Optimizing Your Plant Layout

Architectural Woodwork Institute New England Chapter
Vernon, CT
12 February 2004
This Presentation’s Purpose
Equip you to evaluate your layout’s efficiency...

- Assessing your plant layout
- Selecting the optimal organization
- Matching handling equipment to the process
Why Evaluate Your Layout?

To improve your overall productivity by...

- Reducing labor
- Lowering product damage
- Increasing throughput speed
- Incorporating new processes
- Improving safety and morale
Tools for Analyzing Your Plant’s Flow

- From-To Chart
- Travel Chart
- Activity Relationship Chart
## The From-To Chart

<table>
<thead>
<tr>
<th>FROM</th>
<th>TO</th>
<th>In</th>
<th>Rip Saw</th>
<th>Resaw</th>
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Constructing a *From-To Chart*

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1.1.
Constructing a From-To Chart

To build a From-To Chart...

1. List your operations in identical order across the top of the columns and down the row on the left hand side of the chart.

If possible arrange the list in the order or direction of your current layout from beginning to end.
## Constructing a From-To Chart

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<th>Parts/ Load</th>
<th>Loads/ Month</th>
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2. Compile the process sequences for a group of representative products using information from your route sheets or process charts.

Calculate the volume of parts required per period.

Determine the number of parts per standard load - For example if you handle parts on factory carts, calculate the parts per cart.

Calculate the flow volume:

\[
\frac{\text{No. of parts per period}}{\text{Parts per load}}
\]
### Constructing a From-To Chart

#### 3.

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</table>
Constructing a From-To Chart

3. Track the flow of loads through each process sequence.

Enter the loads per period in the proper cell for each activity pair.

Sum the number of loads in each cell.

Total each row and column to check for accuracy.
Constructing a From-To Chart

Other instructions...

- Complete a chart for each product or part family.
- Don’t forget to track the movement of waste, rework, empty containers, and supplies.
Analyzing a Layout Using a From-To Chart

A From-To Chart tells you...

- **Sequence of Flow** - the paths that products take through your plant
- **Intensity of Flow** - the rate of flow on the various paths
- **Amount of Backtracking** - the operations pairs that require reversing flow

Note that entries below the diagonal line indicate backtracking.
The Travel Chart

The Travel Chart considers these points...

- The best layout minimizes total handling cost
- Cost is related to travel distance

And enables comparison of layout alternatives.
## Constructing a Travel Chart

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**TOTAL**
Constructing a Travel Chart

1. List the move distance on a clean From-To Chart for each active operation pair.
Constructing a Travel Chart

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FROM

TO
Constructing a Travel Chart

2. Multiply the number of moves on the From-To Chart by the move distance for each active operation pair.

Record the resulting total move distance on the Travel Chart in the cell for that pair.

Total each row and column to check for accuracy.

Record the total move distance for the layout in the lower right hand cell.
Comparing Layouts With The Travel Chart

3. Identify potential layout revisions that reduce the total travel distance.

Measure new travel distances.

Existing Layout

1

3 2

4 5

6 7

8

Alternative Layout

1

3 2

4 7

6 5

8
## Comparing Layouts With The Travel Chart

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Comparing Layouts With The Travel Chart
### Comparing Layouts With The Travel Chart

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**4.** Comparing Layouts With The Travel Chart

Comparing Layouts With The Travel Chart
4. Compare the total move distances in the lowermost right hand cell for each layout alternative.

Select the alternative with the lowest total move distance.
The Activity Relationship Chart

1. REWORK/REJECTS
2. A & B PARTS
3. C PARTS
4. SPECIALS
5. DRW. BOX ASSEM.
6. CUSTOM BAND AREA
7. CUSTOM DRILL AREA
8. HPL LAMINATION
9. WHITEWOOD SAND
10. CABINET ASSEMBLY
**The Activity Relationship Chart**

An Activity Relationship Chart considers layout factors beyond the flow of material...

- **Support Services** - Maintenance, utilities, and other infrastructure activities must often be located close to certain production functions.

- **People** - Management and communication needs can often dictate the arrangement of production activities.

- **Environmental Issues** - Hazardous or dirty operations must often be located away from a related function.
The Activity Relationship Chart

Relationship Between Operations 1 & 3

Reason Code

Relationship Rating

1

2

3

6
The Activity Relationship Chart

An Activity Relationship Chart contains two vital pieces of information...

- Relationship Rating - The importance of the relationship between two departments or activities is tabulated with a color-coded entry:

  - Red: Closeness absolutely necessary
  - Green: Closeness especially important
  - Blue: Closeness important
  - Yellow: Ordinary closeness OK
  - Uncolored: Closeness unimportant
  - Orange: Closeness not desirable
The Activity Relationship Chart

- Relationship Reason - The reason for a ranking is tabulated with a numerical code:

1 - materials flow
2 - communications
3 - equipment sharing
4 - personnel sharing
5 - supervision
6 - utilities sharing
7 - safety
The Activity Relationship Chart

[Diagram of the Activity Relationship Chart with details and ratings]

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Completing an Activity Relationship Chart

Other advice...

- Do not over assign A ratings.
- Involve all relevant personnel.
- Map the relationships graphically.
Layout Tools for Download

- **From-To Chart**
  
  Click here to download a copy

- **Activity Relationship Chart**
  
  Click here to download a copy
Organization Types

PROCESS LAYOUT
Like machines grouped together

PART-FOCUSED
JOB SHOP
Provides basic specialization

Type A Parts
- Mitre
- Shapers
- Drill
- Sander

Type B Parts
- Mitre
- Shaper
- Drill
- Sanders


Organization Types

**SEMI-CELL**
Parts with dissimilar cycle times requiring a variety of machine sequences

**CELL**
Parts with similar routings in a continuous flow
Machine Cell

Cell provides machining with minimal handling time...
Machine Cell

Portability of machines provides flexible sequencing...
Organization Types

PROCESS FLOW LINE
High volume parts with similar process requirements

SUPER MACHINE
Small lot sizes with complex process requirements

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An Example of Product Focus

Many plants have organized parts machining operations by process...

- PROFILERS/SHAPERS
- ROUTERS/BUCK SHAPERS
- SUB-ASSEMBLY
- ASSEMBLY BUFFER/CHAIR ASSEMBLY
- CNC ROUTERS/TENONERS/MORTISERS
- BAND SAWS/TURNING/PROFILE PLANING
- ROUGH MILL/EDGE GLUING
- FLAT BELT/WIDE BELT SANDERS
- EDGE SANDERS
- PUMP/SPOOL/FLAP SANDERS
Organizing By Product

Products often exhibit part family standardization...
Product-Focused Layouts

Efficiency can be gained by organizing this plant by product or by component type...

ROUGH MILL

BACK POSTS

BACK PARTS

SEAT RAILS

FRONT POSTS

ARMS/STUMPS

BACK ASSEMBLY

CHAIR ASSEMBLY
Product-Focused Layout

Reorganizing by part family reduces handling, increases teamwork, and reduces complexity...
Re-Layout Benefits

- 33% increase in capacity
- 50% reduction in throughput time
- 20% reduction in labor cost
Pareto’s Law

Remember 80/20...

A Items
20% of products that generate 80% of sales

B Items
30% of products that generate 15% of sales

C Items
50% of products that generate 5% of sales

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Material Handling Alternatives

Consider these principles...

- Minimize work.
- Consider human limitations.
- Minimize safety hazards.
- Use space efficiently.
- Integrate with the process.
- Be environmentally friendly.
And remember...

- Handling adds cost not value.
- The best handling system is no handling at all.
Factory Carts

Investment: Low
Operating Cost: High
Space Utilization: Moderate
Stackability: None
Flexibility: High

Moving a variety of materials on variable flow paths
Pallets

Investment  Low
Operating Cost  High
Space Utilization  Moderate
Stackability  High
Flexibility  Moderate

Moving easily-stacked materials on variable flow paths
Roller Conveyors

Investment: Moderate
Operating Cost: High
Space Utilization: Above Average
Stackability: Poor
Flexibility: Moderate

Moving easily-stacked materials on relatively fixed flow paths
Fork Lifts & Racks

- Investment: High
- Operating Cost: High
- Space Utilization: Above Average
- Stackability: Excellent
- Flexibility: Moderate

Moving easily-stacked materials + Using building height
A Case Study
A Case Study

Let's look at a kitchen cabinet producer that has revamped its entire process to improve its ability to serve its customers.

The original plant (graphic 1) was equipped with high volume machinery (graphics 2 and 3) that required the storage of thousands of parts ahead of the assembly line.

Their ability to expand their product line was restrained by the lack of space to store these unsold parts.
Original Plant

1. MAIN MACHINING

PARTS STORAGE

CABINET ASSEMBLY

WAREHOUSE

SUPPLIES & PACKING
2. High-Volume Panel Saw
High-Volume Edge Banders
Initial Expansion

Customers demanded a wider variety of products. In response the company added wood doors/drawer fronts and accessories such as mouldings, shelving, and wine racks.

Graphic 4 shows additions of:

- A small finishing room to stain and lacquer wood doors and other wood components
- A small accessories department

Cabinet parts continued to be machined on the high volume machinery.
Initial Expansion/Re-Layout

4.

MAIN MACHINING

PARTS STORAGE

ACCESSORIES

WARE-HOUSE

CABINET ASSEMBLY

SUPPLIES & PACKING

FINISHING
Second Re-Layout

The market continued demanding more cabinet configurations and cabinet colors. The company decided to convert space used for parts storage to production by making parts to order.

Graphic 5 shows the necessary layout changes.

Graphics 6, 7, and 8 show examples of fast set-up machinery that enabled manufacturing lot sizes of one. These machines were linked to the company’s computer system to provide real time information to the operators.
Second Re-Layout

5.

FINISHING

PARTS STORAGE

MAIN MACHINING

SPECIAL PARTS MACHINING

ACCESSORIES

CABINET ASSEMBLY

SUPPLIES & PACKING

RAW MATERIALS

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6. **Single Beam Panel Saw**

**Information Interface**
7.

Return Conveyor

Single Sided Edge Bander
CNC Drill

Information Interface
The final step will be the installation of a highly flexible strip processing line that will enable just-in-time production of cabinet parts. This line will eliminate the GREY parts storage areas shown in graphics 1, 4, and 5.

The space released from parts storage will also be redeployed for expanded cabinet assembly.

Graphic 9 shows these changes.
Final Re-Layout

9.

MAIN MACHINING

SPECIAL PARTS MACHINING

ACCESSORY ASSEMBLY

CABINET ASSEMBLY

SUPPLIES & PACKING

RAW MATERIALS

FINISHING
Re-Layout Benefits

☑ Expanded Product Offering - The original product line of 2,270 SKUs was expanded to over 1.5 million.

☑ Faster Delivery - Time from order to delivery is now averaging three weeks.

☑ Higher Productivity

  > $220,000+ per man

  > $250+ per square foot
The End Result

Good analysis and planning result in a great layout...
For more information on improving your plant layout contact...

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