Unit 5 □ Retrospective Conversion and Bar-coding

Structure

5.0 Objectives

The objectives of the Unit are to understand :

- What is retrospective conversion of library catalogues
- Importance of retrospective conversion
- Stages of retrospective conversion
- Processes of retrospective conversion
- What is bar coding
- Importance of bar coding in the library context
- Important points should be considered in selecting bar code symbology

5.1 Introduction

One of the fundamental services that a library offers, in addition to collecting and preserving the frutis of a society's intellectual endeavors, is to describe and organize

its collections in order to guide poeople to materials on a certain topic or by a certain author. Libraries collect information, make it readily available, and present that information in an organized fashion. For hudreds of years, libraries are providing indexes and lists of what they owned only in paper form. One of the most highly developed (and cherished) systems of this kind of access is the card catalogue.

Retrospective conversion is a process of creating online cataloguing records for existing documents of a library. That is, it is the process of turning a library's existing manual catalogue into a machine-readable form. The success of retrospective conversion is less linked to the chosen technique itself than to the care bring to the initial analysis, i.e., the main issue is less technological than methodological.

Retrospective Conversion is the process by which data on each item in the library is entered into a computer system so that they can be integrated into the database that is the very foundation of many if not most of the services that the Library provides. The majority of the catalogues to be converted are card catalogues; however other forms include printed book and sheaf etc.

5.2 Benefits of a Retrospective Conversion

The benefits of retrospective conversion of library catalogue records are both local, within the holding institutions, and to the wider library, research and scholarly communities. Once the catalogue records are created they are valuable in themselves since other libraries and services can use them without duplicating professional effort. The some of the advantages of conversion of the card catalogue of a library to online records are :

- It provides greatly improved access for users to the library's collection.
- Facilitate remote access to the library catalogue
- Online catalogue record contain more information than the cards
- Integration of records for older material with current cataloguing
- A much better return on the capital value of a library's stock is achieved, maximizing the value of an investment made over a long period of time.
- The inter-library loan system does not become needlessly burdened with requests that could be satisfied from local stock if only the catalogue records for all items in the library were recorded in machine-readable form.
- Scholars and researchers are provided with information, not previously available, for unique or rare items.

- The burden of supplying items too frequently demanded from a few institutions can be shared since the locations of additional copies are known.
- Individual libraries are, for the first time, able to assess their own holdings in the wider national context enabling prudent management decisions to be made in relation to the acquisition, preservation and withdrawal of items.
- The production of a more accurate picture of the nation's total bibliographic resource.
- Facilitate automated circulation using member and item bar codes.
- There is recognition of the importance of organizing efficient and fair access to the total national resource of bibliographic records.
- Computer technology allows the creation of union catalogues in database form at low unit cost, giving immensely greater availability, far easier to maintain and keep up to date.

5.3 Phases of Retrospective Conversion

Retrospective conversion involves several considerations and it can be accomplished in several ways. The optimum method or combination of methods for a given library depends on many factors. The phases of retrospective conversion are :

- Phase I : Preparing for Retrospective Conversion
- Phase-II : Selection of Retrospective Conversion Techniques
- Phase-III : Staffing
- Phase-IV : Quality Control and Problems Resolutions
- Phase-V : Bar coding

5.3.1 Phase-I Preparing for Retrospective Conversion

This phase is concerned with formulation of goals, selection of conversion basis, and weeding out etc. It consists of the following steps :

- **Goal Setting :** It is essential to assess the expectations of the library, needs and requirements. The impact factors are : possible participation in library network, time available, quality of source of information, and need for reclassification etc.
- **Selection of Sources of Information :** It is necessary to establish a conversion basis, which depends on the completeness of information available in different possible sources : Accession Register, Shelf-List, Catalogue Card, and Non-MARC records etc.

- **Identification of Local Fields :** Current practices for recording this type of information need modification. Some systems will allow local data to be entered in variety of fields, while others require information to be entered in a special field.
- **Selection criteria for matching :** It is necessary to evaluate information from several fields to ascertain that a record matches the item on hand. To be considered a match, the database record and the shelf-list record will normally have same title, author, place, publisher, date, pagination, edition etc. However, "match" may occurred even if there are certain discrepancies between the two set of records under certain conditions. Cataloguing rules and procedures have changed over the years, and cataloguing also involved certain degree of personal interpretations. Hence, there will often be minor variations between shelf-list cards and other sources of information (records in databases).
- **Establish priority :** Retrospective conversion is time consuming activity, Hence, prioritize the collections for computerization on the basis of certain well enumerated policy.
- **Verification of shelf-list :** Weeding is an ongoing process but it becomes critical when the decision to automate is made. Determine what exist in the collection to ensure that each record is worth conversion. Titles/copies no longer in the collection or may be discarded should not be converted.
- **Selection of record format :** To ensure completeness of information and possibility of participation in library resource sharing programmes etc, It is essential that standard MARC formats for bibliographic descriptions and authority controls in case of personal and corporate names, geographic name, and subject heading etc. should be followed in aspects of cataloguing.
- **Funding :** Both the one time costs and the continuing expenses of retrospective conversion are substantial. The library must commit funds to support record conversion and to maintain records in an automated system. A funding plan will help to determine internal funding resources and the need for external funding. The plan should estimate costs based on following factors : Collection size and types, media of exposition, language and scripts, completeness of present information, standardization, expertise needed, hardware and software cost, cost of annual maintenance etc.
- **Documentation :** It is crucial to successful retrospective conversion and automation programme. If changes in procedures are necessary, add them to the specification. To ensure efficient work flow, different types of manual should be prepared on various facets of the programme.

5.3.2 Phase-II Selection of Retrospective Conversion Techniques

There are different methods of retrospective conversion available today; ranging from manual transcription of cards to fully automated OCR technology. The following cases must be considered separately :

- **Manual Transcription :** It is time consuming process. Need higher initial facilities for conversion of records.
- **Downloading :** Using machine readable data may immediately seem the best solution, it still involves certain works :
  - Relevant records have to be retrieved and extracted from the source database
  - Certain adaptations and enrichment are necessary-adapting authority file based headings, subject terms and local notes etc.
  - Input of local data : class number, book mark, location mark(s), and accession number etc.

Machine readable records may be created in many ways. The choice of a technique or a combination of techniques depend on the different states in which the records may be available, such as

- Catalogue cards or its equivalant, bibliography
- Catalogue cards in digitized form
- Plain text
- Structured text

- **OCR :** The application of optical scanning technology to retrospective conversion continues to evolve. Information currently on paper, microfilm and other media can be scanned and through OCR, made accessible in electronic form for use online. Applying MARC tagging to the bibliographic information will allow the creation of full MARC records.

  Incomplete cataloguing information and illegible or handwritten cards can create problems for this technology. However, these obstacles are small when compared with the possible applications for automating searching, matching, adding local information, and creating new records.
- **Combination of above methods :** An organization may be in a position to employ all these techniques depending on availability of suitable opportunities and/or resources.

5.3.3 Phase-III Staffing

Staffing issues will arise in different steps of the retrospective conversion of library catalogue. There will be additional work for existing staff, and perhaps the need to hire additional staff to assist with such activities as weeding, preparing shelf-list, retrospective conversion (i.e., inputting data/importing data etc.), and implementing the System. The two primary approaches to staffing are :

- Off-site
  - Full vendor contract
  - Batch retrospective conversion
- In-house
  - Libraries can use a number of staffing arrangements to complete a retrospective conversion. In some cases, combinations of arrangements may be preferred. The choice depends on the following points :
    - Budgets
    - Collection size and type
    - Quality expected
    - Time constraints
    - Expertise

5.3.3.1 Full Vendor Contact

An off-site conversion is the easiest and most comprehensive way to convert catalogue provided up to date and complete catalogue is available for the collection. The selected vendor(s) completes the project. The fee is based on various factors, such as **:**

- Volume of records to be converted
- Types of materials
- Languages of the materials
- Special Knowledge requirements
- Volume of new records to be created
- Assignment of local information-subject heading, call number, and location etc.

The library is responsible for complete specifications. The vendor(s) and the library should select a contact person at each end to handle all details. The method does not require additional personnel and equipment. It does not affect curent workflow pattern.

Advantages and limitations of full vendor off-site conversion of library catalogues may be summarized as follows :

Advantages	Limitations
● No need to hire, house, train and supervise retrospective conversion staff ● High conversion rate ● Records meet the quality standard ● Less expensive	● Transfer of source of information (Shelf List Cards) may create problems ● Quality check is a concern ● Not employing high quality workers by the vendor to keep the cost of conversion low

5.3.3.2 Batch Retrospective Conversion

This process is beneficial if the collection consists of mainly books and monographs. If the machine readable records of the collection exist, the data can be formatted for machine upgrading. When pre-existing machine readable records are not available, search arguments are created and entered on floppy for processing. Both alternatives allow the input of local data.

The vendor is responsible for retrieving of matching records. Batch conversion is generally do not allow creation of original records. As a result, no-matches must be resolved by some other method. The cost for batch conversion is generally a unit charge based on the number of records converted. Some vendors may charge a processing fee for each batch processed. Others may require a minimum amount of processing volume.

Advantages and limitations may be summarized as follows :

Advantages	Limitations
● Inexpensive ● Very high rate of conversion ● Library control the quality of data entry ● Vendor(s) takes the responsibility of hardware and software needs.	● The library may have to hire, train, house, and supervise retrospective conversion staff ● Problems of multiple matches should be resolved. ● Quality of records may not satisfy requirement of a MARC format.

5.3.3 In-house Retrospective Conversion

The library may decide to perform retrospective conversion using a large database which generally have hardware and software support for cataloguing. The library enjoys complete control over creation and editing aspects of the retrospective conversion. The immediate costs for this type of conversion programmes are :

- Subscription of databases
- Search charge, if any
- Transaction fees : addition of holding data, download charges etc.

Advantages and disadvantages are :

Advantages	Limitations
• Quality of records depends on the performance of the library workers. • New records can be created at the time of detection • Library control the project	• The library may have to hire, train, house, and supervise retrospective conversion staff • Problems of multiple matches should be resolved. • Quality of records may not satisfy requirement of a MARC format.

5.3.4 Phase-IV Quality Control and Problem Resolution

It often comes toward the end of a retrospective conversion project, and it deals with relatively small portion of the total record processed. The integrity of the database depends, in part, on standardization of the editing process. Retrospective conversion problems solving requires a historical as well as current knowledge of cataloguing policy. Professional who earned their degree since adoption of AACR2 need to take crash course in cataloguing history to understand the format of some of the records they will encounter.

It also requires knowledge of insitution specific cataloguing practice and accession policy etc. Knowing what is not possible on the local system helps to define and limit the options available for solving the problems. Problems in retrospective conversion can be categorized as follows :

- Elements of Bibliographic Descriptions
- Title problems
- Main title and a supplement belong to the same record

- Date problems
- Edition conflicts
- Collation problems
- Photocopies of thesis/monographs
- Publishers
- Independently published items bound together
- Authority control
- Weeding problems : Lost, missing and withdrawn volumes
- Database preparation
- Duplicate record resolution
- Merging local information
- Filling indicator

5.3.5 Phase-V Bar coding

Bar codes were first introduced in the early 80's in the USA to support the grocery industry. Their usage received a forced boost in 1982 when the Department of Defense, USA issued Military Standard 1189, requiring their suppliers to adapt to their far code standards. One thing to remember with bar codes-the application software that accepts the bar code data is in 95% control of the success or failure of an application.

5.4 Opportunity and the need for a National Strategy

There is recognition of the importance of organizing efficient and fair access to the total national resource of bibliographic records. There is concern that all converted records should meet bibliographic standards of a level, which will ensure effective consultation and exchange.

Within the higher education community there is ample empirical evidence that, if retrospective conversion is left to the decisions of individual institutions, its achievement will be haphazard and long-drawn out. Since the achievement of 'universal' retrospective conversion will benefit the whole of the centrally/state funded community, it seems essential to promote a co-coordinated national effort. Further more the centre/state community is both the major provider and the major user of the scholarly library resources in India. It is therefore a responsibility for the centre/state sector to make its own major contribution towards unlocking the nation's total resource of scholarly library material.

There is a need to develop a strategy for implementing a national programme of retrospective conversion. This should incorporate a business plan with tight budgeting and be prepared at an early date. If nothing is done, the consequences for research, especially in the humanities and social sciences, will be seriously affected and will prevent the full use of the unrivalled resources in the nation's often unknown and frequently under-utilized library collections. Significant developments in recent years have provided both the challenge and the opportunity to tackle the retrospective conversion of library catalogues at a national level. A distributed approach, presenting a virtual union catalogue to the user, is the likely way ahead.

The implementation and management of a national programme should be entrusted to an umbrella management group, representative of bodies currently active in the field. This group should have its own secretariat and be responsible for :

- Overall planning,
- Funding,
- Establishing criteria for projects and priorities,
- Tendering,
- Ensuring that catalogues/databases are properly maintained, standards met, and regular monitoring of progress.

There is a need for one body to have responsibility for coordinating a national strategy. At present, agencies and institutions operate independently; there is no single body with overall responsibility for coordinating projects and setting priorities for retrospective conversion in India. The national body must address the following issues.

- **Complexity :** Retrospective conversion of library catalogues is complex. In addition to the number of records requiring conversion, there are problems posed by the sheer range of meterials; the languages and scripts involved; and making sure that the large number of libraries from so many sectors-each sector with its own priorities-can work together effectively toward a common goal.
- **Access to items :** A national programme of retrospective conversion requires agreed criteria to ensure satisfactory access to items in the collections of the participating institutions. The legitimate interests of owners must be protected. In return for funding, reasonable facilities for access must be guaranteed for consultation of material, either in its original state, or, where this is not possible, in a surrogate format.

- **Access to catalogue records-standards and distribution :** Converted records will need to be produced to acceptable standards and a decision made as to how these records are to be distributed and accessed. The common bibliographic data and formal rules to which converted catalogues conform should be the minimum required to enable the catalogue records to be consulted effectively and exchanged within and across national boundaries. Records created as a result of a national retrospective conversion programme should ideally remain in the public domain.
- **Staffing and expertise :** There is a need for skilled cataloguers (they are no longer produced by departments of library and information studies in the numbers that they were) and expertise in the management of retrospective conversion projects. Many smaller libraries, and libraries which are not publicly funded, are administered by part-time or voluntary staff and, even when the necessary expertise is possessed by the staff in post there may be little or no spare time to undertake the additional work involved. In the event of a team of cataloguers with the necessary skills being appointed, or brought in form outside the library, the necessary accommodation and equipment must be available.
- **Preservation :** It might be argued that increased handling of items can lead to accelerated deterioration in the physical condition of the items concerned. Collections are far more likely to be in danger through lack of knowledge of what they contain, or inadequate awareness by the owning institutions of the value of the items they possess. This can easily lead to neglect and dispersal of material and prejudice scholarship and the value of collections.
- **Priorities :** Priorties will need to be set to determine which catalogues should be included in the initial phase of a national programme. If the catalogues of larger library collections are converted first then many smaller libraries can benefit from access to the records created; however, conversion of records in particular subject areas, languages, or by dates of publication might be deemed to have greater importance. Priorities will have to be set with full knowledge of local circumstances and other factors, which might assist the shaping of a particular project.
- **Collaboration :** The success of a national programme must depend on the collaboration of libraries across sectors. Cooperation will entail guarantees on the part of participating libraries that they will provide reasonable access; ensure retention of material for which catalogue records have been converted and, as a general rule, contribute to the funding costs; although for many

smaller and privately funded libraries financial inducements to participate in the programme are likely to be necessary.

- **Costs :** Money is vital to solving the problem, as the total cost of retrospective conversion nationally would be very high. As a general rule, matching money would be expected from institutions in receipt of special funding—this could be in 'kind', but it could also come from a third party. Allowing for matching money of 50 per cent, the additional money required would be provided from the central pool.
- **Management :** Machinery will have to established for managing a national programme—to coordinate effort, set priorities, target funds and ensure the maintenance of the programme. There needs to be proper management of the awarding of grants; the progress of individual institutions will need to be monitored; applications will have to be vetted; allocation of funds accommodated within budgetary constraints and decisions taken to ensure that the greatest benefits from the programme are derived at the earliest possible date.

5.5 Barcode

Barcodes are a fast, easy, and accurate data entry method. The correct use of barcodes can decrease employee time required and increase an organization's efficiency. One thing to remember with bar codes : the application software that accepts the bar code data is in 95% control of the success or failure of an application. Remember that bar codes are just another data input method. Barcodes can be read by optical scanners called barcode readers or scanned from an image by special software.

5.5.1 Definition

A **barcode** (also **bar code**) is a machine-readable representation of information in a visual format on a surface. A bar code is a series of varying width vertical lines (called bars) and spaces. Bars and spaces together are named "elements". There are different combinations of elements, which represent different characters. It is an automatic identification technology, which encodes information into an array of varying width parallel bars and spaces.

The barcode usually does not contain descriptive data. The data in a barcode is just a reference number, which the computer uses to look-up associated record(s) which contain descriptive data and other relevant information. That is, barcodes typically have only identification data in them.

5.5.2 Structure

When a barcode scanner is passed over the bar code, the light source from the scanner is absorbed by the dark bars and not reflected, but it is by the light spaces. A photocell detector in the scanner receives the reflected light and converts the light into an electrical signal.

As the wand is passed over the bar code, the scanner creates a low electrical signal for the spaces (reflected light) and a high electrical signal for the bars (nothing is reflected); the duration of the electrical signal determines wide vs. narrow elements. This signal can be "decoded" by the bar code reader's decoder into the characters that the bar code represents. The decoded data is then passed to the computer in a traditional data format.

Every barcode begins with a special start character and ends with a special stop character. These codes help the reader detect the barcode and figure out whether it is being scanned forward or backward. Some barcodes may include a checksum character just before the stop character.

5.5.3 Benefits :

- Improve Operational Efficiency : Since barcodes permit faster and more accurate recording of information, work in process can move quickly and be tracked precisely. Quite a bit of time can be spent tracking down the location or status of documents, or anything else that circulates within a library.
- Save Time : Depending on the application, time savings can be significant. Even in routine day-to-day operations the time savings of barcodes add up and improve productivity. Consider a checkout/check-in of 10 documents; it will take approximately 5 minutes or more to write down document details and accession numbers compared to about 10 to 20 seconds to scan the barcodes. In a busy operation this can be a significant saving.
- Reduce Errors : Clerical and data entry errors can be a significant source of costs and related problems : unhappy member, and time spent to track down problems are just a few examples. The typical error rate for human data entry

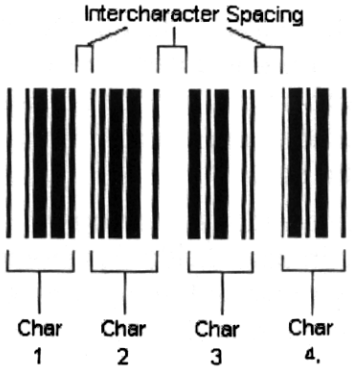
is 1 error per 300 characters. Barcode scanners are much more accurate; the error rate can be as good as 1 error in 36 trillion characters depending on the type of barcode used.

- Cut Costs : Barcodes are effective tools that can be used to address specific, localized problems or integrated into organization-wide information systems. When applied with thought and planning they can save time and reduce errors, resulting in a reduction of costs.

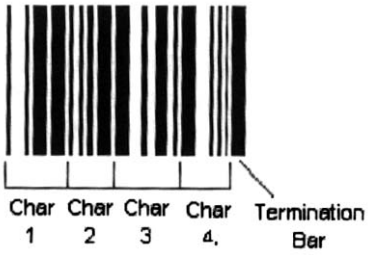
5.5.4 Symbologies

The mapping between messages and barcodes is called a **symbology.** The specification of a symbology includes the encoding of the single digits/characters of the message as well as the start and stop markers into bars and space, the size of the quiet zone required to be before and after the barcode as well as the computation of a checksum. The characteristics are :

- Character Set : A Character Set refers to what data a given barcode symbology can encode. Generally, there are three types of character sets : Numeric, Alpha-numeric, and Full ASCII. In theory, a numeric character set will produce the smallest barcode whereas a Full ASCII character set will require more physical space to encode the same data. Of course, a Full ASCII symbology gives more flexibility in encoding more types of information than a numeric symbology.
- Types : There are generally two types of barcode symbologies : discrete and continuous.
  - A discrete symbology is one where each and every character encoded in the symbol may be interpreted individually without respect to the rest of the barcode. Such symbologies have characters that both start and end with a bar. Individual characters are separated by some amount of inter-character spacing. The inter character spacing carries no information-the only duty of the inter character spacing is to separate the characters.



- A continuous symbology is one in which the individual characters of the symbology cannot be interpreted by themsleves. This is due to the fact that characters start with a bar and end with a space. The final space is "terminated" by the starting bar of the next character. A character cannot be taken individually since, individually, there is no way to know how wide the last space is without knowing where the next character begins. Continuous symbologies normally implement some kind of special termination bar or termination sequence such that the termination bar terminates the last space of the last data character.



In the above example, each character is consists of four bars and four spaces. The first bar of character 2 terminates the last space of character 1. The first bar of character 3 terminates the last space of character 2. The first bar of character 4 terminates the last space of character 3. The termination bar terminates the last space of character 4.

All else being equal, a discrete symbologies require more space to print the same data as a continuous code since the discrete symbology "wastes" space in the inter-character spacing. However, a discrete symbology can generally be printed with less quality-this translates to cheaper printers and more tolerance at scan-time. Other than the amount of space the two types of symbologies require and the types and quality of hardware used to print them, there is no inherent difference in the security afforded by either type. That is to say, it cannot be said that "continuous symbologies are more reliable and secure than discrete symbologies"-nor can the reverse be said.

- Two-width/Multiple-width symbologies : the number of "widths" encoded in its barcodes can also divide Symbologies.

A **Two-Width** symbology has spaces and bars that are either wide or narrow. This has the benefit of simplicity-once it is determine how wide a "narrow" bar or space is, anything over a certain width can be considered "wide". This allows for a large level of print tolerance in lower-quality printing conditions.

A Multiple-Width symbology is one, which has bars and spaces that may be of 3 or more widths. The narrowest bar or space may be X in width, a medium-width space or bar may be 2X in width, and a wide bar may be 3X in width. Since there are more possible combinations available in a multiple-width symbology, data encoding is often more efficient and results in a tighter barcode.

- Fixed/variable Length Symbologies : Symbologies may be either fixed or variable-length.

  A **fixed-length** symbology is one, which must, by definition, encode a certain number of characters or digits. For example, a UPC-A barcode always encodes 12 digits of data. An application may not encode less or more than the pre-defined fixed-length of 12 characters. The symbology itself defines the length of data.

  A **variable-length** symbology is one, which can carry a message of any length. For example, Code 128 may encode any number of characters that can reasonably fit physically in the printed barcode. The symbology itself does not define how many characters of data must be encoded.

  Note that a variable-length symbology can be implemented by an application such that it is, in effect, fixed-length. For example, if you are enocoding an identification number that is always 10 digits in length using Code 128 you are implementing code 128 as if it were fixed-length. However, the fact that you can choose the fixed-length means the symbology itself is variable-length.

5.5.5 Selection of Symbology

For new bar coding projects that don't have industry or customer standards; Code 39 is the typical non-food standard, because almost all bar code equipment reads/prints Code 39. However, Code 39 produces relatively long bar codes; it is not particularly efficient in bar code density, (the maximum density is 9.4 characters per inch including 2 start/stop characters).

Where the label width is an issue and there is numeric data or lower case data, Code 128 is the best alternative; Code 128 also has an extra efficient numeric only packing scheme to produce very dense bar codes, and Code 128 has all 128 ASCII characters. Not all readers read Code 128, so before you settle on it as a standard, be sure that your reader is 128 capable.

The larger the width of the elements, the more space it takes to print the bar code; therefore, the lower the bar code density. The thinner the bar and spaces, the less space

is required and the higher the bar code density. Lower density bar codes are more reliably printed and more consistently read than higher density bar codes, because minor variations (due to printing or damage) are much more serious with high density bar codes-the percentage of distortion is larger. Look at the samples below of different densities :

5.5.6 Barcode Reader/Scanner

There are two basic types of bar code readers : fixed, and portable batch. Fixed readers remain attached to their host computer and terminal and transmit one data item at a time as the data is scanned. Protable batch readers are battery operated and store data into memory for later batch transfer to a host computer. Some advanced portable readers can operate in non-portable mode too, often eliminating the need for a separate fixed reader.

A basic bar code reader consists of a decoder and a scanner, (a cable is also required to interface the decoder to the computer or terminal). The basic operation of a scanner is to scan a bar code symbol and provide an electrial output that corresponds to the bars and spaces of a bar code. A decoder takes the digitized bar space patterns, decodes them to the correct data, and transmits the data to the computer over wires or wireless, immediately or on a batch basis.

5.5.6.1 CCD and LASER Scanners

CCD scanners are a “can’t miss” scanner too. Most have to be placed on the code for reading but some offer “laser-like” distance reading. Some are triggerless and some require the trigger or button to be pushed to initiate reading. CCD scanners scan around 50 times per second; so unsuccessful read attempts go unnoticed.

Traditional CCD scanners have a “depth of field”, (how far you can be away from the bar code and still get a read) of only ½". They have to be placed on the code to

get a read. Just recently, CCD scanners have been developed with a depth of field previously only achieved by laser scanners. These CCD scanners are so unique that they have been termed "Linear Imager" scanners.

With Laser scanners and CCD scanners now sharing the same range, it is important to know the difference between them. Laser scanners use a single spot of light that sweeps accross the bar code in a linear fashion. In a sense, lasers act like a wand, transmitting the signal for each bar and space as it "scans" across. This "scanned" pattern is then decoded. A CCD scanner on the other hand, uses an LED array with thousands of CCD light detectors for the reflected light. The entire bar code "image" is capured and then the array elements are transmitted to form a signal pattern identical to the "scanned" pattern from a wand or laser. There are no moving parts in a CCD scanner. The advantages of moving beam laser scanners are :

- Reading bar codes from a distance (typically 3-18 inches, or up to 17 feet with reading low density bar codes).
- Reading moving objects on an assembly line.
- No-hands operation. Some lasers can be mounted to turn on automatically when an object passes under the scanner. Typically used in blood banks, library check-out, etc.
- Reading through glass windows or thick laminates.
- Reading bar codes on curved surfaces, (bags of parts).
- Reading bar codes inside difficult to reach enclosures.
- Laser scanners emit a laser light beam, which sweeps back and forth across the bar code 36 times per second. At this rate, unsuccessful reading attempts go unnoticed; you will only be aware of the one successful decode. Once a read has occurred, the laser turns off, requiring you to release and pull the trigger again to reactivate the laser scanner.
- The lower the density of the bar code, the further the laser scanner can read a bar code. The higher the density of the bar code, the closer to the bar code the laser scanner must be.

5.5.7 Printing Barcodes

There are several methods of getting printed bar codes; these are :

- Buying photocomposed bar codes from a label manufacturer.
- Printing bar codes with inexpensive labeling software on dot matrix, laser, or inkjet printer.
- Printing bar codes on a specialized bar code label printer.

- For manufactures who need bar codes printed in their product's packaging, use purchased film masters or use bar code suitable for PostScript @ film output.

Whatever printing source you decide upon, there are a few common sense tips to pass on :

- Stay away from colored bar codes (use black) and colored backgrounds (use white). Any other colors lower the contrast between bars and spaces and therefore lower readability.
- Do thorough readability testing on any labels before distribution. Be careful. Don't discover a problem after you have distributed 10,000 labels that need to be recalled.

With the proper PC software, today's printers are capable of printing excelllent quality bar codes. Ink Jet and Dot Matrix printers cannot print high-density bar codes, but laser printers can. Laser printers actually print the best quality bar codes of any commonly available printing technology.

5.5.7.1 Laser Printing

Laser printer can produce outstanding quality barcode labels. The quality is consistent even when toner gets low. Labels are sectionalized on A-4/any suitable size page in multiple columns and/or rows. Since laser printers feed one sheet at a time, it is impractical to print one label at a time. There is an unprintable area 1/4" inch to the left, right, top, and bottom of any form.

Laser printers are great for producing batches of labels, but if you need only one label (where there are multiple labels per page) at a time, dot matrix or thermal transfer printers are required. Laser printing is the best quality of all types. There are several types of label stock available for laser printers.

5.5.7.2 Ink Jet Printers

These printers are getting better and better. They print pages of labels. Also, use label stock specifically meant for inkjet printers-the stock is usually coated to minimize ink bleed. Always test bar code labels for readability before printing in bulk.

Windows programmes almost exclusively support Inkjet printers. Select a printer that has a separate black cartridge in addition to the color cartridge.

If labels are going to be exposed to water, don't use the inkjet printers-most inkjet ink is water-soluble. Inkjet printers are NOT the best printer to use to print labels that need to withstand the weather or are subjected to constant scanning.

5.5.7.3 Thermal Transfer Printing

Thermal transfer printers are required to print one label at a time or to print a roll of labels so that labels can be applied by applicators directly to boxes. Mostly thermal transfer printers do volume industrial printing in the 90's. They are fast and produce excellent quality bar codes.

Thermal transfer refers to the print head heating up and melting a ribbon onto the label surface. Most thermal transfer printers can also produce "direct thermal" labels, but paper instead of a soft ribbon wears out the print head 10 times faster; another disadvantage of thermal printing is that most thermal labels cannot be read with IR light and deteriorate in sunlight to non-readability over time. The media cost is about the same as laser and direct thermal. Therefore thermal transfer printing is far more popular than thermal printing for serious label production.

The basic paper lables with inexpensive ribbons produce bar codes that can be smeared or smudged with hard rubbing by the fingers. Smudge proof labels can be produced with more expensive synthetic label stock.

The print heads wear out on thermal transfer printers. To maximize the print head life, clean it between every ribbon change to avoid continually replacing print heads. Unlike most dot matrix and laser printers, the thermal transfer printers discussed have scalable text fonts and bar code fonts resident in the printer's firmware. The software necessary to print the bar codes is a series of special command sequences. However, most users want a general purpose design labeling programme which requires no programming.

5.5.7.4 Dot Matrix Printing

Dot matrix printers can produce good quality low volume bar code labels. When printing low-medium (3.7 cpi or lower for Code 39), the labels can be excellent quality. The Epson, IBM, and Okidata printers have adequate graphics capability to yield good quality bar codes.

Both 24-pin and 9-pin printers can produce good quality bar codes. The 24-pin printers produce better bar codes than 9-pin printers, especially as the ribbon is getting low on ink. The 24-pins simply put more ink on the paper. The complete process is quite slow for any practical purpose.

5.5.8 Labeling Software

Because dot matrix, Inkjet and Laser printers are in such widespread use, labeling software to make these printers capable of printing bar codes has become readily available. The are two general types of bar code printing programmes available :

- Menu-driven programmes for operators to design and print labels.
- Bar code font programmes to allow printing of bar codes within other Macintosh or Windows programmes; no programming is necessary by the user.

Now a day, most of the integrated library management programme incorporate sufficiently powerful barcode label printing utility.

5.6 References and Further Readings

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5.7 Exercise

1. Define retrospective conversion of library catalogues, and identify it benefits.
2. Briefly describes different phases of retrospective conversion.
3. What is barcode? Describe its applications.