III. DATA ANALYSIS AND BASIC PLANNING

By
Rakesh Nagi
Department of Industrial Engineering
SUNY at Buffalo

0. INTRODUCTION

- After gathering data from engineering and management functions, data analysis and basic planning is performed:
  - Flow planning: of materials, people, equipment, documents...
  - Activity relationship analysis
  - Department, area, function, workstation, building, machine
  - Space planning

1. FLOW PLANNING

1.1 General flow patterns
- Straight-line flow (I-flow)
- Circular flow (U-flow, O-flow)
- Winding flow (S-flow)
- Vertical flow (in multi-story buildings)

1.2 Principles of flow planning
- Maximize directed flow
- Minimize frequencies of flow through work simplification
- Minimize cost of flow
- Combine flows and operations, e.g., Automobile assembly

1.3 Project layout: product is fixed, materials/machines are moved. For very large products.
  - e.g. Aircraft fuselage, ships, CNC machines
1. FLOW PLANNING

1.3  BASIC DEPARTMENTAL LAYOUTS
• Project layout: product is fixed, materials/machines are moved. For very large products.
  e.g. Aircraft fuselage, ships, CNC machines

1.3  BASIC DEPARTMENTAL LAYOUTS
• Product layout: product line departments, flow shop. For standardized products with large & stable demand.
  e.g. Car engines, VCRs

1.3  BASIC DEPARTMENTAL LAYOUTS
• Group layout: group technology / cellular manufacturing. Parts can be divided into part families, rotational, prismatic
  e.g. Couplings, Gears

1.3  BASIC DEPARTMENTAL LAYOUTS
• Process layout: layout of resources by function, job-shop. Small to medium-sized metal cutting industry.
  e.g. Lathe, milling, drilling, welding.
1. FLOW PLANNING

1.3 BASIC DEPARTMENTAL LAYOUTS

- Process layout: layout of resources by function, job-shop. Small to medium-sized metal cutting industry. e.g. Lathe, milling, drilling, welding.

1.4 GROUP TECHNOLOGY

"A manufacturing philosophy that identifies and exploits the similarity of parts and processes in design and manufacture."

- Based on part families and manufacturing cells
- Applicable in batch manufacturing - medium sized lots.
- Advantages:
  - Shorter production time & less WIP
  - Better production planning and control - small cells
  - Reduced tooling and set-up, less NC programming
  - Easy retrieval of design & process planning - variant mode

1.5 Comparison of Layout Types

2. Activity Relationship Analysis

2.1 FLOW ANALYSIS -- FLOW X DISTANCE

<table>
<thead>
<tr>
<th>Product</th>
<th>Quantity</th>
<th>Load-size</th>
<th># Moves</th>
<th>Routing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30</td>
<td>3</td>
<td>10</td>
<td>A-C-B-D-E</td>
</tr>
<tr>
<td>2</td>
<td>12</td>
<td>2</td>
<td>6</td>
<td>A-B-D-E</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>1</td>
<td>1</td>
<td>A-C-D-B-E</td>
</tr>
</tbody>
</table>

* Distance

2.2 QUALITATIVE ANALYSIS

- Organizational relationships
  - Which function has more (less) organizational relationship with another
  - Reporting/cooperating relationships
- Control relationships
  - Centralized vs. Decentralized control; level of control
  - Frequency of review: continuous vs. Periodic
- Environmental relationships
  - Safety, health, noise, or temperature relationships
- Other relationships
  - Utility requirements
  - Process relationships
  - Foundation & floor requirements

2.3 ACTIVITY RELATIONSHIP CHART

Shows the closeness ratings and reasons for closeness requirements between activities.

Construction procedure
1) List all activities
2) Conduct interviews and surveys
3) Define criteria
4) Establish relationship chart
   - A: absolutely necessary
   - E: especially important
   - I: important
   - O: ordinary closeness
   - U: unimportant
   - X: undesirable
5) General review and discussion