work is more than 30%, in some weeks being 40%.

#### **Future Plans**

I must mention some of the future plans we have in the accounting field. We are at the moment finalizing plans for sales and cost-of-sales analyses for two of our packaging companies, and the computer application devised for this will produce information which shows

the gross and net margins obtained by various products, analysed by areas and by the industries using our end-products. Allied to this, we shall be producing screened information drawing attention to any orders where our net margin falls outside a predetermined range. This, you will appreciate, will provide a good means for realistic profit control.

#### **Conclusion**

We realize that we are only just beginning to become familiar with some of the problems of electronic accounting, and we do not in any way claim to be expert yet. We do feel, however, that we have learnt quite a lot which we could not have learned without the computer. We do not, therefore, regret taking the plunge rather than waiting for the computer round the corner. We also feel that our future plans will enable our installation to start paying off in the not too distant future. We were prepared from the start for a two- or three-year build-up period and, generally speaking, I think things have gone as we anticipated, though we did not at first fully assess correctly the magnitude of the task we had undertaken.

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## **A Bank Adopts Automatic Data Processing**

*By R. Hindle*

**This paper, which was presented at the Second Conference of The British Computer Society on 7 July 1960, describes the plans of Martins Bank Limited to use a Pegasus II Computer for recording customer current accounts at a group of branches.**

#### **Inter-Bank Research**

The London Clearing Banks jointly have made considerable progress towards the development of a "self-posting" cheque—a cheque that can activate an electronic accounting system. Such a development would avoid the need for the services of the human beings who otherwise would have the task of interpreting the accounting data, carried by the cheques, into key strokes to activate the machine. This means that cheques (and other vouchers to be handled in the system) must carry the data (i.e. account identity, identity of bank and branch on which drawn, type of transaction and account) in a form of code that can be read automatically by the machine, and also that equipment capable of manipulating cheques, i.e. picking one off a pack, passing it through the reader and depositing it where required by the system, has to be developed. The end-product of this joint study by the banks is merely an input to an electronic system, and individual banks are left with the need to investigate how they might use such input facilities.

The tendency amongst banks in the U.S.A. is to wait until cheque-handling machines are available in their offices, before proceeding with an electronic system for the ordinary current-account function. Of course, studies have been proceeding, aimed at preparing plans for a system in anticipation of the automatic handling and reading devices. The problem in the U.S.A. is, however, somewhat different from that in Great Britain, and some banks in this country have realized the desirability of putting into operation a system with an alternative method of input, so that, in the first instance, systems problems can be solved before tackling the complications of automatic input. This line of approach is entirely compatible with the inter-bank research. Direct automatic input can later be substituted for the input medium chosen in the first instance, and indeed it is quite likely that, at least in the early days, the automatic reading equipment will be used off-line to produce the input medium that has been chosen previously for the earlier move into electronics.

### **One Bank's Approach**

One bank to follow this reasoning is Martins Bank, who were the first bank in the United Kingdom to demonstrate the work of one of its branches being handled by a computer, day to day, as it flowed into the office. As a result of this exercise, which was carried out on the machine in the Ferranti London Computer Centre, a Pegasus II, with magnetic tapes and high-speed paper-tape punch, has been ordered.

If automatic reading and handling of vouchers are not used, it follows that a human operator must read the entry data and convert them into machine input language. Three alternatives are presented. The entries can be keyed directly into the machine as an on-line operation, or punched cards can be set up and these fed to the machine, or the entries can be punched into paper tape. In all three cases the production of input can be a by-product of a keyboard operation producing a print on a paper record, as with an ordinary adding machine: the ability of such a machine to total and to analyse can be used, such functions being indicated on the printed record and fed into the computer via the chosen medium.

On-line operation is not very attractive. It is a wasteful way of operating a very expensive tool and there is nothing in the banking function to justify such a method. Punched cards are obviously very clumsy, compared with paper tape, and so some real benefit has to be demonstrated before they can be chosen. If the system with which the computer has to be integrated is already using punched cards, it is obviously an attractive idea to continue the use of cards, but in banking, with very few exceptions, this is not so. One benefit claimed for punched cards is that they can be sorted mechanically before being fed to the computer, but, when applied to the banking problem, this seems too much a case of keeping a dog and barking oneself. Martins Bank had insisted that any projected electronic system should be capable of sorting entries into account order electronically. Paper tape has the advantage of cheapness, compactness and ease of production by comparatively low-cost machines. There is no possibility of mis-handling resulting in the loss of an entry, and the ease with which sub-totals can be incorporated provides a convenient check of input accuracy. Paper tape, in fact, fits in very conveniently with the concept of branch banking, where a number of such branches will be operated from a single centralized accounting unit. The tape can pass easily between branch and centre, and the vouchers themselves do not have to leave the branch for accounting purposes. Five-channel tape is actually used for the Martins Bank exercise, this being punched in Pegasus code by a punch coupled to an ordinary adding machine.

Few banks, in the past, have coded current accounts with identifying numbers, but account names form a very unsatisfactory key for the purposes of a computer, and account numbers have been accepted as a necessity in future systems. A check-digit system is used, so that

account numbers fed in to the computer are self-checking: Martins Bank, believing that computers were made to relieve human beings of tedious routine, used Pegasus to produce the check digits, after allocating numbers on a block numeric basis. A process of personalization, whereby cheques were printed with account name and number before supplying them to the customer, was introduced, using a small machine operating on addressing-machine lines. Customers helped by bringing in their partly-used cheque books for personalization.

### **Current-Account Operation**

The current-account operation is the "bread and butter" of bank accounting and was the first to be programmed, though already the bank research team is casting its eye on other operations. Current-account keeping is basically a very simple accounting operation, but it is complicated by the degree of account control needed, and also by the statistics that have to be compiled. Electronic processing takes place in four steps:

- (1) Input of entries – "amendments" as computer personnel persist in calling them.
- (2) The electronic sorting of entries into account-number order.
- (3) Updating the balance file.
- (4) Updating the history file.

Functions (3) and (4) are combined in conventional bank accounting practice. This is because the methods used make it more convenient to combine the operations rather than because there is any inherent virtue in such a combination. As is so often the case, the electronic approach is so different from that of other methods, that the techniques that seemed previously to be fundamental facts of life are found no longer to hold good. The decision to separate the conventional account-posting operation into two processes arises from print-out needs, rather than from basic accounting needs. Functions (3) and (4) together have to cover a number of subsidiary needs, which are set out below.

- (a) The balance of the account has to be adjusted in accordance with the entries. It is desirable that the change in balance should be notified to the bank as soon as possible, but certainly no later than the time of opening at the branch on the day following the date of the entry. This is the chief item of information on which branch account control is based. The main function of the balance file arises from this need.
- (b) Account balances have to be printed out (in whole or in part) daily for presentation to the branch. Because of the timing necessary as in (a) above, it is desirable to produce this before completion of the processing.
- (c) Errors and correcting entries have to be detected and eliminated, so that they will not be printed out on statements.

- (d) Statements and ledgers (the latter being in fact no more than a copy of the former) have to be produced on the date indicated by the frequency of statement issue (which is to be detected automatically by the computer) and also in some cases on special request. The main function of the history file is to marshal data on magnetic tape, in readiness for this need.
- (e) The account statistics (e.g. maximum and minimum balances, turnover, and those other figures necessary for account charge computation and for account control) have to be compiled.
- (f) Those account control operations that are definable by logical rules, and are therefore amenable to computer programming, have to be carried out. These include such functions as assembly of combined statistics for groups of accounts, testing debit balances against authorized limits, checking for stopped cheques, and so on.
- (g) A monitoring document has to be produced, to refer the rejected entries to, and provide control totals for the branch.

The first point to pick up, from these diversified operations, is the fact that (apart from the monitoring document at (g) which naturally occupies the monitoring printer of the computer) there are two quite different forms of print-out. If the whole process of account up-dating were to be dealt with in a single computer operation, the two print-out needs would involve two high-speed punches, or alternatively the output would have to be written away on an additional magnetic-tape mechanism, with a subsequent computer operation to convert this into paper tape. In due course the installation is likely to be expanded in some respects, and such developments are in mind already, but, for the basic equipment first to be installed, it seems desirable to program in two sections, each section producing one of the major print-out records in punched paper-tape form, thus permitting early production of the daily balance list and spreading the printing load over the working day. The various electronic functions can then be distributed between the two separate processing operations in their logical sequence.

### **Procedure Adopted**

The sequence of events in the Martins Bank operation is as follows.

The punched paper tape received from the branch bears entries in random order with regard to accounts, and each entry is set up in a standard format recognizable by the computer. Entries are grouped in types (i.e. all debits or all credits) and the nature of each batch is identified at the head by a code number, which is effectively the transaction code, from which the computer detects the particular routine that it is to follow. The individual entry format is in three blocks, representing account number, a three-digit description (e.g. the last three digits of a cheque number) and the sterling

amount. The entries themselves are broken up into small groups, followed by a total, and at the end is a grand total of all entries.

The computer checks the entry format as the tape is fed in, and rejects any items not conforming to standard format. Rejections are punched out on paper tape for immediate print-out on the monitoring printer. Account numbers are checked individually by means of a check digit, incorporated in the number, which is calculated in conformity with the well-known loaded modulus 11 principle. Entries with invalid account numbers are also rejected on input. Sub-totals are checked also, allowing for rejected items, and in the event of a failure to agree, the whole batch is punched for immediate print-out, so that the error can be investigated. Final totals are also agreed. Accepted entries are written on to magnetic tape.

The next process is to sort the entries into account-number order by normal computer technique, the entries in correct order being written on to magnetic tape.

### **Balance File Updating**

A balance file is held on magnetic tape for each branch serviced by the computer. The information recorded is as under:

Account number and name.

Current balance.

Limit of overdraft granted by the Manager (this will be £0 if no limit is granted).

Total of £ - days (called products) to date, worked on the day-to-day balance. This provides statistics on the basis of which interest can be calculated.

Turnover (i.e. total amount debited to the account to date during the accounting period) and a count of transactions. Commission charges are derived from these statistics.

Group-account statistics, where a number of accounts have to be assessed as a whole, and in particular where "set-off" arrangements are made (i.e. where a credit balance of one account is to be allowed against a debit balance in another for interest calculation, etc.).

Stopped cheques relating to the account.

The *sorted-entry* tape is processed against the balance file of the branch to which it relates, correct tape identity being proved by the computer before beginning the run. Data are read from the balance file, and, if there is no match with the account number of the next entry, they are written away unchanged on to a new balance-file tape. No corrections are made on the old balance tape which, therefore, can be retained for a while in case of inquiry or the possible need to reconstitute the work. Where account numbers match the balance, the statistics are adjusted according to the entries for that account, and only the corrected data are written on to the new balance file. During this process, the new balance is checked against the limit prescribed for the account. Also, debits arising from cheque payments are com-

pared with the stop list, and the monitor printer draws attention to the apparent payment of any cheque which the customer has requested to be stopped. Whilst this process is being carried out, the fast paper-tape punch reproduces the account number and name, followed by the revised balance. Where this has exceeded the limit set by the manager, such limit is printed alongside to draw the attention of the branch to the excess. New accounts are inserted in their correct numerical position. A block alpha-numeric system of account numbering is adopted, so that the accounts are also in substantially correct alphabetic order.

The paper tape produced during this process is printed out, to give the balance list which keeps the branch manager informed on the progress of accounts. Consequently, the timing is to be such as to place this list on the desk of the branch manager, before the time of opening of the bank on the day following receipt of the entries. The audit sheet from the monitoring printer will be returned at the same time. This will detail invalid items that require the attention of branch staff, and it will provide proven totals for branch use.

Whilst the individual entries are being processed against the balance file, they are subjected to a further process of audit. Inevitably, some entries will be in error and correcting entries will have been passed by the branch to cancel them. Both error and correction will appear on the sorted entry tape. When entries are called in for the purpose of adjusting the balance, these errors and corrections will have no arithmetic effect. However, they are not to appear in the history file. The computer at this stage marries error with correction and eliminates both, only entries that are required for the history file being written out on to a new *audited-entry* magnetic tape.

### **History File Processing**

The history-file tape carries for each account the following data:

- Account number and name (in the form in which it is to appear at the heading of the account).
- An indication of the dates when statements have to be produced.

Balance from and date of last statement.

Date, description and amount of each entry passed to the account since the last statement issue. Once entries have been printed out on to statements, they are eliminated from the magnetic-tape record at the computer centre.

The audited-entry magnetic tape is processed against the history-file tape. Each account is examined to see if a statement is to be produced on that day. If so, the whole of the information for the account on the history-file tape is punched out on the high-speed punch, followed by any entries for that account appearing on the audited-entry tape. A closing balance is computed and punched out. A new history-file tape then receives the account number, name and statement periodicity followed by the new balance and date of operation. No detailed entries in this account are written on to the file. On the other hand, if a statement is not needed, the whole of the block of information referring to that account is transferred to the new history-file tape, followed by any entries appearing on the audited-entry tape for that account. Thus, once more, the principle of not overwriting a tape, but instead, of writing the updated information on to a new tape, is adopted.

The information on the punched paper tape, produced during the history-file processing, is printed out on continuous stationery in duplicate, in the form of statements of account. One copy goes to the customer and the other is retained by the branch as its own account record, taking the place of the more usual ledger.

### **Experimental run and program amendment**

The program used for the original experimental run was very successful. It was written for Pegasus I, and so had to be revised to take advantage of the Pegasus II which is to be installed by the Bank. Inevitably, also, methods of improving the operation arose from a careful review, and so a major program re-writing operation is now in progress. A more detailed account of the program is better left, therefore, until the new version is available.