Lecture #21

ERDM

Prof. John W. Sutherland

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Last Couple of Classes

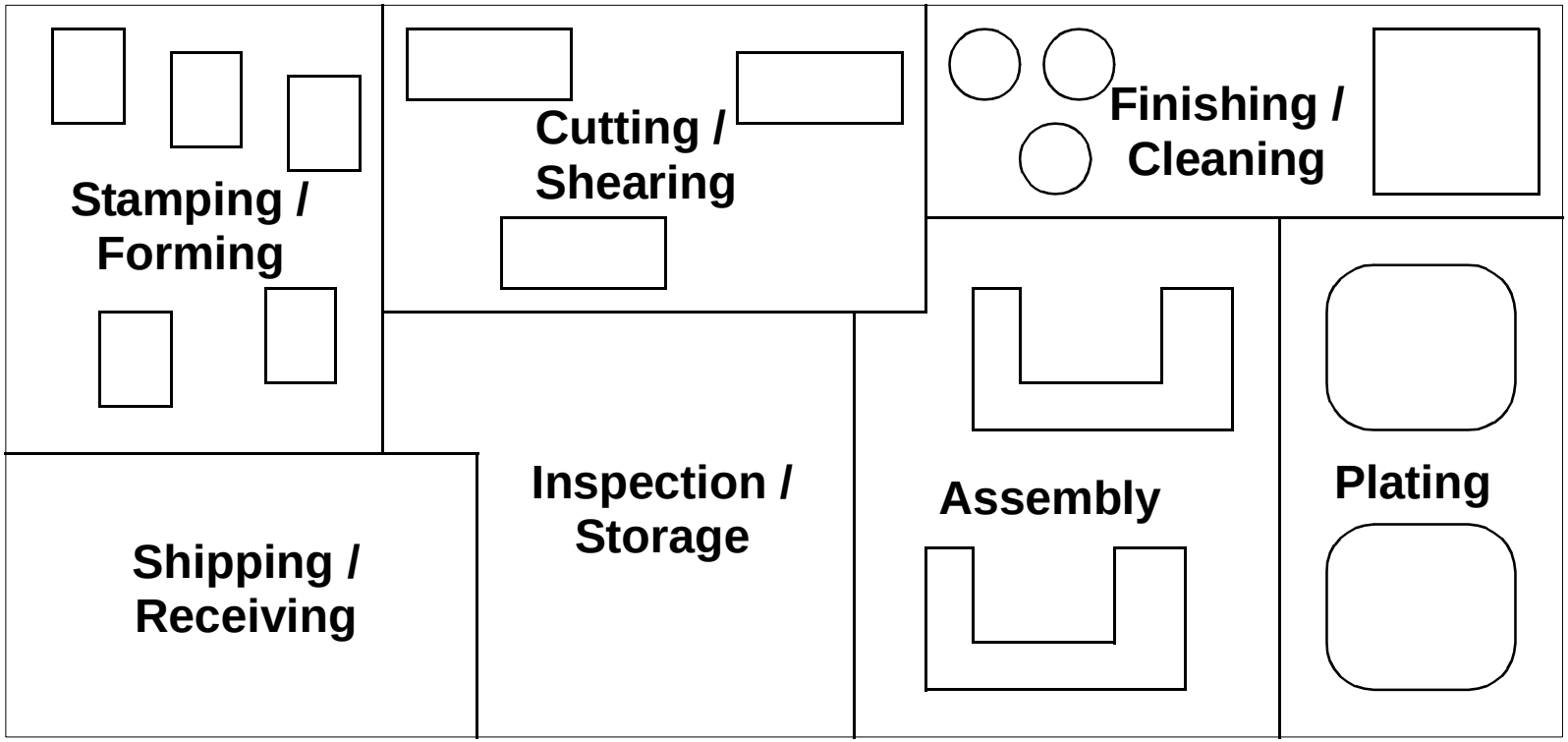
We've focused on disassembly. Specifically, we've looked at product configuration, fastening systems, and the disassmbly operation itself. Why?

- **Recycling recovery efficiencies may be improved if part sorting has been performed.**
- **Remanufacturing or value recovery systems require parts in their "as disassembled" form.**
- **Maintenance**

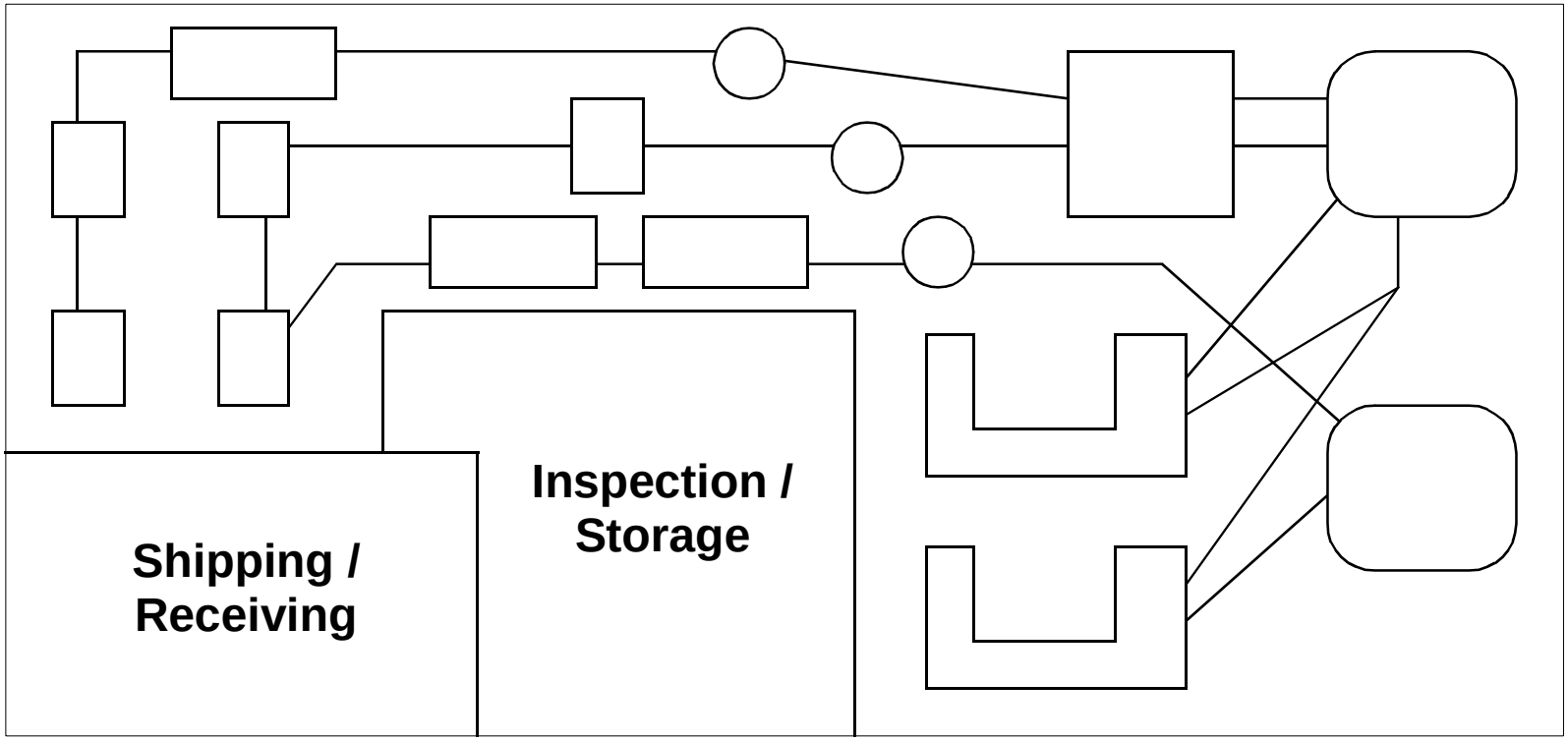
Let's envision a situation where a company plans to receive used products. The intent is to recover maximum value from these products.

Manufacturing System Layouts

- **Functional Layout**

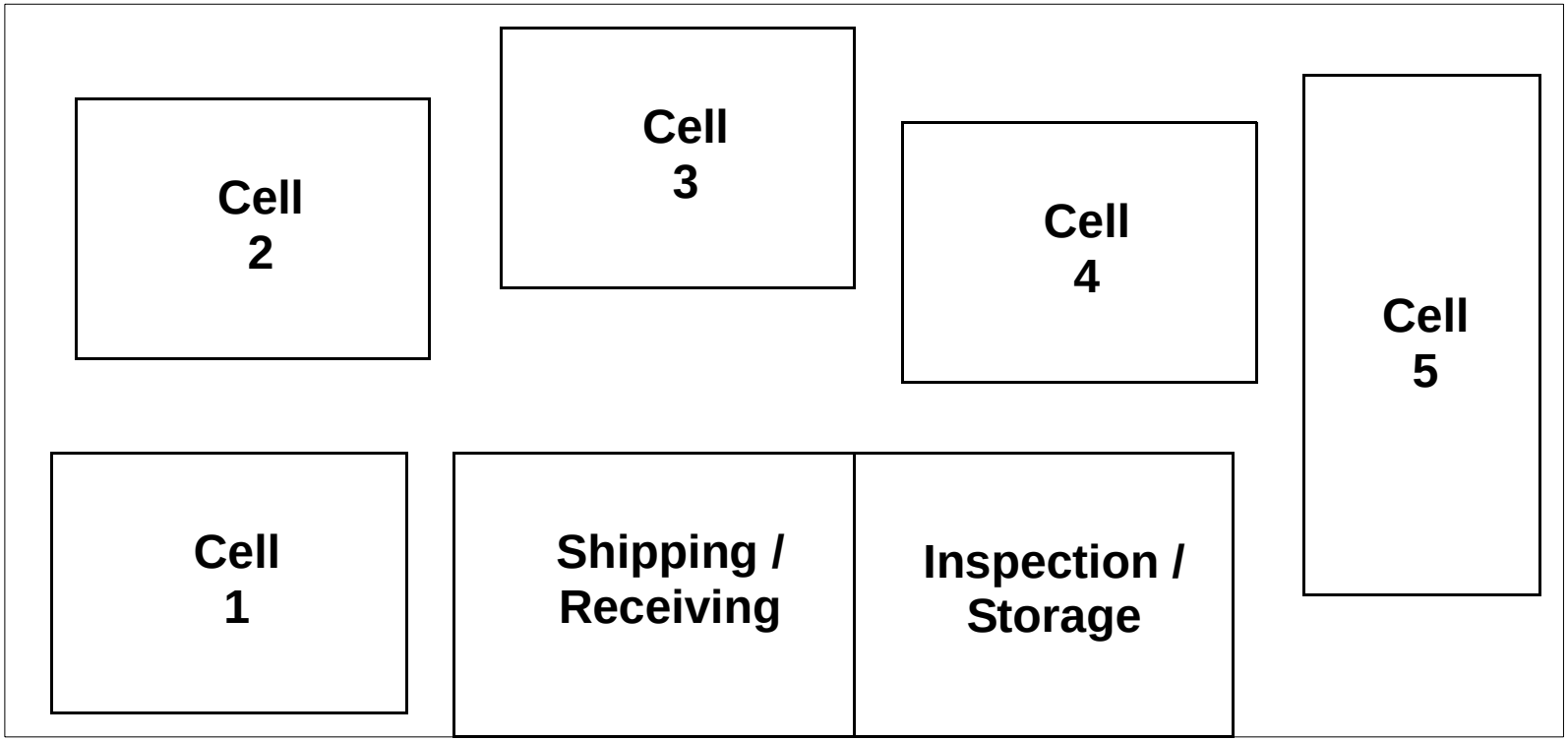


- **Line Layout**



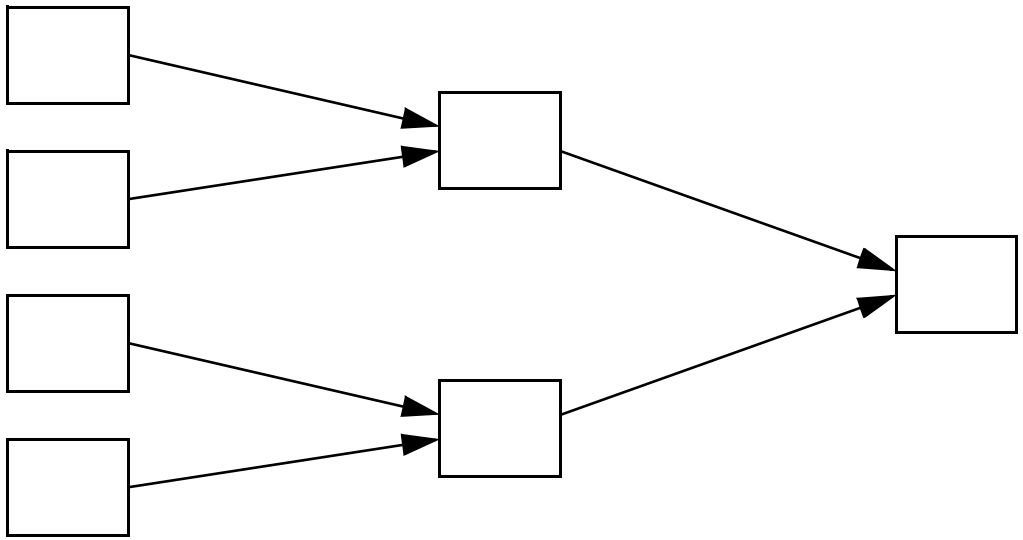
- **Layout problems -- address with IE techniques**

- **Group Layout**



Use group technology coding system to define cells

Part Flow - Assembly

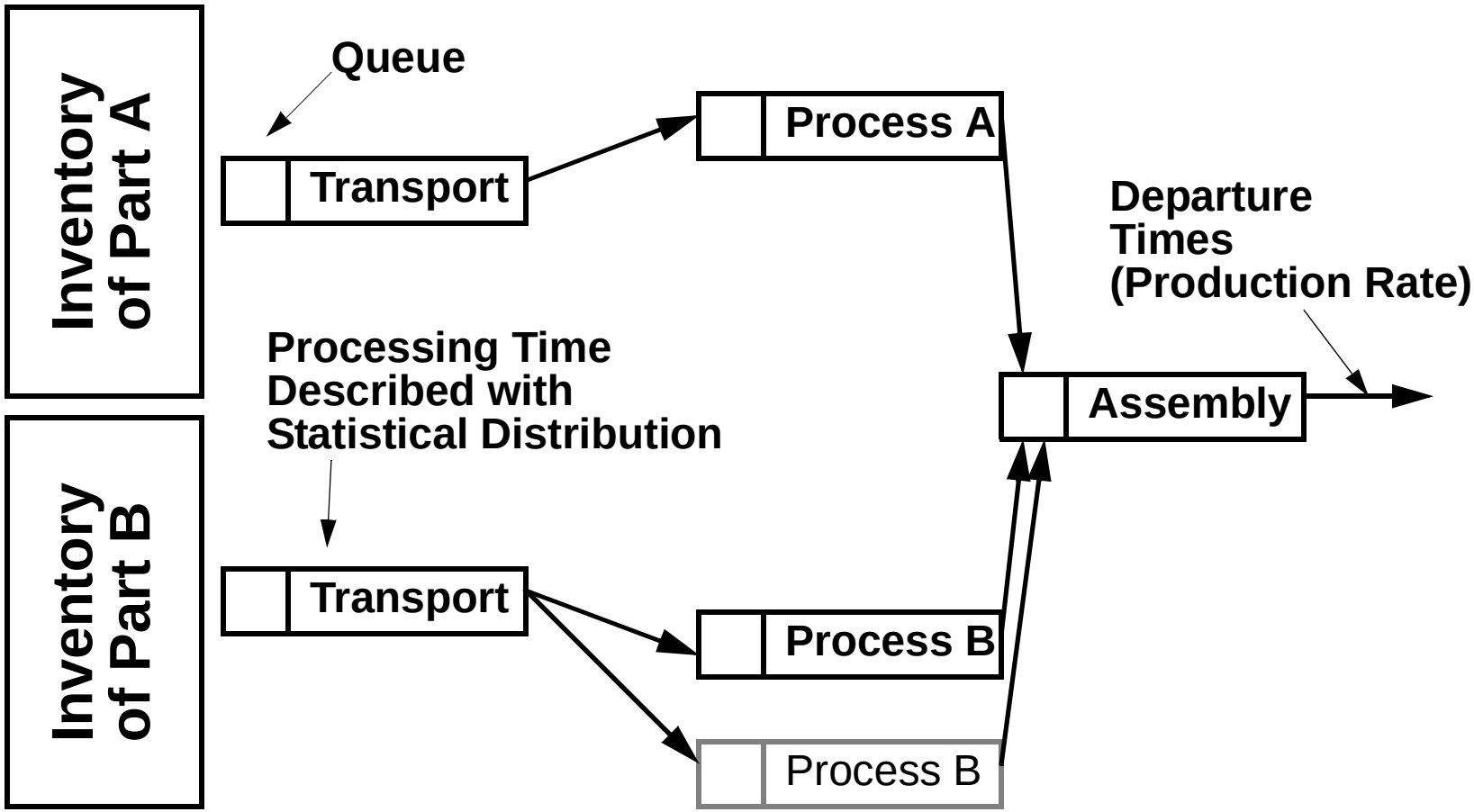


Manufacturing system is focused on taking individual parts and combining them to produce a product

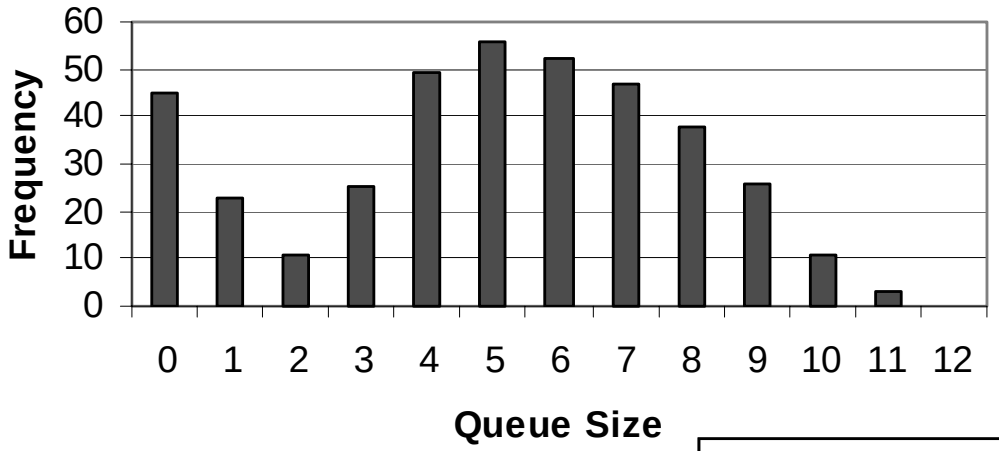
Assembly Systems

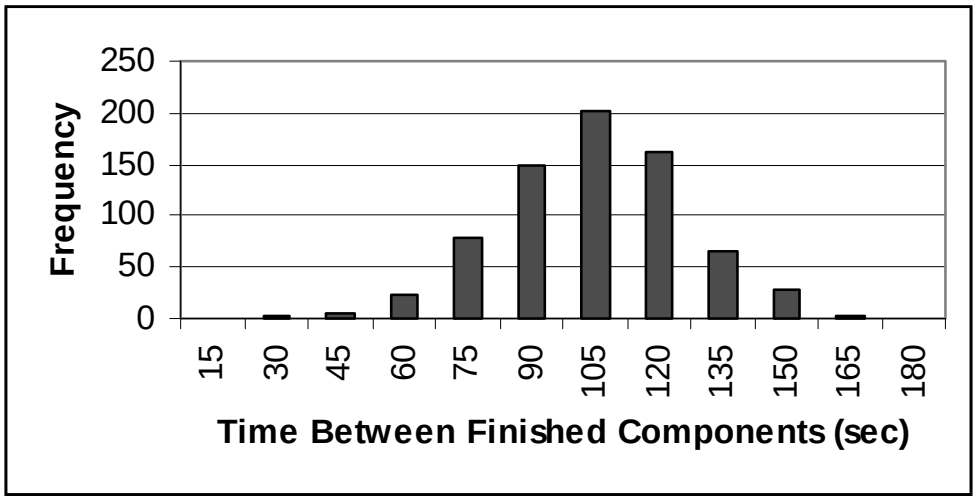
- **Discrete event simulation often used for system design. How many stations, work handling devices, in-process storage??**
- **Generally, assembly plan is fixed.**
- **Parts are clean & undamaged. Part-to-part variation is relatively small. Parts are interchangeable.**
- **Want to minimize work in process, and inventory in general. 1-Build assemblies to order. 2-Forecast demand & build as needed. 3-Build and store.**

Modeling Assembly Systems



Representative Output





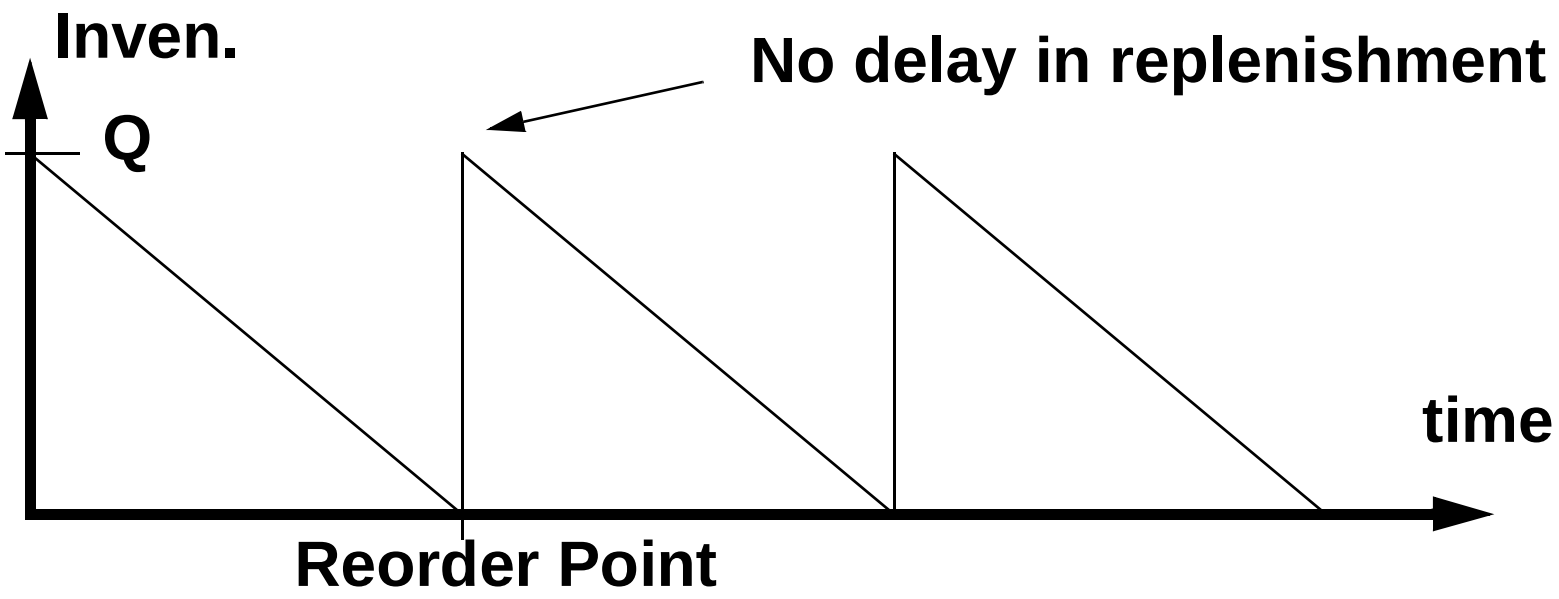
Inventory

- **As noted, want to keep inventory small -- minimizes capital investment.**
- **Purchasing parts -- transaction cost + variable cost.**
- **Parts stored in inventory incur a holding cost.**
- **Common problem how often should we be replenishing our inventory? Use R parts per year**

Annual Purch. Cost = R/Q (C_0 + C_1*Q) (Q is amt ordered)

Annual Inventory Cost = Avg # inventoried parts * $/part

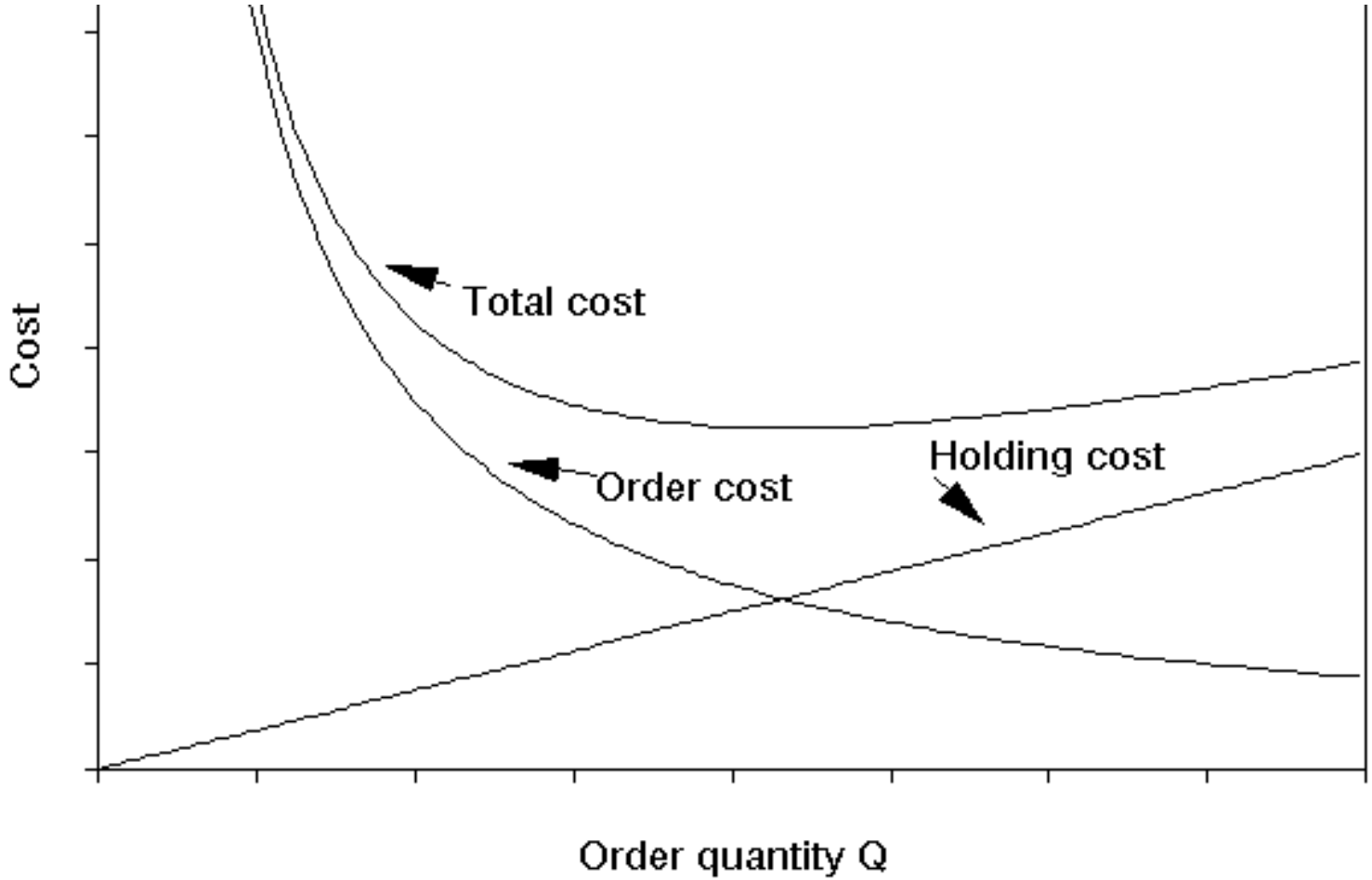
Inventory



$$\text{Total Cost} = R*(C_0/Q + C_1) + Q/2*H$$

$$Q^2 = 2RC_0/H \qquad \text{or} \qquad Q = \text{sqrt}(2RC_0/H) = EOQ$$

Cost Function Behavior



Material Handling & Distribution Networks

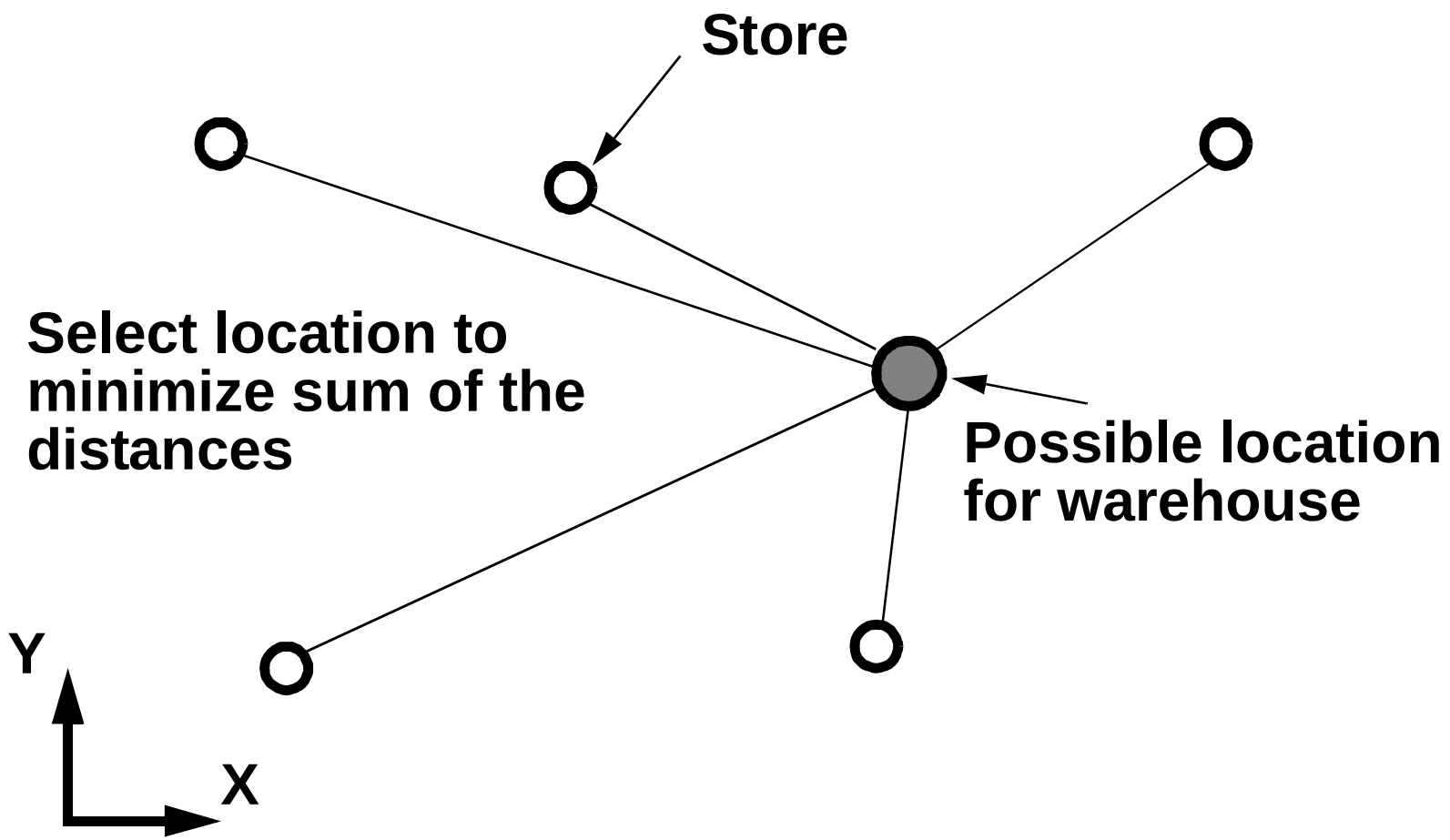
- **Need to have devices/people/equipment to move parts from A to B (AGV's, cranes, lift-trucks, etc.)**
- **Packaging operations group products together for shipping (palletized, shink-wrap, boxed, etc.)**
- **Groups of products to be shipped are accumulated, and then distributed (truck, train, plane, etc.)**
- **Products may go directly to distributor/retailer, or may be stored in a warehouse until needed.**

Modeling: Warehouse & Distribution Problems

- **Where do we locate the warehouses?**
  For example, I have 5 stores, where should I put my warehouse??

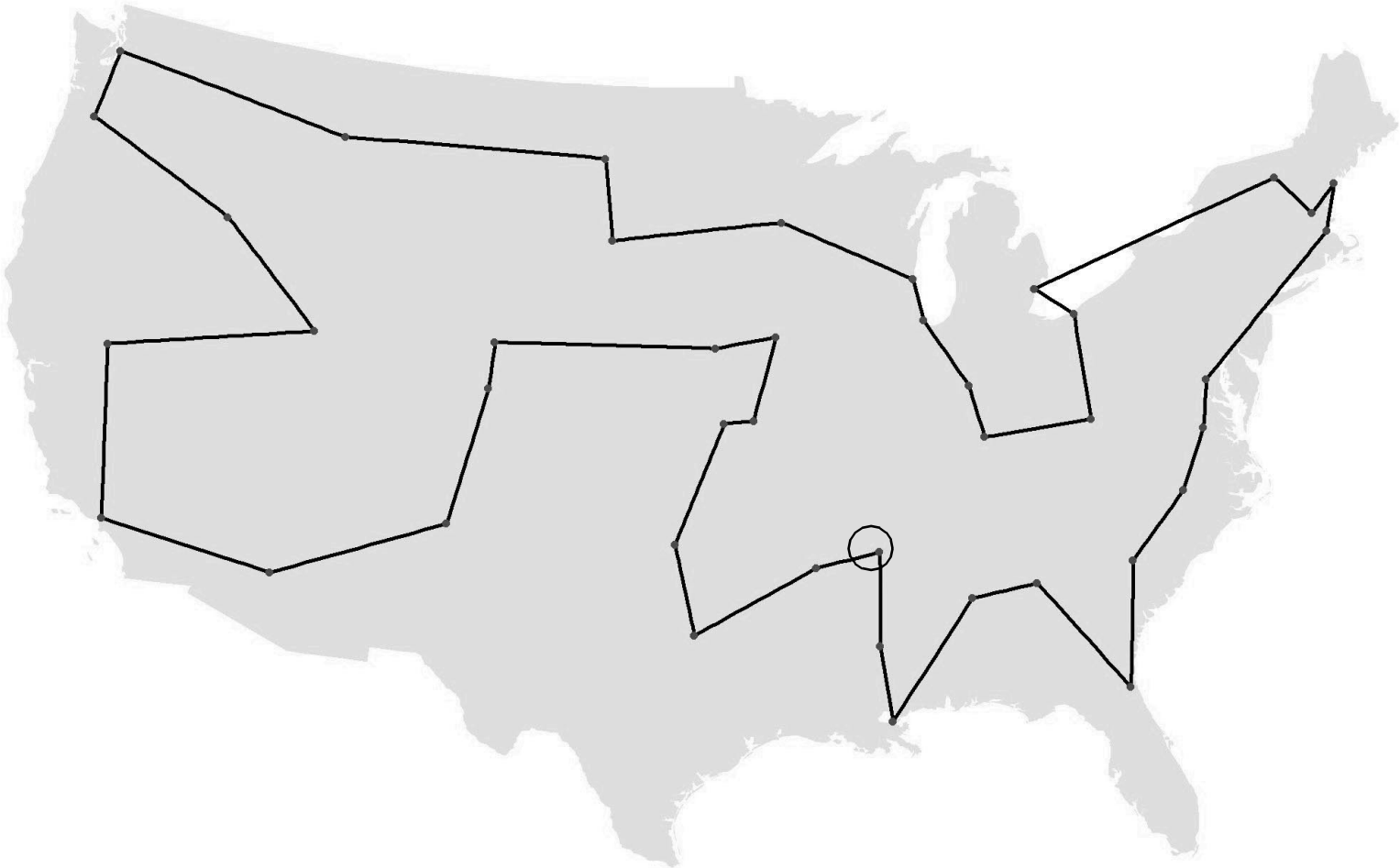
- **How do we minimize distribution cost?**
  What is the best route for trucks to take in distributing our products - Traveling Salesman problem

Warehouse Location



Travelling Salesman Problem

(path to be taken to distribute our products)

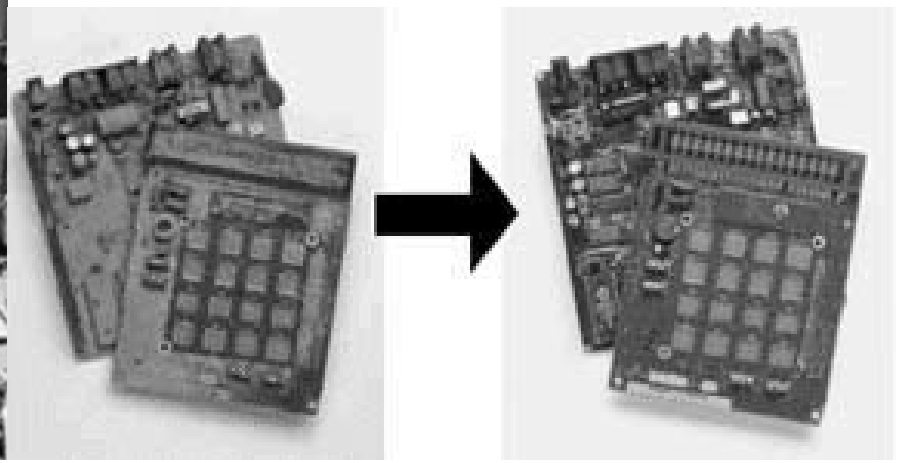


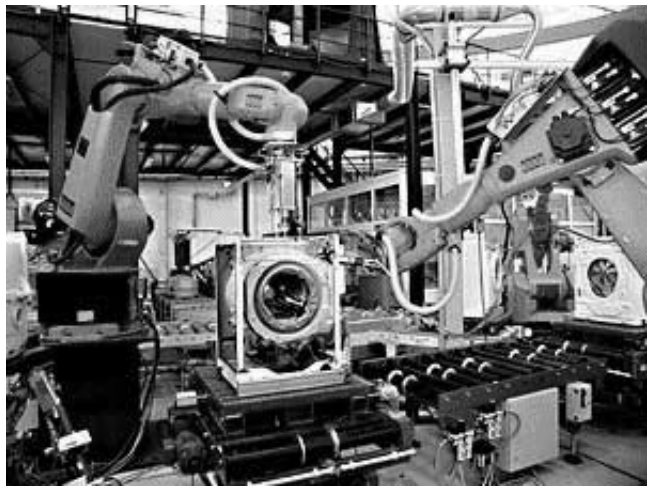
Collection Systems

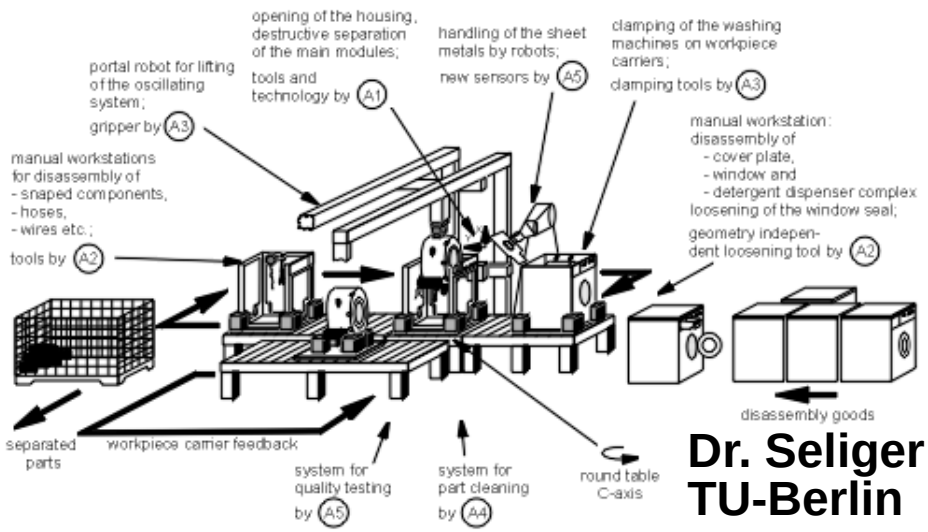
- **Situations:**
  - **Recycling Centers -- where to locate them? -- reverse warehouse problem.**
  - **Recycling Trucks -- what path should they take? Travelling Salesman Problem**
  - **Recovery of takeback products -- collection centers & transportation**

- **Can existing distribution systems be used for takeback? -- Logistical systems used for reverse logistics?**

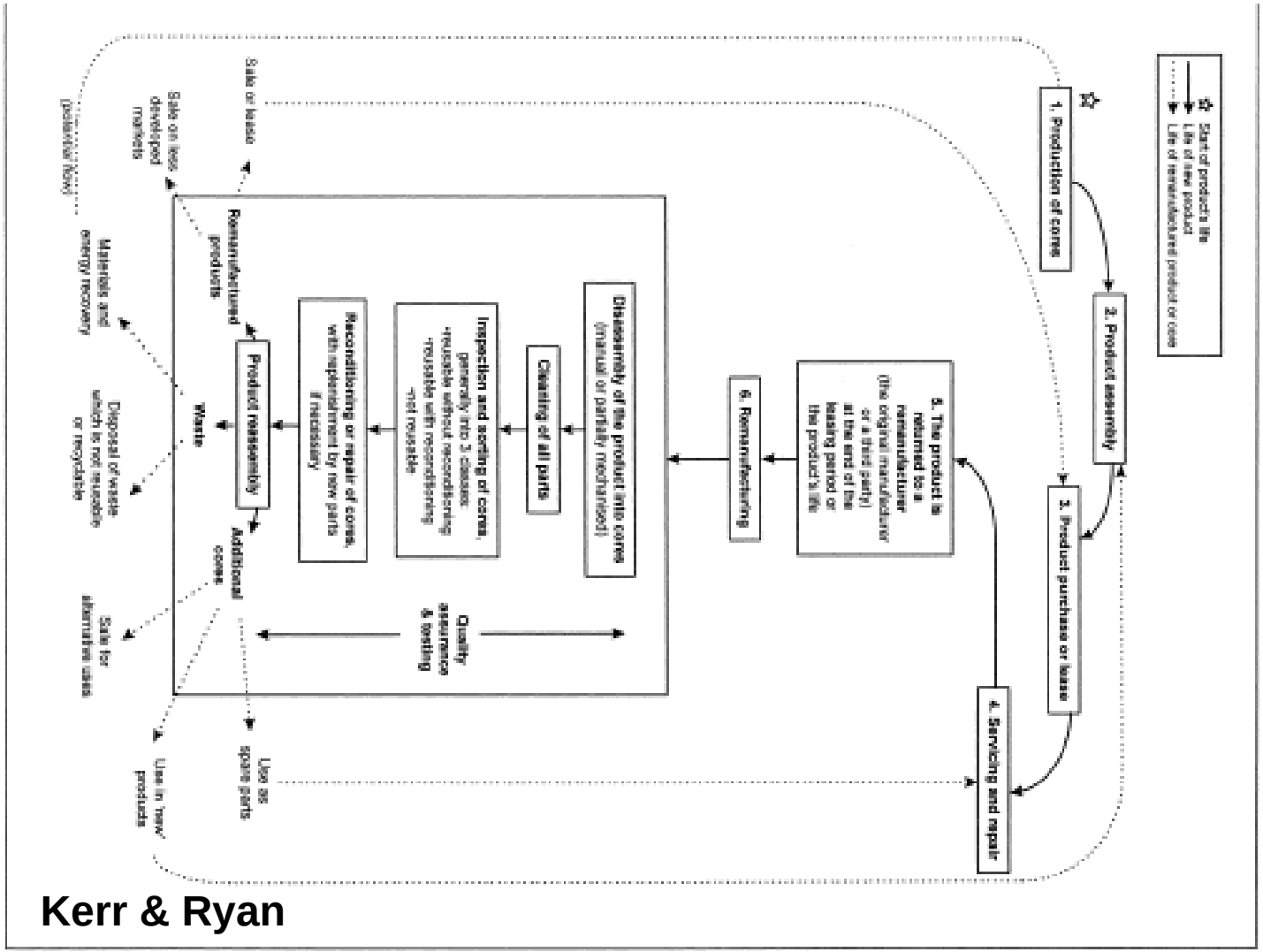
Demanufacturing Systems







Dr. Seliger
TU-Berlin



Kerr & Ryan