Introduction to Operations Management
运营管理概论

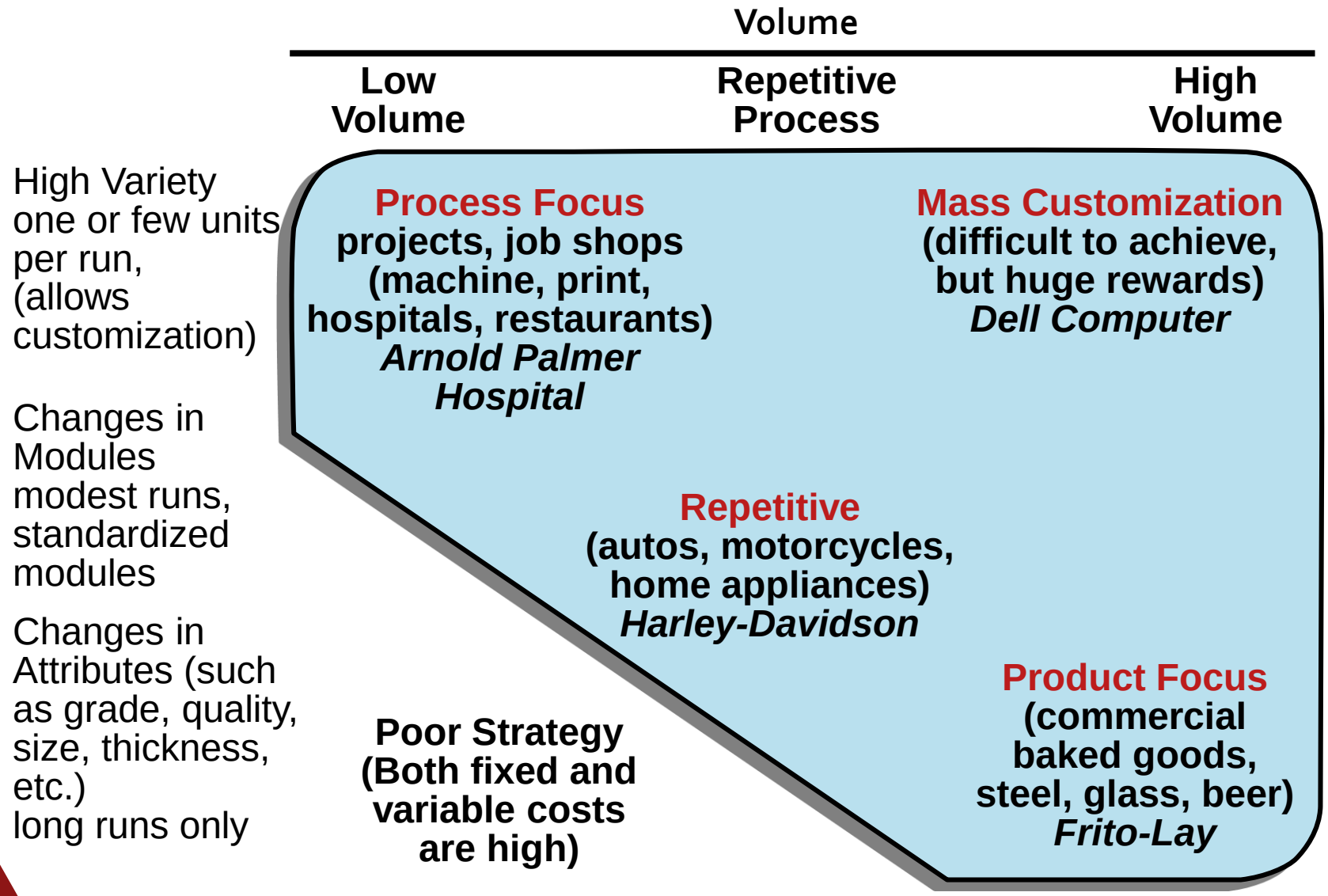
6- Workshops and Productivity

范登波 Thomas VANDENBOGAERDE, CPIM

Thomas.vandenbogaerde@gmail.com

If any question: WeChat: fandengbo85

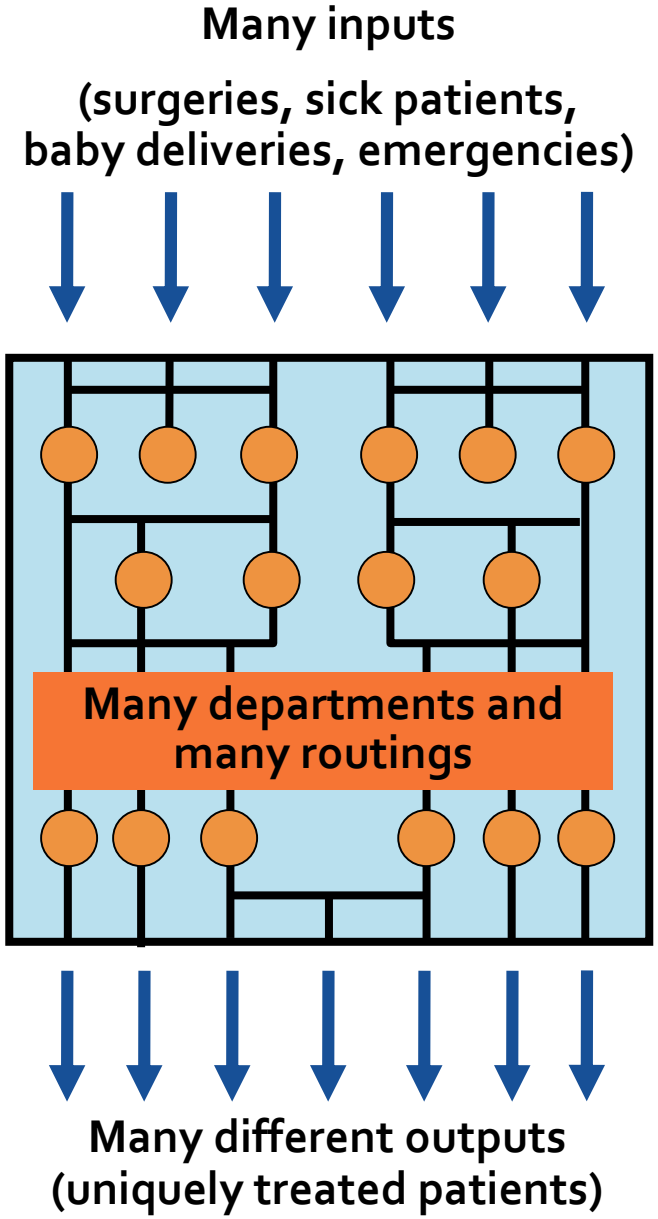
Process, Volume, and Variety



Process Focus

(low volume, high variety, intermittent processes)

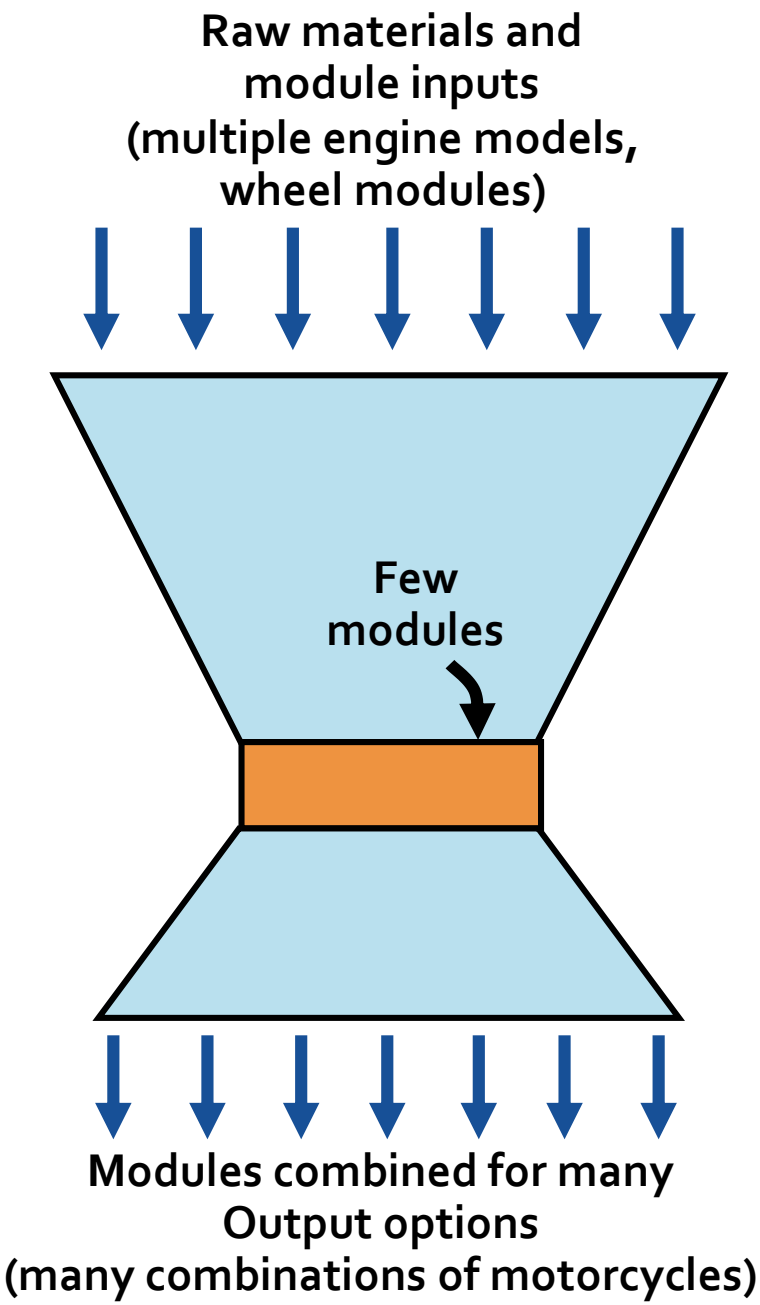
Arnold Palmer Hospital



Repetitive Focus

(modular)

Harley Davidson



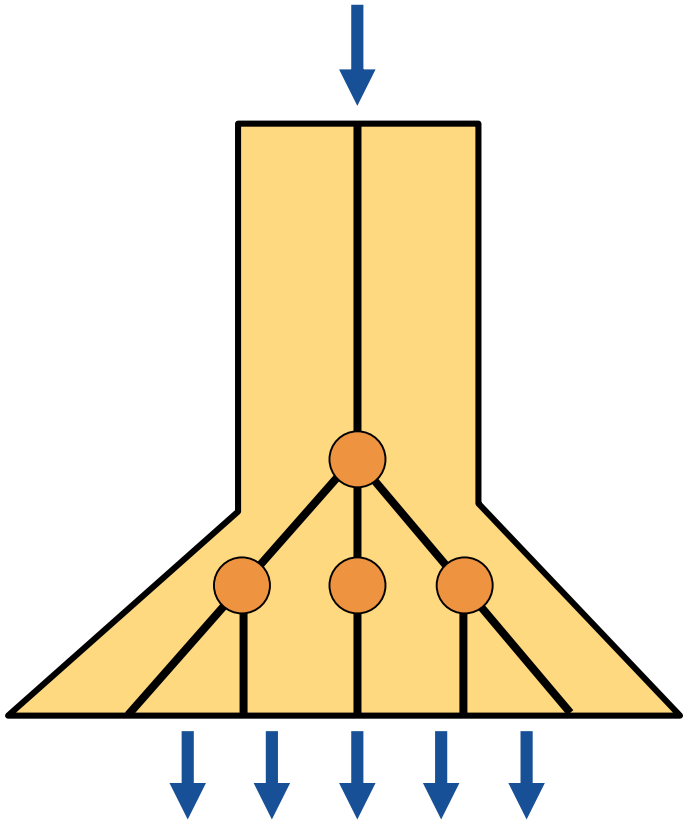
Product Focus

(low-volume, high variety, continuous process)

Frito-Lay

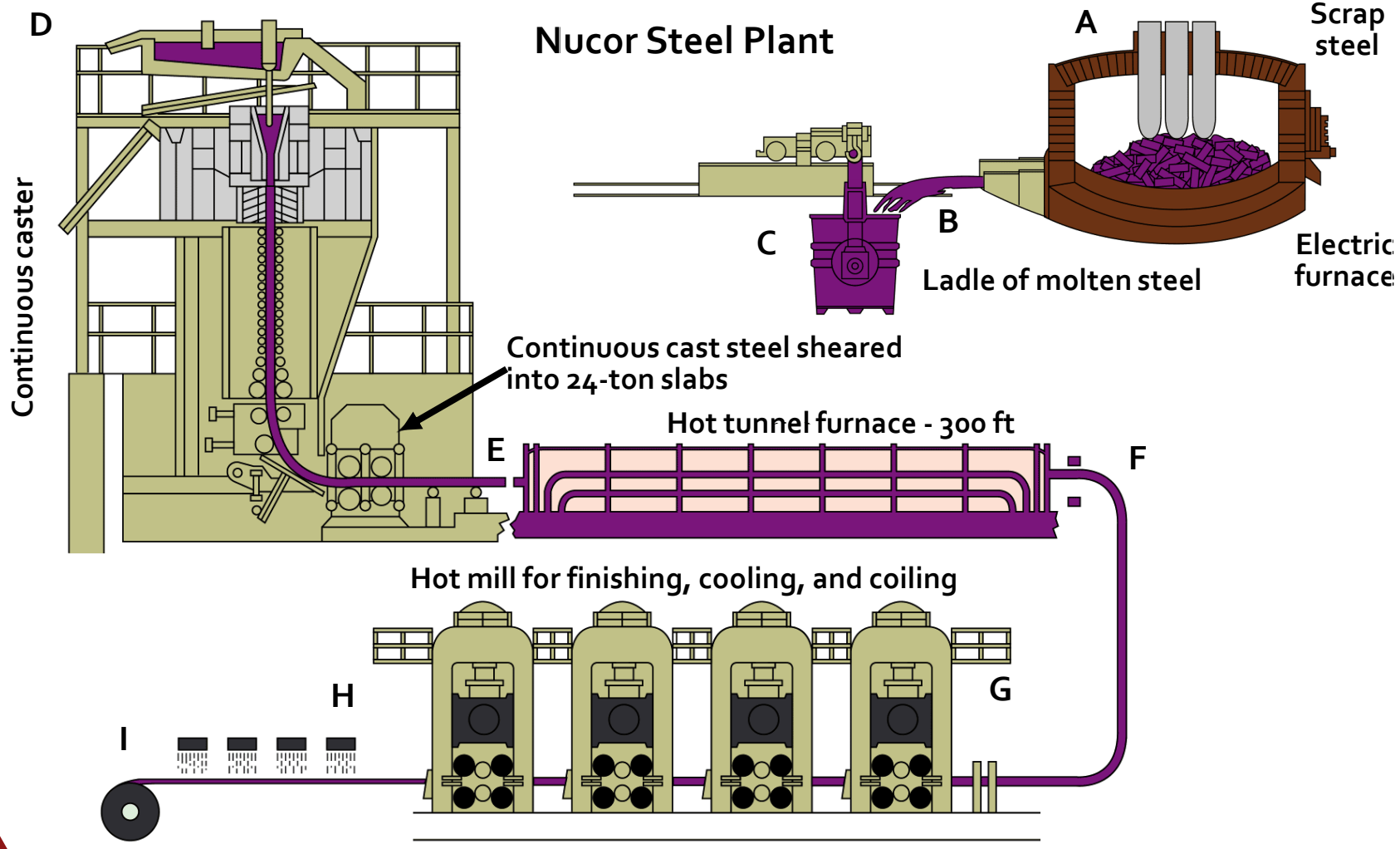
Few Inputs

(corn, potatoes, water, seasoning)



Output variations in size, shape, and packaging
(3-oz, 5-oz, 24-oz package labeled for each material)

Product Focus



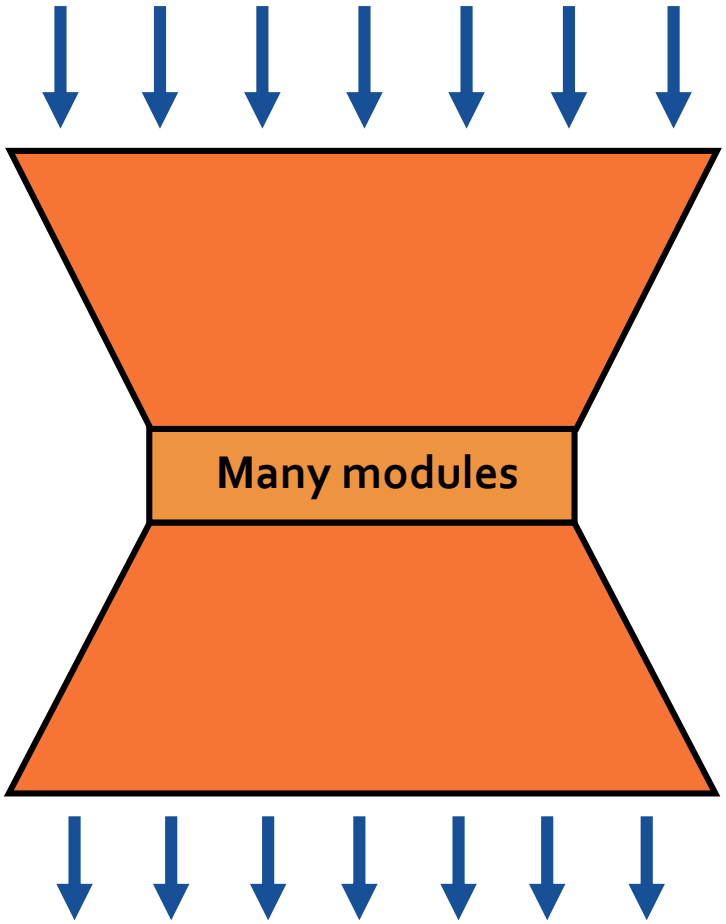
Mass Customization

Item	Number of Choices	
	1970s	21st Century
Vehicle models	140	286
Vehicle types	18	1,212
Bicycle types	8	211,000
Software titles	0	400,000
Web sites	0	162,000,000
Movie releases per year	267	765
New book titles	40,530	300,000
Houston TV channels	5	185
Breakfast cereals	160	340
Items (SKUs) in supermarkets	14,000	150,000
LCD TVs	0	102

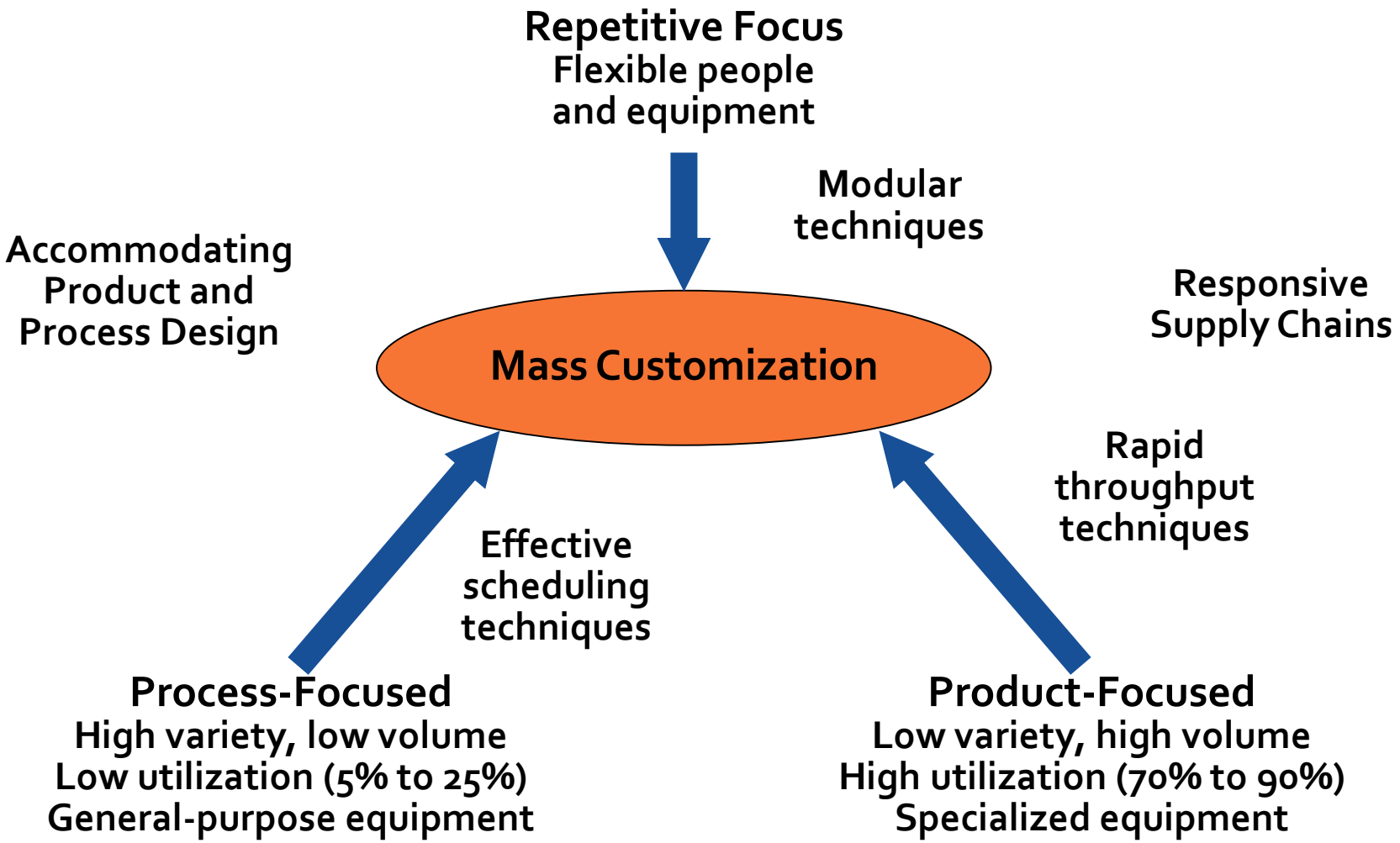
Mass Customization

(high-volume, high-variety)

Dell Computer



Mass Customization



Innovations at McDonald's

- Indoor seating (1950s)
- Drive-through window (1970s)
- Adding breakfast to the menu (1980s)
- Adding play areas (late 1980s)
- Redesign of the kitchens (1990s)
- Self-service kiosk (2004)
- Now three separate dining sections

Six out of the seven are layout decisions!

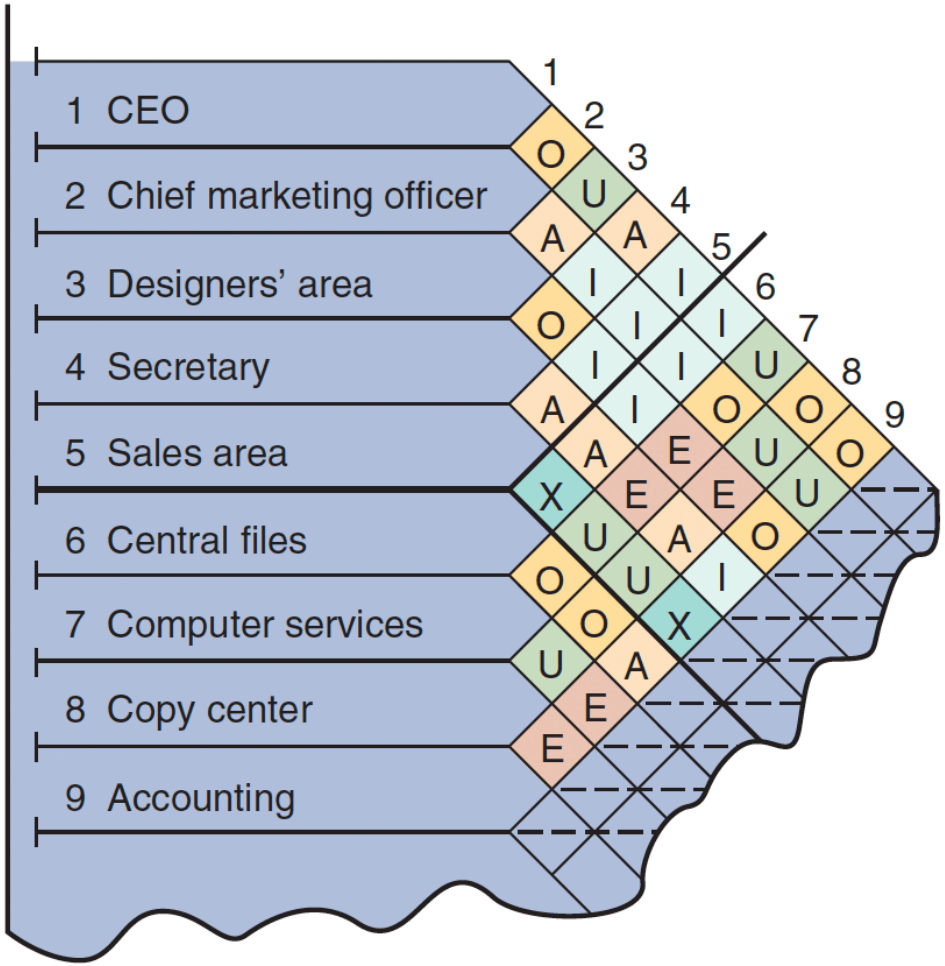
Layout Strategies

	Objectives	Examples
Office	Locate workers requiring frequent contact close to one another	Allstate Insurance Microsoft Corp.
Retail	Expose customer to high-margin items	Kroger's Supermarket Walgreen's Bloomingdale's
Warehouse (storage)	Balance low cost storage with low-cost material handling	Federal-Mogul's warehouse The Gap's distribution center
Project (fixed position)	Move material to the limited storage areas around the site	Ingall Ship Building Corp. Trump Plaza Pittsburgh Airport
Job Shop (process oriented)	Manage varied material flow for each product	Arnold Palmer Hospital Hard Rock Cafe Olive Garden
Work Cell (product families)	Identify a product family, build teams, cross train team members	Hallmark Cards Wheeled Coach Standard Aero
Repetitive/ Continuous (product oriented)	Equalize the task time at each workstation	Sony's TV assembly line Toyota Scion

Office Layout

- **Grouping of workers, their equipment, and spaces to provide comfort, safety, and movement of information**
- **Movement of information is main distinction**
- **Typically in state of flux due to frequent technological changes**

Relationship Chart



Value	CLOSENESS
A	Absolutely necessary
E	Especially important
I	Important
O	Ordinary OK
U	Unimportant
X	Not desirable

Five Helpful Ideas for Supermarket Layout

1. **Locate high-draw items around the periphery of the store**
2. **Use prominent locations for high-impulse and high-margin items**
3. **Distribute power items to both sides of an aisle and disperse them to increase viewing of other items**
4. **Use end-aisle locations**
5. **Convey mission of store through careful positioning of lead-off department**

Store Layout

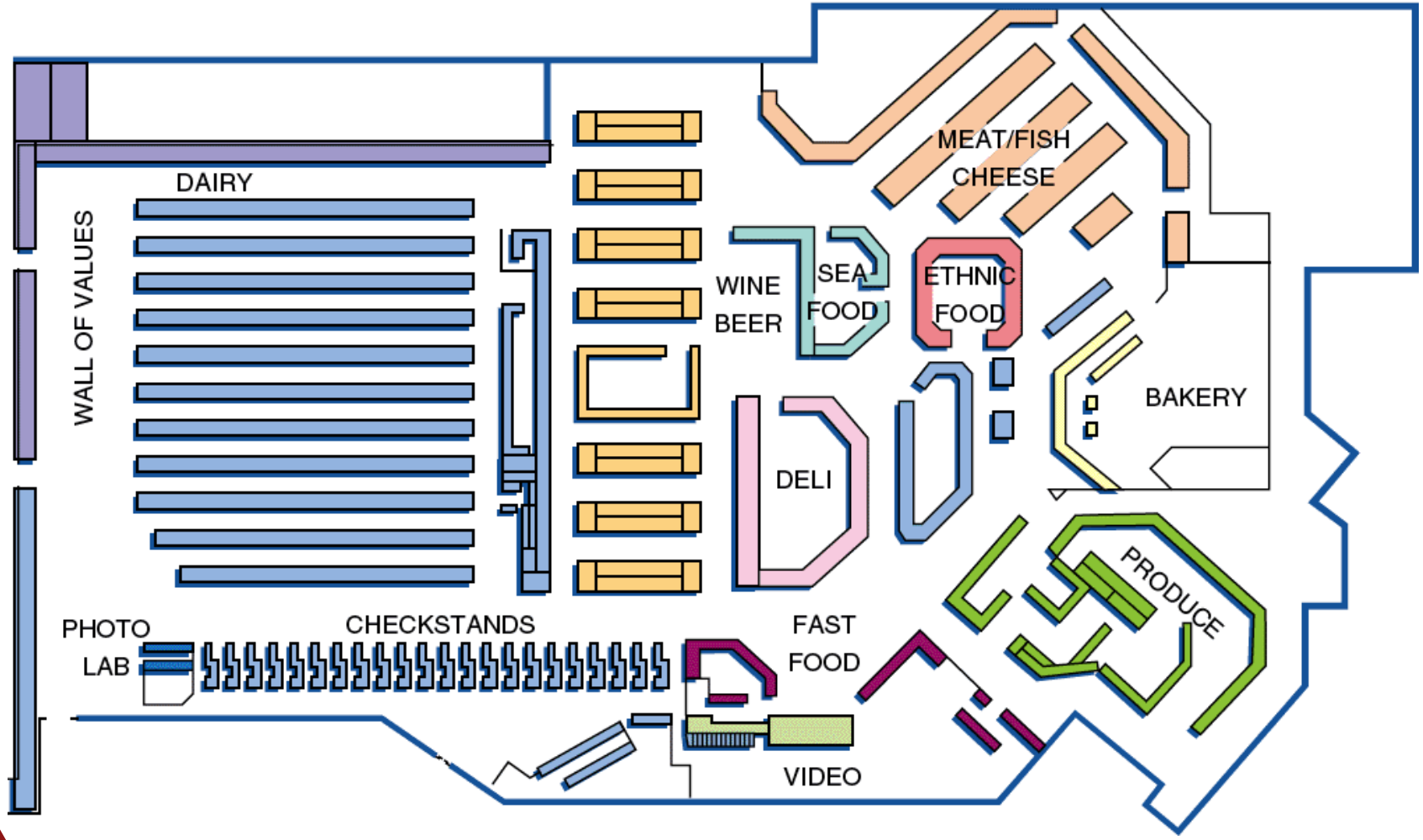
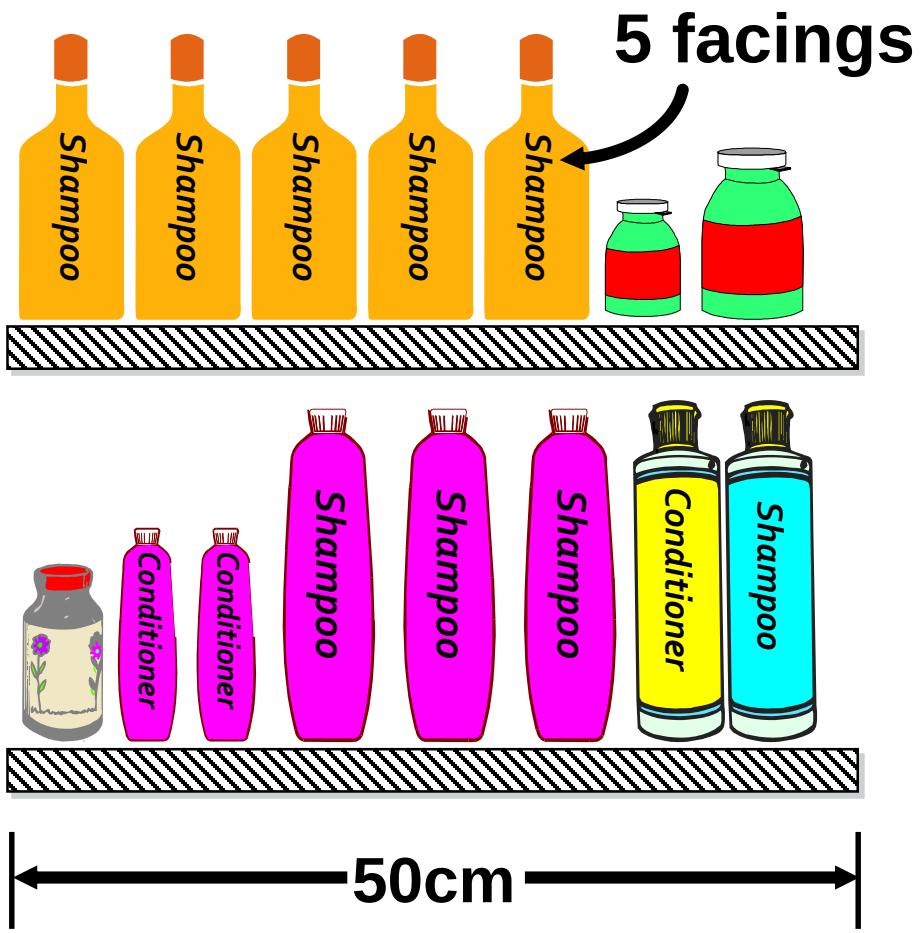


Figure 9.2

Retail Store Shelf Space Planogram

- Computerized tool for shelf-space management
- Generated from store's scanner data on sales
- Often supplied by manufacturer

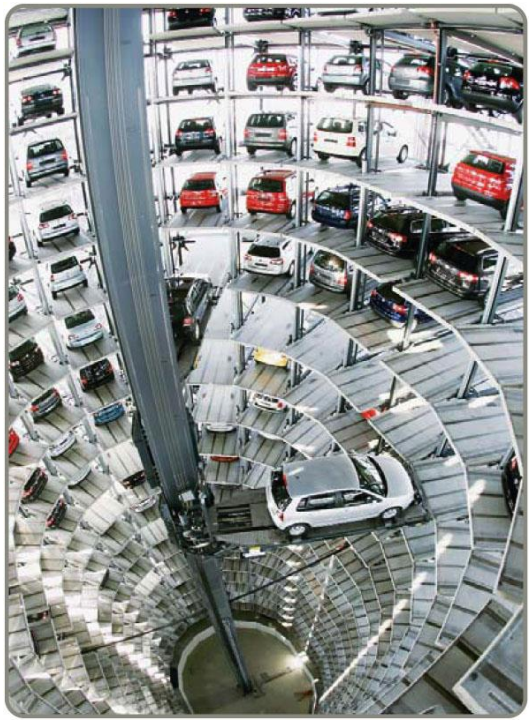


Servicescapes

1. **Ambient conditions** - background characteristics such as lighting, sound, smell, and temperature
2. **Spatial layout and functionality** - which involve customer
   circulation path planning, aisle characteristics, and product grouping
3. **Signs, symbols, and artifacts** - characteristics of building design that carry social significance

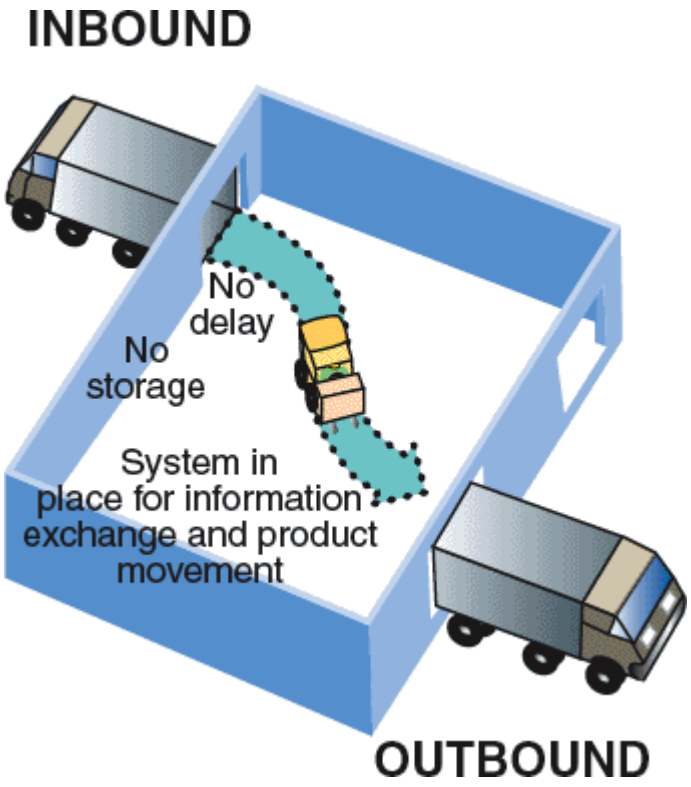
Warehousing and Storage Layouts

- **Warehouse density tends to vary inversely with the number of different items stored**
- **Automated Storage and Retrieval Systems (ASRSs) can significantly improve warehouse productivity by an estimated 500%**
- **Dock location is a key design element**



Cross-Docking

- **Materials are moved directly from receiving to shipping and are not placed in storage in the warehouse**
- **Requires tight scheduling and accurate shipments, bar code or RFID identification used for advanced shipment notification as materials are unloaded**



Random Stocking

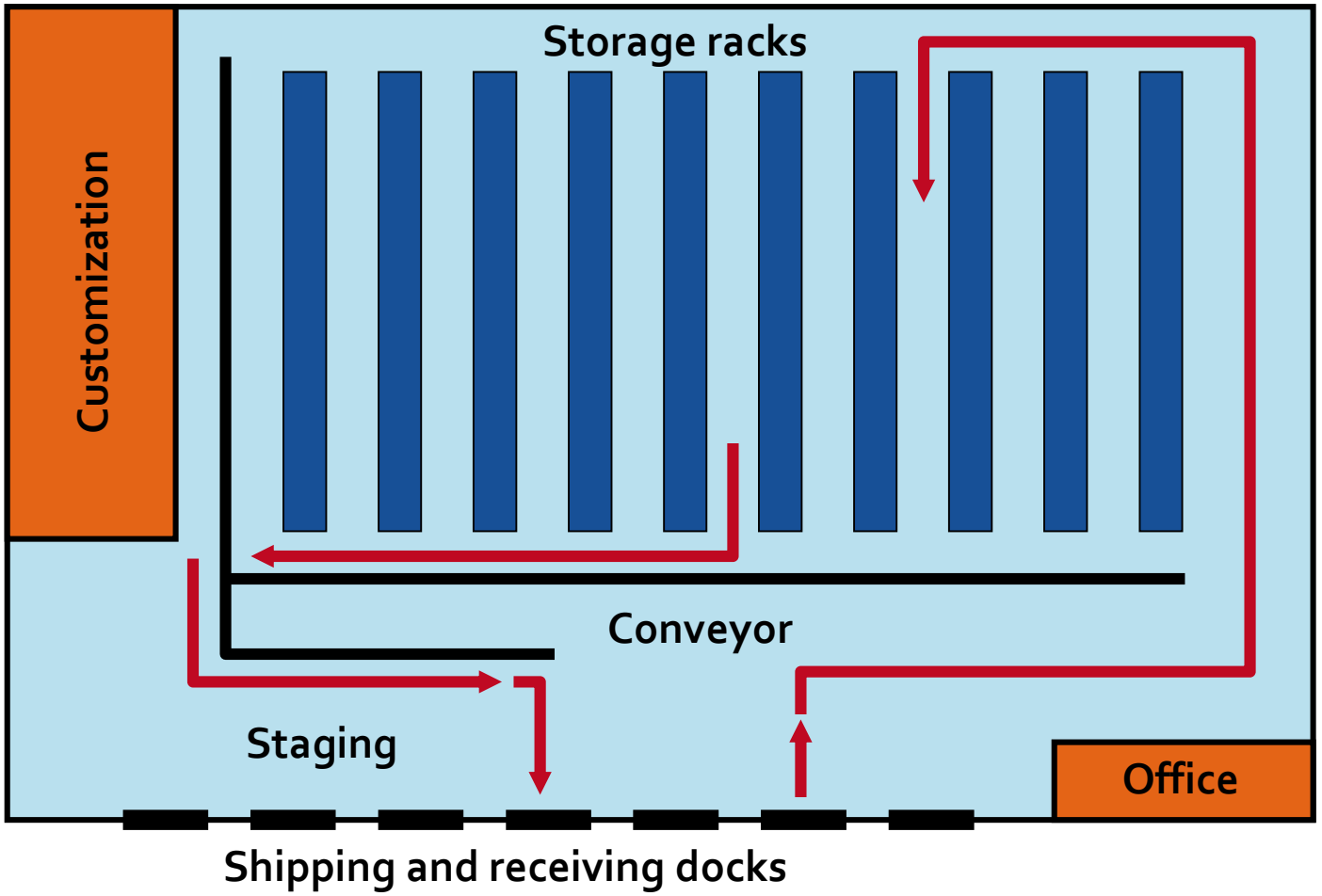
- Typically requires automatic identification systems (AISs) and effective information systems
- Random assignment of stocking locations allows more efficient use of space
- Key tasks
  1. Maintain list of open locations
  2. Maintain accurate records
  3. Sequence items to minimize travel, pick time
  4. Combine picking orders
  5. Assign classes of items to particular areas

Customizing

- **Value-added activities performed at the warehouse**
- **Enable low cost and rapid response strategies**
  - **Assembly of components**
  - **Loading software**
  - **Repairs**
  - **Customized labeling and packaging**

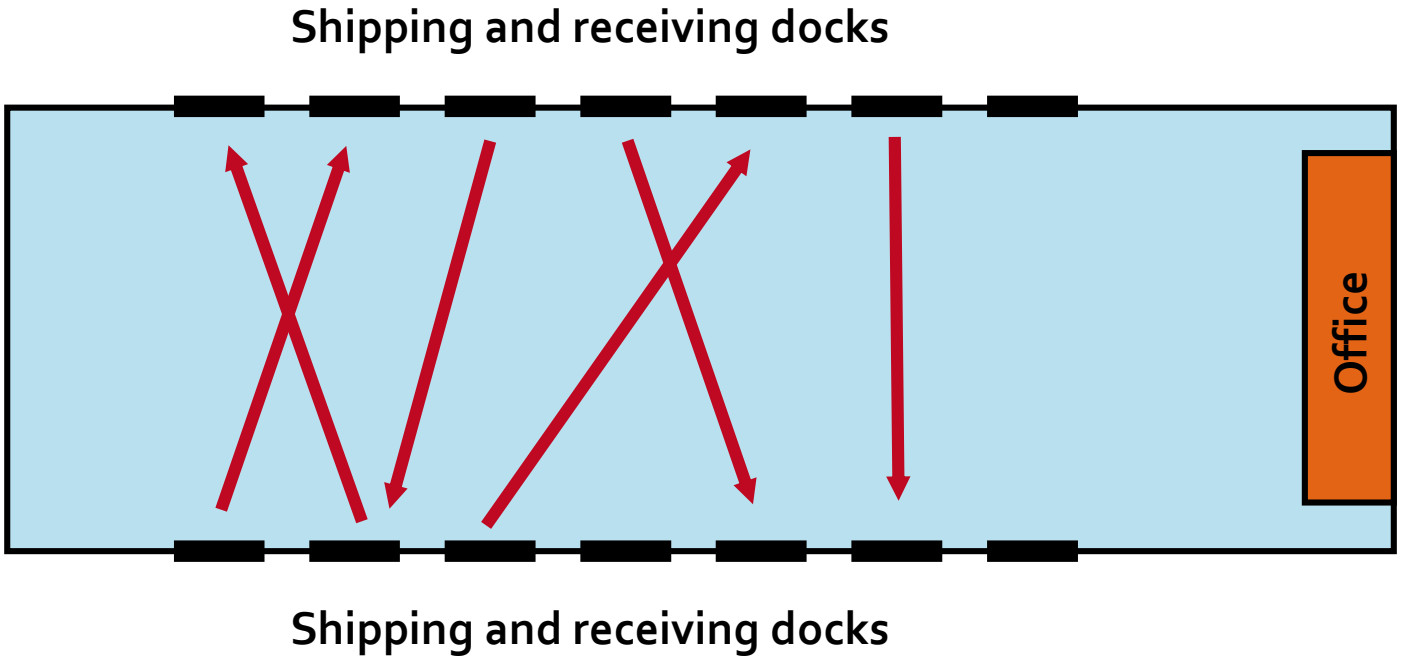
Warehouse Layout

Traditional Layout



Warehouse Layout

Cross-Docking Layout



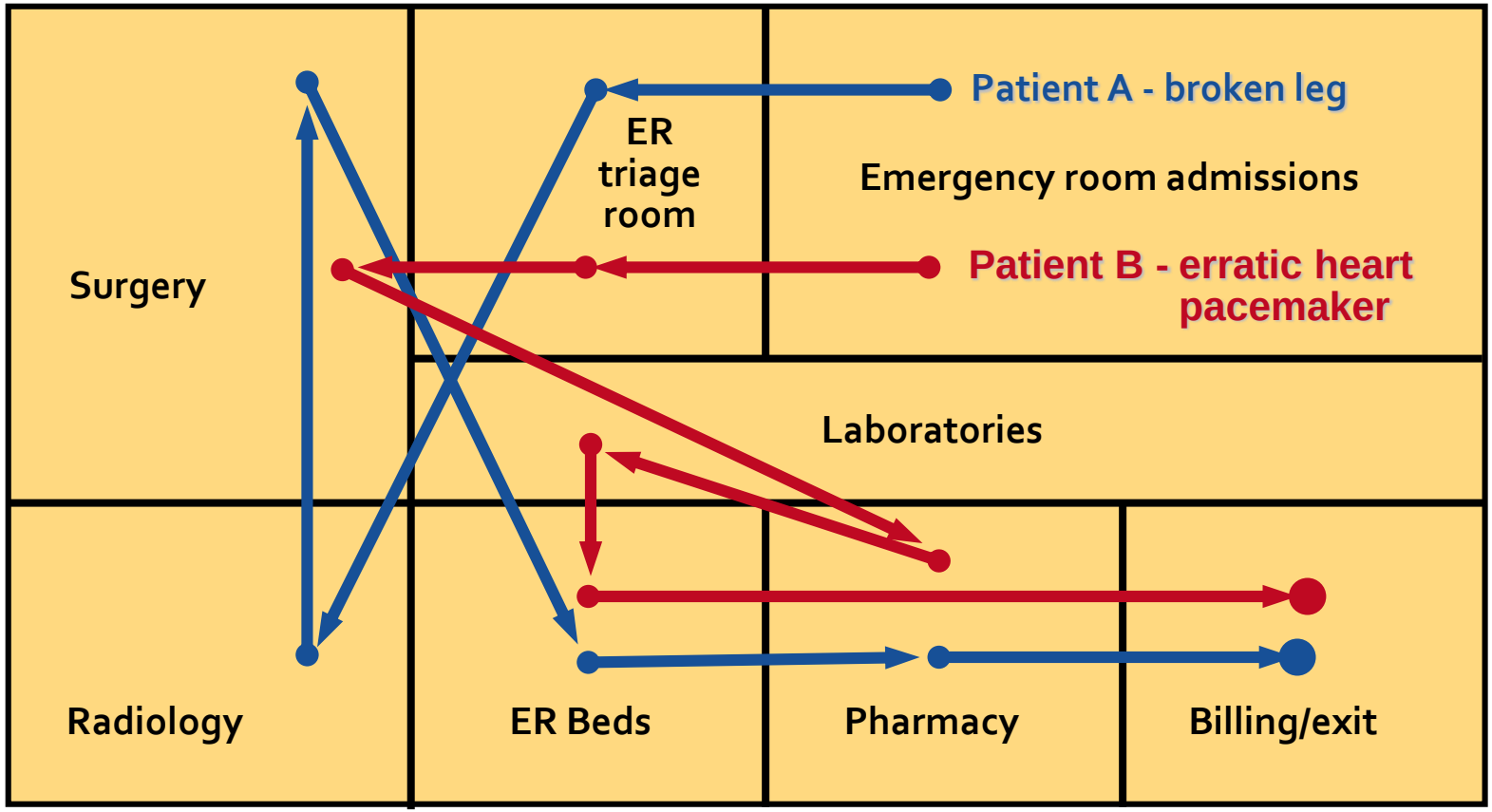
Fixed-Position Layout

- **Product remains in one place**
- **Workers and equipment come to site**
- **Complicating factors**
  - **Limited space at site**
  - **Different materials required at different stages of the project**
  - **Volume of materials needed is dynamic**

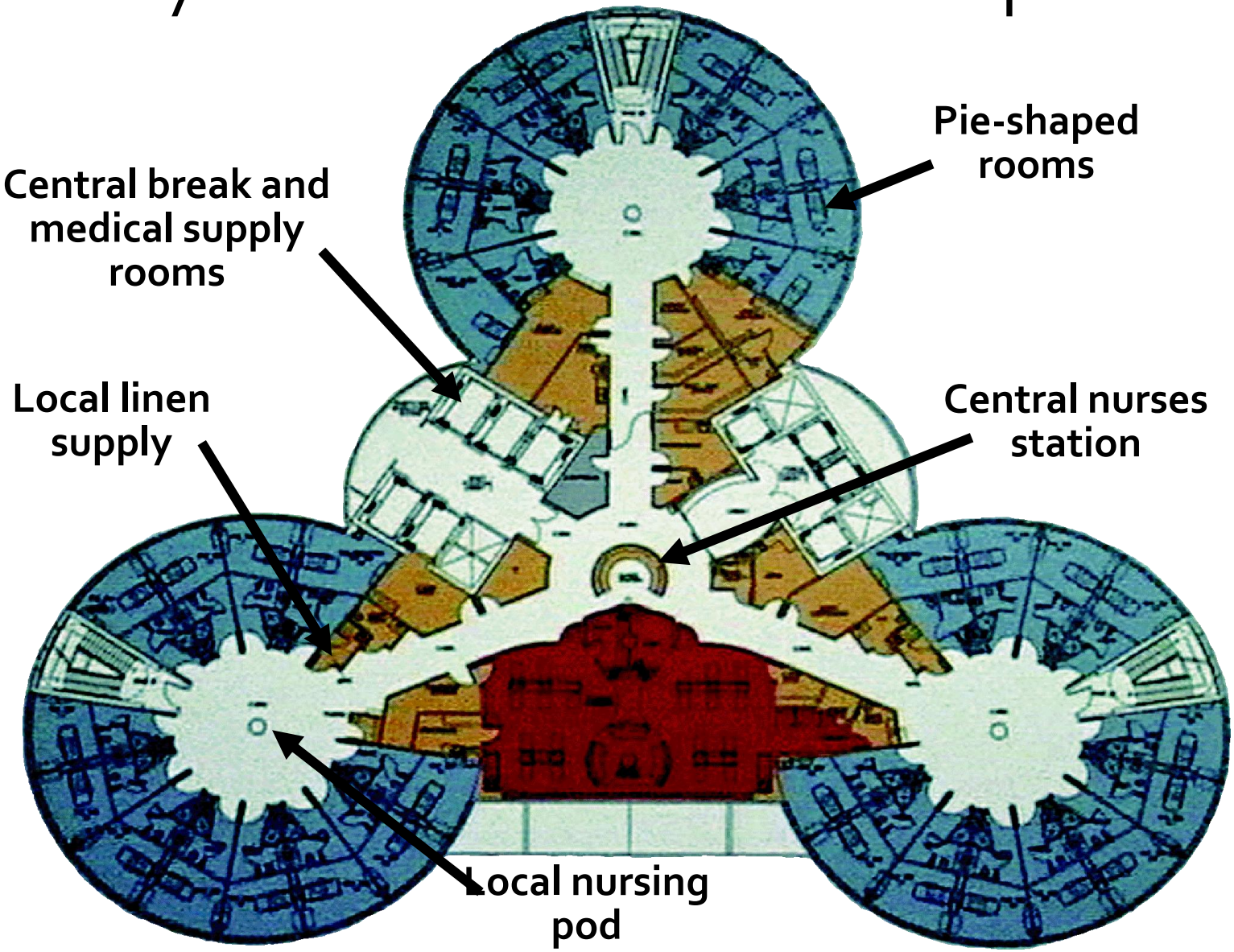
Alternative Strategy

- **As much of the project as possible is completed off-site in a product-oriented facility**
- **This can significantly improve efficiency but is only possible when multiple similar units need to be created**

Process-Oriented Layout



Layout at Arnold Palmer Hospital



Work Cells

- Reorganizes people and machines into groups to focus on single products or product groups
- Group technology identifies products that have similar characteristics for particular cells
- Volume must justify cells
- Cells can be reconfigured as designs or volume changes

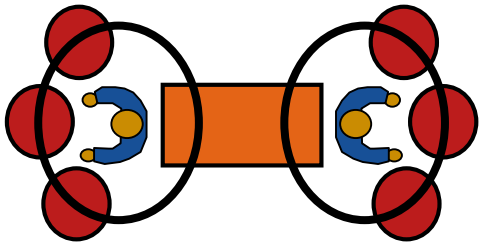
Advantages of Work Cells

1. Reduced work-in-process inventory
2. Less floor space required
3. Reduced raw material and finished goods inventory
4. Reduced direct labor
5. Heightened sense of employee participation
6. Increased use of equipment and machinery
7. Reduced investment in machinery and equipment

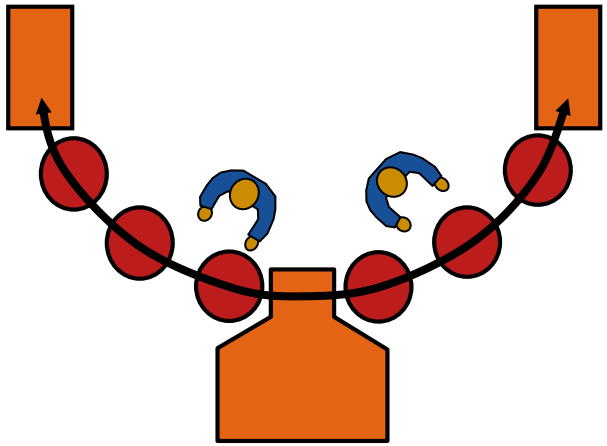
Requirements of Work Cells

1. Identification of families of products
2. A high level of training, flexibility and empowerment of employees
3. Being self-contained, with its own equipment and resources
4. Test (poka-yoke) at each station in the cell

Improving Layouts Using Work Cells

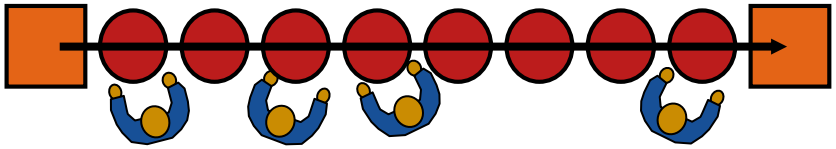


Current layout - workers in small closed areas.

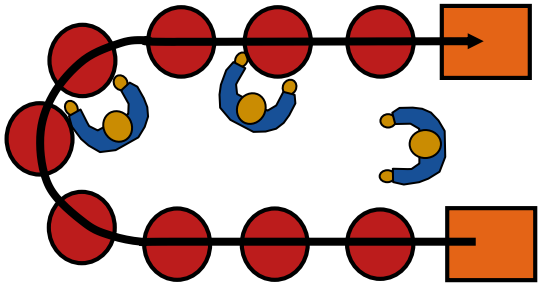


Improved layout - cross-trained workers can assist each other. May be able to add a third worker as additional output is needed.

Improving Layouts Using Work Cells

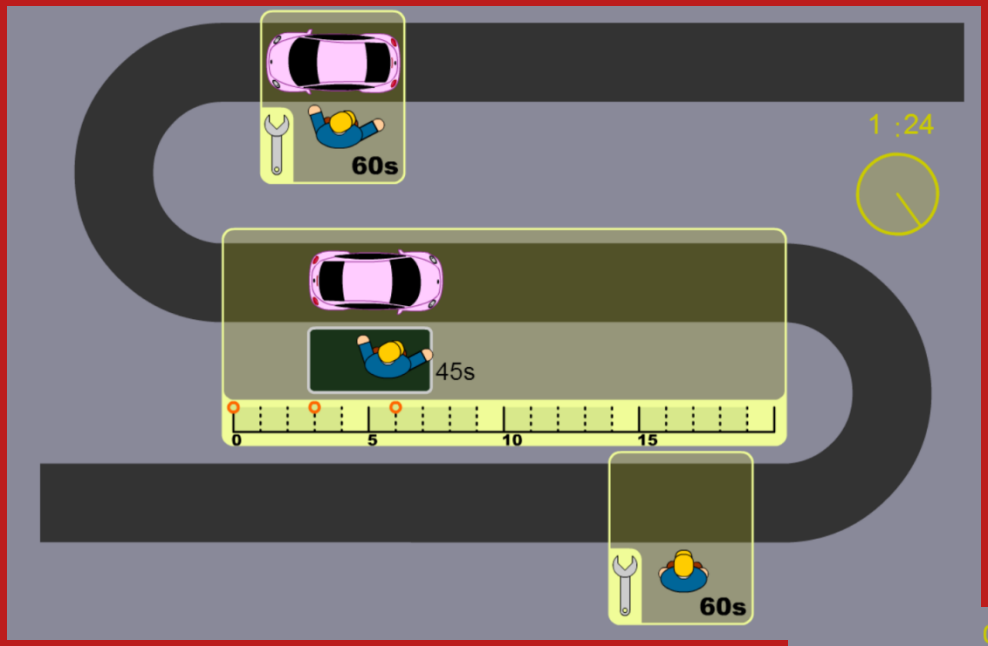


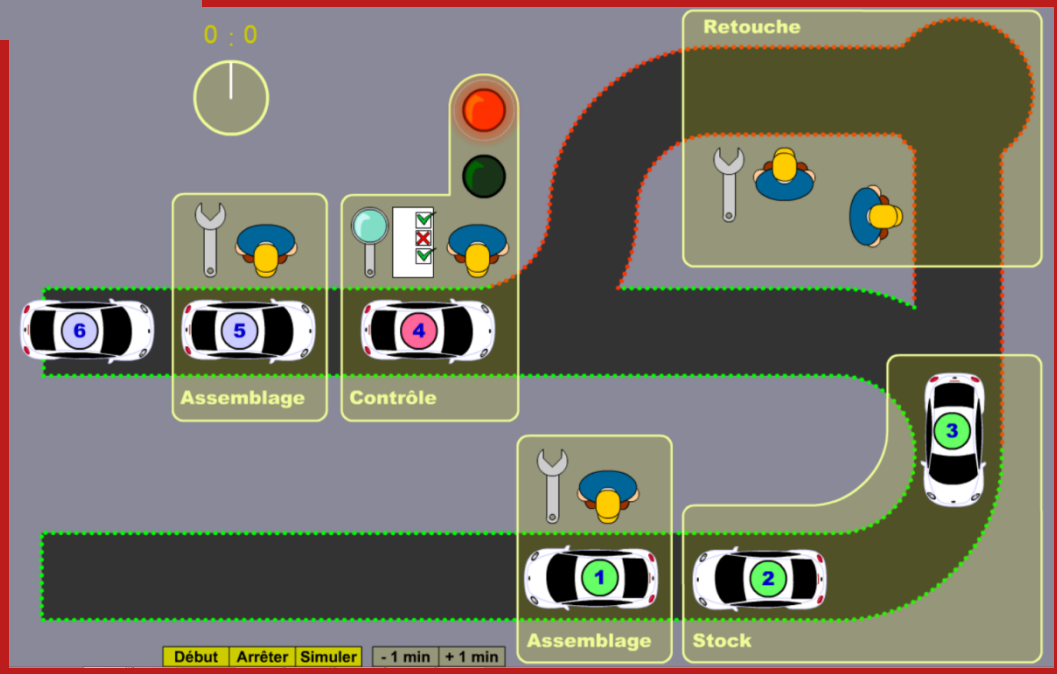
Current layout - straight lines make it hard to balance tasks because work may not be divided evenly



Improved layout - in U shape, workers have better access. Four cross-trained workers were reduced.

U-shaped line may reduce employee movement and space requirements while enhancing communication, reducing the number of workers, and facilitating inspection





Flash animations

Product-Oriented Layouts

- **Fabrication line**
  - **Builds components on a series of machines**
  - **Machine-paced**
  - **Require mechanical or engineering changes to balance**
- **Assembly line**
  - **Puts fabricated parts together at a series of workstations**
  - **Paced by work tasks**
  - **Balanced by moving tasks**

Both types of lines must be balanced so that the time to perform the work at each station is the same

Product-Oriented Layouts

Advantages

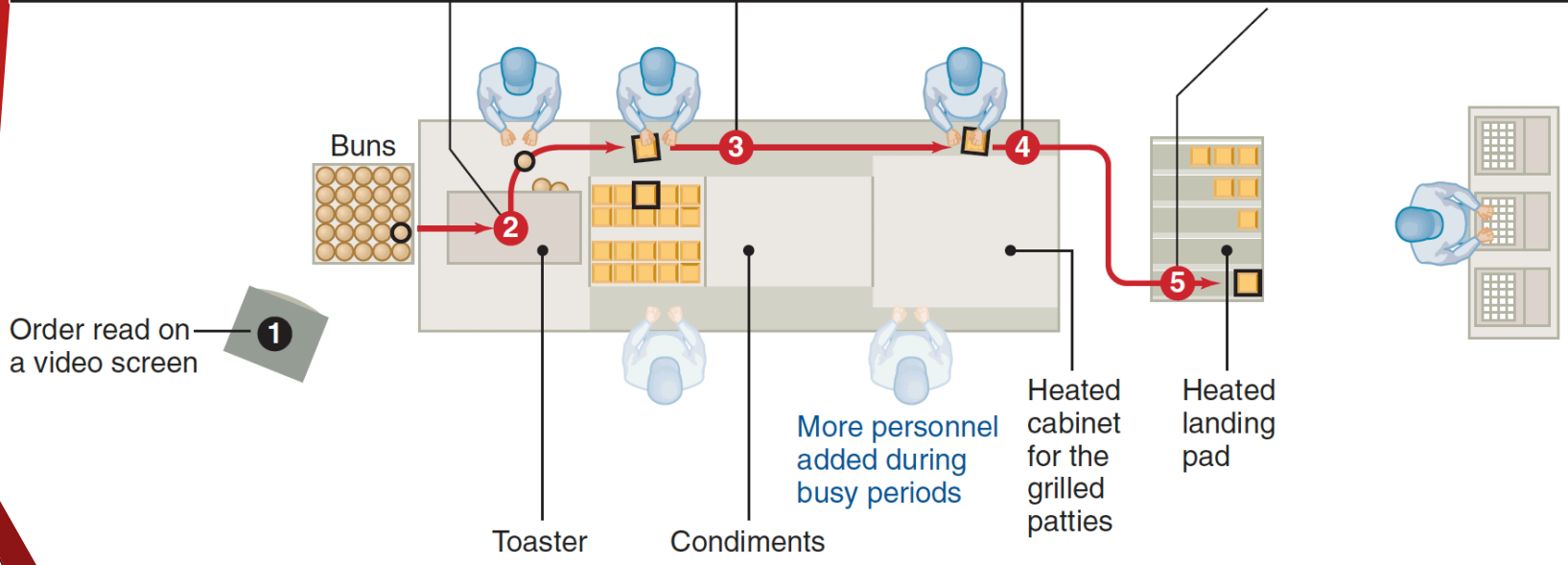
1. Low variable cost per unit
2. Low material handling costs
3. Reduced work-in-process inventories
4. Easier training and supervision
5. Rapid throughput

Disadvantages

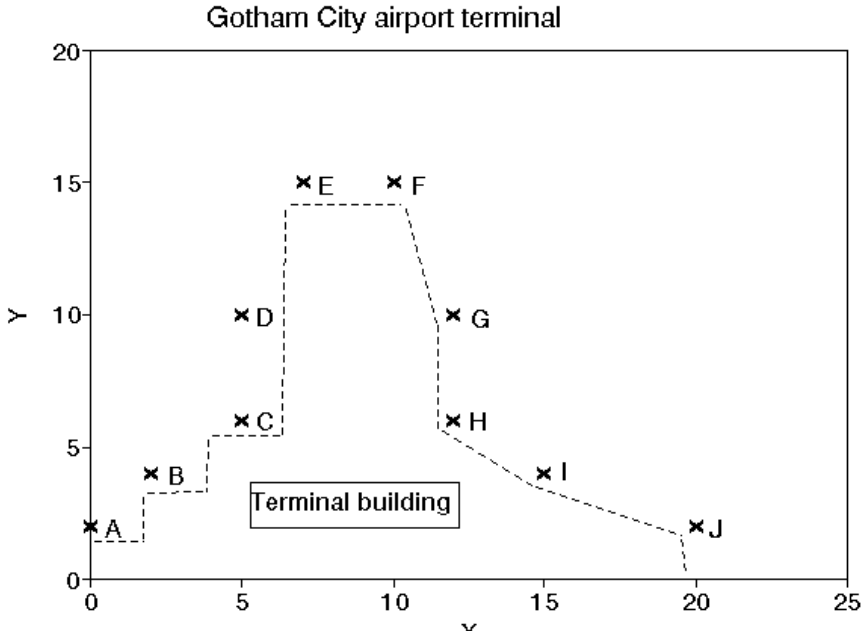
1. High volume is required
2. Work stoppage at any point ties up the whole operation
3. Lack of flexibility in product or production rates

McDonald's Assembly Line

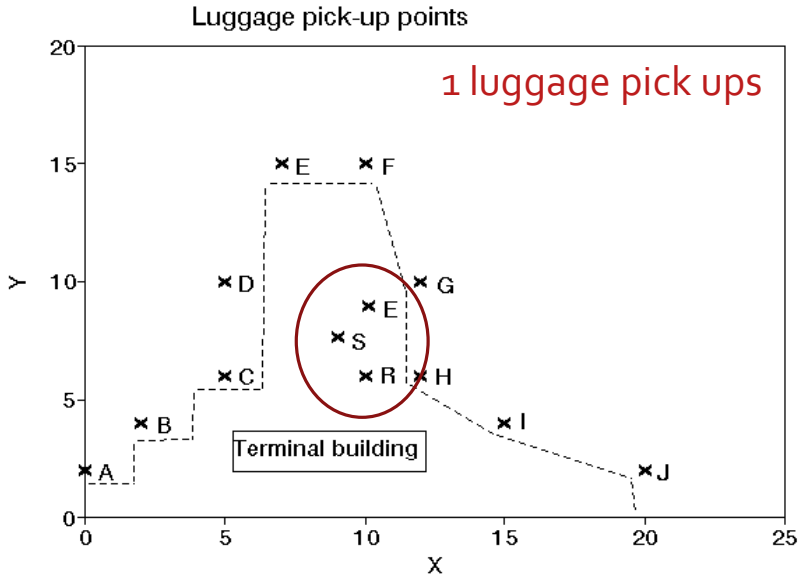
Elapsed time	0:00	0:11	0:31	0:45		1:30
Task time (seconds)		11	20	14	0	45
Task	1. Order	2. Bun toasting	3. Assembly with condiments	4. Wrapping of patty with bun	5. Order picked up immediately to keep it fresh	6 Customer service (order and payment)

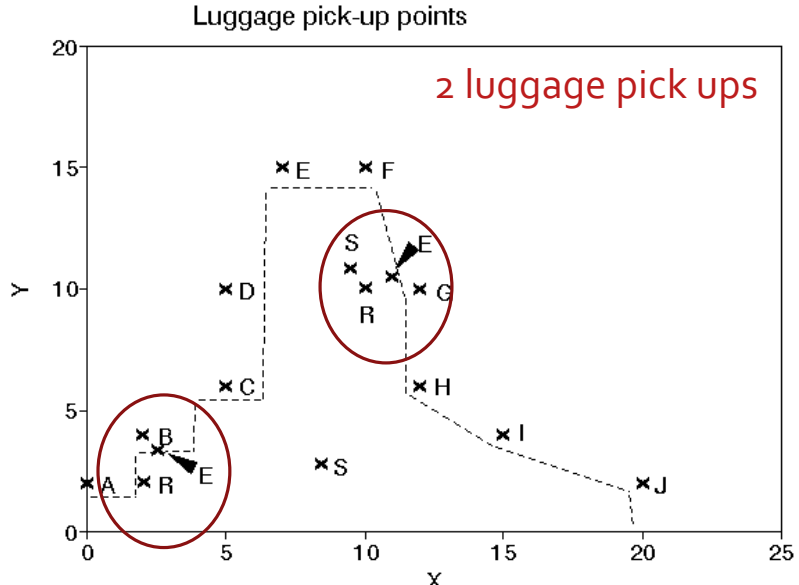


Graphical optimisation (weighted)



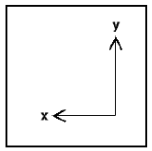
Facility Number	Facility Name	To New 1 Flow/Unit Cost	Location X Axis	Location Y Axis
Existing 1	A	3600	0	2
Existing 2	B	2500	2	4
Existing 3	C	1800	5	6
Existing 4	D	2200	5	10
Existing 5	E	1000	7	15
Existing 6	F	4500	10	15
Existing 7	G	5600	12	10
Existing 8	H	1400	12	6
Existing 9	I	1800	15	4
Existing 10	J	3000	20	2
New 1	NEW			



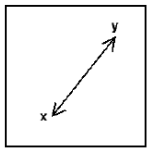


Some assumptions that make optimization very difficult

- Gates are fixed
- Flows are known and allocation is fixed
- Flows are always the same (but they are no flights in the night, and a lot in the morning and evening)
- It may not be possible to put the luggage picking points in these locations
- Flows are not against straight line
- What if a plane is late ?



R=Rectilinear



E=Euclidian

E=Euclidian

- We'll see how to re focus the forecasting energy to immediate results with Lean
- The other solution is through Stochastic simulation

How productive

Is the combination layout / planning?

Times: Little's law

- **Throughput time** : The time for a unit to move through a process
- **Cycle time** : The average time between the units of output emerging from a process.
- **Work-in-process** : The number of units within a process waiting to be processed further (also called work in progress)

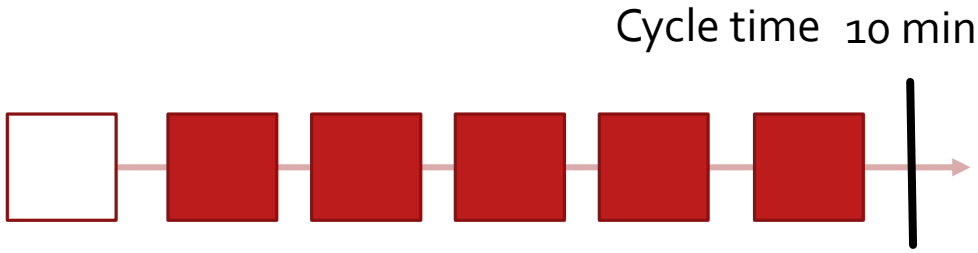
Throughput time

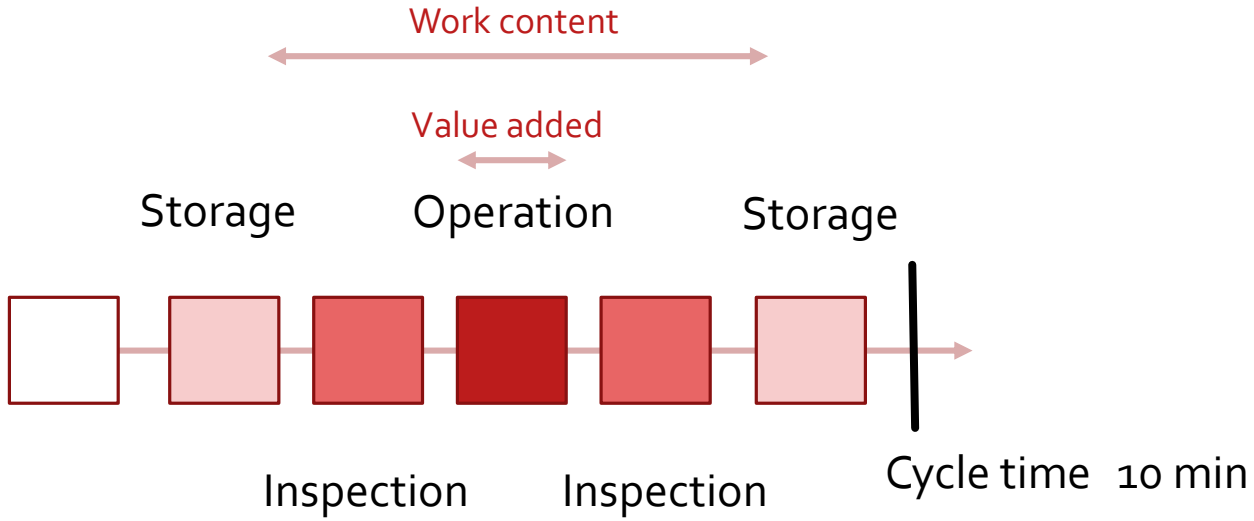
= WIP x Cycle time

- Simple but useful
- Works on any stable process

Note: **Takt time**: Demand frequency
Takt = Operating time / Required qty

The goal is to synchronize takt time and cycle time





- **Throughput efficiency** : relates the throughput time to the real work content done during time time
- **Value-added throughput efficiency**: restricts the concept of work content to only those tasks that are adding value. It usually eliminates activities such as movement, delays, inspections.

$$\text{Throughput efficiency} = \frac{Work\ content}{Throughput\ time}$$

Capacities

- **Input measure of capacity**: Focuses on the resources to express a capacity
- **Output measure of capacity**: Focuses on the product or service to express a capacity
- **Design capacity** : The capacity of a process or facility as it is designed to be, often greater than effective capacity.
- **Effective capacity**: The capacity of a process or facility after maintenance, changeover and other stoppages and loading have been accounted for.
- **Demonstrated capacity:** Proven capacity as achieved in the past

$$\text{Utilization} = \frac{Actual\ ouput}{Design\ capacity}$$

$$\text{Efficiency} = \frac{Actual\ ouput}{Effective\ capacity}$$

Operation	Input measure of capacity	Output measure of capacity
Air-conditioner plant	Machine hours available	**Number of units per week**
Hospital	**Beds available**	Number of patients treated per week
Theatre	**Number of seats**	Number of customers entertained per week
University	**Number of students**	Students graduated per year
Retail store	**Sales floor area**	Number of items sold per day
Airline	**Number of seats available on the sector**	Number of passengers per week
Electricity company	Generator size	**Megawatts of electricity**
Brewery	Volume of fermentation tanks	**Litres per week**

OEE = Overall Equipment Effectiveness
OEE = A x P x Q