



Executive Education: Mini MBA Program

Operations Management

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M.S. Industrial & Management
Engineering

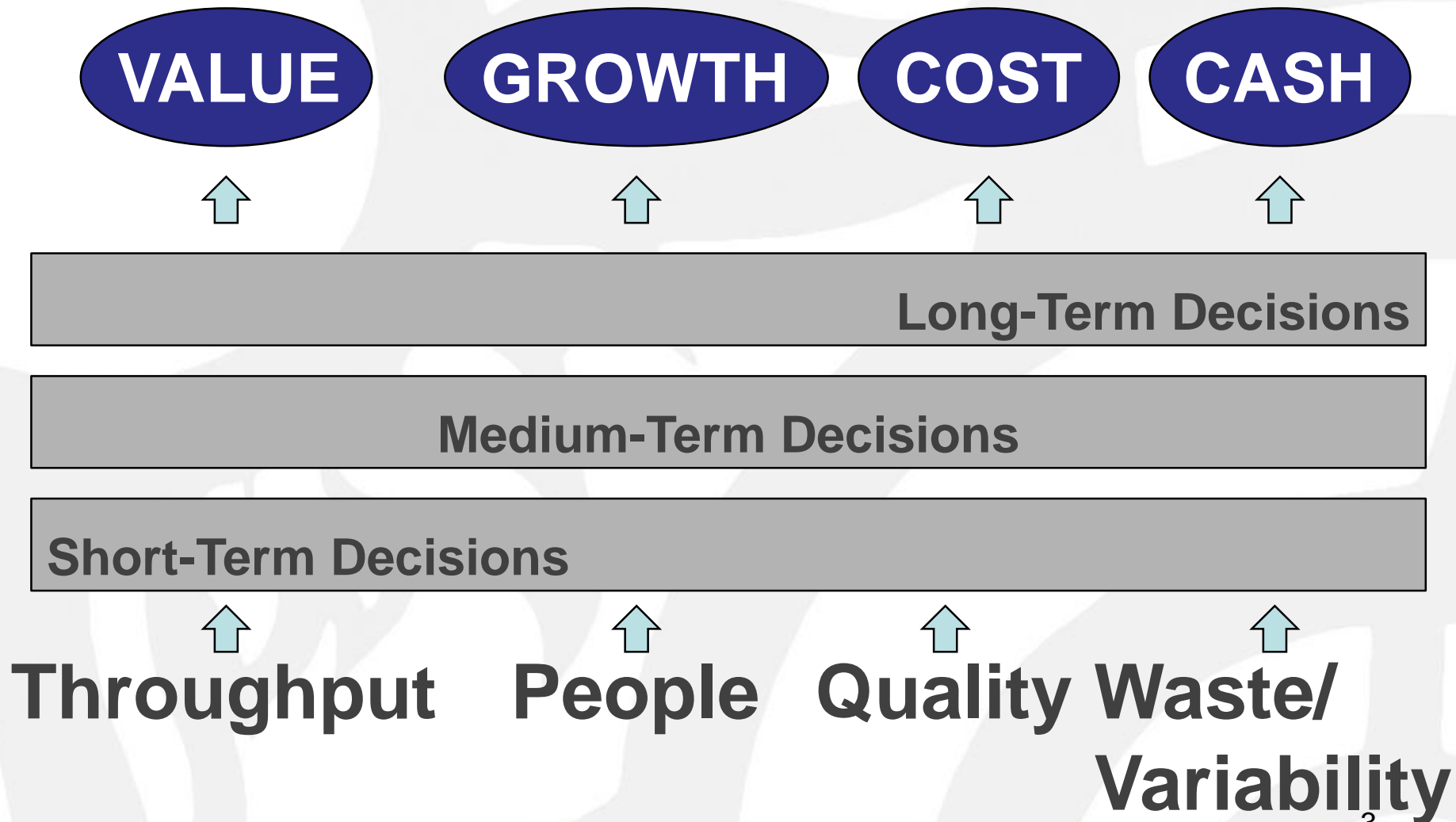
Operations Management

- What is Operations Management?
- Managing Capacity
- Managing Flow (Inventory, Queues)
- Managing Supply Chains

In Lean Six Sigma module:

- *Managing Quality*
- *Managing People*

Why Study Operations Management?



Why Study Operations Management?



“Toyota expects two-billion-dollar recall hit” (AFP)

***Toyota Safety Recall
Spreads to Europe,
China***

By REUTERS

*Published: January 28,
2010*



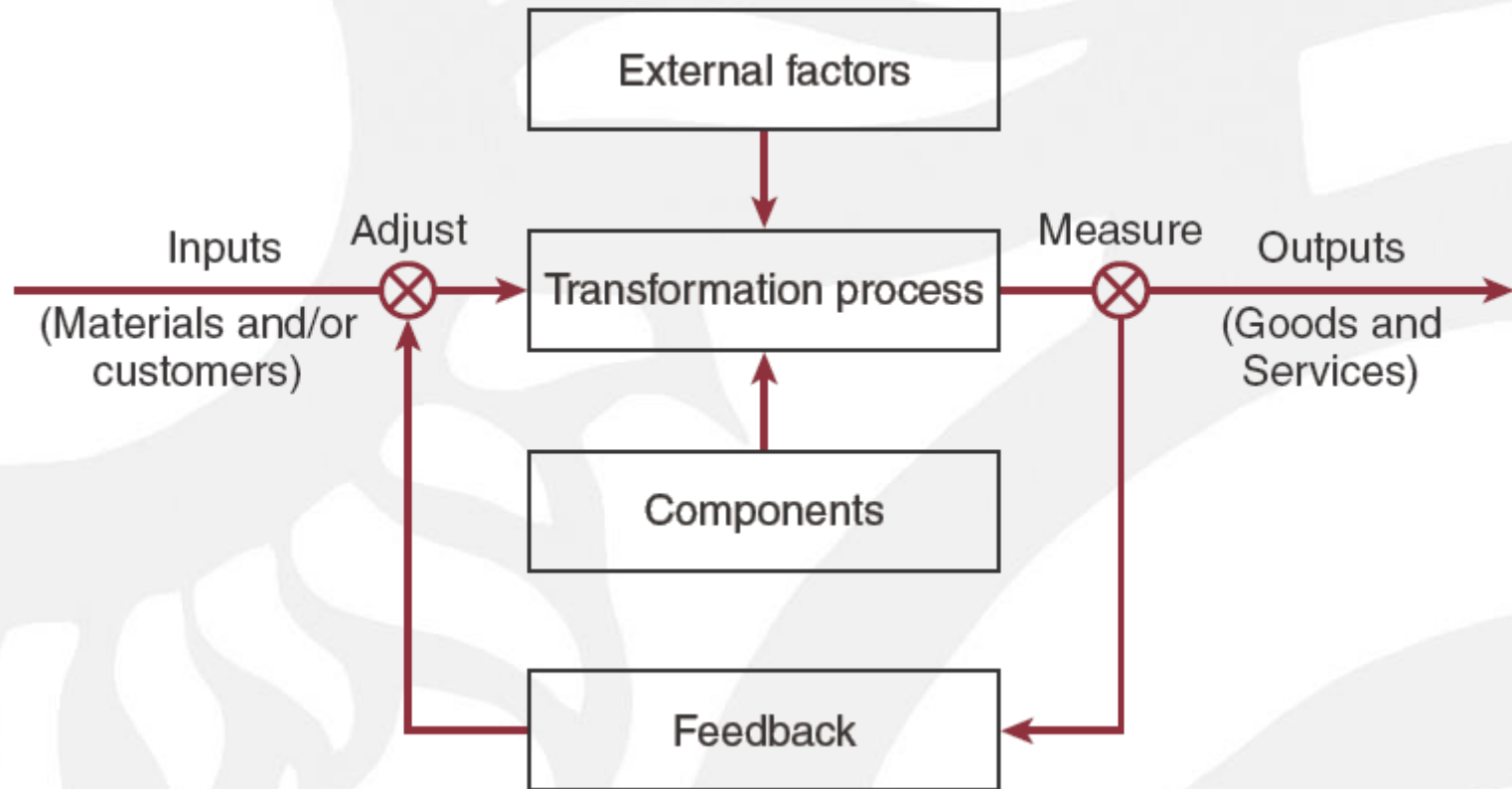
Bloomberg/Getty Images

What Is Operations Management?

- Operations Management
 - Management of the conversion process which transforms inputs such as raw material and labor into outputs in the form of finished goods and services.



The Transformation Process within OM



Which companies excel at Operations and Supply Management?

For Goods?

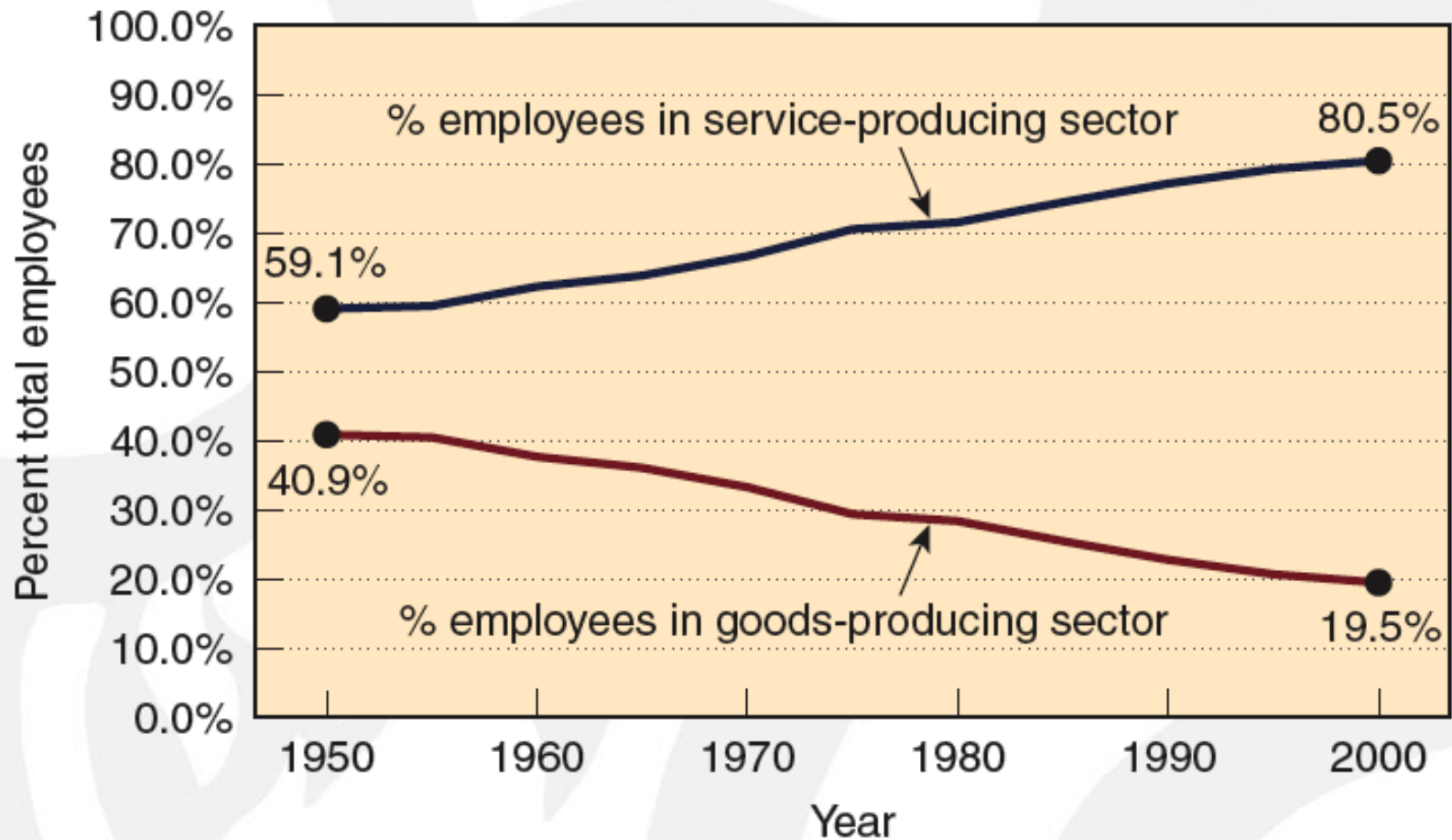
For Services?

Why?

Input-Transformation-Output Relationships for Typical Systems

System	Inputs	Components	Primary Transformation Function(s)	Typical Desired Output
Hospital	Patients, medical supplies	MDs, nurses, equipment	Health care (physiological)	Healthy individuals
Restaurant	Hungry customers, food	Chef, waitstaff, environment	Well-prepared food, well served; agreeable environment (physical and exchange)	Satisfied customers
Automobile factory	Sheet steel, engine parts	Tools, equipment, workers	Fabrication and assembly of cars (physical)	High-quality cars
College or university	High school graduates, books	Teachers, classrooms	Developing knowledge and skills (informational)	Educated individuals
Department store	Shoppers, stock of goods	Displays, salesclerks	Attract shoppers, promote products, fill orders (exchange)	Sales to satisfied customers
Distribution center	Stockkeeping units (SKUs)	Storage bins, stockpickers	Storage and redistribution	Fast delivery, availability of SKUs

Growth in Services in the United States



Source: Eva E. Jacobs, ed., *Handbook of U.S. Labor Statistics*, 5th ed. (Bernan Press, 2001), Table 2-1, pp. 161–164.

Differences Between Goods and Services

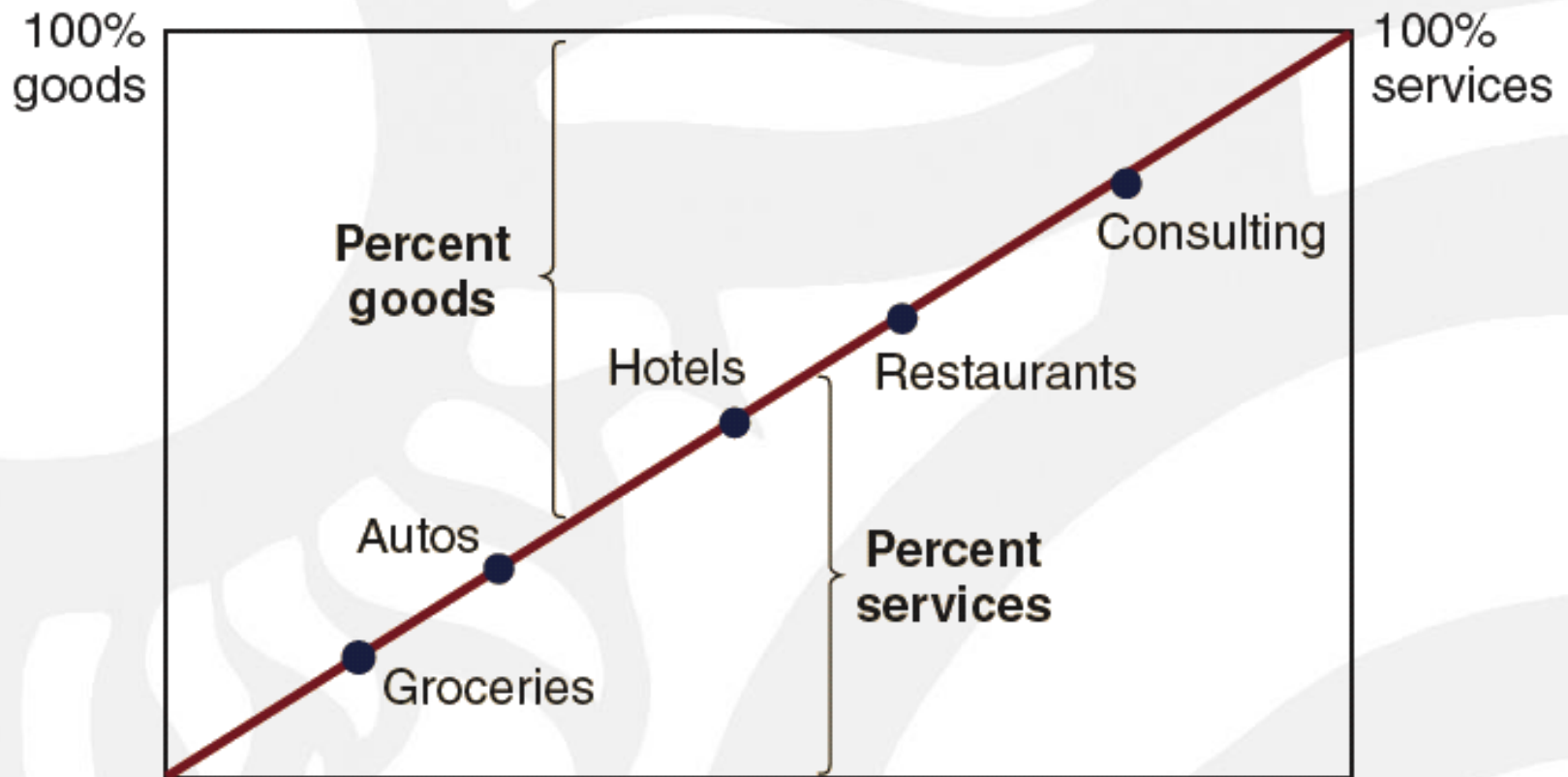
- Goods

- Tangible
- Can be inventoried
- No interaction between customer and process

- Services

- Intangible
- Cannot be inventoried
- Direct interaction between customer and process

Most Products Are a “Bundle” of Goods and Services



Inputs Provided by OM to Other Functional Areas

Functional Area	Processes Performed by That Area	Input Provided by OM
Accounting	Asset valuation Financial statements	On-hand inventory Labor and material costs
Finance	Capital investment analysis Cash flow management	Capacity utilization Make-or-buy decisions
Marketing	New product introduction Customer orders	New process requirements Delivery dates
Human resources	Hiring Training	Job descriptions Worker skills requirements
MIS	Software evaluation Hardware requirements analysis	Data requirements Terminal requirements

Case Study: **Wyatt Earp Buffalo Hunting**

Who is Wyatt Earp?

**What did he do and how
is it related to OSM?**

Strategic Capacity Planning

- Capacity can be defined as the ability to hold, receive, store, or accommodate
- Strategic capacity planning is an approach for determining the overall capacity level of capital intensive resources, including facilities, equipment, and overall labor force size

Capacity Utilization

$$\text{Capacity utilization rate} = \frac{\text{Capacity used}}{\text{Best operating level}}$$

- **Write both in same units of measurement**
- **Capacity used**
 - rate of output actually achieved
- **Best operating level**
 - capacity for which the process was designed

Theoretical vs. Effective Capacity

Effective capacity can be diminished by 4 types of losses:

- **Scheduled downtime**
= hours of operation not available due to management/policy decisions
- **Unscheduled downtime**
= hours of operation not available due to equipment/system breakdowns, employee absences
- **Waste losses**
= hours of operation not available because resources are processing/producing waste
- **Speed losses**
= hours of operation not available because process is required to run at a slower than optimal speed to accommodate poor inputs, poor performance, etc.

Capacity Planning and Management

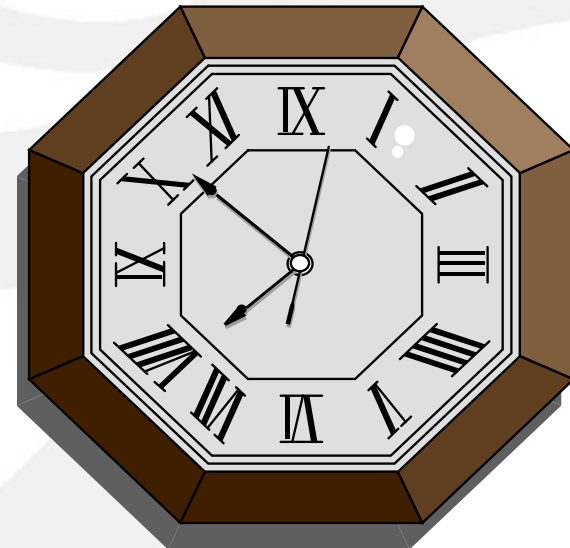
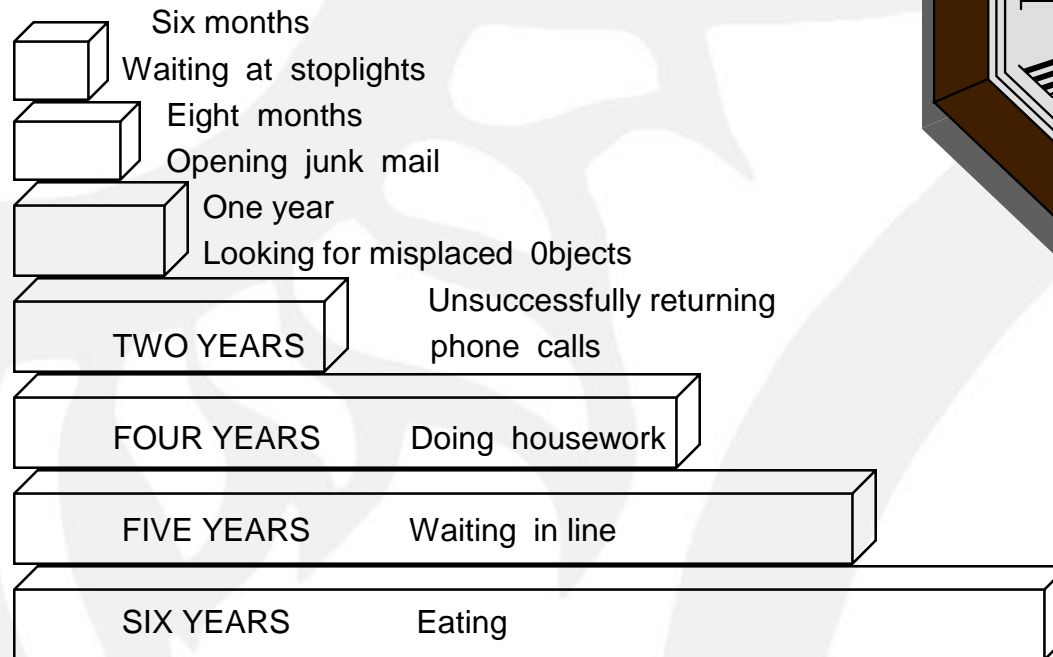
- **Combining Demand Management + Capacity Management**
- **Surge capacity**
- **Assumptions about waste, bottlenecks, inventory and their role in capacity utilization.**
- **Flexible: Plants, Processes, Workers**

Managing Queues



Where the Time Goes

In a life time, the average American will spend--



Maister's Laws of Waiting Lines

- Satisfaction is achieved if service perceptions exceeds expectations.
- Forced to play “catch-up ball.”
(First impressions are important!)

Skinner's Law:

The other line always moves faster.

Jenkins' Corollary:

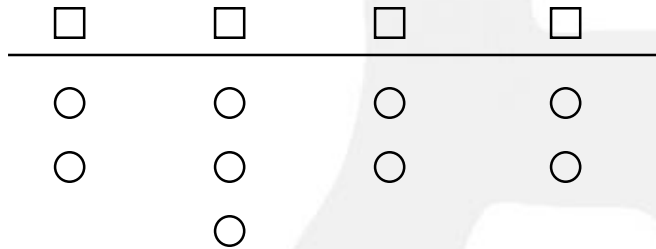
However, when you switch to the other line,
the previous line now moves faster ☺

Queuing Economics

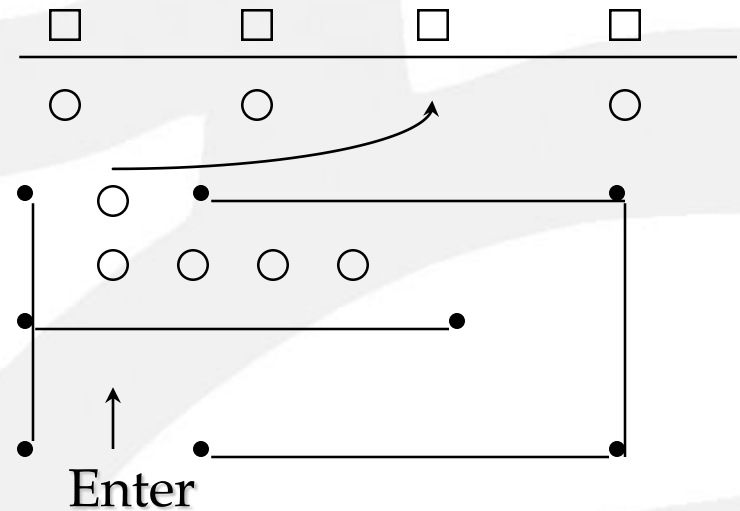
- **Inevitability of Waiting:** Waiting results from variations in arrival rates and service rates
- **Economics of Waiting:** High utilization obtained/purchased at the price of customer waiting – a tradeoff.
- ***Constructive Alternative:*** Make waiting productive (salad bar) or profitable (drinking bar)...Or **Reduce Variability!**

Queue Configurations

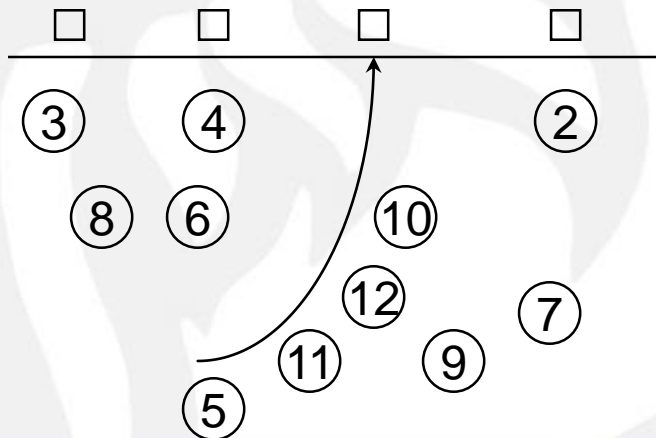
Multiple Queue



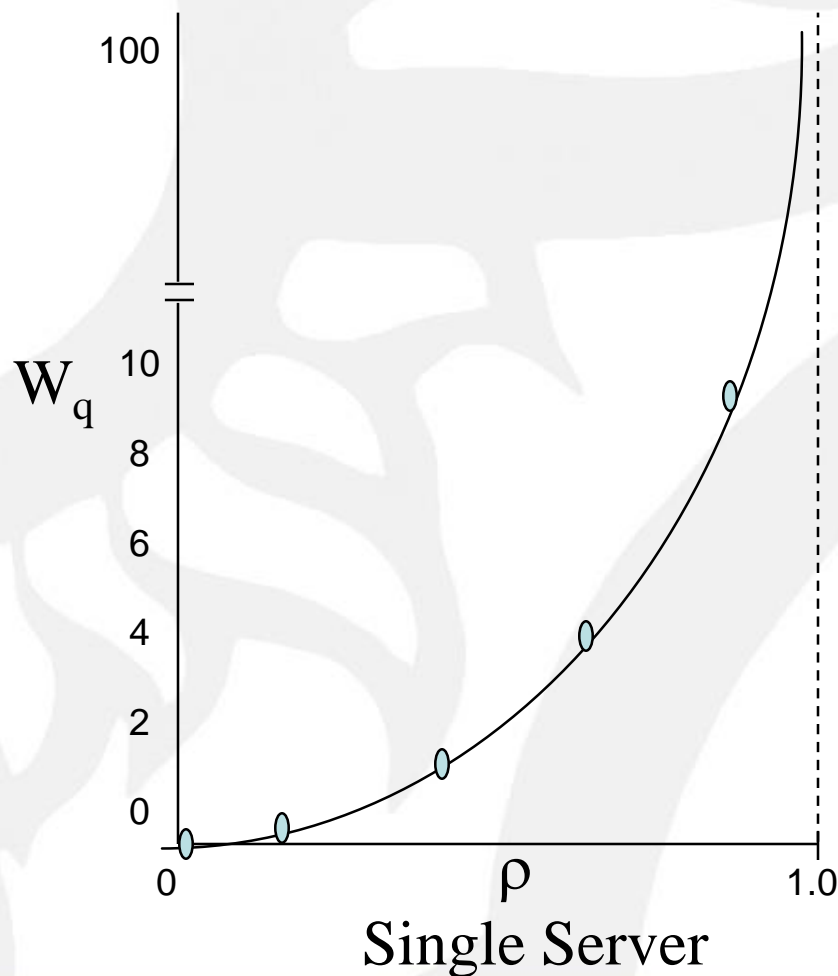
Single queue



Take a Number



Congestion as Utilization $\rightarrow 1$



With: $\rho = \frac{\lambda}{\mu}$

Then: $W_q = \frac{\rho}{\mu - \lambda}$

Approaches to Control Customer Waiting

- **Animate:** Disney distractions, elevator mirror, recorded music
- **Discriminate:** Avis frequent renter treatment (out of sight of regular)
- **Automate:** Use computer scripts to address 75% of questions (telephone)
- **Obfuscate:** Disney lines around corners (shows how fast it's moving, not how long it is)
- **Or....Reduce/Manage Variability!**

Inventory Management

Is inventory good or bad?

Your purchasing & stocking patterns on:

- toilet paper
- cereals
- bananas
- beer
- gas in your car
- newspaper

Definition of Inventory

- **Inventory**

- The stock of any item or resource used in an organization, includes raw materials, finished goods, and work-in-process.

- **Inventory Management System**

- The set of policies and controls that monitors levels of inventory and determines:
 - What levels should be maintained.
 - When stock should be replenished.
 - How large orders should be.

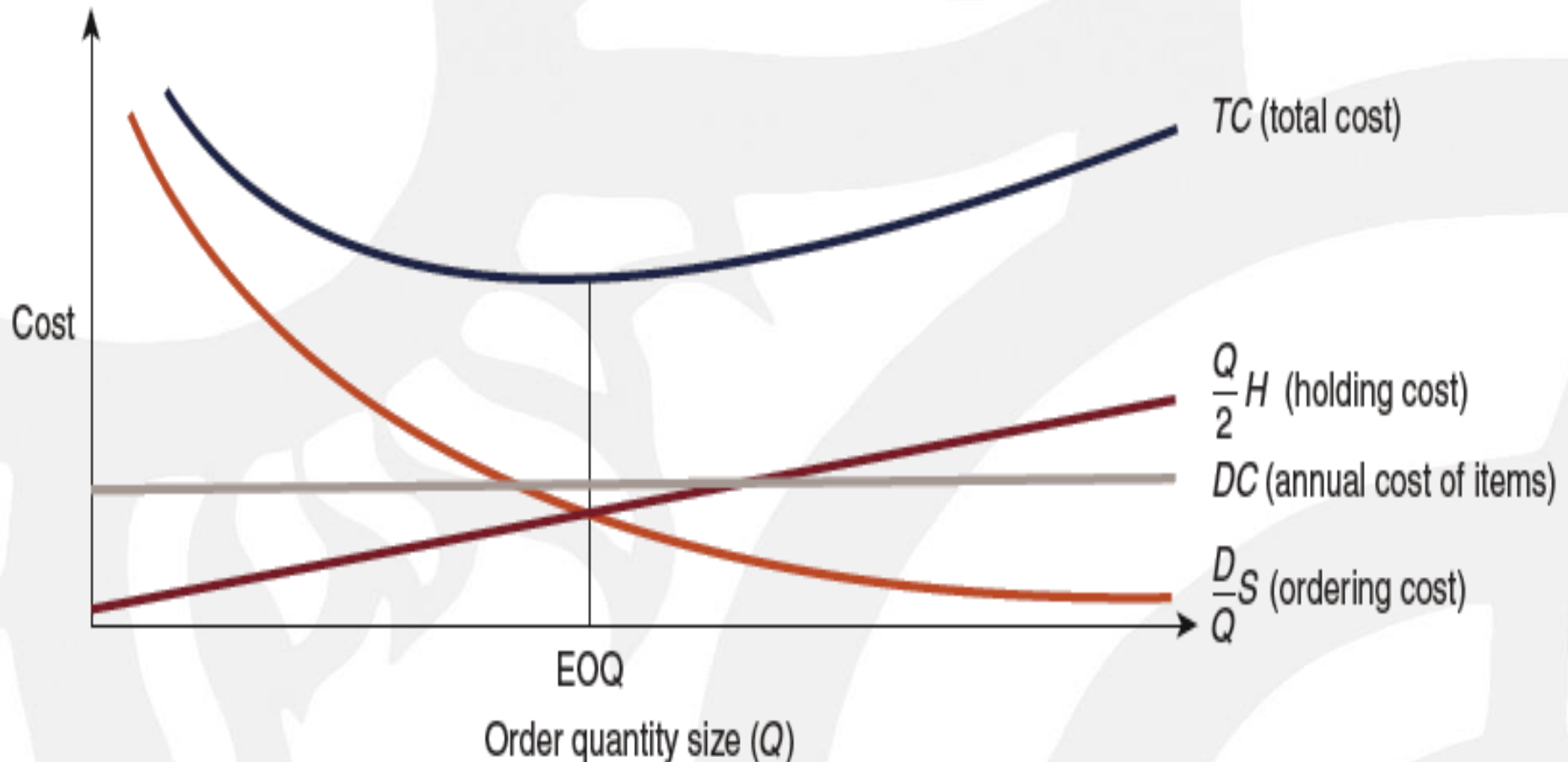
Reason for Maintaining Inventory

- **To protect against uncertainty**
 - Shortages of raw materials.
 - Work-in-process variations.
 - Changes in demand for finished products.
- **To support a strategic plan**
 - As a cyclic demand buffer for a level-output strategy.
- **To take advantage of economies of scale**
 - Large quantity purchases reduce the average total unit costs related to fixed ordering, setup costs, and transportation costs.

Inventory Costs

- Holding or Carrying Costs
 - Storage costs (facility, insurance, taxes, utilities)
 - Capital costs (opportunity costs)
 - Obsolescence/shrinkage costs (depreciated value)
- Setup or Ordering Costs
- Shortage (or Stockout) Costs
- Purchase Costs
- Transportation Costs

Annual Product Costs, Based on Size of the Order



Queues = Inventory

- Both represent a “bunching” of items flowing through the system
- Both are often (mis) managed for the benefit of the producer/service provider to the detriment of the customer.
- Reducing queues and reducing inventories results in a more robust, lower total-cost system.

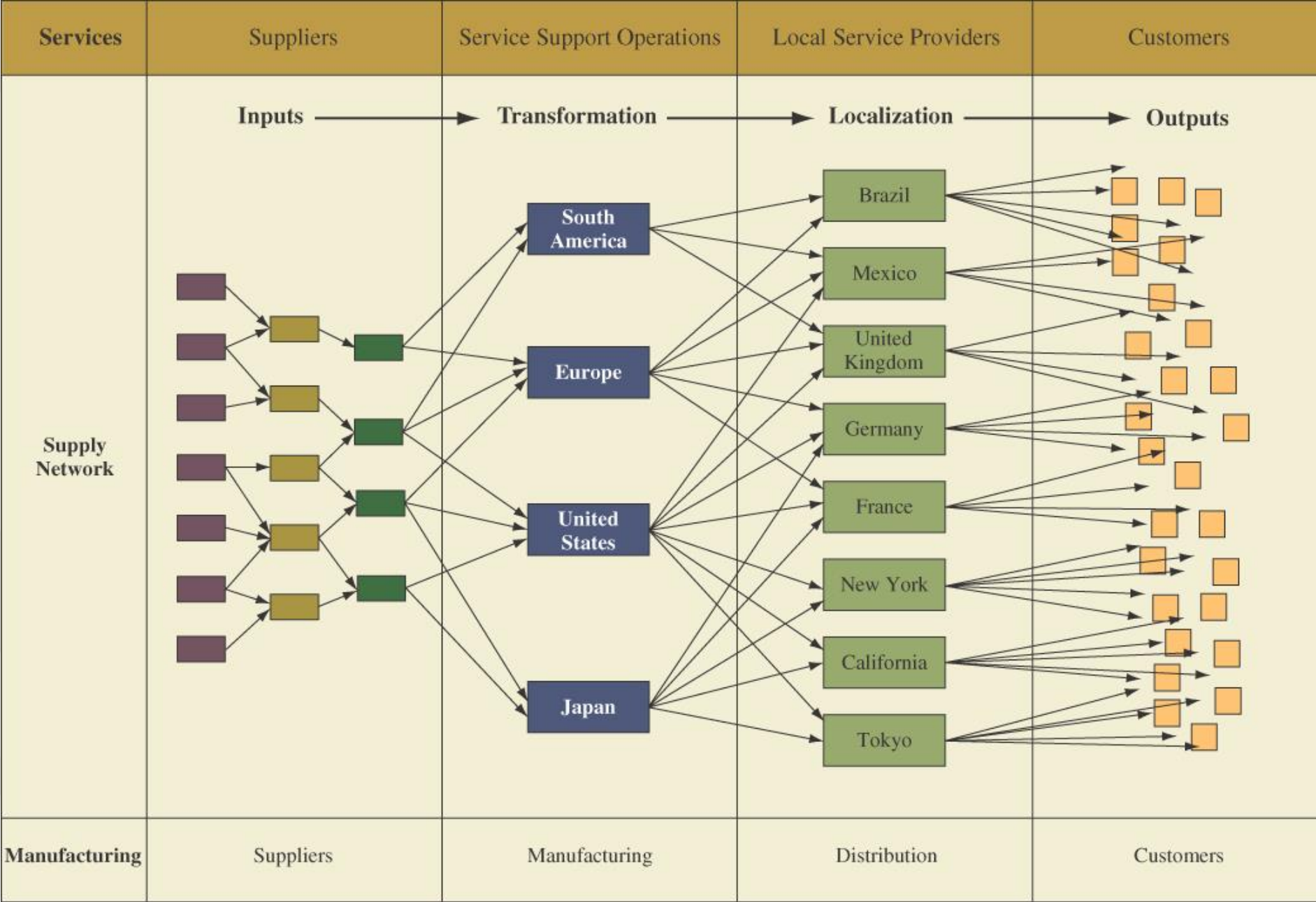
Definition of Supply Chain Management

- **Supply Chain**

- The stages (suppliers, manufacturers, distributors, and customers) that perform the steps in the transformation of raw inputs into finished products.

- **Supply Chain Management**

- A total system approach to managing the entire flow of information, materials, and services from raw-material suppliers through factories and warehouses to the end customer.



Planet Money T-shirt



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