




# **9. Materials handling, computerization, and packaging issues**

- 1. Materials Handling Equipment**
  - 1.1. Manual or nonautomated materials handling systems**
  - 1.2. Automated handling systems**
- 2. Warehousing in just-in-time environment**
- 3. Packaging**
  - 3.1. Functions of packaging**
  - 3.2. Effects of packaging on Costs and Customer Service**
- 4. Computer technology, information, and warehouse management**



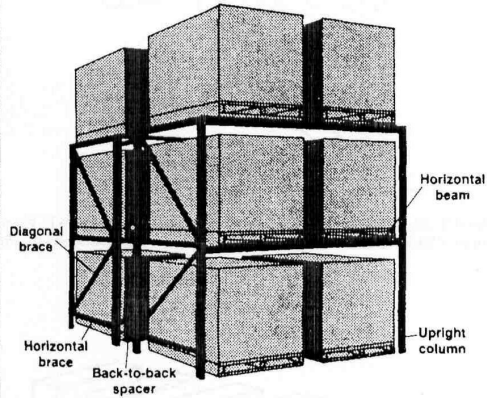
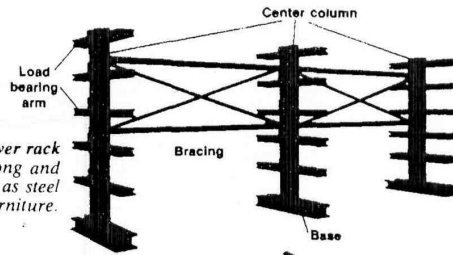
# 1. Storage and Order-Picking Equipment:

racks, shelving, drawers, and operator-controlled devices (e.g., forklift trucks)

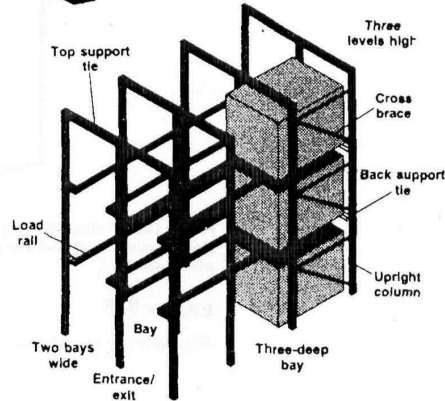
- Storage racks
- Gravity flow storage racks
- Bin shelving systems
- Modular storage drawers and cabinets
- “Fixed” and “movable” storage systems.

## Common rack designs

*Free-standing, double-sided cantilever rack provides 100% accessibility to long and varied loads and rolls, such as steel bars, carpets, and furniture.*

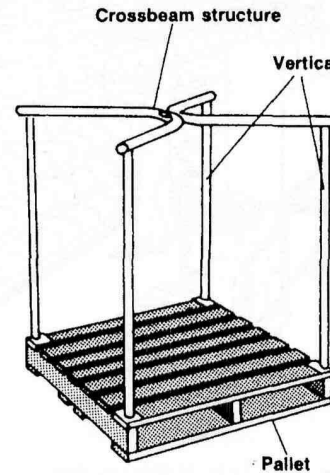


*Two-deep selective pallet rack, provides efficient cube storage and requires minimal aisle space. Loads can be handled from either of two aisles, or from one aisle using a reach truck.*

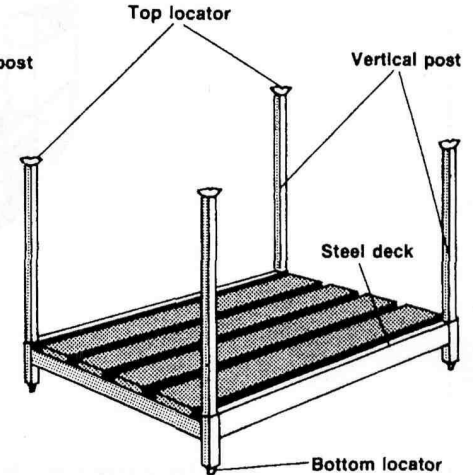


*Drive-in rack, above, differs from drive-through rack by virtue of having back support ties. Both types permit a lift truck to drive into the rack structure to pick up and deposit loads.*

## Racks for flexibility



*Pallet stacking frames attach directly to existing pallets, thus providing stack storage for otherwise unstackable loads.*



*Unitized portable racks enable heavy loads to be stacked, whether palletized or not. Racks can be nested if not disassembled.*

Figure 1 – Nonautomated storage units – storage racks

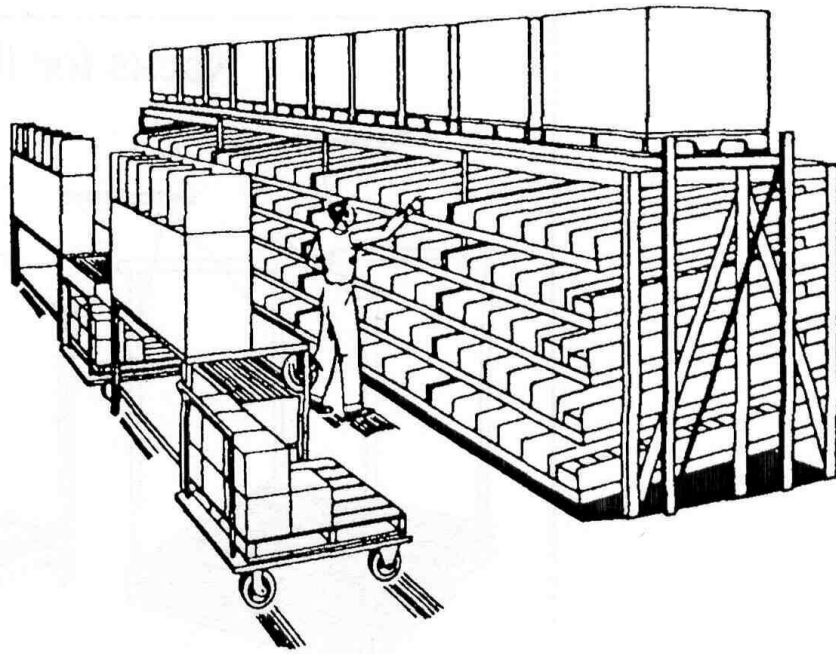


Figure 2 – Gravity flow storage racks

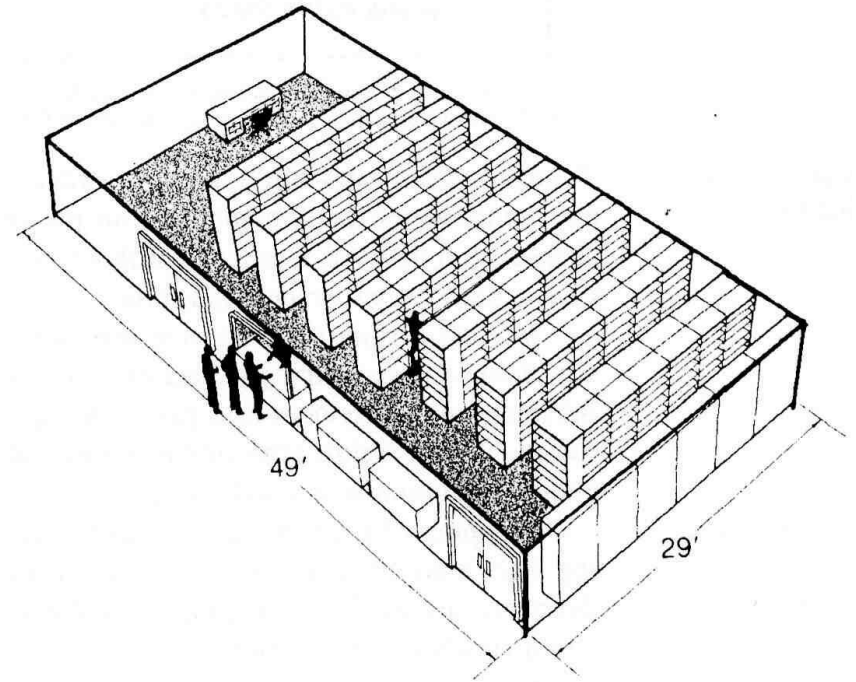


Figure 3 – Bin shelving systems

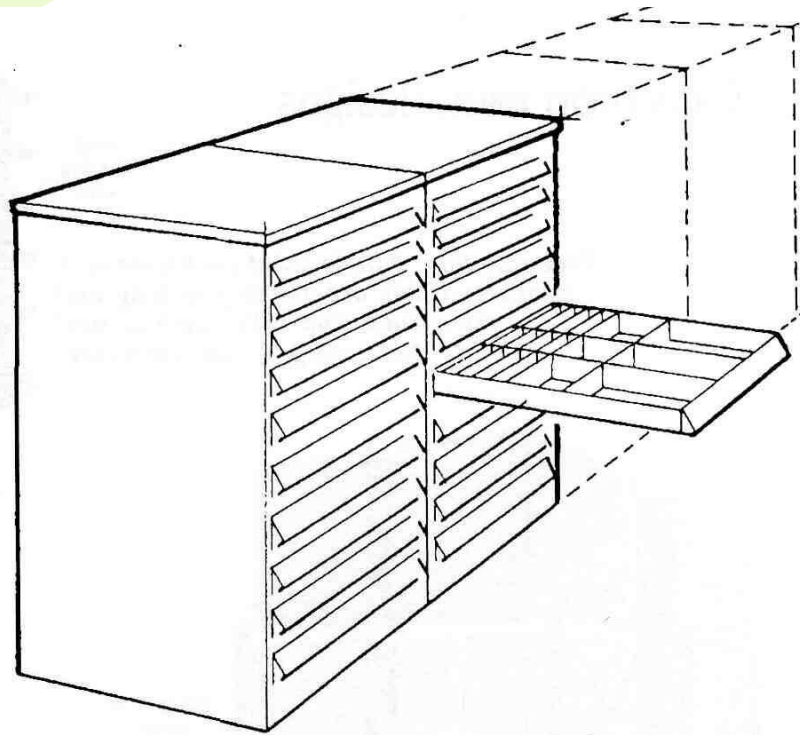


Figure 4 – Modular storage drawers and cabinets

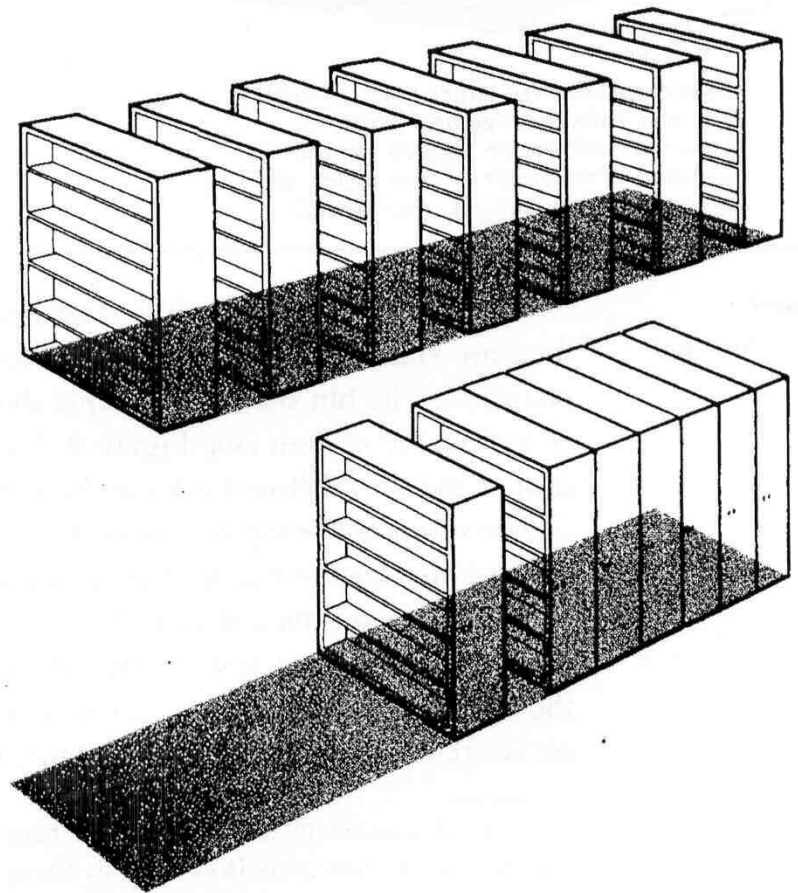


Figure 5 – Bin shelving mezzanine

## 2. Transportation and Sorting Equipment

- Forklift trucks
- Platform trucks
- Hand trucks
- Cranes
- Carts

# Automated Handling Systems

- Automated storage and retrieval systems (AS/RS)
- Carousels
- Case-picking and item-picking equipment
- Conveyors
- Robots
- Scanning systems
- Automatic Guided Vehicle Systems (AGVSs)



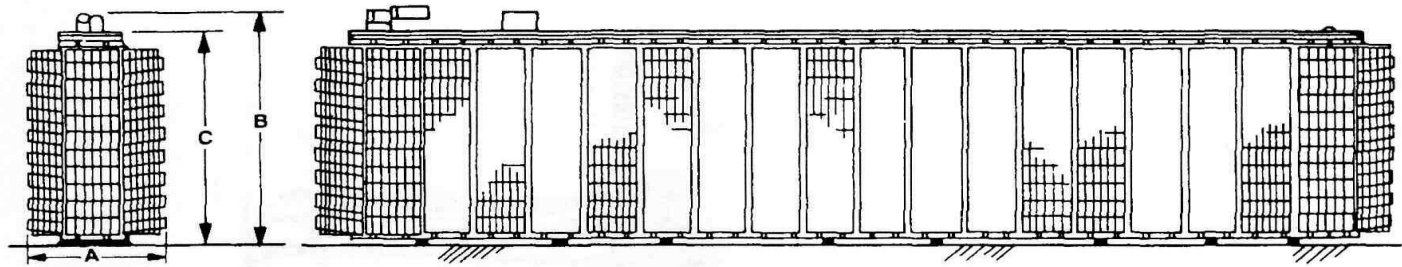
# ***Benefits of Automated Materials Handling Systems***

Benefit	Percent of respondents that “agree” or “strongly agree”
Labor cost reduction	98.8%
Ability to increase output rate	95.2
Improvement in consistency of service	92.1
Reduction in materials handling	92.1
Increased accuracy level	89.5
Service availability	87,0
Improvement in speed of service	81.0



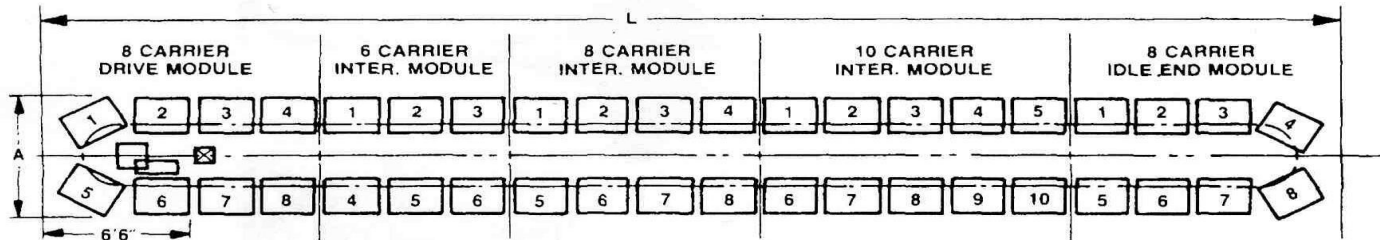
# ***Disadvantages of Automated Materials Handling Systems***

- Initial capital cost.
- Downtime or unreliability of equipment/maintenance interruptions.
- Software-related problems (e.g., poor documentation, incompatibility, failure).
- Capacity problems.
- Lack of flexibility to respond to changing environment.
- Maintenance costs.
- User interface and training.
- Worker acceptance.
- Obsolescence.

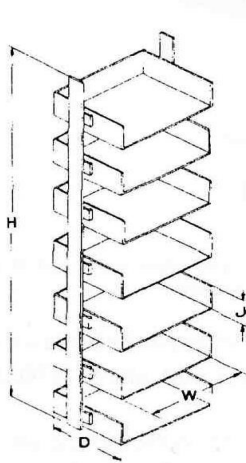


A. End elevation

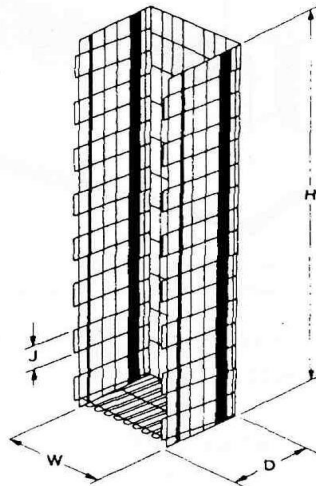
B. Side elevation



C. Plan view



D. Sheet metal carrier and shelves



E. Wire carrier and shelves

Figure 6 – Horizontal carousels

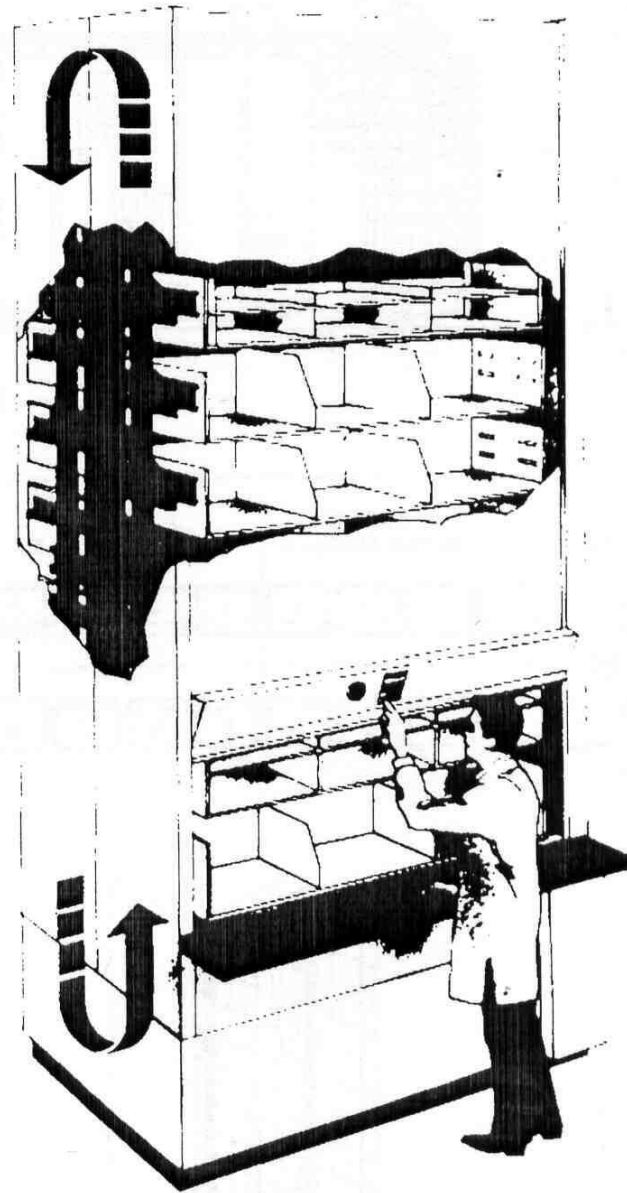


Figure 7 – Vertical carousels

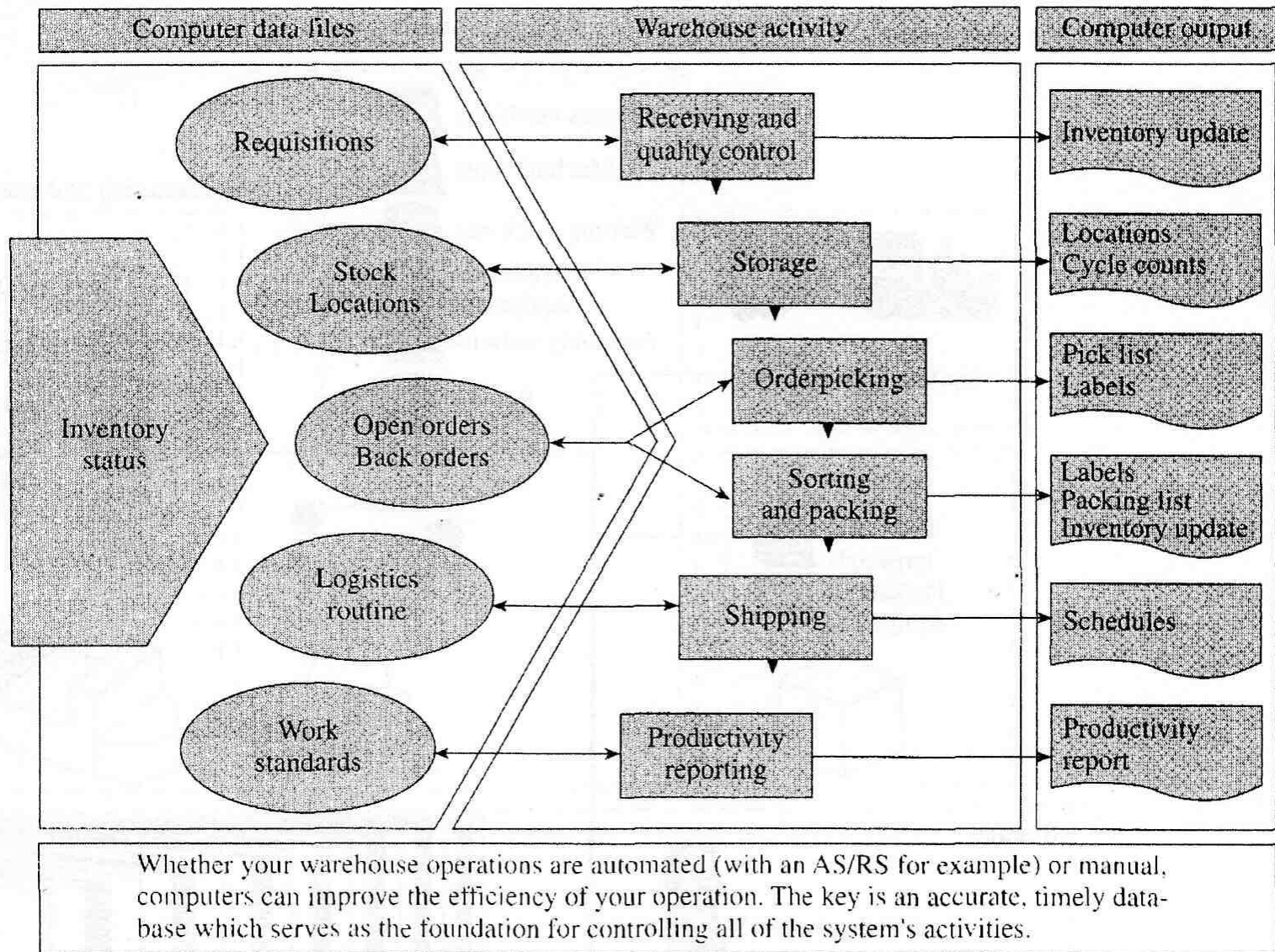
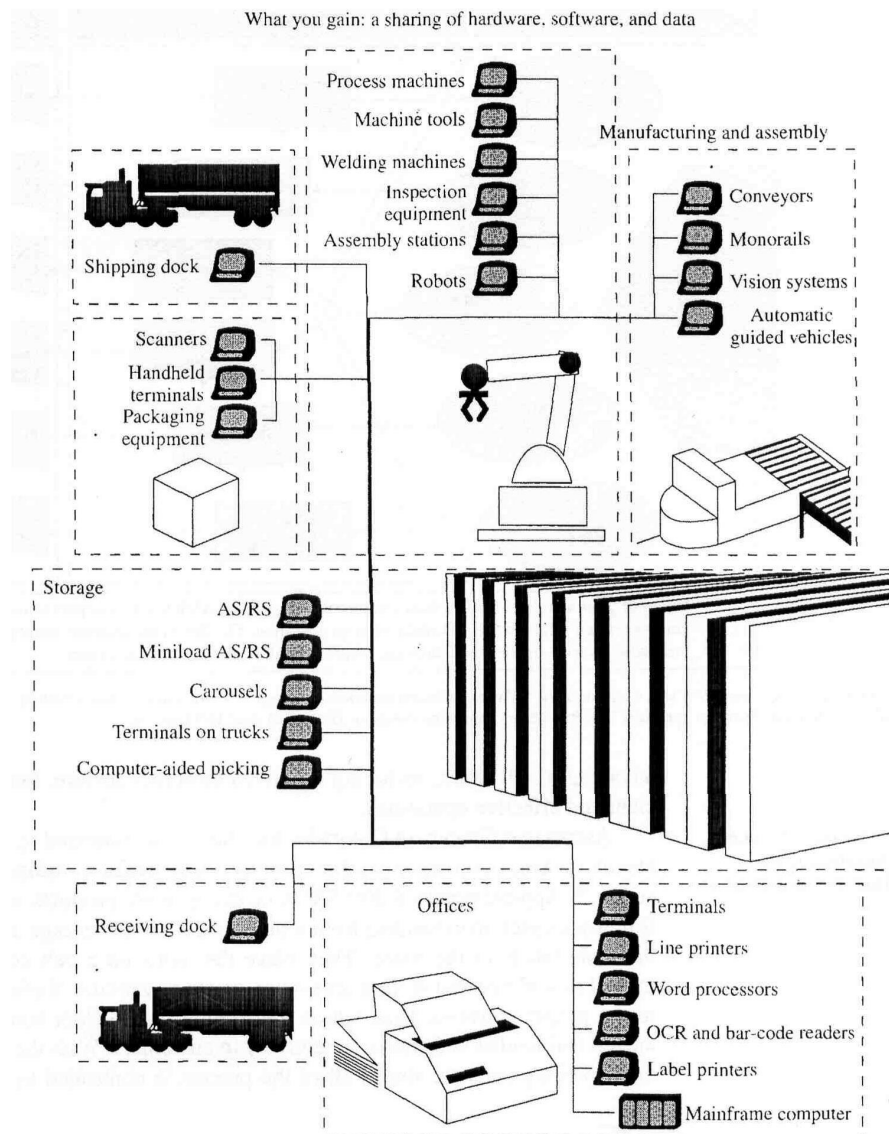


Figure 8 – Computers throughout the warehouse



A local area network (LAN) can link computers and computerlike devices, from different manufacturers, each with their own communications protocols. This means that incompatible equipment can “talk” with each other and share resources like mass memory storage and processors. And, as a result, a variety of computerized handling equipment and systems can be electronically connected into an integrated manufacturing operation.

Figure 9 – A local area network (LAN) example