Chapter 6

Automated Data Collection

Introduction

Automated Data Collection (ADC) is the use of a programmable logic device to capture and enter data into a computer system without the use of a keyboard. The computer relies on machine readable symbols to increase the speed and accuracy of data collection.

Bar code is the predominant ADC technology used. Its applications appear unlimited. It is used for item tracking, inventory control, time and attendance recording, work-in-process monitoring, quality control, check-in/check-out, sortation, order entry, document tracking, access control, personal identification, shipping and receiving, warehousing, and point-of-sale.

Bar code is not a system in itself, rather, it is an extremely effective identification tool that provides accurate and timely data to support management systems.

Bar codes are a pattern of varying-width light and dark elements (typically bars) that represent numbers, letters or punctuation symbols. The encodation scheme defining the data represented by the bars and spaces is called a symbology, of which there are many. The principle behind bar coding is simple. Each code is made up of binary digits. A narrow bar represents the “0” and a wide bar a “1”. In some symbologies, such as the 3-of-9 and Interleaved 2-of-5, the spaces between the bars also have significance.

In use, one may think of a bar code as Morse Code in light. They are really just dots (narrow bars) and dashes (wide bars), and that’s how the scanner sees them. A bar code symbol is illuminated by an infrared or visible light source: dark bars absorb the light and spaces reflect it back into the scanner. A laser scanner has one beam of light being reflected off a vibrating mirror. It “rastors” so fast that it looks like a solid bar. A scanner transforms the light fluctuations into electrical impulses which mimic the dot or dash, just like ship-to-ship messages in old war movies. A decoder uses mathematical algorithms to translate the electrical impulses into a binary code and transmit the decoded data message to a hand-held terminal, PC, controller, or host computer system.

Scanners use visible and infrared light-emitting diode (LED), helium-neon laser of solid state laser diode (visible and infrared) light to read the bar code symbol. Some scanners require contact with the symbol, others read at distances up to several feet. Some scanners are stationary, others hand-held.

The usage of bar coding is an industry accepted discipline.

Benefits

1. Improves Customer Service
    - Reduces picking errors
    - Quicker turnaround
    - Accurate shipping
2. Reduces Inventory Costs
    - More inventory turns
    - Control and lower outdated stock
    - Lower safety stock
    - Better stock location
    - Accurate item receiving
    - Reduces or eliminates paper
    - Identification of slow movers
3. Reduces Non Value Added Tasks
    - Faster receiving and stocking process
    - Daily cycle count replaces periodic physical inventory
    - Less time correcting errors...the error rate for keyboard data entry is one per every 300 characters entered, compared to an error rate of one to every 2,000,000 characters entered by ADC technology
    - Easier recordkeeping
4. Reduce Labor Costs
    - More efficient utilization of time
    - Employee accountability
    - Automatic tie into time recording
5. Improves Cash Flow
    - Advanced shipping notification results in faster notification of shipping and therefore quicker payment.

Steps for Successful Utilization and Implementation

1. Education — Obtain entrance-level education about the technology and what it could do. This guideline and sessions at NAGASA meetings may provide the necessary education.

2. Organize a team.

   - Together identify the problem
   - Determine the cause
   - State the system goal
   - Identify a method to measure the goal

3. Identify types of activities needed to improve to meet the goal.

4. Develop a flow diagram of how the new (improved) system is to work.

   - What happens?
   - Where does it happen?
   - When does it happen?
   - Who makes it happen?

5. Develop a functional specification explaining how the system is expected to work.

   - Include samples of computer screens and reports
   - Examples of labels for production, location, etc.
   - Information to be bar coded and what would be captured
   - Where the information is obtained and is to go
   - Interfaces to other systems

6. Get "buy-in" from the people who are going to use the system.

   - Be sure they understand the change in methods and activities
   - Obtain their input and modify specifications for any improvements obtained.

7. Develop a Request for Proposal from the specifications developed.

8. Request several bar code system suppliers to review the RFP and provide a quote.

9. Meet with the suppliers to understand how the supplier's proposal would meet the requirements. Experienced suppliers may address some issues overlooked by the team

10. Select supplier based upon "fit".

    - People
    - Business System
    - Hardware/Software

11. With the selected supplier, develop the tasks, responsibility for each, and timeline. Keep in mind the human interfaces.

12. Implement. Train and retrain and retrain and retrain.

13. Evaluate. Check to see goal was reached.

Bar Code Symbology

Code 39 (3-of-9) — Code 39 symbology was developed by Intermec in 1974 to meet the requirements for a fully alphanumeric bar code in data entry systems. This bar code is especially effective in applications that use alphanumeric data for item identification. The bar code is also widely employed by users of numeric data who see the advantages and flexibility of an alphanumeric option.

Code 39 is widely used in many industries and is the standard for many government bar code specifications, including the U.S. Department of Defense. Code 39 is defined in American National Standard Institute (ANSI) standard MH10-1983, and is also known as USD 3 and 3 of 9.

The code 39 character set includes the digits 0-9, the letters A-Z (upper case only), and the following symbols: space, minus (-), plus (+), period (.), dollars sign ($), slash (/), and percent (%). A special start / stop character is placed at the beginning and end of each bar-code.

Code 39 can be read by just about every scanner on the market. It is widely used for in-house solution; that is, applications where the bar codes will be used internally. It is also used for transferring data between companies. For example, Automotive Industry Action Group (AIAG) defines a set of labeling standards for marking inter-company shipments within the industry, their labels use Code 39.

See Appendix A for additional code 39 details.

Code 128 — Code 128 provides excellent density for all numeric data and good density for alphanumeric data. It is often selected over Code 39 in new applications because of its density and because it offers a much larger selection of characters. The Code 128 standard is maintained by AIM (Automatic Identification Manufacturers).

The code 128 character set includes the digits 0-9, the letters A-Z (upper and lower case), and all standard ASCII symbols and control codes.

When planning a system, a useful technique to help protect against errors is to include a data identifier (DI) in every bar code. This data identifier tells you what is encoded. For more information and a list of data identifiers, refer to ANSI document MH10.8.2M.

See Appendix B for additional code 128 details.

NAGASA Adopted Bar Code Symbology — NAGASA has adopted the use of the Graphics Industry Bar Code (GIBC) developed by the Graphic Communications Association (GCA). GIBC utilizes code 39 & 128 plus provides supplier bar code labeling formats (data contents) of the Primary and Secondary bar code symbols for use within graphics arts industry. Appendix C provides details of the GIBC specification.

Bar Code Scanning — In the bar code system, the scanner / reader is the device which actually reads the bar code symbol. The scanner interprets the bars and spaces by directing a beam of light at the bar code symbol. The scanner reads by recording, digitizing, and decoding the pattern reflected back from the symbol. The dark bars absorb the light and the spaces or light bars reflect the light.

There are many different types of scanners. However, there are only two basic categories: contact and non-contact.

CONTACT scanners are the type that have to touch or come in close proximity to the bar code symbol. Wands, penlights, and CCD's (Charged Coupled Devices) are examples of the contact scanners. The contact scanner is typically less expensive than the non-contact scanner.

NON-CONTACT scanners do not have to be in close proximity to the bar code symbol in order to read it. A moving beam laser scanner is the most common non-contact scanner. There are scanners available employing other light sources such as infrared or visible red. The fixed-position laser scanner is used in hands-free and unattended applications. These units are ideal for applications where the item is moved past the scanner. This application is used in manufacturing and distributing centers to track work in process.

Whenever real time scanning is not possible, consider scanners / readers that can process batch information in the unit itself, and later download to the host.

It has been proven that most bar code readers do not work well if the quiet zone is no less than 1 / 4 of an inch.

Choose a scanner that can withstand change in:

- Personnel
- Operations
- Applications software
- Computer systems

Bar Code Printing — Bar code printing is the process of printing the bar code label.

Before getting started with the printing, a label needs to designed. A few questions need answers before the label design can happen:

- What are the immediate needs and in the future?
- What application do I need to meet a customer's bar code label requirements?
- Do I want to implement an inventory control system?
- What are the environmental effects? (heat, dirt)
- What is size, type, shape and amount of data (static/sequential or variable), cost, and volume?

Character Per Inch (CPI)— In other words, how much information is needed to fit on a bar code label. By varying the width of the narrow element in any symbology you can make the code bigger (easier to decode) or smaller (more of a challenge). You probably will not need to get too technical about this, just find out the number of characters to be encoded and measure the space available for the code. Most software purchased today will maintain proper bar/space ratios.

Two things to remember about bar coded CPI. First, there is always a start and stop character, so add two characters to your calculations. Start and stop characters are unique to each symbology and tell the scanner's software which symbology (code) is about to come up and that the data has ended (like a period to end the sentence). Second is the quiet zone. There must be about a quarter inch on either side of the code. There are exceptions, but you will be safe with a quarter inch. Do not add this half inch total (front and back quarter inch) to the CPI calculation, rather, subtract it from the space available. Always start with the most simple bar code that solves the problems plus; they are more accurate and faster to read.

The structure of the 39 & 128 bar code enables it to be printed by a wide variety of techniques, including offset, letterpress, dot matrix printers, and non-impact printing devices.

Bar code symbols can be successfully printed by nearly every printing process. When using less accurate processes, bar codes should be printed at lower density (larger unit size). A well planned approach to symbol printing is the basis for successful scanning. Good planning may also produce considerable cost savings by choosing the most economical means for generating bar code labels.

There are two methods of bar code printing. One can be done off-site or by buying the labels preprinted. This method can provide a high volume of high quality bar code labels quickly and economically. The second method is on-site printing, which will require the purchase of a printer and software.

To purchase a printer for on-site production there are a few requirements to keep in mind:

- First read rate (FRR) measures the chances of getting a read with the first scan.
- Substitution error rate (SER) defines those conditions where a reading provides the wrong information and the fact that a bad read is not immediately apparent.
- Print contrast ratio (PCR) is an indication of signal strength. It is the difference in light reflectivity between printed marks and the background against which these marks are printed.
- Print density
- Label material
  - — Face stock
  - — Paper
  - — Synthetic
- Label application
  - — Adhesive
  - — Permanent
  - — Removable

Examination of these requirements will determine which printing technology may be used:

- Dot matrix
- Flexography
- Gravure
- Laser
- Lithography
- Thermal
- Thermal transfer

Appendix D provides detail printing specification for bar code 39.

Before taking the first step, there are three areas one should consider before implementation. They are:

1. Do not reinvent the wheel if you do not have to. That is, if the supplier of your present computer system has enhancements for handling bar codes, you should examine the features to determine if they meet your needs. In other words, what you need may already exist.

2. Do not rule out your own computer system supplier. Some of these suppliers are integrating bar code applications into their software. Experience with bar code standards, equipment, and software is essential.

3. Make sure you understand.

- What can be done with a bar code to really improve your operation.
- How it will benefit your business.
- How the use of a bar code will eliminate steps in the process, not merely automate old ones.

Resources

Publications — NAGASA suggests companies obtain a free Automatic I.D. News subscription. Provide the following information:

- Name and address
- Business type
- Title

Fax to (413) 637-4343 or mail to:

Automatic I.D. News
Advanstar Communications Inc.
P.O. Box 5040
Pittsfield, MA 01203-9648

Bar Code Vendors —

- Contact others companies in your area who utilize bar codes for vendor references.
- Utilize yellow pages to locate local suppliers of bar code software and equipment.
- Contact one or more of the following vendors to determine local or nearby support.
- Be sure to ask for and check vendor supplied references, preferably in your area.

Bar Code Equipment Vendors —

	Readers	Printers	Software	Consulting
AccuScan 4000 DeKalb Technology Parkway Suite 550 Atlanta, GA 30340 800-950-0101 www.accuscan.com	**X**	**X**	**X**	**X**
Accu-Sort Systems, Inc. 511 School House Road Telford, PA 18969-1196 800-227-2633 www.accsort.com	**X**	**X**		
American Barcode Concepts 4630 E. Elwood Street Suite 1 Phoenix, AZ 85040 602-894-5564 www.amerbar.com/barcode/	**X**	**X**	**X**	**X**
Compsee Inc. 402 N. Main Street P.O. Box 1209 Mount Gilead, NC 27306 407-724-4321 www.compsee.com	**X**	**X**	**X**	**X**
Datamax 4501 Pkwy Commerce Blvd. Orlando, FL 32808 407-578-8007 Fax 407-578-8377				**X**
Intermec Corporation 6001 36th Avenue West P.O. Box 4280 206-348-2870	**X**	**X**	**X**	**X**
LXE, Inc. 125 Technology Parkway Norcross, GA 30092 770-447-4224 Fax 770-446-9160 www.lxe.com	**X**			
Metrologic Coles Road at Route 42 Blackwood, NJ 08012 609-228-8100 www.metrologic.com	**X**			

	Readers	Printers	Software	Consulting
Norand Corporation 550 Second Street, N.E. Cedar Rapids, IA 52401 319-369-3100 www.norand.com	**X**	**X**	**X**	**X**
The Peak Technologies Group, Inc. Corporate Headquarters 8990 Old Annapolis Road Columbia, MD 21045-2179 800-950-6372 www.peaktech.com	**X**	**X**	**X**	**X**
PSC, Inc. 675 Basket Road Webster, NY 14580 800-828-6489 716-265-1600 www.pscnet.com	**X**			
Psion 150 Baker Avenue Concord, MA 01742 508-371-0310	**X**	**X**	**X**	
Tharo Systems, Inc. P.O. Box 798 Brunswick, OH 44212 330-273-4408	**X**	**X**		**X**
Zebra Technologies Corp. 333 Corporate Woods Pk Vernon Hills, IL 60061 847-634-6700 Fax 847-821-2544 www.zebra.com		**X**	**X**	

Industry Associations —

AIM USA (Automated Identification Manufacturers)
634 Alpha Drive
Pittsburgh, PA 15238
412-963-8588
Fax 412-963-8753
www.aimusa.org

American Warehouse Association
1300 W. Higgins Road, Suite 111
Park Ridge, IL 60068
847-292-1891
Fax 847-292-1896
logistx@aol.com
www.logistx.dartgc.com

ANSI (American National Standards Institute)
11 West 42nd Street
New York, NY 10036
212-642-4900
Fax 212-398-0023
www.ansi.org

Graphic Communications Association
100 Dangerfield Road
Alexandria, VA 22314-2888
703-519-8160
Fax 703-548-2867
akotok@gca.org
www.gca.org

HIBCC (Health Industry Business Communications Council)
5110 N. 40th St. Ste 250
Phoenix, AZ 85018
602-381-1091
Fax 602-381-1093
info@hibcc.org
www.hibcc.org

Information Management Institute, Inc.
RRI Box 2030
Kingfield, MA 04947
207-235-2225
Fax 207-235-2226

Material Handling Industry
8720 Red Oak Blvd.
Charlotte, NC 28217
704-522-6644
Fax 704-522-7826

SISAC (Serial Industry Systems Advisory Committee)
160 5th Avenue
New York, NY 10010
212-929-1393
Fax 212-989-7542

UCC (Uniform Code Council, Inc. (UPC Codes))
8163 Old Yankee Road, Ste J
Dayton, OH 45458
513-435-3870
Fax 513-435-4749
www.uc-council.org

Warehouse Advisory Council
150 Clove Road
P.O. Box 401
Little Falls, NJ 07424
800-882-8684
Fax 201-256-0205