REPUBLIC POLYTECHNIC

Problem 03
Layout Designing

SCHOOL OF ENGINEERING

Layout Decisions

- The need for layout decisions:
  - Support new product or service introduction
  - Support change in the design of products or services
  - Remove inefficient operations, e.g. high-cost process
  - Remove hazards

- A good layout design is able to:
  - Support changes in volume of output or mix of products
  - Support changes in equipment or work methods
  - Address environmental, legal and other statutory requirements

Layout Decisions

- Factors to consider when deciding layout type:
  - Demand forecast
  - Types of issues
  - Floor area
  - Budget
  - Process requirement
  - System objectives
  - Needs to support future changes in demand/ variety

- Basic layout types:
  1. Fixed-position
  2. Product
  3. Process
  4. Cellular
  5. Mixed

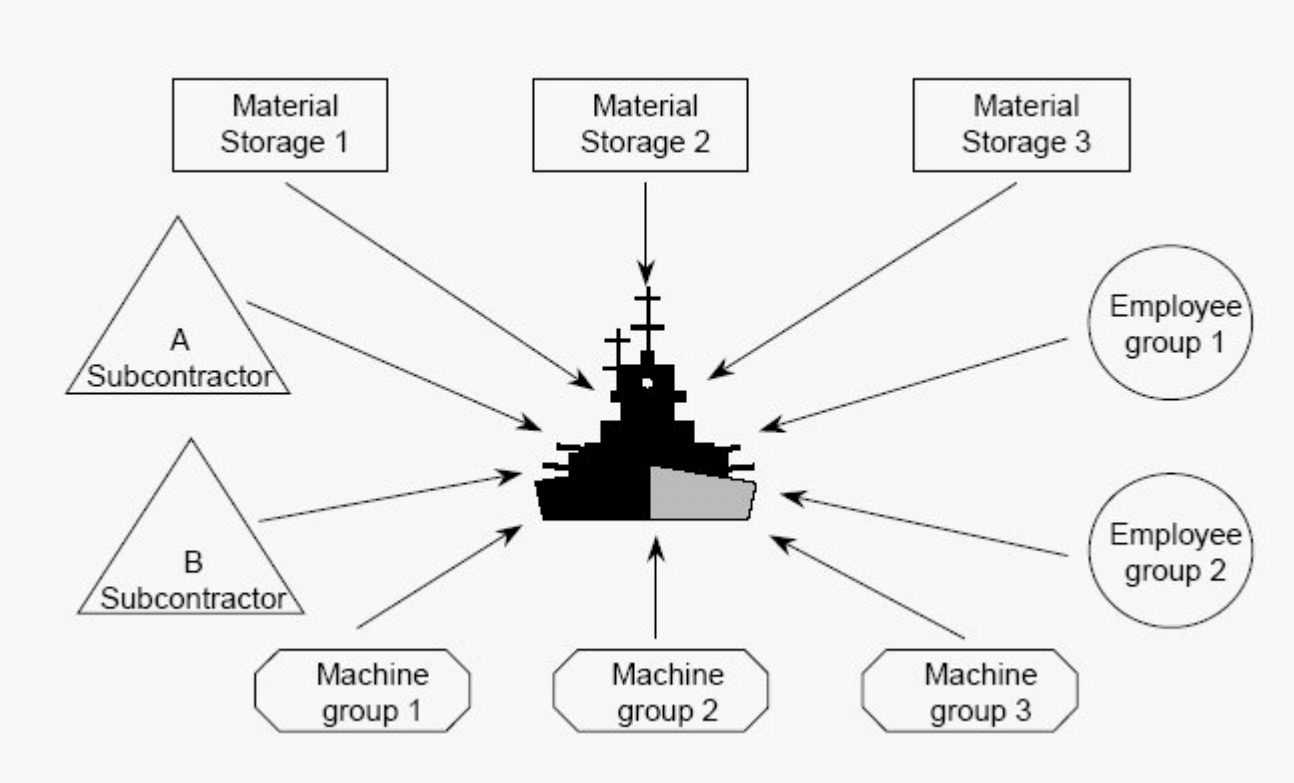
Basic Layout Types

1. Fixed-Position Layout

- Layout in which the product remains stationary and workers, materials and equipment are moved as and when needed
- Equipment and tooling costs are low compared to other layout types
- Not geared for high-production quantities
- Used when the product is bulky, heavy or fragile
- High degree of product customization can be achieved
- Minimizes the amount of product movement
- Examples: Ship building
  Aircraft assembly

Basic Layout Types

An example of Fixed-position layout: Ship building



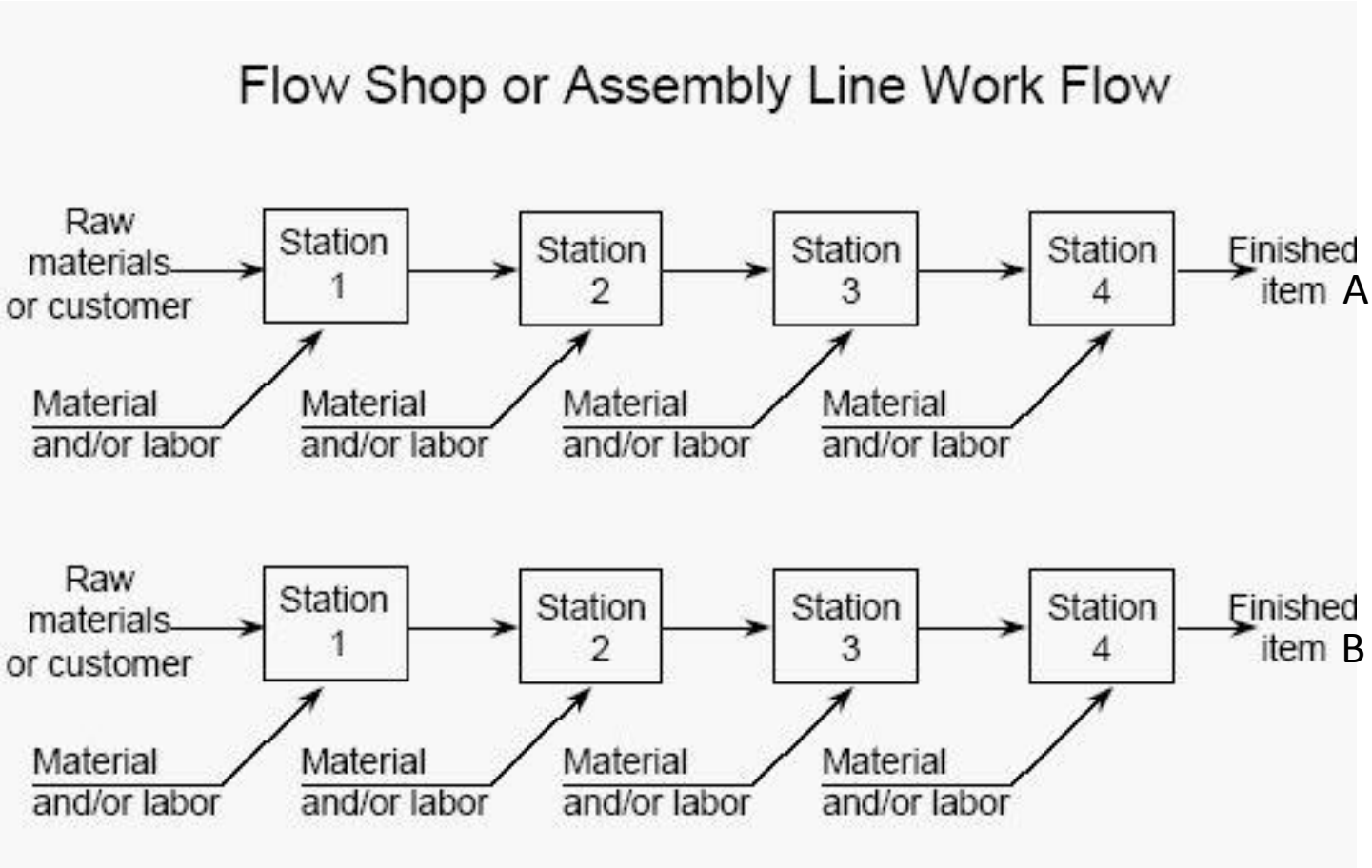
Basic Layout Types

2. Product Layout

- Layout that uses standardized processing operations to achieve smooth, rapid, high-volume flow
- Equipment and tooling costs are generally higher
- High levels of labor and equipment utilization can be achieved
- Requires balance of time between operations: i.e. line balancing
- Provides opportunities for process automation
- Can achieve low production cost per unit
- Examples: Domestic appliance manufacture
  Chemical plating

Basic Layout Types

An example of Product layout: Product Assembly Line



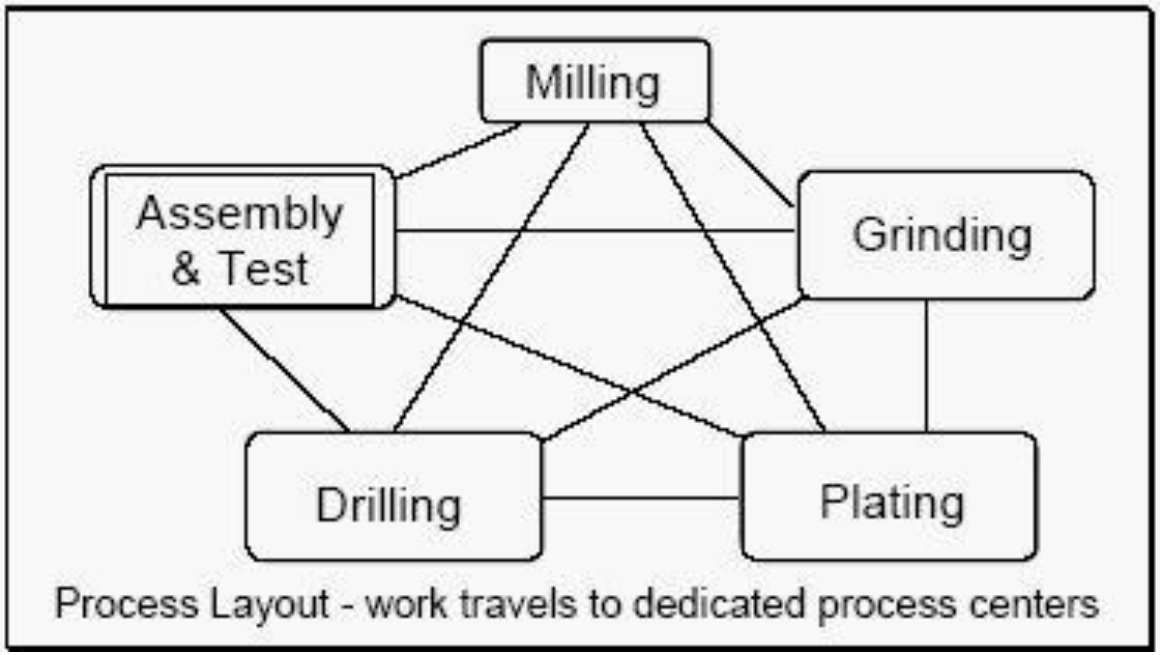
Basic Layout Types

3. Process Layout

- For producing a fairly large number of similar products (in batches)
- Consists of several well-defined operations
- Equipment and tools are less costly than those in product-layouts
- High degree of labor specialization by process
- Equipment breakdown can be easily managed due to multiple machines
- Frequent set-up of machines to handle product (batch) changes
- Examples: Components machining
  Semiconductor chip assembly

Basic Layout Types

An example of Process layout: Components machining



Basic Layout Types

4. Cellular Layout

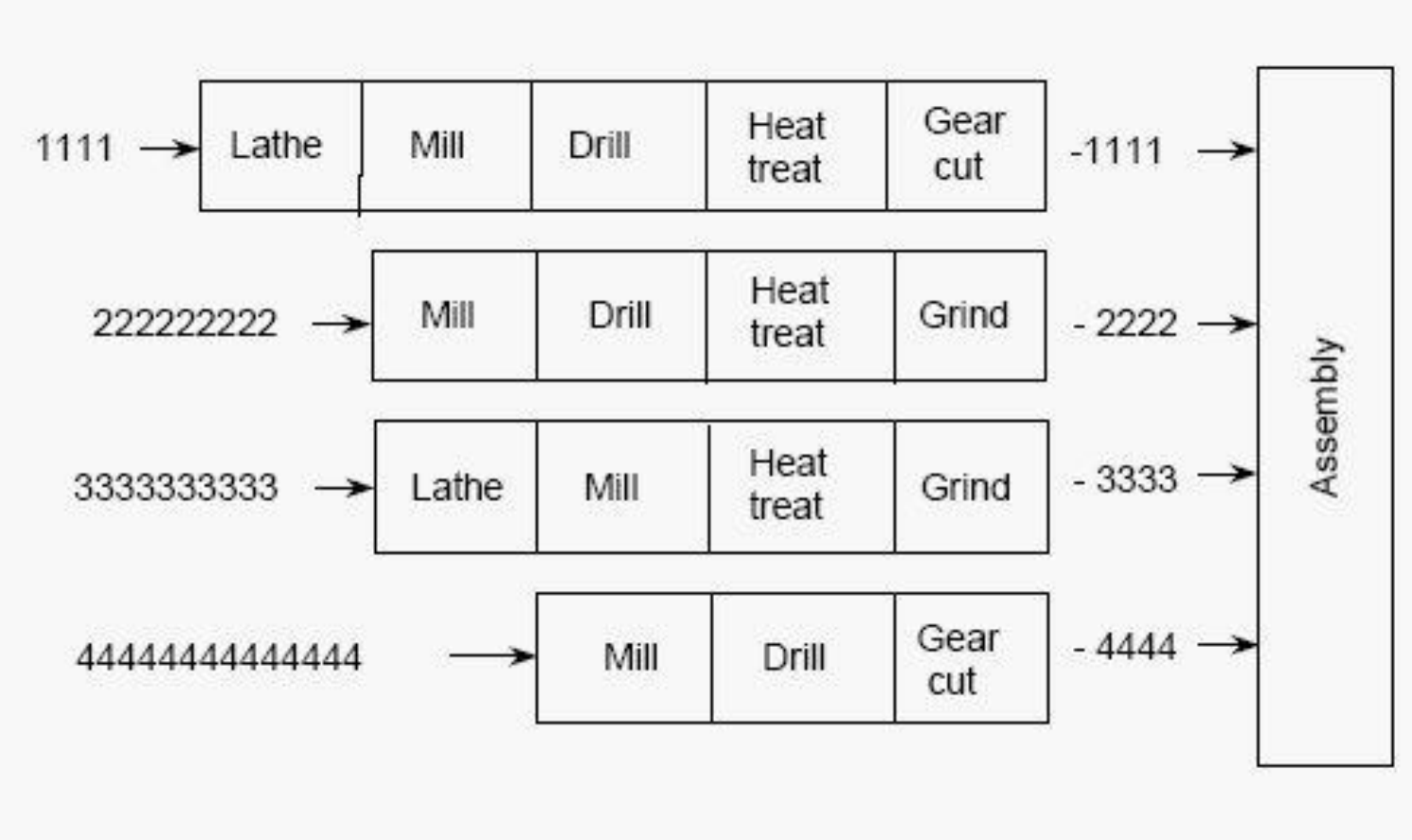
- Layout in which machines are grouped into a cell that can handle items with similar processing requirements
- Grouping into part families of items with similar design or manufacturing characteristics is called group technology
- Group technology helps in achieving process standardization when processing large quantities of different components
- Examples: Domestic appliance manufacture
  Machine component manufacture

5. Mixed Layout

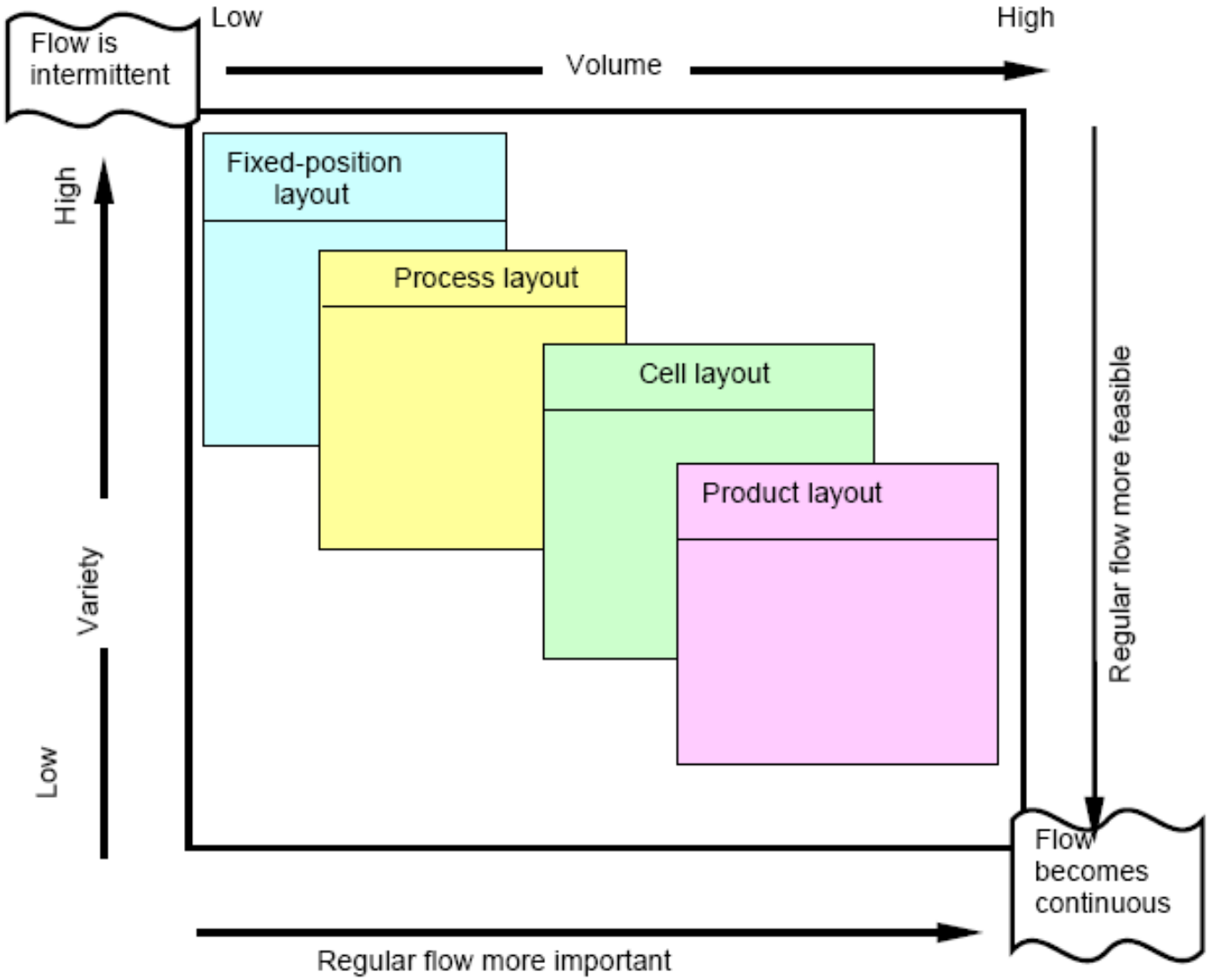
- A combination of product, process and/or cellular layouts across the entire product manufacturing flow

Basic Layout Types

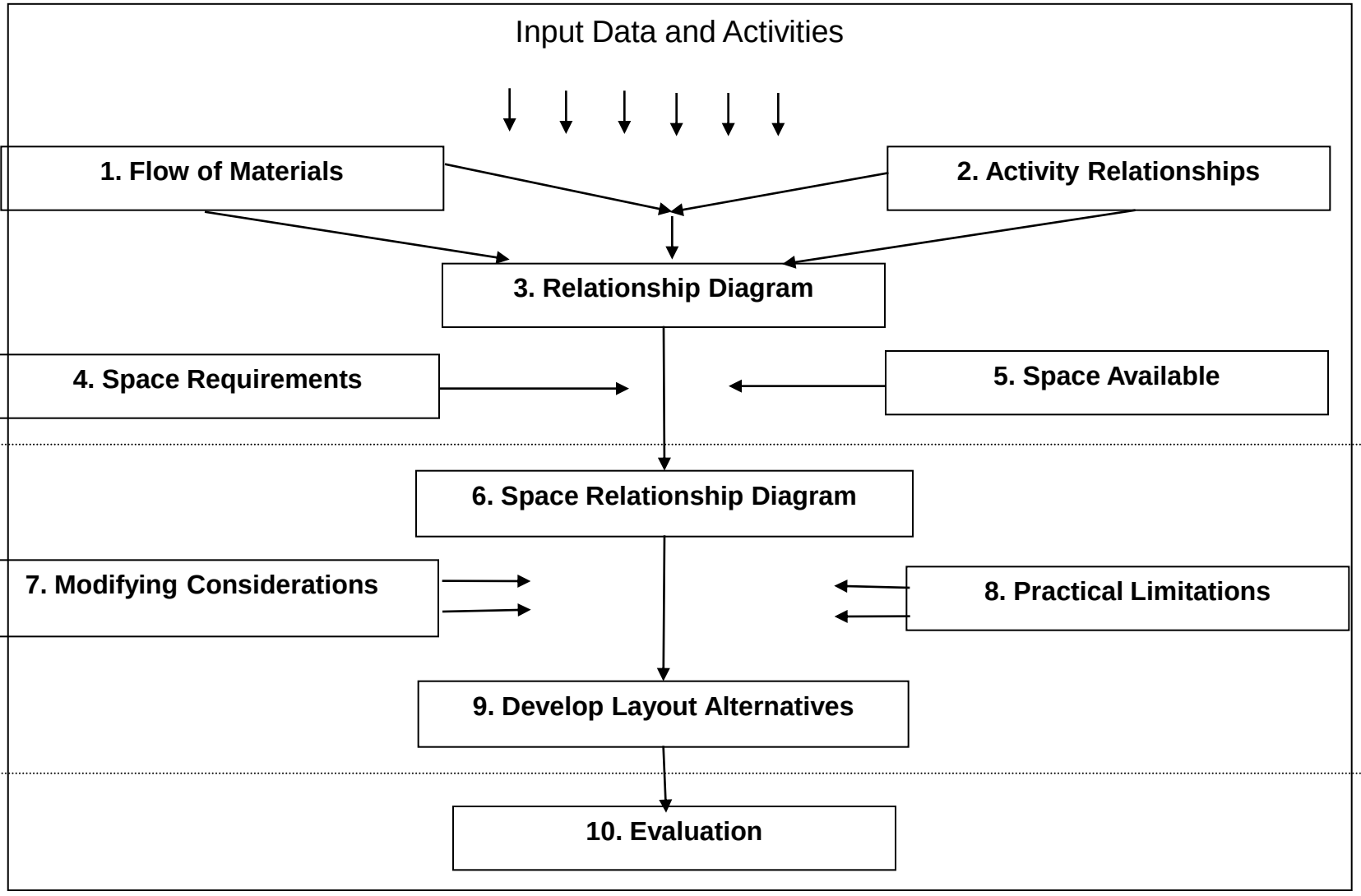
An example of Cellular layout: Machine components manufacture



Layout Types



Systematic Layout Planning (Muther's)



P03 Sample Solution

Problem Objectives

- Analyze a product and determine the process flow in manufacturing of the product
- Identify different types of layout and explain what is the advantages and disadvantages of each layout
- Select a suitable type of layout for the process
- Know the process of layout design

Sample Solution

- Some essential questions for Jenny

  - How is the forecasted demand trend?
  - Are product customization required?
  - Can the kitchen area take up a big space?
  - How much fund is allocated for setting up the shop?
  - Is there any preference for manual handwork over machine task?

Sample Solution

- Assumptions when recommending layout type to use

  - Medium level of volume forecast for different types of sandwiches
  - Forecasted volume are steady and expected to sustain.
  - Minor product customization (medium level of varieties).
  - Budget constraint on equipment purchase.
  - There is no preference for manual handwork over machine task.
  - Regular flow of the whole kitchen is medium, as bread-baking, salad and ham preparations mainly happen during preparation before Jenny’s sandwich shop opens.

Sample Solution

- A suitable kitchen layout for Jenny

  - A process-layout as some cooking methods share the same processes and equipment
  - Limited kitchen area to set up individual lines for each type of food
  - Utilization of the kitchen equipment is better
  - Can cater to some level of customization
  - Repeat orders may not be processed consecutively as the same equipment is being used to process other food

Developing the layout

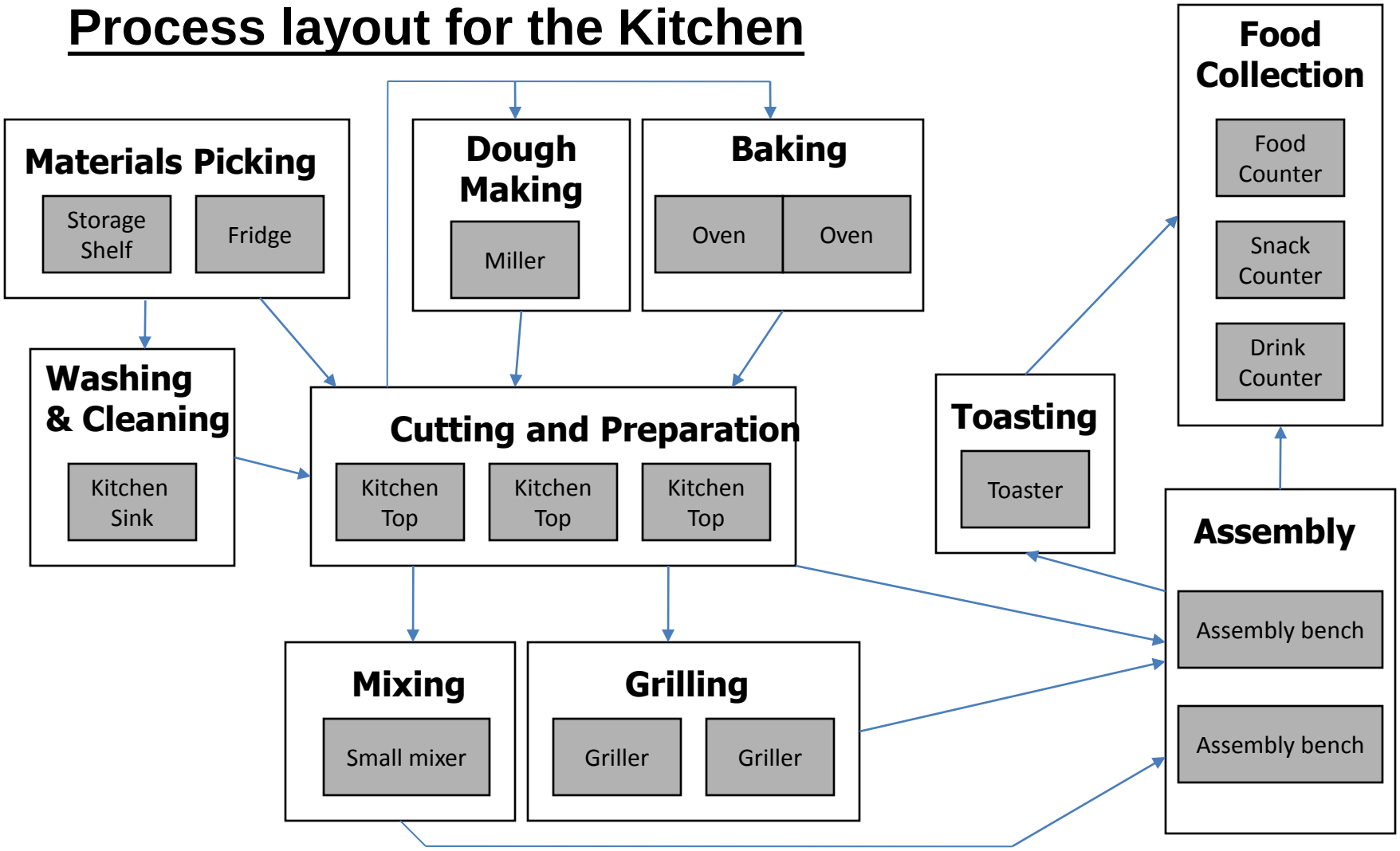
- In process layout, it is important to reduce the flow of materials in the facility
  - 2 departments with high flow between them should be situated close together

It is therefore necessary to know the material flow and activity relationship between departments

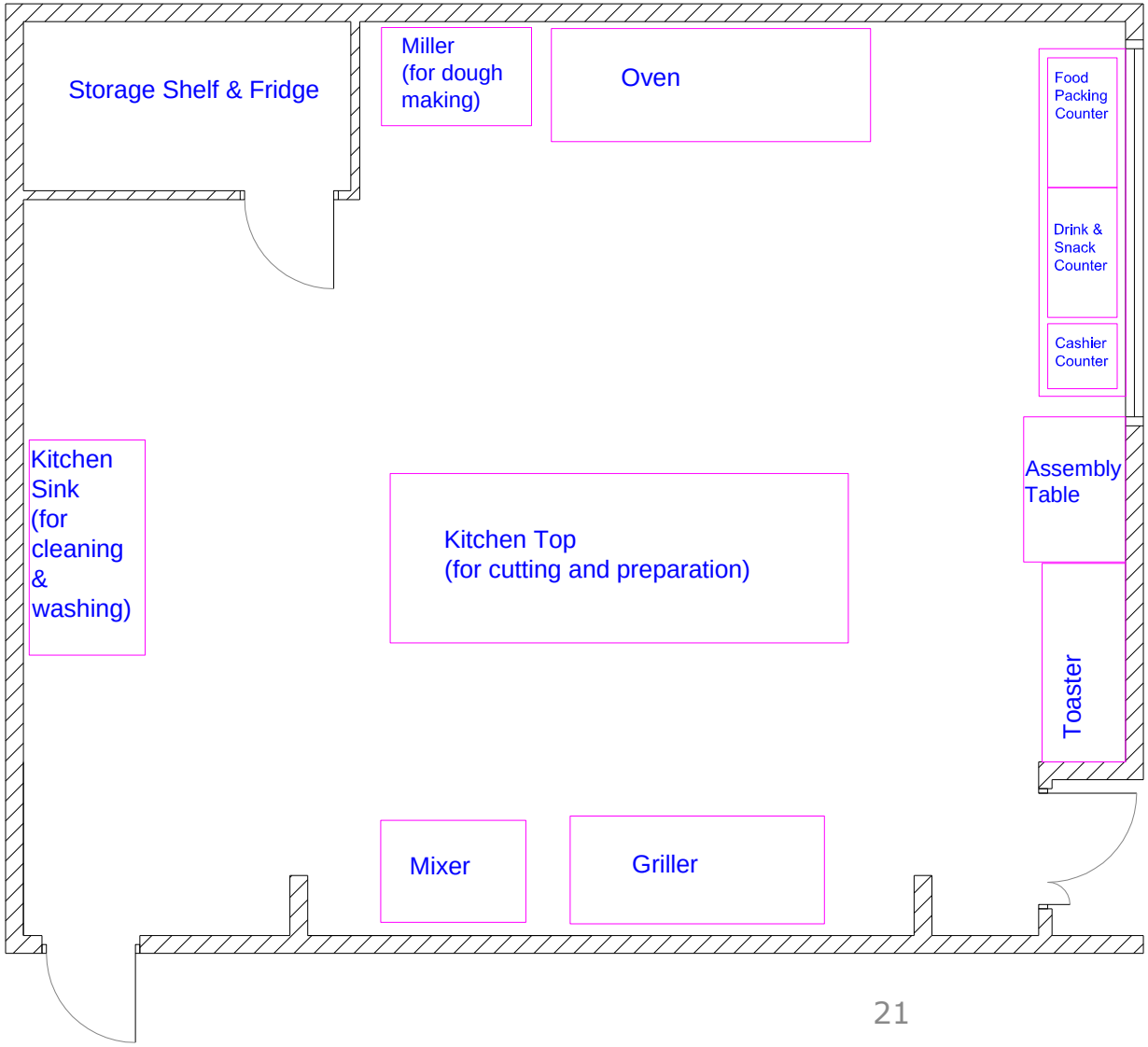
- The space required for each department have to be ascertained based on:
  - Equipment (Number of equipment required has to be worked out)
  - Aisle space
  - Maintenance/ servicing space
- A space relationship diagram can then be developed and detailed layout of equipment done upon considering practical limitations and other modifying considerations
  - Various alternatives can be generated before the best one is chosen

Sample Solution

Process layout for the Kitchen



Suggested Jenny's Kitchen Layout



Learning Objectives

- Identify different types of layout and explain the advantages and disadvantages of each layout
- Select a suitable type of layout based on the type of process required in the facility
- Apply the procedures of layout design
- Application of AutoCAD