Lecture #24

ERDM

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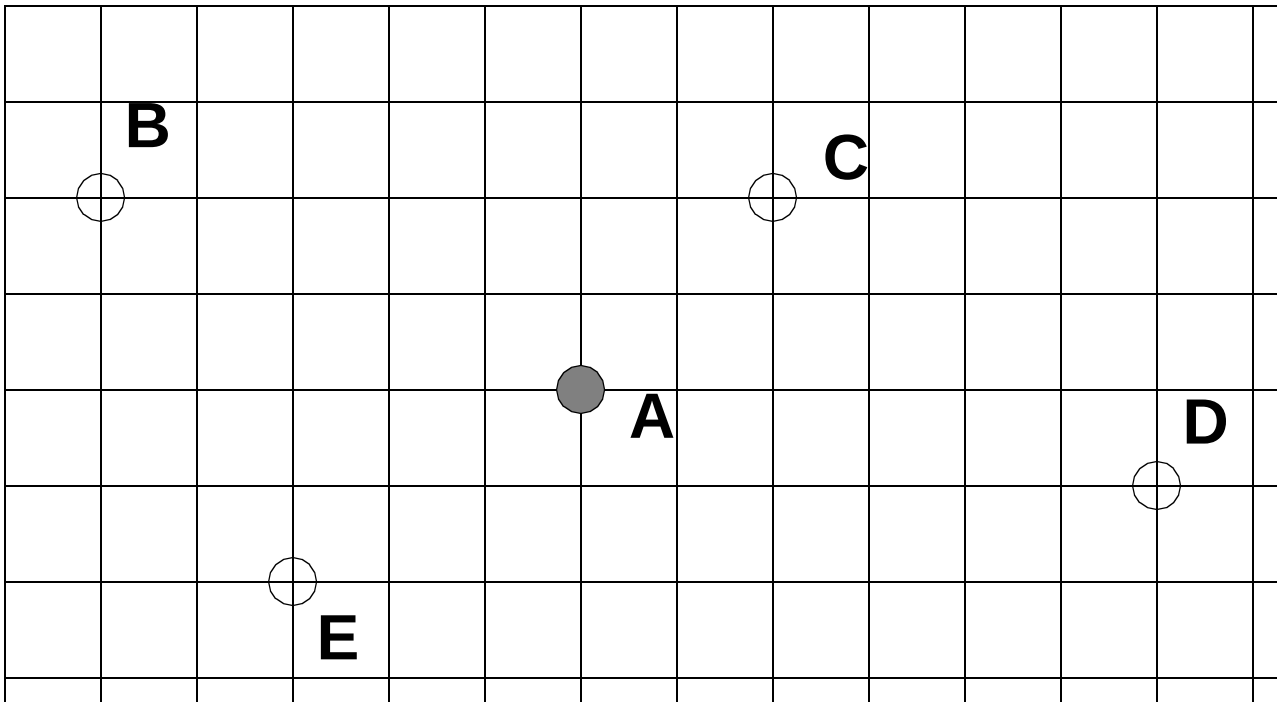
Route Selection

- **A truck is loaded with products at the warehouse. In what order should we stop at the stores?**



The Distance Matrix

Distance Matrix -- Matrix is symmetric

$$\begin{bmatrix} 0 & 5.4 & 2.8 & 6.1 & 3.6 \\ & 0 & 7 & 11.4 & 4.5 \\ & & 0 & 5 & 6.4 \\ & & & 0 & 9.1 \\ & & & & 0 \end{bmatrix}$$

Add labels!!

Branch & Bound Method

Start at A, assume a path from A-B-C-D-E-A

A-B: 5.4

B-C: 7

C-D: 5

D-E: 9.1

E-A: 3.6 or D-E-A: 12.7 (E is last node -- return to A)

Distance = 30.1 -- this serves as our upper bound.

Branch & Bound Solution

- **In our first branch, instead of going from C-D-E, consider C-E-D. Of course A-B-C is (12.4)**
  C-D is (6.4) & E-D-A is (15.2). Total is 34. Higher than our upper bound, so we don't wish to consider. Branch below C has been "fathomed".

- **Move up the branch to node B. Consider alternatives to B-C. How about B-D? B-D is (11.4)**

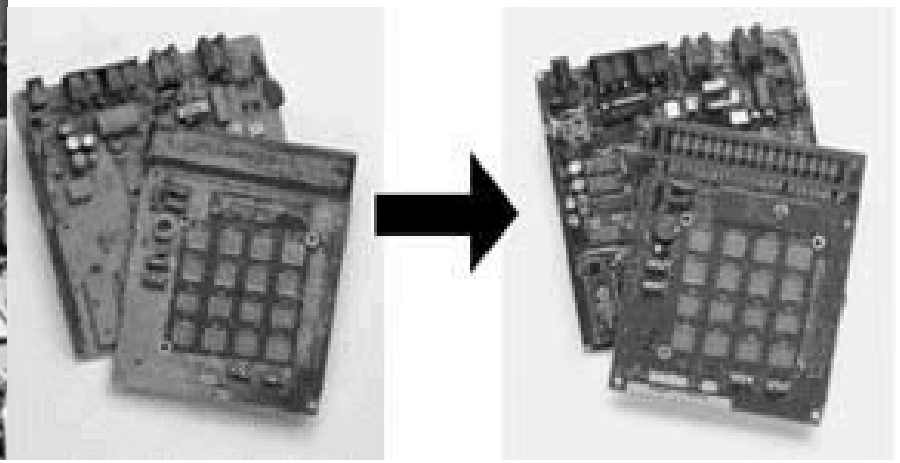
- **and so forth....**

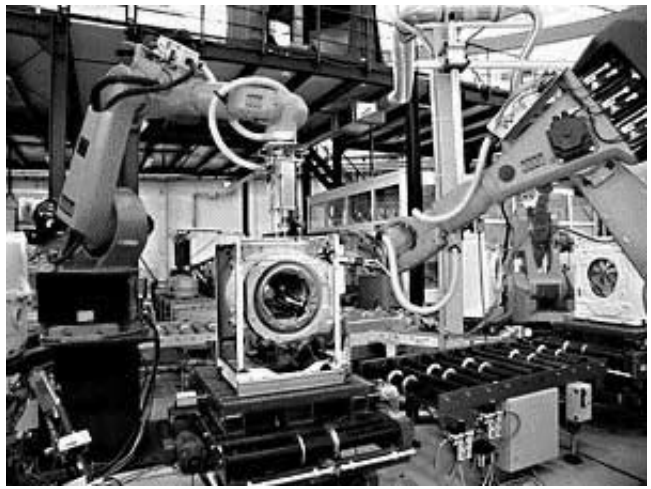
Collection Systems

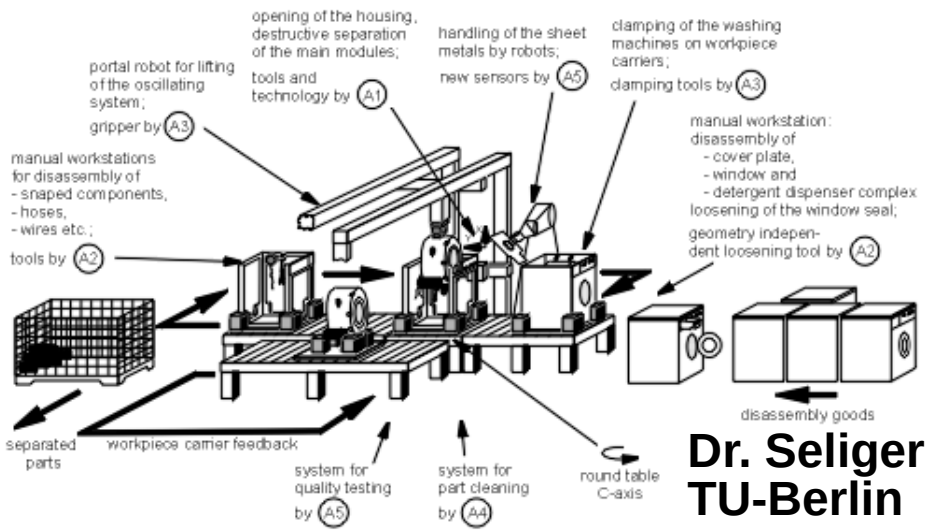
- **Situations:**
  - **Recycling Centers -- where to locate them? -- reverse warehouse problem.**
  - **Recycling Trucks -- what path should they take? Travelling Salesman Problem**
  - **Recovery of takeback products -- collection centers & transportation**

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

Demanufacturing Systems







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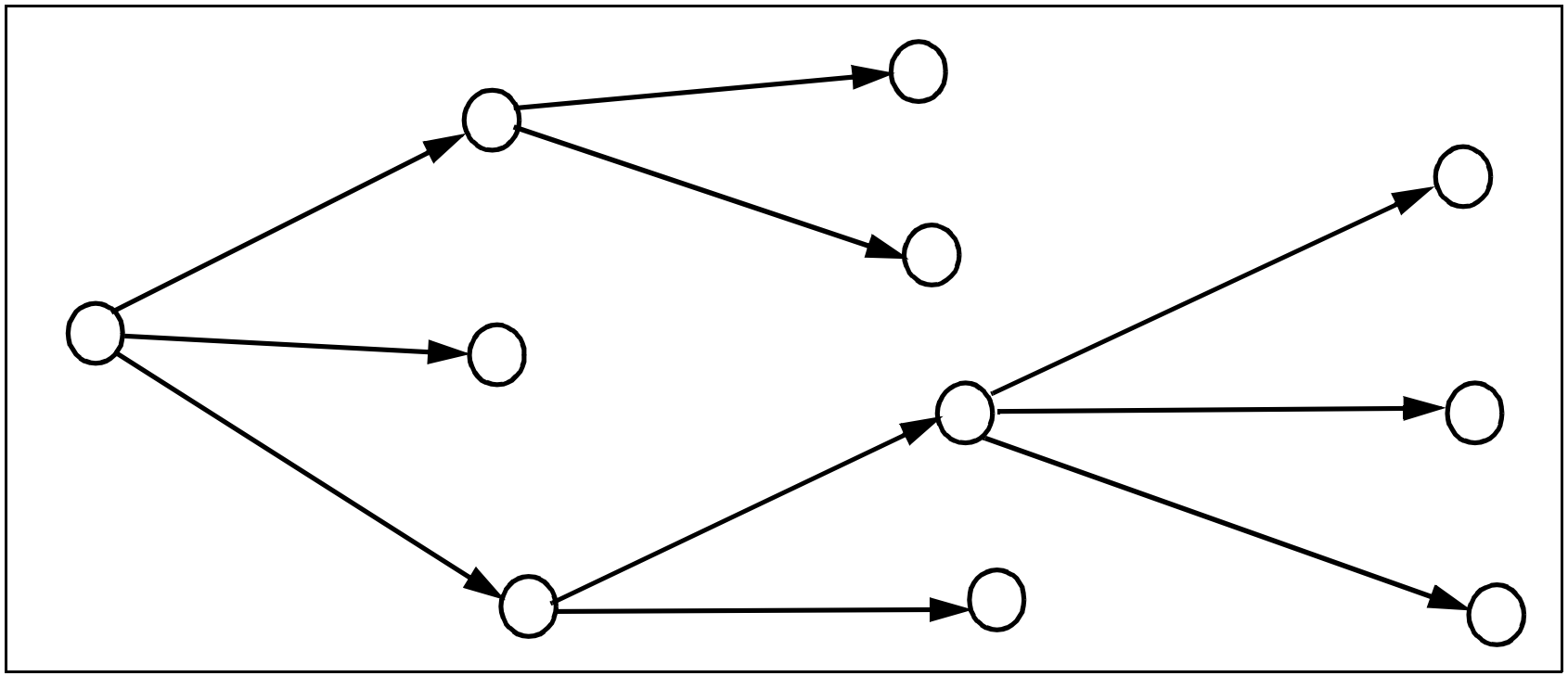
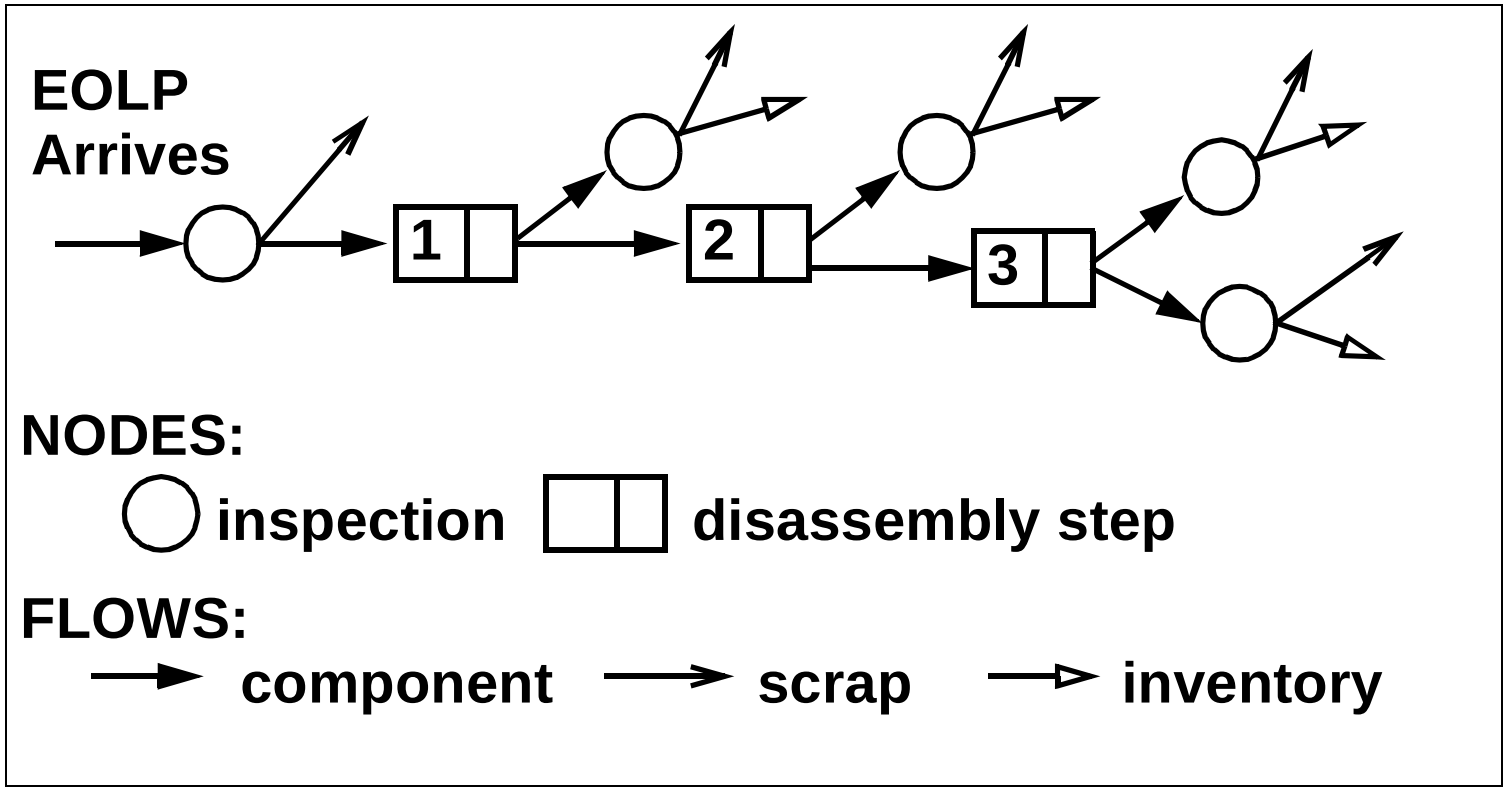
Disassembly Systems

- **We have briefly discussed how we might look at an assembly process. What about the reverse??**

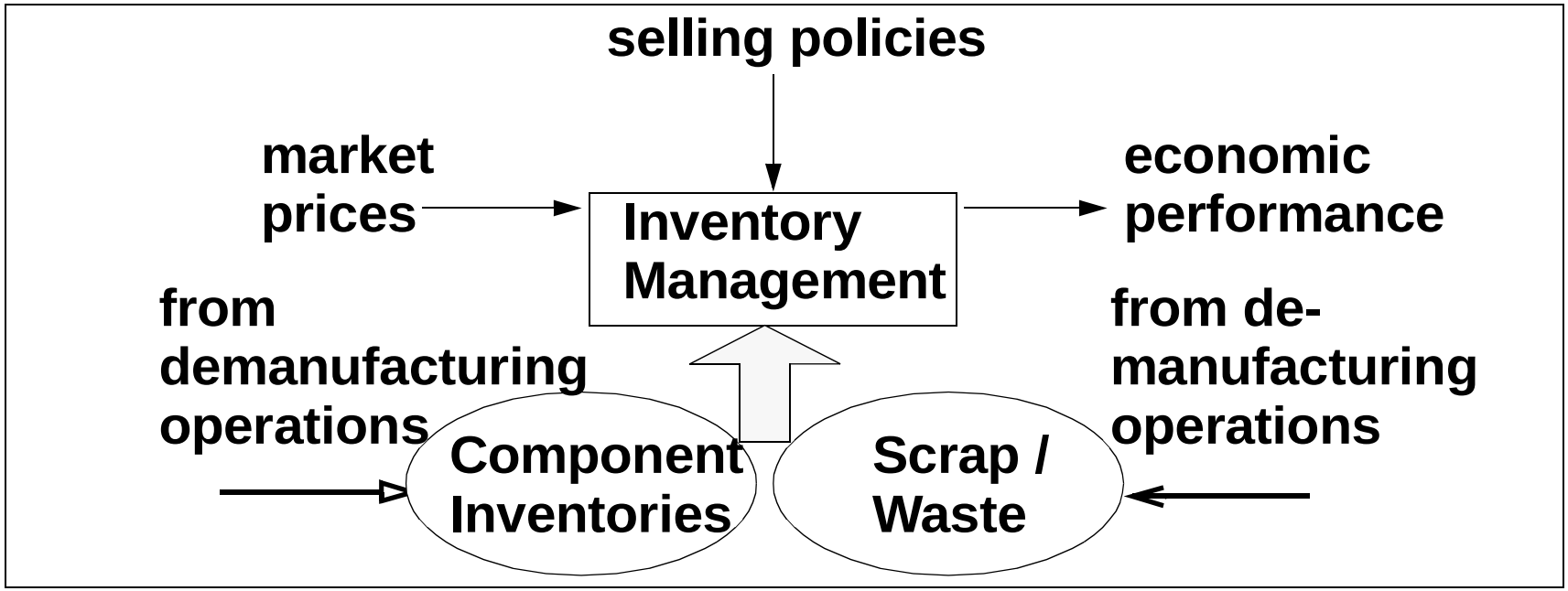


Disassembly Operations



As products arrive, they are disassembled. Parts are placed into inventory.

Management of Used Components



- **If disassembled parts can be immediately handled -- no problem. Most often though, they are stored in inventory until needed.**

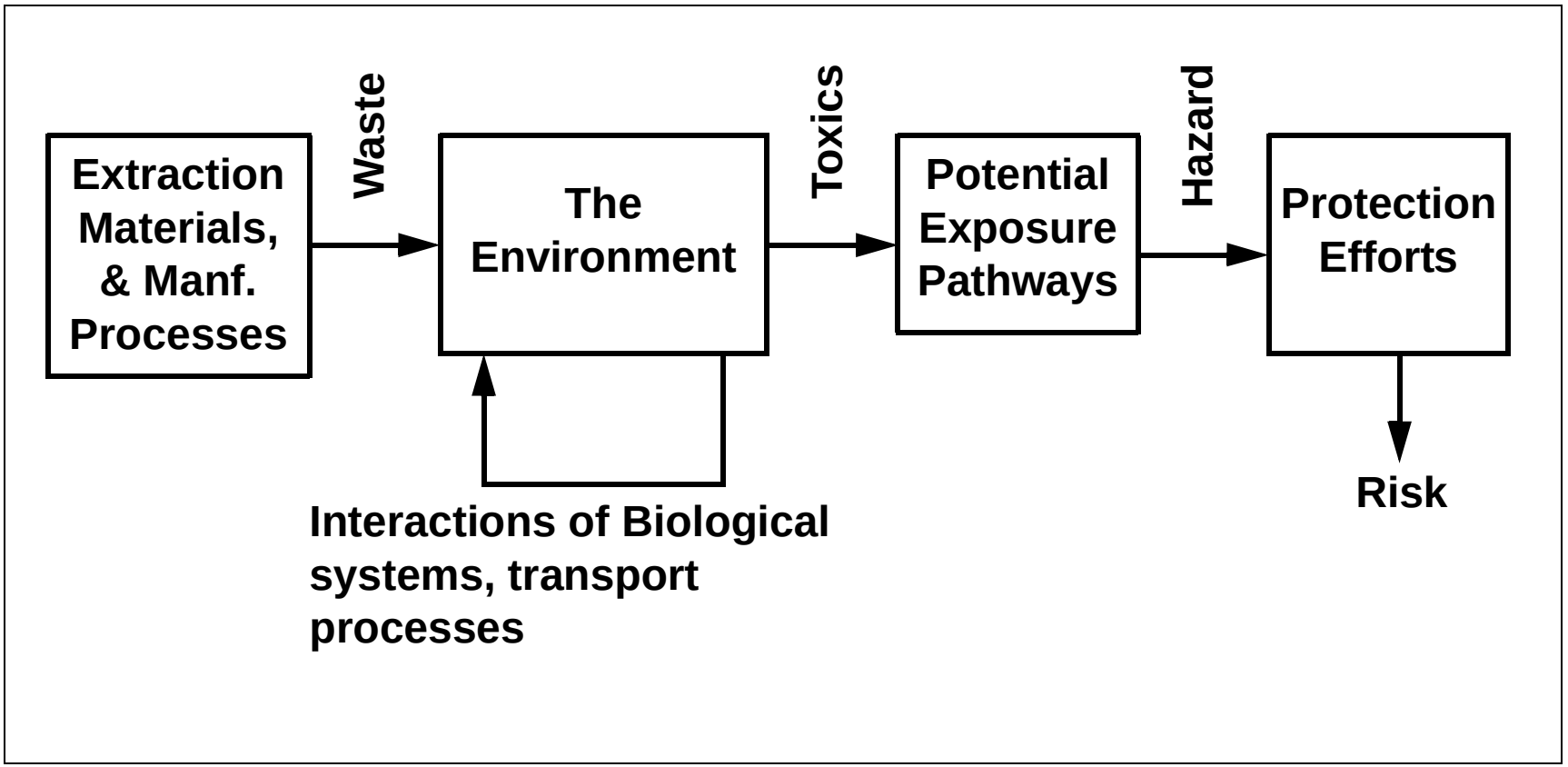
Used Parts Inventory

- **We don't want to accumulate parts we can't sell. Remember, there is a holding cost for stuff stored in inventory.**

- **Market price for used components changes over time. We might be willing to sit on some inventory if there is a chance the market price will go up soon.**

- **The demand is not the same for the individual parts recovered from the demanufacturing of a product.**

A Miscellaneous Topic
Hazard Assessment & Risk



Discussion

- **We know that many processes produce waste.**
- **Consume landfills**
- **Damage/contaminate natural resources**
- **Dangerous substances into environment**

- **The Environment**
- **Organisms within the environment “see” the waste**
- **Food chains may concentrate or transform waste**
- **Airflows, water-flows, movement of organisms may transport wastes**

Discussion Continued

- **Humans interact with the Environment & may be exposed to toxics through various pathways**
- **Breathe air**
- **Eat Food & drink water**
- **Dermal exposure**

- **Toxics that we are not exposed to -- are not hazards, e.g., methane atmosphere on a distant planet.**

- **Hazards -- pathway present so that we may be impacted by exposure to a toxic.**

Pathways

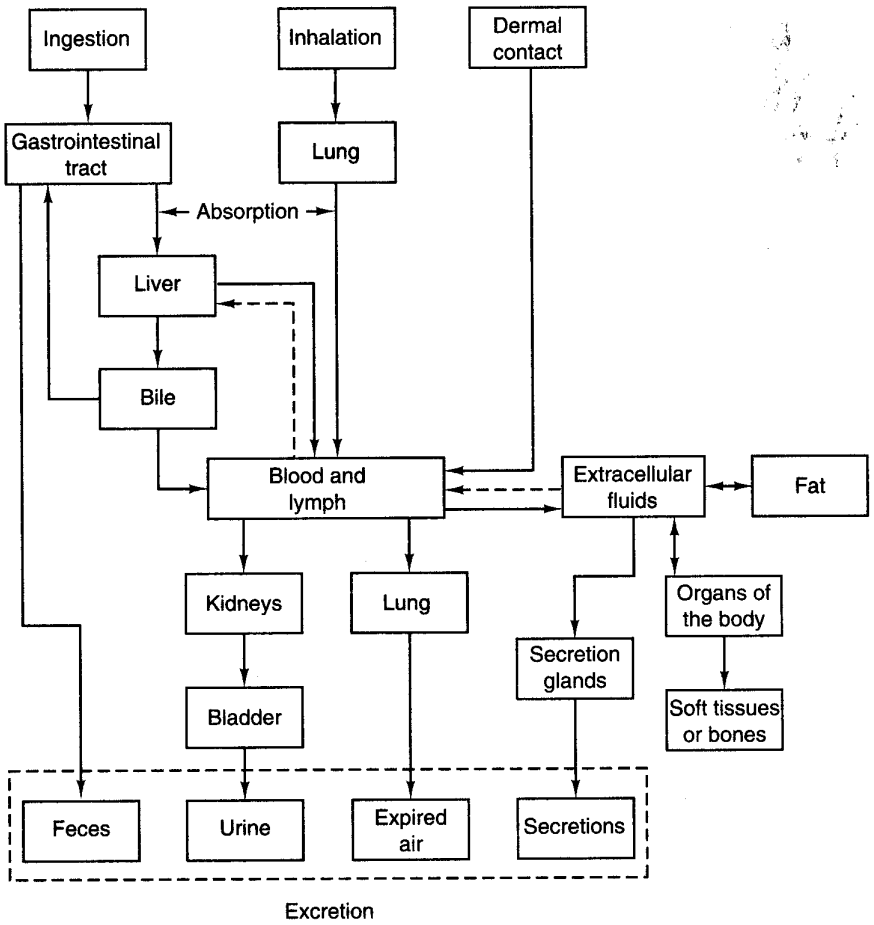


Figure 4.2 Dose manifestation pathways in dose/response assessments: Routes of absorption, distribution, and excretion of toxic chemicals in a mammalian system. (Office of Policy Analysis, *Principles of Risk Assessment: A Technical Review*. Washington, DC: U.S. Environmental Protection Agency, 1987.)

Risk

- **If hazard exists -- potential problem**
- **We can minimize risk of hazard through protection efforts (gas masks, protective clothing, washing food, etc.)**
- **Risk vs. perceived risk**
- **Toxicology**

Risk

Table 4.1 Annual Mortality Rate Associated with Certain Occurrences and Activities in the Netherlands

Activity/Occurrence	Annual Mortality Rate	Lifetime Mortality Rate
Drowning as a result of a dike collapse	1×10^{-7} (1 in 10 million)	1 in 133,000
Bee sting	2×10^{-7} (1 in 5.5 million)	1 in 73,000
Being struck by lightning	5×10^{-7} (1 in 2 million)	1 in 27,000
Flying	1×10^{-6} (1 in 814,000)	1 in 11,000
Walking	2×10^{-5} (1 in 54,000)	1 in 720
Cycling	4×10^{-5} (1 in 26,000)	1 in 350
Driving a car	2×10^{-4} (1 in 5,700)	1 in 76
Riding a moped	2×10^{-4} (1 in 5,000)	1 in 67
Riding a motorcycle	1×10^{-3} (1 in 1,000)	1 in 13
Smoking cigarettes (one pack per day)	5×10^{-3} (1 in 200)	1 in 3

Source: Ministry of Housing, Physical Planning, and Environment, ***National Environmental Policy Plan: Premises for Risk Management***, p. 7, The Hague, The Netherlands, 1991.

Observation / Control of Risk

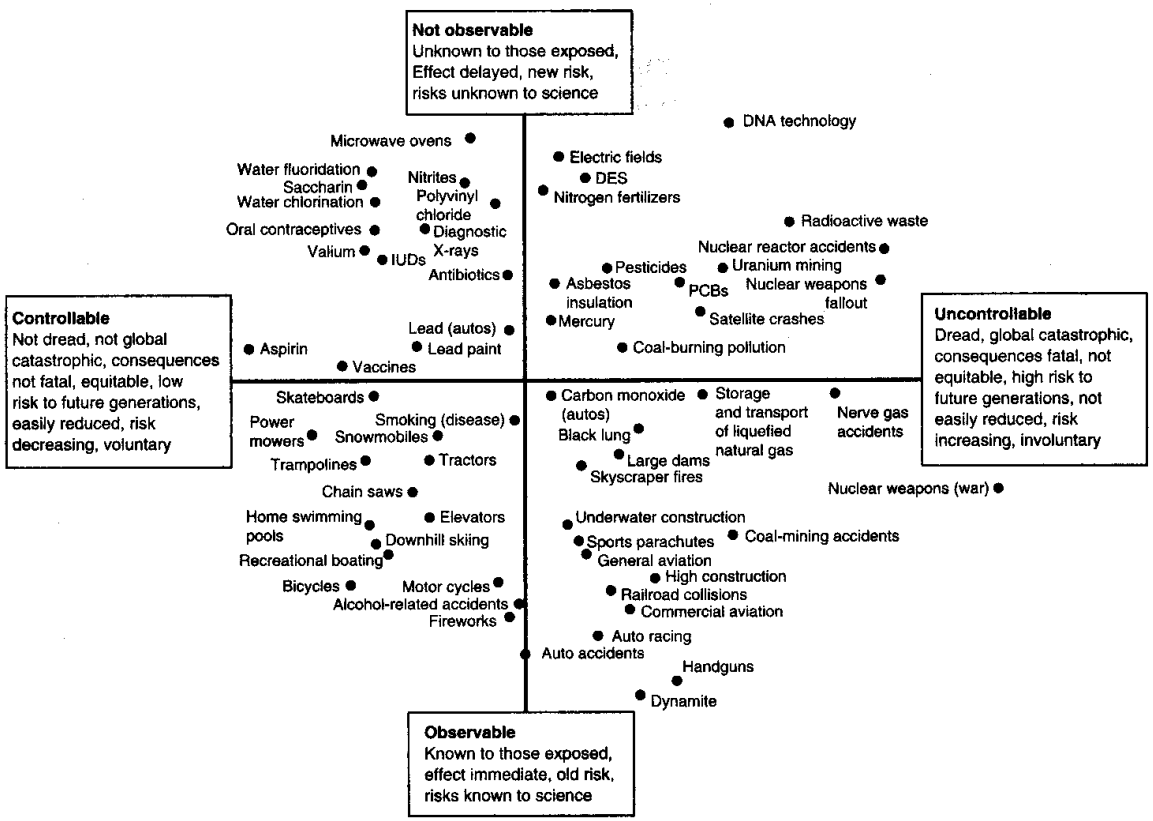


Figure 4.1 The location of risks in "risk space". The axes are the degree to which the risks are controllable and observable. (Reproduced with permission from M. G. Morgan, Risk analysis and management, *Scientific American, 269* (1): 32–41. Copyright 1993 by Scientific American, Inc.)

Perceived Risk

Environmental Problem	Public Priority Ranking	US EPA Ranking
Chemical Waste Disposal	1	16
Water Pollution	2	10
Chemical Plant Accidents	3	21
Air Pollution	4	1,2,3
Oil Tanker Spillage	5	22
Indoor Radon	-	4
Indoor air pollution	10	5
Non-nuclear radiation (other than radon)	13	6