white paper

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Automatic Identification and Data Collection: Scanning Into the Future

The success of Supply Chain Management (SCM) as a vehicle for improved productivity and improved return on investments often overshadows the fundamental components that make SCM a reality. One of these components is the bar code. For the benefit of the newcomer, this paper briefly outlines what Supply Chain Management is, how the Automatic Identification and Data Collection (AIDC) industry and bar coding affect SCM, and how SCM systems can benefit from the bar code application technologies of today and tomorrow.

Supply Chain Management

Supply Chain Management is defined generally as a process-oriented, integrated approach to procuring, producing, and delivering products and services to customers. SCM has a broad scope that includes sub-suppliers, suppliers, internal operations, trade customers, retail customers, and end-users. SCM covers the management of material, information, and funds flow. Simply stated, SCM is the science of moving or processing "something" to "somewhere." It is fueling the rebirth of the Industrial Age by reducing costs, improving service, enhancing revenues, and empowering both the providers and users of products and services.

The advancements in manufacturing, transportation, and the development of computer and communication technologies ("the information technology revolution") have, without a doubt, aided in the development and explosive growth of SCM in today's economy. Some of these advances have been born out of the Automatic Identification and Data Collection (AIDC) industry. Commonly known as the "bar code" market, the AIDC industry has been at the forefront of both the bar code and bar code data capture development; it has dramatically improved the amount of data transferred and the success at which it is accurately collected. Bringing portability, standardization, and validation to the data that drives the SCM world has been the single task of the AIDC industry. What is done with that data – how it is collected, processed, communicated, stored, or otherwise manipulated – determines its value as computers and networks come to be regarded as technology tools for enterprise coordination.

What is AIDC?

AIDC is Automatic Identification and Data Collection. All code-reading systems share the following features:

First, there is a product, part, component, package, pallet, tote box, barrel, etc. Accurate identification of this item, while moving into or through production, warehousing, or the distribution pipeline, will contribute to higher throughput, lower labor costs, more efficient handling, increased security, more accurate audit trails, or some combination of them all.

Next, a label, tag or coding device is affixed to the item so that it can be automatically read to identify what the item is, where it came from, where or to whom it's going, or whatever else might be needed by the user.

And then an automatic or hand-held bar code reader, optical character reader, magnetic stripe reader, vision system, or radio frequency interrogator will read the code, validate it, and convert the content into system-meaningful control and information output.

Finally, the code reader transmits the output to networked PC's, mini-computers, relays, solenoids, microprocessors, programmable controllers, diverters, counters, video displays, horns, bells, whistles, etc….for data manipulation or communication.

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Electronics & High Tech

Why Automatic Identification?

Today, JIT, Quick Response, Efficient Consumer Response (ECR), and contemporary SCM systems all address the productivity challenges that businesses have faced for years.

Most firms recognize that control of raw material, semi-finished, and finished goods inventories from receipt through processing to shipment and sale is fundamental to improved productivity. Tighter stock control leads to faster order turnaround, improved resource utilization, lower inventory investment, and reduced costs.

Further, a simple reduction in time per unit produced may well be counterproductive without enhancement of the discipline and control that guard the integrity of receiving, processing, assembly, packaging, storage, shipping, and transportation operations.

The best decision-making is executed on the basis of feedback on events while, not after, they occur. It follows, then, that to achieve greater productivity, contemporary systems must provide discipline and control that is based not only upon plans and performance goals, but also upon the dynamics of the actual operation. These are not new concepts. Their mastery, however, has become critical to survival.

Automatic identification systems have emerged during the past 30 years as the major source of real-time feedback. They allow businesses to monitor operations, manage resources, and flag anomalies before they impact throughput and launch the JIT and Quick Response programs, which have been so important to growing market share and the bottom line.

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Technologies for Automatic Identification

Included under the automatic identification umbrella are the following technologies:

- Bar Code
- Optical Character Recognition
- Radio Frequency Identification (RFID)
- Machine Vision
- Magnetic Stripe
- Smart Cards
- Touch Memory
- Voice Data Entry
- Radio Frequency Data Communications (RFDC)

Worldwide automatic identification sales have grown from about $1 billion in 1986 and are expected to reach $10 billion in 2000. Although the lion's share of the market belongs to bar code, other technologies have gained acceptance in those applications where they provide the better solution. Users generally find that the technologies are more complementary than competitive.

Coding for Automatic Identification Systems

Codes, code media, and coding devices are the key to and the Achilles' heel of automatic identification systems. Prospective users should take the time to familiarize themselves with the alternatives – and carefully evaluate them in the light of their specific application requirements. Coding for identification systems consists of the following five major elements:

- Code Content – The characteristics and amount of data to be encoded as well as the symbology or coding algorithm
- Code Medium – The materials to be used to fabricate the code or coding device
- Code Generation – The method of fabrication
- Code Verification – The technique(s) used to check the quality and readability of the code
- Code Application – How the code is affixed to the item

The size and format of the code will depend not only upon content but also upon available coding area, the nature and speed of product flow, and the type of reading equipment to be used.

Medium selection, generation technique, and application method will depend upon the intended uses and the environment in which the code will be expected to perform. Assessment of the myriad of options available must be thorough, as the one selected can well determine the success or failure of the entire SCM process.

The Bar Code

The Technology

Early bar code scanners used a white light source or helium-neon laser, rotating mirrors, and sensors to locate, read, and decode miniature patterns with high data content anywhere within a field of view then as much as two feet high by two feet deep. Sweeping through this field at rates of up to 360 times per second, scanners took several looks at each code as it passed and compared and validated them prior to providing an output. Given proper code design, the devices accommodated wide variations in code alignment and orientation. Their capabilities represented a major breakthrough in automatic data capture.

Background

In 1933, initial patents covering the use of optical sensors for package sortation were issued in Switzerland. On October 20, 1949, Norman Woodland and Bernard Silver filed a U.S. patent application, disclosing the first bar code symbology as well as an optical scanner that could read intelligent codes on the fly.

Until the mid-1960s, the primary focus of identification technology was in the area of direct machine control – from conveyor line sortation to automatic bobbin replenishment in textile mills. Early systems

used photo-electrics and retro-reflective inks and tape arranged in machine-readable formats or patterns. The systems were invariably justified on the basis of labor cost reduction.

In the 1960s, railroads around the world evaluated optical code readers for automatic rail car identification and the grocery industry launched its program for automating supermarket checkout.

Although labor savings were cited as the basis for justification of investment, the pioneers saw significant additional potential in the real-time information provided by these systems that identified items-in-process with unique multi-digit serial numbers. The main thrust of the rail industry program was improved utilization of the existing rail car fleet through better, more timely visibility of car location. That of the grocery industry was tighter control of inventories, stock replenishment, and check stand security.

In 1969, Volkswagen installed the first white-light moving beam scanner to identify and count components moving along an overhead conveyor line. In 1971, Buick Motor Division of General Motors installed the world's first industrial laser scanning system to count transmissions as they moved from production to shipping on a power and free conveyor.

Within two years, pioneers at Kimberly Clark, Scott Paper, General Trading, Kroger, and a number of other consumer products companies had implemented scanning systems to control the flow and sortation of finished products to shipping. In every case, labor cost reduction was used for purchase justification. The real payoff, however, came from improved visibility, accuracy, discipline, and control of line operations.

Automatic Identification Manufacturers (AIM) & Bar Code Standards

In 1971, a group of five companies including Computer Identics, Identicon, MEKontrol, 3M, and the Electronics Corporation of America met in Pittsburgh with executives of the Material Handling Institute, Inc. (MHI). Their objective was to examine the possibility of forming a trade group to legitimize and promote the use of identification technology for tracking and controlling product movement in manufacturing and distribution. Chartered in 1972 as the Automatic Identification Manufacturers (AIM) product section of MHI, the group's first roster included nine companies with estimated total identification product sales of less than $25 million. An independent, global trade association today, AIM lists over 170 member companies with annual sales projected to reach $10 billion by the year 2000.

Although the AIM umbrella covers the range of identification technologies available, there is little doubt about the significant impact of its efforts on the dramatic growth of the bar code market segment.

In spite of early successes in the automotive industry and consumer products warehousing industry, growth during the 1970s was slow. A primary constraint on growth was suppliers' reluctance to collaborate on code or symbol standards for non-point-of-sale applications, and user concern that a premature purchase might leave them with a non-standard, unsupported solution. In the material-handling sector, conveyor and storage system suppliers were generally reluctant to sponsor bar code implementation unless specifically requested by the client. The situation began to change a few years later with pressure for symbology standardization from the government and consumer product manufacturers.

In conjunction with inter-industry Federation of Automated Coding Technologies (FACT), the Uniform Code Council (UCC), and other organizations, AIM has developed standards for manufacturer identification programs, symbology specifications, symbol and equipment testing, academic curricula, and related seminars and conferences.

Today, formal standards have been promulgated by the United States Department of Defense, the American National Standards Institute (ANSI), and such industry organizations as the Automotive Industry Action Group (AIAG), the Health Industry Business Communications Council, the Telecommunications Industry Forum, and a host of other trade and professional groups worldwide.

Primary symbologies for which standards have been developed include:

- Universal Product Code (UPC)/ European Article Number (EAN): The numeric-only, linear symbols developed for grocery supermarket point-of-sale applications in 1973 and now widely used in a variety of other retail markets. UPC/EAN are fixed-length codes suitable for unique manufacturer and item identification only. They are not often used in the manufacturing or warehouse environment.
- Interleaved 2-of-5 Code: A compact, numeric-only, linear symbology used in a number of applications where alpha character encoding is not required; e.g., the current standard for grocery shipping container ID (SCC-14).
- Code 39: An alphanumeric, linear symbology adopted by a wide number of

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industry and government organizations for item and shipping package and container identification.

- Code 128: The linear symbology of choice for Quick Response and Efficient Consumer Response (ECR), Code 128 provides the architecture for high-density encoding of the full 128-character ASCII set, variable length fields, elaborate character-by-character, and full symbol integrity checking. It provides the highest numeric-only data density for a linear symbol. UCC/EAN-128 was adopted in 1989 in the U.S. by the Uniform Code Council (UCC) and internationally by EAN International (European Article Number Association) for serialized shipping container identification (SSCC-18).
- Two-Dimensional Stacked and Matrix Symbologies: Two dimensional symbols emerged during the late 1980s as a result of improvements in scanning technology and requirements in some sectors for encoding large amounts of data in relatively small areas.

Two-dimensional stacked symbology, PDF-417, has the capability of encoding up to 2,000 characters in four square inches, the equivalent of the entire Gettysburg Address. Two-dimensional codes allow companies to add quality assurance, traceablility, and reliability to the manufacturing and distribution process. The benefits of 2-D symbologies include more data capacity and improved error correction. 2-D symbologies represent tomorrow's technology in practice today.

The AIDC industry is constantly developing new and better ways of improving total Supply Chain Management; for example controlling processes through a manufacturing line to effective warehouse and inventory management, and then tracking the movement of goods in the distribution and delivery chain, right into the retail store and beyond. Primary areas of focus for AIDC development include manufacturing (WIP, product ID, location), goods receiving, inventory control, warehouse management, shipping, finished goods or packing, distribution (finished goods, pick/putaway), and transportation (compliance labeling, electronic data interchange).

SCM and AIDC Tomorrow: Radio Frequency Identification (RFID)

The future of AIDC will represent unprecedented growth of SCM opportunities. The AIDC industry is taking the current technology of radio frequency identification (RFID) and expanding its breadth and scope to improve the total supply chain and information transportation marketplace.

RFID is an automatic identification technology which complements scanned 1-D and 2-D bar codes, while extending the applicability of data capture and computing products. RFID tags carry data that can be modified using radio frequency technology. In essence, each tag carries an electronic memory. This feature fits into SCM where information is to be exchanged, modified, or collected without reference to a common database. The ability to write/validate and print on demand, under the guidance of the International Standards Organization (ISO) concerning the standardization of RFID for "Item Identification," has opened a floodgate of opportunities and applications for variable on-demand RFID labeling.

SCM is a fundamental component in the business community and our daily lives. Technology, automation, and competition will continue to improve the SCM process. To that end, the Automatic Identification and Data Collection market will continue to improve on its current technologies while developing new and exciting products that will propel the SCM process forward. The AIDC industry will continue to encourage clients to implement new and improved SCM processes, and will aid in successfully providing what all businesses desire – customer satisfaction.