

**"Stock Accounting and Automatic Reordering in Small Retail Businesses by IBM 1130 Computer"**

**Doug Glading. C. 1964**

**Title:** "Stock Accounting and Automatic Reordering in Small Retail Businesses by IBM 1130 Computer"

**Author:** D. G. Glading

**Inquiries to:** D. G. Glading  
IBM United Kingdom Limited  
Newtown House  
Maid Marion Way  
NOTTINGHAM  
Great Britain

**Telephone:** Nottingham 45912

**Abstract:**

A small retail chain of less than 30 outlets selling, for example, clothing can successfully use an IBM 1130 Computer. Branch sales transactions reordered by punched or printed swing tickets and converted into 80-column cards can be quickly and simply validated and posted onto random access disk files. The logical capabilities of the 1130 make it practical to introduce an automatic reorder system which can drastically reduce branch stock levels. Systems Engineers must, however, consider the capacity of the user when designing the overall system. This paper discusses the general problems in introducing a computer into a small business, the systems considerations relevant to the commercial use of the 1130 and suitable levels of stock accounting and automatic reordering techniques to introduce.

93 0 9 11

### Introduction

This paper reviews the application of the IBM 1130 computing system to a particular commercial data-processing problem. It describes the market considered, the general problems encountered in employing a computer in this type of business, the systems considerations associated with the utilization of an IBM 1130 and realistic stock control/automatic reordering methods. It can be seen that the user can benefit considerably without recourse to undue sophistication and that, given a reasonably capable user, the IBM Systems Engineer should not find his task difficult, nor protracted.

### General Survey

The IBM 1130, which was introduced as a small but powerful scientific computer, can be equally useful as a purely commercial data processing system whether it is to replace unit record equipment where volumes and cost do not justify the System/360 model 20 or to open up a large field of new data processing users. A number of these small users will of course be technically based organisations such as engineering manufacturers who may well use the 1130 for both design computation and commercial accounting.

In Retail Distribution, however, there are a considerable number of small groups operating from 2 or 3 shops to, say 40 outlets. It is in this area in particular that the 1130 has much to offer as it can handle all normal stock accounting functions and in addition can easily allow the adoption of stock control procedures ranging in sophistication from the simplest to the most complex - limited only by the capacity of the organisations management to appreciate and implement.

An example is the use of an 1130 system in a small retail chain of less than 30 shops, selling clothing, footwear and camping equipment. The branch shops, in this case, receive goods from three sources - the central warehouse, direct from manufacturers in response to centrally placed long-term contracts or by independent purchase by individual branch managers. An average branch stocks perhaps 2,000 items (stock keeping units). Maintenance of stock figures for each branch by unit record equipment proved difficult due to the extensive collating and summary punching involved. A further accounting machine would have overcome this handling problem but would not have allowed much extension of inventory control.

The installation of an 1130 model 2B (8K word core storage plus disk) with card reader/punch and line printer allows the old tasks to be easily managed and offers very much more potential at little increase in cost.

### General Problem Areas

Although the 1130 itself may be attractive to the small retail group in both cost and capability, it is not going to be widely accepted if it needs a number of skilled competent systems analysts and programmers (a requirement which is likely to be expensive and difficult to fulfill). Fortunately this is not so. Each and every program required for an installation such as this can be written in the Fortran 4 language - a language which is particularly efficient on the 1130, yet simple. Ad hoc reports can be produced just as quickly using Fortran on the 1130 as by plugging up a unit record panel.

User personnel who are capable of drawing up careful logic diagrams of the various runs involved usually prove capable of translating these into Fortran code and compiling and maintaining operational programs. The amount of analysis involved in implementing a straightforward stock recording plus simple stock control project on an 1130 is not prohibitive and both analysts and coding may well only require two people. Often there is likely to be within the organisation someone such as a junior buyer who has the potential to implement, and subsequently further develop, such a project to the mutual benefit of both himself and the organisation. The actual operation of the 1130 system is no more difficult than unit record equipment - and often there is the older, reliable but inflexible unit record supervisor who appreciates the title of Computer Operations Manager.

### The User

The initiative must rest with the user in a project of this size - IBM Systems Engineers can only provide technical backup, guidance in inventory techniques and data processing experience. A chaotic organisation with muddled methods may unfortunately require more than the normal advice and guidance of the IBM Systems Engineer. The emphasis must therefore be put on the initiation of a simple straightforward system.

Introduction of a logical, accurate yet simple computer-based system will produce noticeable benefits. Only when the user has assimilated all the reasons behind the resulting improvements should he be encouraged to refine his techniques. Some users may never reach this stage - but will still have benefited. Rapid introduction of methods which, for example, cut branch stocks to the very minimum consistent with what might be the completely new concept of a service level of less than 100% will unsettle shop personnel. These staff in particular must remain confident that a computer-controlled system is going to serve them at least as well as the old methods. The overall direction of any scheme must of course stem from a member of the

board who has the drive and flexibility required and the capacity to appreciate the statistics and analyses put before him.

#### System Consideration

The designed system must be a simple system and an efficient one. An 1130 computer can carry out exceedingly complex series of manipulations using, say, the Scientific Subroutine Package or the Linear Programming suite. But this is not the environment considered. This is an application which required the Systems Engineer to map out a sequence of straightforward, uncomplicated programs.

If this aim can be achieved then the installation should go that much more smoothly. For it is the intricate octopus program that will handicap the customer and the Systems Engineer as it will be difficult to test, to alter and to know the ramifications of alterations, and to ensure that each operational run is fully successful and known to be so. This user can take corrective action and rerun the abortive program which only updates one or two fields of a file but should not be exposed to any really tangled labyrinth to unravel.

Naturally a sequence of fairly unambitious programs may be a little more time consuming. However, the user will be able to find his feet more quickly this way and appreciate that he is in control - otherwise far too much reliance will be placed on the continuous detailed support of the Systems Engineer. The system design stage then, as always, is critical and there are a number of considerations that can be born in mind.

#### File Storage

The capacity of the 1130's disk storage file (2315) may appear small to those used to large data processing systems, but is quite adequate for many small organisations. If one considers that one 2315 disk pack may contain what might have occupied a conventional card file of 15,000 - 20,000 80-column cards it should be apparent that there is the capacity for storing the day-to-day data requirements of most of the businesses of the size discussed.

The 2315 disk comprises 1,600 sectors each of 320 words. Some of this space will be occupied by the Disk Monitor, utility programs, compilers, etc. A practical area for user's data is between 1250 and 1450 sectors depending on what system routines and how many user problem program object modules are stored on disk. Obviously whatever space there is remaining beyond data files can be used for

storing programs, choosing the most frequently used.

Records, for efficient utilization of disk space, should be 320 words long, or some subdivision of that length (e. g. 160, 90 words). A record in most retail systems will consist of general details about each item (e. g. description, prices), warehouse details (e. g. stock, average demand, various history figures) and details for each outlet (e. g. stock, average sales, last sale date). This structure usually applies though there might be cases where the range of goods stocked by different branches differs widely, justifying a more complicated file structure. Some fairly simple method of data compression is worthwhile for certain fields (e. g. storing two week numbers in one Fortran integer word, one as tens and units, the other as thousands and hundreds) to get within, say, the 160 word boundary.

#### Size of Files

If the branch outlet details can be held in 6 words, and the remaining item information in 40 words, then a 160 word record can contain the data for a 20-branch group. A 1300-sector long file thus holds the details of 52,000 stock keeping units (S. K. U's - one item at one outlet). This means that the complete particulars of the chain might fit onto one 2315 disk pack for manipulation, or enquiry, or extrapolation. It has up until now been exceedingly difficult to centrally administer 50,000 SKU's efficiently, let alone practice any new management techniques of stock control and forecasting.

Where there is a larger range of items it is usually the case that these fall naturally into 2 or 3 subdivisions - for example, mens, ladies and childrens shoes; or dresses, blouses and skirts; or summer and winter ranges. A simple one digit sort could separate all transaction cards for independent processing against the relevant disk.

In the 1130 installation referred to earlier, a natural division occurs between items held in the central warehouse, items bought by contract for direct delivery, and local branch managers purchases. The local purchases are not controlled too closely (i. e. separate details are not kept for each size and colour) as the policy of the company is to allow each branch manager a certain percentage of his current gross profits for his own purchases, providing he maintains an adequate return on his investments. The 1130 can of course easily monitor his success at this.

### File Organisation

It is rarely possible to introduce a completely new item coding structure in any organisation so that it is unlikely that the item code can be made equal to the disk address. In Fortran the sequential record location within the file is used to address the disk - the Monitor translates this number into a physical location and gets the record from that location. Where data referencing mainly originates from sales swing tickets it may be possible to prefix or suffix the item code with the disk address, given a sufficiently stable range to eliminate major file reorganisations.

A Disk Address table look-up technique is probably the best general answer, as it usually is possible to spare 1 or 2K of core for this table in the majority of programs. The occasional complex programs can use the overlay capabilities of the Monitor system to overlay parts of program, or parts of the look-up table. The latter will normally incur very little time penalty since some primitive presequencing of card input is usually practical.

The fast core logic speed of the 1130 makes a straightforward table look-up rapid. Where the item codes are in sequential order in the table an even faster binary search routine can be written, utilising some of the mathematical routines such as logarithms available as standard functions in 1130 Fortran. A successful file arrangement is to load the original file sequentially, leaving 10% or so of the file blank. Any additions of new items can be added to the file in this spare area. The index table look-up can then be binary in the sequential part of the file and step-by-step in the addition area. An active file is easily reorganised when necessary by punching out all live records into card and reloading, constructing a new index table.

### Security

As we are dealing with a single-storage device system, file security must be considered very carefully indeed. However this is not an insuperable hurdle. There have even been, for example, successful single disk system/360 model 30's with no tape drives!

There are two approaches to this problem in the 1130 case. The first is to regularly dump the file or files to cards. There is a standard Disk Utility Program to do this, which with the slower model 6 1442 card read/punch will dump at an effective rate of 3,000 words per minute. A fairly large data file may thus require some 2½ hours of punching and perhaps 10,000 cards. Some reduction in this task can be achieved if it is possible to only punch

out the variable information on the file, although this may well be over 80% of it. In this case the original deck, and program, used to set up the file, plus any additions or amendments, must be preserved to reload the fixed information such as the description.

The alternative method, where there is perhaps already a high bill for cards but plenty of machine time, is to use duplicate disk files. Those programs which actually update the disk file are run against both disks. The introduction of suitable hash total checking techniques is of course essential to highlight disagreements - and to indicate the disk in error. With this method must go the straightforward systems approach advocated earlier. Dumping to cards need only be done when it becomes necessary to reorganise the file.

The choice of method must depend on the circumstances of the case. Adopting both methods, duplication for the major file(s) and dumping for smaller files, is likely to prove reasonable.

### Sterling

Systems Engineers from IBM United Kingdom have to face up to the inconvenience of handling sterling for some years yet. Fortunately the 1130 lends itself quite well to handling selling and cost prices as they can conveniently be held as pence. One 1130 Fortran Integer Variable will hold a number of up to 32767, which is roughly £135 in pence. Accumulations for invoices, valuations etc. do require one to work in hundreds of pounds and pence but all additions, conversions and so forth can always be handled by subroutines. A full set of routines does exist, including multiplication etc. of sterling quantities held in the above way, as it happens written by an IBM Sales Manager to keep his hand in at Fortran.

### Data Input

Input to an 1130 can be by punched paper tape and/or punched card, although a small user is unlikely to find it necessary to use both. Of the two methods paper tape is the least less expensive, but cards will probably prove by far the better system choice. In situations which only require from 2 to 6 punches/perforators the flexibility of cards in program coding, sorting, stacker selection etc. is easily worthwhile.

For stores selling such goods as clothing and tents the most satisfactory, or more accurately the least unsatisfactory, method of capturing sales

data is by punched or printed sales swing ticket. Typically each item has attached to it upon receipt at the shop or in the central warehouse, a 2-part centrally prepared swing tag. One part of this tag is returned to the data processing location after a sale.

These branch sales transaction tickets are converted into IBM 80-column punched cards using Keypunches or, if they are punched tags, a converter. Together with various other transactions cards representing inter-branch sales etc. these cards must go through the usual type of reconciliation run to check against branch cash takings. The 1130 program for this job can allow all cards to be reconciled in one run as it is simple to accumulate as many totals as necessary and print them out in whatever format is convenient.

Not only can the 1130 carry out this straightforward cash totalling and reconciling but, with its fast logical capabilities, it can check the item code and selling price recorded for each sale against a table in core storage. Any questionable cards where code and price do not tie up due to reasons such as markdowns or mispunching, can be printed and separated out by stacker selection at the card reader.

If, in addition, the disk record address of each item is also punched in the sales transaction cards for checking, the occurrence of conflicting data in a card is not only shown up by the out sorting of the card but in many cases the 1130 can indicate what the correct data ought to be. This should virtually eliminate the all too frequent unit record situation of the daily transactions of a branch failing to reconcile with no indication of which transaction is in error and subsequent serious delay or misposting of sales and cash.

Furthermore this approach of allowing the 1130 to verify transactions allows the user to make savings by permitting the adoption of the cheaper, more flexible printed sales swing tag in preference to the punched swing ticket as the cost of verifier operators wages, overheads and machines can be eliminated. The recording of several sales transactions per 80 column card is also now practical, considerably cutting card costs and speeding even further reconciliation and stock record updating runs on the 1130. In peak periods (e. g. on Mondays when Saturday's sales have to be punched up) the 1130 keyboard can also be used as a data conversion device, verifying each transaction as it is entered, reconciling branch batches and even storing the data on disk for subsequent updating runs.

#### The Monitor System.

In the same way that the System /360 machines have their Operating



Systems, the 1130 has its Monitor with many similar features to ease the task of the user. For example the small commercial user benefits from the protection of the disk space management facility of the Monitor which prevents a new file overlapping an old file. He benefits from the automatic overlay program structuring which the Monitor carries out for oversize programs or from the overlay structuring he performs himself. His day to day operations are eased by the choice of stacking a job stream in the reader or initiating disk-stored jobs from the console.

### Printing

In considering the use of an 1130 for a particular retail group there is one feature of the 1130 in particular which must be carefully related to the known and probable applications for the system. The 1132 printer may appear to limit the utilization of the system slightly in that it cannot cope with very high volumes of printing which might occur where there is a great deal of retail correspondence (credit accounts perhaps). Apart from such cases small retail groups will generally be printing purchase ledger (i. e. wholesale orders placed), warehouse invoicing out to branches, and reports. The existence of some known limitation in printing capability can even be beneficial, by encouraging the employment of exception reporting.

With the console typewriter the 1130 system has two output writing devices - a distinct advantage in any small system such as this. The systems design can be more practical and more aligned with operating needs rather than be restricted by machine considerations as in unit record design. The typewriter can ease the load of the 1132 printer by printing interim and terminal error messages, control totals, keyboard stock enquiries and so on.

### Stock Control and Automatic Reordering

#### Alternative Data Capture

In those fields where it is not practical to record individual sales transactions, periodic stock counting can combine well with the 1130. Given the latest stock count at a branch the 1130 can refer to the previous stock figure and the despatches to that branch to calculate the sales for that period and furthermore perform a comprehensive "reasonableness" check on the result. This technique would be applicable to say chains of tobacconists or of bread shops, using mark-sense cards. The 1130 Route Account Package may, however, come into the reckoning here.

### Stock Reduction

Replenishment one-for-one for footwear sales, or fulfillment of a day-to-day requirement in the case of a bakery, does not tax the 1130. The forecasting of sales and the automatic generation of orders on a central warehouse on behalf of each branch, even at most developed level, is still within the capability of the 1130. Other factors, however, may indicate the choice of not too ambitious techniques. The simple selection of a forecast based on a single exponential smoothed average sales figure plus a proportionate safety stock to generate orders can lead to drastic stock reductions at branches. Branch managers who have always had stock ordering responsibility in an atmosphere of central stock recording and review will always over-order selling lines and rarely run-down static lines.

As sales history builds up and the benefits of a simple automatic reordering system become apparent and appreciated, further sophistication can be introduced. Accurate data on the fluctuation ("noise") in S.K.U. sales, measured by standard deviation or mean absolute deviation (MAD) are not normally known but can be gathered by the 1130. Once an average figure for MAD (using exponential smoothing again) is established and some consideration given to past, current and desired service levels the principle of dynamically tailoring safety stock to suit the current behaviour of each SKU can be introduced.

### Seasonality

Similarly in the simple automatic reorder procedures initially implemented goods can be considered to be either in-season or out-of-season where the dates of the season are guessed at. With a reasonably high alpha-factor for rapid response to changes, normal forecasting based on the exponentially smoothed sales average can be used in season. During the last weeks of a season stock is run down to a fixed low level which is replenished one for one as required during the off-season. A more detailed method of seasonality control, probably of the Base Series index type, can be investigated and incorporated in the more accurate reordering system.

Providing this is considered in the early stages of system design space can be left in the general item data area of the record layout. It is not practical, and will probably prove not essential, to include a base index in each branch subrecord. The company-wide seasonal behaviour index should correspond closely enough to the behaviour of that item in each branch.

### Progress

It is almost certainly unrealistic to hope to progress further than this in the first two years or so of an 1130 installation in a small retail group. The 1130 is well suited to handle the computation facets (with some program overlaying) of Fourier-analysis based Adaptive-smoothing techniques but benefits from such refinements are likely to be outweighed by the difficulties of comprehension and appreciation. Simple Probability forecasting (Vector-smoothing) could be introduced for selected items. More return is to be expected from concentration on improving the meaningfulness of reports and the flow of management information.

### Warehouse Orders

Once the 1130 has carried out its periodic forecasting and review run, the orders generated can be invoiced. As the deliveries for each branch may be in the range 100 - 300 items an in-core sort is possible to print the invoice in warehouse location order. Where stocks are insufficient to satisfy all branches who warrant delivery rationing can be carried out. The random access facility of the 1130 file allows, in many cases probably for the first time, the automatic establishment of substitute items.

One usual side effect of the introduction of logical rules for automatic retail reordering is that the frequency of delivery goes up, although the quantity of each item delivered goes down to, or towards, some minimum economic delivery quantity fixed for that item.

### Reports

The availability of comprehensive data in such compact form and the power of Fortran enable the 1130 to produce the widest possible range of reports, analyses, charts and simple graphs. Stock valuation for one disk file, which could be a company's entire stock file, by branch and warehouse now takes perhaps 2½ minutes - a small percentage of the normal time once needed. Branch comparisons by absolute sales, or relative sales, buyer performance comparisons, profitability figures are all quickly produced in the most convenient, compact form, regularly or to order. Very rapid production of "one-off" selective tabulations can be achieved by using a general purpose tabulation/report program in conjunction with a master file of cards containing basic data for each item. Cards representing items to be included in the report (e.g. all items priced 12/11 - 17/11 in tax group 3 sorted into alphabetic order) can be outsourced from the

master card deck whilst the 1130 finishes its current task and quickly run through as soon as it is free.

### Summary

To review: the use of an 1130 in small retail businesses for stock control and automatic reordering is usually practical. The 1130 can offer more accurate stock recording, to a more comprehensive degree than ever possible before. Lack of sales history and dangers of antagonising or bewildering staff make it wise to start with a simple automatic reordering system, which will, however, still offer striking reductions in branch stock levels.

Basically, due to the subroutine and overlay capabilities of the 1130 Fortran compiler and Disk Monitor there is no limit to the sophistication of techniques - the limit is most likely to be found in what can be appreciated by the various shop managers, buyers, warehouse managers, up to and including the board. Advanced ideas have to be implemented slowly and carefully in these small organisations, however demonstrable the benefits of an immediate plunge into the latest methods of retail control, unless there is an exceptional quality of staff.

The variety of reports and analyses produced by the 1130 will also significantly improve the efficiency of the organisation. Subsequently the forecasting methods can be refined further, and inventory levels scientifically held to a minimum. With increasing familiarity with the system and its potential, further exercises can be carried out by the organisation - for example careful simulation of future policies.

The 1130 computer can be sold for commercial work. Systems Engineers can install the 1130 computer successfully in commercial users without undue stress.