Availability of Forms and Materials

We are often asked to supply various forms, books, or other materials which we have prepared for our own use. Generally, we are not in the business of selling materials. However, some of our techniques are new; materials are not available from commercial suppliers; or it is more convenient to obtain them from us.

Therefore we have established a policy of providing a source of supply to our clients and enrollees in our training programs. Our charges are essentially only the amount necessary to cover our costs plus handling and shipping. Certain forms may be available in Microsoft Excel format from our website at www.RichardMuther.com.

How to Lay Out a Warehouse or Distribution Center

Solutions to Exercises and Case Problems

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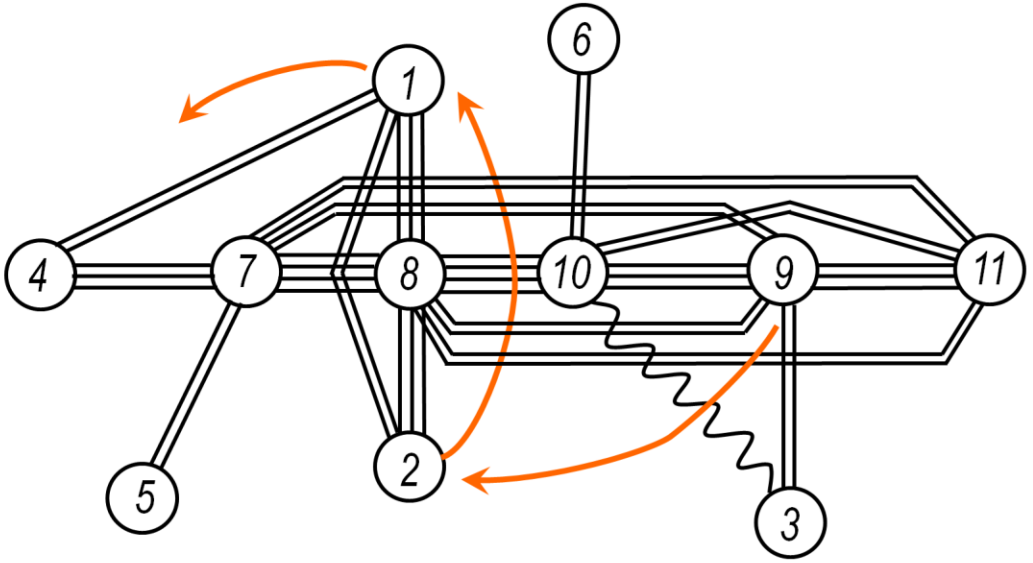
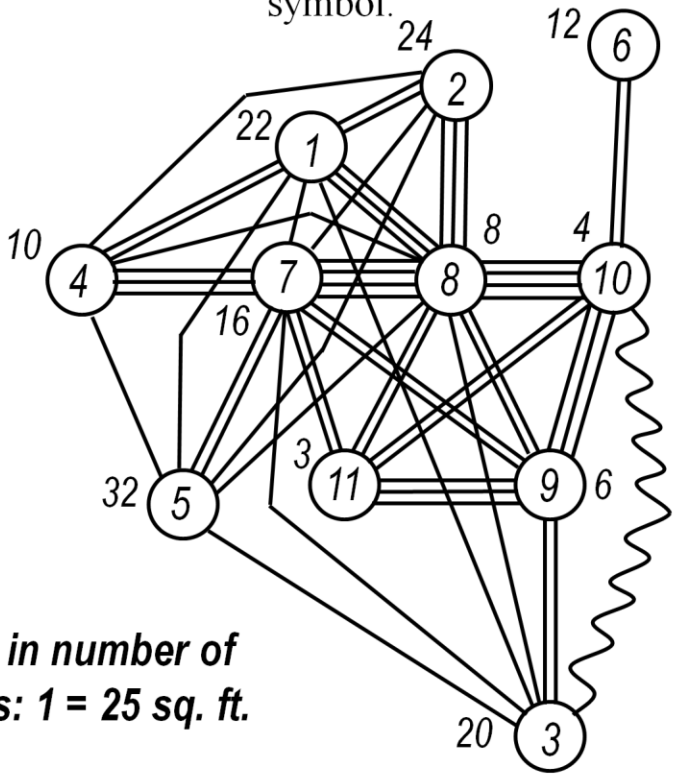


Mid-Continent Chemical Activity-Relationship Diagram

1. Please re-draw for best fit and then add O's
2. Convert space needed to number of squares at the scale of the drawing
3. Write the number of squares needed for each activity next to its symbol.

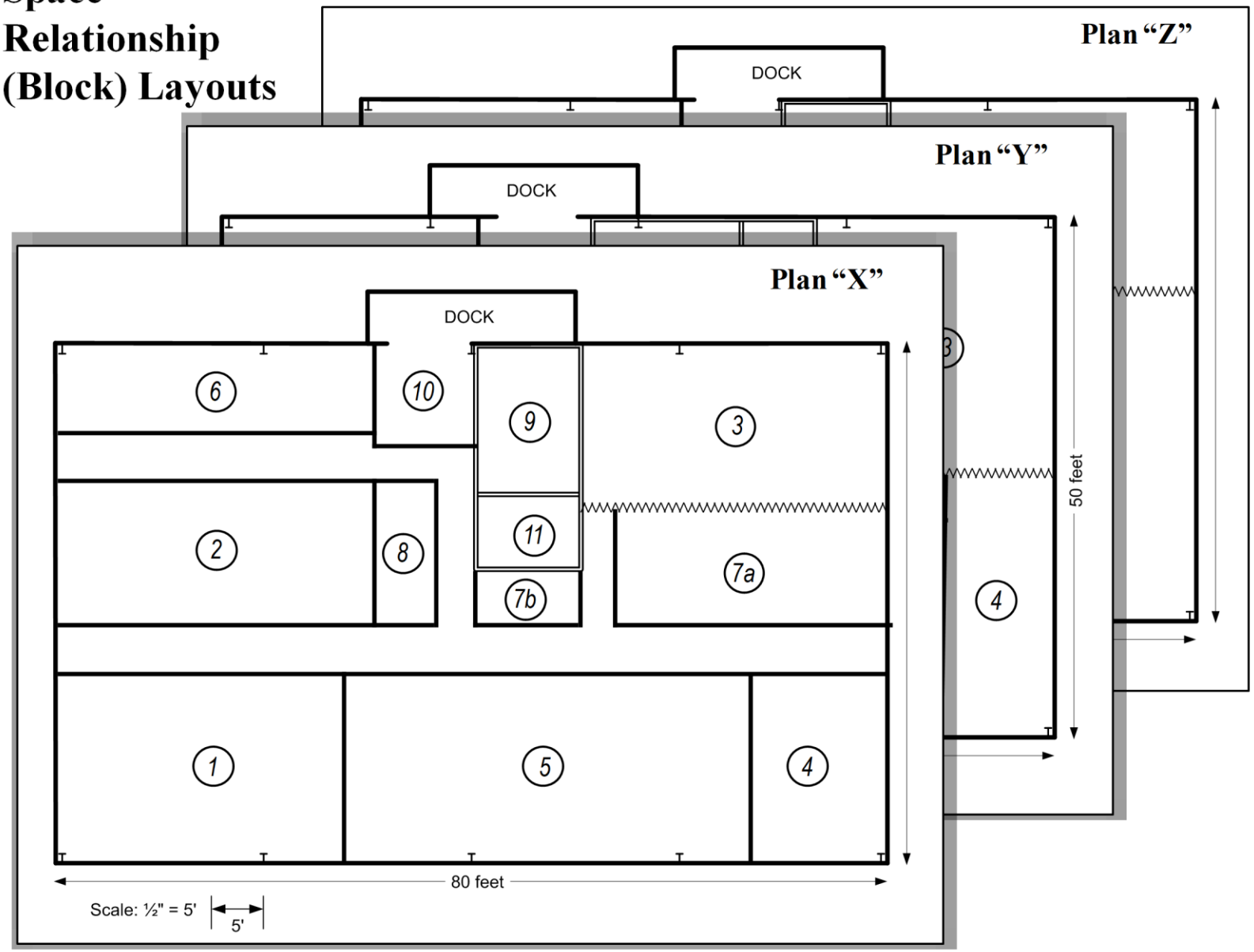
2 A's Re-draw for
5 E's best fit then add O's
10 I's
1 X



Space in number of squares: 1 = 25 sq. ft.

8A

Space Relationship (Block) Layouts



Evaluation of Alternative Arrangements

EVALUATING ALTERNATIVES

Plant: *Mid-Continent Chemical*

Project: *Block Layout* Date: *5/14*

Weights set by *LTD* Tally by *LTD*

Ratings by *LTD* Approved by _____

EVALUATING DESCRIPTION			
A	Almost Perfect	O	Ordinary Results
E	Especially Good	U	Unimportant
I	Important Results	X	Not Acceptable

Description of Alternatives:

Enter a brief phrase identifying each alternative.

A. *Plan "X" Split fab right; Restroom in middle*

B. *Plan "Y" Fab center; Move dock; Restroom on outside wall*

C. *Plan "Z" Fab bottom; Split tubing; Restroom in middle*

D.

E.

FACTOR / CONSIDERATION	WT.	ALTERNATIVE A	B	C	D	E
1 *Conveinience For Personnel*	8	O 8	E 24	E 24		
2 *Ease Of Material Flow*	10	A 40	I 20	E 30		
3 *Construction Cost*	6	A 24	E 18	I 12		
4 *Protection Of Materials*	5	I 10	A 20	A 20		
5 *Ease Of Supervision*	4	E 12	O 4	A 16		
6						
7						
8						
9						
10						
11						
12						
Totals		94	86	102		

Rating Scale:

A/4: Almost Perfect - (Excellent)
E/3: Especially Good - (Very Good)
I/2 : Important Results Obtained - (Good)
O/1: Ordinary Results - (Fair)
U/0: Unimportant Results - (Poor)
X : Not Acceptable - (Not Satisfactory)

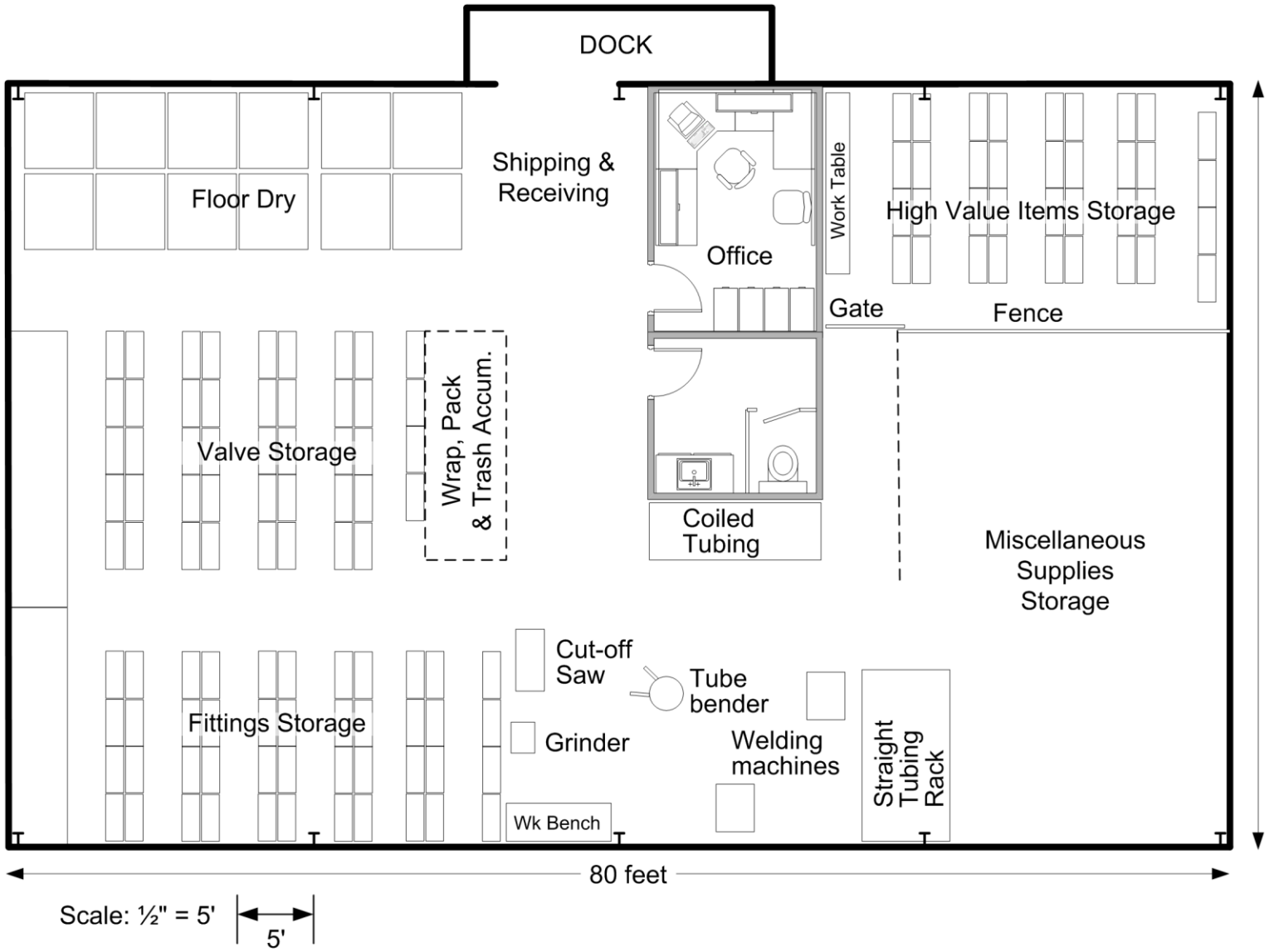
Reference Notes:

a. _____ d. _____

b. _____ e. _____

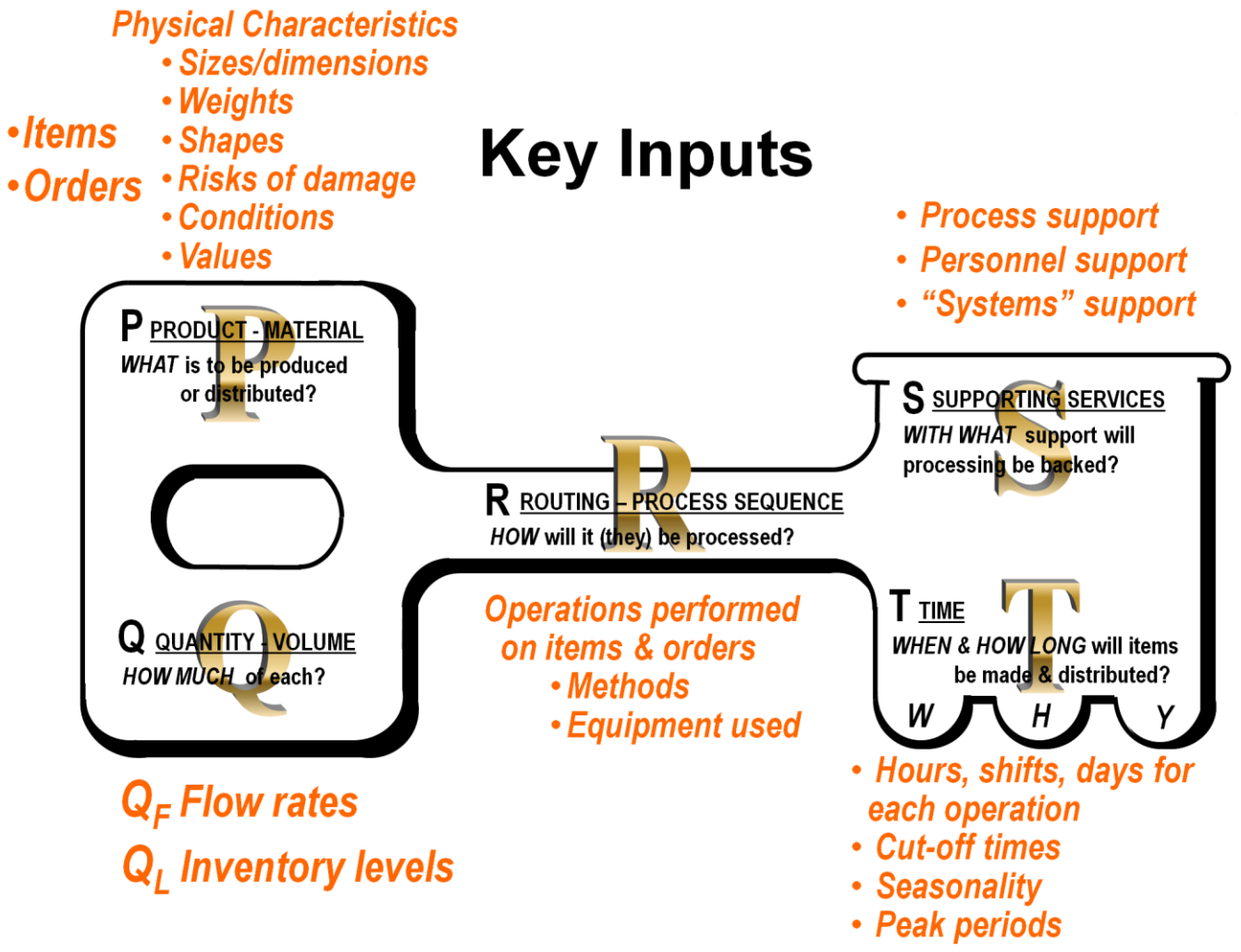
c. _____ f. _____

Detailed Selected Plan



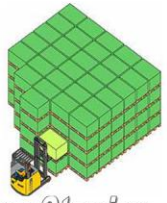
Main Points

1. Facilities planning requires five types of key input data.
2. For ease of recall, the five key inputs are designated by the five-letter sequence: P-Q-R-S-T. These stand for:
   - *Products* (or materials or services)
   - *Quantities* (sales volumes & inventory)
   - *Routing* (or processes of necessary operations)
   - *Supporting Services* (for people, processes and information systems)
   - *Timing* (operating hours, seasons, urgency…)
3. The facilities planner must collect data from others for each of the five key inputs.
4. When collecting data, be sure to challenge its correctness and underlying assumptions, especially regarding "R" the routing or process.
5. This act of challenging is symbolized by the letters W-H-Y on the teeth of the key.



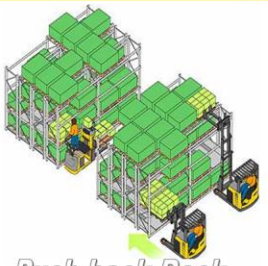
Notes

R_x for Storage Equipment

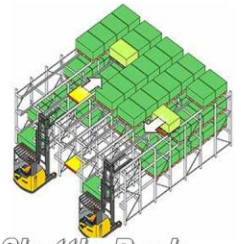


Floor Staging

Pallet Flow Rack



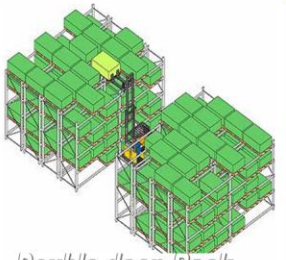
Push-back Rack



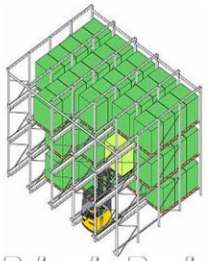
Powered Shuttle Rack

Single-deep Pallet Rack

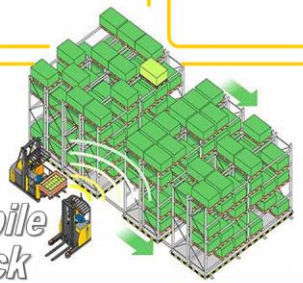
Tall Rack; Very Narrow Aisle



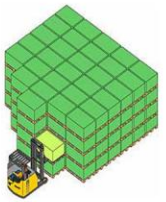
Double-deep Rack



Drive-in Rack



Mobile Rack



Floor Stack

FLOW Intensity (Cube/period)

Inventory LEVEL (Cube on hand)

SPACE Cost or limits

R_X for Unit Load Storage Equipment

Information needed to choose the best type of storage equipment:

- ***Inventory levels: pallets to be stored, by item, by item-lot and total***
- ***Flow intensities: pallets per period; turnover; days on hand***
- ***Seasonality***
- ***Stackability***
- ***Stock rotation requirements***
- ***Order-picking quantities and methods***
- ***Space available: area and clear height***
- ***Space cost; Occupancy cost***
- ***Budget***

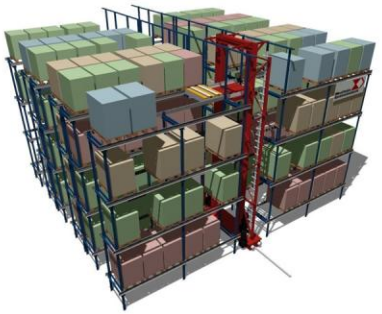
Main Points

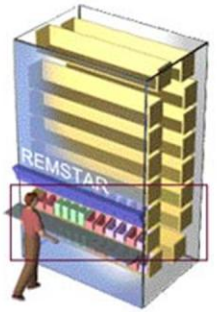
1. Certain conditions favor the use of high-density storage methods. When enough of these conditions are present, or when they dominate the planning, then high-density methods are likely to be chosen.
2. Generally, the facility must have high overhead clearance to make such methods worthwhile.
3. As a rule, the higher the storage density, the more costly and slow is the access to stored materials.
4. As with all storage methods decisions, the equipment selected must integrate with the material handling methods that serve it.

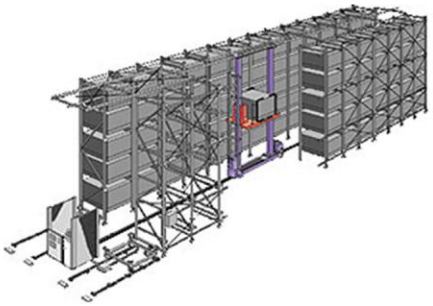
Conditions Favoring High-density Storage Methods

Factors or considerations that favor high-density, high-bay, and/or very-narrow-aisle equipment.

Large quantity to be stored
Lack of floor space or land
Very expensive space or land
Cooler or freezer space (costly to run)
Alternative is split locations
Sufficient overhead clearance
Capital available for equipment
Product cannot be floor stacked
Good maintenance capability
Large number of very small items
(Vertical carousel; mini-load)
External picking preferred







32A

Notes

Case Problem

Please read pages 1 & 2 of the case. Then answer the questions here.

Refer to RMA-2288 for ten potential storage methods and for some factors to consider.

BKG, Inc. – Storage Methods Selection

Questions:

1. What storage methods make the most sense? Why?
   - *Single-deep pallet rack for items with 1 or 2 pallets to be stored*
   - *Floor stack for items with many pallets (>10) to store.*
   - *Or, pallet flow rack if budget available???*
   - *2-deep rack or push-back for 3 – 10 pallets??? or force to 1-deep and floor stack; 2 methods instead of 3???*

2. What are the most important factors to consider when selecting storage methods?
   - *Number of loads to be stored (Inventory profile)*
   - *Stackability*
   - *Space available: area and clear height*
   - *Need for stock rotation*
   - *Budget*

3. What additional information would you like to have?
   - *Order-picking requirements & methods*
   - *Current storage method (rack type)*

RICHARD MUTHER & ASSOCIATES – S-7111-3-ppt

4A

Notes

Clean House Products (CHP, Inc.)

Problem:

You have been asked to determine if the pickers' complaints are valid and, if so, what could be done to improve the situation.

1. Do you consider the additional centimeters of height to be an issue? What more would you like to know?
   - *Yes.* - *How many pickers?* - *How many items (pick positions)?*

2. What about the replenishment issue of blocked aisles and use of an expensive truck to reload picking positions? What more would you like to know?
   - *Yes* - *Replen frequency and volume by item*

3. If yes, what improvements might be considered?
   - *Increase pick positions for problem items; replen at night?*
   - *Separate picking area with pallets at floor level like before*

4. What additional information would you need to evaluate these improvements?
   - *Space available for picking area? Reclaim*

5. What might have been missed – or should have been considered – when deciding upon storage methods and planning the new distribution center?
   - *Impact of pallet storage method on case picking method from storage*
   - *Impact of reserve storage method on replenishment method*

Personal Care Products

Questions:

1. What do you think of the material flow from truck to storage rack?

   Seems wasteful. Too many touches. Too many delays

2. What is being optimized?

   a. Cycle time? *Not. At least 1 extra wait.*

   b. Floor space? *Apparently not. Entire first bay is staging and full.*

   c. Material handling labor *?? Not clear. Depends upon wage rates*

   Truck driver; forklift operator; pallet transporter; deep-reach operator

   d. Capital investment? *Yes.*

   - *Delivery truck very expensive. Unload quick.*
   - *Sit down fork lift expensive. Don't use to travel. Keep it lowering and staging.*
   - *Pallet transporters inexpensive. Use to travel laterally. Keep expensive forks for lowering and lifting*
   - *Double-deep reach truck expensive. Don't use to travel.*
   - *Keep in storage aisle doing what it does best.*

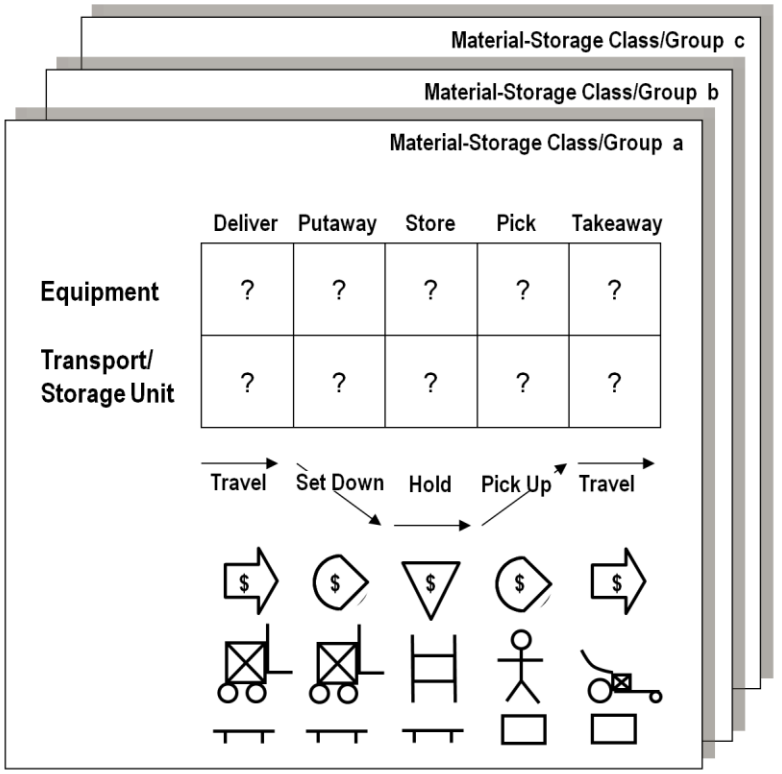
Setting Warehouse Handling & Storage Methods

Main Points

1. Selecting warehouse handling and storage methods is best done by material-storage class or group.
2. Each group consists of items that are similar in physical and other characteristics, including order structure. Thus, they can be handled and stored in the same way.
3. Handling-and-storing methods must be compatible on either side of the storage. That is, the delivery and putaway equipment must be compatible with the storage equipment. And the picking and takeaway equipment must also be compatible with the storage equipment.
4. Compatibility and suitability depend upon a variety of factors.
5. Note that the method of picking and taking away may differ from the one used to deliver and put away.

Factors or considerations when selecting handling & storing methods

P – Product/mat'l. characteristics
P – Transport unit/container
Q – Inventory level
Q – Flow: Pick Q; Replenish Q
R – Routes & distance to-from
R – Picking methods
R – Equipment available
R – Mechanical interfaces
R – Ergonomics
S – Space available/required
S – Service/maint. required
S – Skill/training required
T – Picking time/urgency
Budget; Date needed



RICHARD MUTHER & ASSOCIATES - S-2269-ppt

3A

Notes

Main Points

1. Certain conditions favor the use of automation or mechanization in picking, sorting, assembling, and conveying.

2. When enough of these conditions are present, or when they dominate the planning, then automation or mechanization are appropriate.

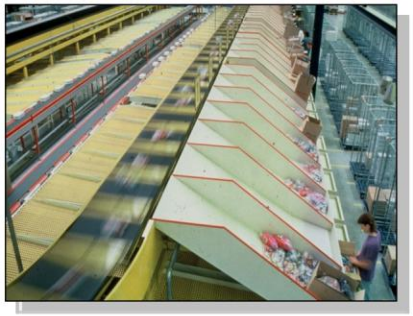
3. As a rule, the more automated or mechanized the facility, the more difficult the response to significant changes in products, orders, product mix, volumes, and processing.

4. Autonomous AGVs are perhaps an exception with respect to scalability. Once a system is in place, additional units (capacity) can be added at relatively small cost. Hence their popularity in e-commerce where the need for additional capacity has been rapid, in additional to being seasonal.

Conditions Favoring Automation or Mechanization

Factors or considerations that favor sortation, layer picking, conveying, dispensing, AGVs, robotics...

Uniform products
High labor cost
Multiple shift operations
High volumes (items & orders)
Low cost of capital & available
High tax rate (depreciation value)
Low daily variability of demand
Large facility; long distances
Long orders needing assembly
Zone picking; assembly required
Good maintenance capability
Stable product mix & design
Long/sufficient product life



RICHARD MUTHER & ASSOCIATES - S-2268-ppt

11A

Notes

Compatibility of Handling & Storage Methods, continued…

1. How many positions are being added in the flow rack alternative? **240 – 224 = 16**
2. If a narrow aisle truck is used, can CelTel get by with only one? What if it breaks down?
   Probably not
3. How much will CelTel pay for each *additional* pallet position, assuming the following costs:
   a. Narrow aisle truck and battery charger: $25,000 — **25,000 x 2 = $50,000**
   b. Pallet flow rack: $200 per position — **240 x $200 = $48,000**
   c. Selective single-deep pallet rack: $50 per position — **224 x $50 = ($11,200)**

   $86,800 / 16 = $5420
4. Are more pallet flow rack positions needed? **No**
5. Is pallet flow rack a good investment in this situation? **No**
6. Should you check the planner's assumption about the turret trucks being not able to tilt their forks? How would you check this? **Yes. Call manufacturer or dealer.**
7. Would it change your thinking if you found that the turret trucks could be modified for $5,000 each? **Probably not. Still $2925 per position gained.**
8. What is the impact (in this case) of introducing pallet flow rack as a storage method:
   a. On material handing? **New truck type.**
   b. On warehouse layout? **Monument. Access issues for VNA.**

Salad Bags, Inc. (SBI)

Questions:

1. Would you implement case-picking from flow rack as proposed? _____
   - *No • Cannot make current situation worse.*

2. What are the options for case picking if flow rack must be used to increase storage capacity?
   - *Limit bottom to 5 positions. Set 1st pallet on floor. No worse than today.*
   - *Clamp off and replenish with 1/2 pallets.*
   - *Clamp off to appropriate height and take to a separate pick area.*
   - *Set up a carton flow line for case picking.*
   - *Robotic picking (station or gantry).*

Homart Distributors – Overview continued…

The warehouse manager believes that material flow can be improved through a rearrangement project. The general manager agrees and has authorized a planning team to review the current material flows and make recommendations.

The current layout has separate docks for receiving and shipping on opposite sides of the building. Receiving and check-in takes place in an unusual, raised-up area, about 2 meters (6 feet) above the main building floor. Received materials are lowered to the floor for putaway. Both receiving and shipping locations can be changed if costs can be justified.

Purchasing, inventory control, personnel and accounting offices span the front of the building between receiving and shipping. The office area includes a break room for all employees, including warehouse personnel. Restrooms are adjacent to the offices and receiving area. See RMA – 7139-2.

Questions:

1. What type of storage layout makes the most sense for Homart Distributors. (refer to RMA – S-2101). ***Layout by Customer (Retail Dept) since they order separately***
2. Can you make a list of activity-areas for the rearrangement project? ***Sort of… Not entirely sure.***
3. What additional information would be helpful? ***Process chart***

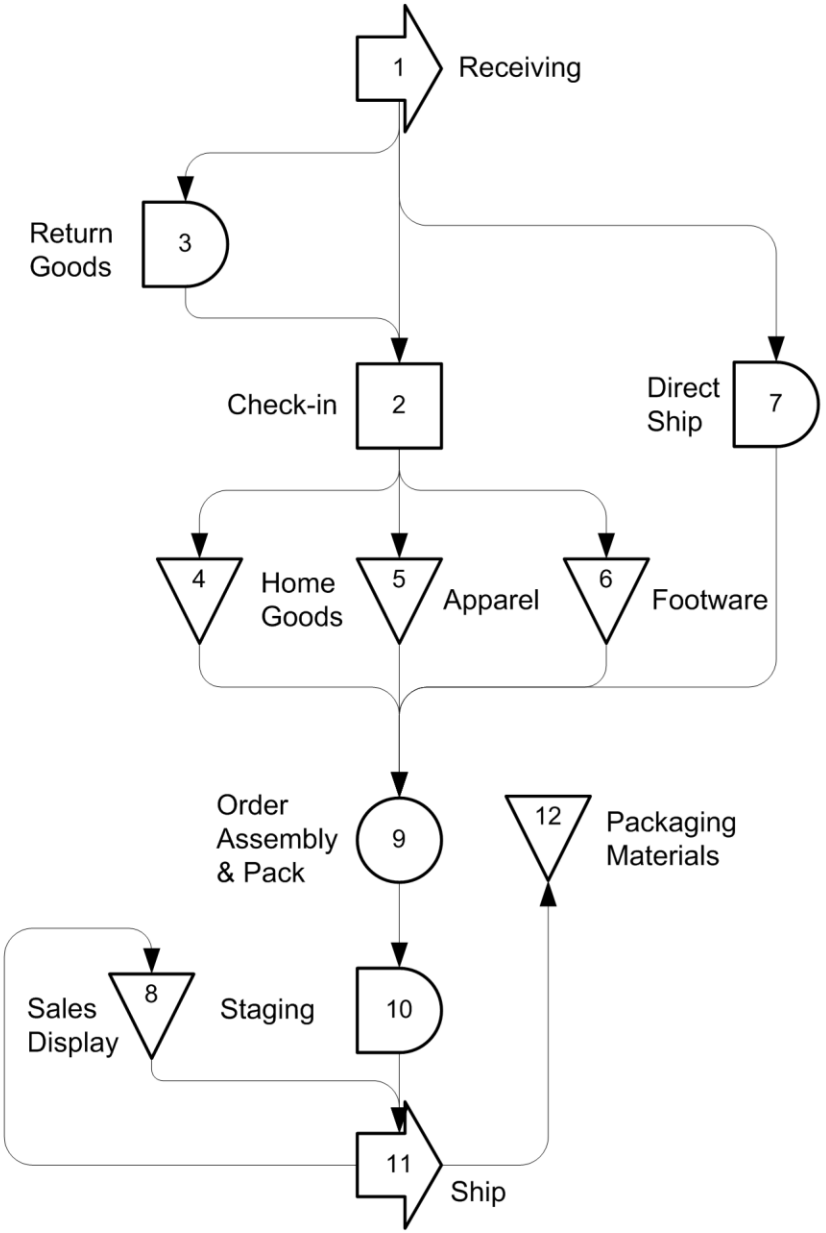
Homart Distributors
Flow Process Chart

This chart shows the flow paths between operational activity-areas in the Homart Central Warehouse.

To establish flow of materials relationships between areas, we need to quantify the movement on each route.

How will you go about doing this? What information will you need?

Identify what is moved on each route
Estimate moves per period
Understand differences in material handling effort
Account for differences with equivalence factors to get a common unit of measure



Homart Distributors

Move Summary Data

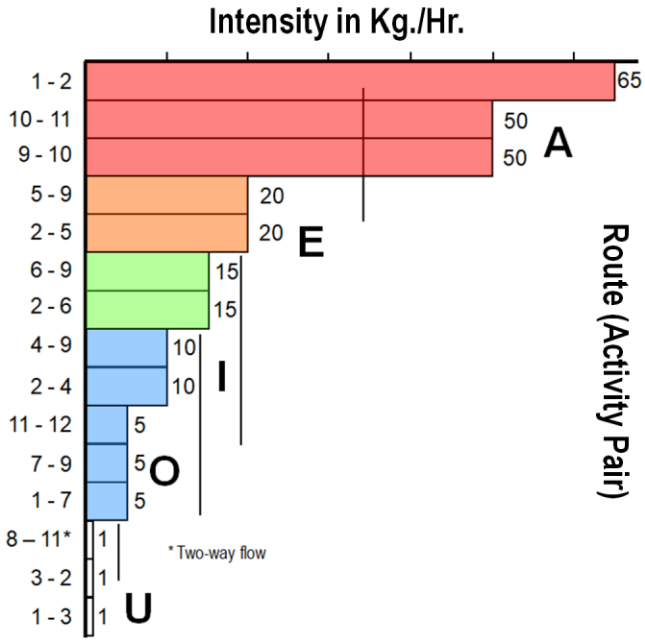
	Route	Dist. in m.	Classes of Materials: Tubs of Loose Items (a)	Bundles, banded & Firm (b)	Large Cartons (c)	Other Odd Items (d)	Kg per Hour (e)	Rating (f)	Kg-M /Hr. Transp. Work (g)
1	1 -- 2	10	--	20	42	3	65	A / I	650
2	1 -- 3	16	--	--	--	1	1	U / U	16
3	1 -- 7	60	--	--	5	--	5	O / O	300
4	2 -- 4	45	3	5	2	--	10	O / I	450
5	2 -- 5	65	5	8	7	--	20	E / A	1300
6	2 -- 6	88	1	4	10	--	15	I / A	1320
7	3 -- 2	6	--	--	--	1	1	U / U	6
8	4 -- 9	20	9	--	1	--	10	O / O	200
9	5 -- 9	40	14	--	6	--	20	E / E	800
10	6 -- 9	60	5	--	10	--	15	I / E	900
11	7 -- 9	25	--	--	5	--	5	O / O	125
12	8 -- 11*	35	--	--	--	1*	1	U / U	35
13	9 -- 10	20	--	20	25	5	50	A / E	1000
14	10 -- 11	10	--	20	25	5	50	A / I	500
15	11 -- 12	40	--	--	--	5	5	O / O	200
	Totals		37	77	138	20			

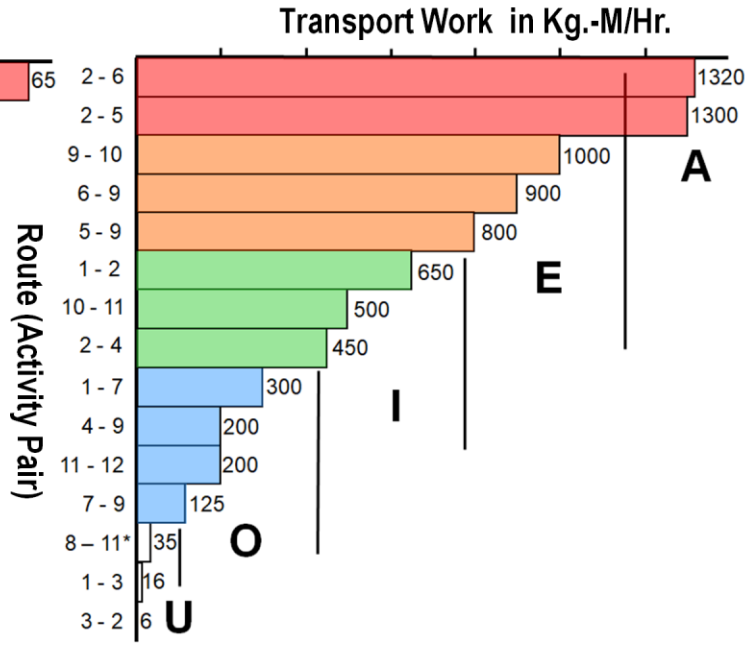
RICHARD MUTHER & ASSOCIATES - 7232-2-SOLN-ppt * Two-way flow

Main Points

1. In Systematic Layout Planning (SLP) and its companion method Systematic Handling Analysis (SHA), route intensities are calibrated from units per period into vowel letter ratings (A, E, I, O, U).
2. Ratings are assigned by inspection of the break points in a sorted bar (Pareto) chart.
3. In SLP, this step is necessary so that flow of materials relationships otherwise expressed numerically can be combined with subjective closeness ratings for reasons other than flow of materials.
4. When there are many routes, rating their route intensities has the additional benefit of focusing attention on those with the highest intensities. In a good layout, these should be short.
5. Transport Work (TW) = Route Intensity x Route Distance. TW is a measure of material handling effort. It, too, also be calibrated into vowel-letter ratings. When routes (moves) that are the highest in transport work have only moderate or even low intensities, we may have opportunities to improve the layout.

Calibration of Route Intensities & Transport





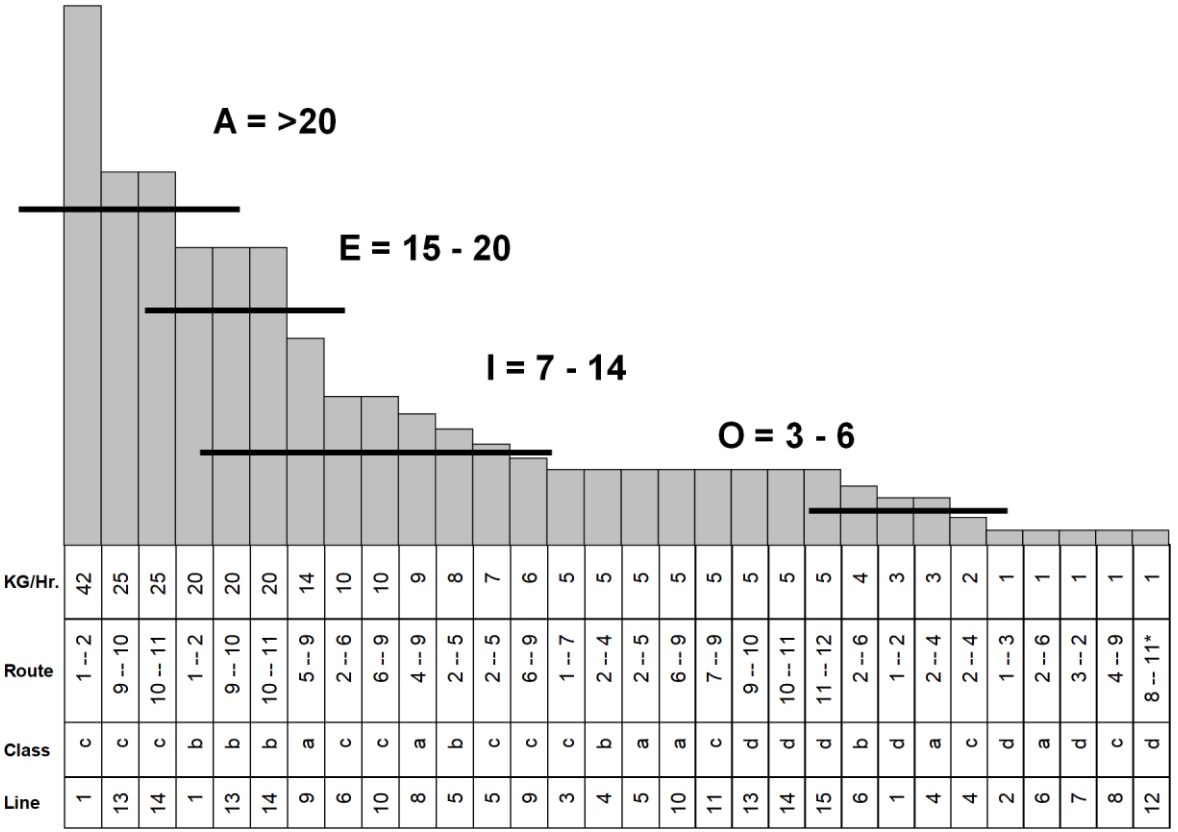
5B

Notes

Main Points

1. Calibration of route-class intensities enables the planner to see how much route flow is associated with each of several diverse material classes. Or, to isolate on the flows of a single class. Both can be helpful in identifying layout improvements and in selection of material handling methods.
2. Flow intensities (units per period) are determined for each class on each route and then plotted from highest to lowest in a bar (Pareto) chart.
3. Ratings are assigned by inspection of break points in the chart.
4. Routes connect pairs of activity-areas. When there is flow in both directions between a pair, this should be added before plotting since it is the total intensity between the activities that determines relative closeness desired.
5. In Systematic Layout Planning (SLP) and its companion method Systematic Handling Analysis (SHA), route-class intensities are calibrated from units per period into vowel letter ratings (A, E, I, O, U).

Calibration of Route-Class Intensities



KG/Hr.	42	25	25	20	20	20	14	10	10	9	8	7	6	5	5	5	5	5	5	5	5	4	3	3	2	1	1	1	1	1
Route	1 -- 2	9 -- 10	10 -- 11	1 -- 2	9 -- 10	10 -- 11	5 -- 9	2 -- 6	6 -- 9	4 -- 9	2 -- 5	2 -- 5	6 -- 9	1 -- 7	2 -- 4	2 -- 5	6 -- 9	7 -- 9	9 -- 10	10 -- 11	11 -- 12	2 -- 6	1 -- 2	2 -- 4	2 -- 4	1 -- 3	2 -- 6	3 -- 2	4 -- 9	8 -- 11*
Class	c	c	c	b	b	b	a	c	c	a	b	c	c	c	b	a	a	c	d	d	d	b	d	a	c	d	a	d	c	d
Line	1	13	14	1	13	14	9	6	10	8	5	5	9	3	4	5	10	11	13	14	15	6	1	4	4	2	6	7	8	12

5C

Notes

Case Problem

1. Work the move summary data in a meaningful way and show the transport work in Column g.

Dist. X ∑ a+b+c+d

2. What should be shown in Column (e)?

Route intensity:a+b+c+d

3. Which route has the highest intensity of flow?

Route 1

4. Which routes are probably the most costly?

Routes 5 & 6

5. Which routes might be candidates for complex (mechanized or automatic equipment)?

Routes 1, 14 & 15

6. Which moves might be candidates for an indirect system of moves?

Routes 4,6,8,10

7. Which classes have the most movement? What is the implication for planning?

Plan c & b methods first

8. How might you represent these numbers as flow lines on a Quantified Flow Diagram?

Calibrate into A,E,I,O; then draw 4,3,2,1 lines.

Route-class moves or Route totals.

Homart Distributors

Move Summary Data

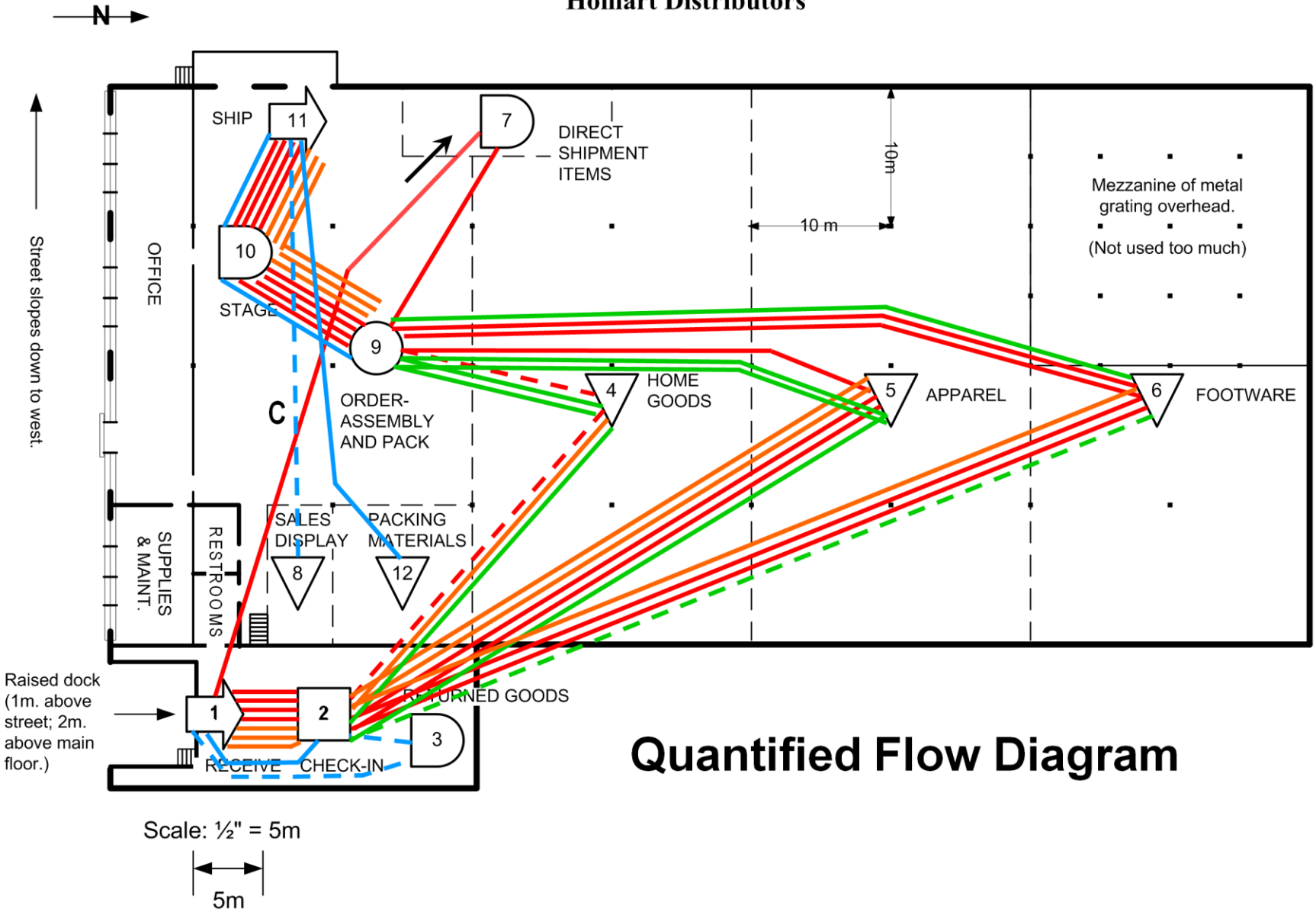
	Route	Dist. in m.	Classes of Materials: Tubs of Loose Items (a)	Bundles, banded & Firm (b)	Large Cartons (c)	Other Odd Items (d)	Kg per Hour (e)	Rating (f)	Kg-M /Hr. Transp. Work (g)
1	1 -- 2	10	--	/// 20	//// 42	/ 3	65	A / I	650
2	1 -- 3	16	--	--	--	⋰ 1	1	U / U	16
3	1 -- 7	60	--	--	/ 5	--	5	O / O	300
4	2 -- 4	45	/ 3	/ 5	⋰ 2	--	10	O / I	450
5	2 -- 5	65	/ 5	// 8	// 7	--	20	E / A	1300
6	2 -- 6	88	⋰ 1	/ 4	// 10	--	15	I / A	1320
7	3 -- 2	6	--	--	--	⋰ 1	1	U / U	6
8	4 -- 9	20	// 9	--	⋰ 1	--	10	O / O	200
9	5 -- 9	40	// 14	--	/ 6	--	20	E / E	800
10	6 -- 9	60	/ 5	--	// 10	--	15	I / E	900
11	7 -- 9	25	--	--	/ 5	--	5	O / O	125
12	8 -- 11*	35	--	--	--	⋰ 1*	1	U / U	35
13	9 -- 10	20	--	/// 20	//// 25	/ 5	50	A / E	1000
14	10 -- 11	10	--	/// 20	//// 25	/ 5	50	A / I	500
15	11 -- 12	40	--	--	--	/ 5	5	O / O	200
	Totals		37	77	138	20			

RICHARD MUTHER & ASSOCIATES - 7232-2-SOLN-ppt * Two-way flow

5D

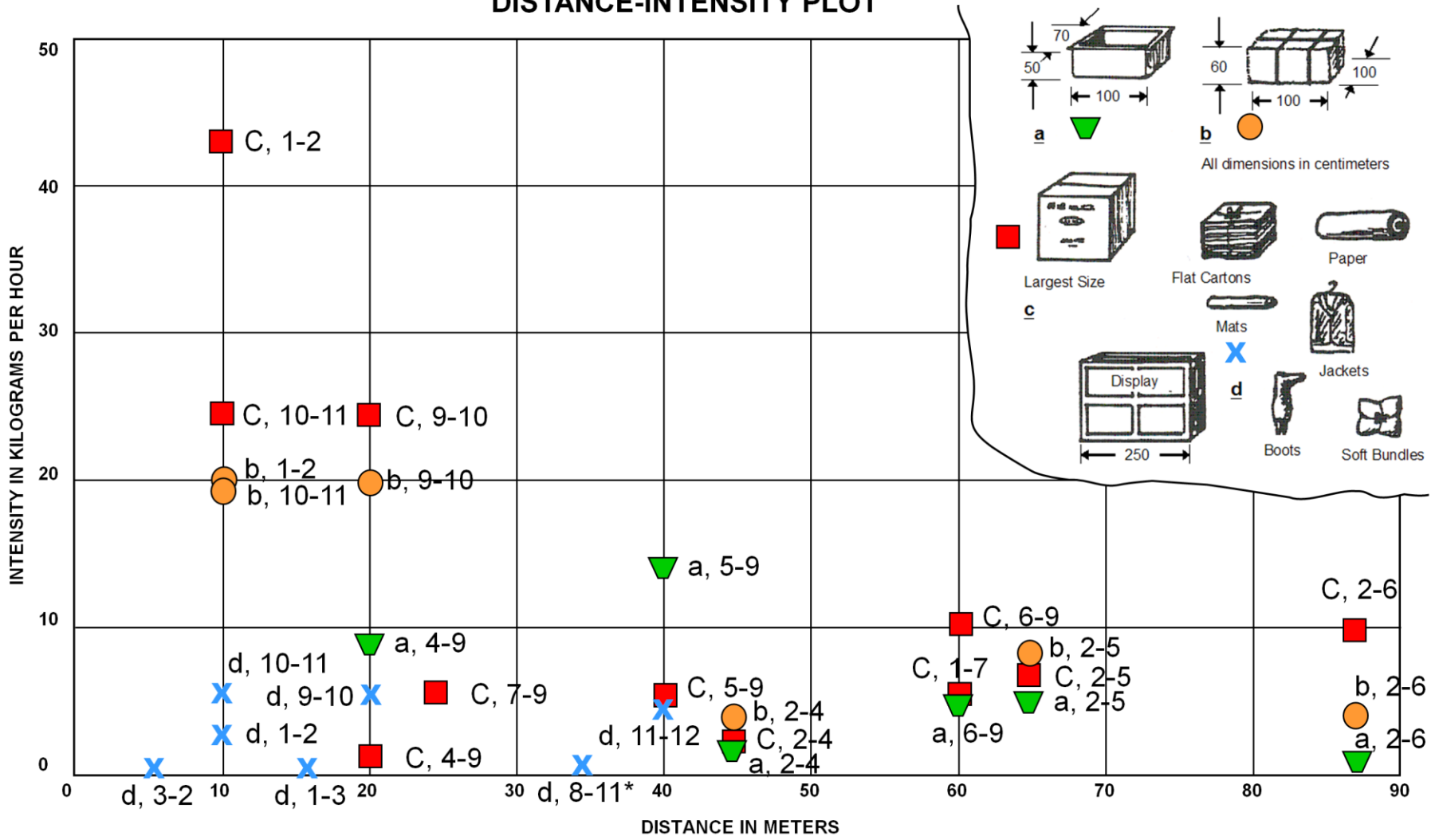
Notes

Homart Distributors



Quantified Flow Diagram

DISTANCE-INTENSITY PLOT



*1/2 Kg. each way

Homart Distributors -- Considerations Other Than Flow continued…

Questions:

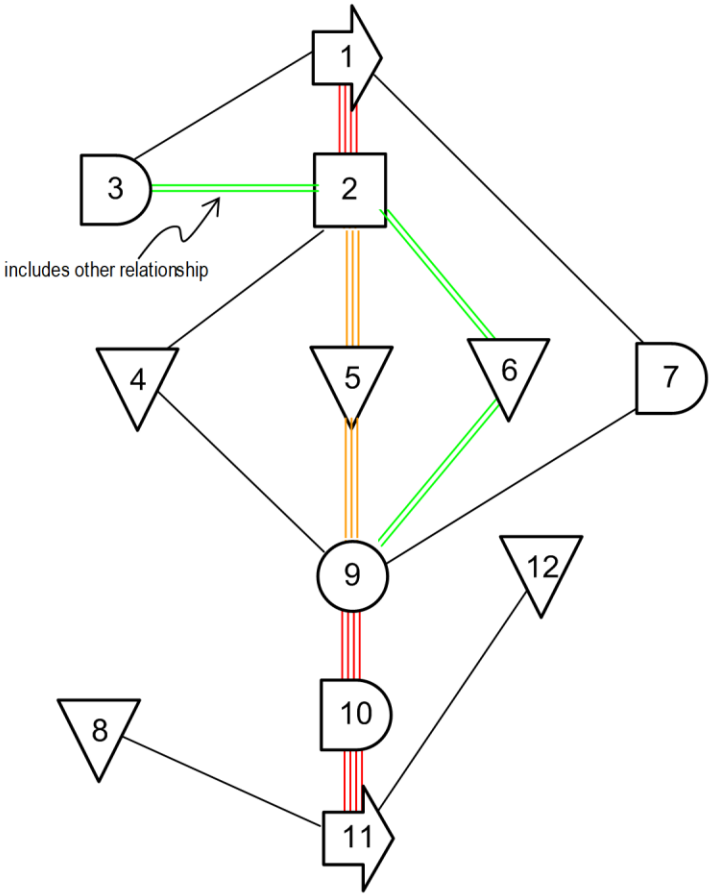
1. How would you combine these relationships with those based upon flow of materials?

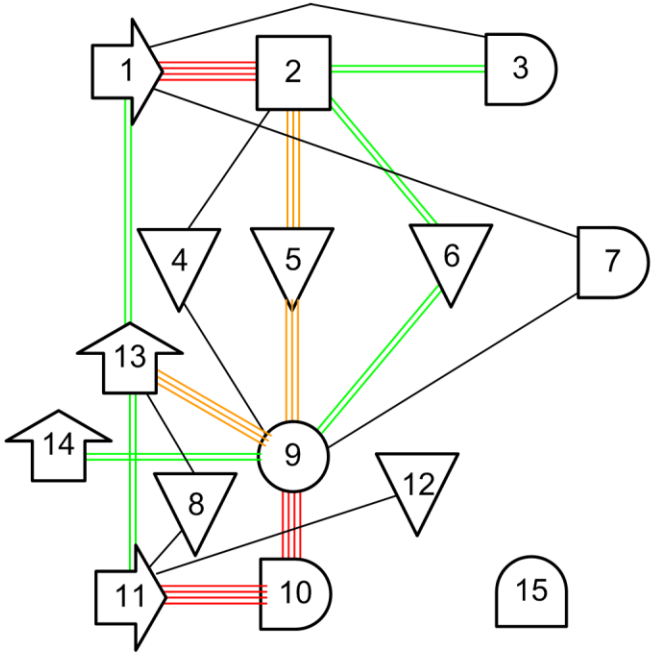
- *Convert vowel letters to point values: 4,3,2,1,0,-1*
- *Decide on relative importance of flow and other. Then assign ratio: 1 to 1; 2 to 1, etc.*
- *Add points for flow and other*
- *Re-rate combined point values (8, 7, 6 ... or 12, 11, 10…) then calibrate to A, E, I, O, U, X*
- *Apply judgment and adjust as needed to get final combined ratings.*

2. How much weight should be given to "flow" versus "other-than-flow" relationships.

- *Depends upon situation and nature of warehouse*
- *Larger, high-volume facilities may use 2:1 Flow to Other ratio*

Homart Distributors – Activity Relationship Diagram





1. Which activity-areas and relationships are not yet shown? Refer to Relationship Chart of Combined Flow & Other Relationships

   13, 14, 15

2. Add these in a new diagram, adjusting this one as needed.

BKG, Inc. – Storage Space Calculation

BKG has decided to store a newly acquired product line in selective, single-deep pallet rack. Pallet size is 48" x 48". The current racks are full, so new ones must be purchased. You have been assigned to acquire enough pallet rack to hold 1000 pallets of material and to estimate the space that will be needed for this product zone in a new warehouse layout. The current sit-down, counterbalanced forklifts must be used. These require a 12-foot aisle.

Questions:

1. What are the most significant determinants of floor space required?
   - ***Storage height: Number of tiers or levels in rack; stack height if on floor***
   - ***Aisle width to access storage***
   - ***Rack dimensions and configuration (e.g. flue space between racks)***
2. How much space will be required per pallet rack position? Per pallet of stored material?
   - ***Depends upon storage height, aisle width and rack dimensions***
3. What is the difference between space per position and space per stored pallet?
   - ***Utilization rate: planned or average % of positions occupied***
4. What is your estimate of space required, if the positions are typically 90% utilized?

BKG Selective Pallet Rack Sketch – Counterbalanced Lift Trucks

Questions:

1. How many tiers high? ***4***

2. How many positions per cross-beam? ***2***

3. How many positions rack section?
   2 x 4 = 8

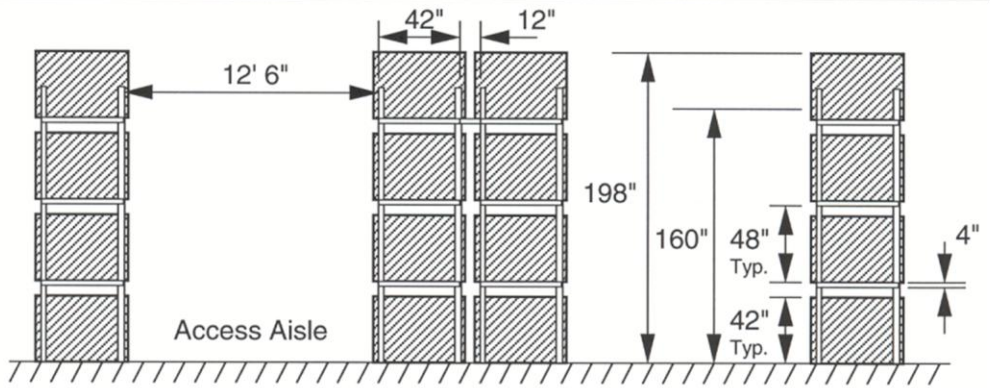
4. How to allow for aisle space?
   upright to upright/2

5. How much floor area per rack section?
   rack depth +half of aisle+half of flue x width of rack section

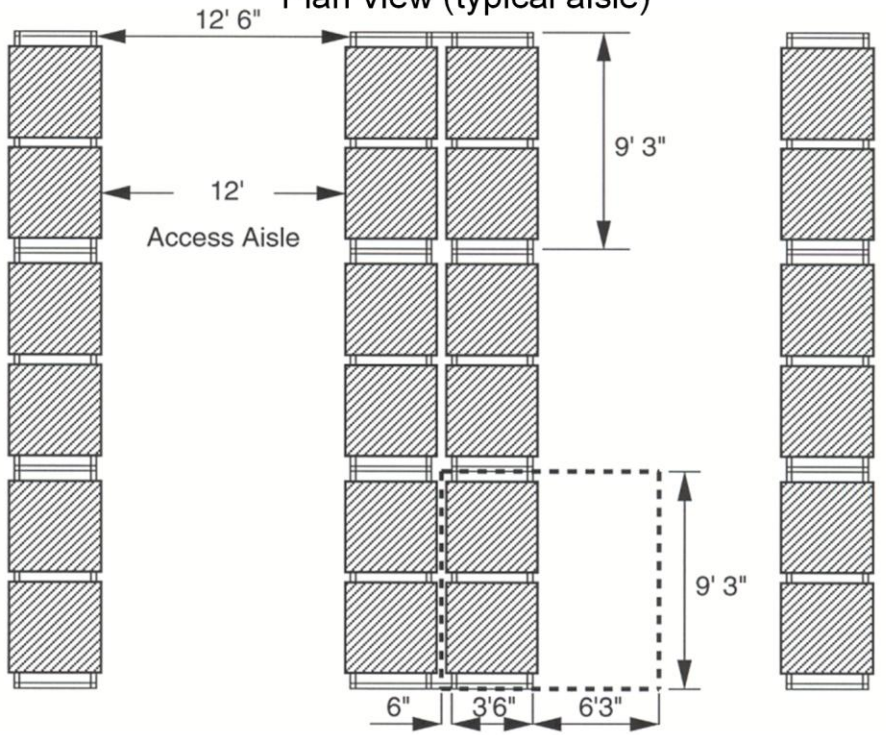
6. How much space per position?
   area per rack section / 8

7. How much space per stored pallet assuming 90% utilization.
   space per position / 0.9

Elevation sketch



Plan view (typical aisle)



RICHARD MUTHER & ASSOCIATES - S-7110-3a-ppt

6A

BKG, Inc. – Storage Space Calculation

Handling & Storage Method	**Assumptions** 48" x 48" x 42" palletized unit load	**Space per pallet position** (at 100% utilization)	**Space per stored pallet** (at 90% utilization)
Single-deep, selective pallet rack; Counterbalanced, sit-down forklift	• 4 pallets high • 9' wide by 4" high beam • 42" uprights; 12" spacer, back-to-back • 12' aisle • Counterbalanced truck	11.9 sq. ft. per pallet	13.2 sq. ft. per pallet
Single-deep, selective pallet rack; Narrow-aisle, stand-up reach truck	• 4 pallets high • 9' wide by 4" high beam • 42" uprights; 12" spacer, back-to-back • 8'6" aisle • Narrow-aisle reach truck	9.8 sq. ft. per pallet	10.9 sq. ft. per pallet

1. How many square feet are needed to store 1000 pallets?

   1000 x 13.2 = 13,200

2. How many pallet positions are needed to store 1000 pallets?

   1000 / 0.9 = 1100

3. How much space can be saved by using a narrow-aisle (stand-up) truck?

   13,200 – 10,900 = 2,300 1- (10.9/13.2) = 17.4%

4. How many aisles must you have before the reach truck gains you one more aisle?

   1 / 0.174 = 6

Art Supplies, Inc.

Art Supplies, Inc. has outgrown their current facility and is looking for a new location. You have been assigned to estimate 5-year space requirements for the pallet rack area. Today, this area occupies 20,000 square feet. Racks are four tiers high with case picking at floor level.

Today's rack area is overflowing. Many pallets are stored in aisles and several rented trailers. You should have 20% more rack area for today's needs. *1.2 = 24,000

Business volume is expected to increase by 20% over the next 5 years with no changes expected in sourcing or inventory policy. * 1.2

The number of items stored is expected to increase by 10%. But no changes are expected to product packaging or overall pallet dimensions. *1.1

At the new location you plan to store five tiers high. *0.8

You also plan to use narrow-aisle trucks. These should reduce floor space needed by about 10%. *0.9

Question: 20000*1.2 = 24,000 * 1.2*1.1*0.8*0.9 = 22,810 = 23,000

What is your 5-year estimate of pallet rack space (rounded to the nearest 1000 sq. ft).

WAREHOUSE SPACE CONVERSION WORKSHEET

Plant *Art Supplies, Inc.* Project *New Warehouse*
By *SB* With *MG*
Date *2/2* Sheet *1* of *1*

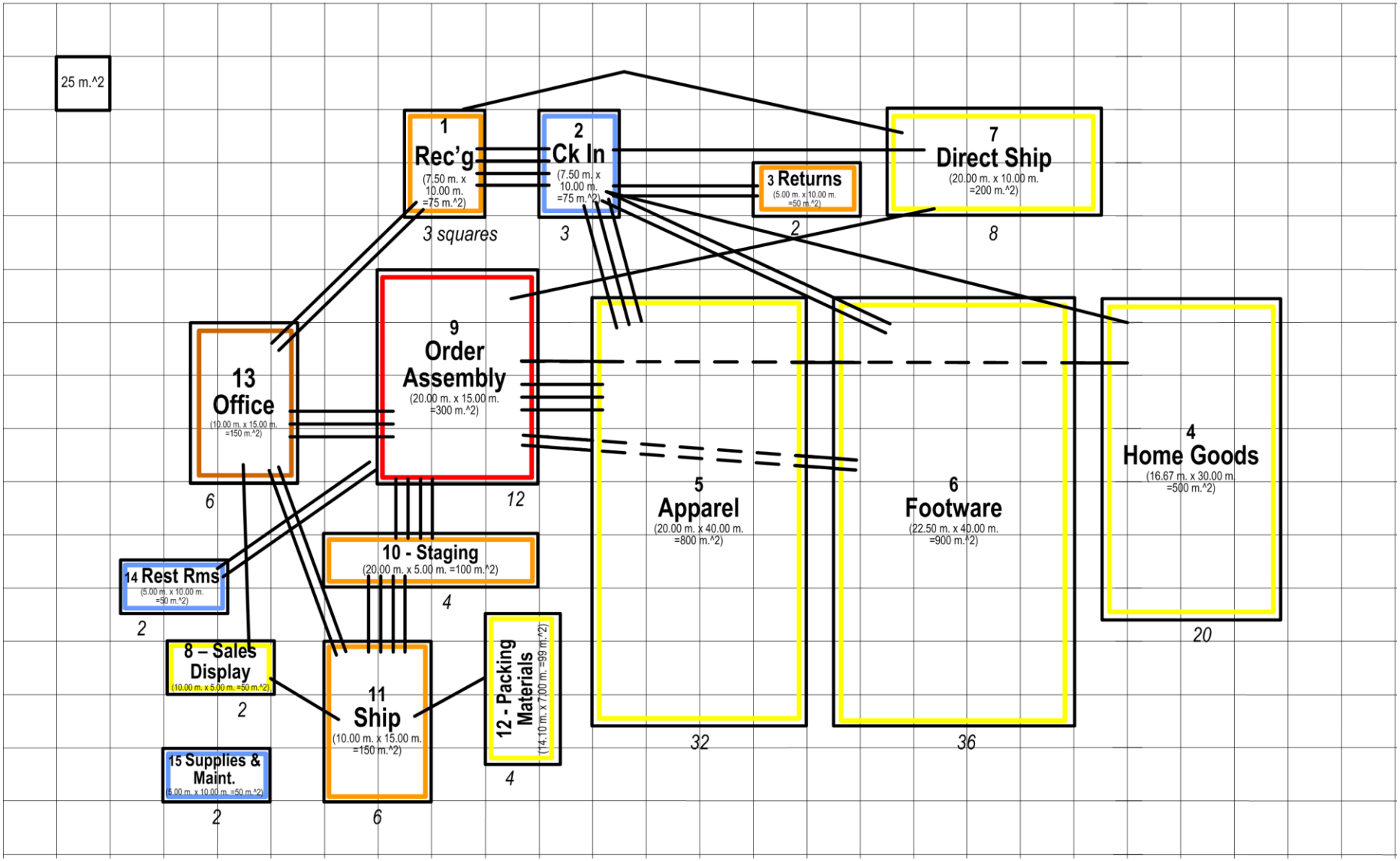
#	Material Class	Unit of Measure	Present Capacity	+ or - Adjust.	Should Have Now	Volume Index	Turns Undex	Variety Index	Storage Index	Product Index	Max Index	Total Index	Planning Horizon (5-year) Reqmt.
a	Pallet Rack	sq.ft.	20,000	1.2	24000	1.2	1.0	1.1	0.72	1.0	1.0	0.9504	23000

WAREHOUSE SPACE CONVERSION WORKSHEET

Plant *Navarro* Project *New Warehouse Space*
By *CP* With *Team*
Date *5/28* Sheet *1* of *1*

#	Material Class	Unit of Measure	Present Capacity	+ or - Adjust.	Should Have Now	Volume Index	Turns Undex	Variety Index	Storage Index	Product Index	Max Index	Total Index	Planning Horizon (5-year) Reqmt.
a	Small Items	feet of shelving	5,000	--	5,000	1.6	0.50	1.25	1.00	0.50	1.20	0.60	3,000
b	Full (unbroken) pallet loads	pallet positions	2,000	1.2	2,400	1.6	0.67	1.10	1.00	1.00	1.00	1.18	2,830
c	Big, bulky items outside	square feet	20,000	--	20,000	1.6	0.75	1.25	1.00	1.00	1.00	1.50	30,000
d	Big, bulky items inside	pallet rack openings	40	1.2	48	1.6	0.75	1.00	1.00	1.00	1.00	1.20	58

Homart Distributors – Space Relationship Diagram

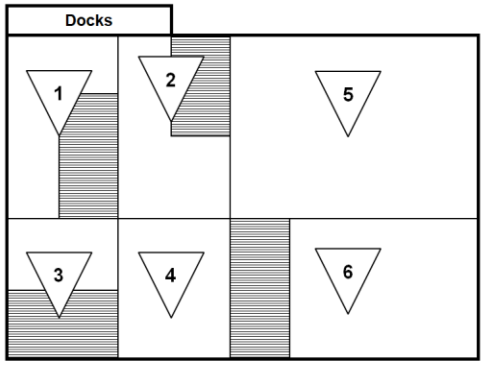


Adjustment for Types of Space

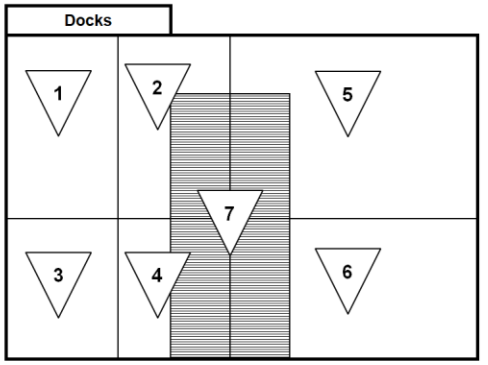
Main Points

1. Assume that the shaded areas represent physical features such as:
   a. Extra fire protection;
   b. Spill containment and retention;
   c. Extra lighting;
   d. Distribution of utilities;
   e. Temperature control;
   f. Security fencing, etc.
2. Which layout will likely be the least expensive to install? Why? Alt. B Compact special feature
3. Which layout will be the most flexible, over time? Why? Alt. C "Special" feature available throughout
4. The layouts above put the most popular storage zones nearest the dock, based on flow of materials. But attention to flow relationships without considering types of space may result in poor layout decisions.

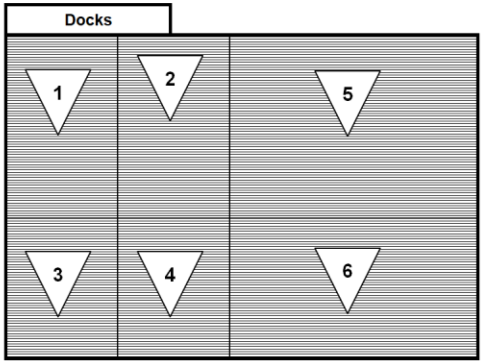
A.



B.



C.



5A

Notes

Layout Adjustment -- Aisles

Questions

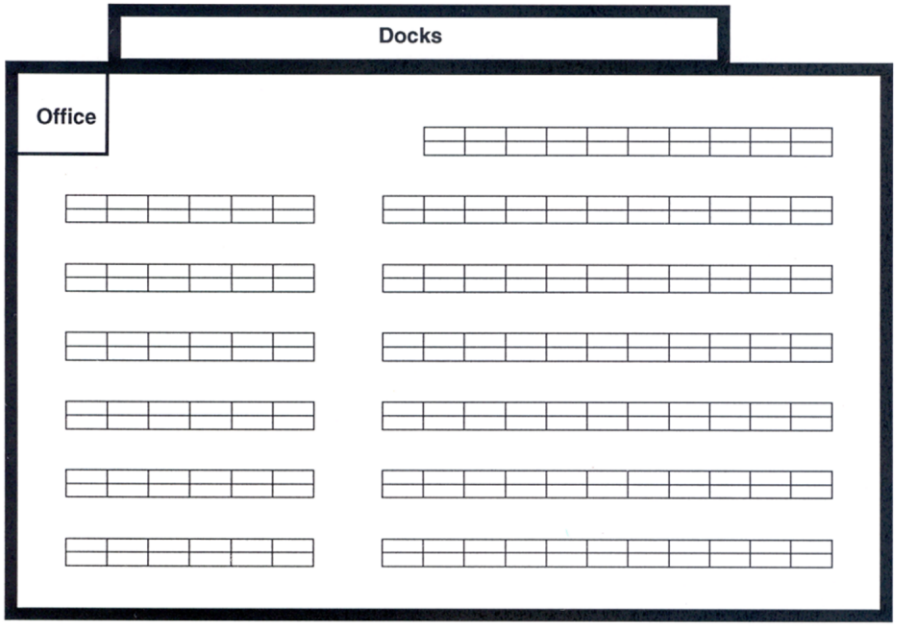
1. Do you see any problems or have any concerns about this rack layout?
   Congestion in center
   Safety near office?
   Visibility from docks
   Length of storage aisles on right side

2. What should main or "cross" aisles accomplish?
   Rapid travel across the layout
   Movement between areas

3. What is the primary factor that should govern the length of storage aisles?
   Picking method: Cart or pallet jack; truck; VNA wire or rail guidance

4. What are the considerations or factors that should govern rack and aisle orientation (direction)?
   Space utilization
   Visibility
   Potential congestion

5. What is undesirable about perimeter aisles?
   Wastes half the aisle

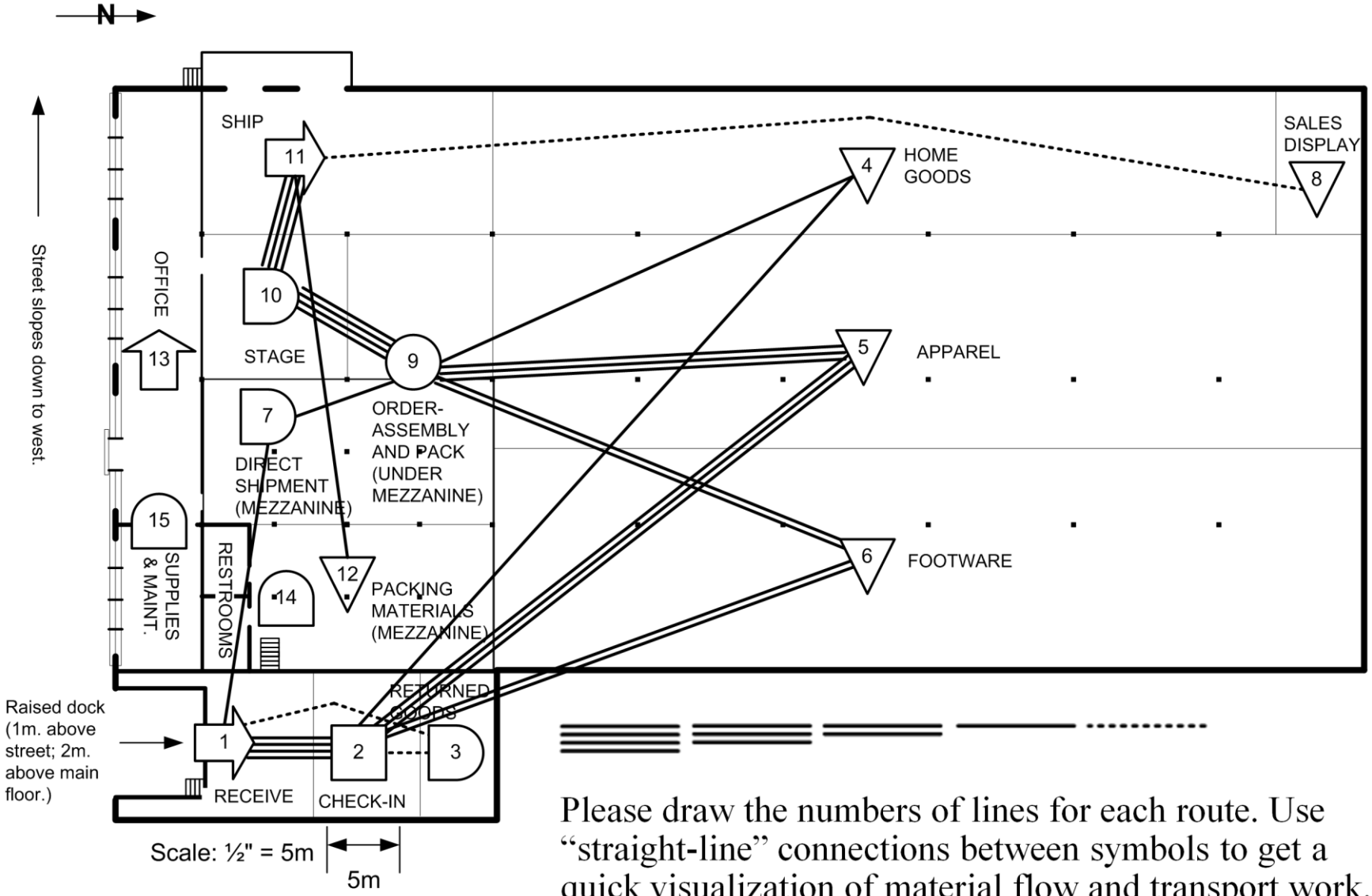


In this warehouse layout, orders will be picked to pallets from the floor and the first tier of racks. Pickers will ride on stand-up, electric pallet trucks. Aisles are 12 feet wide to accommodate forklift putaway and replenishment of picking locations.

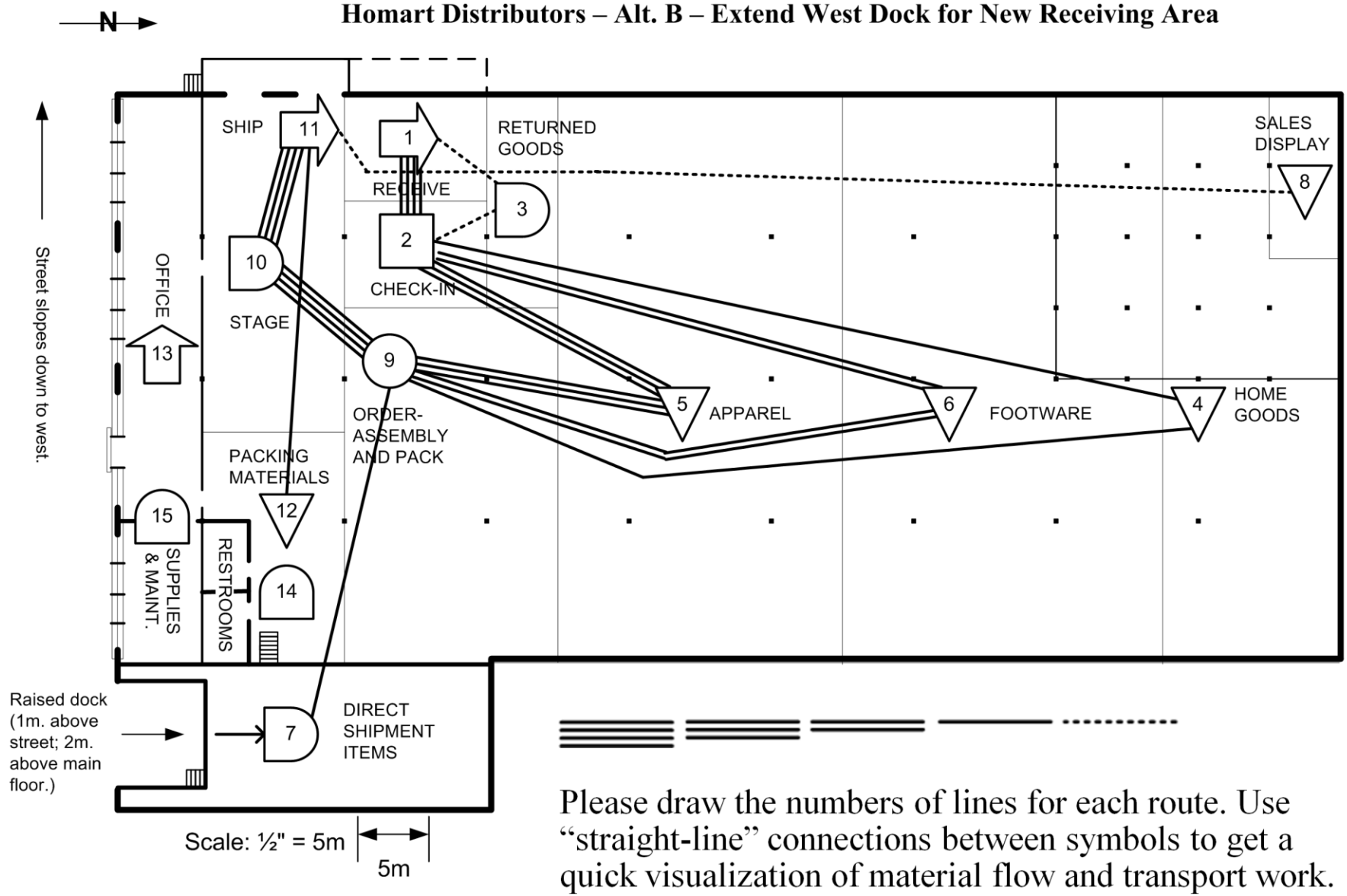
7A

Notes

Homart Distributors – Alt. A – North-South Storage Areas & Racks

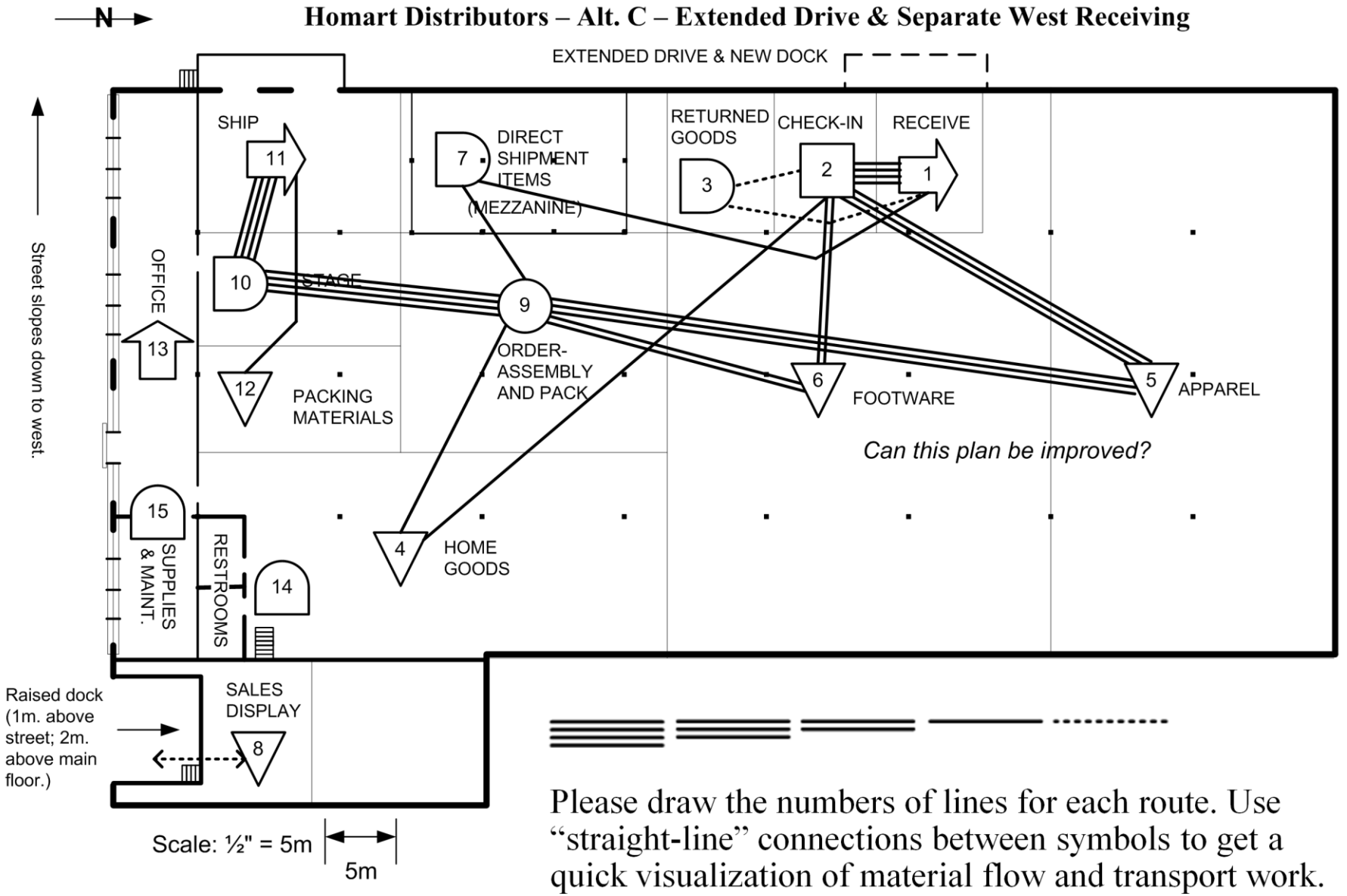


Please draw the numbers of lines for each route. Use "straight-line" connections between symbols to get a quick visualization of material flow and transport work.



Please draw the numbers of lines for each route. Use "straight-line" connections between symbols to get a quick visualization of material flow and transport work.

6A



Homart Transport Work Comparison

	Route	Total Intensity: Kg/Hr	Currrent Dist. in m.	Current Transp. Work	Alt. A Proposed Right-angle Dist. in m.	Alt. A Proposed Transp. Work	Alt. B Proposed Right-angle Dist. in m.	Alt. B Proposed Transp. Work	Alt. C Proposed Right-angle Dist. in m.	Alt. C Proposed Transp. Work	Your Proposed Right-angle Dist. in m.	Your Proposed Transp. Work
1	1 -- 2	65	10	650	10	650	10	650	10	650		
2	1 -- 3	1	16	16	16	16	5	5	5	5		
3	1 -- 7	5	60	300	20	100	10	50	25	125		
4	2 -- 4	10	45	450	70	700	70	700	55	550		
5	2 -- 5	20	65	1300	60	1200	35	700	45	900		
6	2 -- 6	15	88	1320	45	675	60	900	20	300		
7	3 -- 2	1	6	6	6	6	5	5	5	5		
8	4 -- 9	10	20	200	45	450	55	550	25	250		
9	5 -- 9	20	40	800	40	800	20	400	50	1000		
10	6 -- 9	15	60	900	45	675	40	600	30	450		
11	7 -- 9	5	25	125	10	50	25	125	25	125		
12	8 -- 11*	1	35	35	70	70	70	70	0	0		
13	9 -- 10	50	20	1000	15	750	20	1000	20	1000		
14	10 -- 11	50	10	500	10	500	10	500	10	500		
15	11 -- 12	5	40	200	35	175	25	125	15	75		
	Totals		Total TW	7802	Total TW	6817	Total TW	6380	Total TW	5935	Total TW	

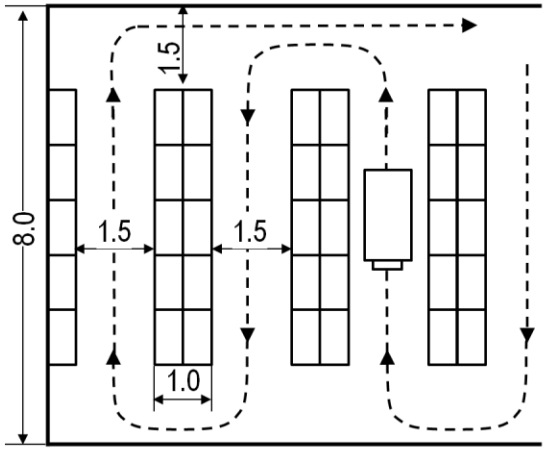
vs. current -13% -22% -31%

vs. next best -7% -7%

11A

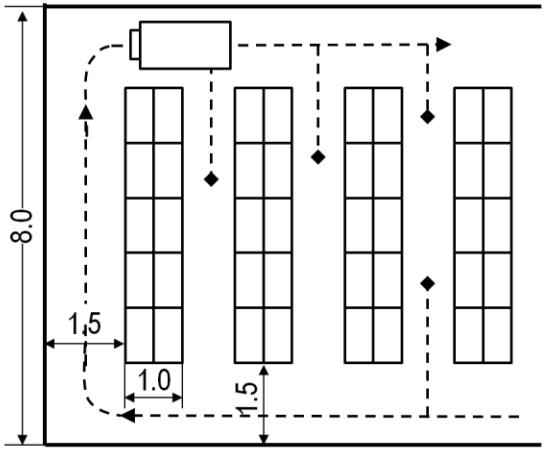
Layout of Order Picking Shelf Area

Long Line (Serpentine)



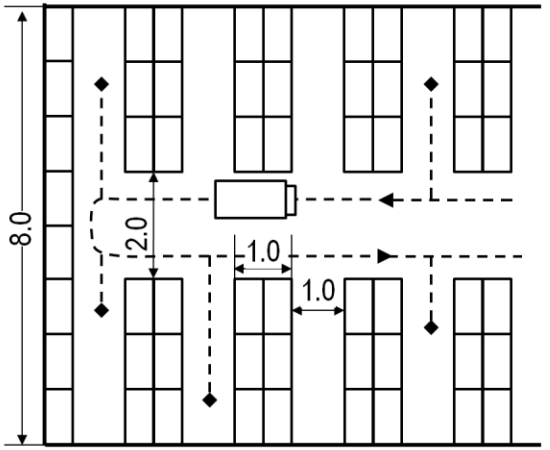
Base Case
"Long walk" thru
Travel time = 1.0
Aisle space = 75%
35 bin shelf units

Outside Aisle



Walk in from perimeter
Travel time = 0.75
Aisle space = 70%
40 bin shelf units

Center Aisle

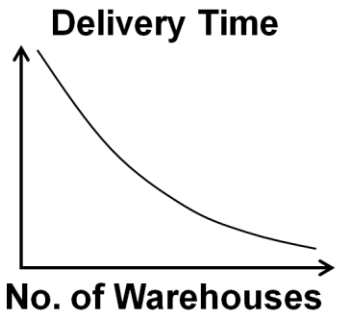


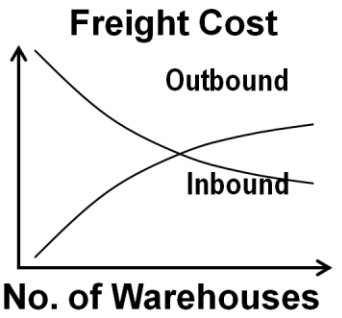
Walk out from center
Travel time = 0.65
Aisle space = 62%
56 bin shelf units

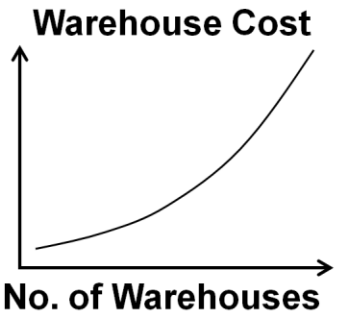
Exercise

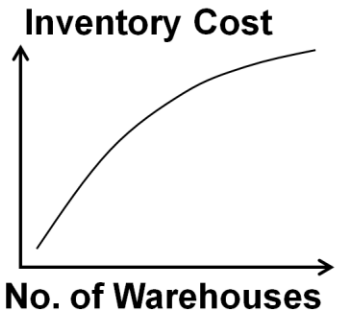
As the number of warehouses in any distribution network increases, please indicate the effect on each of the considerations shown here. Draw the graph that you would expect for each consideration.

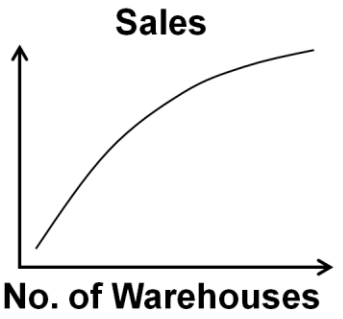
Number of Warehouses and their Consequences

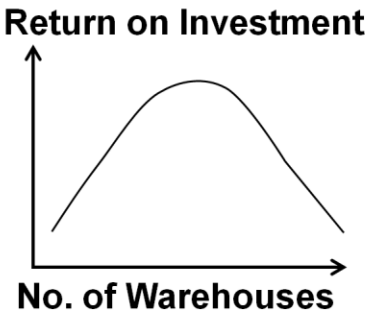












RICHARD MUTHER & ASSOCIATES - 7253-ppt

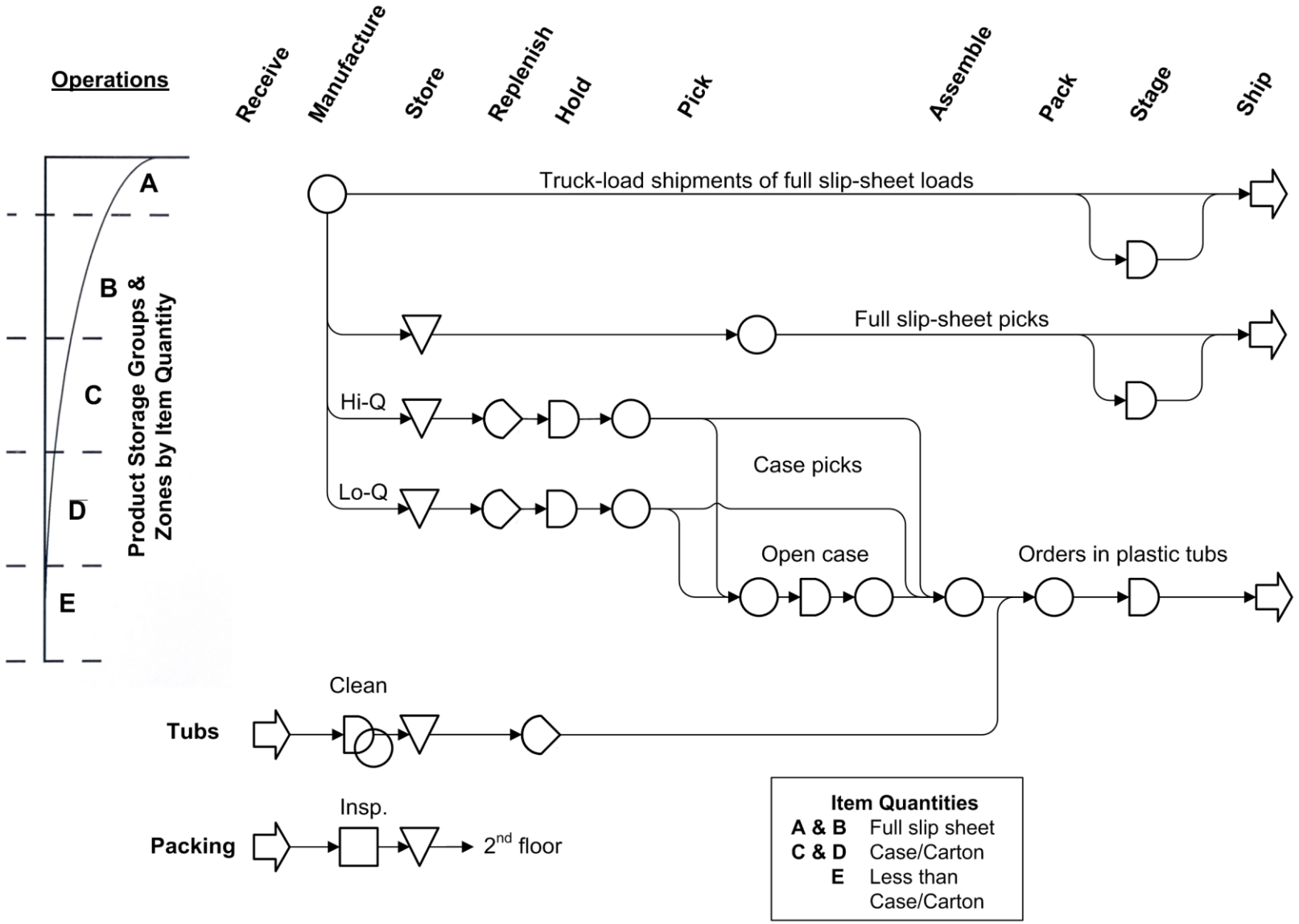
4A

Notes

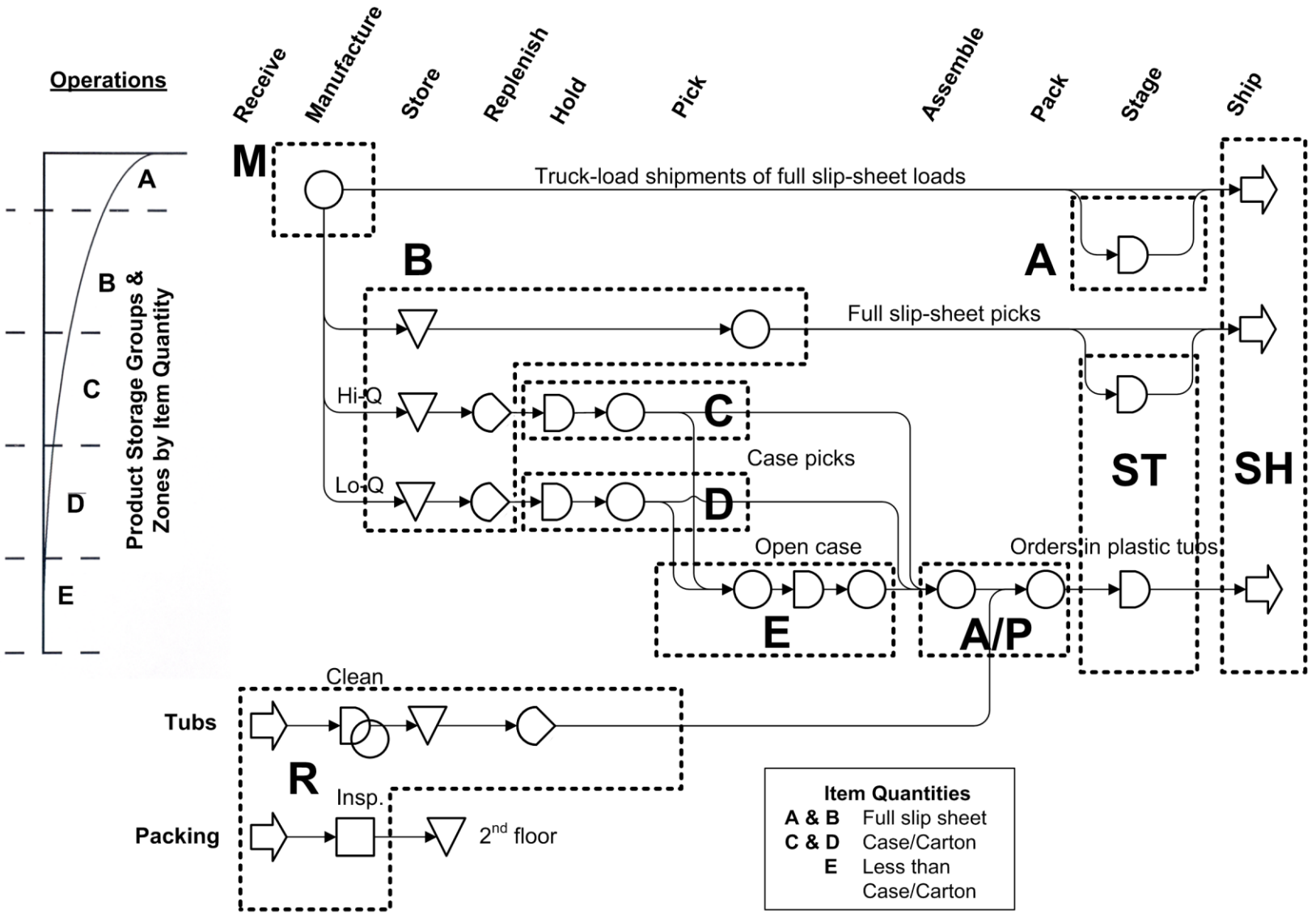
Toiletries, Inc. – Questions

1. What Phase of SLP are you in? **Phase II**
2. Can you prepare a list of activity-areas from the information given? **Sort of…**
3. What additional key inputs would be useful? **P-Q-R**
4. What fundamental information do you need to prepare layout plans?
5. In developing a layout plan, which do you feel will be most important: **Relationships**
   a. Flow of materials? **Flow** **>Movement Summary or From-To**
   b. Other-than-flow considerations? **>treat as Modifying Considerations**
6. What methods would you use to estimate space requirements: (Calculation, Conversion from current space, or Rough Layout method) **Space**
   a. For bulk storage of full slip sheet loads? **Calculation, Conversion**
   b. For order-picking of cartons and items?
   c. Order assembly and packing? **Conversion, Rough Layout**
   d. For 2nd floor packaging material storage?

Toiletries, Ltd. – Flow Process Chart



Toiletries, Ltd. – Definition of Activity-Areas



RICHARD MUTHER & ASSOCIATES – 7163-33b-ppt

Toiletries, Ltd. – List of Activity-Areas

1. R — Receiving packaging material
2. P — Packaging storage
3. M — Manufacturing
4. A — Slip sheet staging for truck load shipment
5. B — Slip sheet storage for bulk pick and reserve
6. C — Case pick area – High Q (most popular items)
7. D — Case pick area – Low Q (less popular items)
8. E — Item picking area
9. A/P — Order assembly and pack
10. ST — Order staging for shipment
11. SH — Shipping, including dock office

Toiletries, Inc. – Alternative Layout Plans

The Distribution Manager has proposed a layout for the planned warehouse addition. See RMA – 7163-21. In arriving at this layout, she used the activity-areas and space requirements shown on RMA – 7163-22. Her arrangement of activity-areas was based on the operation process chart that you developed earlier. (See RMA – 7163-33a). Flow-of-materials, as indicated on the process chart, was her primary consideration. Her intended methods of handling and storing are shown on RMA – 7163-23.

Questions:

1. What technique(s) could be used to evaluate this layout and compare it to other alternatives? ***Quantified Flow Diagram Distance-Intensity Plot***

   Weighted-Factor Method? (but need two layouts to compare)

2. What additional information will you need to apply this technique(s)?

   Move Summary: Material Classes , Routes
   Moves of each class on each route
   Common / Equivalent unit of flow intensity

3. What do you think about this layout? If you were to develop a second alternative, what would you change?

MATERIAL CLASSIFICATION SUMMARY

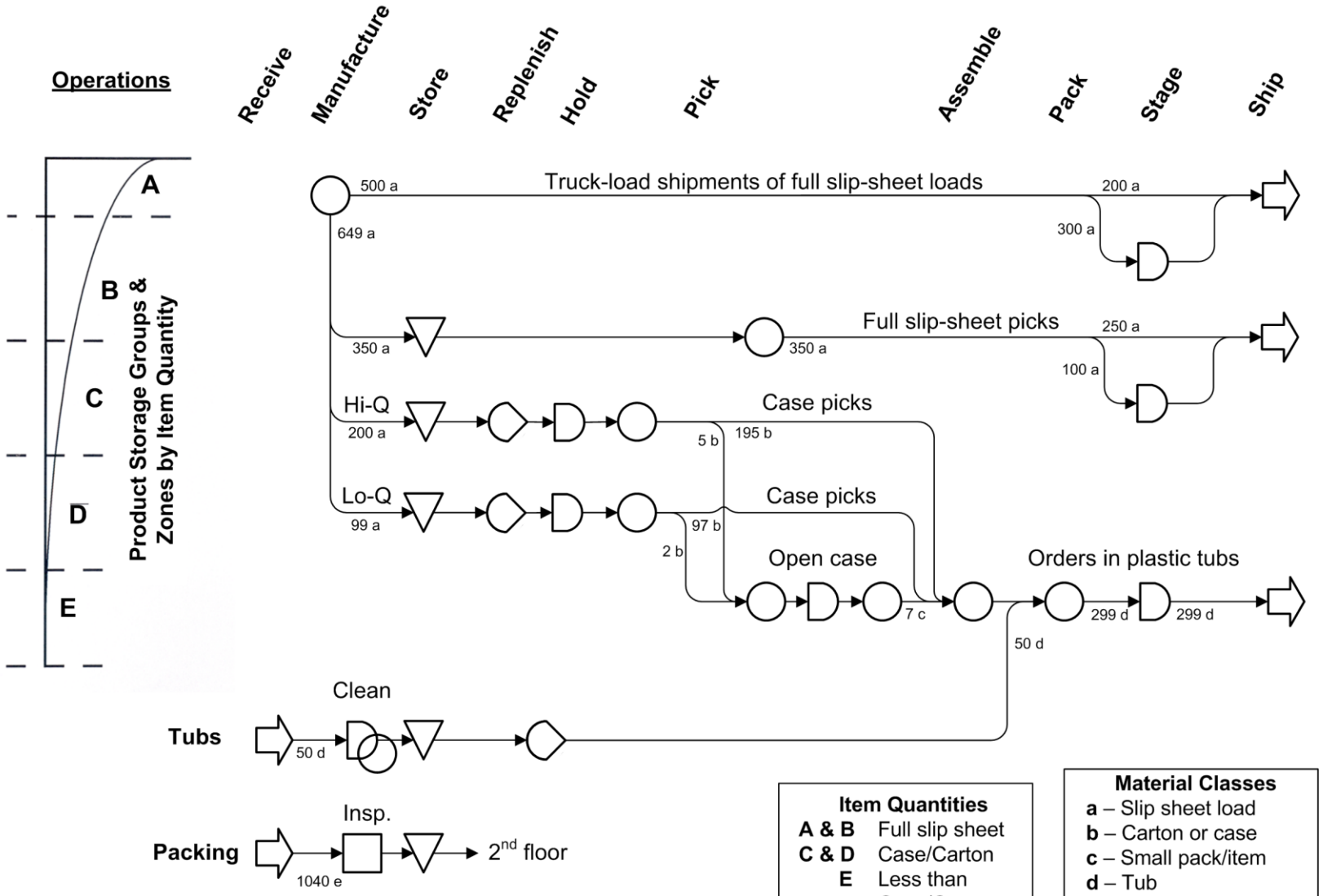
Plant: Toiletries, Ltd. | Project: New DC
By: TJ | With: LH
Date: 5/3 | Sheet: 1 of 1

	MATERIAL CLASS		CLASSIFICATION CRITERIA		TYPICAL EXAMPLES
	Description	Class Identif.	Physical Characteristics (Size, Weight, Shape, Risk, Condition)	Other Characteristics (Quantity, Timing, Special Control)	
1	Slip sheet load	a	40" x 48" up to 48" high, stackable	All items from manufacturing are delivered in full slip sheet loads.	
2					
3	Corrugated carton or case (filledO	b	12" x 12" x 4" up tp 18" x 18" x 8"		Gross of toothpaste tubes. On dozen packs of 12 tubes each.
4					
5	Small pack or individual item	c	High variety of shapes and sizes.	Watch for breakage (glass bottle or jar)	Flat pack of 10 lipsticks.
6			Average size 32" x 16" x 8"; average weight 90 lbs.		
7	Tubs -- empty or containing product	d	24" x24" x 30", nestable when empty. Covers for stacking when full.	Small quantities of each item. Time quite often important. (Svc. parts)	
8					
9	Packing material	e	Small, flat bundles up to 14" x 18" x 12" or cases of empty containers		Carton of empty mouthwash bottles
10					
11					
12					

Notes:

Toiletries, Inc. – Process Chart & Material Flows

Material Flow in Equivalent Slip Sheet Loads per Day



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2C

SUMMARY OF MOVES

Plant *Toiletries, Ltd. Current DC* Project *New DC*

By *TJ* With *LH*

Date *5/19* Sheet *1* of *1*

Unit of Flow in *Equivalent Slip Sheet Loads* per *Day (avg.)*

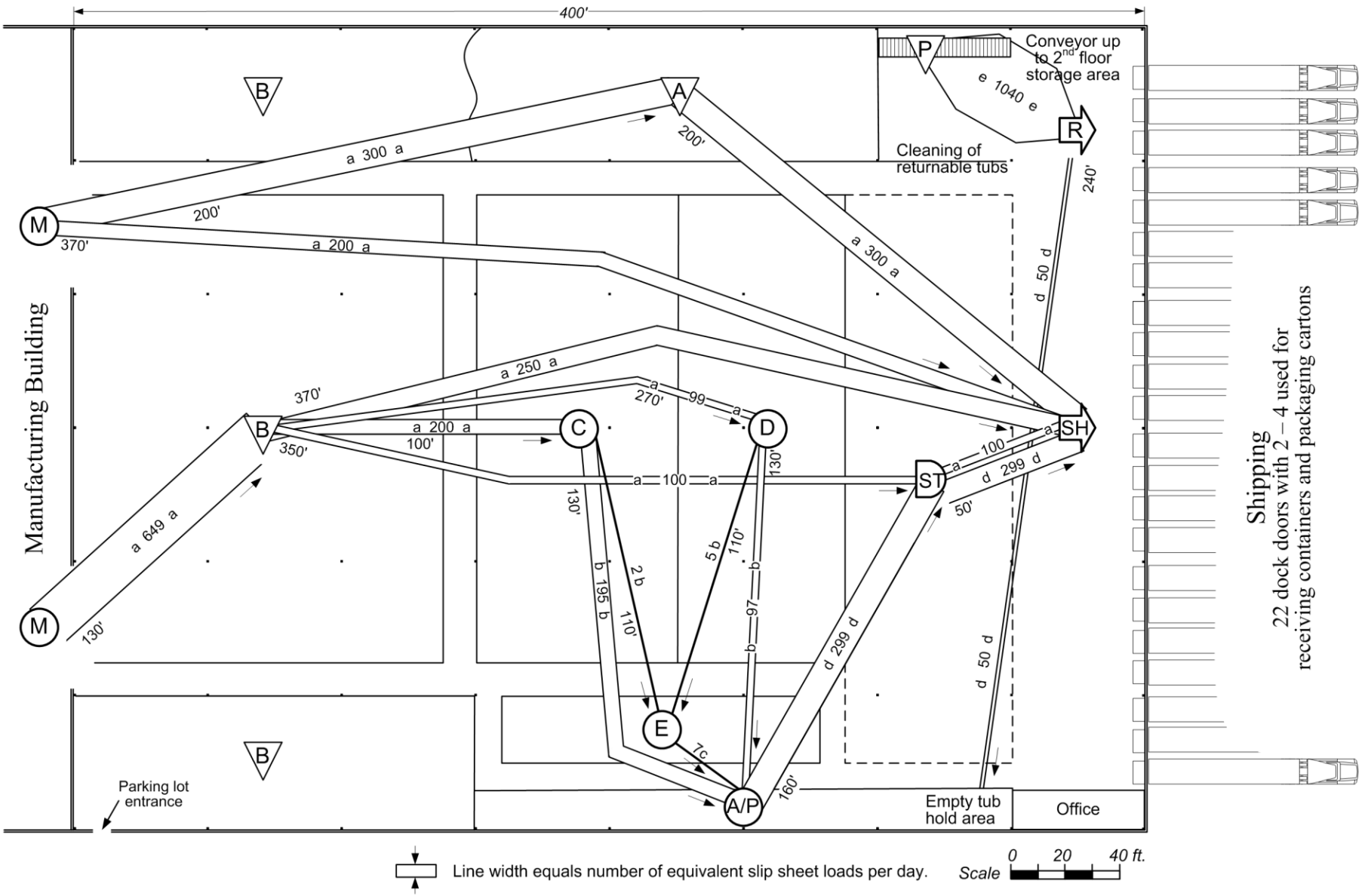
Basis for Unit of Flow (or Conversion Values) *Cube equivalent to full slip sheet load*

ROUTE ■ FROM-TO ☐ BOTH DIRECTIONS	Distance in	Total Intensity	PRODUCT-MATERIAL Class a Slip Sheet Loads	Class b Cartons & Cases	Class c Small Pack or Item	Class d Tub	Class e Packing Material	Class	Class
1 R -- P		1040					1040		
2 M -- SH		200	200						
3 M -- A		300	300						
4 A -- SH		300	300						
5 M -- B		649	649						
6 B -- C		200	200						
7 B -- D		99	99						
8 C -- E		5		5					
9 D -- E		2		2					
10 B -- SH		250	250						
11 B -- ST		100	100						
12 C -- A/P		195		195					
13 D -- A/P		97		97					
14 E -- A/P		7			7				
15 A/P -- ST		299				299			
16 R -- A/P		50				50(a)			
17 ST -- SH		399	100			299			
18									
30									
TOTAL		4192	2198	299	7	648	1040		

Notes *(a) Nested , empty tubs*

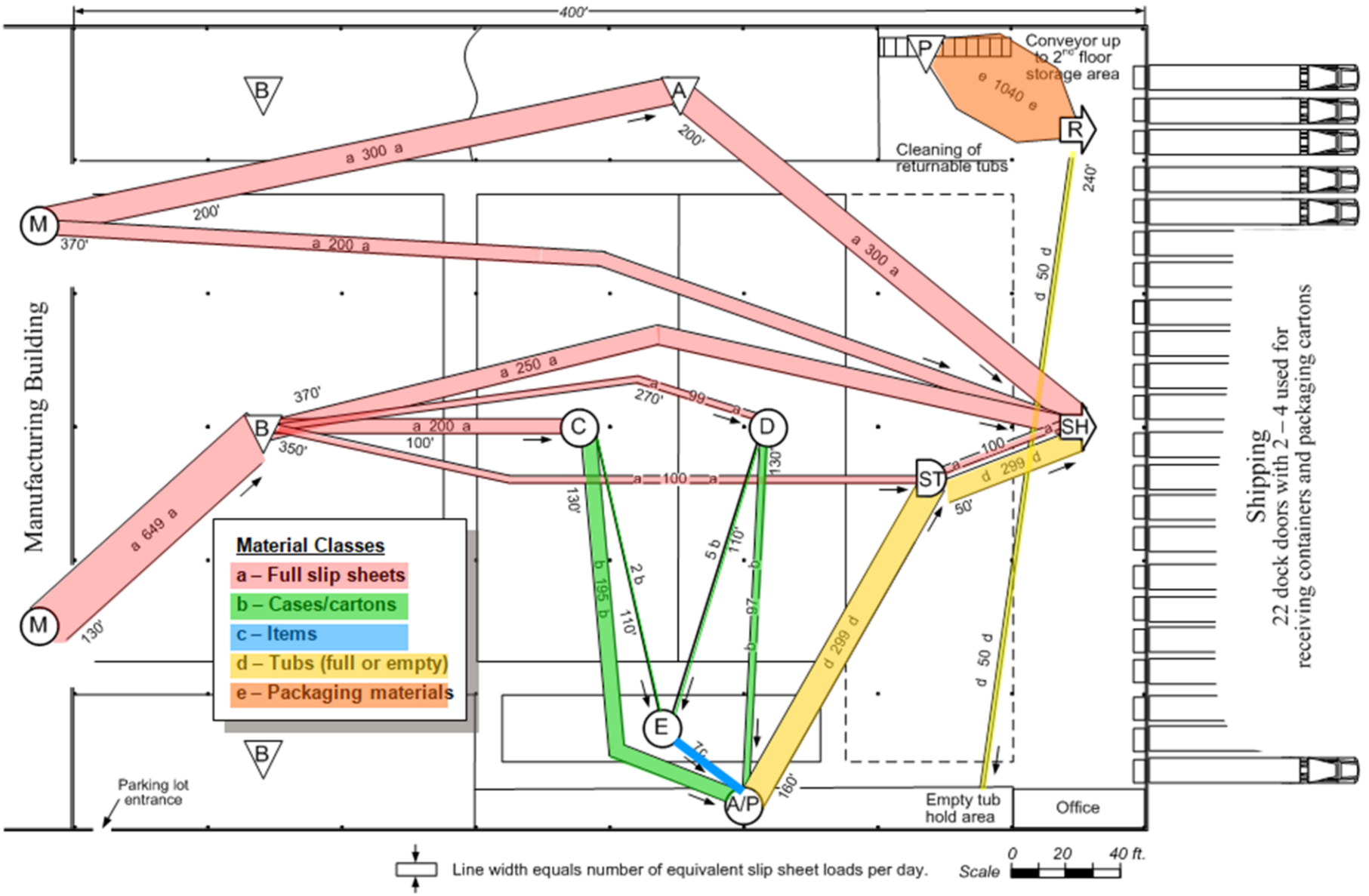
(b) Empty hampers, knocked down

Toiletries Ltd. – Quantified Flow Diagram: Proposed Layout



RICHARD MUTHER & ASSOCIATES - 7263-8b-ppt

Toiletries Ltd. – Quantified Flow Diagram: Proposed Layout



Company/Unit/Plant *Toiletries, Ltd. Current Flows; Proposed Layout*

DISTANCE-INTENSITY PLOT

By *TJ* With *LH*

Date *5/19* Sheet *1* of *1*

Product-Material Items or Classes plotted

Class a. Slip Sheet Loads
Class b. Cartons & Cases
Class c. Small Pack/Item
Class d. Tub
Class e. Packing Material

ROUTES PLOTTED ON CHART

1 R -- P
2 M -- SH
3 M -- A
4 A -- SH
5 M -- B
6 B -- C
7 B -- D
8 C -- E
9 D -- E
10 B -- SH
11 B -- ST
12 C -- A/P
13 D -- A/P
14 E -- A/P
15 A/P -- ST
16 R -- A/P
17 ST -- SH
18
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20
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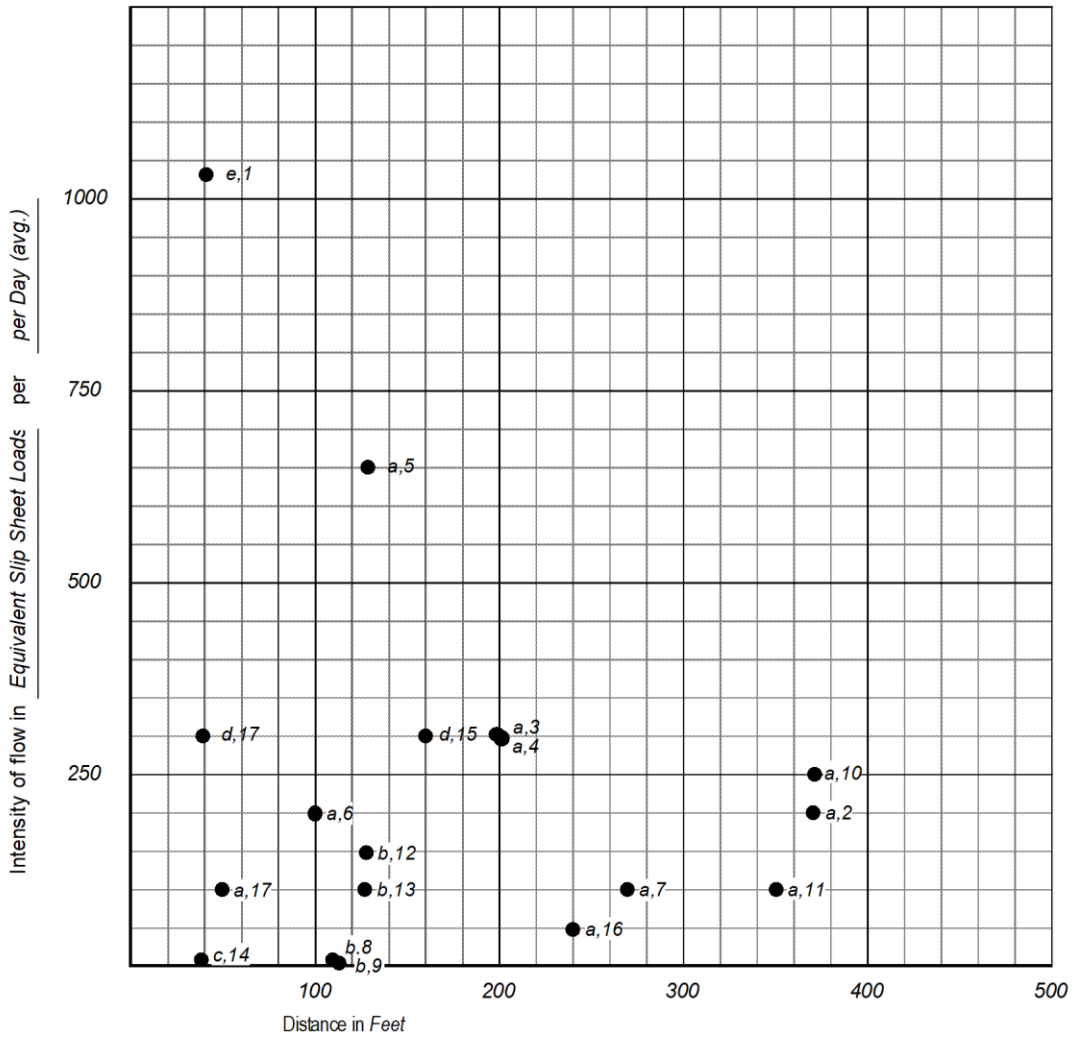

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Toiletries, Inc. – Revised Expansion Plan continued…

The new activity-areas will operate on one shift only. The consumer-direct products are seasonal, with holiday-related sales about 50% above typical monthly volume.

Because of site restrictions, the warehouse addition cannot be made any larger than currently planned. While it is sized three bays larger than needed for today's activities, the consumer-direct and private label operations are estimated to need much more than three bays.

Problem:

Given what you already know about the planned warehouse addition, and following the logic of Systematic Layout Planning (SLP), please answer the questions below.

1. What Phase are you in? ***Still Phase II, but… Check the lease! Check upstairs space…***
2. Can you prepare a list of activity-areas from the information given?
   Sort of…
3. What additional key inputs would be useful?
   P-Q-R and S for new products and processes

Toiletries, Inc. – Revised Expansion Plan continued…

4. What fundamental information do you need to develop alternative layout plans?

   Relationships & Space

5. How much importance should be given to reasons "other-than-flow" when developing alternative plans?

   More than before > Relationship Chart, combine flow+other

6. The space for new activities must be carved out of other activity-areas. How do you propose to accommodate the new space requirements? What space-saving methods would you explore? (See also RMA – 169, SLP Storage Space Checklist).

   Rack bulk storage? Mezzanine? Production lot sizes & scheduling

7. The Distribution Manager is concerned about a changing mix of businesses and logistics requirements. Which activity-areas would you be most concerned about giving enough space?

   Private label; Direct Mail; Case pick; Item pick; Staging

8. Which activity-areas will need the most attention when developing detailed equipment layouts for handling, storage, production, and support?

   Private label; Direct Mail; Case pick; Item pick; Order assembly; Office

9. Which P-Q analyses or statistical profiles will be most useful in the detailed layout and slotting of your order-filling areas?

Toiletries, Ltd. Layout Project Plan

Phase I – Location: Check lease; check 2nd floor space available

Phase II – Overall Layout:

1. *Get & review input data for new products. Update activity list.*
2. *Update flow analysis & relationships: Process chart; Mat'l Classes Units of measure; Move Summary (#247) or From-To (#136)*
   Other-than-flow Relationship Chart (#130 or #131)
   Combine flow & other; Post to Relationship Chart; then diagram.
3. *Determine space requirements (#150); balance to space available.*
   Draw space relationship diagram; make scaled templates.
4. *Develop preliminary alternatives and refine.*
5. *Evaluate costs & benefits; select best plan.*

Phase III – Detail Layouts: (Flow Process or Relationship Chart; (Relationship Diagram; Space on #150; 2 or more alts., Eval on #173)

Bulk storage & staging	*Stage & ship*
Case pick Hi-Q	*Receive and tote wash*
Case pick Lo-Q	*Office & personnel services*
Item pick	*Private label*
Order-assy & pack	*Direct mail specialty*

Phase IV – Installation Planning & Installation

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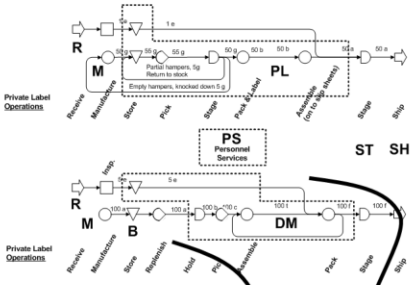
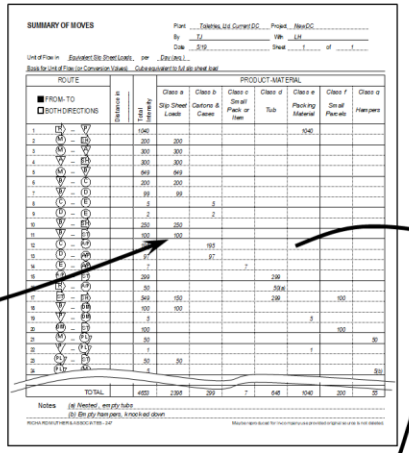
Toiletries, Ltd. Revised Expansion Planning

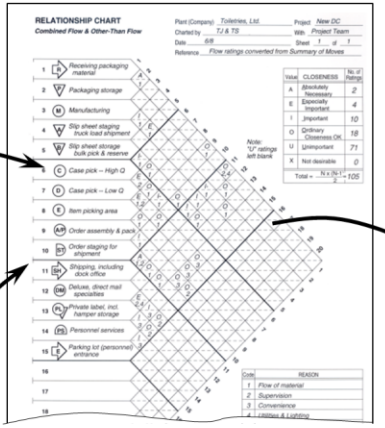
Key Inputs: P-Q-R



Flow of Materials



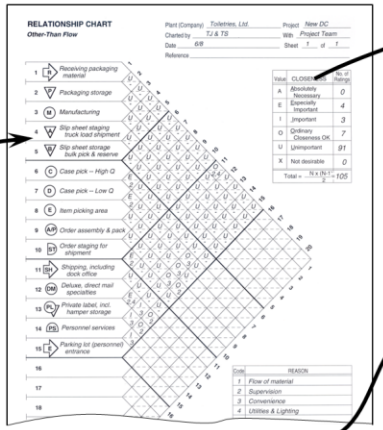
Combined Flow & Other Relationships



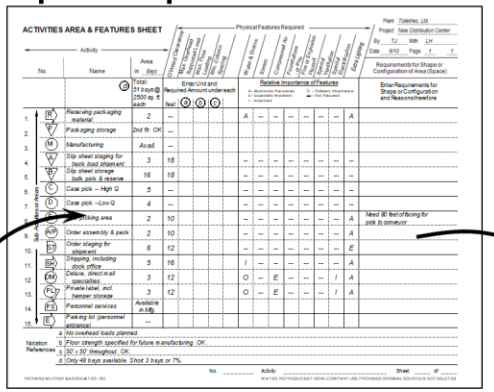
Activity-Areas

1. R — Receiving packaging material
2. P — Packaging storage
3. M — Manufacturing
4. A — Slip sheet staging for truck load shipment
5. B — Slip sheet storage for bulk pick and reserve
6. C — Case pick area – High Q (most popular items)
7. D — Case pick area – Low Q (less popular items)
8. E — Item picking area
9. A/P — Order assembly and pack
10. ST — Order staging for shipment
11. SH — Shipping, including dock office
12. DM — Deluxe, Direct Mail Specialties
13. PL — Private Label, including hamper storage
14. PS — Personnel Services
14. E — Parking lot (personnel) entrance

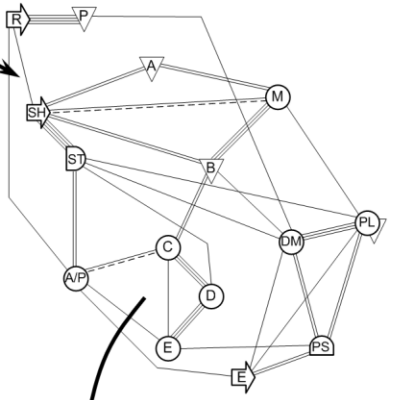
Relationships Other-Than-Flow



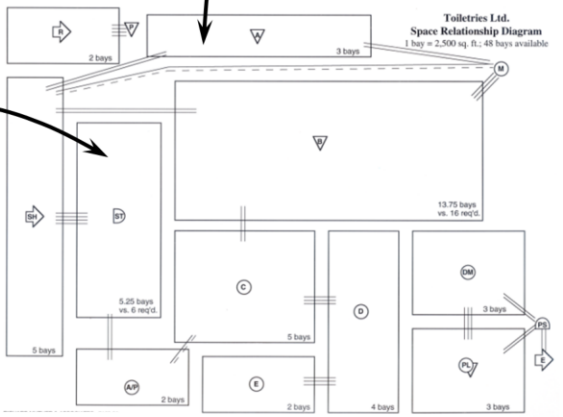
Space Requirements



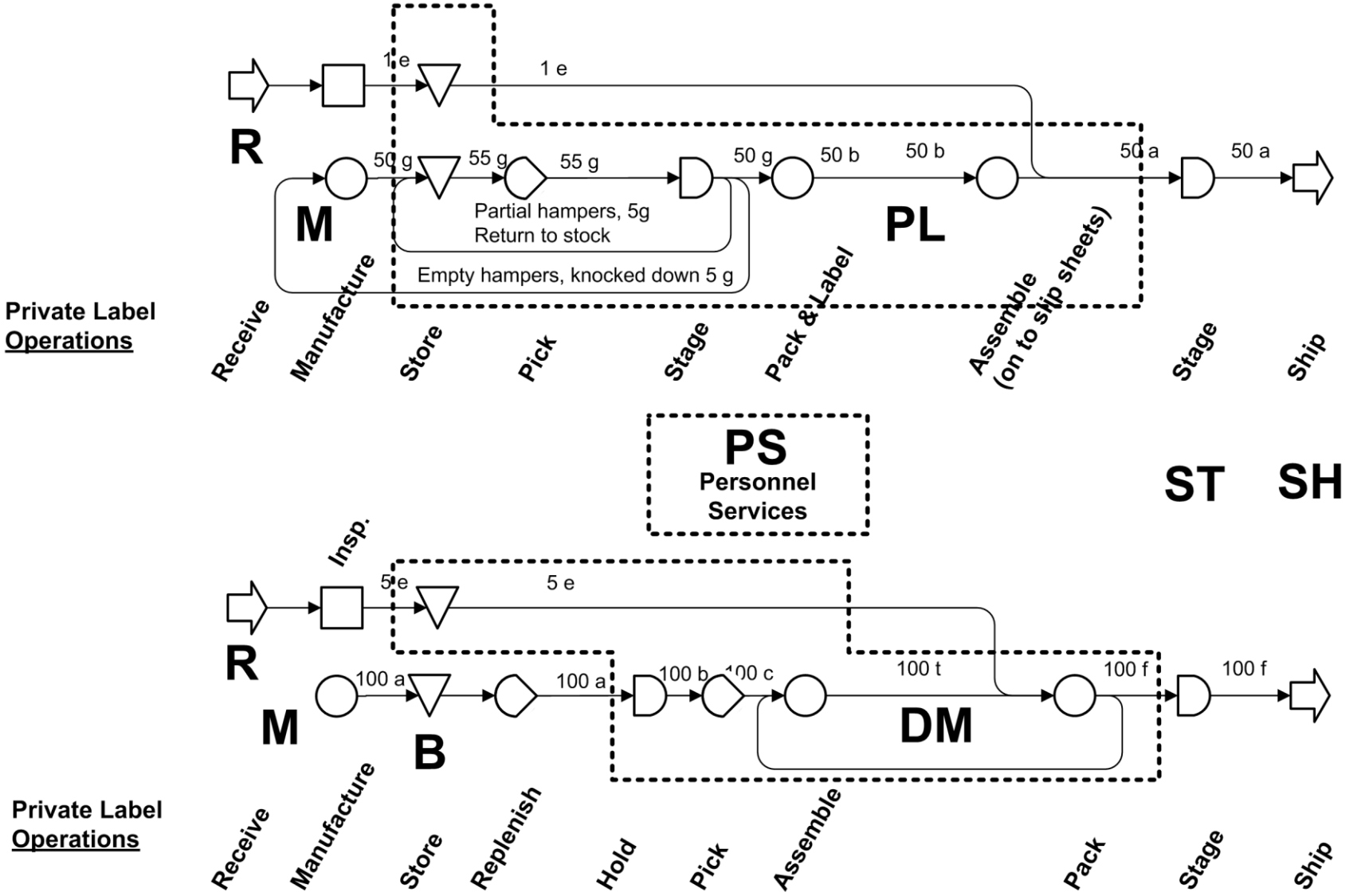
Activity Relationship Diagram



Space Relationship Diagram



Toiletries, Ltd. – Definition of New Activity-Areas



Toiletries, Ltd. – Planned Activity-Areas

1. R — Receiving packaging material
2. P — Packaging storage
3. M — Manufacturing
4. A — Slip sheet staging for truck load shipment
5. B — Slip sheet storage for bulk pick and reserve
6. C — Case pick area – High Q (most popular items)
7. D — Case pick area – Low Q (less popular items)
8. E — Item picking area
9. A/P — Order assembly and pack
10. ST — Order staging for shipment
11. SH — Shipping, including dock office
12. DM — Deluxe, Direct Mail Specialties
13. PL — Private Label, including hamper storage
14. PS — Personnel Services
14. E — Parking lot (personnel) entrance

SUMMARY OF MOVES

Plant *Toiletries, Ltd. Current DC* Project *New DC*

By *TJ* With *LH*

Date *5/19* Sheet *1* of *1*

Unit of Flow in *Equivalent Slip Sheet Loads* per *Day (avg.)*

Basis for Unit of Flow (or Conversion Values) *Cube equivalent to full slip sheet load*

ROUTE ■ FROM-TO ☐ BOTH DIRECTIONS	Distance in	Total Intensity	PRODUCT-MATERIAL Class a Slip Sheet Loads	Class b Cartons & Cases	Class c Small Pack or Item	Class d Tub	Class e Packing Material	Class f Small Parcels	Class g Hampers
1 R – P		1040					1040		
2 M – SH		200	200						
3 M – A		300	300						
4 A – SH		300	300						
5 M – B		649	649						
6 B – C		200	200						
7 B – D		99	99						
8 C – E		5		5					
9 D – E		2		2					
10 B – SH		250	250						
11 B – ST		100	100						
12 C – A/P		195		195					
13 D – A/P		97		97					
14 E – A/P		7			7				
15 A/P – ST		299				299			
16 R – A/P		50				50(a)			
17 ST – SH		549	150			299		100	
18 B – DM		100	100						
19 P – DM		5					5		
20 DM – ST		100						100	
21 M – PL7		50							50
22 P – PL7		1					1		
23 PL7 – ST		50	50						
24 PL7 – M		5							5(b)
30									
TOTAL		4653	2398	299	7	648	1040	200	55

Notes *(a) Nested , empty tubs*

(b) Empty hampers, knocked down

RELATIONSHIP CHART

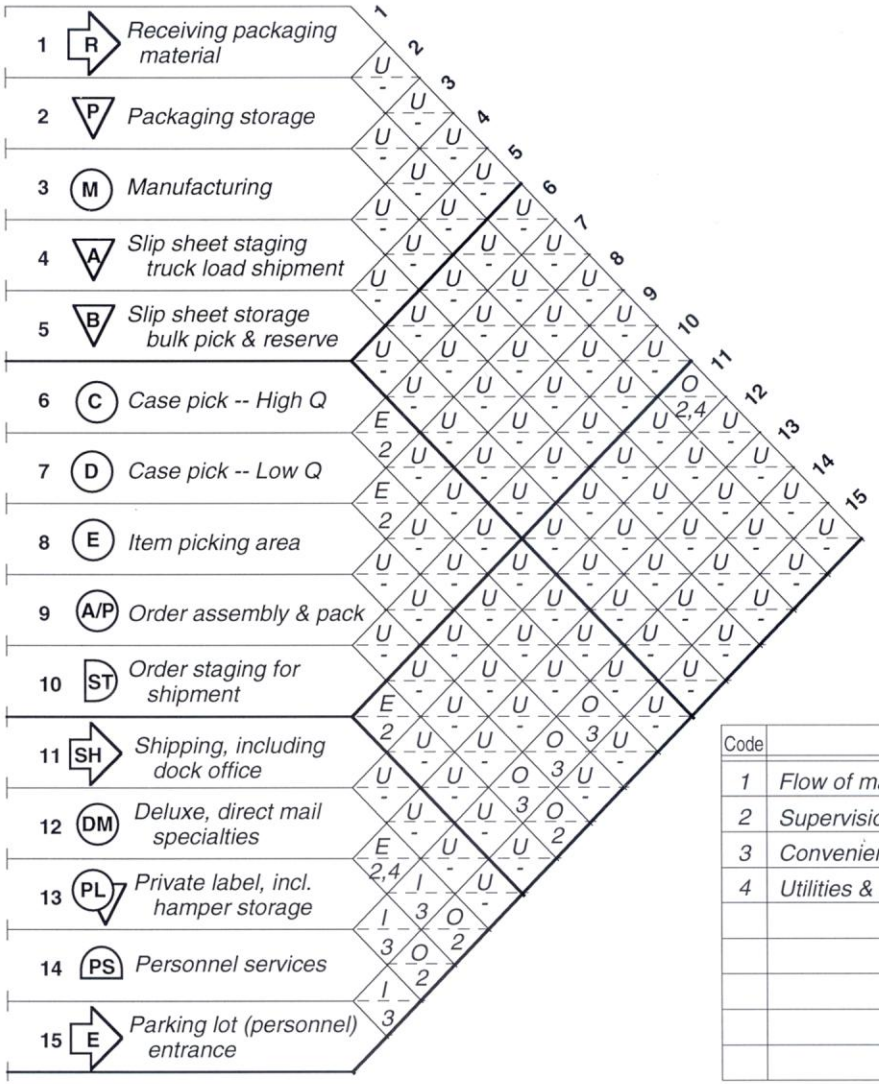
Other-Than Flow

Plant (Company) *Toiletries, Ltd.* Project *New DC*

Charted by *TJ & TS* With *Project Team*

Date *6/8* Sheet *1* of *1*

Reference



Value	CLOSENESS	No. of Ratings
A	Absolutely Necessary	0
E	Especially Important	4
I	Important	3
O	Ordinary Closeness OK	7
U	Unimportant	91
X	Not desirable	0

Total = $\frac{N \times (N-1)}{2} = 105$

Code	REASON
1	Flow of material
2	Supervision
3	Convenience
4	Utilities & Lighting

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RELATIONSHIP CHART

Combined Flow & Other-Than Flow

Plant (Company) *Toiletries, Ltd.* Project *New DC*

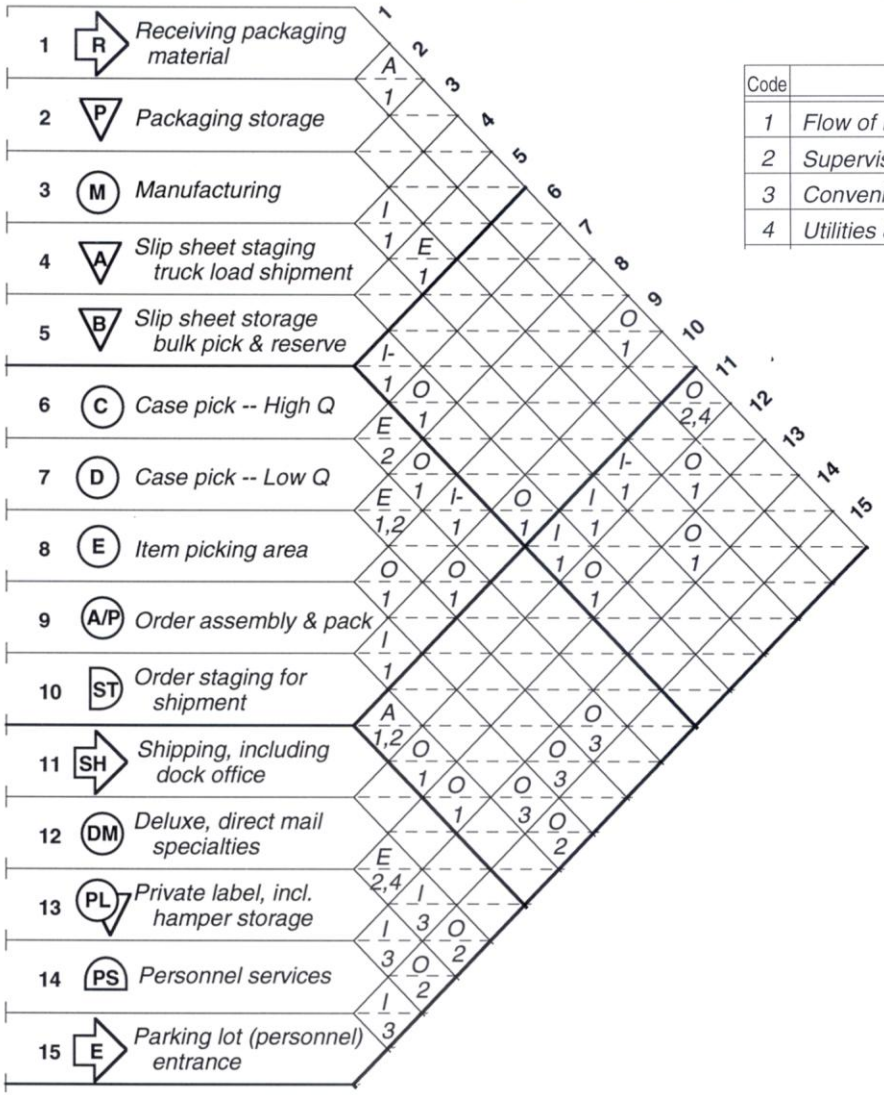
Charted by *TJ & TS* With *Project Team*

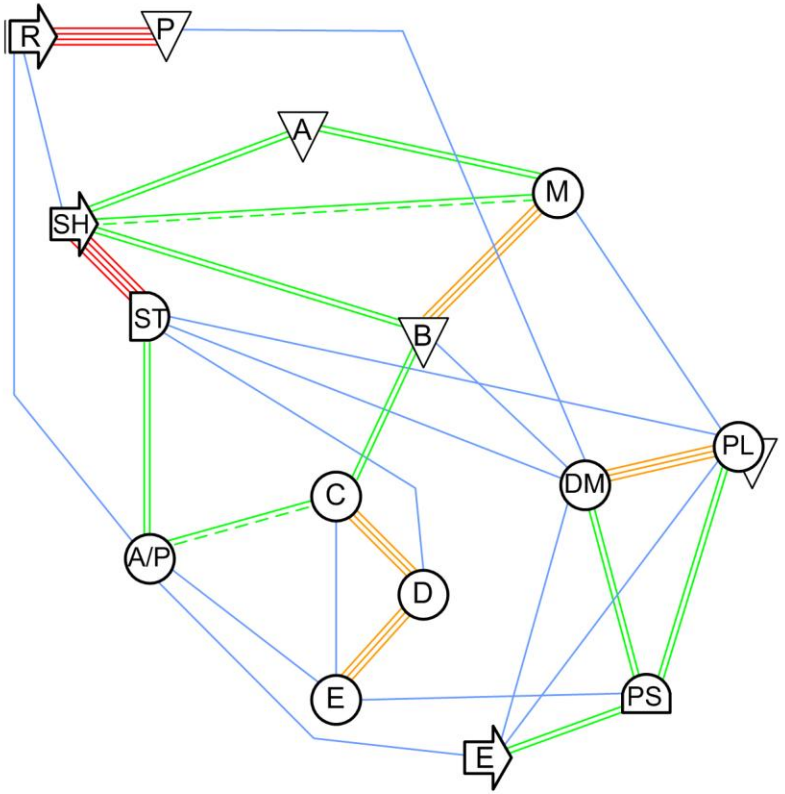
Date *6/8* Sheet *1* of *1*

Reference *Flow ratings converted from Summary of Moves*

Code	REASON
1	Flow of material
2	Supervision
3	Convenience
4	Utilities & Lighting

Value	CLOSENESS	No. of Ratings
A	Absolutely Necessary	0
E	Especially Important	4
I	Important	3
O	Ordinary Closeness OK	7
U	Unimportant	91
X	Not desirable	0
Total = $\frac{N \times (N-1)}{2}$		= 105





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ACTIVITIES AREA & FEATURES SHEET

Plant *Toiletries, Ltd.*
Project *New Distribution Center*
By *TJ* With *LH*
Date *6/10* Page *1* *1*

Physical Features Required

Activity No.	Activity Name	Area in *Bays*	O'Head Clearance	Max. Overhead Supported Load	Max. Floor Loading	Min. Column Spacing	Water & Drains	Steam	Compressed Air	Foundations - or Pits	Fire or Explosion Hazard	Special Ventilation	Special Electrification	Extra Lighting	Requirements for Shape or Configuration of Area (Space)
		(d) Total: *51 bays @ 2500 sq. ft. each*	Enter Unit and Required Amount under each: *feet*	(a)	(b)	(c)	Relative Importance of Features: A - Absolutely Necessary; E - Especially Important; I - Important; O - Ordinary Importance; — - Not Required								Enter Requirements for Shape or Configuration and Reasons therefore
1.	R Receiving packaging material	*2*	--				*A*	--	--	--	--	--	--	*A*	
2.	P Packaging storage	*2nd flr. OK*	--												
3.	M Manufacturing	*Avail.*	--												
4.	A Slip sheet staging for truck load shipment	*3*	*18*				--	--	--	--	--	--	--	--	
5.	B Slip sheet storage bulk pick & reserve	*16*	*18*				--	--	--	--	--	--	--	--	
6.	C Case pick -- High Q	*5*	--				--	--	--	--	--	--	--	--	
7.	D Case pick --Low Q	*4*	--				--	--	--	--	--	--	--	--	
8.	E Item picking area	*2*	*10*				--	--	--	--	--	--	--	*A*	*Need 80 feet of facing for pick to conveyor*
9.	A/P Order assembly & pack	*2*	*10*				--	--	--	--	--	--	--	*A*	
10.	ST Order staging for shipment	*6*	*12*				--	--	--	--	--	--	--	*E*	
11.	SH Shipping, including dock office	*5*	*16*				*I*	--	--	--	--	--	--	*A*	
12.	DM Deluxe, direct mail specialties	*3*	*12*				*O*	--	*E*	--	--	--	*I*	*A*	
13.	PL Private label, incl. hamper storage	*3*	*12*				*O*	--	*E*	--	--	--	*I*	*A*	
14.	PS Personnel services	*Available in Mfg.*													
15.	E Parking lot (personnel entrance)	--													

Sub-Activities or Areas

Notation References

a *No overhead loads planned.*
b *Floor strength specified for future manufacturing. OK.*
c *50' x 50' throughout. OK.*
d *Only 48 bays available. Short 3 bays or 7%.*

No. _____ Activity _____ Sheet _____ of _____

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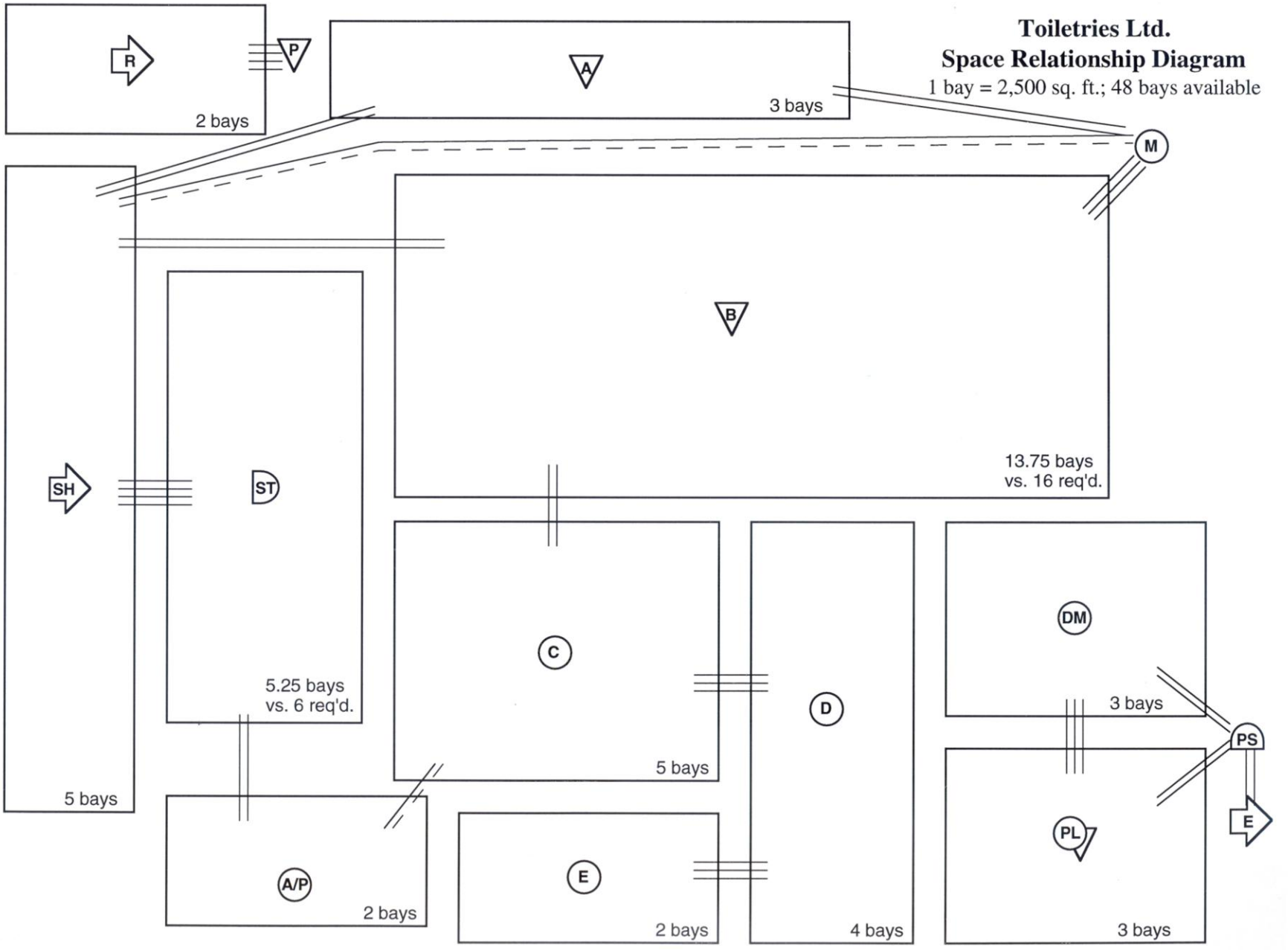

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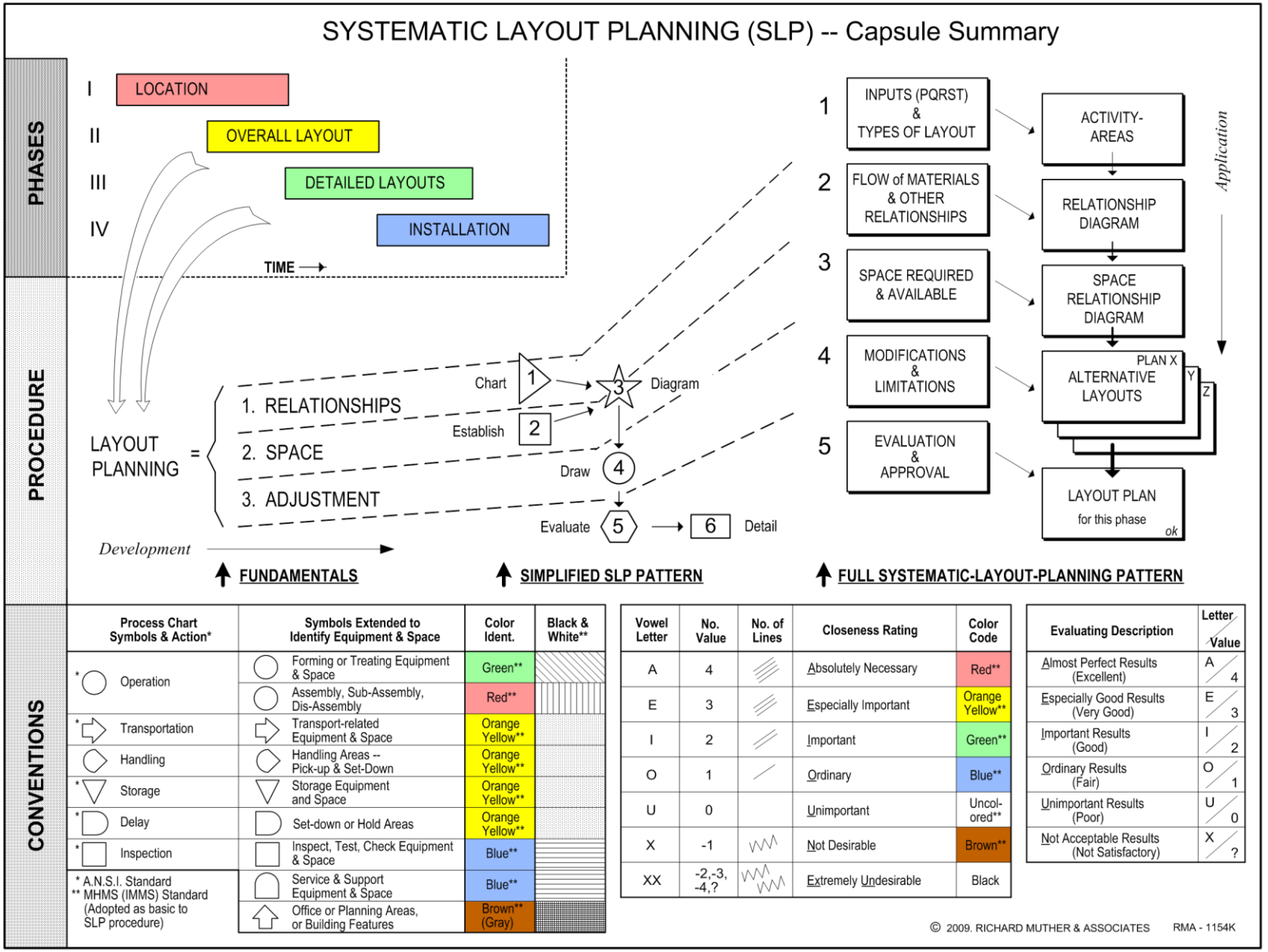
7B7

SYSTEMATIC LAYOUT PLANNING (SLP) -- Capsule Summary



CONVENTIONS

Process Chart Symbols & Action*	Symbols Extended to Identify Equipment & Space	Color Ident.	Black & White**
* Operation	Forming or Treating Equipment & Space	Green**	
	Assembly, Sub-Assembly, Dis-Assembly	Red**	
* Transportation	Transport-related Equipment & Space	Orange Yellow**	
Handling	Handling Areas -- Pick-up & Set-Down	Orange Yellow**	
* Storage	Storage Equipment and Space	Orange Yellow**	
* Delay	Set-down or Hold Areas	Orange Yellow**	
* Inspection	Inspect, Test, Check Equipment & Space	Blue**	
* A.N.S.I. Standard ** MHMS (IMMS) Standard (Adopted as basic to SLP procedure)	Service & Support Equipment & Space	Blue**	
	Office or Planning Areas, or Building Features	Brown** (Gray)	

Vowel Letter	No. Value	No. of Lines	Closeness Rating	Color Code
A	4		Absolutely Necessary	Red**
E	3		Especially Important	Orange Yellow**
I	2		Important	Green**
O	1		Ordinary	Blue**
U	0		Unimportant	Uncol-ored**
X	-1		Not Desirable	Brown**
XX	-2,-3, -4,?		Extremely Undesirable	Black

Evaluating Description	Letter / Value
Almost Perfect Results (Excellent)	A / 4
Especially Good Results (Very Good)	E / 3
Important Results (Good)	I / 2
Ordinary Results (Fair)	O / 1
Unimportant Results (Poor)	U / 0
Not Acceptable Results (Not Satisfactory)	X / ?

RICHARD MUTHER & ASSOCIATES - 1154K-ppt

Integrating Layout Planning & Material Handling Analysis

1. Fundamentals

Every **Layout** involves:
RELATIONSHIPS
SPACE
ADJUSTMENT

Every **Handling** Plan involves:
MATERIALS
MOVES
METHODS

2. Basic Integrated Planning