FACULTY OF ECONOMICS AND BUSINESS ADMINISTRATION

DEPARTMENT BUSINESS INFORMATICS AND OPERATIONS MANAGEMENT
RESEARCH GROUP OPERATIONS AND PRODUCTION MANAGEMENT

OPERATIONS MANAGEMENT
PRODUCTION AND LOGISTICS MANAGEMENT

Programme: BSc in Business Engineering & BSc in Business Economics

Prof. dr. Veronique Limère

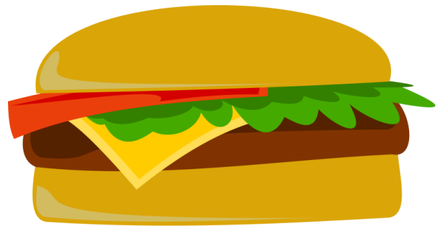
INTRODUCTION

OPERATIONS MANAGEMENT (OM) …

… in a cheeseburger stand

Cut tomatoes
Unpack meat & cheese
Grill meat
Add spices
Unpack sandwich
Put meat on sandwich bottom
Add cheese
Add salad and tomatoes
Add sauce
Add sandwich top
Pack in box

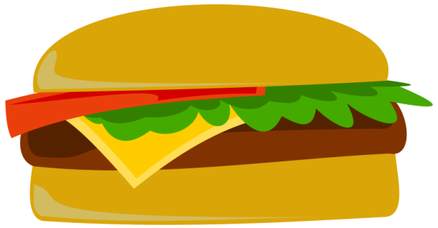
Total production time: 15’



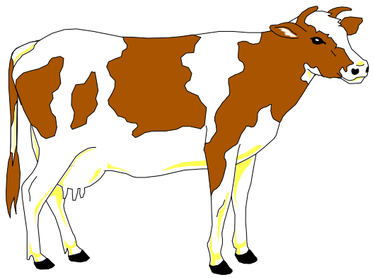
Problems?
Solutions?

Clients want to wait for only 5’ (fast food)

OM IN A CHEESEBURGER STAND



- The meat must be ordered in advance,
  it takes four weeks before it is being delivered.
- The meat can only be kept for 2 weeks.



Problems?
Solutions?

Meat stock
(<2 weeks)

Replenishment lead time = 4 weeks

Production lead time = 15'

Clients want to wait for only 5'

THINK-PAIR-SHARE

Imagine you have to run this cheeseburger stand. What are some of the operations management decisions that have to be taken?

- Think of some decisions?
- Think about how you would make these decisions?

- THINK during 1 minute: think for your self
- PAIR during 5 minutes: discuss in pairs
- SHARE afterwards: let us share some thoughts

OUTLINE

- An example
- Definitions of Operations Management
- Strategy and competition
  - Performance management
  - Productivity
- Managing and analyzing business processes: Little's law

DEFINITIONS OF OPERATIONS MANAGEMENT

- *"Operations management is the planning, scheduling, and control of the activities that transform inputs into finished goods and services"*

  APICS Dictionary

  APICS (www.apics.org)
  Widely recognized professional society for people interested in supply chain and operations management

- *"Operations Management deals with the design and management of products, processes, services and supply chains. It considers the acquisition, development, and utilization of resources that firms need to deliver the goods and services their clients want."*

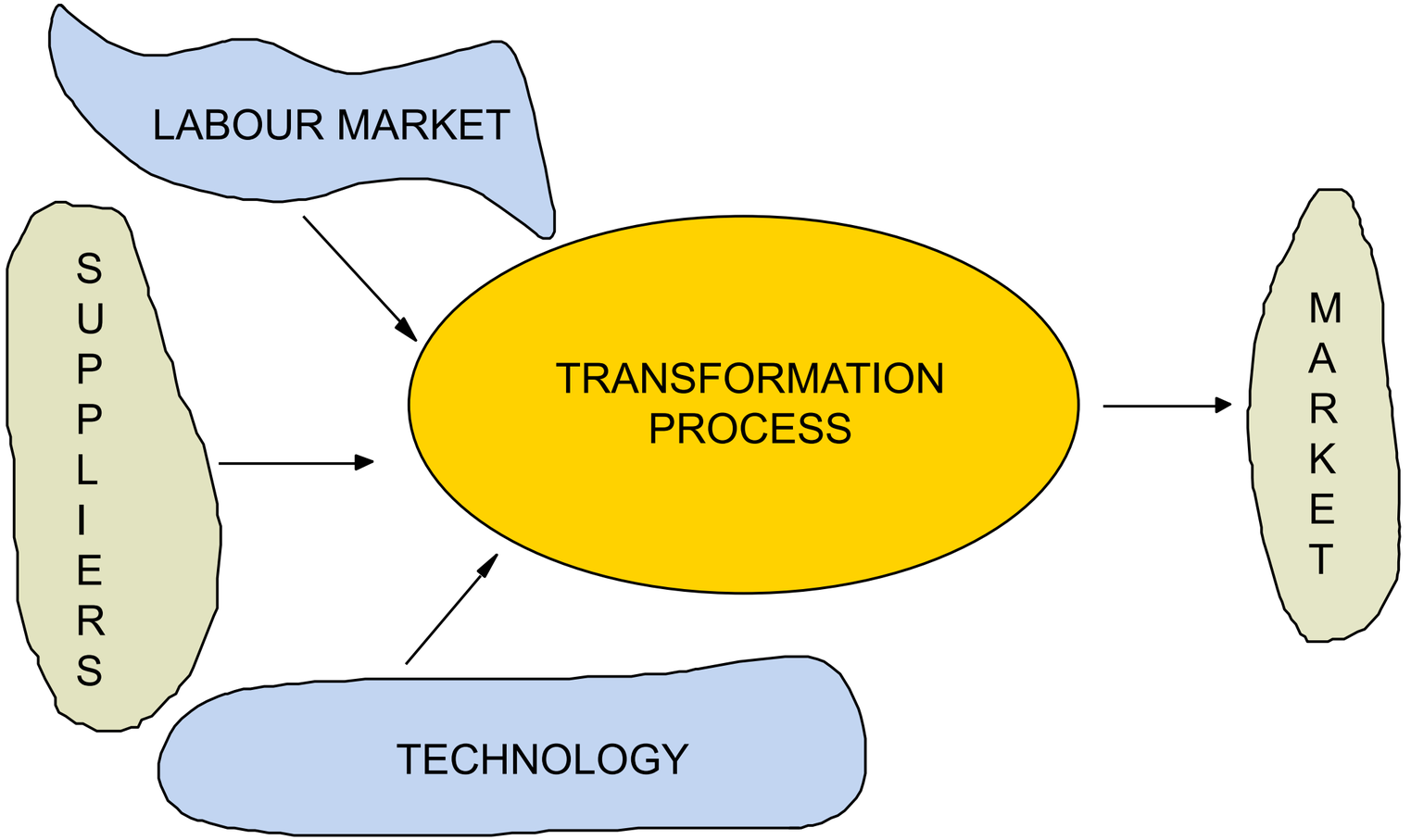
  MIT Sloan School of Management

DEFINITIONS OF OPERATIONS MANAGEMENT

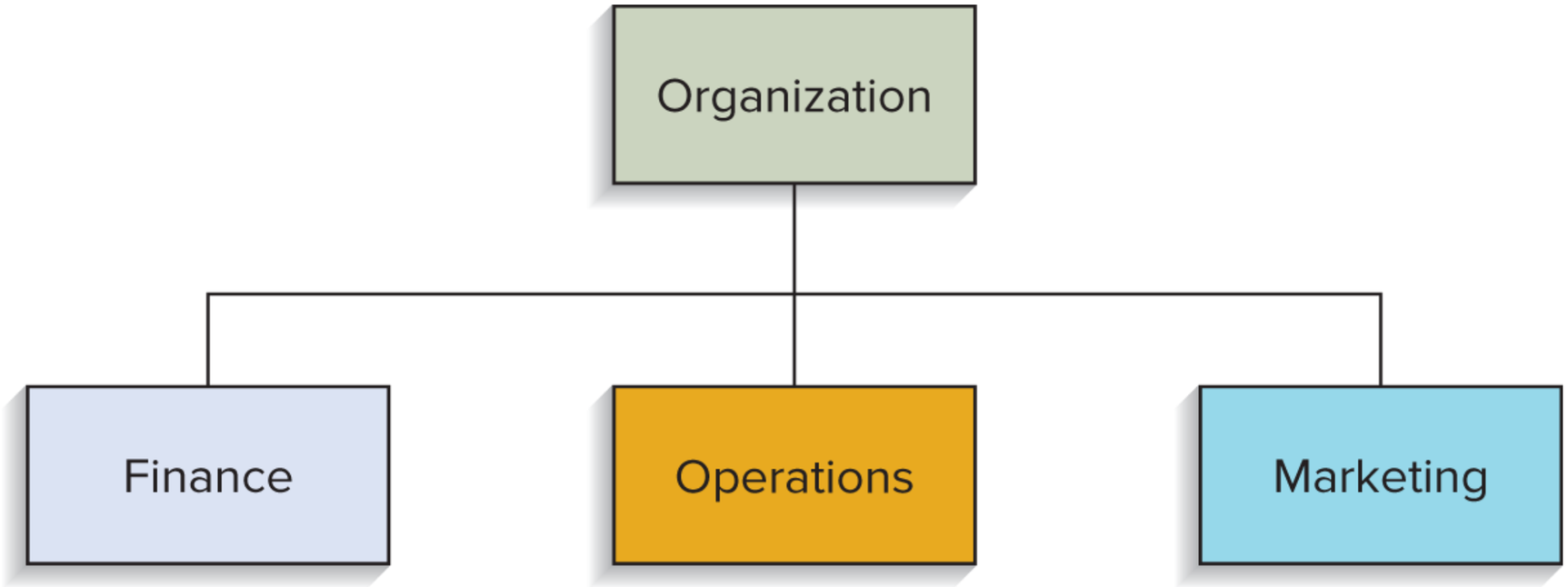
- *“Operations management is an area of management concerned with overseeing, designing, and controlling the process of production and redesigning business operations in the production of goods or services. It involves the responsibility of ensuring that business operations are efficient in terms of using as few resources as needed, and effective in terms of meeting customer requirements. It is concerned with managing the transformation process that converts inputs (in the forms of raw materials, labor, and energy) into outputs (in the form of goods and/or services).”*

  Wikipedia

OPERATIONS = TRANSFORMATION PROCESSES



3 BASIC FUNCTIONS OF ORGANIZATIONS



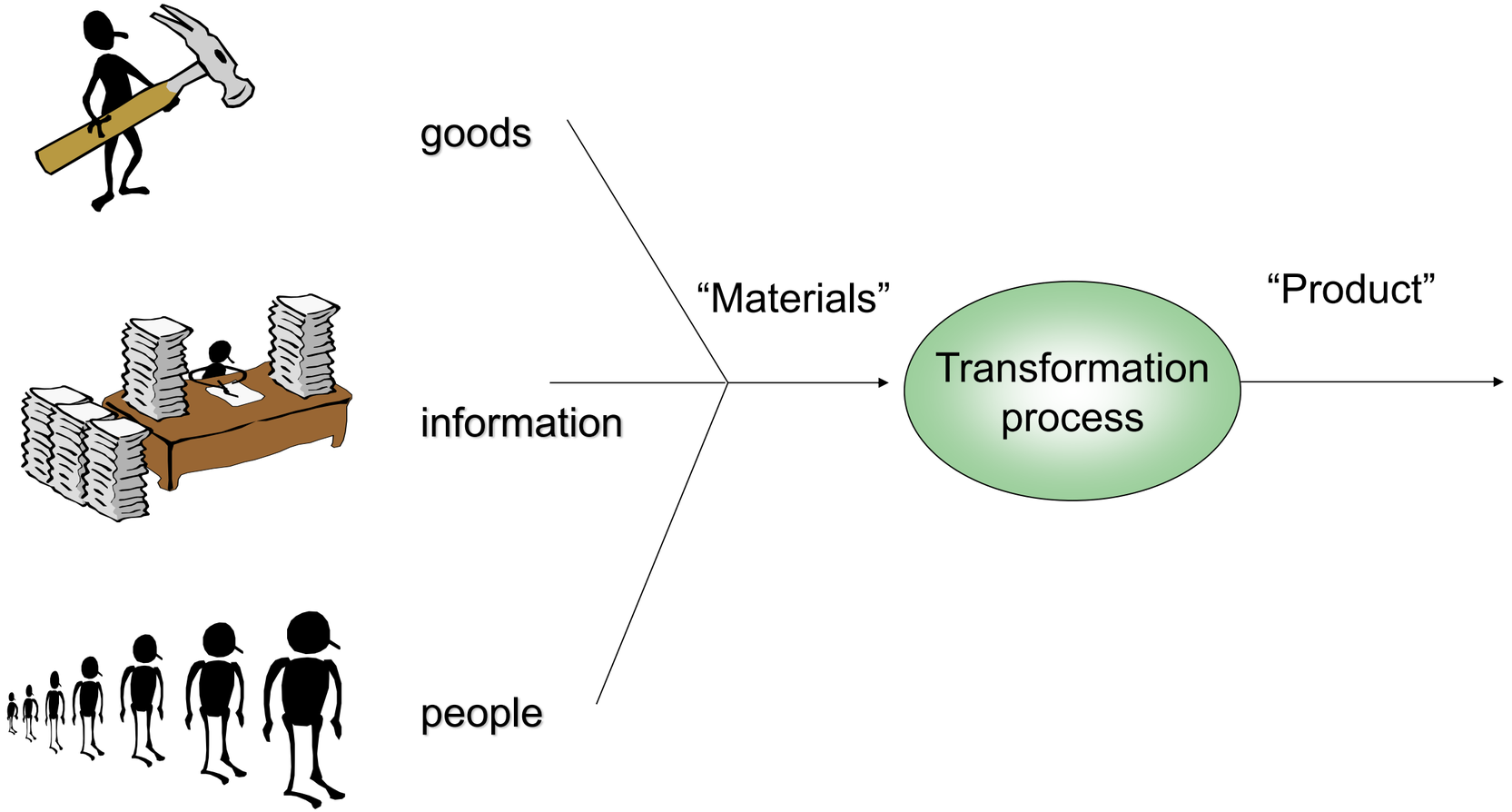
Decisions on
processes,
capacity,
inventory,
…

YOUR INTERESTS?

What other business than a cheeseburger stand can you think of?

E.g., businesses that you are in contact with on a regular basis, personal interests, …

OPERATIONS = TRANSFORMATION PROCESSES



OPERATIONS = TRANSFORMATION PROCESSES

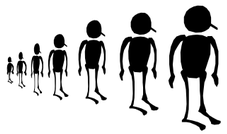
- Typical material processors:

mining and extraction, food production, automotive, assembly, machine construction, retail operations, warehousing and distribution, postal services, transport

- Typical information processors:

accountants, bank back offices, market research organization, financial analysts, news service, university research unit, archives, telecom company

- Typical people processors



hairdressers, hotels, hospitals, mass rapid transports, theatres, theme parks, dentists, schools

SOME OPERATIONS DESCRIBED IN TERMS OF THEIR INPUTS, PURPOSE AND OUTPUTS

Type of operation	*What are the operation's inputs?*	*What does the operation do?*	*What are operation's outputs?*
Airline	Aircraft Pilots and air crew Ground crew *Passengers* *Cargo*	Moves passengers and freight around the world	Transported passengers and freight
Department store	*Goods for sale* Staff sales Computerised registers *Customers*	Displays goods Gives sales advice Sells goods	Customers and goods 'Assembled' together
Police department	Police officers Computer systems *Information* *Public (law-abiding and criminal)*	Prevents crime Solves crime Apprehends criminals	Lawful society Public with feeling of security
Frozen food manufacturer	*Fresh food* Operators Food-processing equipment Freezers	Food preparation Freezes	Frozen food

Note: input resources that are transformed are printed in *italics*.

From: Operations and Process Management: Principles and Practice for Strategic Impact, Third Edition
Nigel Slack; Alistair Brandon-Jones; Robert Johnston; Alan Bett

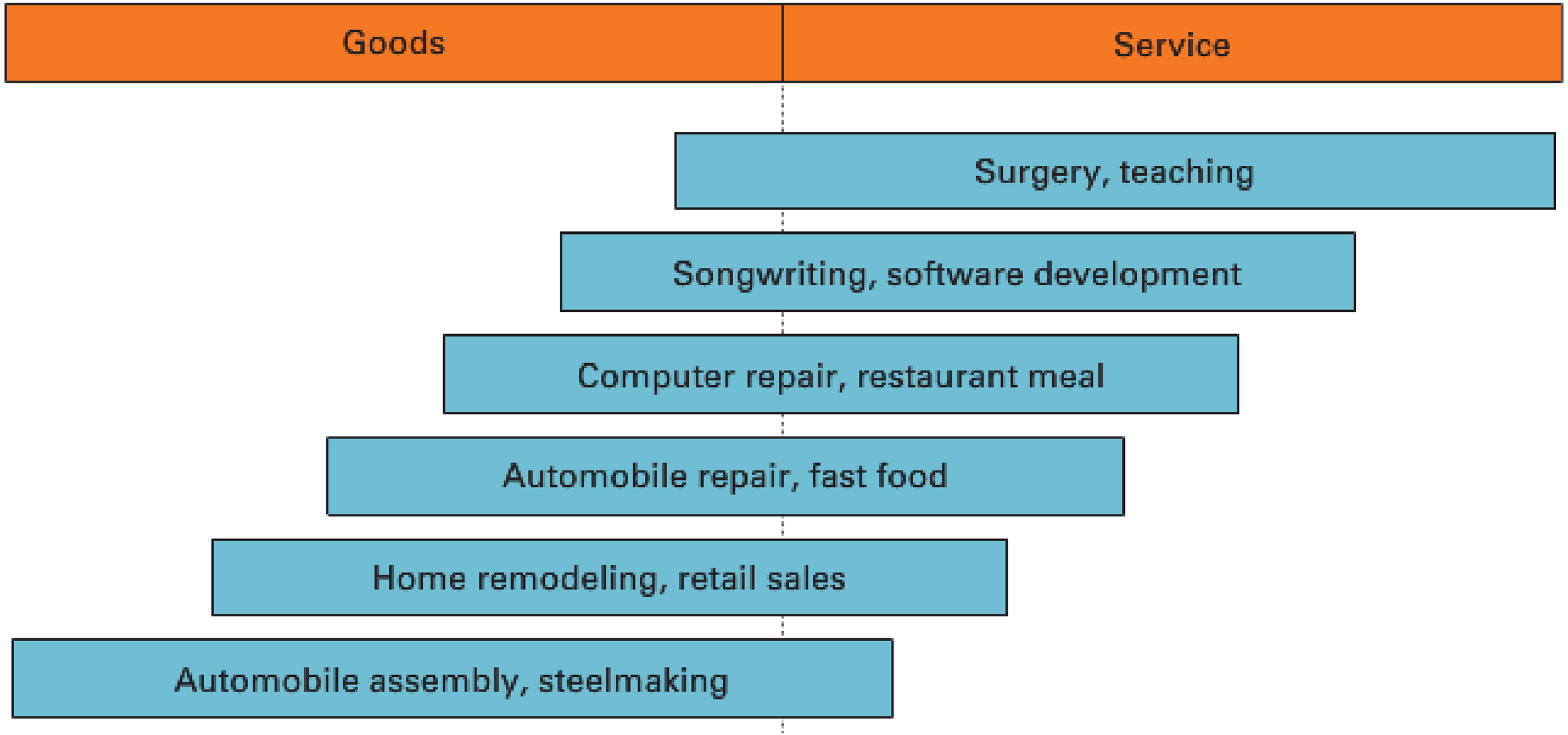
PRODUCTION OF GOODS VS. DELIVERY OF SERVICES

- **Goods** are physical items that include raw materials, parts, subassemblies, and final products
- **Services** are activities that provide some combination of time, location, form, or psychological value
- Goods and services often occur jointly
  - ➢ having the oil changed in your car is a service, but the oil that is delivered is a good

CHARACTERISTICS OF SERVICES	CHARACTERISTICS OF GOODS
Intangible: Ride in an airline seat	Tangible: The seat itself
Produced and consumed simultaneously: Beauty salon produces a haircut that is consumed as it is produced	Product can usually be kept in inventory (beauty care products)
Unique: Your investments and medical care are unique	Similar products produced (iPods)
High customer interaction: Often what the customer is paying for (consulting, education)	Limited customer involvement in production
Inconsistent product definition: Auto insurance changes with age and type of car	Product standardized (iPhone)
Often knowledge based: Legal, education, and medical services are hard to automate	Standard tangible product tends to make automation feasible
Services dispersed: Service may occur at retail store, local office, house call, or via internet.	Product typically produced at a fixed facility
Quality may be hard to evaluate: Consulting, education, and medical services	Many aspects of quality for tangible products are easy to evaluate (strength of a bolt)
Reselling is unusual: Musical concert or medical care	Product often has some residual value

From: Operations Management, Global Edition, 11th Edition
Jay Heizer; Barry Render

THE GOODS-SERVICE CONTINUUM



From: Operations Management: Theory and Practice: Gobal Edition 11e, 11th Edition
Stevenson, William

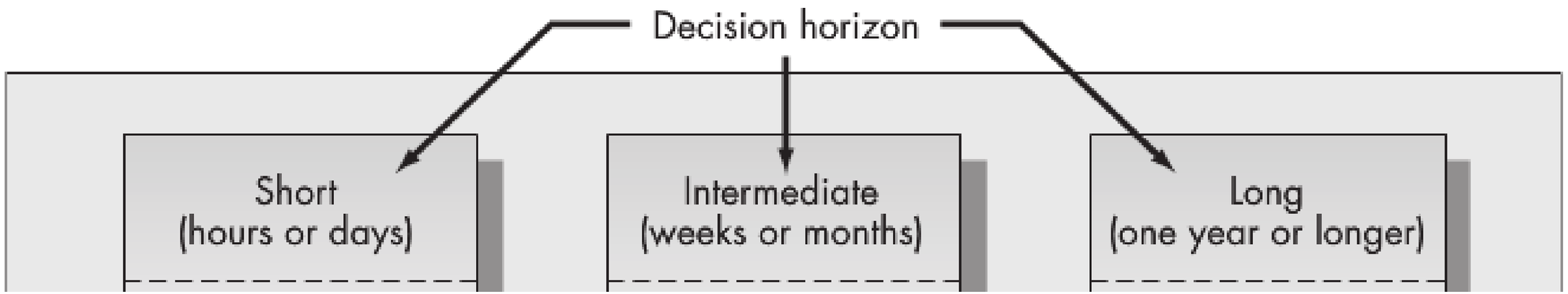
MANUFACTURING MATTERS!

- Shift from the manufacturing sector to the service sector
- Towards a knowledge economy

- Many services exist to support manufacturing
- Manufacturing and innovation
  - Manufacturing naturally leads to innovation
  - Return on innovations: after R&D

https://www.flandersmake.be/en/about-us

DECISION HORIZON



Operational Tactical Strategic

DECISION HORIZON

OM ranges from strategic to tactical and operational levels.

- **Strategic issues**

  determining the size and location of manufacturing plants, deciding the structure of service or telecommunications networks, and designing technology supply chains.

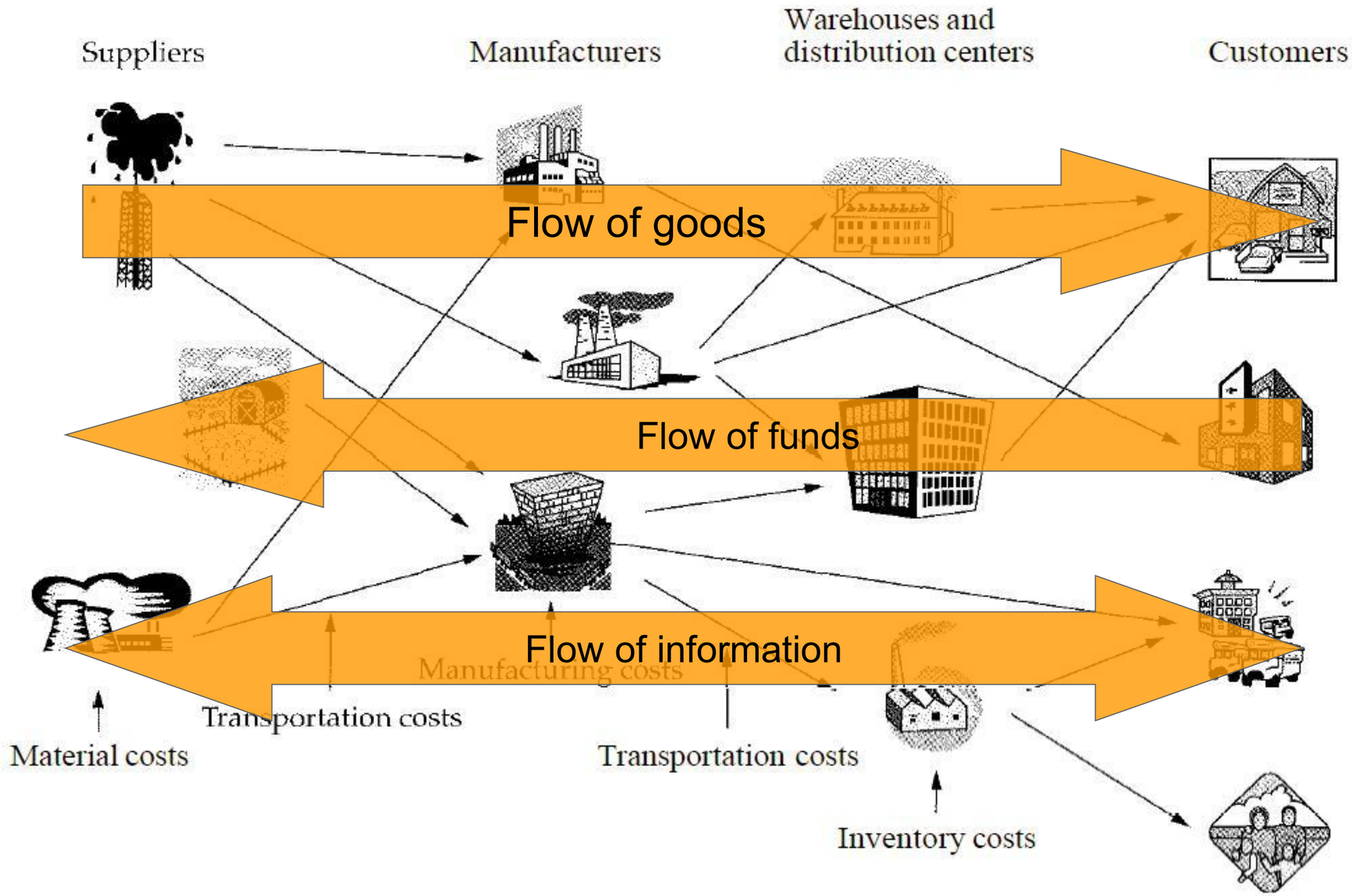
- **Tactical issues**

  plant layout and structure, project management methods, and equipment selection and replacement.

- **Operational issues**

  production scheduling and control, inventory management, quality control and inspection, traffic and materials handling, and equipment maintenance policies.

MANAGING FLOWS BETWEEN PROCESSES



OUTLINE

- An example
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STRATEGY AND COMPETITION

- **Business strategy** sets the terms and goals for a company to follow = long term plan of action
- **Operations strategy** = the means by which the firm deploys its resources to achieve its competitive goals
- **Operations management** is concerned with implementing the operations strategy

A FRAMEWORK FOR OPERATIONS STRATEGY

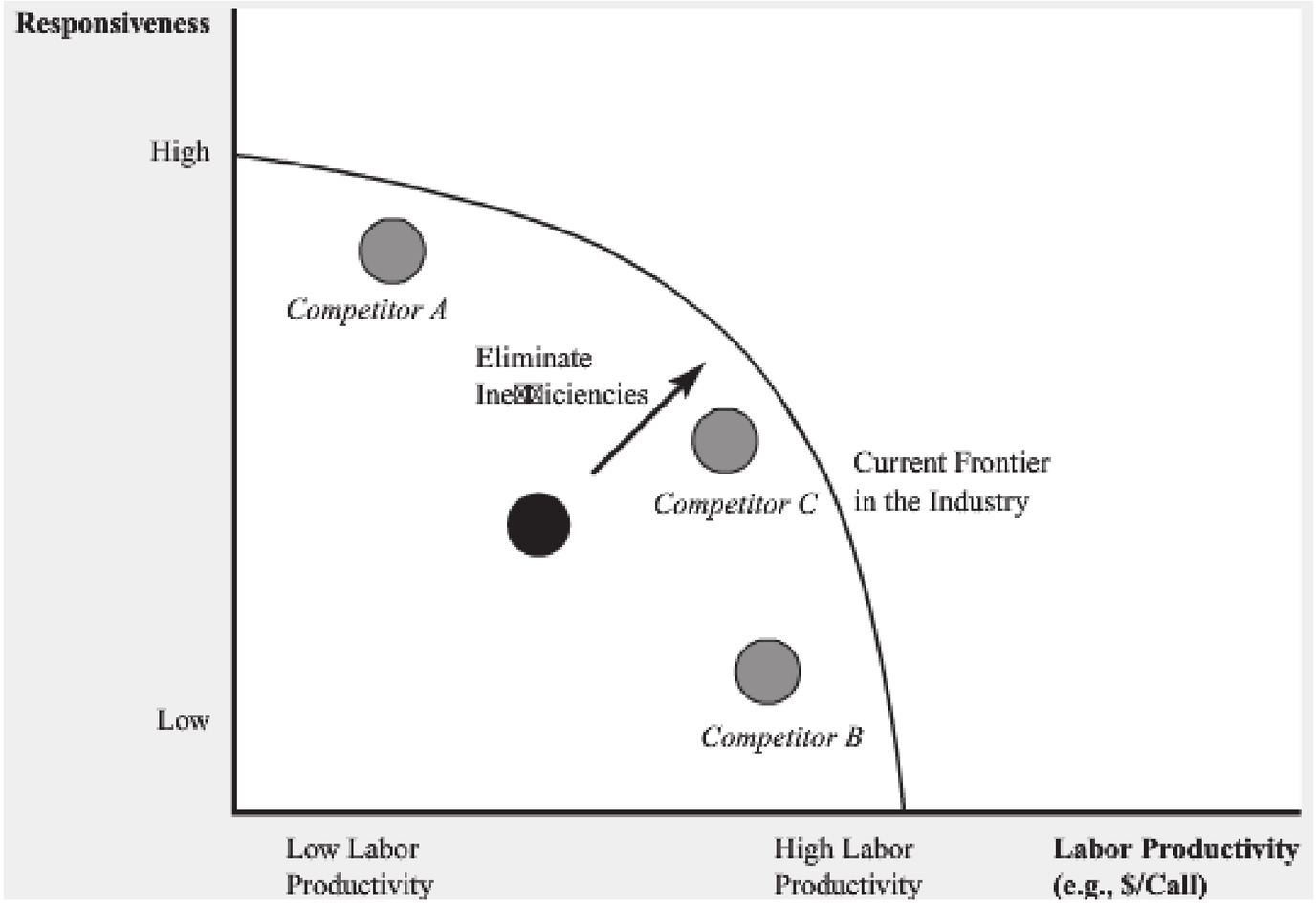
Strategic dimensions

- Cost
- Product differentiation (both differentiation from competitors and differentiation within a firm)
- Quality
- Delivery speed
- Delivery reliability
- Flexibility

Operations management is concerned with implementing the operations strategy to **achieve leadership along one of these dimensions**

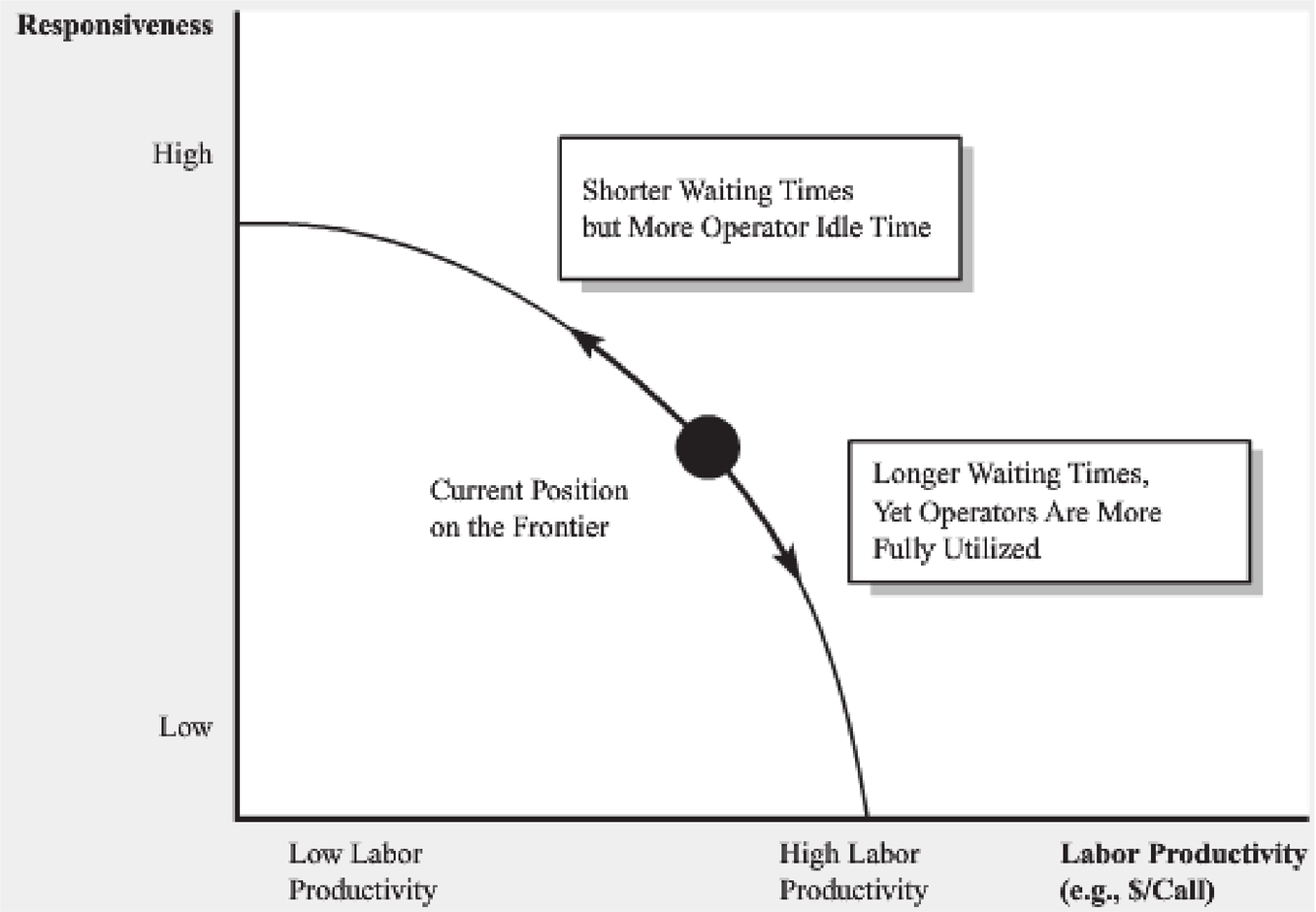
USE OF OM TOOLS TO IMPLEMENT A STRATEGY

OM tools can be applied to ensure that resources are used as efficiently as possible



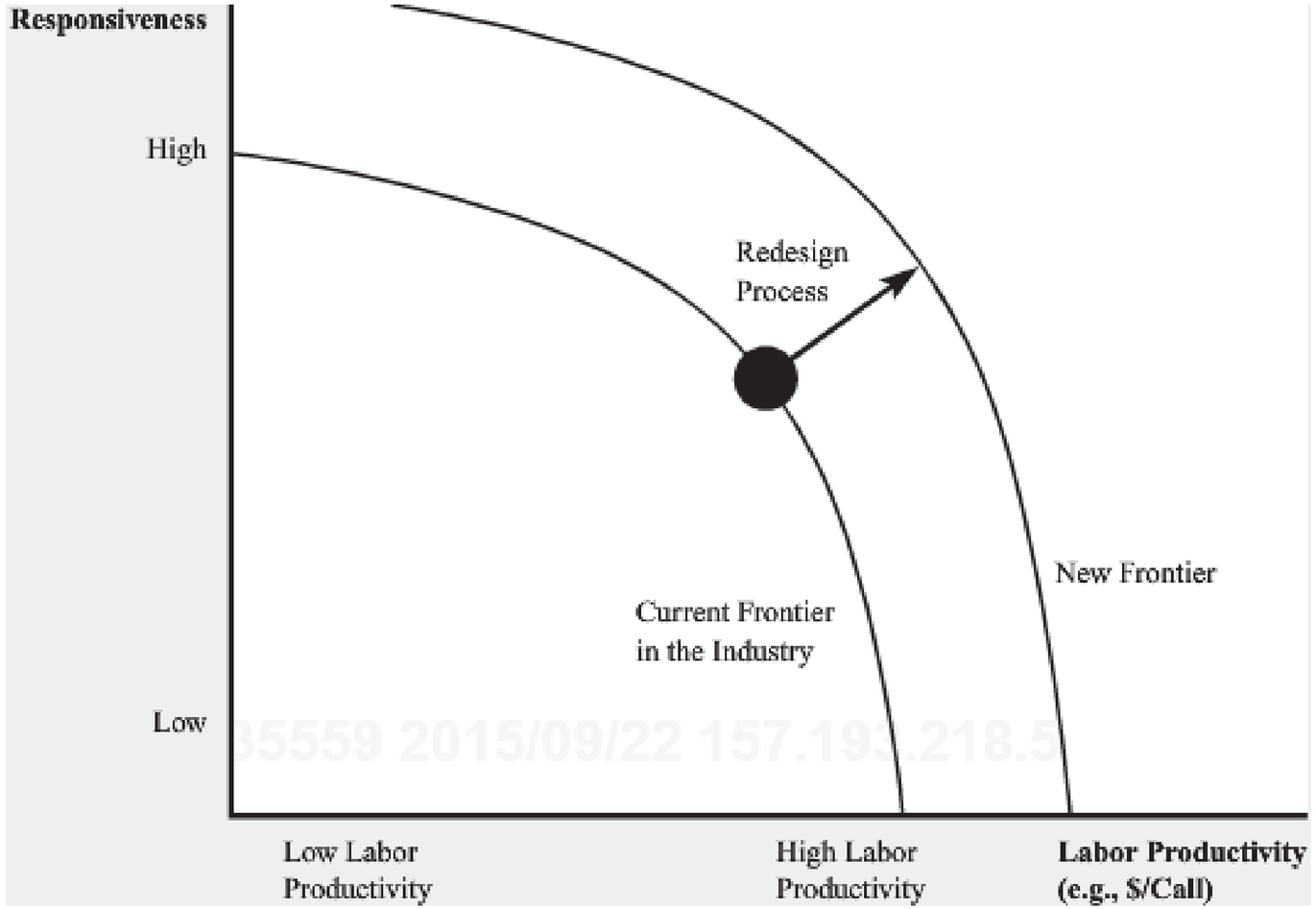
USE OF OM TOOLS TO IMPLEMENT A STRATEGY

OM tools can be used to make desirable trade-offs between competing objectives



USE OF OM TOOLS TO IMPLEMENT A STRATEGY

OM tools can be used to redesign or restructure our operations so that we can improve performance along multiple dimensions simultaneously

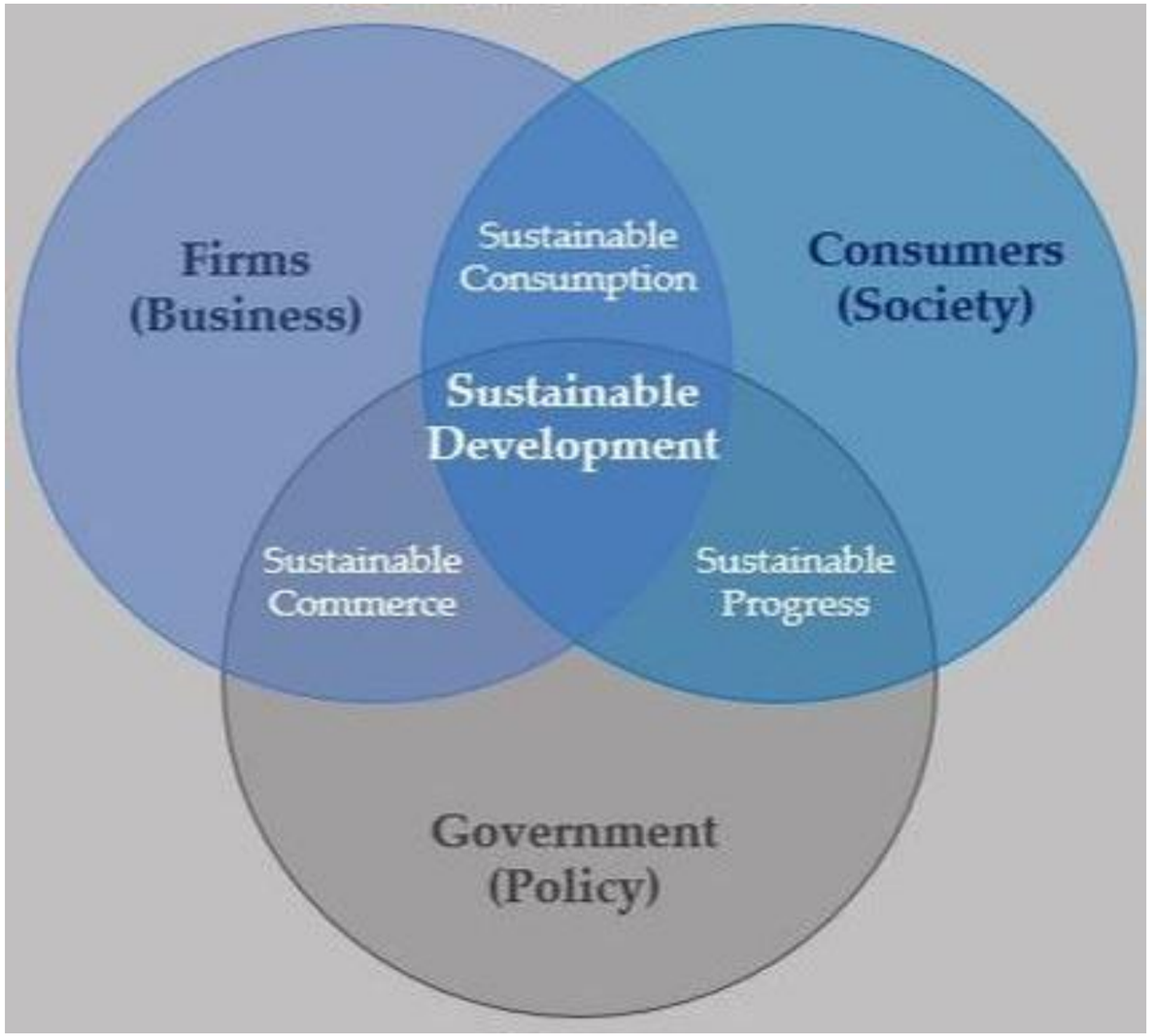


SUSTAINABILITY AS AN OPERATIONS STRATEGY

"Probably one of the most surprising findings in Nike's recently published 2013 Sustainable Business Performance Summary is that the company is not achieving revenue growth and profits despite sustainability but because of it. **Corporate social responsibility** and sustainability have become important areas for most global players but while many tag them on to the agenda as a somewhat cumbersome task, few fully realize the potential that sustainability means."

SUSTAINABILITY AS AN OPERATIONS STRATEGY

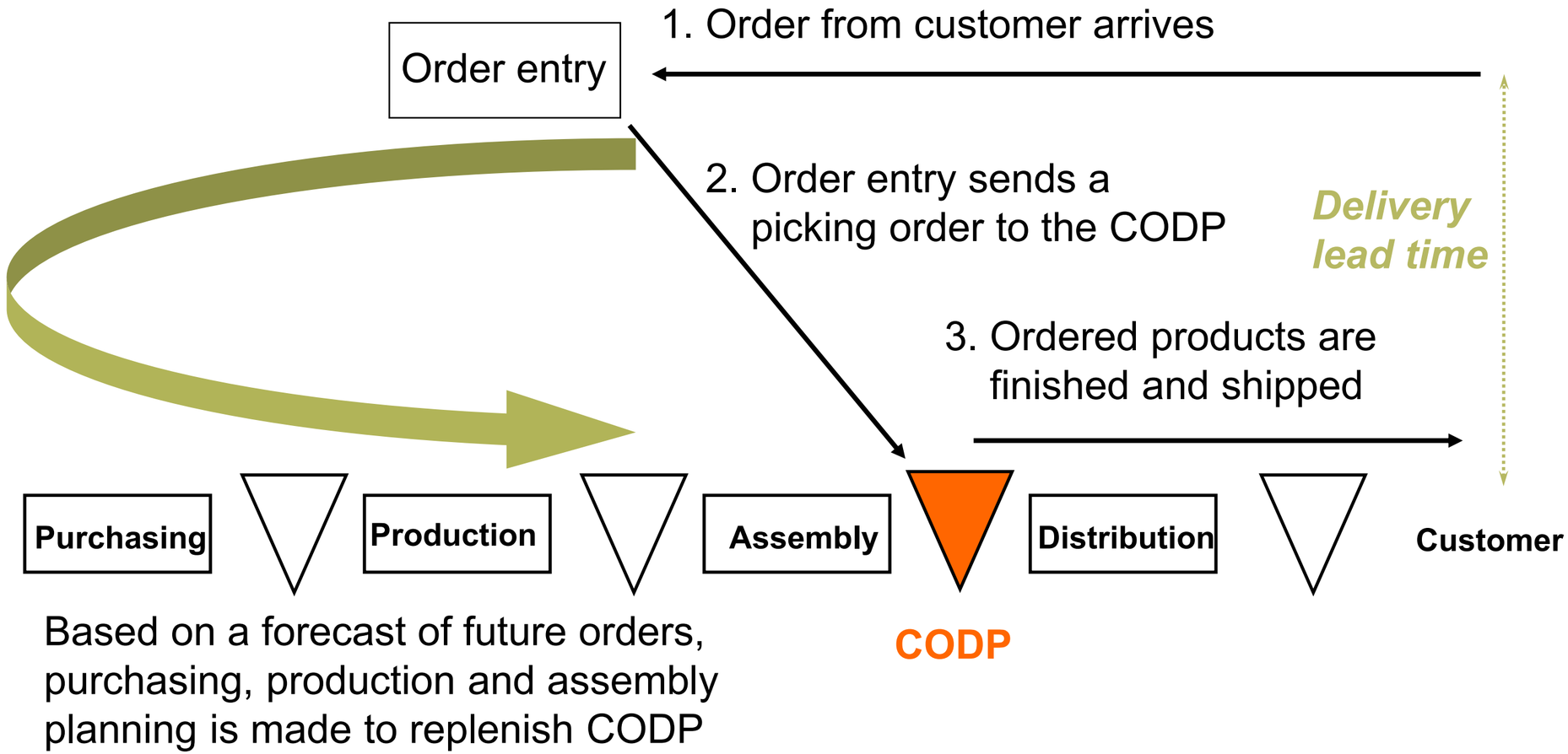
- A shared responsibility →
- Often win-win:
  sustainable operations cut costs (Lean)
- Sustainable innovations
- Sustainability as a marketing strategy



© Colin Gabler

THE CUSTOMER ORDER DECOUPLING POINT (CODP)

The CODP is the inventory point in the value chain for a product, where the product is linked to a specific customer order (order penetration point)



THE CUSTOMER ORDER DECOUPLING POINT (CODP)

- Downstream from CODP: flow based on actual orders
- Upstream from CODP: flow based on forecasts
- Dutch: KOOP = Klanten Order Ontkoppel Punt

POSSIBLE CODP POSITIONS

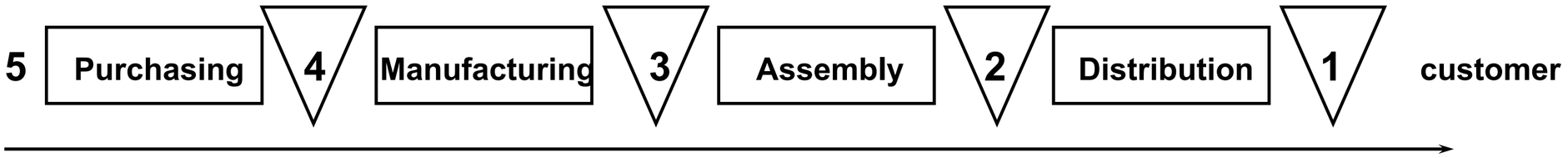
1: Manufacture and distribute to stock (DTS)

2: Manufacture to stock, distribute to order (MTS)

3: Assemble to order (ATO)

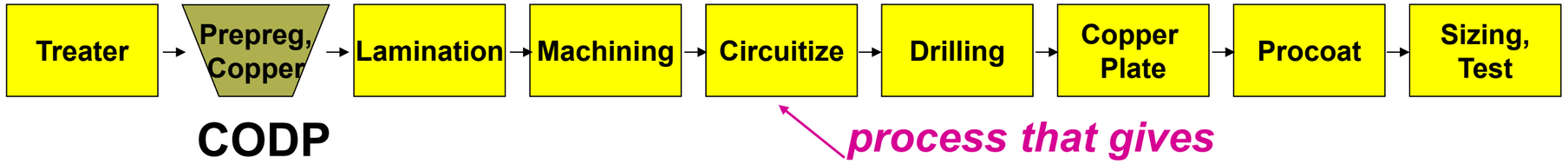
4: Manufacture to order (MTO)

5: Engineer to order (ETO)

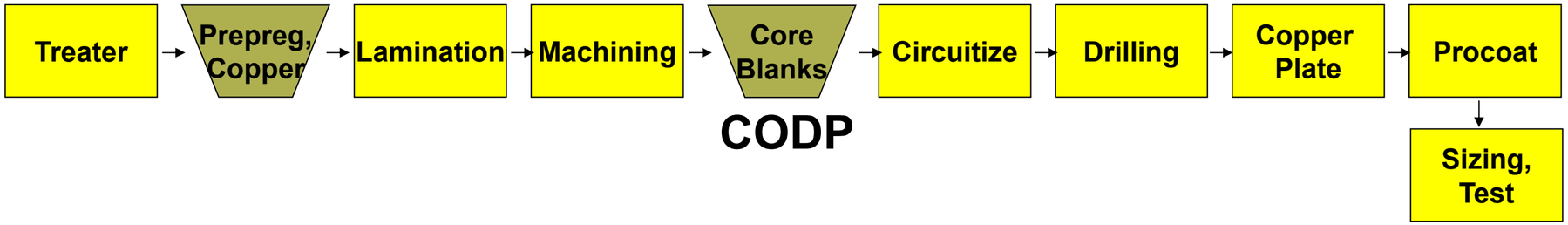


IBM PANEL PLANT

Original Line



Revised Line



- Moving CODP closer to customer shortens lead time
- Lamination and machining are the same for all panels, so 'core blanks' can be made based on forecast and then customized based on individual orders

WHY CODP SHOULD BE DOWNSTREAM

WHY CODP SHOULD BE UPSTREAM

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PERFORMANCE MEASUREMENT: KPI'S

Every company should have a performance scoreboard, according to the balanced scorecard approach:

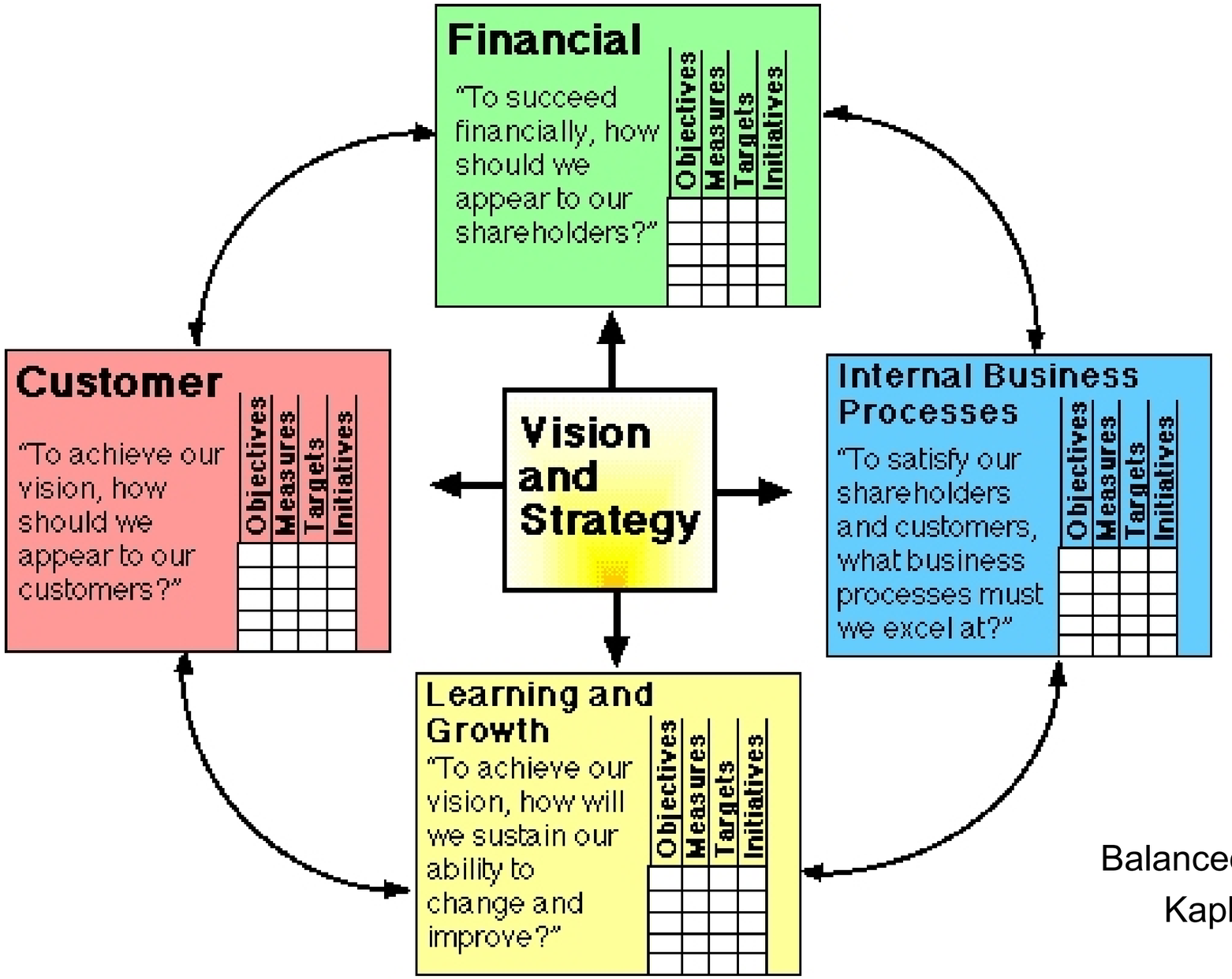
- a holistic set of performance metrics (and corresponding performance standards) that address the major concerns of customers, stockholders, employees and suppliers

Implementing such a set of Key Performance Indicators (KPI's) is a prerequisite to performance improvement:

- people behave based on the way they are measured
- what gets measured gets improved
- it is hard to win a game without a scoreboard; it is hard to even know which game you are playing without a scoreboard

Possible objectives:

- To study the performance of a system over a period of time
- To compare the performance of different systems
- To compare the actual and planned performance of a system



Balanced scorecard approach

Kaplan and Norton (1992)

EXAMPLES OF PERFORMANCE MEASURES FOR OM

Financial
- Return on assets
- Cost
- Cash flow
- Profits

Operations
- Productivity
- Quality

Order fulfillment
- Order accuracy
- Time to fill orders
- Percentage of incomplete orders shipped
- Percentage of orders delivered on time

Suppliers
- Quality
- On-time delivery
- Cooperation
- Flexibility

Inventory
- Average value
- Turnover
- Weeks of supply

Customers
- Customer satisfaction
- Percentage of customer complaints

From: Operations Management: Theory and Practice: Gobal Edition 11e, 11th Edition
Stevenson, William

Performance Metric	Description	Unit
Delivery Performance	The percentage of orders that are fulfilled on or before the original scheduled or committed date or before the customer's requested date.	%
Order fulfilment performance (MTS): fill rate	The percentage of ship-from-stock orders shipped within 24 hours (or within the agreed period) of order receipt	%
Order fulfilment performance (ETO, MTO): order fulfillment lead time	The average actual lead time consistently achieved, from your direct customer signature/authorization to customer receipt of order or to installation complete.	days
Perfect Order fulfilment	The percentage of perfect fulfilled orders	%
Supply-chain response time	Total numbers of days between an expressed need or idea for a new product and the moment the product is launched in the market (average of the last 5 new products introduced)	days
Production flexibility	The number of days required to achieve an unplanned sustainable 20% increase in production	days
Total supply-chain management cost (in % of sales)	The sum of yearly costs for order management, material acquisition, Inventory Carrying, Supply Chain Planning and Management Information System Cost.	%
The Cost of Quality non-conformances (as % of sales)	The cost of materials, labor and problem diagnosis for product defects.	%
Value-added productivity	= (total product revenue - total material purchases)/ (number of employees)	Ratio
Cash-to-cash cycle time	= inventory days of supply + days sales outstanding - average payment period for materials	days
Inventory days of supply	(Average value of total inventory*365)/(Cost of Goods Sold) - based on one year (measured at least monthly or more) or number reported in Financial statement	days
Asset turns	Total gross product revenue/total net assets	Ratio

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THE PRODUCTIVITY CHALLENGE

- Productivity is the ratio of production output over production inputs (= resources).

Productivity = Output/Input

Input = labor, material, capital, energy,…
Output = product **or** service

- Productivity = efficiency + effectiveness
  - Efficiency = how well are the inputs used?
  - Effectiveness = how well is the output made?

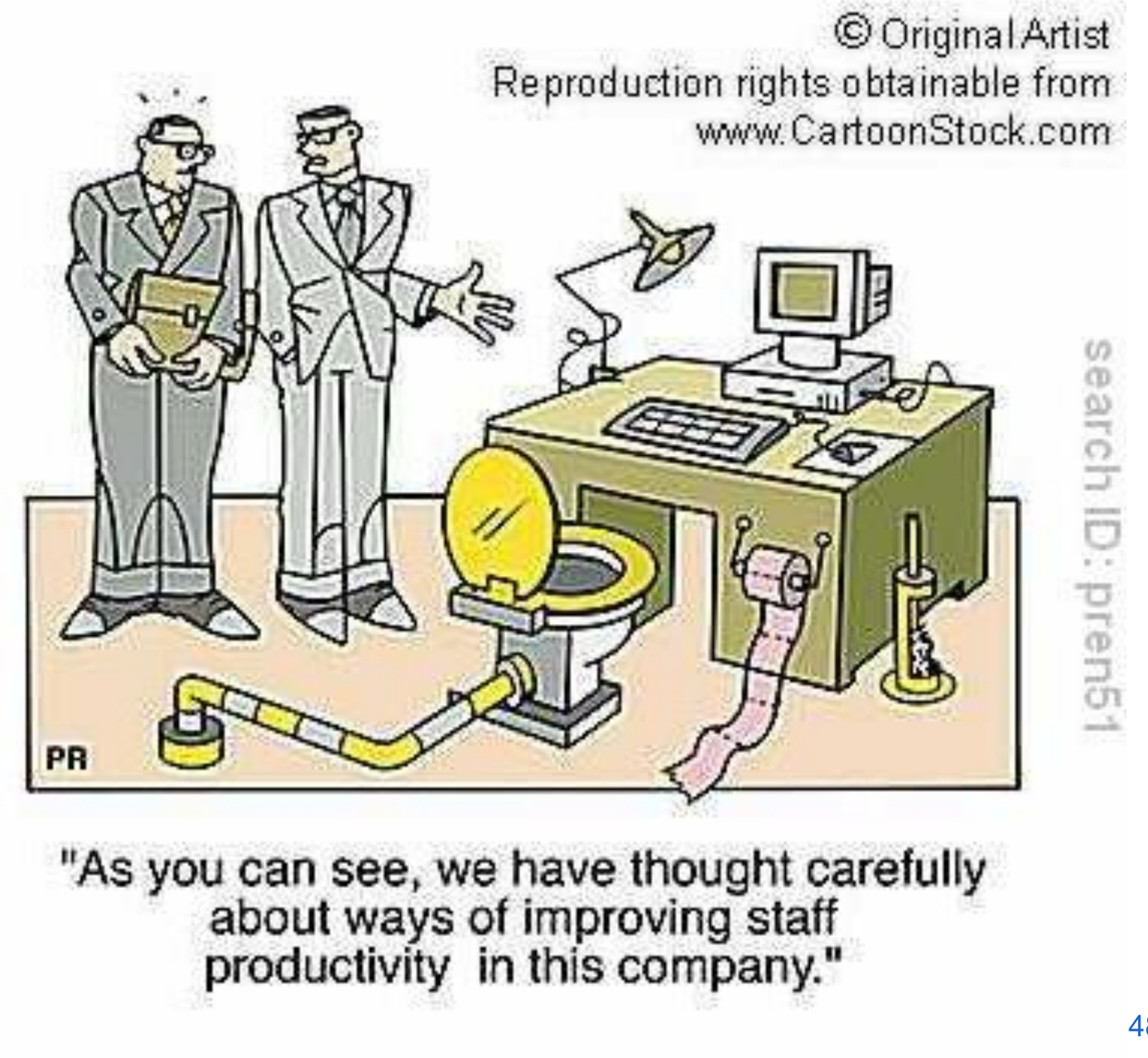
PRODUCTIVITY

Increased production

≠

Increased productivity

Higher productivity means that more is produced with the same expenditure of resources.



PRODUCTIVITY MEASUREMENT

- Although the concept of productivity is simple, measuring productivity is not an easy task
  - If an industry produces different types of output, a common unit of measurement is needed to obtain aggregate output
  - The same is true for obtaining aggregate input when different input resources (land, labor, materials,…) are used
- “Aggregation problem”
- To overcome this problem:
  - input and output can be expressed in monetary terms
  - partial productivities may be expressed

PARTIAL PRODUCTIVITY

= the ratio of output over input from a single input factor

$$Material\ productivity = \frac{Total\ output}{Material\ input}$$

$$Labor\ productivity = \frac{Total\ output}{Man\ hours}$$

$$Capital\ productivity = \frac{Total\ output}{Cost\ of\ capital}$$

$$Energy\ productivity = \frac{Total\ output}{Energy\ consumption}$$

The type of partial productivity used depends on the nature of the enterprise:

- For capital intensive industries: capital productivity
- For industries with costly material resources: material productivity

PRODUCTIVITY MEASUREMENT

Example:

- A potter works 8h/day, producing 400 pots/month using a wood-fired kiln
- Change in the method of work: 500 instead of 400 pots/month with the same equipment and hours of work
- What is the potter’s productivity increase?

PRODUCTIVITY MEASUREMENT

- Assume that he was unable to sell all 500 pots and had to lower his price from $2 to $1.80 a pot
- What is the potter's productivity increase in monetary terms?

PRODUCTIVITY MEASUREMENT

- Assume the potter replaces his wood-fired kiln by an oil-fired kiln. Investment cost = $6000; amortization over 10 years. Also, he will need oil instead of wood which will cost him $10/month more. He can now produce 600 pots/month and sell them at $1.60/pot.
- What is the impact on labor productivity in monetary terms?

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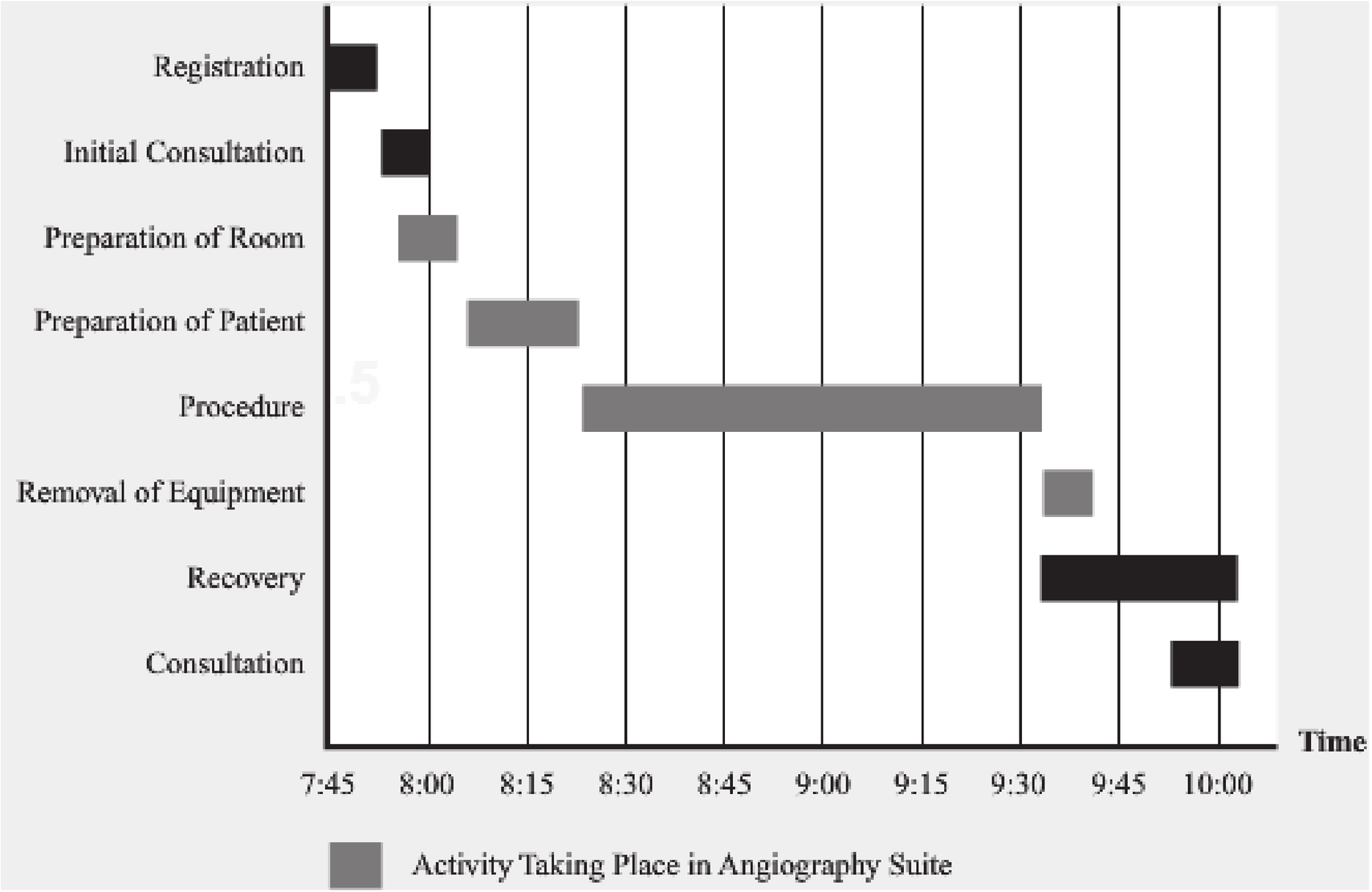
MANAGING AND ANALYZING BUSINESS PROCESSES

@ Presbytarian Hospital Philadelphia – radiology unit

- Registration of the patient
- Initial consultation with the doctor
- Preparation of the procedure
- Actual procedure
- Removal of all equipment
- Recovery
- Consultation with the doctor

Understand the system and analyze its efficiency

PROCESS MAPPING



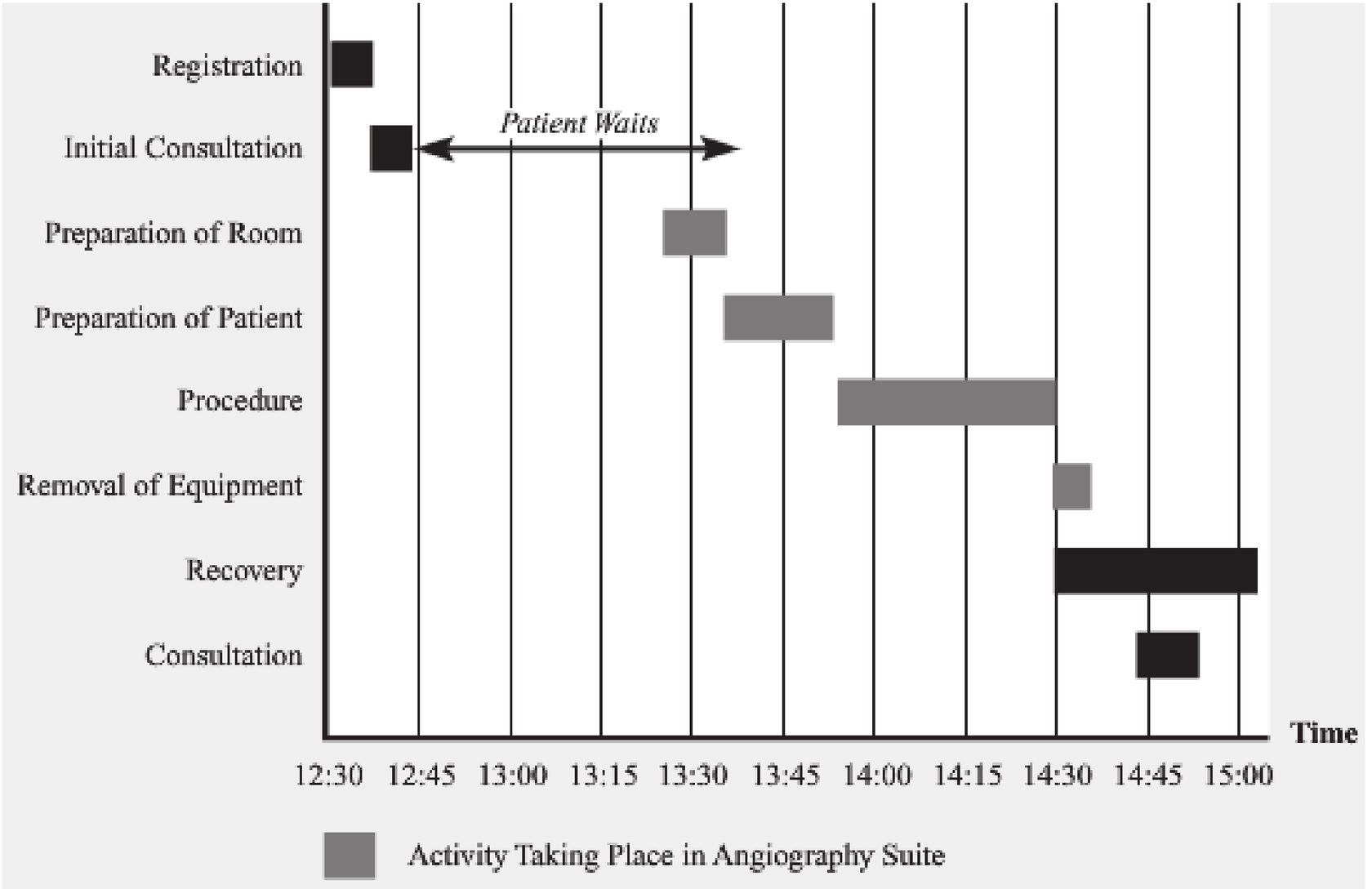
Gantt chart summarizing the activities – critical path

PROCESS MAPPING

Patient log

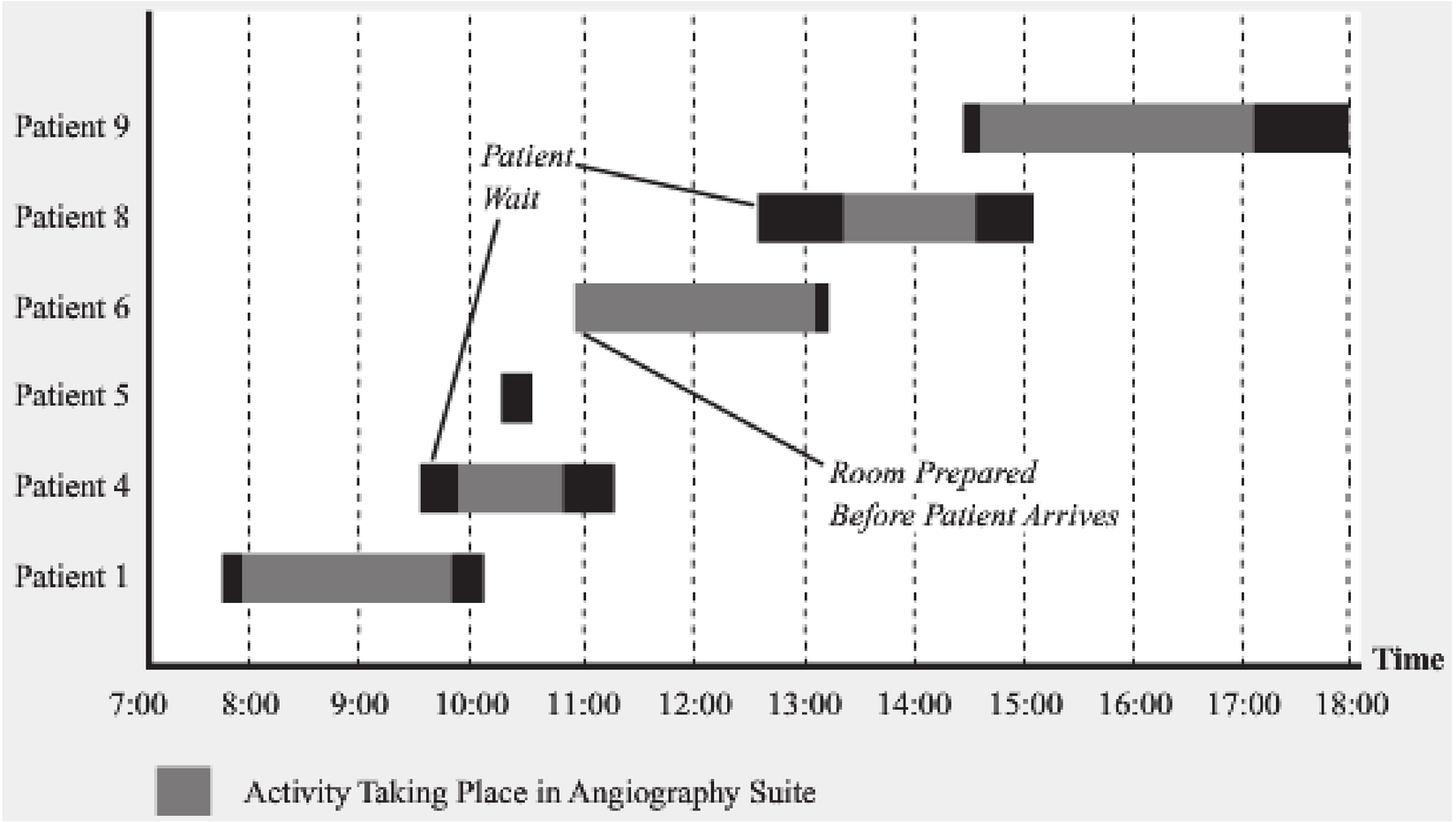
Patient	Arrival	Departure	Flow time (min.)	Room assignment
1	7:35	8:50	75	Main room
2	7:45	10:05	140	
3	8:10	10:10	120	
4	9:30	11:15	105	Main room
5	10:15	10:30	15	Main room
6	10:30	13:35	185	Main room
7	11:05	13:15	130	
8	12:35	15:05	150	Main room
9	14:30	18:10	220	Main room
10	14:35	15:45	70	
11	14:40	17:20	160	

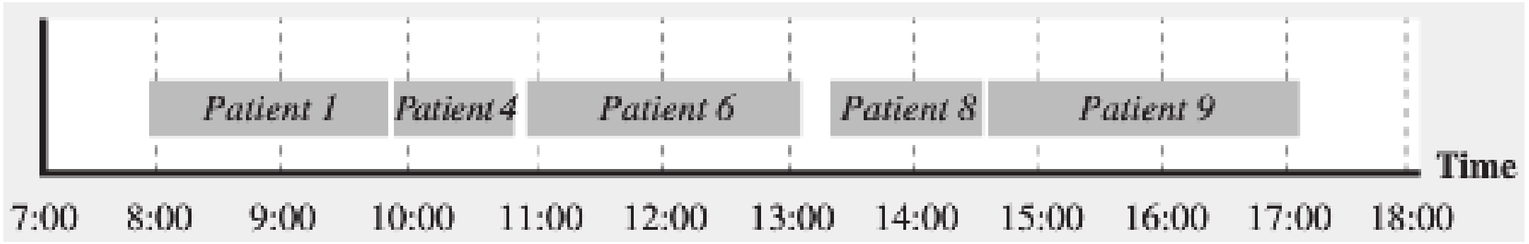
PROCESS MAPPING



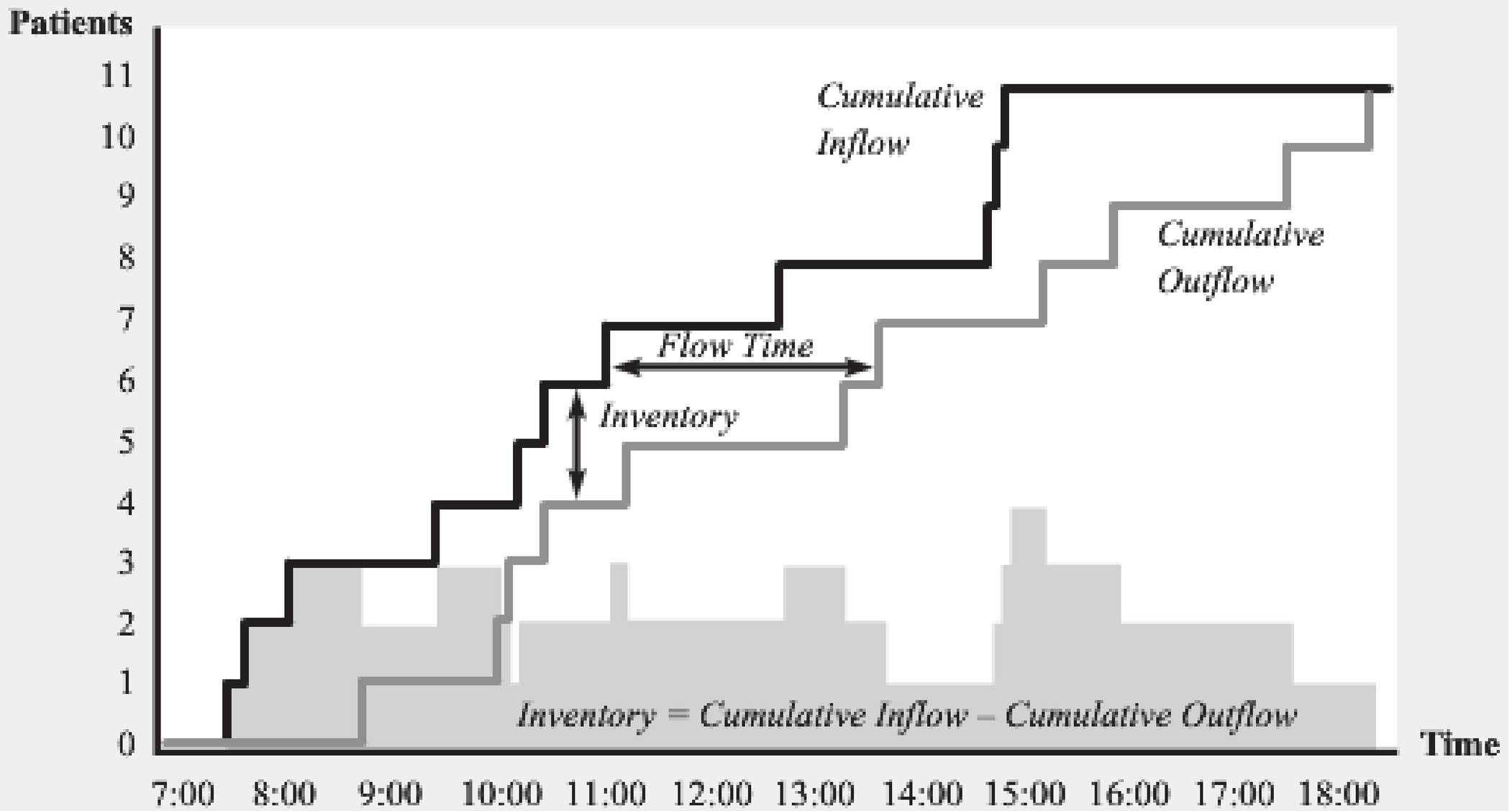
Gantt chart summarizing the activities for a patient arriving at 12:30

PROCESS MAPPING – USAGE OF THE MAIN ROOM





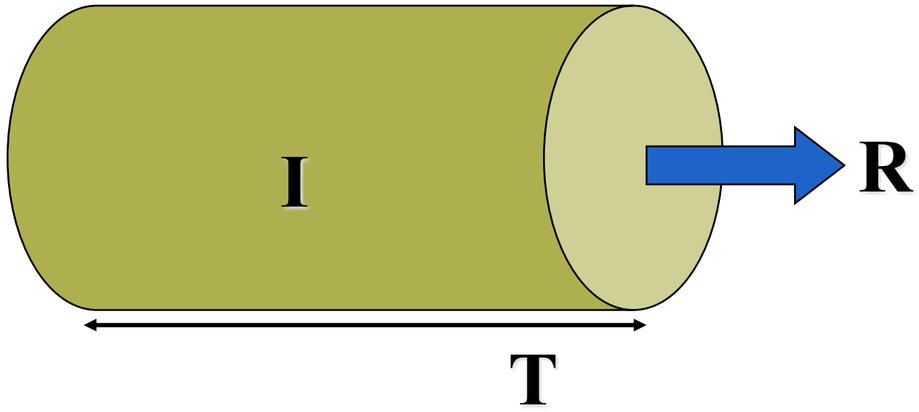
PROCESS MAPPING – CUMULATIVE IN- AND OUTFLOW



LITTLE'S LAW

There is a simple, linear relationship between

- Flow rate R (throughput rate)
- Flow time T
- Inventory I



$$I = R \times T$$

– **Little's Law always holds!**

LITTLE'S LAW

@ Presbytarian Hospital Philadelphia – radiology unit

- Flow rate R = 11/10.58h, which is equal to 1.04 patients/hour
- Flow time T = 2.08 hours

- Inventory I = 2.16 patients

Note: for services, the flow unit can be a person

LITTLE'S LAW

As soon as 2 values are known, the third is easily determined.

Examples:

- R = 5000 claims per year
- T = 5 weeks = 1/10 year

  → Average inventory I = 500 files in process

- R = 20,000 tablets per day
- I = 200,000 tablets

  → Average flow time T = 10 days

LITTLE'S LAW : MATCHING SUPPLY WITH DEMAND

Reducing inventory is possible by

- Reducing flow rate R (usually not an option)
- Reducing flow time T ("time-based competition")

To produce at a certain througput rate (demand):

- Production time
- Waiting time:
  - Due to mismatch between supply and demand
  - Due to uncertainty (production time, demand, …)

→ this will lead to work-in-process inventory

Buffers:

- Inventory (e.g., bread)
- Lead time (e.g., patients waiting in the hospital)
- Capacity (e.g., guests in a luxury hotel)

QUESTIONS/REMARKS