BAR CODES

ARE THEY FOR YOU ?

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NOVEMBER 15, 1983

BAR CODES - ARE THEY FOR YOU?

THE USE OF BAR CODES IS BECOMING INCREASINGLY POPULAR IN MANY APPLICATION SYSTEMS AREAS. BUT WHEN DOES IT MAKE SENSE TO USE THEM, AND WHY? THE PURPOSE OF THIS PAPER IS TO EXAMINE:
THE ELEMENTS OF BAR CODES AND BAR CODE SYSTEMS,
WHAT THE ALTERNATIVES FOR HP3000 USERS ARE,
SEVERAL IMPLEMENTATIONS OF CURRENT BAR CODE TECHNOLOGY,
AND WHAT TO LOOK FOREWARD TO IN THE FUTURE.

BAR CODES ARE GRAPHIC REPRESENTATIONS, IN MACHINE READABLE FORMAT, OF CHARACTERS OF INFORMATION. THEY ALLOW RAPID DATA COLLECTION WITHOUT KEYING IT INTO A TERMINAL. THEY ASSIST IN SOLVING THREE MAJOR DATA COLLECTION PROBLEMS: THE COST OF CAPTURING DATA, THE TIMELINESS OF THE DATA CAPTURED AND THE ACCURACY OF THE DATA CAPTURED. THE WAYS IN WHICH BAR CODING SOLVES THESE DATA COLLECTION PROBLEMS WILL BE DETAILED THROUGHOUT THIS PAPER.

HISTORY

THE LARGEST SINGLE FACTOR IN ESTABLISHING BAR CODING AS A SUCCESSFUL NEW TECHNOLOGY HAS BEEN THE EXPERIENCE OF THE GROCERY INDUSTRY. WITH THE OBJECTIVE OF AUTOMATING SUPERMARKET CHECKOUT LINES, GROCERY RETAILERS AND SUPPLIERS AGREED TO COOPERATE. THE RESULT, ALMOST 80% OF ALL GROCERY STORE ITEMS ARE BAR CODED. SUPERMARKETS USING BAR CODE SCANNERS IN THEIR CHECKOUT COUNTERS ARE ABLE TO TAKE ADVANTAGE OF THIS, REALIZING IMPROVEMENTS IN INVENTORY CONTROL, MERCHANDIZING, AND SCHEDULING EMPLOYEES TIME.

THE AMERICAN BLOOD COMMISSION, ALONG WITH GROUPS FROM EUROPE AND AISA, HAVE ESTABLISHED THE USE OF BAR CODES IN A BLOOD CODING OPERATION. THIS HAS PROVEN VERY SUCCESSFUL FOR THOSE INVOLVED, WITH IMPROVED ACCURACY AND PRODUCTIVITY IN HANDLING BLOOD PRODUCTS.

A THIRD AND VERY IMPORTANT FACTOR IN BAR CODES, HAS BEEN THE ESTABLISHMENT OF LOGMARS. SET UP BY THE DEPT OF DEFENSE IN 1980, LOGMARS OBJECTIVES WERE TO ESTABLISH A MACHINE READABLE SYMBOLOGY TO BE MARKED BY COMMERICAL VENDORS
AND DOD ACTIVITIES ON ITEMS, UNIT PACKS, OUTER CONTAINERS AND SELECTED DOCUMENTATION, AND TO ESTABLISH PROCEDURES FOR USE OF THE SYMBOLOGY. THIS MEANT, ANYONE SUPPLYING THE DOD AFTER JULY 1982 HAD TO MOVE INTO BAR CODE TECHNOLOGY.

IN ADDITION TO THESE USES, THE BASIC NEED OF AMERICAN INDUSTRY TO COLLECT ACCURATE AND TIMELY DATA FROM AREAS INCLUDING MANUFACTURING, INSPECTION, TRANSPORTATION, AND INVENTORY HAS ADDED TO THE INCREASED POPULARITY OF BAR CODES

SYMBOLOGY

THE BASIC COMPONENT OF ANY BAR CODE IS TO REPRESENT ONE CHARACTER OF INFORMATION WITH A SYMBOL. THIS SYMBOL IS COMPOSED OF BLACK AND WHITE, NARROW AND WIDE LINES. THE LINES ARE REFERRED TO AS BARS. THE SPECIFIC ARRANGEMENT OF LINES (OR BARS) IS CALLED A BAR CODE SYMBOL FORMAT.

WIDE BARS AND WIDE SPACES ARE INTERPRETED AS BINARY 1. NARROW BARS AND NARROW SPACES ARE INTERPRETED AS BINARY 0. A BAR CODE READER (OR SCANNER) REALLY ONLY LOOKS AT THE CHARACTERISTICS OF BLACK OR WHITE, AND WIDE OR NARROW.

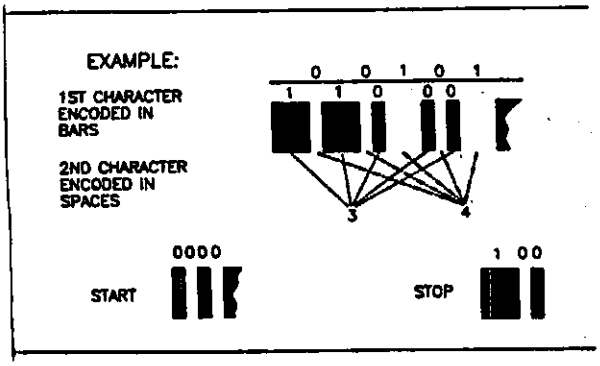
QUIET-ZONES MUST BE PROVIDED AT BOTH ENDS OF THE BAR CODE. THEY PROVIDE SEPARATION OF THE PRINTED AREA FROM THE ACTUAL BAR CODE. AT THE LEFT (OR PRECEEDING THE FIRST CHARACTER) OF THE BAR CODE, IS THE START CODE. THE STOP CODE IS LOCATED AT THE RIGHT OF THE BAR CODE. START AND STOP CHARACTERS ARE USED BY THE SCANNER TO IDENTIFY THE ACTUAL BEGINNING AND ENDING OF EACH BAR CODE. THEY ALSO PERMIT BIDIRECTIONAL READING.

OPTIONAL CHECKSUM CHARACTERS MAY ALSO BE INCLUDED IN THE BAR CODE TO IMPROVE RELIABILITY. THE VALUE OF THE CHECKSUM IS DETERMINED BY AND ALGORITHM PERFORMED ON THE BAR CODE DATA CHARACTERS. A CHECKSUM IF USED, BECOMES THE LAST CHARACTER OF THE SYMBOL (PRECEEDING THE STOP CHARACTER).

OVER 25 DIFFERENT SYMBOLOGIES HAVE BEEN DEVELOPED OVER THE LAST 15 YEARS. WE WILL EXAMINE TWO OF THE MOST POPULAR INDUSTRIAL SYMBOLOGIES.

INTERLEAVED TWO OF FIVE

INTERLEAVED TWO OF FIVE IS A SELF CHECKING CONTINUOUS CODE USED TO REPESENT THE CHARACTERS 0-9. IT HAS BEEN WIDELY ACCEPTED IN WAREHOUSING AND HEAVY INDUSTRY. THE DISTRIBUTION SYMBOLOGY STUDY GROUP HAS RECOMMENDED INTERLEAVED 2 OF 5 AS A STANDARD FOR NUMERIC LABELING OF CORRIGATED SHIPPING CONTAINERS. BECAUSE OF ITS HIGH DENSITY (SMALLER BAR CODES) IT HAS BEEN GAINING POPULARITY. HOWEVER, MANY APPLICAIONS REQUIRE THE CODING OF ALPHANUMERIC DATA, WHICH 2 OF 5 WILL NOT DO.



3 OF 9.

3 OF 9, ALSO KNOWN AS CODE 39, IS BY FAR THE MOST POPULAR ALPHA NUMERIC SYMBOLOGY. IT HAS BEEN ACCEPTED AS THE STANDARD BY BOTH LOGMARS AND THE DISTRIBUTION SYMBOLOGY STUDY GROUP. 3 OF 9 IS A 9 ELEMENT CODE, WITH 3 ELEMENTS BEING WIDE AND 6 BEING NARROW (HENCE ITS NAME). BOTH BAR AND SPACES ARE POSITIONED TO ENCODE LOGIC VALUES. 43 ALPHANUMERIC CHARACTERS, PLUS START AND STOP ARE ENCODABLE. WHEN COMPARED WITH INTERLEAVED 2 OF 5 CODE 39 IS TWICE AS LONG FOR THE SAME NUMBER OF CHARACTERS, BUT DOES OF COURSE HAVE ALPHANUMERIC CODING CAPABILITIES.

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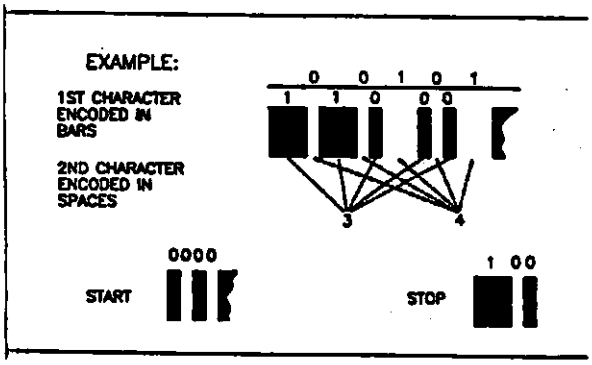
3 of 9 Code Character Set Encodation

CHAR.	PATTERN	BARS	SPACES	CHAR.	PATTERN	BARS	SPACES
1		10001	0100	M		11000	0001
2		01001	0100	N		00101	0001
3		11000	0100	O		10100	0001
4		00101	0100	P		01100	0001
5		10100	0100	Q		00011	0001
6		01100	0100	R		10010	0001
7		00011	0100	S		01010	0001
8		10010	0100	T		00110	0001
9		01010	0100	U		10001	1000
0		00110	0100	V		01001	1000
A		10001	0010	W		11000	1000
B		01001	0010	X		00101	1000
C		11000	0010	Y		10100	1000
D		00101	0010	Z		01100	1000
E		10100	0010	-		00011	1000
F		01100	0010	.		10010	1000
G		00011	0010	SPACE		01010	1000
H		10010	0010	$		00110	1000
I		01010	0010	/		00000	1110
J		00110	0010	+		00000	1101
K		10001	0001	%		00000	1011
L		01001	0001			00000	0111



BAR CODE SYSTEMS

A BAR CODE SYSTEM CONSISTS, MOST BASICALLY OF STORING AND RETRIEVING DATA. IT IS POSSIBLE HOWEVER, TO BREAK DOWN THESE COMPONENTS INTO A MORE MEANINGFUL GROUPING.

1. What data will be stored in bar code format? Singular pieces of information used for key identification purposes are good candidates. If this information is entered on a repetitive basis, or accuracy is a critical priority, bar codes should be considered. Examples of this type of data are: item or part numbers in an inventory control system, item numbers and location numbers in a warehouse tracking system, work order numbers in a work in process tracking system, and purchase order numbers in a material receiving system. It is also becomming increasingly popular to have a host computer generate the identification keys for bar coding in different tracking systems. An example would be one Move Ticket number generated to track a specific item number received on a specific purchase order.

2. How will the data be stored?
Storage in this case means the physical bar coded data. It may be a paper document, a label, etc..
What symbology will be used? Typically if alphanumeric data must be encoded, code 39 will be the choice. If only numeric data is required, the choices are numerous.
What media will be used to hold the bar coded data? Plastic coated labels may be required in some environments. Maybe your normal printer paper stock is fine. How this media will be physically utilized in the operation is one of the main determining factors.
How the bar code data will be printed is of major importance. Print size, ink quality, and print technique all impact the readability of a bar code.
And what good is a bar code if you can't read it?

3. How will the data be retrieved (or read) ? Encoded data must be read by an optical scanner that in turn sends a logic signal to a decoder. The decoder then translates the scanned data into computer readable form. Bar code readers must be capable of accurately handling this operation. The type of reader selected is determined by physical layout, system flow, the need for real time updates, and other system hardware.

4. How is a successful system measured? Determining what is to be stored how it will be stored, and how to retrieve it requires careful planning, selection, and implementation. As with any complex integration problem, success is not guaranteed.
One method of measuring success is to examine what is called the first read rate. Since accurate, fast, and cost effective data capture is the underlying objective in using bar codes, the number of scans required to read any one bar code is critical. A first read rate (number of times a bar code is read on the first scan) of 80% should be considered the minimum for success. It is important to note that if a bar code is not read on the first scan, it has not been misread. It must simply be re-scanned until it is successfully read. Actual misreading of a bar code is called error substitution.
The error substitution rate (expressed in characters) should be better than one in a million when using code 39.

BAR CODE HARDWARE

PRINTING BAR CODES

There are two basic considerations in printing: what to print on (the media) and what to print with. With media, readability is of course a primary factor, however durability is equally important. If time and environment will damage a bar code, it's readability is gone. In selecting a media, look first at its optical characteristics, then at how those characteristics can be preserved (possibly plastic coating). It is not uncommon to mix media in a bar code system. Using adhesive label's on storage bins with printed material move documents, for example, combines two different technologies. Make certain that both produce compatible bar codes, ie. can be scanned

The choice of printers breaks out into three catagories: volume - how many labels or documents are required in a particular time frame, resolution - is the density and print quality good, and cost - is the printer cost effective for the application.

TYPE	VOLUME	RESOLUTION	COST
Formed Impact - Drummer	Low/Medium	High	Low/Medium
Formed Impact - Daisywheel	Low/Medium	Low/Medium	Low/Medium
Electro$tatic	High	Medium	High
Laser	High	Low/Medium	High
Ink Jet	High	Low/Medium	High
Thermal	Low	Medium	Low
Dot Matrix	Low	Low	Low

There is also another choice, not listed above. That is, to have bar codes printed commercially. In a situation where bar codes (usually labels) may be pre-assigned and therefore pre-printed, commercial printing should always be considered. Where pre-assignment is not possible because the content of the bar code is not known long before printing, then using an in house printer for "on-demand" bar codes is the solution.

Physical layout for on-demand printing usually means having a printer located near the place where the bar code will be needed. This translates into multiple printers and generally rules out the high cost choices. Once a cost range is determined, volume must be considered. On demand printing does not always imply low volume. Placing one slow printer, like a thermal, in a critical path operation will undoubtably create a bottleneck in the system flow. Resolution is important not only for readability, but for bar code size. Many labels, and certain documents, leave available space for only very small bar codes.

Printer flexibility is another important area to consider. Dot matrix tends to be the most flexible of the low cost printers, being able to produce documents and labels. The drummer printer, which has the best resolution, can only print labels. Thermal printers lack media flexibility.

For the HP3000 user, printer choices are fairly broad. Hewlett Packard manufactures an excellent high end laser printer - the 2680. Using the 2680 to print bar codes would satisfy anyones need for real high volume output, making even commercial printing unnecessary. Where low/moderate volumes of labels or documents are required, the HP2631G (Option 200) dot matrix printer will do the work in a very cost effective way. Other manufacturers who have products in the lower cost end of the market are Intermec and Scanmark. They have specialized in the drummer type printers, used to print bar code labels.

READING BAR CODES.

Scanners for reading bar codes can be split into two catagories: fixed and hand held. Fixed scanners (or moving beam scanners) are generally laser and read the bar codes as they move past the scanner. Automated material handling conveyors are one example. Bar coded containers move on a conveyor past a fixed scanner.
As the scanner interprets the code, it is sent automatically to the decoder and then to an on-line computer. Automated conveyors with fixed head scanners like these, can be used for product sortation after order picking.

Hand held scanners are the type where a wand, or sometimes a gun, is passed over the stationary bar code. With a wand, the operator places it in the quiet zone, making light contact with the code surface. The wand is then pulled across the entire code, as if drawing a light pencil line. Normally the bar code reader will emit a beep if the code was read correctly. This operation works very well on flat surfaces, but not so well on curved surfaces. The height of the bar is also an important factor. There is a natural tendency to move the wand through the top or bottom of the code before scanning the entire thing. To minimize this, all bars should be at least 0.3 inches in height. Where the entire code is excessively long, even 0.3 inches may not be sufficient.

Hand held scanners can be either on line, or portable. A typical on line application example would involve attaching the bar code reader to an on line terminal. As PO's are received, the hand held wand would be used to scan a bar coded PO number. When this data is sent to the host computer, it will look (to the computer) as if the data came from the terminal.

A portable bar code reader typically collects data (scanned or keyed) in its memory until the collection process is done. The reader is then taken to a download station where, by using a direct cable to the computer, all the data stored in the portable can be downloaded to a host CPU. An example of this would be stockroom cycle counting. The operator would go to the stockroom with a portable reader and a cycle count report. The item number from the report would be scanned, the bar coded loction on the bin would be scanned, and the quantity counted keyed in. Once all counts were complete the bar code reader would be taken to a work station for downloading.

Currently HP has four offerings in the hand held scanner catagory. The HP3075A and HP3076A are complete data capture terminals designed for the manufacturing environment. These terminals can be used with VPLUS and data capture on the HP3000 and HP1000. They will read bar codes, badges, and include a small CRT display. Each terminal occupies a seperate port and must be configured in to the HP3000 just like any other terminal.

The 16800A is a dedicated bar code reader with an RS232 port that will attach to any HP terminal. One very powerful feature of this device is that it actually shares a line and port with an existing terminal. This is called evesdrop mode, and means the HP3000 will communicate with the 16800A and a terminal at the same time, on the same port. Data entry can be done using THE 16800A ALONE, THE TERMINAL ALONE, OR READING BAR CODES WITH THE 16800A AND INPUTING ADDITIONAL DATA FROM THE TERMINAL.
WITH EXISTING VPLUS APPLICTIONS
THE 16800A CAN BE CABLED IN AND USED TO READ BAR CODES WITH ZERO PROGRAMMING CHANGES! IT IS ALSO PROGRAMMABLE.

The HP92911A is a similar concept to the 16800A. It is a less expensive dedicated bar code reader that attaches to any HP262X terminal. It tpo requires no special software or reprogramming, but does require that ENTER or RETURN be pressed to transmit the result of each bar code read to the computer.

Other manufacturers supplying bar code readers include INTERMEC, MSI, and Telxon. All three manufacture portable bar code readers which are compatible with the HP3000, in varying degrees.

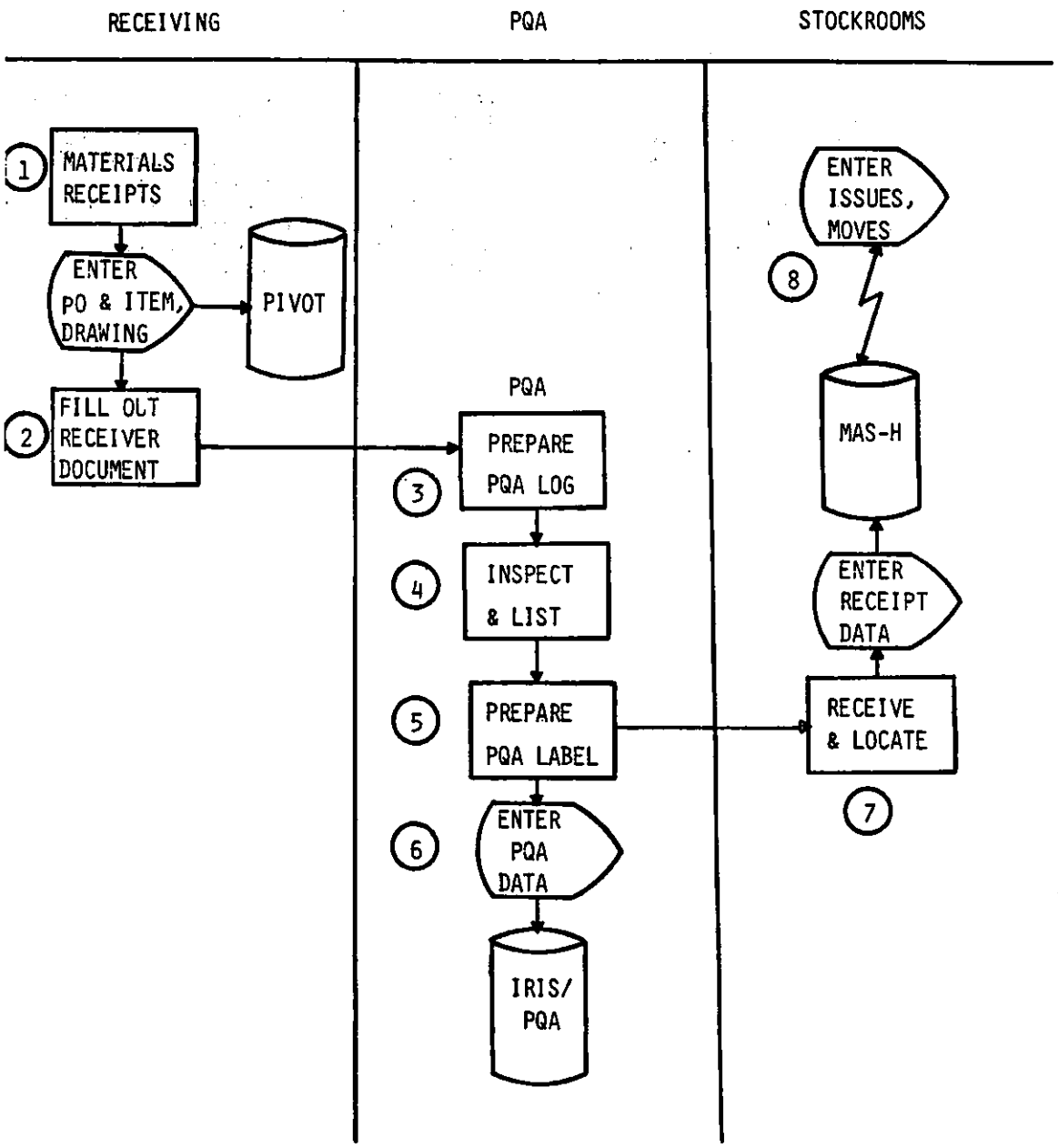
APPLICATION EXAMPLES

MANUFACTURING

General Electrics Nuclear Control and Instrumentation Division in San Jose , Calif. processes over 5000 inventory transactions a day through its manufacturing system. This manufacturing system is a hybrid combonaion of Martin Marietta's MASH package and several locally developed systems (PIVOT & IRIS). Originally running on two seperate HP3000's with no realtime interface the flow went in to receiving (PIVOT), then to PQA - inspection (IRIS/PQA), and then to the stockroom (MASH). Once material was received into the stockroom it could be issued or moved using MASH. All this created the need for redundant data entry, timing problems, and accompanying lack of accuracy.
See the "PRESENT METHODOLOGY" flow.

AUTOMATED DATA CAPTURE

PRESENT METHODOLOGY



It was decided that two courses of action needed to be taken to help minimize these problems: the use of automated data capture and creation of a common integrated material tracking data base.
See the "Project Scope".

AUTOMATED DATA CAPTURE

PROJECT SCOPE

PURPOSE: INCREASE INVENTORY SYSTEM ACCURACY WHILE REDUCING MANUAL DATA ENTRY REQUIREMENTS

OBJECTIVES:

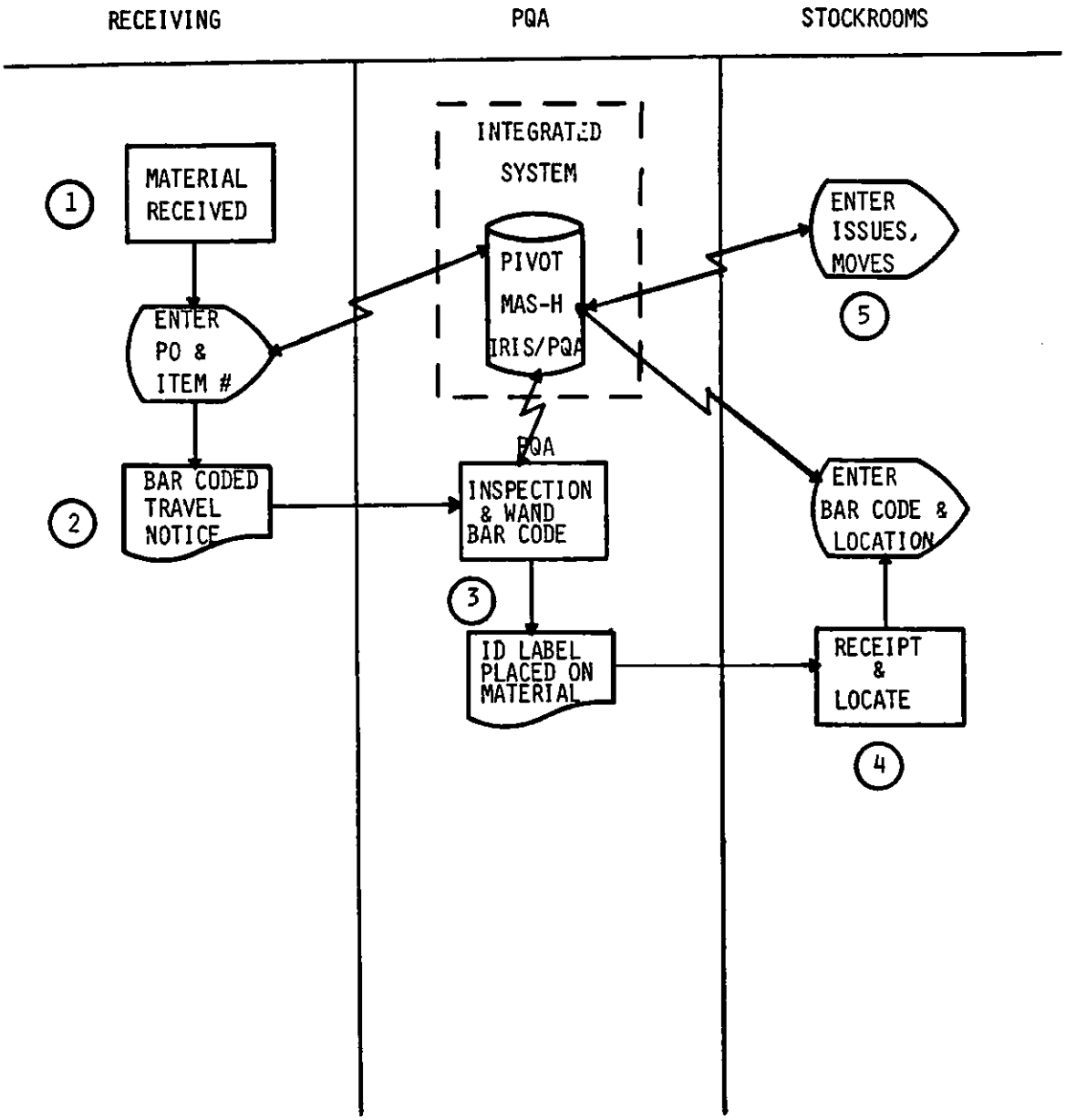
- REAL TIME DATA CAPTURE
  - ELIMINATE TIMING PROBLEM
- BAR-CODE DATA ENTRY
  - ELIMINATE MANUAL DATA ENTRY ERRORS
  - AUTOMATIC ENTRY OF MATERIAL LOCATIONS
  - INCREASES SPEED AND ACCURACY OF INVENTORY COUNTING PROCESS
- TRACKING MATERIAL
  - COMMON DATA BASE
  - ONE COMPUTER SYSTEM

A new system flow, utilizing bar codes for data capture, was identified (see BAR CODE MATERIAL TRACKING PLANNED METHODOLOGY).

AUTOMATED DATA CAPTURE

BAR-CODE MATERIAL TRACKING

PLANNED METHODOLOGY



Under this flow five steps were identified:

1. Material Received.
   PO Number and Item-no are entered into a receiving screen.
   The receipt is recorded and added to a common tracking data base.
2. A Travel Notice (like a move ticket) with a bar coded Travel Notice number, is printed at the receiving work station. One travel notice for each individual PO/ITEM-NO combinaton is printed.
3. As material arrives at inspection (PQA) the bar coded TN number is scanned real time to change it's locaion. Once inspection is complete, bar coded labels for all parts are printed and applied individually to each part as it is packaged.
4. Once packaged and labeled, material leaves PQA and arrives at the stockroom. The TN number is scanned to update its location. A material handler takes the parts and puts them away. Using a portable hand held reader, the item-no and store location are scanned and the putaway quantity is keyed in.
5. Material can be moved and issued by using a portable reader at the store location: scan item-no and store location, key in work order-no, and key in quantity. Eventually work order-no will also be bar coded. Optionally a real-time hand held device can be used to record those transactions by using the accompanying paperwork.

Looking at this system strictly from the bar code perspective, four different operations (and types of hardware) are being used:

1. Printing bar coded documents - the TN document.
2. Scanning the TN number with a hand held real time reader.
3. Printing bar code labels, one for each part in a high volume.
4. Scanning the bar coded label and storage location label with a portable hand held device. Key quantity into this same device. When the portable reader is full, download the data to the HP3000.

Additional operational restrictions were the capability to print a bar code label in a minimum of four seconds, being able to print a bar code label that could represent 22 code39 characters in less than 3 inches of width, and making sure all hardware was fully compatible with HP3000. Since both item-no and location were alpha-numeric characters, code39 was chosen. All bar code hardware had to be able to work with code 39.

For printing the bar coded TN document the HP2631G, option 200, was selected. Since its only IO port is an HPIB, it must be driven from an HP2648A graphics terminal on the HP3000. Although the option 200 printer has the capability to produce bar codes, there is no software package available with it to do this. Consequently it was necessary to write a COBOL program sending different series of escape sequences through the HP2648A to the HP2631G. Fortunately the instructions for doing this are documented fairly will in the option 200 manual.

The HP16800A was selected as the real time hand held reader. This device was so easy to use and integrate into the existing system, that 10 minutes after unpacking it, the reader was fully functional. The only setup required is checking and possibly resetting 24 toggle switches on the back of the unit.

Hardware selection for printing bar code labels was more difficult. The bar code size and print speed requirements ruled out dot matrix. Cost constraints eliminated the high cost printers. Finally a drummer type printer manufactured by INTERMEC(8220) was selected. In spite of the fact that this printer has an RS232 port and should communicate directly with the HP3000, it lacks the necessary internal protocol. This was solved by using a data concentrator to dirve all the label printer. This device is basically a 16 port multiplexor, with special firmware for an HP3000 interface.

However no HP3000 foreign device interface is that easy. The INTERMEC data concentrator will only work in an ENQ/ACK protocol. This means the data concentrator must be driven by a special SPL program that totally controls its protocol.

Selection of a portable hand held device was based as much on the ability to interface to the HP3000 as the ability to collect the required data. The hand held portable had to be programmable for structuring the input data, plus easy for the operators to learn and use. All the data collected in the portable had to be directly downloadable to the HP3000 via an RS232 line.

Although several portables would handle the data collection operation, the Telxon was judged to be easiest to interface with the HP3000. Working on a DC1/DC2 protocol, data can be copied from the Telxon terminal to the HP3000 as simply as using FCOPY. A specific application program was written however, to handle the communications and error routines.

For a major system implementation, the the bar code system was installed with very few problems and, once they were corrected, was very well received by the users. The major problems encountered during implementation were:

1. Having to rework the basic data concentrator protocol. This was due to innadequate testing with multiple system users printing bar codes.
2. Having an initial first read rate below 50%. Printing bar code labels that were too long for their height caused this problem. For a 22 character item-no printed using code 39, over 2 1/2 inches in length were required while the height remained 0.3 inches. With those particular dimensions it is almost impossible for even the steadiest of hands to successfully scan the bar coded label. The solution was to remove lot-no from the right most portion of item-no effectively reducing it to 16 characters in length. This in turn allowed the first read rate to climb to well over 80%.
3. During the first few days of using portables, the material handler would not turn them in for downloading until the terminal's memory had filled up. In two cases that meant loosing some the data that had been collected. It also made the data less real time. The solution was for every material handler to turn in each terminal at least every couple hours. That way the data is close to real time, and the terminal memories are impossible to over fill.

No other major problems were encountered upon implementation. This wa due in a large part, to almost totally planning out a good bar code system strategy. Making sure that a bar code created on one type of printer can be interpreted by both types of readers. The volume levels and size requirement were planned out in the beginning. The system is capable of producing the right types of bar codes at the time they're needed. And the data elements chosen to be bar coded were the right ones. They provide for optimal cost effectiveness and the efficiency of saving time.

DISTRIBUTION

The area of distribution, with its critical high volume material flows and its need for fast turnaround provides an excellent area for further bar code application. One such opportunity is within the new Warehouse Management (WM3000) package, currently being developed ar HP. This project is somewhat unique in that the use of bar codes is being integrated into the system design.

The front end warehouse flow goes from receiving, through any inspection or packaging areas, to putaway. Putaway includes producing a selected (on demand) routed putaway report. The other half of the system flow starts with picking, goes through packaging, to shipping. Bar code applications will be implemented at the following points:

1. Receiving.
   As a single purchase order line item is received, a bar coded move document can be automatically printed. If an entire truck load shipment is to be received at once, a bar coded report listing everything on the shipment can be printed.
2. Tracking
   As each receipt moves through different areas of the warehouse its path can be recorded and tracked by, minimally, scanning the move document number with a real time hand held device.
3. Putaway.
   Rather than printing a requested putaway report, it can be optionally downloaded to a portable hand held reader. The material handler then takes only the portable reader and the items to be putaway out to the stock area. In serial fashion each location will appear directing the person where to go. As each item is putaway, the item-no is scanned and the putway quantity verified. Then the next location to be putaway is displayed. When the putaway is complete, the portable reader is returned to a work station where the putaway confirmation data is downloaded to the HP3000.
4. Cycle Counts.
   Cycle counts can work one of two ways, using a printed cycle count report or downloading the proposed count information to a portable hand held device (very similar to putaway). The portable device, if used, would direct the material handler throughout the warehouse. When all cycle counts are complete, the portable is returned to a work station and its data downloaded to the HP3000.
5. Picking.
   Based upon a variety of criteria a pick list is requested. It can be printed, or loaded to a portable bar code reader. From here on in, the scenario is like putaway going in reverse.
6. Packaging/Shipping.
   As each line item passes through the packaging and shipping area, the bar coded pick number is scanned to automatically record its movement.

To ensure optimal integration and ease of use, the entire bar code system will use only HP hardware, including some new low cost bar coding equipement.

THE FUTURE

Before discussing the specific future of bar codes, what about other possible alternatives?

OCR - Optical Character Recognition.

OCR uses a special style of human readable characters which can be read by page readers and hand held wands. Hand held wands have not caught on because of expense and limitations (they can only read 0-9 plus 8 alpha characters). The number of misreads today is significantly higher than for bar codes. Until low reader cost and virtually error free reading can be offerred, OCR will gain little in popularity.

Magnetic Stripe.

Magnetic Stripe is prohibitively expensive both to print and read. Until some breakthru in cost occurs, it will remain beyond the reach of most systems.

Bar codes on the other hand, are getting cheaper, more popular, and seem to be on the steeply rising portion of the life cycle curve. Things to look for in the near future are less expensive, more versitile products. HP is making a comitment in this area.

There are already a lot of very good, very advanced technologies available today. The use of hand held laser scanners will continue to grow. Although superior to wand scanners, they currently cost a lot more - enough to negate most of the relative benefit.

Automated material handling equipment is here, but must become more cost effective. Look for software packages like WM3000 to commonly control product sortation systems in the near future. And soon after, the control of stacker cranes and forklifts.

CONCLUSION

When trying to design a bar code system, first make sure your problem is one of data collection. Is there a problem with data costs, accurracy, and timeliness? If you're convinced that bar codes are the solution to your problem, then approach their use very systematically:

1. What data element should be bar coded?
2. How should the data be stored?
3. How should it be retrieved?
4. Set up a plan for measuring the success or failure of your bar code implementation.

And finally, when your ready to make a decision: select good quality equipment, make sure it will interface well with the HP3000, and ensure it can be serviced quickly and effectively.