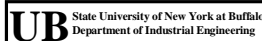


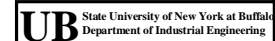
III. DATA ANALYSIS AND BASIC PLANNING

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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

- **Continuous flow:** chemical/process industry - crude oil in pipeline, food grains in food processing industry
- **Discrete flow:** manufacturing industry - job-shops, machine shops, auto industry.
- **Logistic systems:**
 - Materials management
 - Material flow systems
 - Physical distribution systems
- **Definition:** process of arranging activities in combinations of basic flow patters (based on flow analysis), both quantitative (from-to chart) and qualitative (activity relationship diagram).



1. FLOW PLANNING

HIERARCHICAL DECOMPOSITION

- Flow within a workstations
- Flow within a department (intra-cell)
- Flow between departments (inter-cell)

1.1 General flow patterns

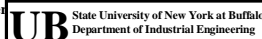
- Straight-line flow (I-flow)
- Circular flow (U-flow, O-flow)
- Winding flow (S-flow)
- Vertical flow (in multi-story buildings)



1. FLOW PLANNING

1.2 Principles of flow planning

- **Maximize directed flow**
 - Directed flow: uninterrupted flow, does not intersect others
 - No backtracking of material
- **Minimize frequencies of flow through work simplification**
 - Deliver directly to the point of use - eliminate waste
 - Plan appropriate unit of load, use pallets to min. Trips
 - Combine flows and operations, e.g., Automobile assembly
- **Minimize cost of flow**
 - Reduce travel distance
 - Mechanize or automate transfer



1. FLOW PLANNING

1.3 BASIC DEPARTMENTAL LAYOUTS

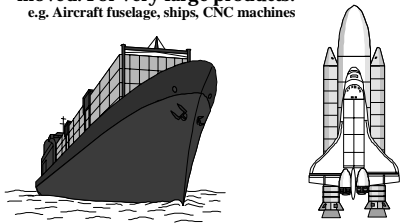
- **Project layout:** product is fixed, materials/machines are moved. For very large products.
e.g. Aircraft fuselage, ships, CNC machines



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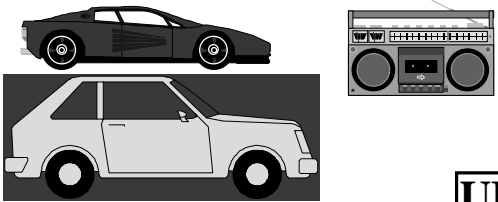
- **Product layout:** product line departments, flow shop. For standardized products with large & stable demand.
e.g. Car engines, VCRs

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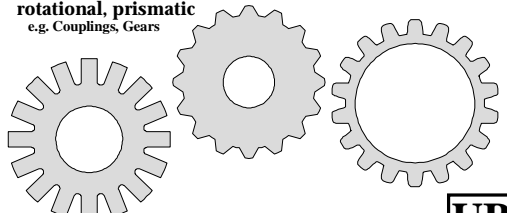
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e.g. Couplings, Gears

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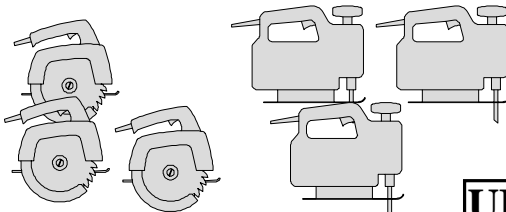
- **Process layout:** layout of resources by function, job-shop. Small to medium-sized metal cutting industry.
e.g. Lathe, milling, drilling, welding,

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1. FLOW PLANNING

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

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1.5 Comparison of Layout Types

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2. Activity Relationship Analysis

2.1 FLOW ANALYSIS -- FLOW X DISTANCE

- Frequency - from-to chart (# of material movements)

Product	Quantity	Load-size	# Moves	Routing
1	30	3	10	A-C-B-D-E
2	12	2	6	A-B-D-E
3	7	1	1	A-C-D-B-E

- Distance

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2. Activity Relationship Analysis

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

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2. Activity Relationship Analysis

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

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