Webinar: Material Handling 101

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www.RichardMuther.com

Distribution Operations Analysis and Design (DOAD) Series

Material Handling 101
Fundamentals, Analysis and Selection

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www.scl.gatech.edu/mh101

Georgia Tech Supply Chain & Logistics Institute

Stewart School of Industrial & Systems Engineering

Preview of our On-Site Course

- **Day One –**
  - How to Attack Material Handling Problems
  - Systematic Handling Analysis (SHA)
  - Fundamental Principles & Concepts
  - Warehousing Case Problem
- **Day Two –**
  - Inbound Logistics & Handling
  - Manufacturing Case Problem
  - Workplace Handling & Ergonomics
  - How to Select the Best Handling Methods

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

About This Preview

- Not teaching *how to*; showing *what* we teach in our work course.
- Not fully-explaining each slide; just giving you an idea of what we cover.
- Going to move very fast; clicking through animations that we do slowly in class.
- Showing case exercises; not reading them.
- Time permitting, will show applications by users of the method we are teaching, incl. graduates of the class.
- Available for follow-up questions by email or phone. www.RichardMuther.com or 770-859-0161

Notes

Main Points

1. Many material handling problems can be resolved with common-sense instinct and experience. But when the scope is large, or the choices unfamiliar, this approach breaks down.
2. Universal problem-solving procedures can be used, such as those found in Continuous Improvement or Total Quality programs (also called "Lean" and "Six Sigma").
3. Surveys are an organized way to uncover opportunities.
4. Measurement of existing conditions can also reveal and define problems and opportunities for improvement.
5. Organized, systematic analysis is the best way to tackle large or complex projects.

Work Course Objectives

1. **Provide formal training in material handling analysis**
2. **Boost your confidence when analyzing and justifying material handling investments**
3. **Improve the professionalism of your plans and proposals**
4. **Insulate you from industry fads and hype**
5. **Prepare you to lead material handling improvements**

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Notes

Main Points

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How to Attack Material Handling Problems

1. **Instinct & Experience**
2. **Universal Problem-Solving Procedure**
3. **Checklists, Rules, Principles**
4. **Measurement of Existing Conditions**
5. **Organized, Systematic Handling Analysis (SHA)**

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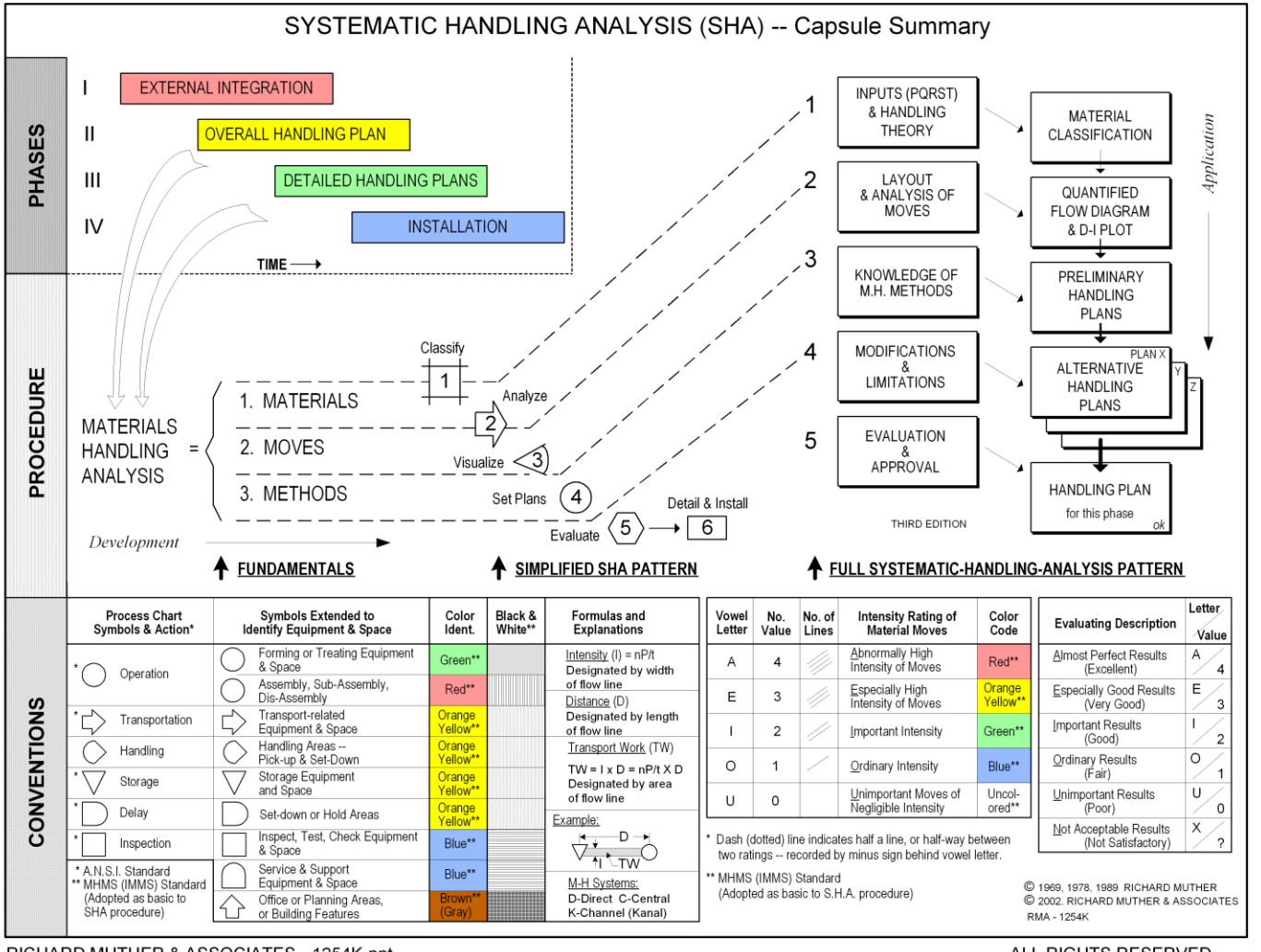
Notes

Main Points

1. Systematic Handling Analysis (SHA) is an organized universally applicable approach to any materials handling project.
2. SHA consists of:
   - Framework of Phases
   - Pattern of Procedures
   - Set of Conventions
3. SHA was first published in the 1960s by Richard Muther and Knut Haganäs. Its development and subsequent refinement reflects the experience of more than 1000 projects.
4. SHA is a companion to the well-known Systematic Layout Planning (SLP) also developed by Richard Muther.



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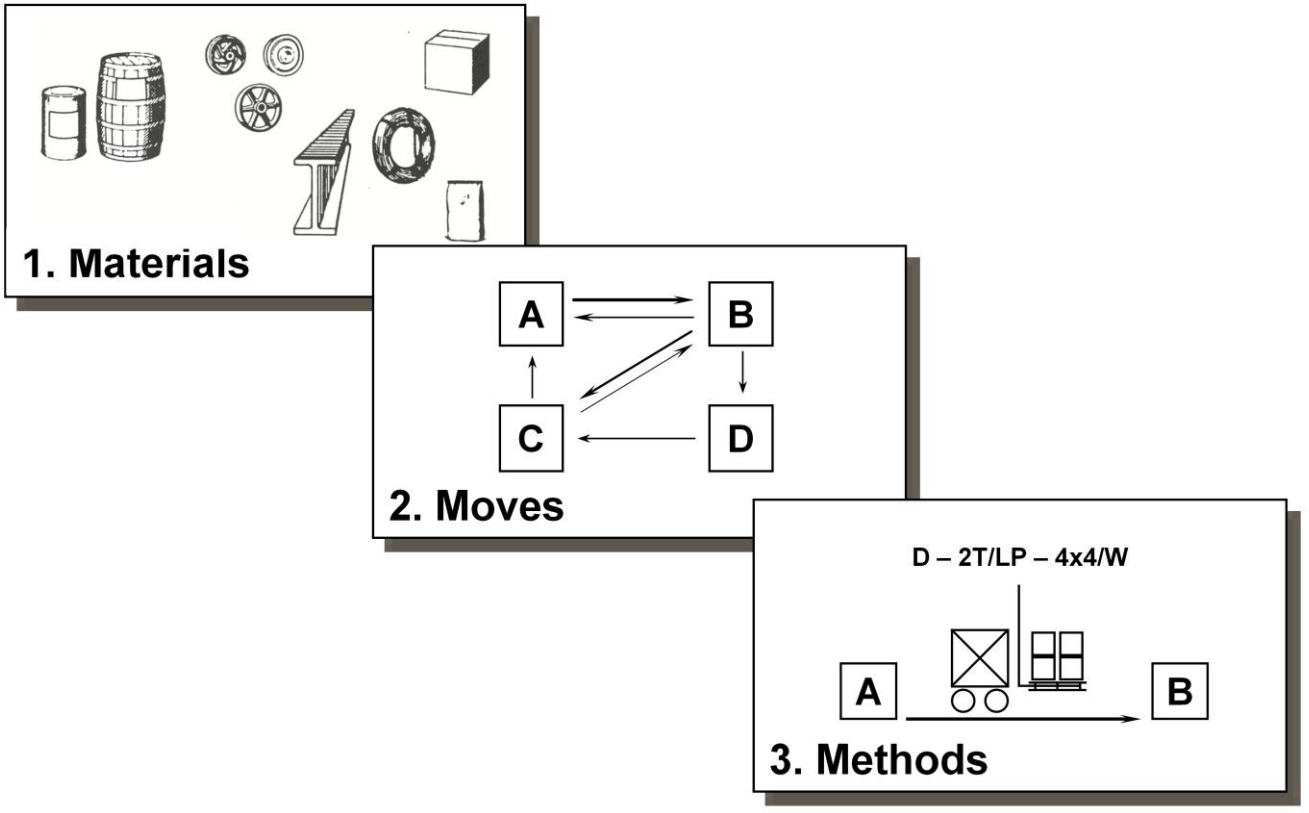
Notes

Main Points

1. Any material handling study involves three fundamentals:
    a. Materials to be moved
    b. Moves to be made
    c. Methods of moving the materials.
2. Selection of methods should follow a systematic analysis of materials and moves.
3. By applying the three fundamentals – *in the order shown* – the material handling engineer assures better decisions and methods.

What Is Material Handling?



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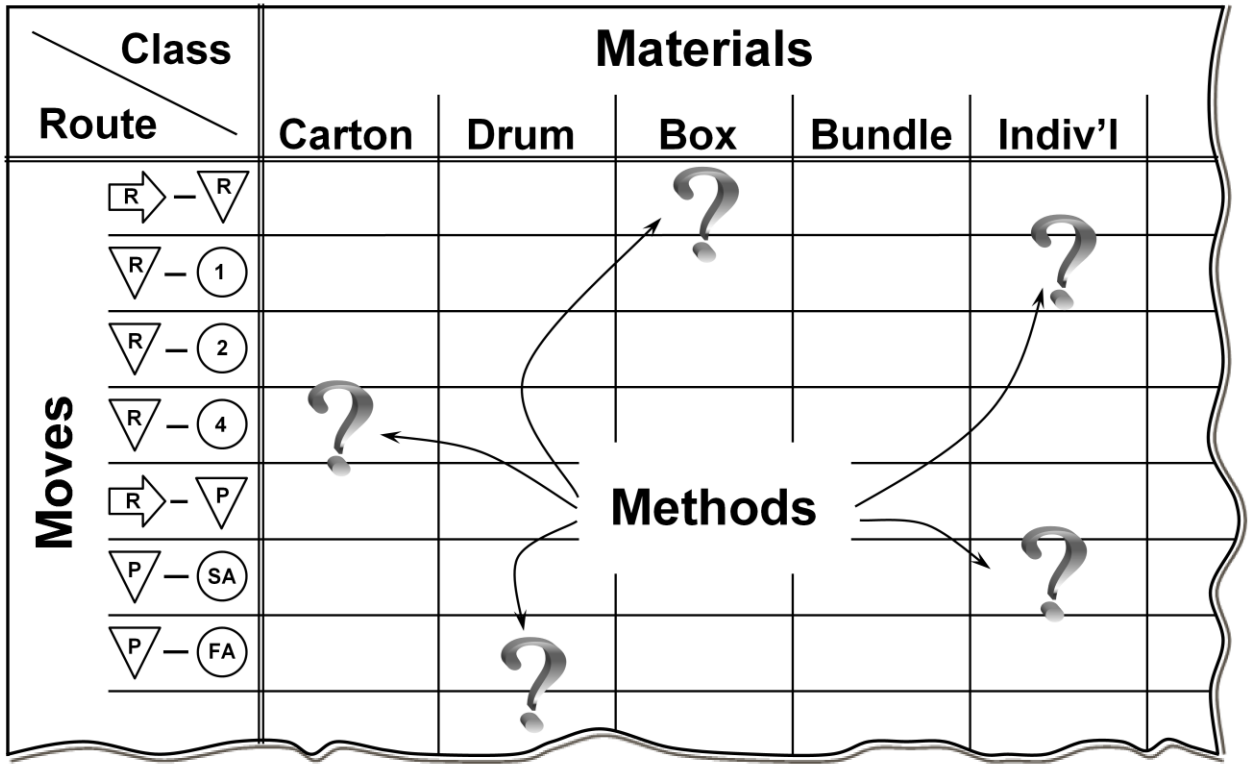
Notes

Main Points

1. The three fundamentals of Materials, Moves, and Methods can be related on a simple chart or table.
2. Columns represent each class of similar or common material.
3. Rows represent each route on which movement takes place.
4. Individual moves are represented at the intersections of columns and rows – wherever a class moves on a route.
5. Methods are needed for each move.
6. Material handling analysis seeks the best set of material handling methods.

What Is Material Handling?



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Notes

Main Points

1. Equipment is only one aspect of a material handling method.
2. A method also includes its transport unit – whatever is being physically moved.
3. A method includes the manner or system in which the move is made.
4. A material handling method is not completely described until all three aspects are decided or known.

Methods, Plans, and Systems

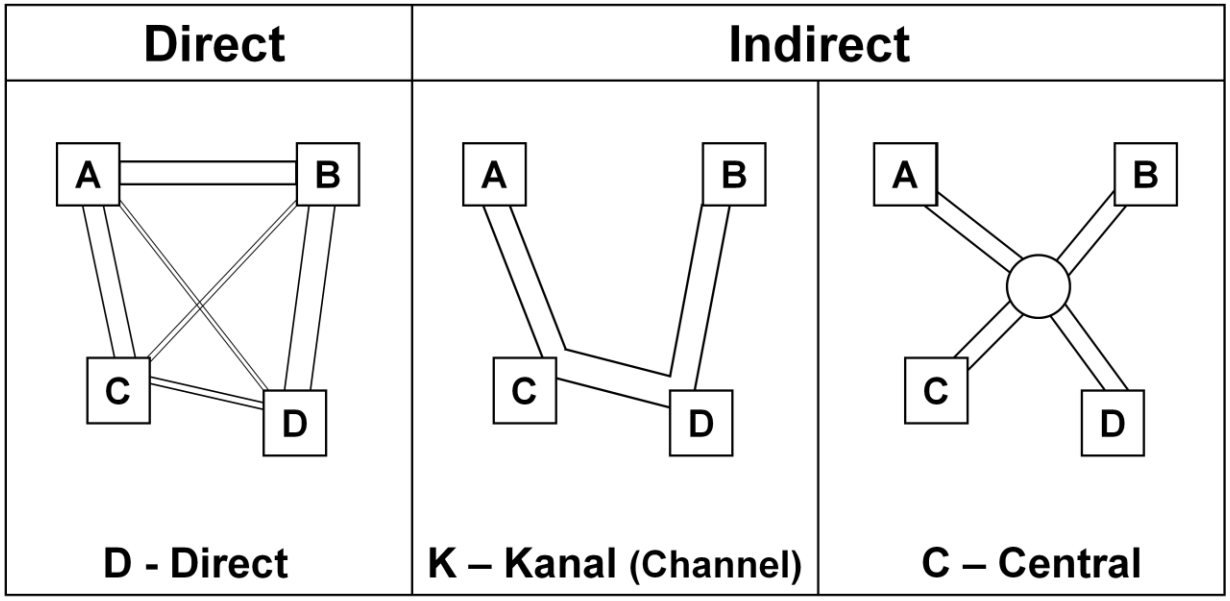
- Material handling *method:*
  - Handling equipment (E)
  - Transport unit (T)
  - System of moves (S)

Notes

Main Points

1. By Material Handling Systems we mean the general way in which the different movements are tied together, both from a geographical and physical standpoint.
2. In a Direct System, materials move from origin to destination over the shortest practical path.
3. In a Channel System, materials move is a pre-established route and flow to destination together with other materials moving to or from other areas.
4. In a Central System, materials move from origin to a centralized sorting and/or dispatching area and then on to destination.

Classical Material Handling Systems



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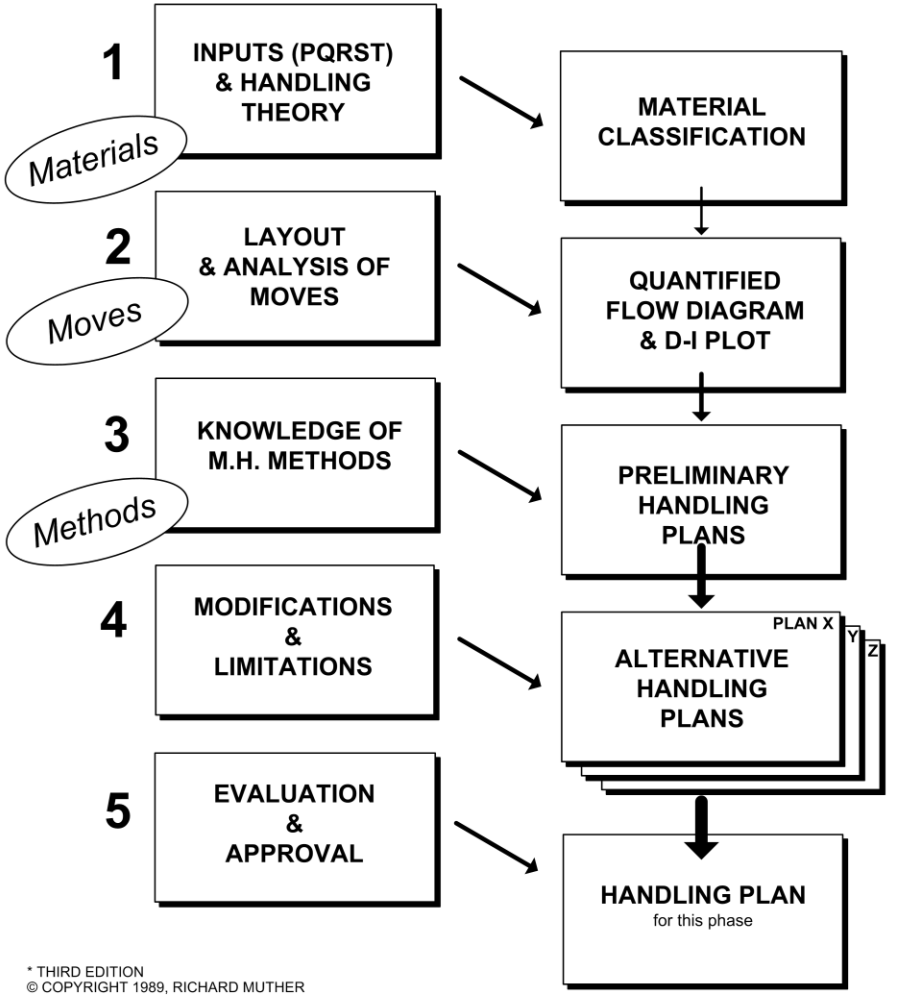
Notes

Main Points

1. SHA Pattern of Procedures is a five-section series of procedures resting squarely of the three fundamentals of *materials*, *moves* and *methods*.
2. The Pattern applies to both Phase II, Overall Handling Plan, and Phase III, Detailed Handling Plans.
3. The left-hand boxes of the pattern represent data collection and analysis.
4. The right-hand boxes represent synthesis and output of results.
5. The SHA Pattern requires that two or more alternatives be developed and evaluated before a plan is approved.
6. The more complicated the problem, the more useful and time-saving this pattern becomes.

Systematic Handling Analysis Pattern*

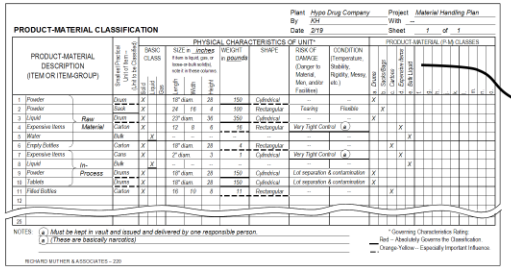


* THIRD EDITION

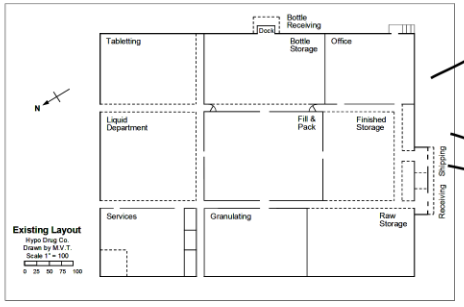
Notes

S.H.A. in Action

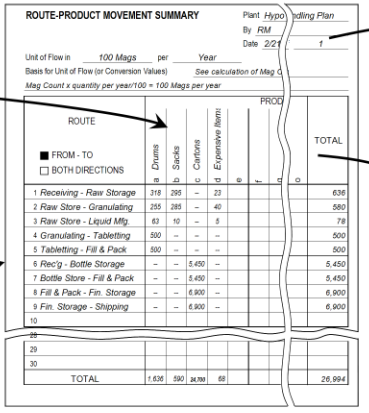
1. Key Input Data: P, Q, R, S, T



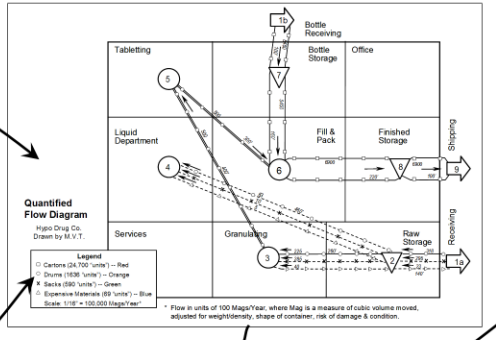
1. Material Classification



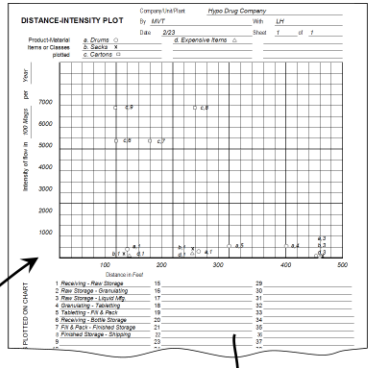
2a. Layout



2b. Analysis of Moves



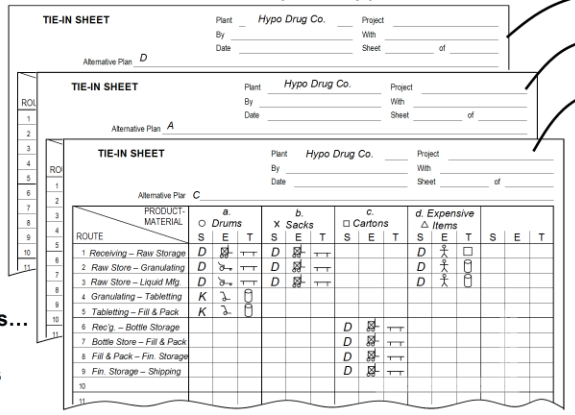
2c. Quantified Flow Diagram

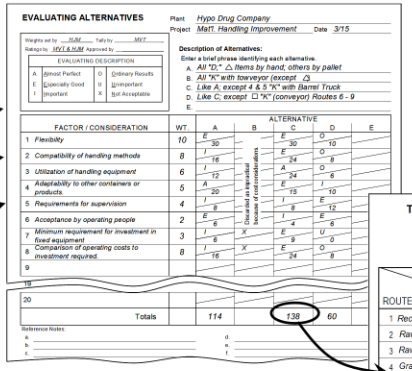


2d. Distance-Intensity Plot

3. Experience, knowledge, and understanding of materials handling methods… leading to Preliminary Handling Plans

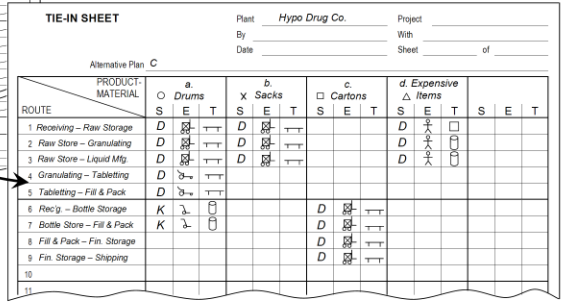
4. Alternative Handling Plans based on modification and limitations to preliminary plans





5a. Evaluation

5b. Selected Handling Plan
Phase II – Overall Handling Plan



Steps and key documents of Systematic Handling Analysis (SHA). The example is for the overall handling plan (Phase II) between departments in a pharmaceutical manufacturing plant.

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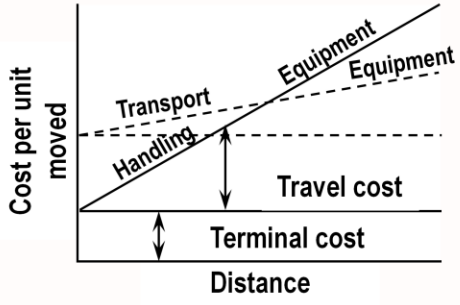
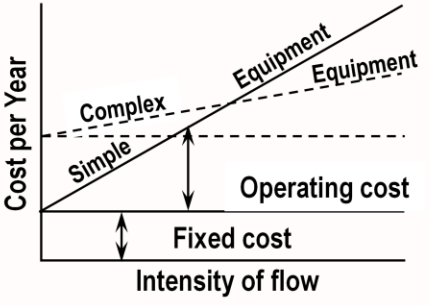
Main Points

1. Distance and intensity are the primary drivers of material handling cost.
2. Distance and intensity can be visualized as a flow diagram or as a plot.
3. Transport Work is the product of Intensity times Distance and approximates material handling cost.
4. In a Quantified Flow Diagram, the length of a flow line gives the Distance, the width gives the Intensity, and the area under the flow line is Transport Work.
5. In a Distance-Intensity Plot, the area "behind" a plotted points is Transport Work.
6. The Quantified Flow Diagram and the Distance-Intensity Plot display the same information (Distance, Intensity, and Transport Work) in different ways.

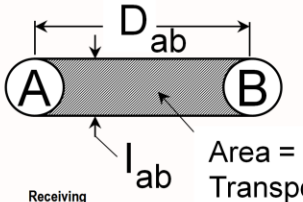
Analyzing Materials & Moves

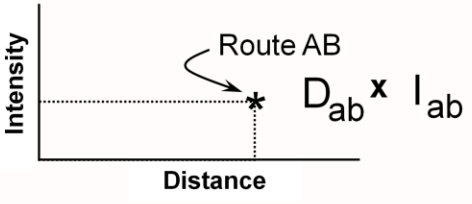
Theory & Economics



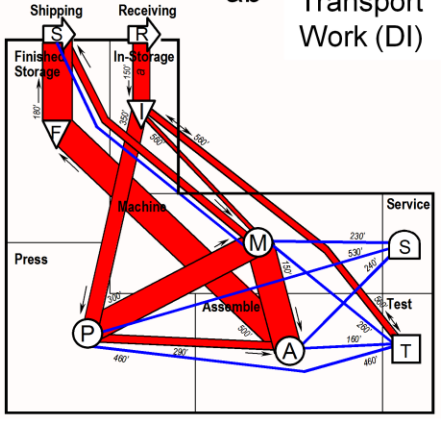


Visualization of the Problem

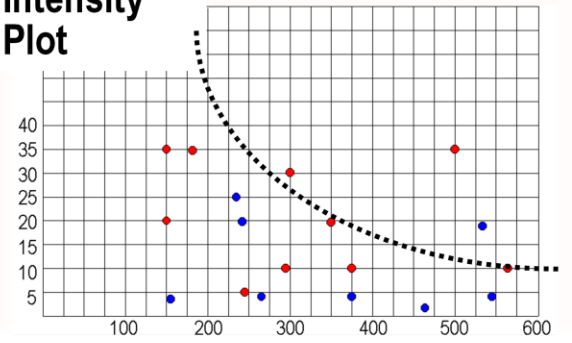




Quantified Flow Diagram



Distance-Intensity Plot



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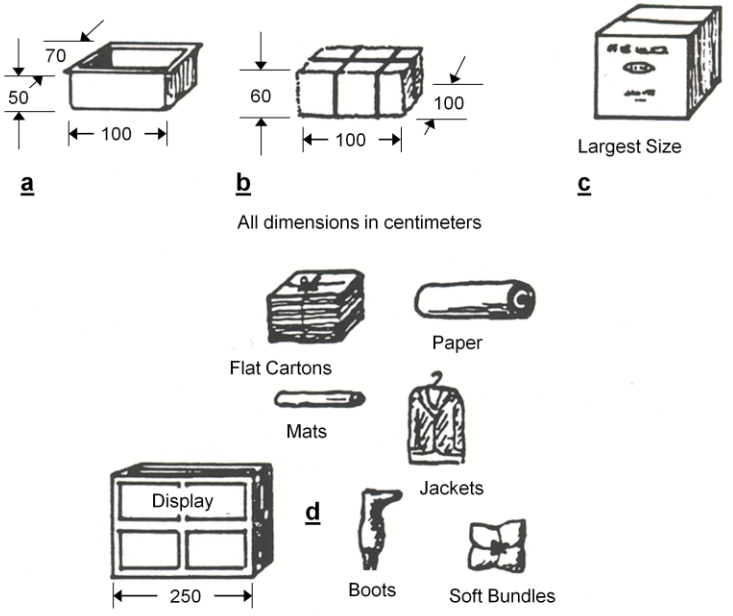
Notes

Case Problem

Please review all pages of the case. Then use the information provided to prepare a Preliminary Handling Plan.

Homart Distributors

Homart distributes clothing and soft home goods from its central warehouse to over 70 branch retail stores. Large cartons and bundles are received, weighing up to 50 kilograms (about 100 lbs.) and are up to 1 meter (39 inches) cubed. A table of data showing the materials moved inside the building (in Kg./hour) is shown on RMA-7232-2. The company's situation is shown on RMA-7232-3.



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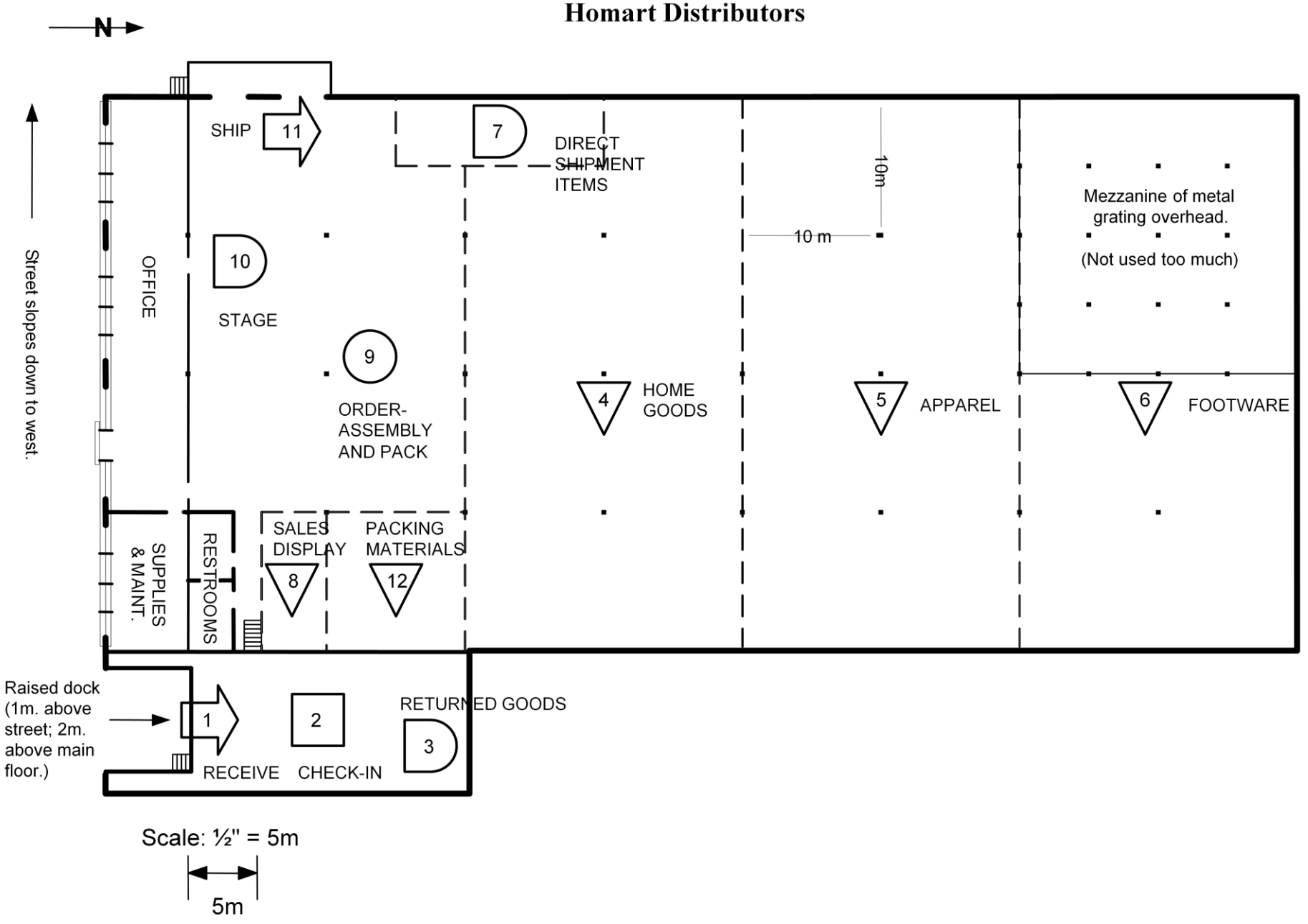
Notes

Homart Distributors

Move Summary Data

	Route	Dist. in m.	Classes of Materials				(e)	(f)	Transp. Work (g)
			Tubs of Loose Items (a)	Bundles, banded & Firm (b)	Large Cartons (c)	Other Odd Items (d)			
1	1 -- 2	10	--	20	42	3			
2	1 -- 3	16	--	--	--	1			
3	1 -- 7	60	--	--	5	--			
4	2 -- 4	45	3	5	2	--			
5	2 -- 5	65	5	8	7	--			
6	2 -- 6	88	1	4	10	--			
7	3 -- 2	6	--	--	--	1			
8	4 -- 9	20	9	--	1	--			
9	5 -- 9	40	14	--	6	--			
10	6 -- 9	60	5	--	10	--			
11	7 -- 9	25	--	--	5	--			
12	8 -- 11*	35	--	--	--	1*			
13	9 -- 10	20	--	20	25	5			
14	10 -- 11	10	--	20	25	5			
15	11 -- 12	40	--	--	--	5			
	Totals								

Homart Distributors



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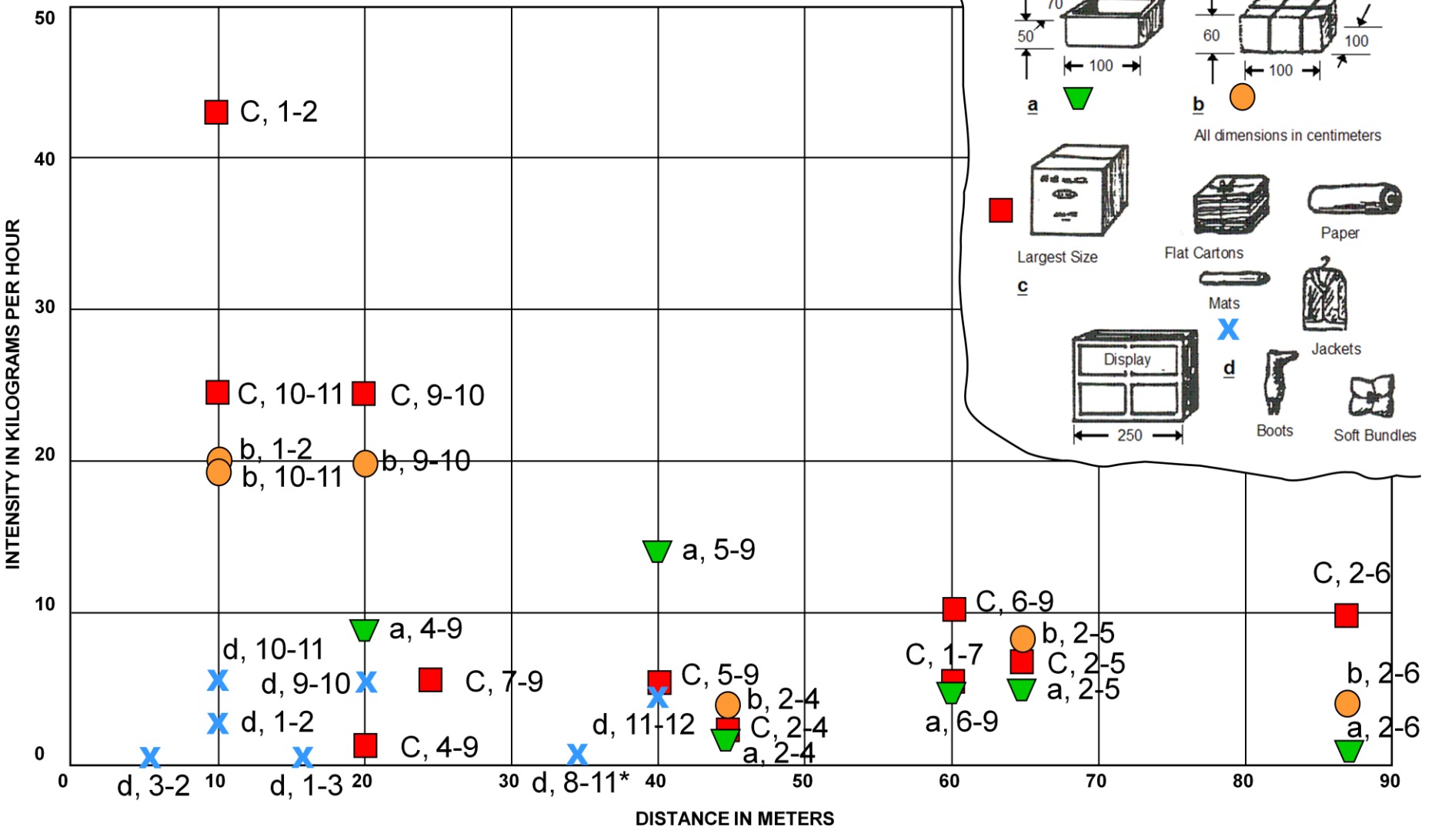
DISTANCE-INTENSITY PLOT



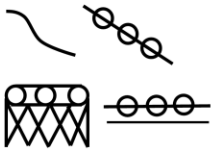
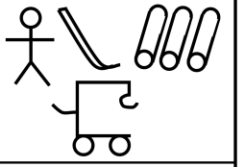
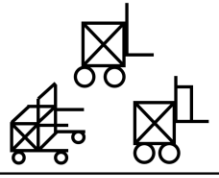
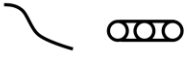
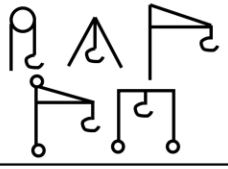
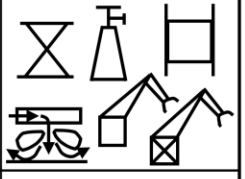
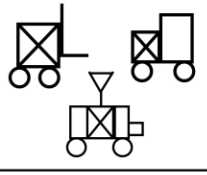
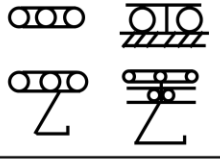
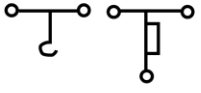
*1/2 Kg. each way

RICHARD MUTHER & ASSOCIATES - 7232-4 FILLED-IN.ppt

Guide to Materials Handling Equipment Selection

Main Points

1. The "cost-drivers" of distance and intensity result in four general classes of material handling equipment:
    a. Simple handling
    b. Simple travel
    c. Complex handling
    d. Complex travel
2. The Quantified Flow Diagram pictures distance and intensity and thus suggests the appropriate general class of equipment.
3. When general classes are overlaid on technical classes, the result is a general guide to equipment selection.
4. Such a guide is only as complete as the builder's or user's knowledge and understanding of material handling equipment.
5. Research and added experience will always increase the choices available.

Shape-of-Line \ Type	Vehicles	Conveyors	Cranes/Hoists	Combinations/ Others
Short Thin Line • Simple (Inexpensive) Handling Equipment				
Long Thin Line • Simple (Inexpensive) Travel Equipment		—	—	
Short Thick Line • Complex (Expensive) Handling Equipment				
Long Thick Line • Complex (Expensive) Travel Equipment				—

Basic components include: Platform, Power, Wheels, Hook.

Note: This does not cover all possible handling methods; rather it suggests what to consider for different materials, quantities, and routes. It relates to the classic material handling methods: mobile vehicles (trucks), conveyors, and cranes (hoists).

RICHARD MUTHER - 1241-ppt

From: SIMPLIFIED SYSTEMATIC HANDLING ANALYSIS, R. Muther et al., Mgmt. & Ind'l. Research Publications

Notes

TIE-IN SHEET

Plant _____ Project _____

By _____ With _____

Date _____ Sheet _____ of _____

Alternative Plan _____

PRODUCT-MATERIAL / ROUTE															
	S	E	T	S	E	T	S	E	T	S	E	T	S	E	T
1															
2															
3															
4															
5															
6															
7															
8															
9															
10															
11															
12															
13															
14															
15															
16															
17															

RICHARD MUTHER & ASSOCIATES – 281 (7220-5 soln worksheet)

Main Points

1. In Section 5 of the SHA Pattern, alternative plans are evaluated on costs and intangible factors or considerations.
2. SHA uses a vowel-code convention to rate the performance of each plan on each of several weighted factors.
3. Vowel code ratings are converted to points and multiplied by factor weights to arrive a scores. These are totaled for each plan.
4. A plan must score 15% better than the next highest alternative to be considered better.
5. Plans receiving an "X" (Not acceptable) rating on any factor are removed from consideration unless the objectionable feature can be eliminated or corrected.
6. In the example here, Plan A is the clear winner, but the others are comparable. Costs and payback are considered separately. To be selected, Plan A must provide an acceptable financial return. And a less desirable alternative could be chosen on the basis of better financial results.

EVALUATING ALTERNATIVES

Plant *Homart Distributors*
Project *Material Handling System* Date *6/2*

Weights set by *RI, RM, RW* Tally by *LH*
Ratings by *Plan Team* Approved by

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

Description of Alternatives:
Enter a brief phrase identifying each alternative.

A. *Transporting conveyors to/from storage*
B. *Platform & order-picking trucks*
C. *Conveyors plus sortation to shipping*
D. *Trucks into storage; conveyors out*
E.

FACTOR / CONSIDERATION	WT.	ALTERNATIVE A	B	C	D	E
1 *Utilization of space*	3	*E* 9	*A* 12	*E* 9	*A* 12	
2 *Break-down & maintenance problems*	8	*E* 24	*A-* 28	*O* 8	*E* 24	
3 *Flexibility (New products; higher volumes)*	7	*E* 21	*A-* 25	*I* 14	*E* 21	
4 *Installation problems*	4	*I* 8	*E-* 10	*O* 4	*I* 8	
5 *Ease of supervision*	9	*A* 36	*I* 18	*A* 36	*I* 18	
6 *Ability to meet peak requirements*	10	*A* 40	*E* 30	*A* 40	*A-* 35	
7 *Working conditions & safety*	10	*A* 40	*I* 20	*E* 30	*I* 20	
20						
Totals		*178*	*143*	*141*	*138*	

Reference Notes:
a.
b.
c.
d.
e.
f.

RICHARD MUTHER & ASSOCIATES - 173 (FILLED-IN 7232-10)-ppt

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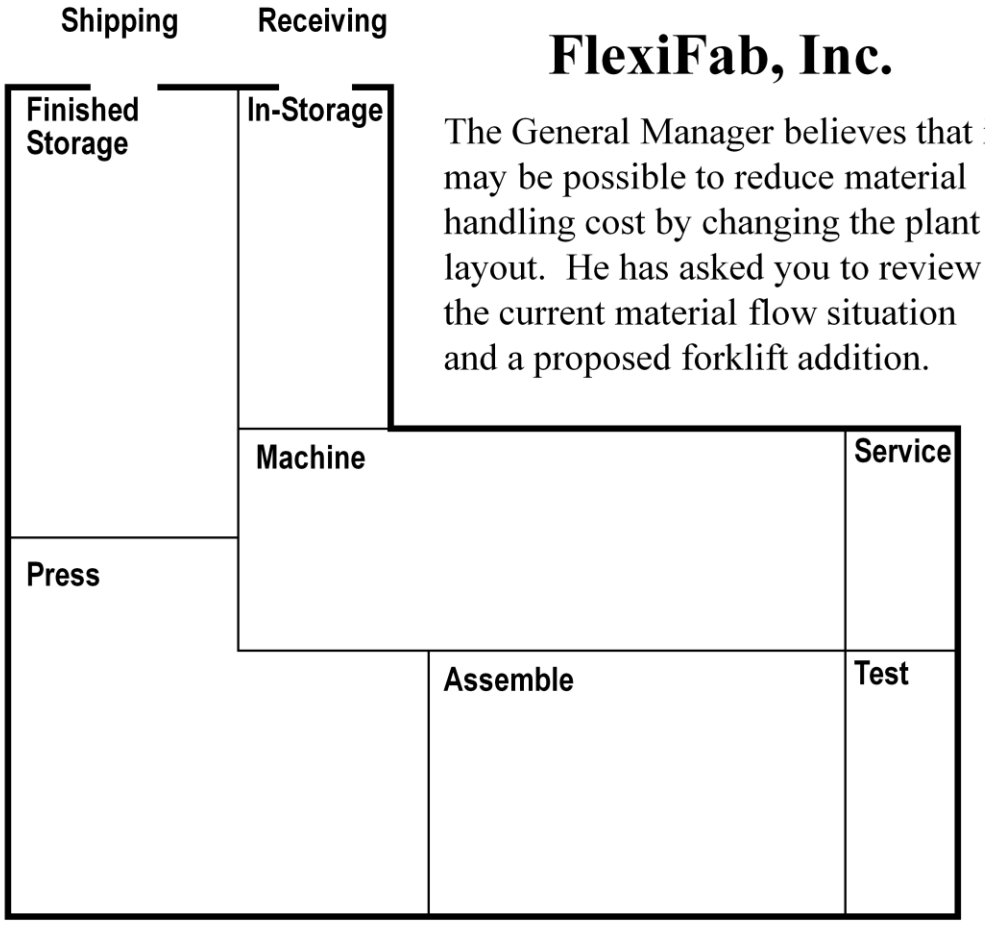
Notes

Case Problem

Please read all four pages of the case problem and then answer the questions that follow.

FlexiFab, Inc.



The General Manager believes that it may be possible to reduce material handling cost by changing the plant layout. He has asked you to review the current material flow situation and a proposed forklift addition.

Notes

Case Problem

Please read all four pages of the case problem and then answer the questions that follow.

On this page, please fill in the empty column on the right with total flow intensity.

Note: You must first decide on a unit of measure for total flow.

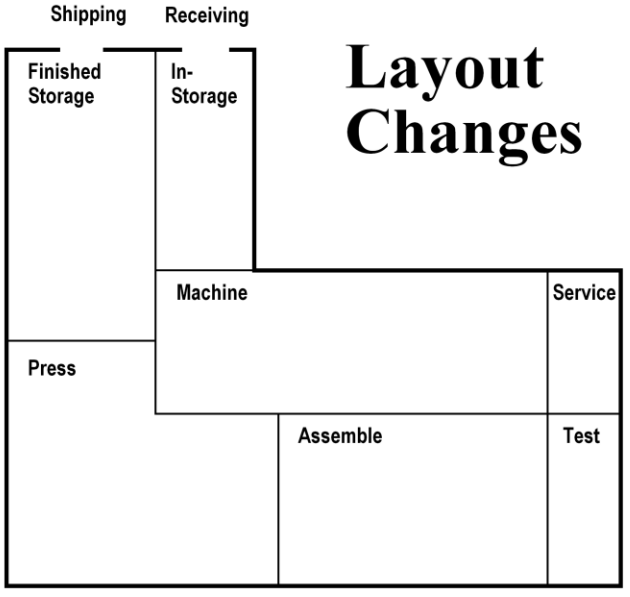
Current Flows

Route	Distance In Feet	Materials* Pallet Loads Per Day	Materials* Trays/Pans Per Day	
Flow in one direction				
1. Receiving – In Storage	150	20	--	___
2. In-Storage – Press	350	20	--	___
3. In Storage – Machine	240	5	--	___
4. Press – Machine	300	30	--	___
5. Machine – Assemble	150	35	--	___
6. Press – Assemble	290	10	--	___
7. Assemble – Finished Storage	500	35	--	___
8. Finished Storage – Shipping	180	35	--	___
9. Machining -- Shipping	375	10	20	___
Flow in both directions				
10. Test – Press	460	--	10	___
11. Test – Machine	260	--	10	___
12. Test – Assemble	160	--	15	___
13. Test – In Storage	560	10	--	___
14. Service – Press	530	--	20	___
15. Service – Machine	230	--	25	___
16. Service -- Assemble	240	--	20	___

Pallets are used to transport all raw and work-in-process. Trays of various sizes are used, but are generally 12" x 18". Pans are about the same but deeper. Assume 5 trays/pans equal one pallet load.

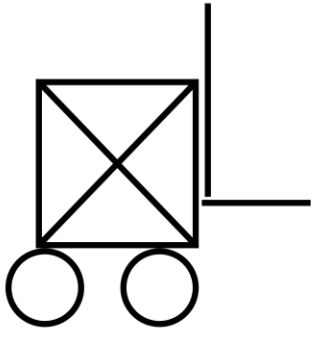
Notes

FlexiFab continued…



Layout Changes

Could material handling be reduced by improving the current layout? What techniques might be used to compare alternative plans?

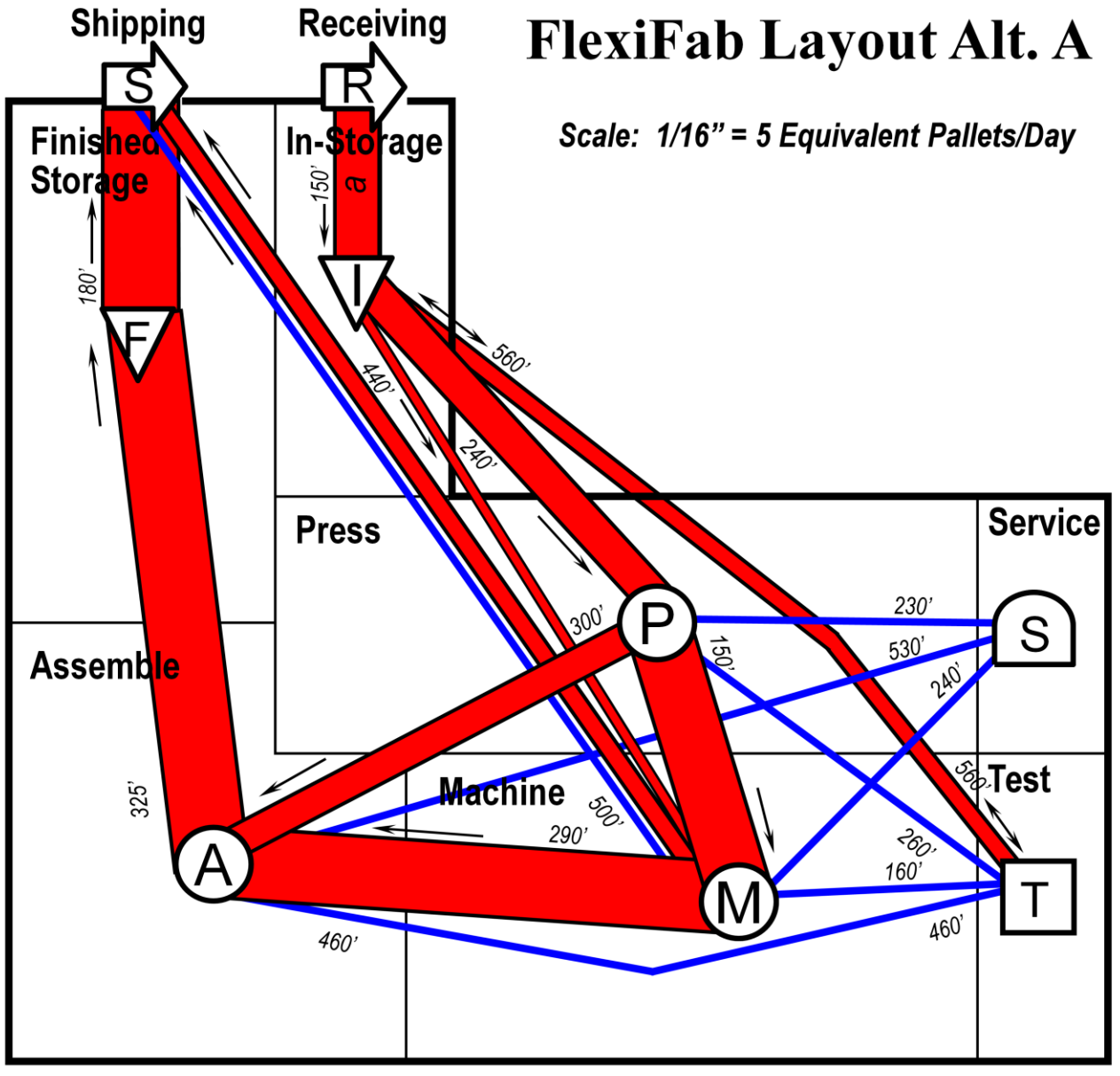


Additional Forklift

Is an additional forklift necessary? How might the productivity of existing trucks be improved? What techniques might be used to arrive at an answer?

FlexiFab Layout Alt. A

Scale: 1/16" = 5 Equivalent Pallets/Day



Equivalent Pallets/Day

ROUTE	a. Pallets	b. Trays/ Pans
R – I	20	--
I – P	20	--
I – M	5	--
P – M	30	--
M – A	35	--
P – A	10	--
A – F	35	--
F – Sh	35	--
M – Sh	10	4
T – P	--	2
T – M	--	2
T – A	--	3
T – I	10	--
Sv – P	--	4
Sv – M	--	5
Sv – A	--	4

TIE-IN SHEET

Plant _____ Project _____

By _____ With _____

Date _____ Sheet _____ of _____

Alternative Plan _____

PRODUCT-MATERIAL / ROUTE															
	S	E	T	S	E	T	S	E	T	S	E	T	S	E	T
1															
2															
3															
4															
5															
6															
7															
8															
9															
10															
11															
12															
13															
14															
15															
16															
17															

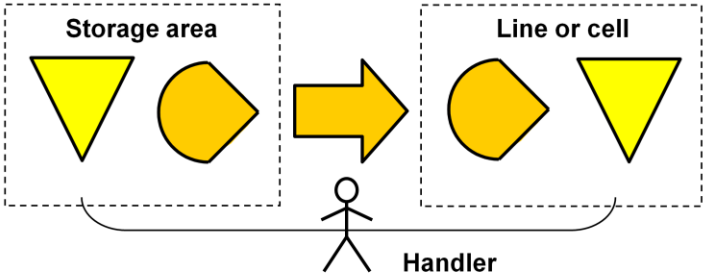
RICHARD MUTHER & ASSOCIATES – 281 (7217-8 soln worksheet)

Main Points

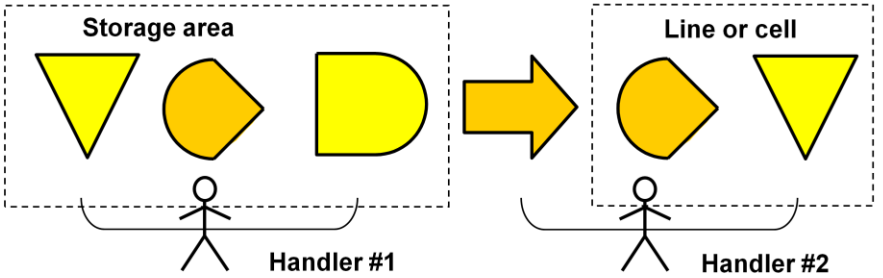
1. Many line-feeding and cell delivery systems are indirect – meaning that a route is traveled to serve two or more line stations, cells, or drop zones feeding line stations or cells.
2. Deliveries from an intermediate storage area, (stock room or supermarket) are inherently indirect, central systems in which items are received from multiple sources and typically dispatched to multiple places along a line or in cells.
3. Choice of system is driven by such considerations as:
   a. Distance and travel time.
   b. Space constraints or other conditions at point of use.
   c. Types of equipment used or needed in storage and for travel to lines or cells.
   d. Organizational structure and responsibilities for material handling.
   e. Availability of labor in line or cell (e.g. idle time to replenish).
   f. Operational availability and balance. (Is material handling always available?)

Indirect Systems for Line-feeding and Cell Delivery

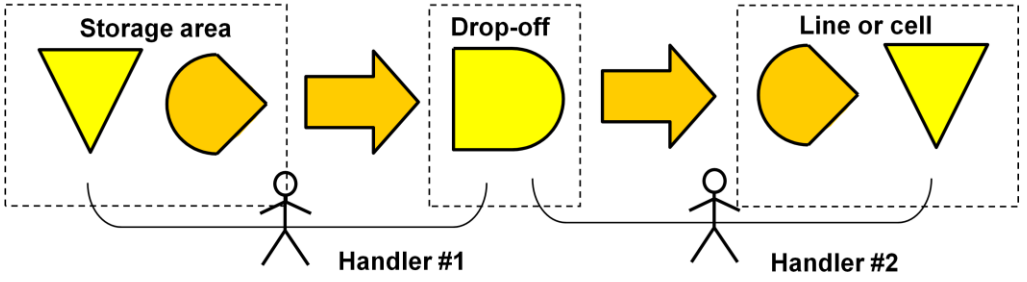
Combined Pick & Delivery Route (picker delivers)



Decoupled Pick & Delivery Route (one picks; one delivers)



Decoupled Delivery & Replenish (drop zone)



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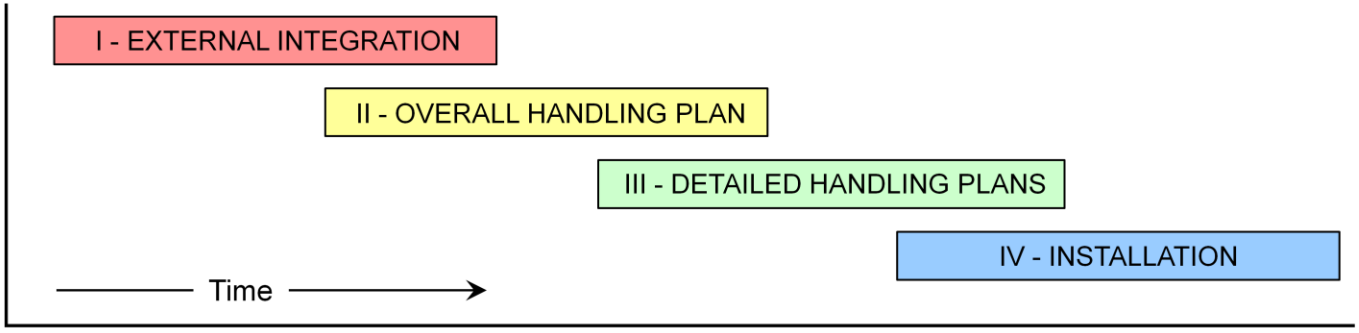
Notes

Main Points

1. As each project runs its course – from initial stated objective to installed physical reality – it passes through four sequential and phases. For best results, the phases should overlap.
2. Phase I and Phase IV are frequently not part of the material handling engineer's specific problem. In a sense, they "frame" the strictly planning phases II and III.
3. Phase I considers situations and conditions *outside* our problem area, over which we may have little or no control. Yet these "externals" may influence or constrain our plans in Phases II and III.

Four Phases of Systematic Handling Analysis (SHA)



Phase I:

Examine all movements to and from the area in question preparatory to integration with the overall handling plan(s).

Phase II:

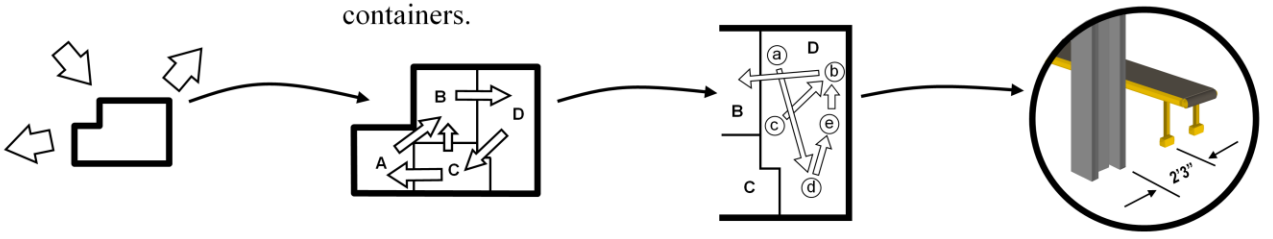
Plan the method(s) of moving materials *between* areas. Make major decisions about system, type of equipment and containers.

Phase III:

Plan the method(s) of moving materials *within* each area – between workplaces and/or storage points.

Phase IV:

Prepare drawings and specifications: obtain and install equipment; train workers; follow through.



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FROM THE BOOK: SYSTEMATIC HANDLING ANALYSIS, BY MUTHER & HAGANAS

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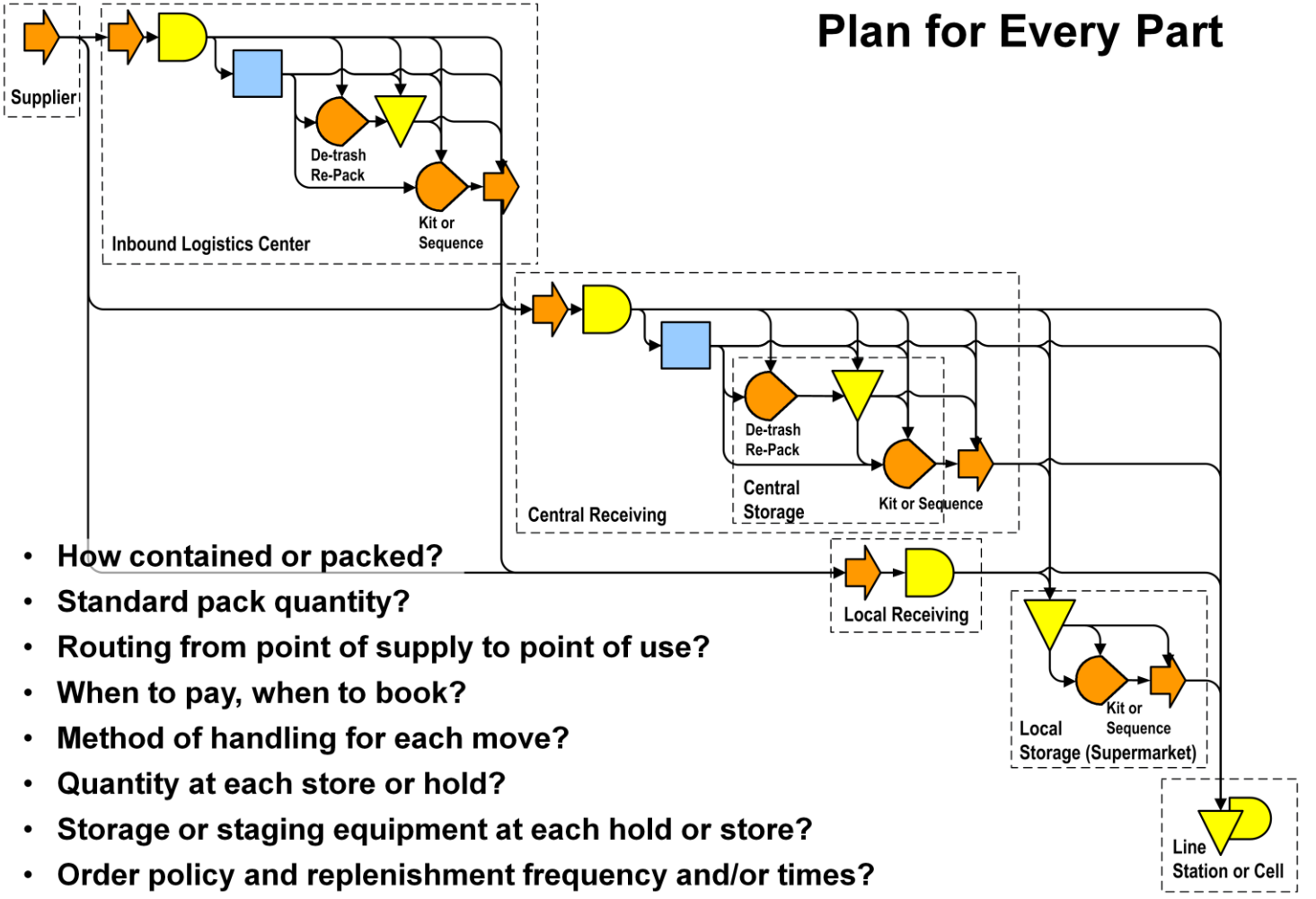
Notes

Main Points

1. The acronym PFEP stands for "Plan for Every Part" and is popular among disciples of the Toyota Production System.
2. Each part gets delivered somehow. But rarely does a document (i.e. Material Handling Plan) describe all aspects of its containment, movement, and storage.
3. When engineering lean material handling systems, it is essential to document the replenishment of each part or item.
4. Ideally, the planner should have all of the data elements listed on RMA – L-2224.
5. An electronic database will be useful in maintaining this large amount of information.
6. To develop a plan for every part, it is wise to follow Systematic Handling Analysis (SHA) and work "top down." First establishing the overall plan for major classes of materials or parts. Then work out the details of each part or item within the methods planned for its class.

Plan for Every Part



- **How contained or packed?**
- **Standard pack quantity?**
- **Routing from point of supply to point of use?**
- **When to pay, when to book?**
- **Method of handling for each move?**
- **Quantity at each store or hold?**
- **Storage or staging equipment at each hold or store?**
- **Order policy and replenishment frequency and/or times?**

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Notes

SHA Application Retail DC: 800K Sq. ft. 66 routes

MOVEMENT SUMMARY — MOVE: MATERIAL / MEASUREMENT

Intensity of Material Movement recorded in Equivalent Pallets

MATERIAL CLASSES →					a		b		c		d		e		f		ROUTE TOTAL		
Route No.	Activity No.	ROUTES Activity Name ■ From - To ☐ Both Directions	Distance in	Physical Situation	Group 1 Pallets		Group 3 Pallets		Picked Cases		Picked Inners & Eaches		Packed Cartons		Stacks of Empty Pallets		Intensity in (Equiv.) Pallets	Transport Work in Pallet Feet per Day	RATING
					Intensity, Condition	Rating, T.W.	Intensity, Condition	Rating, T.W.	Intensity, Condition	Rating, T.W.	Intensity, Condition	Rating, T.W.	Intensity, Condition	Rating, T.W.	Intensity, Condition	Rating, T.W.			
1	1	Receiving	299		68	E	0		0		0		0		0		68		I
	3	Special Processing				20332		0		0		0		0		0		20332	
2	1	Receiving	720		0		13	O	0		0		0		0		13		O
	10	Other Group 3				0		9360		0		0		0		0		9360	
3	1	Receiving	247		123	E	0		0		0		0		0		123		E
	11	NE/NS Pallet Pick				30381		0		0		0		0		0		30381	
4	1	Receiving	1,070		10	O	0		0		0		0		0		10		O
	12	NE/NS Case Flow				10700		0		0		0		0		0		10700	
5	1	Receiving	845		4	U	0		0		0		0		0		4		U
	13b	NE/NS<Carton/Each				3380		0		0		0		0		0		3380	
6	1	Receiving	229		174	A	0		0		0		0		0		174		E
	14	NE/NS Reserve				39846		0		0		0		0		0		39846	
7	1	Receiving	623		29	O	0		0		0		0		0		29		O
	15	Seasonal				18067		0		0		0		0		0		18067	
8	1	Receiving	152		43	I	0		0		0		0		0		43		O
	16	Fragile				6536		0		0		0		0		0		6536	
9	1	Receiving	617		7	U	0		0		0		0		0		7		U
	17	Secure				4319		0		0		0		0		0		4319	
10	1	Receiving	502		15	O	0		0		0		0		0		15		O
	23	Store Replenishment				7530		0		0		0		0		0		7530	
MATERIAL CLASS TOTAL		Intensity			473		13		0		0		0		0		486		
		Transp. Work				141091		9360		0		0		0		0		150451	
		Rating			A		O		E		O		U		I		Check Totals		

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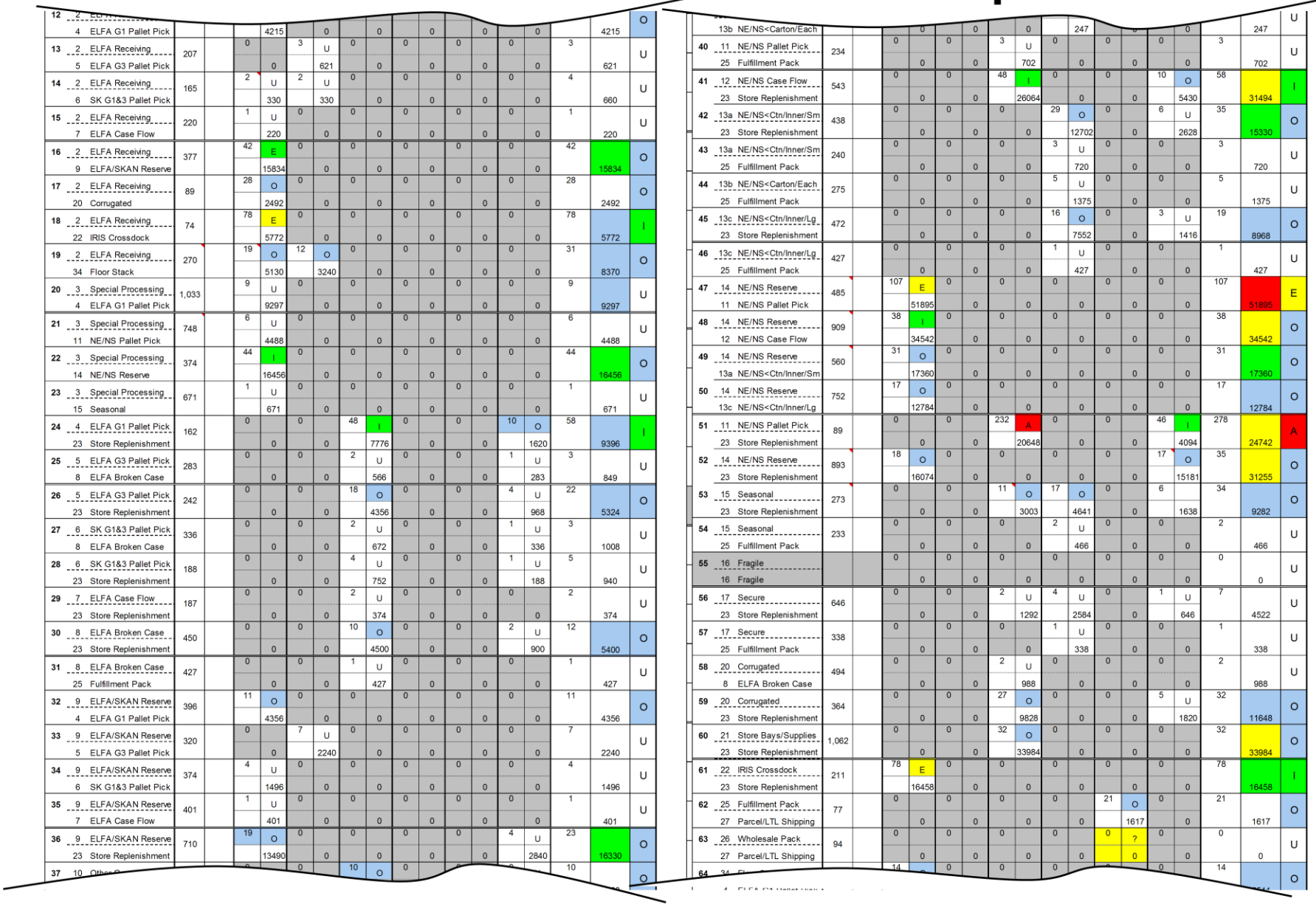
SHA Application Retail DC: 800K Sq. ft. 66 routes



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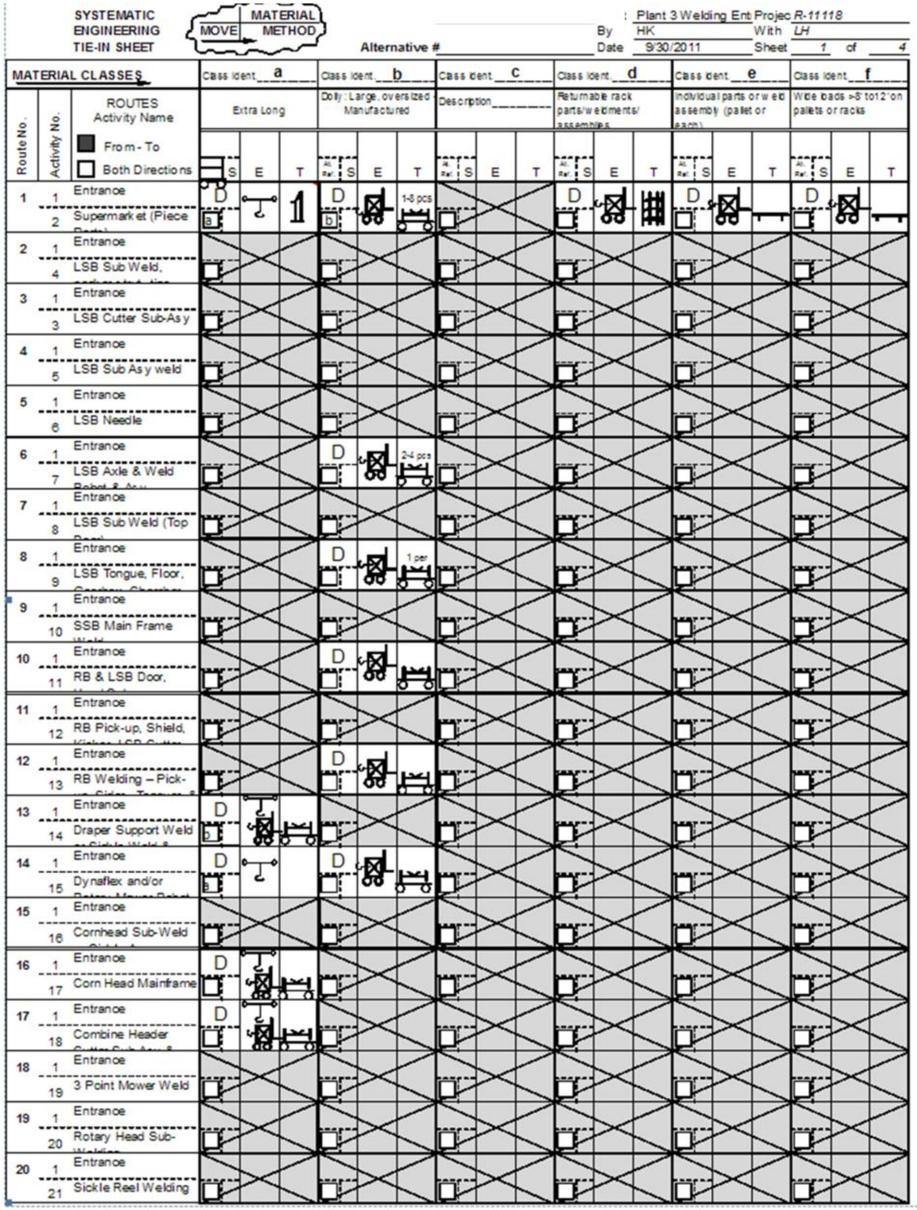
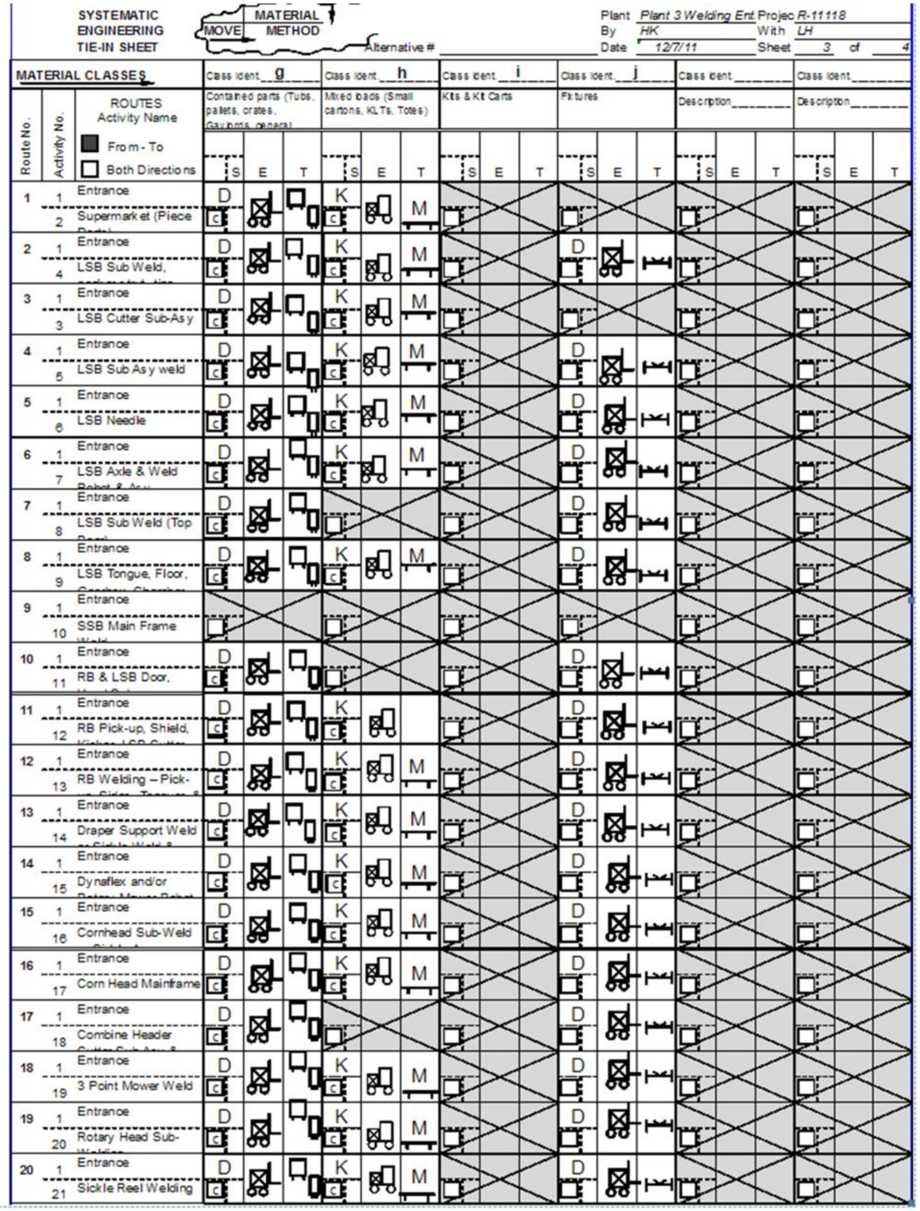
SHA Application Manufacturing: 350K sq.ft. Metal Fab





Webinar: Material Handling 101

Lee Hales

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