DESIGN AND PILOT TEST OF A BAR CODE SYSTEM
FOR INVENTORY CONTROL

A Thesis Presented to
The Faculty of the College of Engineering and Technology
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of the Requirements for the Degree
Master of Science

by
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TO MY WIFE
TO MY PARENTS
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Gratitude is also extended to Adrian Garcia for his friendship and help in this thesis.

Lastly, but most important, I would like to express my gratitude to my wife Annelisse for her love, understanding, and patience, to my parents Jorge and Milka and my sister Lala for their continuous love and support before, during and after the course of my studies, Muchas gracias por todo, los quiero mucho.

Thank to all of you
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CHAPTER I
INTRODUCTION

Management of inventory is an important and potentially complex function in any manufacturing company. The size and complexity of the task of managing inventories will vary depending upon the number of different products produced and component complexity. These factors determine the total number of items in the company’s inventory system. Items can vary in terms of size, weight and perishability, all of which influence material handling, storage and time considerations.

The managing of inventories is not simply a question of keeping track of the materials. There should be goals for desired inventory performance, so that actions can be taken to achieve these goals. It is the responsibility of company management to formulate company policies for inventory management and control. These policies should be statements of target inventory investments for certain planning periods in each of several inventory categories, such as raw material, work in process (WIP), and finished goods, cycle stock; and safety stock for example.

How much inventory is enough? This question cannot be answered alone, since the equation includes other important variables. There are relationships among inventory levels, customer service, purchasing, production efficiency, accuracy and reliability of the system. These and other factors determine the level of inventories required by a given company.
There are costs associated with inventory information but more importantly there are costs associated with the wrong information if so collected. One of the ways to decrease the chances of collecting wrong information is the use of bar coding. Bar coding is a technology that can be used to save time, human-power and to collect needed, reliable, accurate and timely information.

As the knowledge of bar coding technology spreads, more companies are implementing systems using this technology. In particular, many are seeking to streamline their product tracking systems through the use of bar code data entry. The products being tracked may be as diverse as claim files in an insurance office, automotive parts in a metal fabrication shop, groceries in/out of a convenience store, and clothing in a sewing factory. Bar coding has already become an important part of some businesses and industries. For example there is wide spread use of the UPC bar code in the grocery and retail business. Bar coding and automatic identification systems have been cost-effective management tools for the 1980’s and are expected by some experts to be even more important for the 1990’s. Companies are rewarded for using bar coding by improved asset management and resource allocation. The use of a bar code system can significantly reduce the effort required for keeping track of the material as well as in meet the goals of a desired inventory performance.

GOAL OF THIS STUDY

This study proposed the design and pilot test of a system to document and control inventory by the use of bar codes in a selected manufacturing plant. Two limitations should be noted. The system as developed was not an exhaustive design for an entire
inventory system, rather it was limited to incoming raw material and raw material inventory releases into production. Hardware and software available from the Center for Automatic Identification Education and Research, Ohio University, were used in the design and testing process. This report describes the system as developed.

STATEMENT AND ANALYSIS OF THE PROBLEM

TS-TRIM in Athens, Ohio is a full-scale sewing factory that produces seat covers, door liners, trim panels and headliners for automobiles. The company employs approximately three hundred people and has a manufacturing plant of 104,000 sq.ft. A high volume production scheme is used based on a Just-In-Time (JIT) system. The current exception to JIT is the incoming raw materials, for which inventory is stored in-plant. The company was interested in adopting an improved inventory management system for incoming materials.

TS-TRIM experienced a problem with the inventory accuracy and control of incoming raw materials. There were three main problems in documenting and controlling incoming raw material; excessive record keeping, errors in inventory record keeping due to human factors, and downtime caused by inventory difficulty. When raw material is received and unloaded, an immediate inventory update is not always taken. If materials are unloaded at the receiving dock while inventory clerks are busy with other activities, they tended to memorize the location, type, and quantity on the assumption they would record the data later at their convenience. Inventory was sometimes not recorded due to the stock being used before it could be entered into the inventory records. This led to a lack of control due to usage of the new material prior to recording it in inventory.
Because the current system does not take advantage of existing bar code technology, workers must relabel all incoming inventory with new tags. This led to a large amount of paperwork. Inventory error also occurred due to human factors such as include loss in concentration and data recording errors. One consequence of inventory records inaccuracy has been stockouts; a problem at T.S.TRIM. This had occasionally led to shutdown of production lines. It also had contributed to inefficient utilization of personnel.
CHAPTER II
BACKGROUND AND SIGNIFICANCE

There are two main considerations in implementing bar coding in any inventory control situation. The first consideration is an understanding of inventory control and of bar coding technology, and the second is the awareness of the advantages from the combination of both.

INVENTORY CONTROL

Inventories play an important role in any type of organization; thus they directly affect material management. Inventories provide a rational approach to operations by aiding smooth flow of materials, effective utilization of facilities, and efficiency materials management. The various operations of both manufacturing and non-manufacturing businesses are connected - from raw material to finished goods - through the inventory control process (Magad & Amos, 1989). With adequate inventories, supplies can be ordered and used in production lines without excessive costs for setups and ordering. This allows more efficient handling of inventory and increase in productivity. Various Japanese techniques of inventory control, such as Just-In-Time (JIT), try to achieve these benefits without maintaining large inventories (Buffa & Taubert, 1984).

The inventory system can sometimes determine the type of materials management operations a company requires. According to Magad & Amos (1989) and Silver (1985), it is not uncommon for companies to have from 10 to 55 percent of their total invested
capital in inventories; so inventory control is vital to all segments of the company. In most businesses, including manufacturing, wholesale, retail and health care, inventories serve an important role in achieving the company’s objectives. Inventories may include raw materials, work-in-process, semi-finished parts, and/or finished products. An adequate inventory control procedure can contribute to improved customer services, maximized return on investment, increased production efficiency, minimized inventory investment and to improved inventory management.

**Improved customer service**

Inventories provide protection against lack of product due to demand variability in the marketplace. If forecast of demand are realizable, inventory levels can meet the estimates with relative accuracy and can be kept fairly low.

Exposure to lack of inventory (stockout) occurs when levels of materials or products are low and in danger of being depleted. Normally the lack of a particular product could shut down an assembly line and/or cause customers to purchase from competitors. A manufacturer who purchases materials or parts from a single source may have increased risk of inadequate supplies due to production problems on the part of the suppliers. In order to reduce chances for stockout the increase in inventory is the effortless solution but the degree of consequence depends on product cost. If the product cost is very high, a company cannot always afford to invest in excess inventory, if it is low, the inventory can be obtained inexpensively, and high inventory levels can be maintained. High obsolescence, another important consideration, is similar to high product costs. Another factor is the space required. Bulkier items require more space consequently
fewer bulky items can be maintained in inventory and the space cost per item is necessarily greater (Magad, 1989; Salvendy, 1982; Silver, 1985).

The consequences of stockout, including the potential for losing business and customer goodwill, are intangible. Management is often unwilling to reduce its inventories to minimum levels in the face of uncertain demand and the long lead times sometimes required to obtain new supplies. The effect of this uncertainty is to increase inventories, thereby decreasing the frequency of exposure to stockout. Quantities ordered, demand, lead time, inventories levels, and times to order independently influence the risk of stockout. According to Salvendy (1982), "Minimum inventories require closer scheduling for materials management and better inventory systems than high inventory levels" (p. 11.4.6).

**Maximizing return on investment**

Investment in inventories is a major cost, so a major management objective is to maintain minimum inventories. Because there are many different processes and activities, there are no standard inventory levels that apply to all companies. Different investment levels are required for different product lines within the same company; so the establishment of inventory levels must be a joint decision of production, materials management, marketing, and management. Various factors influence the inventory levels of a company. Among them are the use of manufactured or purchased components, type of product, distance from suppliers and customers, warehousing availability, production cycle time, consignment stocking policies, and of course, efficiency of inventory systems (Magad & Amos, 1989).
Inventory management requires the establishment of procedures, policies, rules, and guides for various inventory situations. It also requires management to explicitly analyze different situations during the production, material management, warehousing, and marketing phases. Inventory must be carefully analyzed to detect short-term seasonal fluctuations, identify long-term trends as early as possible, and avoid the end-of-year inventory situations that perennially cause problems for many companies. The analysis also should involve evaluations of finished goods, work-in-process, and raw materials. According to Buffa & Tauber (1984), actual inventory levels can be compared to planned inventory levels to determine whether differences are due to changes in volume, scrap rate, labor cost, lead time, inventory system efficiency, and so on. These analyses are the basis for corrective actions that are made to meet financial objectives and to determine whether inventory costs are within the company's objectives.

**Increased production efficiency**

Maintaining the right inventory system allows the efficient material management. Accuracy and reliability of data are very important factors to increase production efficiency. Efficient use of employees time is also an important factor. Inventory usually acts as a buffer between production and demand, giving to management the necessary information (reports) to increase the productivity in the actual system.

**Minimized inventory investment**

In an industry with many types of inventories, the aggregate inventory investment may be large; therefore, to determine the right inventory is very important to minimize inventory investment. To achieve this objective, periodic marketing evaluations combined
with inventory systems evaluation can enable management to decrease inventory investment. This requires a system with the capability of measuring finished goods, work-in-process, and raw material inventories (Magad & Amos, 1989).

Determination of the total dollars invested in inventories constitutes an absolute measurement of inventory investment. This can be used for comparisons and to obtain relative measures of investment. Actual levels can be compared to budgeted levels, and variances can be analyzed, providing a basis for corrective action.

**Improved management**

One benefit of proper inventory control is improved managerial performance in several areas; financial, marketing, materials management, manufacturing and purchasing. This improvement can occur in many ways. For example, marketing can improve sales through better service to customers; there will be fewer stockouts, less obsolescence, more accurate customer service, and more accurate pricing of products. Another very important aspect of management improvement is the need for fast, reliable and accurate inventory system information. Without it any objective will not be possible.

**BAR CODING**

Bar coding is a widely used automatic identification technology. It can be effectively used in a variety of applications. Bar coding has become an important way to cut the cost of data entry and control because it is relatively inexpensive to install, it speeds up data collection and provides reliable and accurate information better than any other automatic identification technology (Adams 1990; Burke 1984; Palmer, 1989). According to Adams (1990), bar coding is the unsung hero of many computer-based
business systems. It is extensively implemented in grocery stores, and rapidly gaining increasing visibility in a good range of applications such as inventory control, work-in-process tracking, MRP and MRPII, receiving, shipping, retail, warehousing, and health care applications.

**Bar code**

A bar code is a printable machine language. Bar codes are messages where the information is encoded by using the widths of printed bars, the widths of spaces between bars, and the relative positions of wide or narrow bars and spaces. They provide the means of the printed symbol that later can be read by an instrument called a bar code reader (Burke, 1984).

**Symbology**

There are many different ways to arrange dark bars and light spaces to code information. Therefore, there are many different bar code symbologies. "Symbology is the term used to describe the unambiguous rules specifying the way that data is encoded into the bar and space widths" (Palmer, 1989, p. 15). According to Adams (1990), "There are more than fifty different coding schemes, with a dozen of them in common use today. These different ways of arranging bar code patterns each have different properties that make them useful for different applications" (p. 3).

Some common characteristics among the various bar codes in use are:

+ Two general categories - discrete and continuous. In a discrete code, each character stand alone and can be decoded independently from the adjacent character. Each character is separated from its adjacent characters by loosely tolerated intercharacter gaps. A
continuous code has no intercharacter gaps. The end of one character is indicated by the start of the next character (Adams, 1990; Palmer, 1989).

+ Two basic width schemes - those that employ only two element widths (wide and narrow) and those that employ multiple widths.

+ Fixed or variable length - some symbologies are used in a fixed length environment because of data security considerations, while others can be used to encode true variable length data.

+ Density - data storage densities or characters per unit length of symbol vary from symbology to symbology. The data storage capacity per unit length is set by the size of the X dimension (width of a narrow bar of space) and the number of bar code elements to represent the data.

+ Self-checking - According to Palmer (1989), a symbology is named self-checking if a single printing defect will not cause a character to be transposed into another valid character in the same symbology.

+ Start/Stop Characters - is used to identify the leading and trailing ends of the bar code symbol. It is a unique character, which allows symbols to be scanned bidirectionally.

+ Quite zones - is an area clear and free of all printing preceding the start character and following the stop character.

According to Uniform Symbology Specification develop by Automatic Identification Manufacturers (AIM) Technical Symbology Committee (1986), pertinent USS-39 characteristics are:

+ encodable character set-alphanumeric

+ 7 special characters: . space $ / + %

+ 1 start/stop characters: *

+ quiet zone

+ code type is discrete.

+ symbol length is variable.

+ bidirectional decoding (the beam of light can scan the bar code either from right to left or from left to right.

+ character self checking.

+ does not have a number of required check characters.

+ smallest nominal element is 0.0075 inches (0.191 mm).

+ maximum data character density is 9.8 char./inch (3.7 char./cm).

+ non-data overhead is equivalent to 2 characters (start/stop characters).

Figure 1 shows a code 39 symbol description encoding the message "1A". The name 39 is derived from the code structure which specifies that out of a total of nine elements (bars or spaces) three must be wide.

**Bar code reading**

The hardware required to read a bar code includes a scanner and a decoder. The term "scanner" only designates the optoelectronic part of the device that transforms the
Figure 1

Symbol Description. Encoding the message "1A"
optical image of the bar code into electrical signals. The decoder transforms the electrical signal from the scanner into American Standard Code for Information Interchange (ASCII) representations of data.

All bars and spaces scanned are decoded into characters but some characters may not be transmitted to the computer. The check character (if present) may be transmitted. Readers may typically be programmed to respond to control characters by performing system-specific functions and the literal translation of these symbols is not usually transmitted.

According to Palmer (1989), in order to decode the information in a bar code symbol, a bar code reader (scanner and decoder) has to perform five basic functions:

1. Determine the widths of each of the symbol’s bars and spaces.
2. Quantize the elements widths into a number of levels appropriate to the symbology being used (2 for code 39).
3. Ensure that the quantized element widths are consistent with all of the encodation rules for the symbology. Compare the pattern of quantized element widths to a table of stored values for that symbology, and determine the encoded data.
4. If necessary, reverse the data order. The reading direction is determine by examining the start/stop characters.
5. Confirm that valid quiet zones exist at both ends of the symbol.

The first step is accomplished by the scanner and the others four by the decoder.
BAR CODE & INVENTORY CONTROL APPLICATIONS

Inventory control is an important function of any company. Numerous examples of bar coding used in inventory control show the benefits of combining these activities.

In one example, General Dynamics' advanced tactical weapon system facility in Pomona, California reduced staffing by 50 percent . . . by switching to bar code labeling and electronic data collection. "Their accuracy rate for tracking equipment has climbed to 97.8 percent compared with 76 percent using their previous identification tag procedure" (General Dynamics, 1989).

Another example of improvement occurred at Memorex Telex's Raleigh, North Carolina facility.

By installing a bar code system, the inventory investment decreased by 10-15%, cut its clerical errors to almost zero and true measurement tools became available for the first time. The company's ability to give specific board counts and product information to any of its departments heads increase by virtually 100% after installation of a bar code system (Albernathy, 1988).

Cooper Industries' Superior Plant in Springfield, Ohio demonstrated benefits available by adding computer technology (scanners) to standard material handling. The new system reduced Cooper's costs; the on-hand inventory was reduced 40%, in-process inventory 50%, and at the same time rush orders for parts were virtually eliminated and that reduced their manufacturing costs significantly. Also, as the company began shipping products more promptly, their late aftermarket shipments dropped from 40% to less than
4%. Employee productivity rose in that, "where a single worker could once push through perhaps five stores and retrieves an hour, each worker is now completing an average of sixteen transactions in the same time period" (Scanner, software, 1986).

Another article describes how a manufacturer of instruments for measuring shock and pressure has increased employee productivity and eased data entry activity while producing more accurate, timely information using a bar code system.

Endevco, a major supplier of accelerometers and transducers, installed a system to monitor its manufacturing. This application gave Endevco useful experience for going to other applications. Quantifying the benefits of the new system is not entirely possible at such an early stage. Bar coding, however, is clearly a quicker and more accurate method of data entry. The new method has eliminated about 50% of the work of a data entry person, who uses that gained time on other duties. An actual, objective benefit of the system, however, is Endevco’s ability to reduce its payroll staff almost 36% (Bar code system, 1987).

With the help of an outside label supplier, Chrysler Corp.’s assembly plant support systems group recently developed a special bar code label and applicator system. Only a few cents each, the labels provided a low-cost method of tracking work-in-process (WIP) through sequential manufacturing steps in an automotive assembly environment. A plant manager stated that "... during a recent 30-day pilot test, the bar codes labels and applicator system scored an impressive 99.9% reliability rating" (Bar code labels eliminate manual tracking, 1989).
Still another example states the benefits.

For the nurses of Butterworth Hospital, a 529 bed, not-for-profit acute care hospital and referral center in Grand Rapids, MI, keeping track of patient-chargeable items was a frustrating, time-consuming task. With the previous system the hospital was capturing about 70% of the patient chargeable, and with this new system we are capturing about 98 percent of them (Billing system, 1990).

In 1986, industrial engineers at Union Carbide’s coating service facility in Indianapolis began to exploring alternatives to time-consuming, error-prone, manual work-in-process tracking methods. They discovered that bar code technology, along with the right software, improved not only time and attendance and resource allocation data as well. After the implementation of the bar code system, the systems development & integration manager stated, "Inventory control of all the various industrial gases and powders used in the coating process is now highly accurate. Quality control and customer service have both improved as well and are now able to pinpoint a customer’s order immediately." (Abdian, 1987).

These selected examples indicated that benefits do exist from the integration of bar coding into inventory control. Integration should only occur after a clear understanding of inventory control and bar coding technology and the awareness of advantages from the combination of both.
CHAPTER III

METHODOLOGY

This study was conducted in three major phases. The first phase involved analysis of the company’s existing inventory control and procedures, the second phase was the design of a proposed system and the third phase was an actual test of the system.

ANALYSIS OF CURRENT SYSTEM

A first step in analyzing the current system was to meet with the company’s production manager and production supervisor. The mutually agreed upon goal was to document and control the incoming raw material and raw material released into production by the use of a computerized bar code system.

To design and implement a material tracking system using bar coding, there were three major considerations. First, the raw material needed to be identified, second the individuals responsible for data input and the locations where the product information would be gathered were identified, and third, the types of information gathered and the reports generated by the current system were described.

An analysis of the existing system was made. Supervisors and employees using the current system were interviewed using a questionnaire technique. A sample of the questionnaire is shown in Figure 2. Observations of the inventory and production system indicated how the material moved through the plant, what paperwork accompanied
QUESTIONNAIRE

Name: ___________________________  Date: ___/___/___
Title: ___________________________  Years in the company: __________

WHAT DOCUMENTS DO YOU RECEIVED?

WHAT DOCUMENTS DO YOU SEND AND WHERE?

WHAT DOCUMENTS DO YOU USE FOR YOUR OWN CONTROL?

DO YOU HAVE ANY SUGGESTION THAT YOU THINK IT MAY HELP THIS DESIGN?

Figure 2

Questionnaire
it and how it was used, who recorded what data and why, and the contents of every label, ticket, tag, or mark.

Product flowcharts and data flowcharts were created by the researcher based on observations and interviews in order to understand the current system. Photocopies of the current documents were made and analyzed to find the types, lengths, and uses of record items; for example, numeric, alphanumeric, date, etc. Flowcharts showing data and product flow in the current system can be found in Appendix A. Samples of documents used in the current system are also included in Appendix A.

Observations and discussions led to the conclusion that in using the current system the company experienced problems in inaccuracies in inventory records, stockouts leading to shutdown of production, and inefficient utilization of personnel in production and in the receiving department. Shutdown of a particular production line was an example of downtime caused by inventory record problems.

Excess and inefficient record keeping were consequence of human factors and current system design. Having to transcribe the information from the preprinted AIAG labels to handwritten labels. Increased the opportunities for error due to human factors such as difference in handwriting style; transcription by reading one number and writing another; transposition where a person reads two numbers and writes them in reverse order; and substitution when one character is substituted for another.
DESIGN OF THE PROPOSED SYSTEM

The proposed system design was developed in two phases. The first phase, the general system design, included functions and elements. In phase 2 specifications of the proposed system were developed. The goal of the proposed system was to document and control the incoming raw material and the raw material inventory released into production. Specifics objectives were to reduce time required for data collection, excessive record keeping and downtime, and increase the accuracy and reliability of the data.

General System Design

A general system design was proposed that included functional requirements and systems elements. The system was designed to include three important functions; entering material received, releasing material from inventory into production and updating inventory records. The system elements included hardware and software.

System Functions. As raw material is unloaded from arriving carriers (trucks), it is scanned by personnel using a portable data terminal (PDT). Once all the material received has been scanned, the PDT is taken to the host computer and the information is uploaded in order to update the inventory database. This completes the material received function.

The material allocated for production will also be scanned and after the material has been released into production, the PDT is taken to the host computer to update the database with the material that has been allocated to the production lines.

The records will be updated at this point and the reports can be printed at any time as needed. The reports being printed could be related to material received/allocated
at any given time or date, material below the reorder point, actual stock, physical inventory, supplier information, carrier information as an example. Finally, management will have an updated information of the material received and allocated as well as its impact on the future production schedule. Flow diagrams for the new system and formats for data reporting were prepared. Appendix B shows the proposed data flow diagrams and reports formats.

**System Elements.** The proposed system was designed to be PC computer based due to constraints of the company. Because of the need to collect data at various locations in the plant a portable data terminal (PDT) was selected for use. The requirements needed in the PDT were: a bar code reader, keyboard, memory of at least 128K and a RS232 communication port. Also, the proposed system used database software that automatically maintained updated inventory as received or allocated to an assigned storage area. This allows controlling and documenting stock items. Because T.S.TRIM is an automotive supplier, the labels should follow the Automotive Industry Action Group (AIAG) standards. For small parts a printed bar code shelf label was used. A bar code menu sheet for data entry was also used when fields required for T.S.TRIM were not bar coded on the AIAG labels.
Detailed System Design

The specification and selection of the hardware and software were defined in terms of requirements. Specific products that fulfill the requirements needed were selected.

**Personal Computer.** T.S.TRIM specified that an IBM compatible microcomputer would be used. The PC was required to have at least 40 megabytes of hard disk, an RS232 serial communication port and an internal calendar/clock.

**Printer.** In order to print the reports a IBM graphics printer was needed. The printer report formats required a wide carriage printer.

**Portable Data Terminal.** A Mars Electronics MEQ 300 Portable Data Terminal was selected as the PDT for use in the system. Figure 3 shows the MEQ 300 and its characteristics. The characteristics required from the MEQ 300 were: alphanumeric keypad, memory of up to 512K, bar code scanner, and RS232 cable. This PDT was the only one available to the researcher and it did fulfill the requirements of the system design, consequently it was chosen for use in this application.

**Labels.** The proposed system required 2 types of bar code labels: labels on material and shelf labels. The labels on raw material were to be printed in accordance with Automotive Industry Action Group (AIAG) standard AIAG-B-3. This standard provides specification for printing and applying shipping/part identification labels.

With respect to the data area characteristics, the part number, quantify, supplier number and label serial number shall be included on each label in the designed data areas and shall be displayed in both human readable characters and bar code symbols.
Every MEQ™ 300 Series Laser Scan Terminal is a portable, fully integrated data collection system. Each is designed for rapid gathering of bar coded and key-entered data in a broad range of environments and applications.

- Laser diode bar code scanner
- Full-function data terminal
- RS-232C communication port
- Rechargeable battery pack
- On-board BASIC interpreter
- Optical serial port available for convenient cableless transfer of data.
- Optional scanner available for reading high-density bar codes (as narrow as .005"

Figure 3
Mars Electronics MEQ 300 PDT
There are five areas for each label: part number, quantity, supplier number, serial number, and special data. Each data area shall be separated by thin lines and shall contain its title in the upper left hand corner.

A data identifier code, which is in the first position following the start character of the bar code symbol, shall be used to identify the information to follow. This character is not to be included in the human readable line, but is shown in human readable characters under the title for the appropriate data area. The following are identifier codes for the different types of data:

P -- Part number
C -- Continuation of long part numbers, if required
Q -- Quantity
V -- Supplier number
S -- Unique serial number -- Shipping/Parts Identification Label.

Figure 4 shows a sample of an Automotive Industry Action Group label.

Bar coded shelf identification labels were planned for parts that were too small to marked individually. These labels were custom printed using code 39 symbology and were adhered to the shelf fronts.

Software. In order to integrate the system, the selection of database software and communication software was required. Two application programs were also created.

Six inventory database software packages were analyzed. Table 1 shows the selection criteria and ranking. Barsoft was selected as the most appropriate for this project. Barsoft combines a relational database, for the storage and manipulation of data,
Figure 4

Sample Automotive Industry Action (AIAG) Label
<table>
<thead>
<tr>
<th>SOFTWARE/COMPANY</th>
<th>Able to print bar code labels 40%</th>
<th>Adaptable to T.S.TRIM 40%</th>
<th>User Friendly 20%</th>
<th>Weighted Total 100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACCPAC Plus Compatible</td>
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<td>2</td>
<td>2</td>
<td>1.2</td>
</tr>
<tr>
<td>Microcomputer Specialists</td>
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<td>4.8</td>
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<td></td>
</tr>
<tr>
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<td></td>
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<tr>
<td>Santa Cruz, CA 95062</td>
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<td>1.2</td>
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<td>Comp. Software &amp; Services</td>
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<td>1</td>
</tr>
<tr>
<td>Realtime Automated</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9820 # 16 Indiana</td>
<td></td>
<td></td>
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<tr>
<td>Riverside, CA 92503</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>PC/MRP Introduction</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>1.8</td>
</tr>
<tr>
<td>Software Art Consulting</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>P.O.Box 3621</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Santa Clara, CA 95051</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stock-Master 4.0</td>
<td>0</td>
<td>4</td>
<td>4</td>
<td>2.4</td>
</tr>
<tr>
<td>Applied Micro Bus. Sys., Inc.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>177-F Riverside Ave.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Newport Beach, CA 92663</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1=low 5=high
with complete bar code utilities. Data can be input to the database with an "on-line" bar
code reader connected to the computer and also through a PDT equipped with bar code
reader as well as through the traditional keyboard method. Barsoft is user friendly because
all interactions between the operator and the computer are guided by on-screen menus and
prompts. Samples of input screens and output report formats are show in Appendix C.

At T.S.TRIM approximately 600 different inventory items are divided in two
different inventory record keeping categories, one called "roll of raw material" and the
other called "Japanese sewing parts". Every item has up to 50 fields of information related
to it. The following are fields of information relevant to each item.

* Part number.- indexed item, alphanumeric, maximum of 22 characters.
* Part name.- alphanumeric, maximum of 25 characters.
* On hand.- numeric, maximum of 7 characters.
* System Date.- indexed item, present date, maximum of 8 characters.
* System Date allocated.- indexed item, present date, maximum of 8 characters.
* Data.- numeric, maximum of 6 characters.
* System Time.- indexed item, present time, alphanumeric, maximum of 8 characters.
* System Time allocated.- indexed item, present time, alphanumeric, maximum of 8
  characters.
* Adata.- numeric, maximum of 6 characters.
* Quantity received.- numeric, maximum of 7 characters.
* Quantity allocated.- numeric, maximum of 7 characters.
* Supplier number.- alphanumeric, maximum of 10 characters.
* Supplier name.- alphanumeric, maximum of 19 characters.

* Supplier address.- alphanumeric, maximum of 20 characters.

* City.- alphanumeric, maximum of 8 characters.

* State.- alphanumeric, maximum of 2 characters.

* Zip code.- numeric, maximum of 5 characters.

* Supplier contact.- alphanumeric, maximum of 20 characters.

* Telephone.- alphanumeric, maximum of 15 characters.

* Supplier comments.- alphanumeric, maximum of 15 characters.

* Gross quantity.- numeric, maximum of 6 characters.

* Dye-Lot.- alphanumeric, maximum of 5 characters.

* Shade.- alphanumeric, maximum of 2 characters.

* Employee number.- alphanumeric, maximum of 4 characters.

* Carrier number.- indexed item, alphanumeric, maximum of 6 characters.

* Carrier name.- alphanumeric, maximum of 19 characters.

* Carrier address.- alphanumeric, maximum of 20 characters.

* Ccity.- alphanumeric, maximum of 8 characters.

* Cstate.- alphanumeric, maximum of 2 characters.

* Czip code.- numeric, maximum of 5 characters.

* Carrier contact.- alphanumeric, maximum of 20 characters.

* Ctelephone.- alphanumeric, maximum of 15 characters.

* Ccomments.- alphanumeric, maximum of 15 characters.

* Destination number.- indexed item, alphanumeric, maximum of 5 characters.
* Destination name.- alphanumeric, maximum of 12 characters.

* Destin comments.- alphanumeric, maximum of 15 characters.

* Part location.- alphanumeric, maximum of 6 characters.

* Sys date inventory.- indexed item, present date, maximum of 8 characters.

* Stock count.- numeric, maximum of 6 characters.

* Discrepancy.- numeric, maximum of 6 characters.

* Usage.- numeric, maximum of 4 characters.

* Minimum quantity.- numeric, maximum of 6 characters.

* Reorder quantity.- numeric, maximum of 6 characters.

* Value.- money, maximum of 8 numbers and 2 decimals (8.2)

* Quantity ordered.- numeric, maximum of 6 characters.

* Date ordered.- date, maximum of 8 characters.

* Purchase order.- alphanumeric, maximum of 11 characters.

* First shift.- numeric, maximum of 6 characters.

* Second shift.- numeric, maximum of 6 characters.

Part number, quantity received, supplier number, gross quantity, dye-lot are items given to the company in the supplier labels; those are the ones that will be scanned. Shade, employee number and carrier number are items that must be entered from a bar code menu to be scanned by the operator. The other items are related in the database by the indexed items.

Barsoft uses a method of database design that establishes a universally available database by grouping logically related data items into data sets. Relationships are established by
defining certain data items as "indexed". This means that all the information is stored in one database. There is not need to be concerned about files, files naming or file manipulation. Barsoft only needs the definition of data items and the understanding of the concepts of indexing so the data relationship needed for data entry, recall and reporting purposes can be established.

During the actual inventory taking process, an application program in the PDT (Appendix D) prompts the operator through the sequence and checks for the entry of duplicate bar coded information. The operator is prompted first to enter his/her employee number (clock number for T.S.Trim employees) from a bar code menu (Figure 5) and then to enter trucking company name. Once the operator enters that information, he/she will be prompted to start scanning from the label and menu sheet (Figure 6), the bar code information such as part number A, part number B, type of material, shade of material, supplier, quantity received. The data fields can be scanned in any order because of the data identifiers. After the six items bar coded has been scanned, the program will ask the operator to input from the PDT keyboard the gross quantity received and the dye-lot number from the label. After this sequence has been successfully completed, the program will prompt the operator whether he/she wants to quit or to continue with the next label. Quantity data is entered depending of material received, whether it is roll of raw material or small sewing parts. This is done either by scanning the quantity symbol on a label or by counting the items and entering the data via keyboard.
Brent Elliot
Gene Bartlet
Buck Jones
Jim Martin
Todd Myers
Clay Bradley
George Cozart
John Young

RCCX
RHMH

Figure 5
T.S.TRIM Employees clock number and carrier name
Figure 6

Bar code menu sheet for field shape and type of material
Communications between the PDT and the computer require that both be set to the same communication protocol; i.e., baud rate, parity and number of bits. The communication program used in this application uses baud rate 1200, even parity, and 7 bits. The user needs to type: "C> Mode: Com1:1200,e,7,1" or "C> Mode: Com2:1200,e,7,1" depending on which serial communication port is to be used on the computer.

A wordprocessing editor was use to code the application program for the MEQ 300 portable scanner described earlier in this chapter. The application program was loaded (C>copy a:filename.bas com1) into the MEQ 300 after communication has been established. After the program has been loaded, it will run in the PDT by pressing the combination of 2nd-R keys. Now the PDT is ready to be disconnected from the computer. Automatic collection of data from bar code labels is now possible anywhere. The collected records are stored in a file created in the PDT.

During the physical inventory process, the PDT application program is building a data file in its memory containing a list of records with their respective fields such as part number, date time, quantity received, supplier number, gross quantity, dye-lot, employee number and carrier number. When the inventory operation is complete, the contents of the PDT are uploaded, using communication software, into the host computer system via the serial communication port. After the inventory database has been updated the necessary report will be printed from the computer. The MEQ communication software was used to retrieved the data file stored in the PDT and dump it into the computer for later update of the database inventory. In order to successfully transfer a file into the database a change of file format was required. This was done through a basic
program that converted the fields from comma delimited to carriage return delimited with no line feed. Source code for this program is listed on Appendix E.

**Specification Review**

The proposed system was explained to selected employees and their comments and/or suggestions were solicited. As a result of this feedback, minor changes were made to one input screen and two report formats.

**PILOT TEST OF THE PROJECT**

The system design was tested in two phases. The first phase, off-line testing and system approval, took place at Ohio University. The second phase was performed at the facilities of T.S.TRIM. Equipment and software for the pilot test were provided by the Center for Automatic Identification Education & Research in the College of Engineering and Technology at Ohio University.

**Phase 1**

Off-line testing and system approval occurred at the Center for Automatic Identification Education and Research in the College of Engineering and Technology at Ohio University. This phase of the test was conducted in two stages.

The first stage consisted of tests of hardware and software independent of each other. Barsoft, the database software, was first tested using dummy data. The software functioned as expected. It was then tested with real data obtained from T.S.TRIM. Once the database was functioning as required, tests of the MEQ 300 PDT took place. The application program was downloaded to the PDT. It was first tested using dummy data and then using real data.
After the database and the portable data terminal were shown to be performing satisfactorily, communication software was used to transfer the data files from the Mars MEQ 300 PDT to the computer’s hard disk. At this point a translation program was made to modify the ASCII datafile format in order to have the file in one of the ASCII files formats acceptable to Barsoft. Then the data files were imported into barsoft database using one of the program’s utility features.

After successful integration of the equipment and software, the system was tested first with fictitious data and then with actual data from T.S.TRIM. Personnel from T.S.TRIM were present for this testing and approved the test results.

**Phase 2**

After the satisfactory performance the equipment and software in a lab setting, the system was moved to T.S.TRIM facilities. Barsoft software was installed on a T.S.TRIM IBM personal computer. The database was again tested and sample reports were printed to make sure that the installation was done correctly. The MEQ 300 portable data terminal was loaded with the application program and tested in the office setting with AIAG labels brought from rolls of raw material in receiving department. The function of the database and the PDT were integrated successfully on site. Data gathering test inside the offices provide satisfactory results. T.S.TRIM managers agreed to start the in plant actual test of the system based on scanning the AIAG labels on the rolls of raw materials. Up to this point the system was performing as designed.

The in-plant actual test required inventory personnel to use the PDT to scan the AIAG label on the incoming raw materials. A major problem was discovered that
numerous labels could not be scanned successfully. Analysis of this problem revealed that those labels were not printed in accordance with the AIAG standard. This problem stopped the scanning process and consequently ceased further testing of the system in actual use. Figure 7 shows a representative problem with an AIAG label.
Figure 7

AIAG label without standard required
CHAPTER IV

RESULTS

Based on subjective observations from Phase 1 and Phase 2, it was concluded by the researcher and company personnel that the proposed system performed satisfactorily. The time required to collect data could be decreased, record keeping could be reduced and there could be an increased in accuracy and reliability of the data.

It was found in Phase 1 that the proposed system fulfilled inventory data control and inventory reports needed by T.S.TRIM. The software used (Barsoft) was appropriate to this application. One problem encountered was that a 'translation' program had to be implemented in order to achieve the desired data transfer between the portable data terminal (PDT) and the computer database. The PDT was adequate for use in the intended environment.

In Phase 2 of the pilot test the installation of the hardware and software were done successfully. The on-site test provided a some satisfactory results and demonstrated to T.S.TRIM managers the capabilities of the proposed system design. The system integration was also done satisfactory. The actual field test could not be conducted as planned because many of the labels supplied were not readable by the bar code reader. This was due to poor print quality on the labels.
CHAPTER V
CONCLUSIONS

This study demonstrated that the implementation of a bar code system for inventory control at T.S.TRIM was feasible. Phase 1 of a pilot test of the proposed system carried out at Ohio University yielded satisfactory results. Phase 2 in-plant implementation of the system for T.S.TRIM was not carried out successfully because of defective labels. It is expected that the system could be successfully implemented in-plant if appropriate label standards are met.

A measurement of the impact of bar coding in this particular application could not be assessed because a major problem was detected in the in-plant test and the scanning process could not be successfully concluded. In spite of this obstacle, it was demonstrated in laboratory tests and in T.S.TRIM on site tests that the system performed adequately. This was evident based on the researcher's subjective comparison of the time required to collect data using the current system and the time used to collect the same data using the proposed bar coding system.

Because bar coding has been shown in many cases to increase accuracy and reliability, it can be assumed that this system should yield the same benefits for T.S.TRIM. Also, it can be assumed that downtime will be reduced through bar coding record keeping.
SELECTED REFERENCES


General Dynamics installs new bar code system for fixed asset control. (1989, May). **Material Handling Engineering**, pp. 120.


APPENDIX A

Data Flowcharts, Product Flowcharts and Sample of Documents used in the Current System.
PRODUCT FLOWCHART
Seat Covers and Doors Panels for Honda Accord DX 4 door
MQ165 3t/org - MQ165 5t
PRODUCTION CONTROL
DATA FLOW IN CURRENT SYSTEM

Receive a sewing parts packing list → Receive an usage report → Packing List \(x\) → U. report \(0\) → Packing List \(x\) → U. report \(0\) → Actualize the material usage log → Material usage log → File
through it away

Receive raw material packing list → Packing List \(x\) → Packing List \(x\) → Temporary File

Every morning, last's day used tags are received,

Receive tags raw material → Tag 2 → Tag 2 → Pick up raw material packing list → Make them match → Tag 2 → Temporary File → File
<table>
<thead>
<tr>
<th>ITEM</th>
<th>TYPE</th>
<th>DYE-LOT</th>
<th>COLOR</th>
<th>GROSS</th>
<th>NET</th>
<th>QTY. BY</th>
<th>SHADE</th>
<th>SIZE</th>
<th>Q.C. BY</th>
<th>T. USED</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>MQ165B-57-ORG</td>
<td>LX</td>
<td>844L</td>
<td></td>
<td></td>
<td>1295</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
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<td></td>
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</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Tag No. 3
### USAGE REPORT

**Accord LX - DX - EX Japanese Sewing Parts**

<table>
<thead>
<tr>
<th>Area</th>
<th>Name</th>
<th>Set</th>
<th>Actual</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>F/C</td>
<td>BR 22 x 174L</td>
<td>2</td>
<td>50</td>
<td>1,420</td>
</tr>
<tr>
<td></td>
<td>BL 22 x 174L</td>
<td>2</td>
<td>50</td>
<td>1,420</td>
</tr>
<tr>
<td>F/C</td>
<td>38 x 200L</td>
<td>4</td>
<td>100</td>
<td>3,430</td>
</tr>
<tr>
<td></td>
<td>30 x 200</td>
<td>4</td>
<td>100</td>
<td>1,440</td>
</tr>
<tr>
<td>F/C</td>
<td>32 x 200</td>
<td>5</td>
<td>150</td>
<td>1,440</td>
</tr>
<tr>
<td></td>
<td>30 x 260</td>
<td>4</td>
<td>100</td>
<td>1,440</td>
</tr>
<tr>
<td>F/B</td>
<td>24 x 330L</td>
<td>2</td>
<td>50</td>
<td>1,110</td>
</tr>
<tr>
<td>F/B</td>
<td>20 x 340</td>
<td>2</td>
<td>50</td>
<td>1,110</td>
</tr>
<tr>
<td>F/B</td>
<td>8 x 430</td>
<td>2</td>
<td>50</td>
<td>1,110</td>
</tr>
<tr>
<td></td>
<td>20 x 220</td>
<td>2</td>
<td>50</td>
<td>1,440</td>
</tr>
<tr>
<td>F/B</td>
<td>25 x 200</td>
<td>4</td>
<td>100</td>
<td>2,790</td>
</tr>
<tr>
<td></td>
<td>25 x 140L</td>
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<td>100</td>
<td>2,790</td>
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<td>25 x 140L</td>
<td>4</td>
<td>100</td>
<td>3,240</td>
</tr>
<tr>
<td>R/C</td>
<td>20 x 1040</td>
<td>4</td>
<td>100</td>
<td>820</td>
</tr>
<tr>
<td></td>
<td>20 x 180</td>
<td>4</td>
<td>100</td>
<td>820</td>
</tr>
<tr>
<td>R/B</td>
<td>34 x 410L</td>
<td>2</td>
<td>10</td>
<td>1,440</td>
</tr>
<tr>
<td></td>
<td>34 x 410L</td>
<td>2</td>
<td>10</td>
<td>3,240</td>
</tr>
<tr>
<td>R/B</td>
<td>34 x 640L</td>
<td>2</td>
<td>10</td>
<td>820</td>
</tr>
<tr>
<td></td>
<td>34 x 500L</td>
<td>2</td>
<td>10</td>
<td>820</td>
</tr>
<tr>
<td>R/B</td>
<td>34 x 790</td>
<td>2</td>
<td>10</td>
<td>770</td>
</tr>
<tr>
<td></td>
<td>34 x 170L</td>
<td>2</td>
<td>10</td>
<td>3,240</td>
</tr>
<tr>
<td>R/B</td>
<td>42 x 160</td>
<td>2</td>
<td>10</td>
<td>1,440</td>
</tr>
<tr>
<td>S/S</td>
<td>20 x 340L</td>
<td>4</td>
<td>100</td>
<td>820</td>
</tr>
<tr>
<td></td>
<td>20 x 510</td>
<td>4</td>
<td>100</td>
<td>820</td>
</tr>
<tr>
<td>S/S</td>
<td>20 x 100</td>
<td>4</td>
<td>100</td>
<td>820</td>
</tr>
</tbody>
</table>

**Suspended Wires**

- 2.0 x 280
- 2.0 x 270
- 2.0 x 260
- 2.0 x 210
- 1.4 x 400
- 1.4 x 190
- 1.4 x 140
- 1.4 x 120
- 1.4 x 110
- 1.4 x 80

**Hanger Springs**

- 2.0 x 40
- 2.0 x 50
- 2.0 x 60
- 2.0 x 70
- 2.0 x 80
- 2.0 x 90
- 2.0 x 100
- 2.0 x 110
- 2.0 x 120
- 2.0 x 130

**Cut Hax / Trm Cord**

- 8 x 220
- 8 x 210
- 8 x 145
- 8 x 130
- 8 x 120
- 8 x 110
- 8 x 100

**Carpet Ends**

- RED R10ML
- RED R44L
- RED R37L
- IVORY Y10L

**TRM Cord**

- 8 x 140
- 8 x 130
- 8 x 120

---

Form No. 324

51
LINES SUPPLIER
DATA FLOW IN CURRENT SYSTEM

Supply the lines → Pull out the tags → Tag 1 → Tag 1 → Measure the roll → Write amount on tag → Tag with real amount

Take tags to inventory → Tag 1 → Tag 1 → Inventory

Every time that a roll is pulled,

Write information on the user's sheet → User's sheet → File
<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>AMOUNT NEEDED</th>
<th>AMOUNT PULLED</th>
<th>EXTRA PULLED</th>
<th>AMOUNT RETURNED</th>
<th>ACTUAL USED</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>14X 165.5t</td>
<td>132</td>
<td>170</td>
<td>150</td>
<td>20</td>
<td>0</td>
<td>170 clorox</td>
</tr>
<tr>
<td>14X 165.3t</td>
<td>198</td>
<td>210</td>
<td>183</td>
<td>0</td>
<td>0</td>
<td>183 clorox</td>
</tr>
<tr>
<td>0X 144.9, 3t</td>
<td>130</td>
<td>234</td>
<td>232</td>
<td>13</td>
<td>16</td>
<td>234 red</td>
</tr>
<tr>
<td>0X 144.9, 5t</td>
<td>60</td>
<td>77</td>
<td>76</td>
<td>0</td>
<td>0</td>
<td>76 gray</td>
</tr>
<tr>
<td>0X 144.9, 7t</td>
<td>56</td>
<td>43</td>
<td>12</td>
<td>0</td>
<td>0</td>
<td>55 gray</td>
</tr>
<tr>
<td>14X 185.9, mg</td>
<td>103</td>
<td>96</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>103 red</td>
</tr>
<tr>
<td>14X 146, 3t</td>
<td>83</td>
<td>83</td>
<td>8</td>
<td>8</td>
<td>83</td>
<td>OK gray</td>
</tr>
<tr>
<td>14X 145, 0mg</td>
<td>50</td>
<td>50</td>
<td>192</td>
<td>49</td>
<td>36</td>
<td>205 blue</td>
</tr>
<tr>
<td>14X 145, 5t</td>
<td>132</td>
<td>170</td>
<td>170</td>
<td>5</td>
<td>0</td>
<td>175 blue</td>
</tr>
<tr>
<td>0X 144.9, 5t</td>
<td>55</td>
<td>55</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>55 gray</td>
</tr>
<tr>
<td>14X 146, 0mg</td>
<td>50</td>
<td>205</td>
<td>200</td>
<td>22</td>
<td>17</td>
<td>205 clorox</td>
</tr>
<tr>
<td>14X 145, 1mg</td>
<td>75</td>
<td>308</td>
<td>300</td>
<td>30</td>
<td>22</td>
<td>308 blue</td>
</tr>
<tr>
<td>14X 146, 5t</td>
<td>27</td>
<td>47</td>
<td>20</td>
<td>0</td>
<td>27</td>
<td>gray</td>
</tr>
<tr>
<td>16x 165.36</td>
<td>135</td>
<td>203</td>
<td>200</td>
<td>40</td>
<td>17</td>
<td>223 blue</td>
</tr>
<tr>
<td>PVC</td>
<td>330</td>
<td>330</td>
<td>0</td>
<td>0</td>
<td>330</td>
<td>red</td>
</tr>
<tr>
<td>14X 146, 0mg</td>
<td>308</td>
<td>300</td>
<td>20</td>
<td>12</td>
<td>308</td>
<td>gray</td>
</tr>
</tbody>
</table>
RECEIVING DEPARTMENT
DATA FLOW IN CURRENT SYSTEM

Receive a packing list → Packing List → Packing List → Raw Material record and control → Sign the packing list → Make 3 xerox copies of packing list → Packing List

Purchasing Department

Production control assistant

Inventory

Production Coordinator

File

After the packing list is delivered, the receiving report is done.

Make the receiving report → Receiving Report → Purchase Department

Receive Report → File
Every day

1. Make a daily Receiving log
2. Daily Rec. log
3. File
4. Purchase Department

Office Supplies

1. Receive office supplies
2. Check packing list
3. Packing list
4. Prepare Receiving report
5. Receiving report
6. Receiving report
7. Packing list
8. Receiving report
9. Purchase Department
10. Receiving clerk
# RECEIVING REPORT

**DATE:** 12-9-37

**RECEIVED FROM:** 

**ADDRESS:** 

**CITY/ST/ZIP:** Columbus, Ohio

**CARRIER NAME:** Hogue

**PURCHASE ORDER NUMBER:**

<table>
<thead>
<tr>
<th>QUANTITY</th>
<th>DESCRIPTION</th>
<th>PURCHASE ORDER NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,773,6</td>
<td>R-144 L</td>
<td></td>
</tr>
<tr>
<td>1,773,6</td>
<td>R-144 L</td>
<td></td>
</tr>
<tr>
<td>1,773,6</td>
<td>R-144 L</td>
<td></td>
</tr>
<tr>
<td>1,773,6</td>
<td>R-144 L</td>
<td></td>
</tr>
<tr>
<td>1,773,6</td>
<td>R-144 L</td>
<td></td>
</tr>
<tr>
<td>1,773,6</td>
<td>R-144 L</td>
<td></td>
</tr>
<tr>
<td>1,773,6</td>
<td>R-144 L</td>
<td></td>
</tr>
<tr>
<td>1,773,6</td>
<td>R-144 L</td>
<td></td>
</tr>
</tbody>
</table>

**RECEIVED BY:** 

**DATE:** 

<table>
<thead>
<tr>
<th>TOTAL NUMBER OF CARTONS</th>
<th>CARTON CONDITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>183</td>
<td></td>
</tr>
</tbody>
</table>

Form No. 273

*White - Purchasing*  
*Green - Accounting*  
*Pink - Receiving*
<table>
<thead>
<tr>
<th>REC. NO.</th>
<th>TIME AM/PM</th>
<th>RECEIVED FROM</th>
<th>DESCRIPTION OF CARTONS &amp; CONTENTS</th>
<th>OUR ORDER NUMBER</th>
<th>CARRIER</th>
<th># OF CTNS</th>
<th>RECEIVED BY</th>
</tr>
</thead>
<tbody>
<tr>
<td>003530</td>
<td>6:40 AM</td>
<td>Milliken's Company</td>
<td>3 - Rolls of Fabric 2-392-95 79, B36, 95, 103 2-399-95 99, 102, 95, 103 2-397-95</td>
<td>-</td>
<td>A. O.</td>
<td>3</td>
<td>B.E.</td>
</tr>
<tr>
<td>003531</td>
<td>7:15 AM</td>
<td>Joseph T. Reeves &amp; Son</td>
<td>9 - Mixed Miscellaneous 9, 12 9, 12</td>
<td>L-930117-6</td>
<td>-</td>
<td>6</td>
<td>J.M.</td>
</tr>
<tr>
<td>003532</td>
<td>7:15 AM</td>
<td>De Novo</td>
<td>6 - 397-95 Fasteners</td>
<td>L-930114-8</td>
<td>-</td>
<td>1</td>
<td>J.M.</td>
</tr>
<tr>
<td>003533</td>
<td>7:15 AM</td>
<td>Newton Manufacturing Co.</td>
<td>124 - Assorted Miscellaneous</td>
<td>6-24-130</td>
<td>3</td>
<td>1</td>
<td>J.M.</td>
</tr>
<tr>
<td>003534</td>
<td>9:25 AM</td>
<td>Specialty Commercial Service</td>
<td>16 - Small Miscellaneous</td>
<td>-</td>
<td>S.C.S.</td>
<td>1</td>
<td>J.H.</td>
</tr>
<tr>
<td>003535</td>
<td>10:15 AM</td>
<td>Engineered Laminates</td>
<td>9 - Rolls of Fabric</td>
<td>-</td>
<td>C.N.C.</td>
<td>9</td>
<td>G.B.</td>
</tr>
<tr>
<td>003536</td>
<td>2:15 PM</td>
<td>Hayashi</td>
<td>198 - Rolls of Fabric</td>
<td>-</td>
<td>Haynes</td>
<td>198</td>
<td>J.M.</td>
</tr>
<tr>
<td>003537</td>
<td>3:00 PM</td>
<td>Gerber Co- Net</td>
<td>16 - Small Miscellaneous</td>
<td>2-390120</td>
<td>-</td>
<td>1</td>
<td>G.B.</td>
</tr>
<tr>
<td>003538</td>
<td>3:00 PM</td>
<td>Newton Mfg.</td>
<td>16 - Miscellaneous</td>
<td>2-390170</td>
<td>-</td>
<td>1</td>
<td>G.B.</td>
</tr>
<tr>
<td>003539</td>
<td>5:00 AM</td>
<td>CMH Inc.</td>
<td>(410) G-2 Tracing &amp; Marking</td>
<td>6-90194</td>
<td>Cochran</td>
<td>3</td>
<td>J.Y.</td>
</tr>
<tr>
<td>003540</td>
<td>5:00 AM</td>
<td>Nippon</td>
<td>Empty Boxes</td>
<td>Cochran</td>
<td>2</td>
<td>J.Y.</td>
<td></td>
</tr>
<tr>
<td>003541</td>
<td>5:00 AM</td>
<td>TTE Corp.</td>
<td>Wilt Cond</td>
<td>Cochran</td>
<td>1</td>
<td>J.Y.</td>
<td></td>
</tr>
<tr>
<td>003542</td>
<td>5:00 AM</td>
<td>TTE Corp.</td>
<td>Sewing Thread</td>
<td>Cochran</td>
<td>10</td>
<td>J.Y.</td>
<td></td>
</tr>
<tr>
<td>003543</td>
<td>5:00 AM</td>
<td>HFT</td>
<td>Hi Cut Velcro</td>
<td>800067G</td>
<td>Cochran</td>
<td>34</td>
<td>J.Y.</td>
</tr>
<tr>
<td>003544</td>
<td>5:00 AM</td>
<td>HFT</td>
<td>Auto Fabric, Side Pocket</td>
<td>Cochran</td>
<td>9</td>
<td>J.Y.</td>
<td></td>
</tr>
<tr>
<td>003545</td>
<td>6:00 AM</td>
<td>Milliken</td>
<td>Auto Fabric</td>
<td>Acme-1049</td>
<td>16</td>
<td>J.Y.</td>
<td></td>
</tr>
</tbody>
</table>
INVENTORY
DATA FLOW IN CURRENT SYSTEM

Receive a packing list (xerox copy) → Packing List → Packing List → Make tags for packing list → Tag → Put tag on raw material

Packing list → through it away

Temp File

On the roll

Next morning,

Temporary File

Receive tags from lines suppliers → Tag 1 → Take originals from temporary file → Tag 2 → Make them match → File

When the packing list does not match with the real meters, the packing list and the customer's labels are taken to the purchase department.
PRODUCTION COORDINATOR

DATA FLOW IN CURRENT SYSTEM

Receive a packing list (xerox copy) → Packing List → Packing List → Check for something important → Important → Make necessary arrangements → Packing List → Through it away

Important

no

Through it away

Packing List

x
PURCHASE DEPARTMENT
DATA FLOW IN CURRENT SYSTEM

At any given moment,

Receive a packing list → Packing list x Packing list x Check packing list x Packing list → Through it away

Receive packing list & receiving report of Off. Sup.

Packing list0 1

Receiving Report

Packing list0 1

Receiving Report

Purchase Order

File

Bring purchase order

Packing list0

P. Order 0

Receiving Report

File

Receiving Report

Accounting

Receive R.M. Report, Packing List, Bill of lading

Bill of lading 0

Packing list0

Receiving Report

Receiving Report

Canal Winchester

Receiving Report

Bill of lading 0

Packing list0

Receiving Report

File
Ones a month a summary of the rejected material is prepared.
SEWING RECEIVING
ACTUAL DATA FLOW CHART

1. Make copies of packing list and receiving report
2. Make 3 copies of packing list
3. Tag

- Packing List
  - File
    - Production Control
    - Production Supervisor
    - Receiving Department
    - Purchase Department
Every week a report is prepared to be sent to Japan,

- Prepare weekly report for Trim Cords
- Make 3 copies

Write down every shipment that comes in, every thing is included,

- Prepare weekly receiving report
- Make 3 copies

File
Daily Reports:
- Prepare a daily production report
- File

Production Control
- Daily production
  - File
  - Production line
    - Sewing line
      - File
  - Daily usage
    - Prepare a sewing line sheet
    - File

Pull sheet
APPENDIX B

Data Flowcharts and Sample Documents of the Propose System.
RECEIVED MATERIAL
DATA FLOW IN PROPOSED SYSTEM

Every time that T.S.TRIM received roll of raw material and/or sewing Japanese parts

Scan label → Take portable scanner to host computer → Print reports → As soon as possible

Load received

Daily

Daily Rec. 1
R.R.M.

Purchase department
Accounting

Daily

Daily Rec. 1
S.J.P.

Purchase department
Accounting

Monthly

Monthly Rec. 1
R.R.M.

Purchase department
Accounting

Monthly

Monthly Rec. 1
S.J.P.

Purchase department
Accounting
ALLOCATED MATERIAL
DATA FLOW OF PROPOSED SYSTEM

Every time that T.S.TRIM allocated roll of raw materials and/or sewing Japanese parts

Scan label → Take portable scanner to host computer → Print reports →

On demand

Used/allocated

→ Requested Department

On demand

S.J.P. allocated

→ Requested Department

On demand

R.R.M. allocated

→ Requested Department
APPENDIX C

Barsoft On-screen Menus, Prompts and Sample Reports.
Enter password:
Enter Screen Number for DATA ENTRY:

SCREEN DIRECTORY

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SUPPLIER INFORMATION</td>
</tr>
<tr>
<td>2</td>
<td>STOCK INFORMATION</td>
</tr>
<tr>
<td>3</td>
<td>RECEIVED STOCK</td>
</tr>
<tr>
<td>4</td>
<td>ALLOCATED STOCK</td>
</tr>
<tr>
<td>5</td>
<td>CARRIER INFORMATION</td>
</tr>
<tr>
<td>6</td>
<td>DESTINATION INFORMATION</td>
</tr>
<tr>
<td>7</td>
<td>PHYSICAL INVENTORY</td>
</tr>
<tr>
<td>8</td>
<td>ORDER INFORMATION</td>
</tr>
<tr>
<td>9</td>
<td>MAT. USED EACH DAY</td>
</tr>
<tr>
<td>10</td>
<td>DAILY RECEIVING LOG</td>
</tr>
</tbody>
</table>

1 HELP 2 PAGE 3 PAGE 4 NUMBER 5 NAME 6 7 8 9 10 EXIT
FORWARD BACKWARD SORT SORT
ITEM: SUPPLIER NUMBER TYPE: TEXT LENGTH: 10

SUPPLIER INFORMATION

Use this screen to create/update supplier’s information.

SUPPLIER NUMBER: _____________
SUPPLIER NAME: _______________
SUPPLIER ADDRESS: ________________
CITY: ________ STATE: ______ ZIP CODE: ______
SUPPLIER CONTACT: ________________
TELEPHONE: ________________
COMMENTS: ________________

1 HELP  2 NEXT  3 PREV  4 GO TO  5 REPEAT  6 DELETE  7 SET  8 SEARCH  9 SEARCH 10 EXIT
RECORD  RECORD  INDEX  RECORD  SEARCH  NEXT  PREV
ITEM: SUPPLIER NAME TYPE: TEXT LENGTH: 20

SUPPLIER INFORMATION

Use this screen to create/update supplier's information.

SUPPLIER NUMBER: MIS111222
SUPPLIER NAME: SUPPLIER TWENTY TWO
SUPPLIER ADDRESS: COURT STREET
CITY: CHICAGO STATE: IL ZIP CODE: 57570
SUPPLIER CONTACT: MIKE FOLEY
TELEPHONE: (545) 767-6878
COMMENTS: NONE

1 HELP 2 NEXT 3 PREV 4GO TO 5REPEAT 6DELETE 7 SET 8SEARCH 9SEARCH 10 EXIT
RECORD RECORD INDEX RECORD SEARCH NEXT PREV
<table>
<thead>
<tr>
<th>ITEM: PART NUMBER</th>
<th>TYPE: TEXT</th>
<th>LENGTH: 22</th>
</tr>
</thead>
</table>

**STOCK INFORMATION**  
Use this screen to create/edit PART'S information.

<table>
<thead>
<tr>
<th>PART NUMBER:</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PART NAME:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>USAGE:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUPPLIER NUMBER:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUPPLIER NAME:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| MINIMUM QUANTITY ON HAND: |            |
| REORDER TO WHAT QUANTITY: |            |

| ITEM VALUE: |            |
|            |            |

<p>| PART LOCATION: |            |
|               |            |</p>
<table>
<thead>
<tr>
<th>Stock Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use this screen to create/edit PART'S information.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ITEM</th>
<th>PART NAME</th>
<th>TYPE</th>
<th>LENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>TEXT</td>
<td>25</td>
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</tbody>
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<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>TR96854DGNAL127LST</th>
</tr>
</thead>
<tbody>
<tr>
<td>PART NAME</td>
<td>DX BROWN ST</td>
</tr>
<tr>
<td>USAGE</td>
<td>7</td>
</tr>
<tr>
<td>SUPPLIER NUMBER</td>
<td>MIS900426</td>
</tr>
<tr>
<td>SUPPLIER NAME</td>
<td>SUPPLIER SIX</td>
</tr>
<tr>
<td>MINIMUM QUANTITY ON HAND</td>
<td>53</td>
</tr>
<tr>
<td>REORDER TO WHAT QUANTITY</td>
<td>55</td>
</tr>
<tr>
<td>ITEM VALUE</td>
<td>32.00</td>
</tr>
<tr>
<td>PART LOCATION</td>
<td></td>
</tr>
</tbody>
</table>

1 HELP  2 NEXT  3 PREV  4 TO  5REPEAT  6DELETE  7 SET  8SEARCH  9SEARCH  10 EXIT
RECORD  RECORD  INDEX  RECORD  SEARCH  NEXT  PREV
Use this screen to receive/create quantities of an existing PART NUMBER into the database.

| ITEM: PART NUMBER | TYPE: TEXT | LENGTH: 22 |

**PART NUMBER:**

| PART NAME: |  |

| QUANTITY ON HAND: |  |

| SYS DATE RECEIVED: |  |

| SYS TIME RECEIVED: |  |

| DATA: |  |

| QUANTITY RECEIVED: |  |

| SUPPLIER NUMBER: |  |

| GROSS QUANTITY: |  |

| DYE_LOT: |  |

| SHADE: |  |

| EMPLOYEE NUMBER: |  |

| CARRIER NUMBER: |  |

1 HELP 2 NEXT 3 PREV 4GO TO 5REPEAT 6DELETE 7 SET 8SEARCH 9SEARCH10 EXIT RECORD RECORD INDEX RECORD SEARCH NEXT PREV
Use this screen to receive/create quantities of an existing PART NUMBER into the database.

<table>
<thead>
<tr>
<th>ITEM: SYS TIME RECEIVED</th>
<th>TYPE: TEXT</th>
<th>LENGTH: 8</th>
</tr>
</thead>
</table>

**PART NUMBER:** TR968540RGNAL127L3T
**PART NAME:** DX BROWN 3T
**QUANTITY ON HAND:** 164
**SYS DATE RECEIVED:** 07/31/90
**SYS TIME RECEIVED:** 19:33:07
**DATA:** 164
**QUANTITY RECEIVED:** 49
**SUPPLIER NUMBER:** MIS900426
**GROSS QUANTITY:** 48.9
**DYE_LOT:** 1631
**SHADE:** L
**EMPLOYEE NUMBER:** 1211
**CARRIER NUMBER:** CRR
Use this screen to allocate parts to a specific destination.

<table>
<thead>
<tr>
<th>ITEM: PART NUMBER</th>
<th>TYPE: TEXT</th>
<th>LENGTH: 22</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALLOCATED STOCK</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

|--------------|------------|------------------|-----------------|-----------------|-----------------|---------------------|------------------|----------------|---------|-------|-----------------|---------------------|

1 HELP 2 NEXT 3 PREV 4 GO TO 5 REPEAT 6 DELETE 7 SET BSEARCH 9 SEARCH 10 EXIT
RECORD RECORD INDEX RECORD SEARCH NEXT PREV
ITEM: SYS TIME ALLOCATED  TYPE: TEXT  LENGTH: 8

ALLOCATED STOCK

Use this screen to ALLOCATE parts to a specific destination.

PART NUMBER: TR965A0RGNAL127LL
PART NAME: LX BROWN ORG

QUANTITY ON HAND: 45
DATE ALLOCATED: 08/01/90
TIME ALLOCATED: 10:02:18
DATA ALLOCATED: 45
QUANTITY ALLOCATED: 23
SUPPLIER NUMBER: MIS900419
GROSS QUANTITY: 23.9
DYE_LOT: 23976
SHADE: L
EMPLOYEE NUMBER: 8876

DESTINATION NUMBER: ----> 1 HELP 2 NEXT 3 PREV 400 TO 5REPEAT 6DELETE 7 SET 8SEARCH 9SEARCH10 EXIT
RECORD RECORD INDEX  RECORD SEARCH NEXT PREV
Use this screen to create/update carrier's information.

CARRIER NUMBER: __________
CARRIER NAME: ________________
CARRIER ADDRESS: ________________
CITY: _______ STATE: ___ ZIP CODE: _____
CARRIER CONTACT: ________________
TELEPHONE: ________________
COMMENTS: ________________
CARRIER INFORMATION

Use this screen to create/update carrier's information.

CARRIER NUMBER: CN9999
CARRIER NAME: CARRIER NINE
CARRIER ADDRESS: NINE STREET
CITY: NINE  STATE: NN  ZIP CODE: 99999
CARRIER CONTACT: NUMBER NINE
TELEPHONE: (999) 999-9999
COMMENTS: NONE
ITEM: DESTINATION NUMBER   TYPE: TEXT   LENGTH: 5

DESTINATION INFORM

Use this screen to create/edit destination information. "Destination" are points of end use for items: materials, Japanese sewing parts, work in process and finish products.

DESTINATION NUMBER:       
DESTINATION NAME:         
COMMENTS:                

1 HELP  2 NEXT  3 PREV  4 GO TO  5 REPEAT  6 DELETE  7 SET  8 SEARCH  9 SEARCH  10 EXIT
RECORD  RECORD  INDEX  RECORD  SEARCH  NEXT  PREV
Use this screen to create/edit destination information. "Destination" are points of end use for items: materials, Japanese sewing parts, work in process and finish products.

DESTINATION NUMBER: J128
DESTINATION NAME: JAPANESE 12
COMMENTS: ONLY JAPANESE

1 HELP 2 NEXT 3 PREV 4G0 TO 5REPEAT 6DELETE 7 SET 8SEARCH 9SEARCH10 EXIT
RECORD RECORD INDEX RECORD SEARCH NEXT PREV
Use this screen to take physical inventory of the parts.

PART NUMBER:

PART NAME:

PART NUMBER LOCATION:

DATE OF PHYSICAL INVENTORY:

BOOK INVENTORY:

COUNTED IN STOCK:

DISCREPANCY:

1 HELP  2 NEXT  3 PREV  4 GO TO  5 REPEAT  6 DELETE  7 SET  8 SEARCH  9 SEARCH  10 EXIT

RECORD RECORD INDEX  RECORD SEARCH NEXT PREV
ITEM: SYS DATE INVENTORY    TYPE: DATE    LENGTH: 8

PHYSICAL INVENTORY
================================================================================================================================
Use this screen to take physical inventory of the parts
================================================================================================================================
| PART NUMBER: | TR96834ORQNAL127L5T |
| PART NAME:   | DX BROWN ST          |
| PART NUMBER LOCATION: |
| DATE OF PHYSICAL INVENTORY: | 08/01/90 |
| BOOK INVENTORY: | 168                |
| COUNTED IN STOCK: | 167                |
| DISCREPANCY:  | -1                  |

1 HELP  2 NEXT  3 PREV  4 GO TO  5 REPEAT  6 DELETE  7 SET  8 SEARCH  9 SEARCH 10 EXIT
RECORD RECORD INDEX RECORD SEARCH NEXT PREV
ITEM: PART NUMBER
TYPE: TEXT
LENGTH: 22

ORDER INFORMATION
---------------------------------------------------------
Use this screen to create/update all the orders
---------------------------------------------------------

PART NUMBER: 
PART NAME:
QUANTITY ORDERED: 
DATE ORDERED: 
P.O. #: 
SUPPLIER NUMBER: 
SUPPLIER NAME:

1 HELP 2 NEXT 3 PREV 4 GO TO 5 REPEAT 6 DELETE 7 SET 8 SEARCH 9 SEARCH 10 EXIT
RECORD RECORD INDEX RECORD SEARCH NEXT PREV
Use this screen to create/update all the orders

<table>
<thead>
<tr>
<th>ITEM: DATE ORDERED</th>
<th>TYPE: DATE</th>
<th>LENGTH: 8</th>
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</thead>
<tbody>
<tr>
<td>ORDER INFORMATION</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**PART NUMBER:** TR965340RGNAL127LL
**PART NAME:** LX BROWN ORG
**QUANTITY ORDERED:** 124
**DATE ORDERED:** 06/24/90
**P.O #:** 344958211
**SUPPLIER NUMBER:** MIS900419
**SUPPLIER NAME:**

1 HELP 2 NEXT 3 PREV 400 TO 5REPEAT 6DELETE 7 SET 8SEARCH 9SEARCH10 EXIT
RECORD RECORD INDEX RECORD SEARCH NEXT PREV
<table>
<thead>
<tr>
<th>ITEM: PART NUMBER</th>
<th>TYPE: TEXT</th>
<th>LENGTH: 22</th>
</tr>
</thead>
</table>

**MAT. USED EACH DAY**

Use this screen to actualize quantity of material used each day

<table>
<thead>
<tr>
<th>PART NUMBER:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PART NAME:</td>
<td></td>
</tr>
<tr>
<td>SYS DATE:</td>
<td>___</td>
</tr>
<tr>
<td>FIRST SHIFT:</td>
<td>___</td>
</tr>
<tr>
<td>SECOND SHIFT:</td>
<td>___</td>
</tr>
</tbody>
</table>

1 HELP 2 NEXT 3 PREV 4 GO TO 5 REPEAT 6 DELETE 7 SET 8 SEARCH 9 SEARCH 10 EXIT
RECORD RECORD INDEX RECORD SEARCH NEXT PREV
<table>
<thead>
<tr>
<th>ITEM: PART NAME</th>
<th>TYPE: TEXT</th>
<th>LENGTH: 25</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAT. USED EACH DAY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use this screen to actualize quantity of material used each day</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>TR968540RGNAL127LL</th>
</tr>
</thead>
<tbody>
<tr>
<td>PART NAME</td>
<td>LX BROWN ORG</td>
</tr>
<tr>
<td>SYS DATE</td>
<td>08/01/90</td>
</tr>
<tr>
<td>FIRST SHIFT</td>
<td>12</td>
</tr>
<tr>
<td>SECOND SHIFT</td>
<td>11</td>
</tr>
</tbody>
</table>

1 HELP 2 NEXT 3 PREV 4-20 TO 5 REPEAT 6 DELETE 7 SET 8 SEARCH 9 SEARCH 10 EXIT
| RECORD  | RECORD INDEX  | RECORD SEARCH  | NEXT  | PREV |
ITEM: RECORD NO  TYPE: NUMERIC  LENGTH: 6

DAILY RECEIVING LOG

Use this screen to update the receiving log

RECORD NO:  
SYS TIME:  
SYS DATE:  
RECEIVED FROM:  
DESCRIPTION:  
ORDER NUMBER:  
CARRIER NUMBER:  
CARRIER NAME:  
NUMBER OF CARTONS:  
RECEIVED BY:  

1 HELP  2 NEXT  3 PREV  4GO TO  5REPEAT  6DELETE  7 SET  8SEARCH  9SEARCH10 EXIT  
RECORD RECORD INDEX  RECORD SEARCH  NEXT  PREV
Use this screen to update the receiving log

RECORD NO: 3533
SYS TIME: 20:41:49
SYS DATE: 04/19/90
RECEIVED FROM: JORGE SALCEDO
DESCRIPTION: THREE BOXES OF RAW MATERIAL
ORDER NUMBER: L-980119A
CARRIER NUMBER: CN444
CARRIER NAME: CARRIER FOUR
NUMBER OF CARTONS: 9
RECEIVED BY: J.A.S
Create, Duplicate, Erase, Modify or Run REPORT? (C/D/E/M/R):

CUSTOM REPORT DIRECTORY

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T.S. TRIM INDUSTRIES
10 Kenny Drive
Athens, Ohio 45701

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MQ-146B54QRG-09LORG | EX GRAY ORG           | 82      | -82     | 0.00                |                |
TR96B54QRGNA127LORG | DX BROWN ORG         | 47      | 50      | -3                  | 5.22           |

NOTE: INSUFFICIENT STOCK!
PLEASE INVESTIGATE...........

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T.S. TRIM INDUSTRIES
10 Kenny Drive
Athens, Ohio 45701

07/31/90
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APPENDIX D

Application programs for the MEQ 300 portable scanner.
This is an MEQ Basic application program used in the portable reader to RECEIVE raw material.
It will prompts the operator through the sequence and checks for the entry of duplicated bar coded information during the scanning process.

This statement deletes any file previously stored in the memory of the portable reader (MEQ 300)

10 KILL "****"

This statement allocate data storage for arrays and strings

20 DIM NAME$(1)*25,CRR$(1)*25,DDATE$(10)*8,TTIME$(200)*8
30 DIM PARTP$(50)*25,PARTC$(50)*25,PARTM$(50)*25
40 DIM PARTTS$(50)*25,TOT$(50)*120
50 DIM QUANT$(50)*25,SHADE$(50)*25,SUPPL$(50)
60 DIM C$(1)*25,D$(1)*1
70 DIM N$(1)*25,TT$(1)*100
80 DIM GROSS$(50)*25,DYE$(50)*25,TEMP$(1)*25,VAR*$3,B$*25

Open a data file as # 10 with a length of 100 characters for each record were the information is stored

90 OPEN "DataRec"as #10 LEN= 100

Ask the operator to scan his/her employee number

100 PRINT #0, USING "P1,C30", "SCAN YOUR NUMBER/NAME"

Use a subroutine to read bar coded employee number and truck name

110 GOSUB 2000

Strip the first 4 character from the variable name$

120 NAME$(1)=TEMP$(1)(1:4)
After the employee number has been enter make flag2 equal to 2

```
130  FLAG2=2
140  CLS

Print on the LCD the employee number already scanned

150  PRINT #0,USING "P1,C10",NAME$(1)

Delay time to make sure that is the right employee number

160  FOR K=1 TO 250
170  NEXT K
180  CLS

Ask the operator to scan the carrier number

190  PRINT #0,USING "P1,C30", "SCAN YOUR CARRIER NUMBER"

Go to subroutine to read bar coded carrier name and check if it hasn't been read before

200  GOSUB 2000

Strip the first 6 character from the variable crr$

210  CRR$(1)=TEMP$(1)(1:6)

After the employee number has been enter make flag2 equal to 2

220  FLAGR=2
230  CLS

Print on the LCD the employee number already scanned

240  PRINT #0,USING "P1,C25",CRR$(1)

Delay time to make sure that is the right carrier number

250  FOR K=1 TO 250
260  NEXT K
270  CLS
```
** Loop that indicates number of labels posible to be read **

```
280 FOR I = 1 TO 500
   Tells the operator to continue with the next label

290 PRINT #0, USING "P1,C30","PLEASE.... NEXT LABEL"
300 FOR K=1 TO 400
310 NEXT K
   Make the part number "p" flag (FLAGP), quantity received flag (FLAGQ),
   part number "c" (FLAGC), supplier number (FLAGV), part number "m" (FLAGV),
   and shade (FLAGH) equal to zero

320 FLAGP=0
330 FLAGQ=0
340 FLAGC=0
350 FLAGM=0
360 FLAGV=0
370 FLAGH=0
   Tells the operator to start scanning the next label

380 PRINT #0, USING "P1,C30", "START SCANNING"
```

Start the loop to read six bar coded information from the labels

```
390 FOR J=1 TO 6
   Go to subroutine to read bar coded information and check if it
   hasn't been read before

400 GOSUB 1000
   Make active the flags to know which ones has been read
```
410 PRINT #0, USING "P1,C15","CONTINUE"
420 IF FLAGP = 1 THEN PARTP$(I) = TEMPS$(1)(2:15) : FLAGP= 2
450 IF FLAGQ = 1 THEN QUANT$(I) = TEMPS$(1)(2:8) : FLAGQ= 2
460 IF FLAGC = 1 THEN PARTC$(I) = TEMPS$(1)(2:6) : FLAGC= 2
470 IF FLAGV = 1 THEN SUPPL$(I) = TEMPS$(1)(2:11) : FLAGV= 2
480 IF FLAGM = 1 THEN PARTM$(I) = TEMPS$(1)(2:4) : FLAGM= 2
490 IF FLAGH = 1 THEN SHADE$(I) = TEMPS$(1)(2:3) : FLAGH= 2

; Read the next bar code
490 NEXT J

; Retrieve today's date and store it in variable DDATE$
500 DDATE$(1)=DATE$

; Retrieve actual time and store it in variable TTIME$
505 TTIME$(1)=TIME$

; Ask the operator to key input gross quantity received
510 PRINT #0,USING "P1,C32","GROSS QUANT...?"
520 PRINT #0,USING "P1,C1": INPUT$#1,6,GROSS$(I)
530 CLS

; Ask the operator to key input dye-lot number
540 PRINT #0,USING "P1,C32","DYE-LOT...?"
550 PRINT #0,USING "P1,C1": INPUT$#1,5,DYE$(I)
560 CLS

;-------------------------------------------------------------------------------

570 PARTT$(I)=PARTP$(I)+PARTC$(I)+PARTM$(I)

580 TOTS$(1)=PARTT$(I)+"~"
590 TOTS$(1)=TOTS$(1)+DDATE$(1)+"~"
600 TOTS$(1)=TOTS$(1)+TTIME$(1)+"~"
610 TOTS$(1)=TOTS$(1)+QUANT$(I)+"~"
620 TOTS$(1)=TOTS$(1)+SUPPL$(I)+"~"
630 TOTS$(1)=TOTS$(1)+GROSS$(I)+"~"
640 TOTS$(1)=TOTS$(1)+DYE$(I)+"~"
650 TOTS$(1)=TOTS$(1)+SHADE$(I)+"~"
660 TOTS$(1)=TOTS$(1)+NAME$(I)+"~"
670 TOTS$(1)=TOTS$(1)+CRR$(I)+"~"
680 WRITE #10, USING "P1,C100", TOTS$(1)

`Make the variable TOTS$ empty`

690 TOTS$(1)="

`Ask the operator if he wants to quit or to continue with the next label. Press Q to quit (stop) and N to continue with the next label`

700 PRINT#0, USING "P1,C32","Q/QUIT N/NEXT "
710 PRINT#0, USING "P1,C1":INPUT$#1,1,VAR$
720 IF VAR$="Q" THEN STOP
730 NEXT I

`End of possible labels loop`

1000 FLAG = 0.0
1010 ONBAR GOSUB 1040
ONBAR GOSUB 0
1030     IF FLAG = 1.0 THEN RETURN
1040     TEMP$(1) = barcode$
1050     IF TEMP$(1) = "" OR TEMP$(1) = "Z" THEN GOTO 1040
1060     TEMP$(1) = TEMP$(1)(2:15)
1070     VAR$ = TEMP$(1)(1:1)
1080     IF VAR$="S" THEN GOTO 1250
1085     IF VAR$="2" THEN GOTO 1220
1088     IF VAR$="R" THEN GOTO 1220
1090     IF VAR$="P" AND FLAGP = 2 THEN GOTO 1220
1100     IF VAR$="P" THEN FLAGP = 1 : GOTO 1280
1110     IF VAR$="Q" AND FLAGQ = 2 THEN GOTO 1220
1120     IF VAR$="Q" THEN FLAGQ = 1 : GOTO 1280
1130     IF VAR$="C" AND FLAGC = 2 THEN GOTO 1220
1140     IF VAR$="C" THEN FLAGC = 1 : GOTO 1280
1150     IF VAR$="M" AND FLAGM = 2 THEN GOTO 1220
1160     IF VAR$="M" THEN FLAGM = 1 : GOTO 1280
1170     IF VAR$="V" AND FLAGV = 2 THEN GOTO 1220
1180     IF VAR$="V" THEN FLAGV = 1 : GOTO 1280
1190     IF VAR$="H" AND FLAGH = 2 THEN GOTO 1220
1200     IF VAR$="H" THEN FLAGH = 1 : GOTO 1280
1210     GOTO 1280
1220     PRINT #0, USING "P1,C30","ALREADY SCANNED!...GO TO NEXT"
1230     BEEP : BEEP : BEEP
1240     GOTO 1040
1250     PRINT #0, USING "P1,C31","NOT NEEDED! ...SCAN ANOTHER"
1260     BEEP : BEEP : BEEP
1270     GOTO 1040
1280     CLS
1290     FLAG = 1.0
1300     RETURN

SUB-ROUTINE THAT READ BARCODES AND IDENTIFY WHETHER IT IS A
EMPLOYEE NUMBER OR CARRIER NAME

2000     FLAG = 0.0
2010     ONBAR GOSUB 2040
2020     ONBAR GOSUB 0
2030     IF FLAG = 1.0 THEN RETURN
2040     TEMP$(1) = barcode$
2050     IF TEMP$(1) = "" OR TEMP$(1) = "Z" THEN GOTO 2040
2060     TEMP$(1) = TEMP$(1)(2:15)
2070     VAR$ = TEMP$(1)(1:1)
2080     IF VAR$="S" THEN GOTO 2250
2081 IF VAR$="P" THEN GOTO 2250
2082 IF VAR$="Q" THEN GOTO 2250
2083 IF VAR$="C" THEN GOTO 2250
2084 IF VAR$="M" THEN GOTO 2250
2085 IF VAR$="V" THEN GOTO 2250
2086 IF VAR$="H" THEN GOTO 2250
2090 IF VAR$="2" AND FLAG2 = 2 THEN GOTO 2220
2100 IF VAR$="2" THEN FLAG2 = 1 : GOTO 2280
2110 IF VAR$="R" AND FLAGR = 2 THEN GOTO 2220
2120 IF VAR$="R" THEN FLAGR = 1 : GOTO 2280
2210 GOTO 2280
2220 PRINT #0, USING "P1,C30","ALREADY SCANNED!...GO TO NEXT"
2230 BEEP : BEEP : BEEP
2240 GOTO 2040
2250 PRINT #0, USING "P1,C30","SCAN < NAME > OR < CARRIER >"
2260 BEEP : BEEP : BEEP
2270 GOTO 2040
2280 CLS
2290 FLAG = 1.0
2300 RETURN
This is an MEQ Basic application program used in the portable reader to ALLOCATE raw material. It will prompt the operator through the sequence and checks for the entry of duplicated bar coded information during the scanning process.

This statement deletes any file previously stored in the memory of the portable reader (MEQ 300)

10 KILL "*****"

This statement allocates data storage for arrays and strings

20 DIM NAME$(1)*25,CRR$(1)*25,DDATE$(10)*8,TTIME$(200)*8
30 DIM PARTP$(50)*25,PARTC$(50)*25,PARTM$(50)*25
40 DIM PARTT$(50)*25,TOT$(50)*120
50 DIM QUANT$(50)*25,SHADE$(50)*25,SUPPL$(50)
60 DIM C$(1)*25,D$(1)*1
70 DIM N$(1)*25,TT$(1)*100
80 DIM GROSS$(50)*25,DYE$(50)*25,TEMP$(1)*25,VAR$*3,B$*25

Open a data file as # 10 with a length of 100 characters for each record where the information is stored

90 OPEN "DataAll" as #10 LEN= 100

Ask the operator to scan his/her employee number

100 PRINT #0, USING "P1,C30", "SCAN YOUR NUMBER/NAME"

Use a subroutine to read bar coded employee number and truck name

110 GOSUB 2000

Strip the first 4 character from the variable name$

120 NAME$(1)=TEMP$(1)(1:4)
After the employee number has been enter make flag2 equal to 2

130    FLAG2=2
140    CLS

Print on the LCD the employee number already scanned

150    PRINT #0,USING "P1,C10",NAME$(1)

Delay time to make sure that is the right employee number

160    FOR K=1 TO 250
170    NEXT K
180    CLS

Ask the operator to scan the carrier number

190    PRINT #0,USING "P1,C30", "SCAN YOUR CARRIER NUMBER"

Go to subroutine to read bar coded carrier name and check if it hasn't been read before

200    GOSUB 2000

Strip the first 6 character from the variable crr$

210    CRR$(1)=TEMP$(1)(1:6)

After the employee number has been enter make flag2 equal to 2

220    FLAG2=2
230    CLS

Print on the LCD the employee number already scanned

240    PRINT #0,USING "P1,C25",CRR$(1)'

Delay time to make sure that is the right carrier number

250    FOR K=1 TO 250
260    NEXT K
270    CLS
Loop that indicates number of labels possible to be read

280 FOR I = 1 TO 500

Tells the operator to continue with the next label

290 PRINT #0, USING "P1,C30","PLEASE.... NEXT LABEL"

300 FOR K = 1 TO 400
310 NEXT K

Make the part number "p" flag (FLAGP), quantity received flag (FLAGQ), part number "c" (FLAGC), supplier number (FLAGV), part number "m" (FLAGV), and shade (FLAGH) equal to zero

320 FLAGP = 0
330 FLAGQ = 0
340 FLAGC = 0
350 FLAGM = 0
360 FLAGV = 0
370 FLAGH = 0

Tells the operator to start scanning the next label

380 PRINT #0, USING "P1,C30", "START SCANNING"

Start the loop to read six bar coded information from the labels

390 FOR J = 1 TO 6

Go to subroutine to read bar coded information and check if it hasn’t been read before

400 GOSUB 1000

Make active the flags to know which ones has been read
410 PRINT #0, USING "P1,C15","CONTINUE"
420 IF FLAGP = 1 THEN PARTP$(I) = TEMPS$(1)(2:15) : FLAGP= 2
430 IF FLAGQ = 1 THEN QUANT$(I) = TEMPS$(1)(2:8) : FLAGQ= 2
440 IF FLAGC = 1 THEN PARTC$(I) = TEMPS$(1)(2:6) : FLAGC= 2
450 IF FLAGV = 1 THEN SUPPL$(I) = TEMPS$(1)(2:11) : FLAGV= 2
460 IF FLAGM = 1 THEN PARTM$(I) = TEMPS$(1)(2:4) : FLAGM= 2
470 IF FLAGH = 1 THEN SHADE$(I) = TEMPS$(1)(2:3) : FLAGH= 2

Read the next bar code

490 NEXT J

Retrieve today's date and store it in variable DDATE$

500 DDATE$(1)=DATE$

Retrieve actual time and store it in variable TTIME$

505 TTIME$(1)=TIME$

Ask the operator to key input gross quantity received

510 PRINT #0,USING "P1,C32","GROSS QUANT...?"
520 PRINT #0,USING "P1,C1": INPUT$#1,6,GROSS$(I)
530 CLS

Ask the operator to key input dye-lot number

540 PRINT #0,USING "P1,C32","DYE-LOT...?"
550 PRINT #0,USING "P1,C1": INPUT$#1,5,DYE$(I)
560 CLS

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570 PARTT$(I)=PARTP$(I)+PARTC$(I)+PARTM$(I)

580 TOT$(1)=PARTT$(I)+"~"
590 TOT$(1)=TOT$(1)+DDATE$(1)+"~"
600 TOT$(1)=TOT$(1)+TTIME$(1)+"~"
610 TOT$(1)=TOT$(1)+QUANT$(I)+"-"
620 TOT$(1)=TOT$(1)+SUPPL$(I)+"-"
630 TOT$(1)=TOT$(1)+GROSS$(I)+"-"
640 TOT$(1)=TOT$(1)+DYE$(I)+"-"
650 TOT$(1)=TOT$(1)+SHADE$(I)+"-"
660 TOT$(1)=TOT$(1)+NAME$(1)+"-"
670 TOT$(1)=TOT$(1)+CRR$(1)+"-"
680 WRITE #10 , USING "P1,C100", TOT$(1)

Make the variable TOT$ empty

690 TOT$(1)=""

Ask the operator if he wants to quit or to continue with the next label. Press Q to quit (stop) and N to continue with the next label

700 PRINT#0, USING "P1,C32","Q/QUIT N/NEXT"
710 PRINT#0, USING "P1,C1": INPUT$#1,1, VAR$
720 IF VAR$="Q" THEN STOP
730 NEXT I

End of possible labels loop

Close data file

740 CLOSE #10
750 BEEP:BEEP:BEEP
760 END

Sub-routine that reads barcodes and identify whether it is a part number "p", quantity received, part number "c", supplier number, part number "m"

1000 FLAG = 0.0
1010  ONBAR GOSUB 1040
1020  ONBAR GOSUB 0
1030  IF FLAG = 1.0 THEN RETURN
1040  TEMP$(1) = barcode$
1050  IF TEMP$(1) = "" OR TEMP$(1) = "Z" THEN GOTO 1040
1060  TEMP$(1) = TEMP$(1)(2:15)
1070  VAR$=TEMP$(1)(1:1)
1080  IF VAR$="S" THEN GOTO 1250
1085  IF VAR$="2" THEN GOTO 1220
1088  IF VAR$="R" THEN GOTO 1220
1090  IF VAR$="P" AND FLAGP = 2 THEN GOTO 1220
1100  IF VAR$="P" THEN FLAGP= 1 : GOTO 1280
1110  IF VAR$="Q" AND FLAGQ = 2 THEN GOTO 1220
1120  IF VAR$="Q" THEN FLAGQ= 1 : GOTO 1280
1130  IF VAR$="C" AND FLAGC = 2 THEN GOTO 1220
1140  IF VAR$="C" THEN FLAGC= 1 : GOTO 1280
1150  IF VAR$="M" AND FLAGM = 2 THEN GOTO 1220
1160  IF VAR$="M" THEN FLAGM= 1 : GOTO 1280
1170  IF VAR$="V" AND FLAGV = 2 THEN GOTO 1220
1180  IF VAR$="V" THEN FLAGV= 1 : GOTO 1280
1190  IF VAR$="H" AND FLAGH = 2 THEN GOTO 1220
1200  IF VAR$="H" THEN FLAGH= 1 : GOTO 1280
1210  GOTO 1280
1220  PRINT #0, USING "P1,C30","ALREADY SCANNED!...GO TO NEXT"
1230  BEEP : BEEP : BEEP
1240  GOTO 1040
1250  PRINT #0, USING "P1,C31","NOT NEEDED! ...SCAN ANOTHER"
1260  BEEP : BEEP : BEEP
1270  GOTO 1040
1280  CLS
1290  FLAG = 1.0
1300  RETURN

****************************************************************************************************************************************

' SUB-ROUTINE THAT READ BARCODES AND IDENTIFY WHETHER IT IS A
' EMPLOYEE NUMBER OR CARRIER NAME

****************************************************************************************************************************************

2000  FLAG = 0.0
2010  ONBAR GOSUB 2040
2020  ONBAR GOSUB 0
2030  IF FLAG = 1.0 THEN RETURN
2040  TEMP$(1) = barcode$
2050  IF TEMP$(1) = "" OR TEMP$(1) = "Z" THEN GOTO 2040
2060  TEMP$(1) = TEMP$(1)(2:15)
2070  VAR$=TEMP$(1)(1:1)
2080  IF VAR$="S" THEN GOTO 2250
2081  IF VAR$="P" THEN GOTO 2250
2082  IF VAR$="Q" THEN GOTO 2250
2083  IF VAR$="C" THEN GOTO 2250
2084  IF VAR$="M" THEN GOTO 2250
2085  IF VAR$="V" THEN GOTO 2250
2086  IF VAR$="H" THEN GOTO 2250
2090  IF VAR$="2" AND FLAG2 = 2 THEN GOTO 2220
2100  IF VAR$="2" THEN FLAG2 = 1 : GOTO 2280
2110  IF VAR$="R" AND FLAGR = 2 THEN GOTO 2220
2120  IF VAR$="R" THEN FLAGR = 1 : GOTO 2280
2210  GOTO 2280
2220  PRINT #0, USING "P1,C30","ALREADY SCANNED!...GO TO NEXT"
2230  BEEP : BEEP : BEEP
2240  GOTO 2040
2250  PRINT #0, USING "P1,C30","SCAN < NAME > OR < CARRIER >"
2260  BEEP : BEEP : BEEP
2270  GOTO 2040
2280  cls
2290  flag = 1.0
2300  return
APPENDIX E

Translation Program to Modify the ASCII Datafile Format
OPEN "A:DATAREC" FOR INPUT AS #1

'OPEN FILE FOR BINARY OUTPUT

CLS
z$ = DATE$
inline:
INPUT "Please enter the truck number "; A
IF A < 1 OR A > 9 THEN GOTO errorhand
d$ = STRS(A)
d$ = RIGHT$(d$, 1)
E$ = "A:RECW" + LEFT$(z$, 2) + MID$(z$, 4, 2) + d$ + ".ASC"
PRINT E$

OPEN E$ FOR BINARY AS #2

WHILE NOT EOF(1)

******************************************************************************

INPUT #1, A$
FOR i = 1 TO LEN(A$)
c$ = MID$(A$, i, 1)
IF c$ = "~" THEN GOSUB PRINTING
LOCATE 10, 10: PRINT "Processing Data, Please wait ..."
IF c$ = " " THEN c$ = ""
B$ = B$ + c$
NEXT i

******************************************************************************

WEND
'CLS
LOCATE 10, 10: PRINT "File transferred successfully"
CLOSE
END

******************************************************************************

PRINTING:
X$ = B$
FOR J = 1 TO LEN(X$)
CH$ = MID$(X$, J, 1)
PUT #2, , CH$
NEXT J
'PUT OUT A CR
CH$ = CHR$(13)
PUT #2, , CH$
c$ = ""
B$ = ""
RETURN

errorhand:
PRINT "Sorry!! Number must be between 1 and 9"
PRINT : PRINT "Press any key to continue"
DO WHILE INKEY$ = ""
LOOP
GOTO inline