Material Handling System Costing Module
Experiential Learning Based Exercise

Prepared for:
College-Industry Council on Material Handling Education
Material Handling Industry of America

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Based on Material from:
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Gross & Associates, "Rules of Thumb," © 1999

To use this module:

- o PPT file
- o PDF files of two layouts
- o Excel workbook for calculating costs
- o Give handout to the students

Retail Chain Distribution

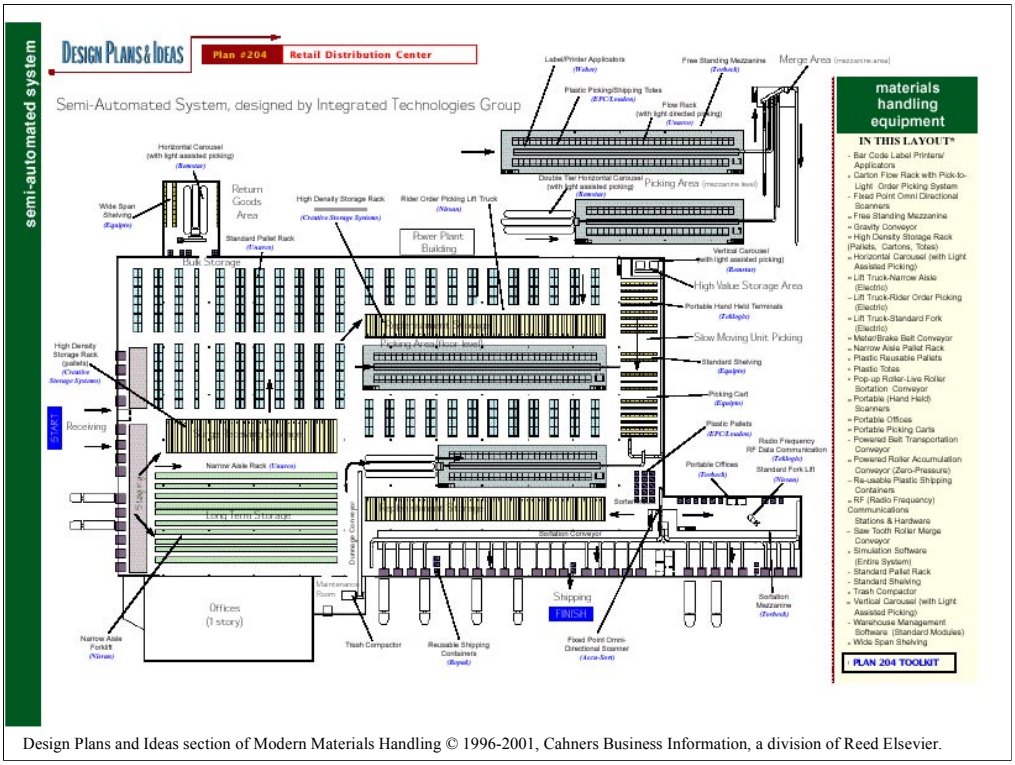
- E.g., Wal-Mart, K-Mart, etc.
- all products except clothes and tobacco
- batteries, CDs, brooms, screws, TP, cosmetics, etc.
- retail stores place order with DC each day
- pick in waves, zones, and sort to store
- WMS to control system
- everything is bar-coded and RF technology used

Retail Distribution Center

- **Semi-automated facility**
- 40 acre complex
- Facility:
  - 148,000 sq. ft. (~100 yds by 100 yds)
  - Max # of SKUs 24,000
  - Max Tput 98,600 units picked/shift

Here is a brief description of the type of design we are considering (we will compare this at the end to a manual system).

98,600 units per shift = 12,960 pc/hour = 540 cartons/hour @ 24 items/carton = 45 pallets/hour @ 12 cartons/pallet



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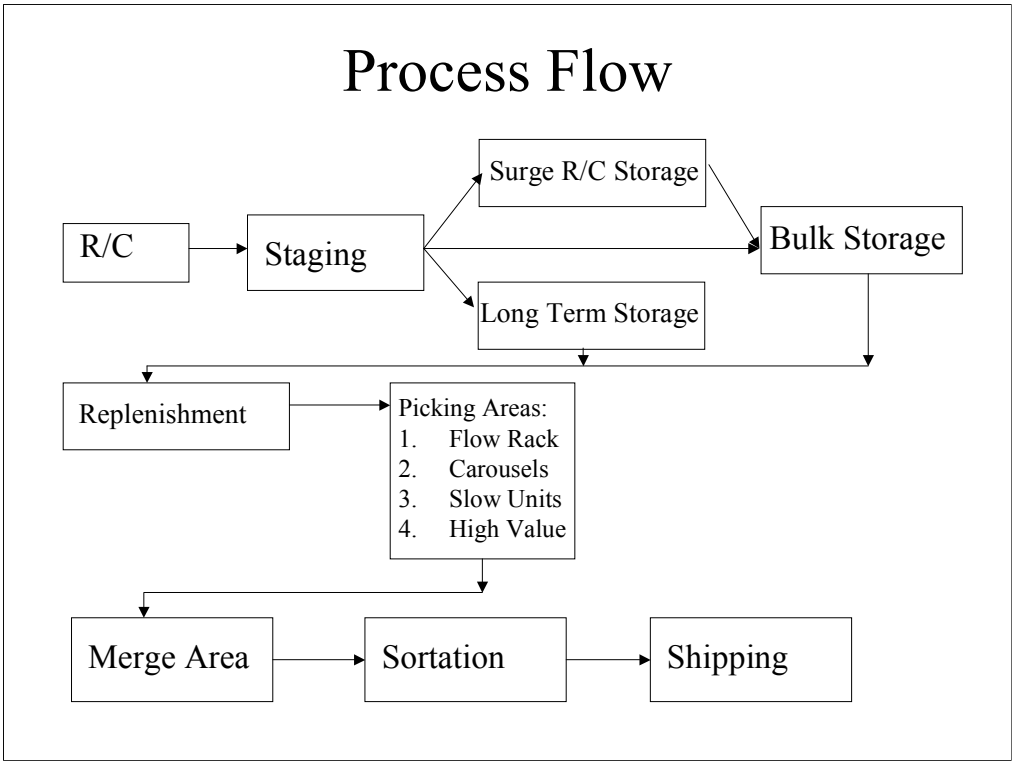
PDF document

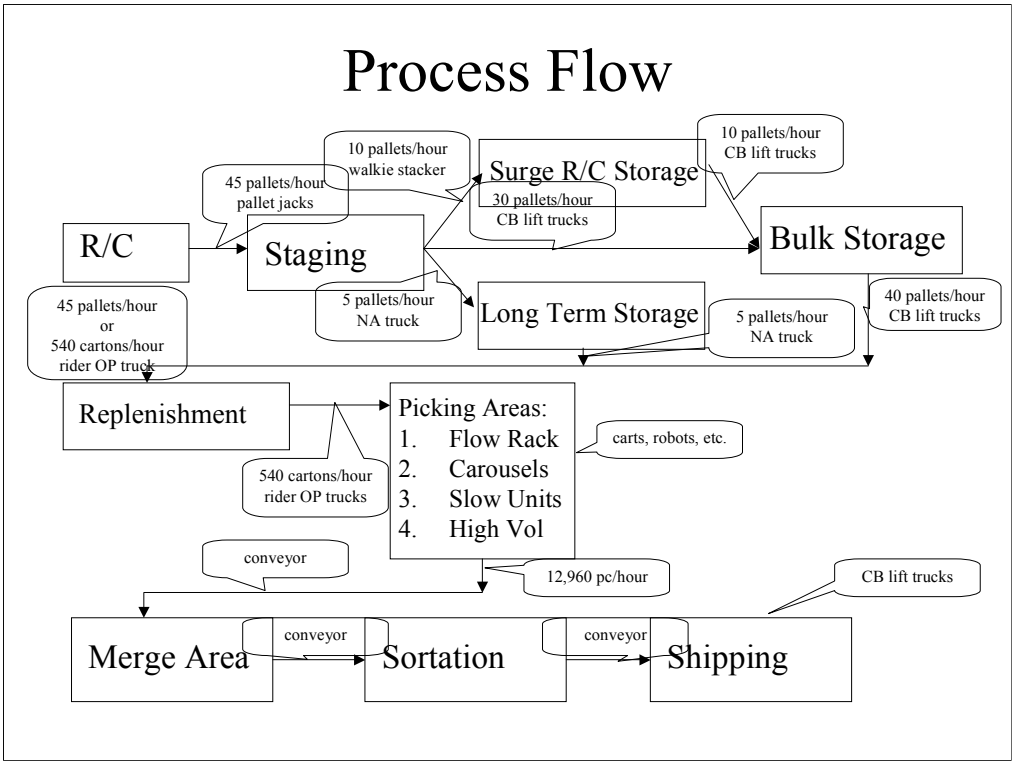
PDF to BMP (or like) converter is needed to do this.



Basic flow chart:

o have the students suggest material handling devices that could be used for each arrow/area.

o provide flow numbers to them



Other choices for material handling methods exist, as well as the split at staging.

Estimate System Costs

1. Building Units (DC, offices, land, etc.)
2. Pallet Jacks
3. Walkie Stackers
4. CB Lift Trucks
5. NA Trucks
6. Rider OP Trucks
7. Picking Carts
8. Conveyors
9. Pallet Rack
10. Picking Racks & Carousels

The green circles are ones that I want the students to calculate the numbers for.

The red slashes are ones that I don't want them to calculate the numbers for – I will do those.

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Estimated System Costs

1. Building Units (DC, offices, land, etc.) –
   153,000 sq. ft. WH only; 11,625 sq. ft. Office Building only; 55,000 sq. ft. WH Mezz; 40 acres of land rural
2. Pallet Jacks – ??
3. Walkie Stackers – ??
4. CB Lift Trucks – ??
5. NA Trucks – ??
6. Rider OP Trucks – ??
7. Picking Carts – 32
8. Conveyors –
   200' live roller; 1150' zero-pressure live roller; 1000' to 2000' belt conveyor; 120' to 150' trash conveyor
9. Pallet Rack –
   2400 to 2600 standard pallet; 500 to 1200 gravity flow rack
10. Picking Racks & Carousels –
    300 to 400 open light-medium shelving; 100 open heavy shelving; 100 to 200 carton flow rack; 360 carriers horizontal carousel; 40 vertical feet vertical carousel

Total Cost (rounded to the nearest million dollars) = $10M ($2M for standard handling equipment; $1M for storage equipment; $5M for building; $1M for land) or $3M+ for installed MH equipment

Note that the following are merely examples. There are other acceptable approaches since in some cases the material handling devices will need to be dedicated to areas. Also, the standards are usually not exact (e.g., there is no standard for an unpowered pallet jack … do you use the standard for a powered pallet truck? What about the CB lift truck standard? How is it less than the powered pallet truck? They must assume longer distances for CB lift truck than for powered pallet truck. Therefore, using a standard of 20/hour for an unpowered pallet jack may be about right or a little low.)

1. Taken from the website.
2. I have them calculate and use their numbers: 45 pallets/hour divided by 20 pallets/hour = 3 pallet jacks (standard may be low)
3. I have them calculate and use their numbers: 10 pallets/hour divided by 15 pallets/hour = 2 walkie stackers (standard may be low)
4. I have them calculate and use their numbers: 80 pallets/hour divided by 10 pallets/hour = 8; Shipping = 45/20 = 3; 11 total (standard based on size of area too – higher standard used in shipping)
5. I have them calculate and use their numbers: 10 pallets/hour divided by 10 = 1
6. I have them calculate and use their numbers: 2*540 cartons/hour divided by 50 cartons/hour = 22
7. Assume 25% of volume handled by cart and 2.5 pc/line (batching): 12,960*25%/2.5 = 1290; 1290/40 = 32
8. Approximate measurements off of layout (see above).
9. Assume 4 high; 600—700 locations; 2400—2600 pallet locations; see estimate for flow rack above
10. Racking taken from layout; H-Carousel: 60 carriers x 3 carousels x 2 levels = 360; V-Carousel: 2 x 20 = 40

Use the spreadsheet to compute the cost of the system (see "Example" worksheet).

Actual Design Comparison

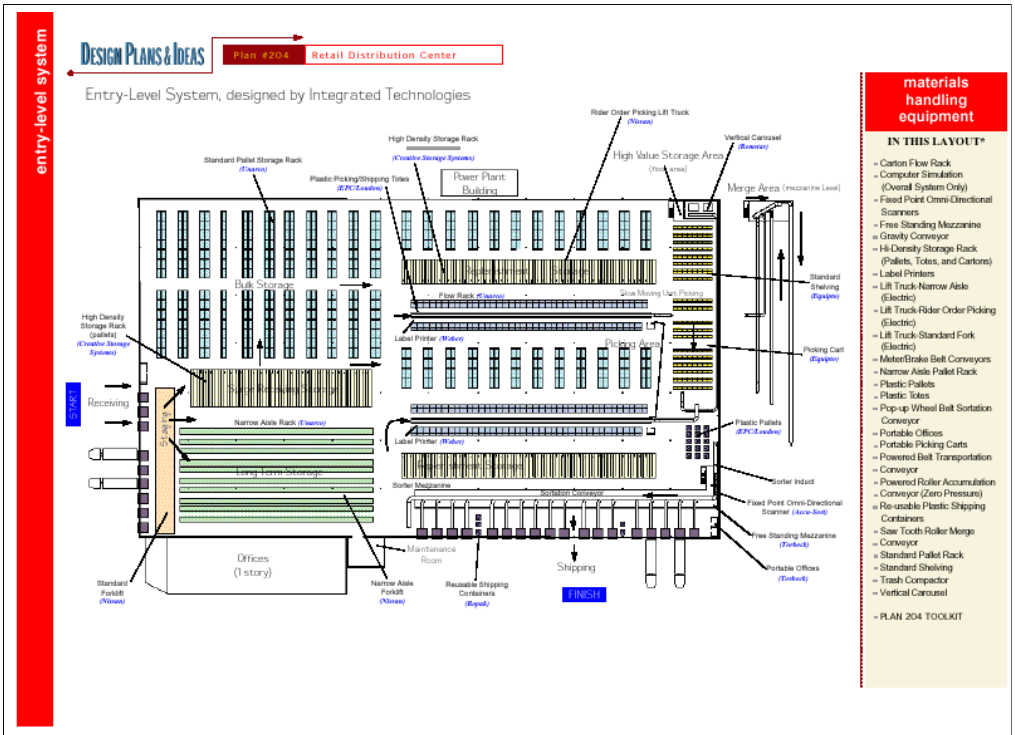
- The cost estimated by the designer of the **semi-automated system** was: $5.8M (excluding land, building).
- The designer estimated the number of employees at 134 (104 R/C & picking; 30 loading & shipping).
- The designer estimated the order accuracy at 96%.

These are from the website. Note that we are off by a factor of 2 (or so). Discuss why that might occur (missed control costs, WMS, etc.)

Retail Distribution Center

- **Manual facility**
- 40 acre complex
- Facility:
  - 135,000 sq. ft.
  - Max # of SKUs 18,000
  - Max Tput 50,000 units picked/shift

Need to compare to another option – manual system with lower throughput.



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Design Comparison

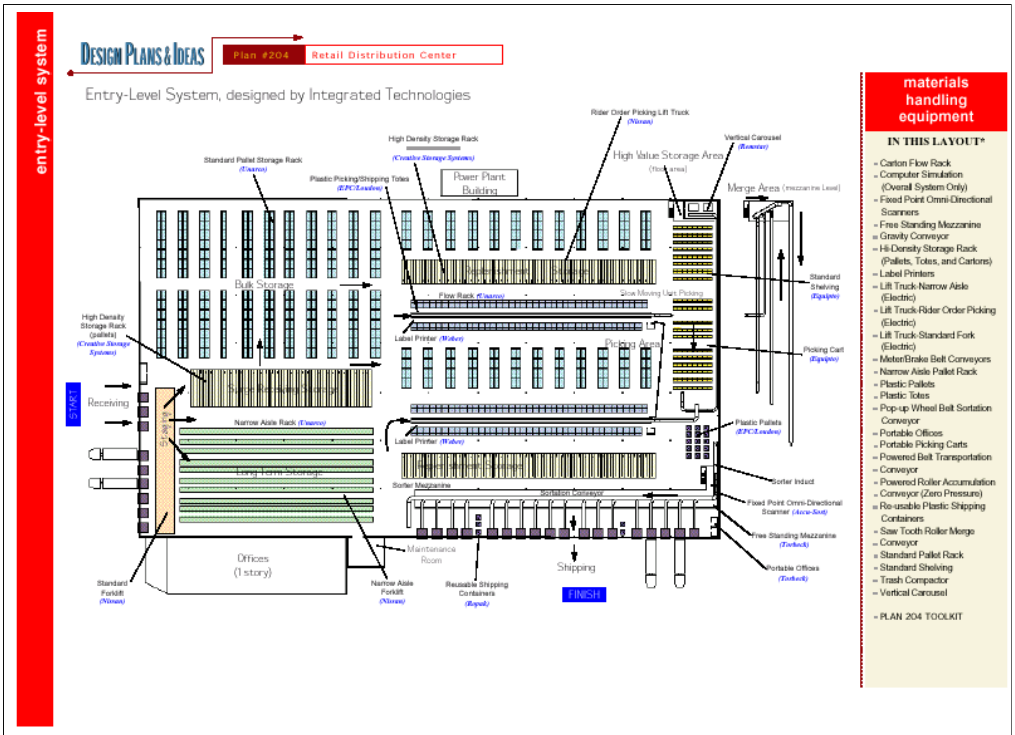
- The cost estimated by the designer of the **manual system** was: $3.2M (excluding land, building).
- The designer estimated the number of employees at 92 (76 R/C & picking; 16 loading & shipping).
- The designer estimated the order accuracy at 87%.

From website.

Side-by-Side Comparison

- Manual:
  - 135,000 square feet
  - $3.2M installed MH
  - 18,000 max SKUs
  - 50,000 picked/shift
  - 92 employees
  - 87% order accuracy
- Semi-Automated:
  - 148,000 square feet
  - $5.8M installed MH
  - 24,000 max SKUs
  - 98,600 picked/shift
  - 134 employees
  - 96% order accuracy

How would you justify the semi-automated design over the manual design? Discuss.



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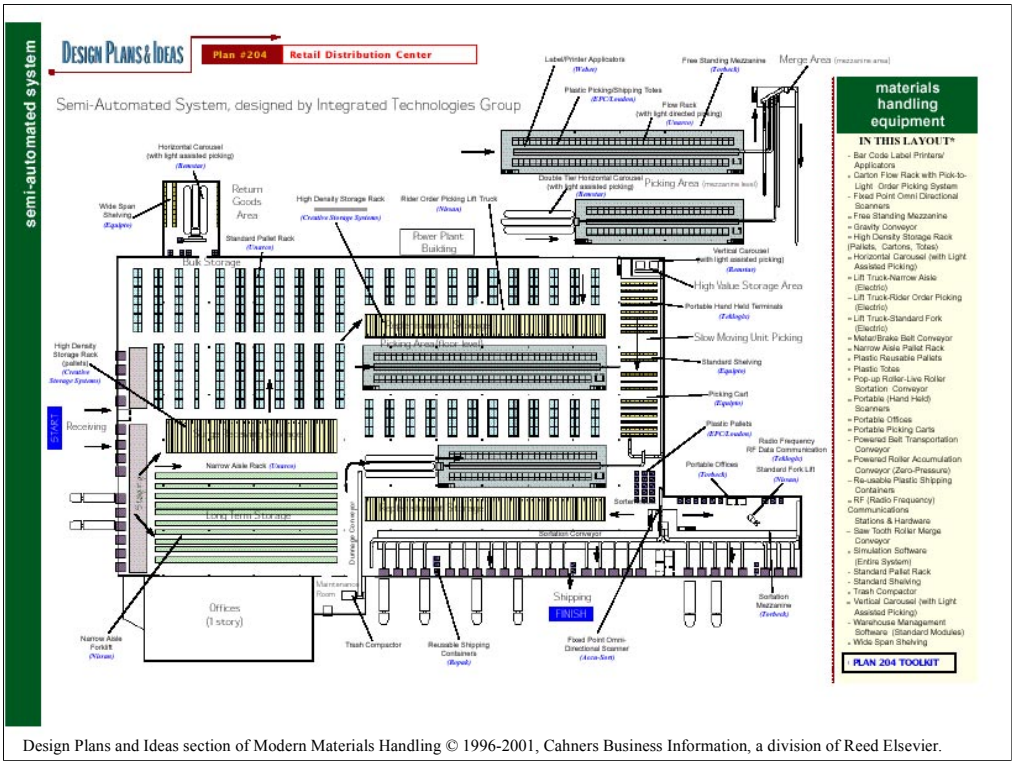

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Just to have them handy.