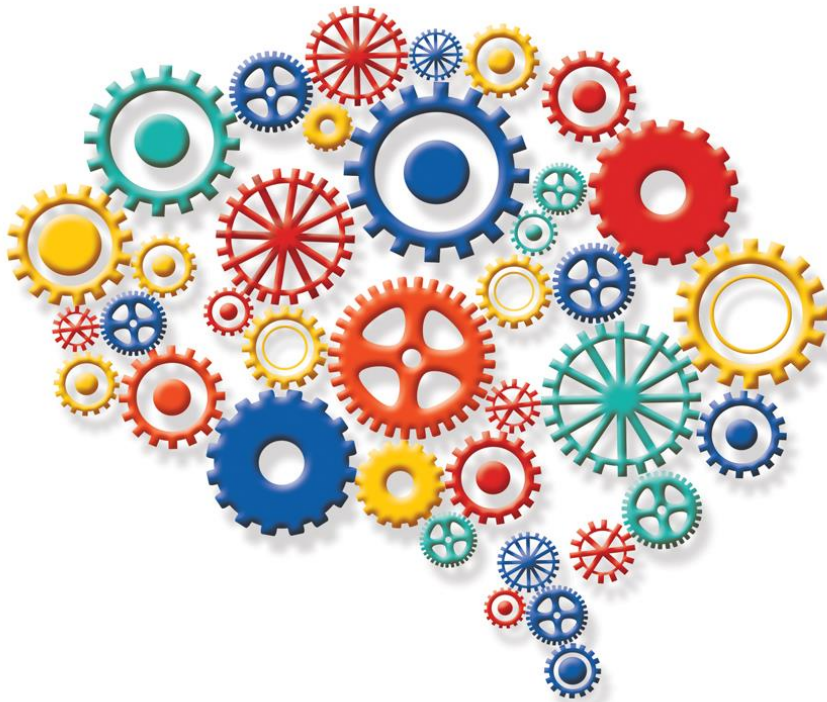
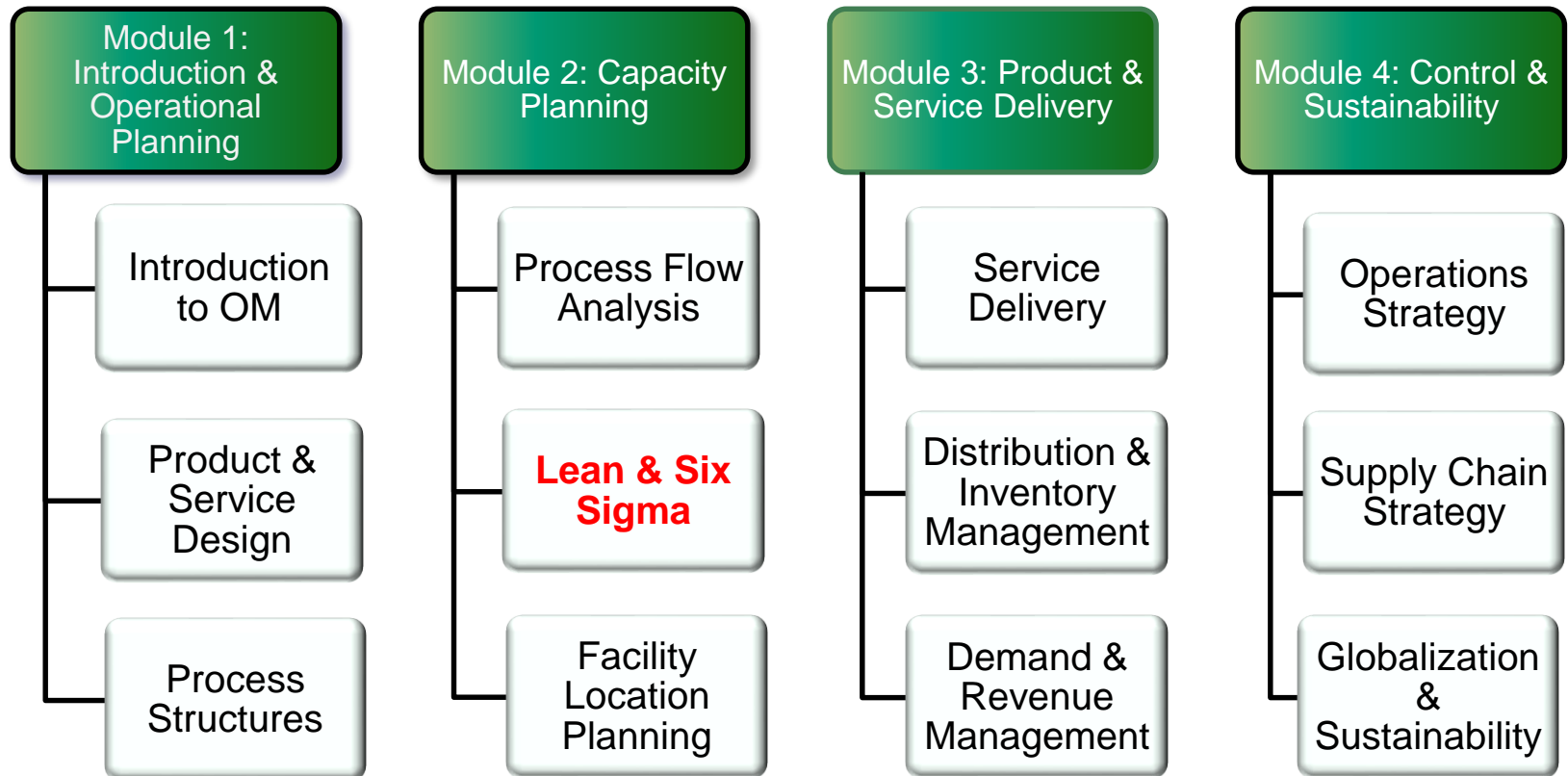


Lecture 5



Lean and Six Sigma

Course Structure



Learning Objectives

- Explain what is JIT / lean operations.
- Identify the sources of waste and briefly describe the push / pull systems
- List some of the obstacles that might be encountered when converting to a JIT system.
- Explain the importance of RATER & SERVQUAL model
- Understand the Six Sigma approach to improving quality and productivity.

JIT / Lean Operations

Business as Usual



Lean Operations



ELIMINATING WASTE

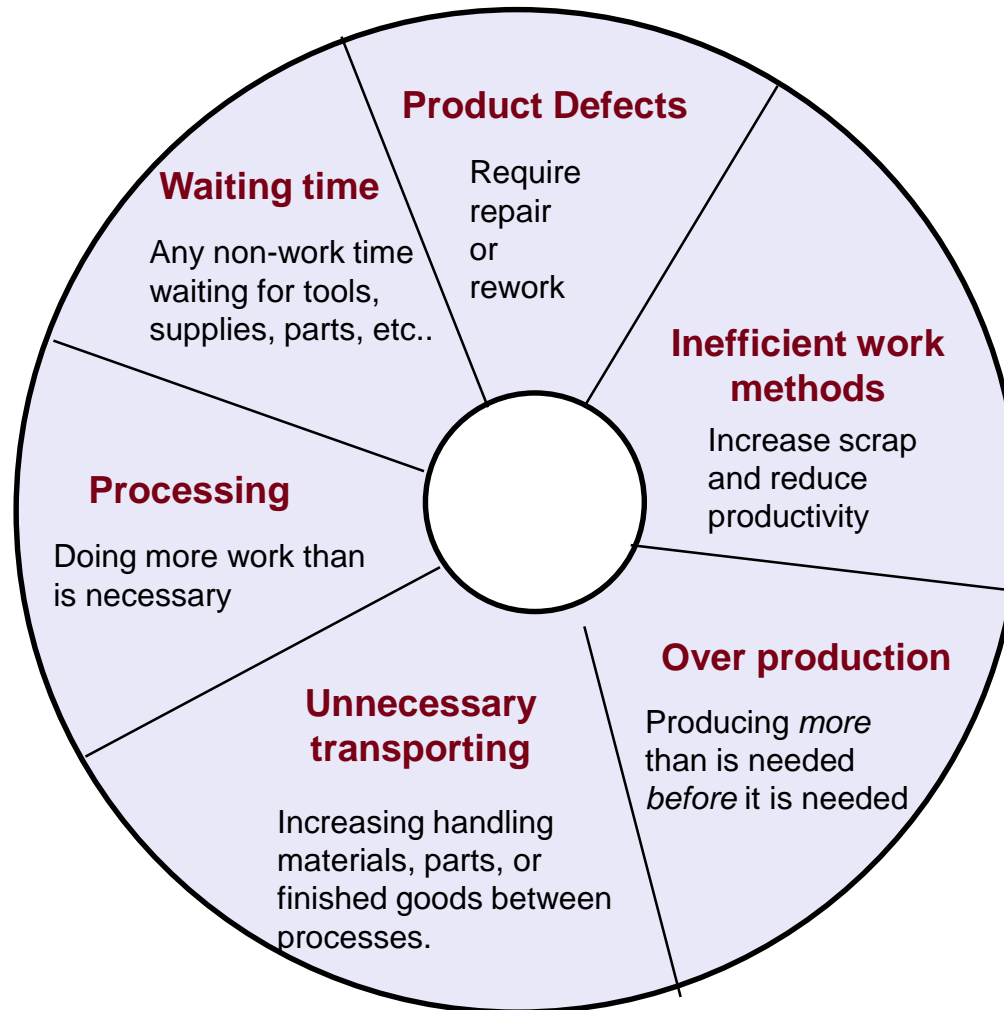
Waste

ム ダ
MU DA

無駄

“Anything that adds Cost
to the product
without adding Value”

Sources of Waste



JIT

- *Just-in-time (JIT)*: A highly coordinated processing system in which goods move through the system, and services are performed, just as they are needed
- JIT = lean operations
- JIT - pull (demand) system

Push vs Pull

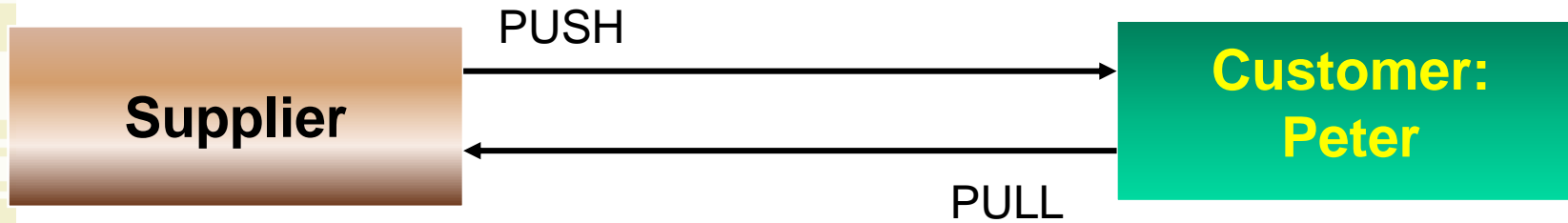
Push System:

- produce in **anticipation** of downstream needs (or customer demand forecast)

Pull System:

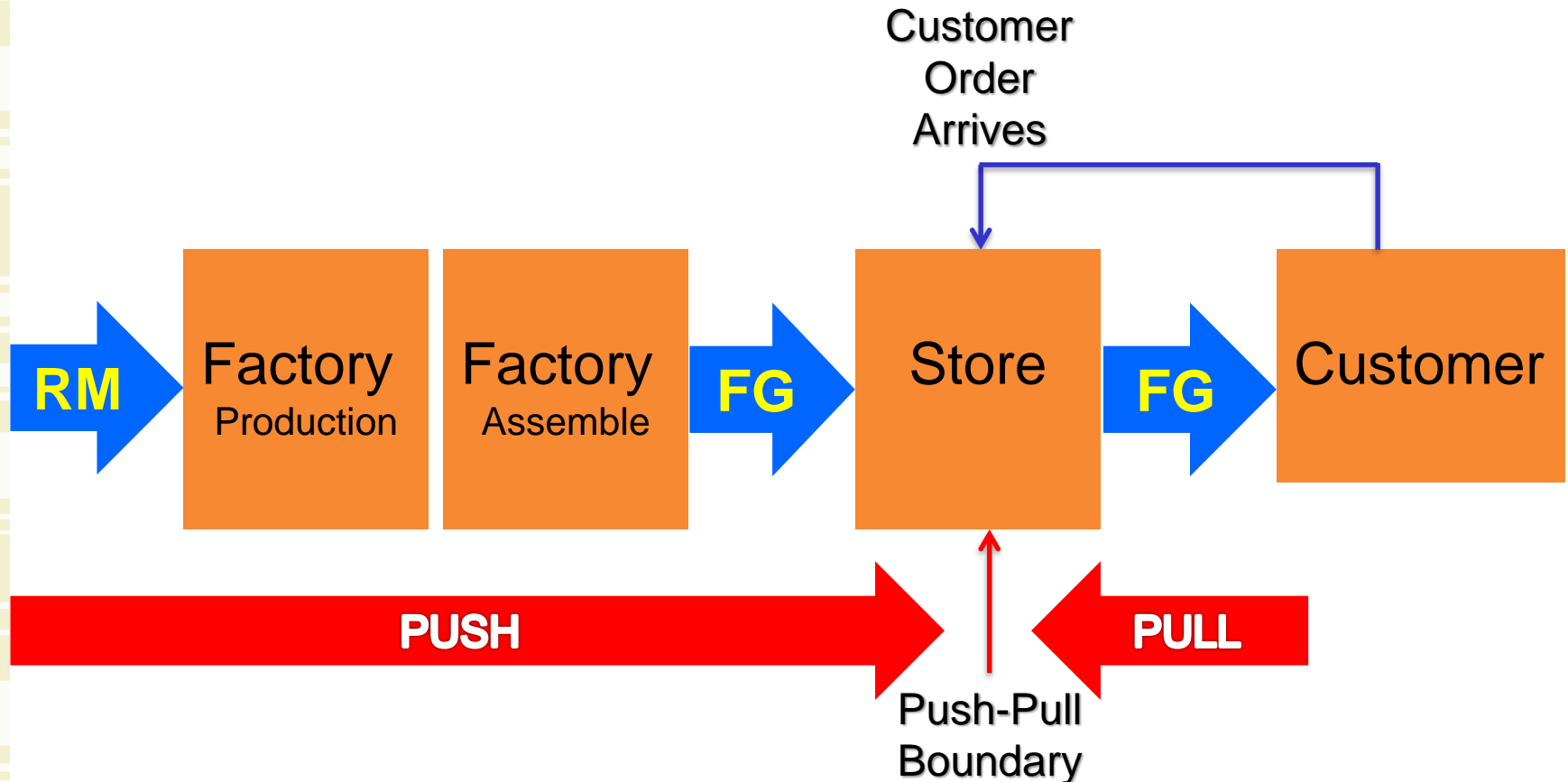
- produce in **response** to the actual downstream need (or customer order)

Push vs Pull (Cont'd)



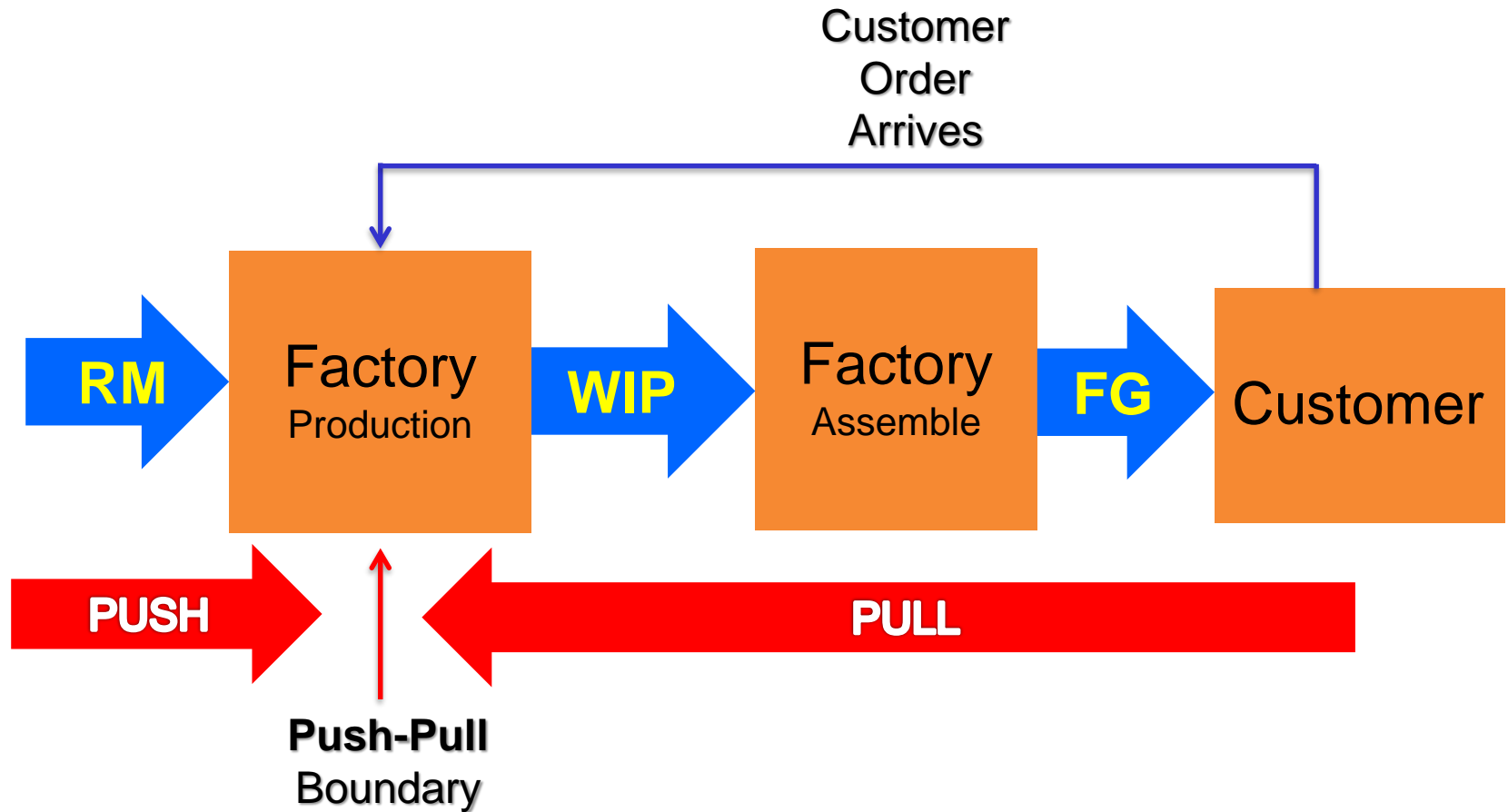
- **Make-to-stock (Push)**
 - The unit Peter purchase was produced before he orders
- **Make-to-order (Pull)**
 - Produce the unit for Peter only after Peter orders

Push-Pull Boundary



The Push-Pull Boundary in a **Make-to-Stock** Supply Chain

Push-Pull Boundary



The Push-Pull Boundary in a **Make-to-Order** Supply Chain

McDonald Push-Pull Process

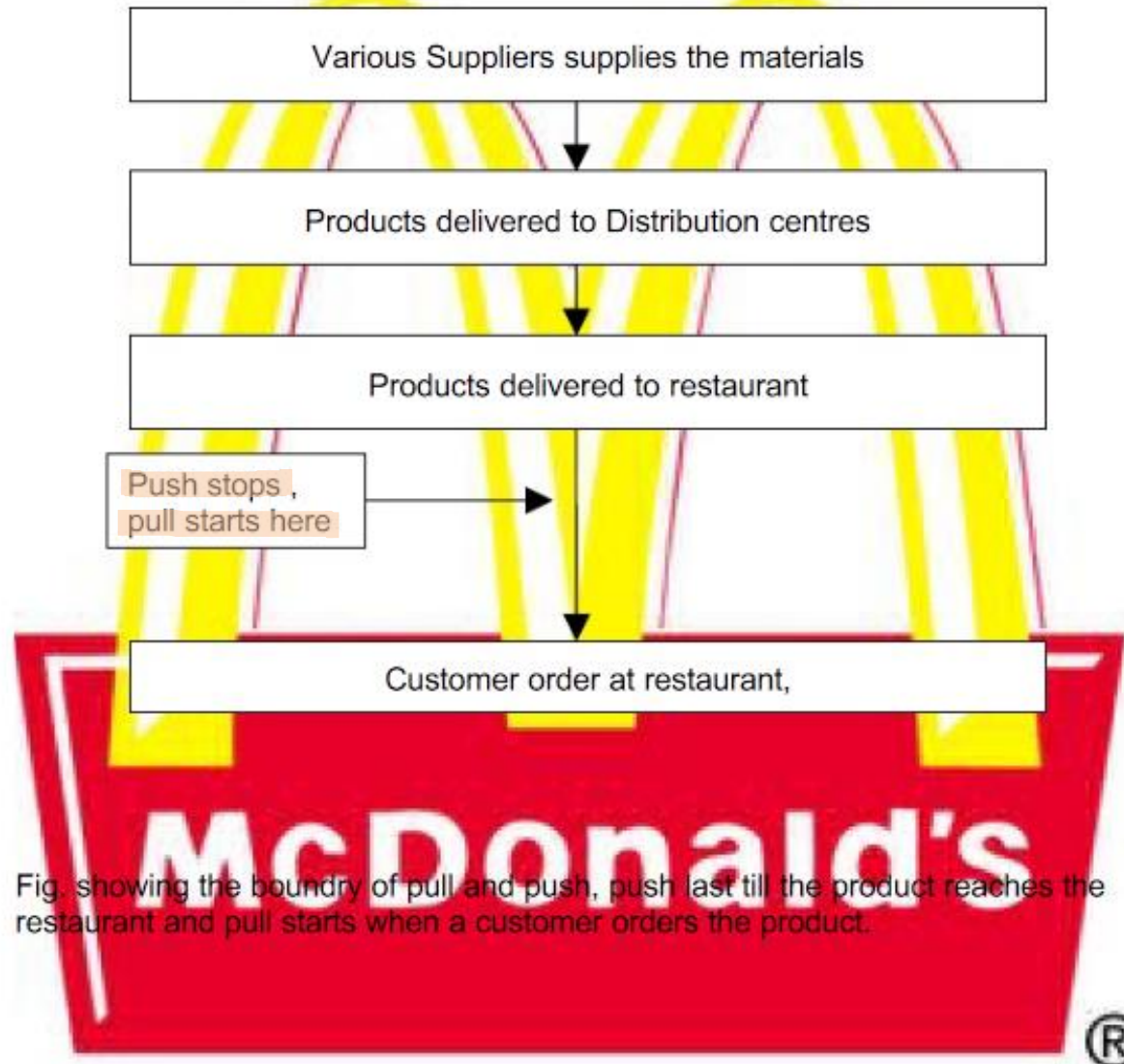


Fig. showing the boundry of pull and push, push last till the product reaches the restaurant and pull starts when a customer orders the product.

Comparison of JIT and Traditional Systems

Factor	Traditional	JIT
Inventory	Much, to offset forecast errors, late deliveries	Minimal necessary to operate
Deliveries	Few, large	Many, small
Lot sizes	Large	Small
Setup; runs	Few, long runs	Many, short runs
Vendors	Long-term relationships are unusual	Partners
Workers	Necessary to do the work	Assets (<i>cross-trained workers</i>)

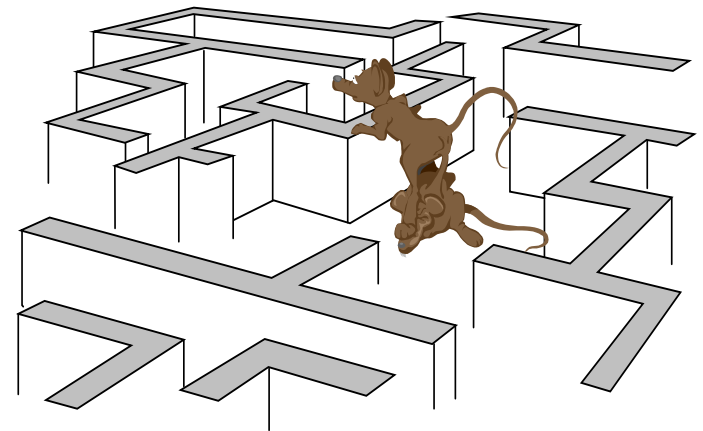


Transitioning to a JIT System

- Get top management commitment
- Decide which parts need most effort
- Obtain support of workers
- Start by trying to reduce setup times
- Gradually convert operations
- Convert suppliers to JIT
- Prepare for obstacles

Obstacles to Conversion

- Management may not be committed
- Workers/management may not be cooperative
- Difficult to change company culture
- Suppliers may resist



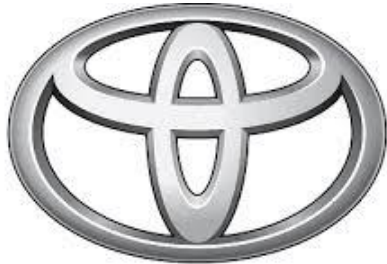
Why Suppliers Resist JIT

- Unwilling to commit resources
- Uneasy about long-term commitments
- Frequent, small deliveries may be difficult
- Burden of quality control shifts to supplier
- Frequent engineering changes may cause JIT changes

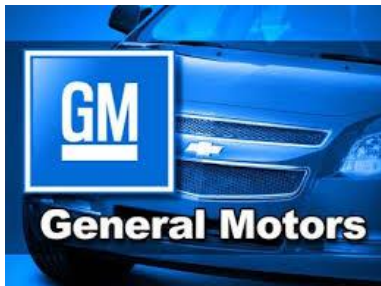
Summary of Benefits of JIT

- Reduced inventory levels
- High quality
- Flexibility
- Reduced lead times
- Increased productivity
- Increased equipment utilization
- Reduced scrap and rework
- Reduced space requirements
- Pressure for good vendor relationships
- Reduced need for indirect labor (*e.g. QC staff*)

Examples of JIT Adopters



TOYOTA



**MARKS &
SPENCER**



ZARA



Quality Management - Six Sigma

Total Quality Management (TQM)

Managing the entire organization so that it excels on all dimensions of products and services that are important to the customer

Two fundamental operational goals:-

1. Careful design of the product or service
2. Ensuring that the organization's systems can consistently produce the design

Five Dimensions of Service Quality (**RATER**)

- ***Responsiveness***: The willingness to help customers & to provide prompt service.
Example: avoid keeping customers waiting for no apparent reason.
- ***Assurance***: Ability to convey trust and confidence; competence and knowledge of work.
Example: competence, politeness & respect for customer, effective communication, bear customer interest at heart

Five Dimensions of Service Quality (cont.)

- ***Tangibles:*** The appearance of physical facilities, equipment, personnel and communication materials. The condition of the physical surroundings is tangible evidence. **Example: cleanliness**
- ***Empathy:*** The ability to provide care, individualized attention to customers. It includes approachability, sensitivity and effort to understand customer's need. **Example: being a good listener**
- ***Reliability:*** Perform promised service dependably and accurately. **Example: receive postal mail at same time each day.**

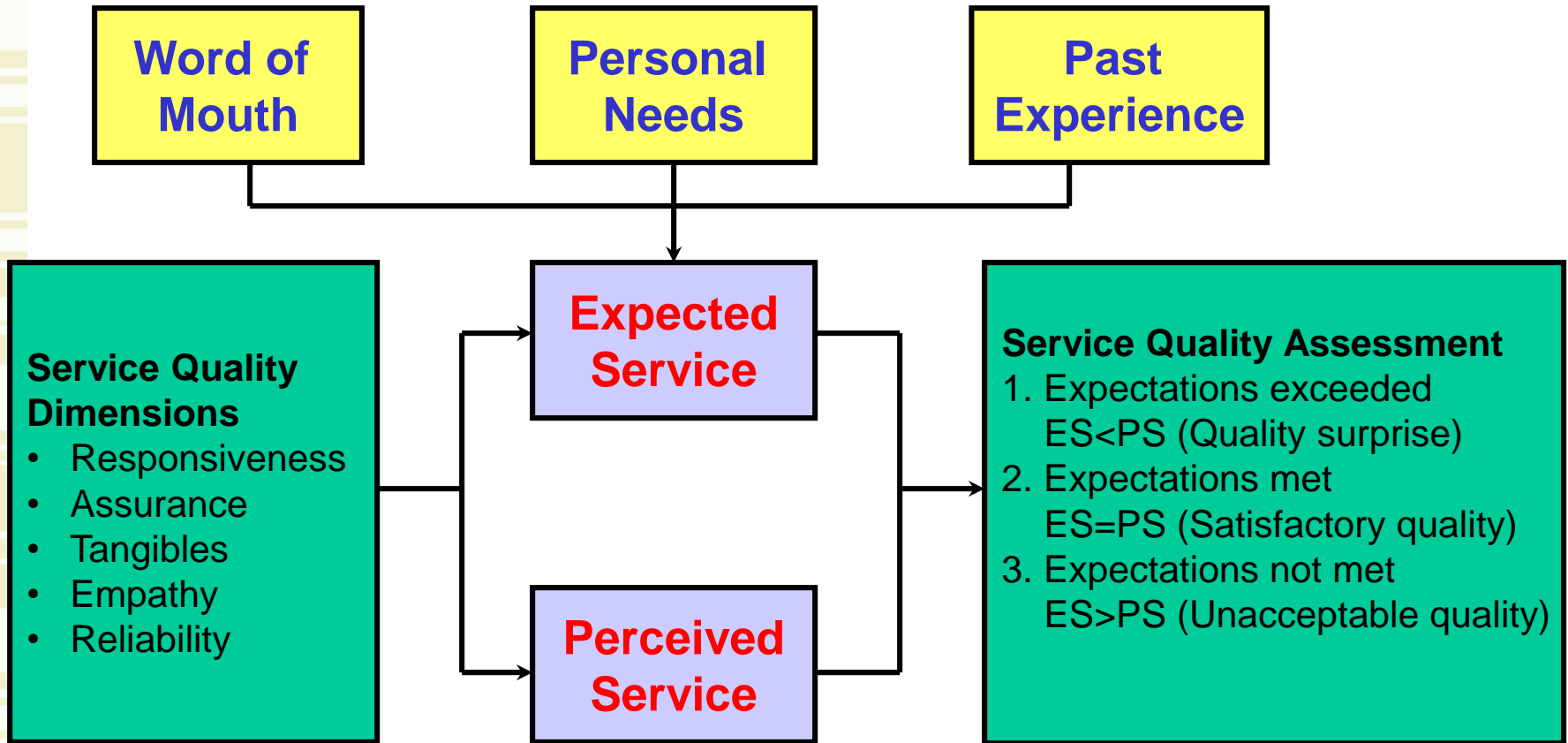


Knowledge checkpoint:

Self assessment

1. When you notice a customer puzzling over a product and offer help and information, you show _____.
2. When you are sensitive to an individual customer's needs when solving problem, you show _____.
3. When you smile and tell a customer, "I can help you with that", you build _____.
4. When you fulfill a customer order on time, you show _____.
5. When you take time to make yourself and your work area presentable, you are paying attention to the _____.

Perceived Service Quality

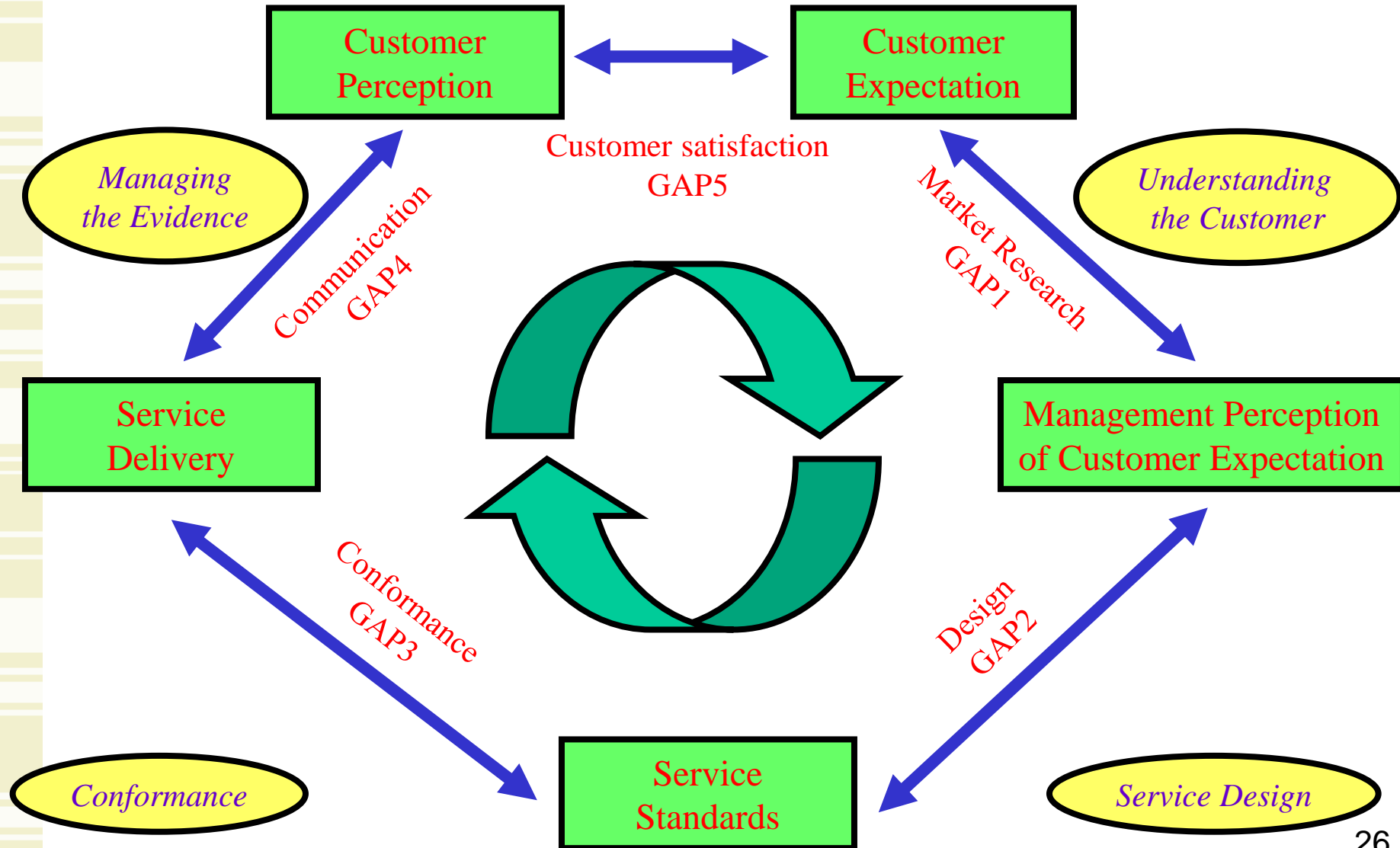


Issues of Measuring Service Quality

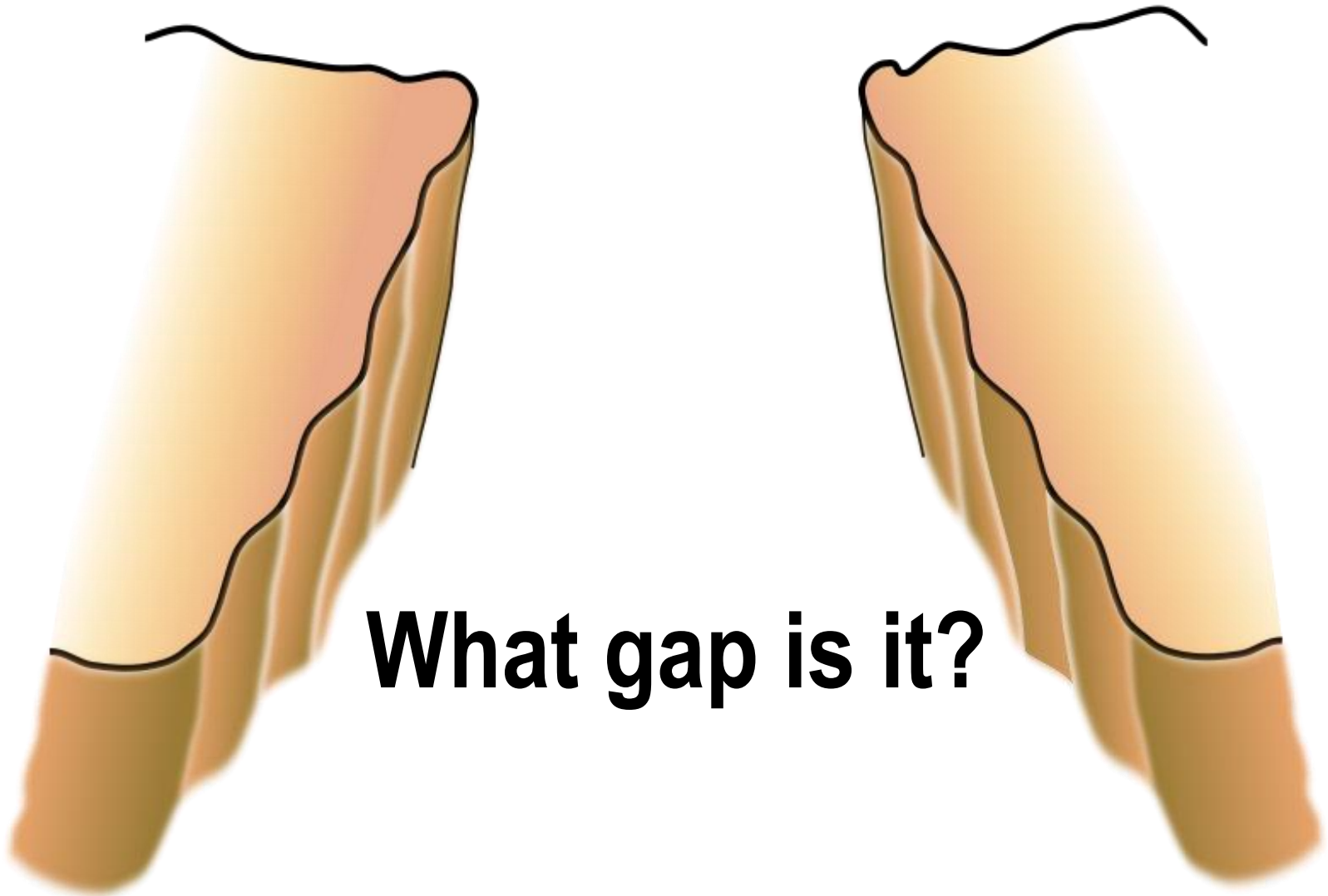
- **Measuring service quality**

- A challenge because customer satisfaction is determined by many intangible factors
- SERVQUAL, an effective tools for surveying customer satisfaction that is based on the service quality gap model for measuring the 5 dimensions of service quality

Service Quality Gap Model (SERVQUAL)



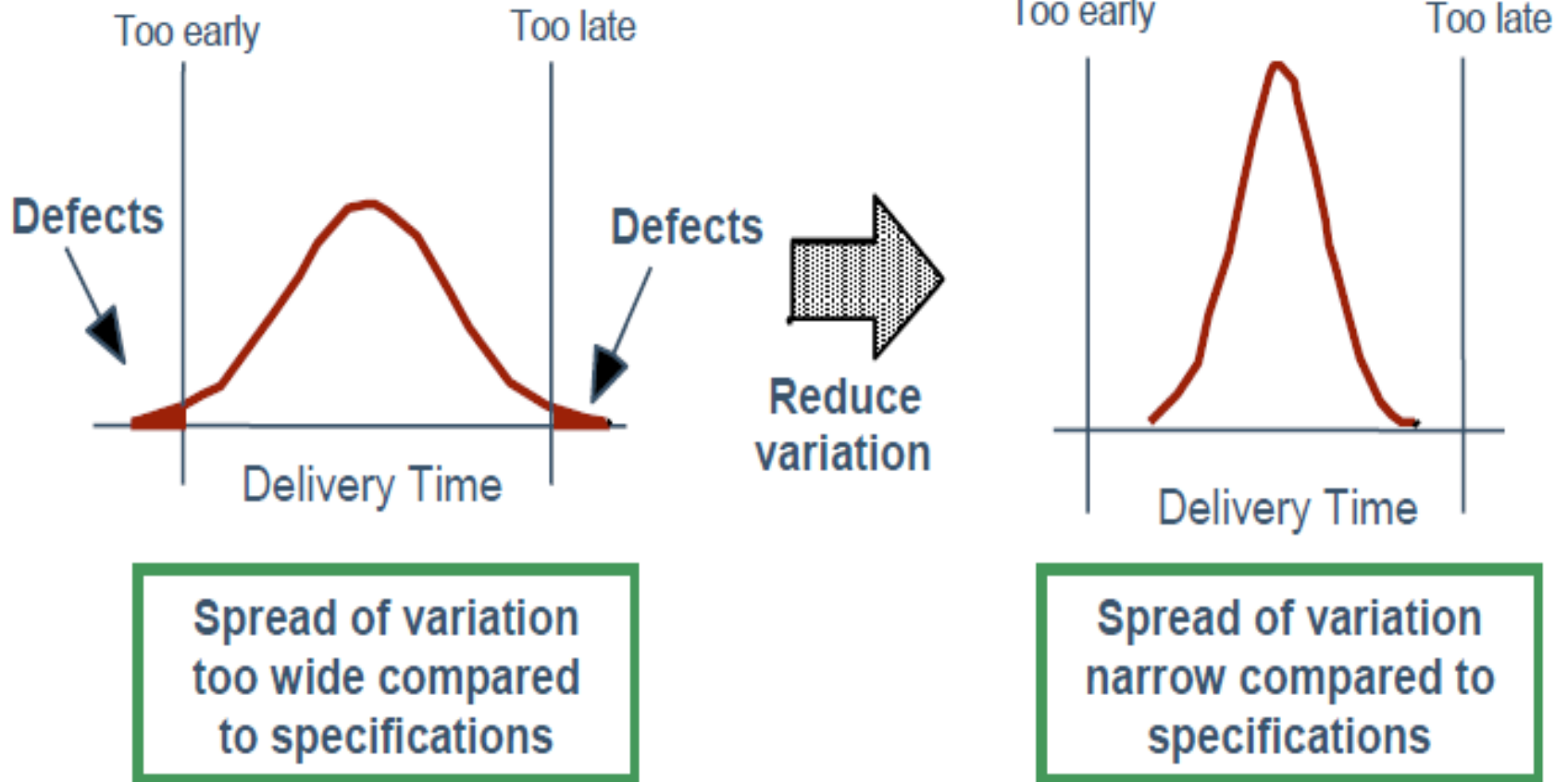
“I SLEPT HERE”



Six Sigma

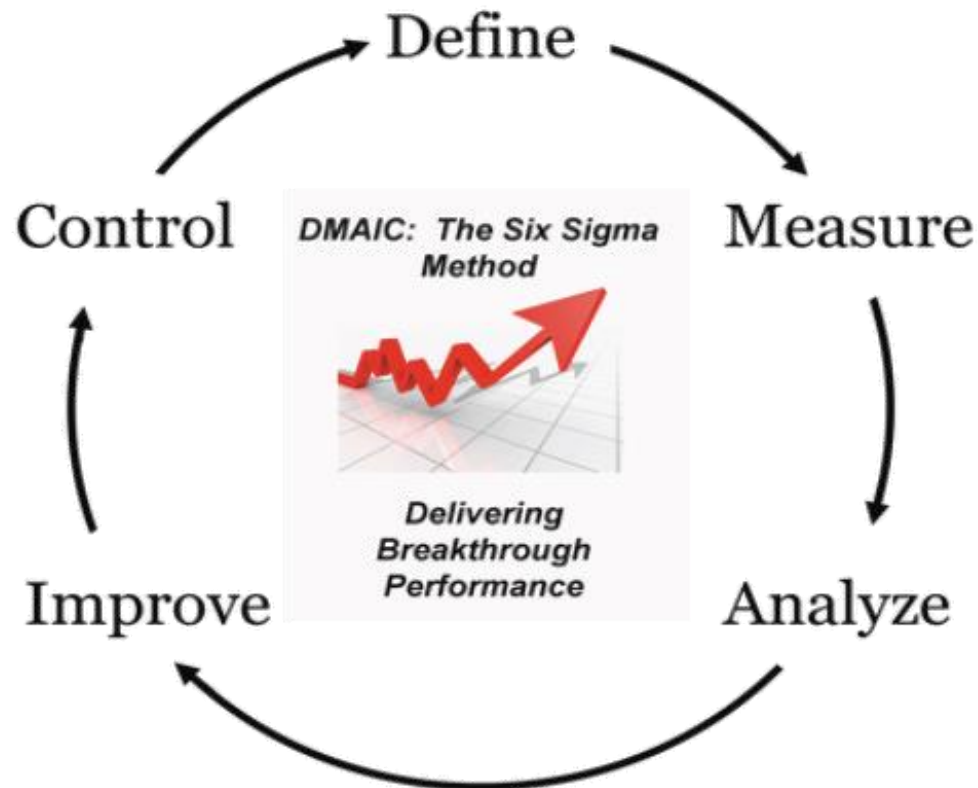
- A philosophy and set of methods companies use to **eliminate defects** in their products and processes
- Seeks to reduce variation in the processes that lead to product defects
- The name, “Six Sigma,” refers to the goal of no more than **3.4 defects per million units**

Goal: Reduce variation



DMAIC

A six sigma methodology for improving quality by identifying and eliminating the root causes



DMAIC Cycle

Define - identify customers and their priorities



Measure - determine how to measure the process and how it is performing

Analyze - determine the most likely causes of defects

Improve - identify means to remove the causes of defects

Control - determine how to maintain the improvements

Six Sigma 7 Basic Tools

Flowchart - a diagram of the sequence of operations

Run chart - depict trends in data over time

Pareto chart - help to break down a problem into components

Checksheet - basic form to standardize data collection

Cause-and-effect diagram - show relationships between causes and problems

Opportunity flow diagram - used to separate value-added from non-value-added

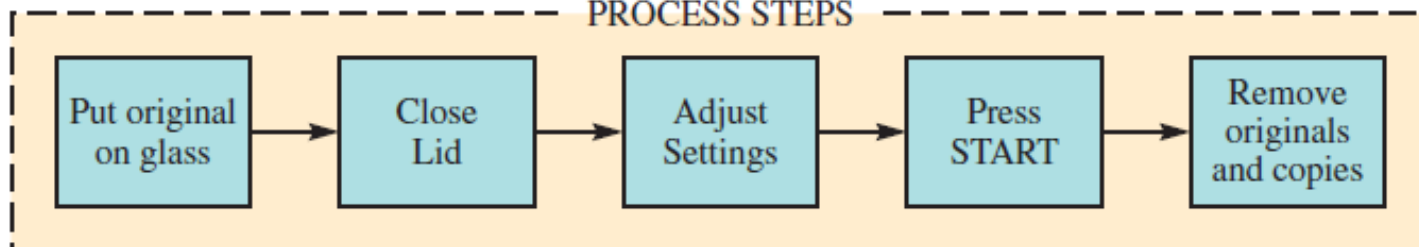
Process control chart - used to assure that processes are in statistical control

Flowchart

Flow Chart of Major Steps in a Process

SUPPLIERS	INPUTS	PROCESSES	OUTPUTS	CUSTOMERS
Manufacturer	Copier	Making a Photocopy	Copies	You
Office Supply Company	Paper			File
	Toner			Others
Yourself	Original			
Power Company	Electricity			

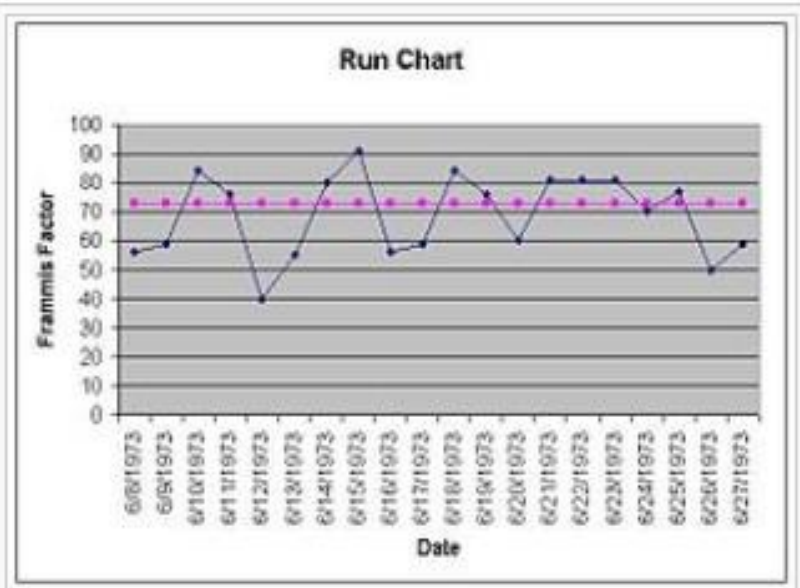
PROCESS STEPS



Source: Rath & Strong, *Rath & Strong's Six Sigma Pocket Guide*, 2001.

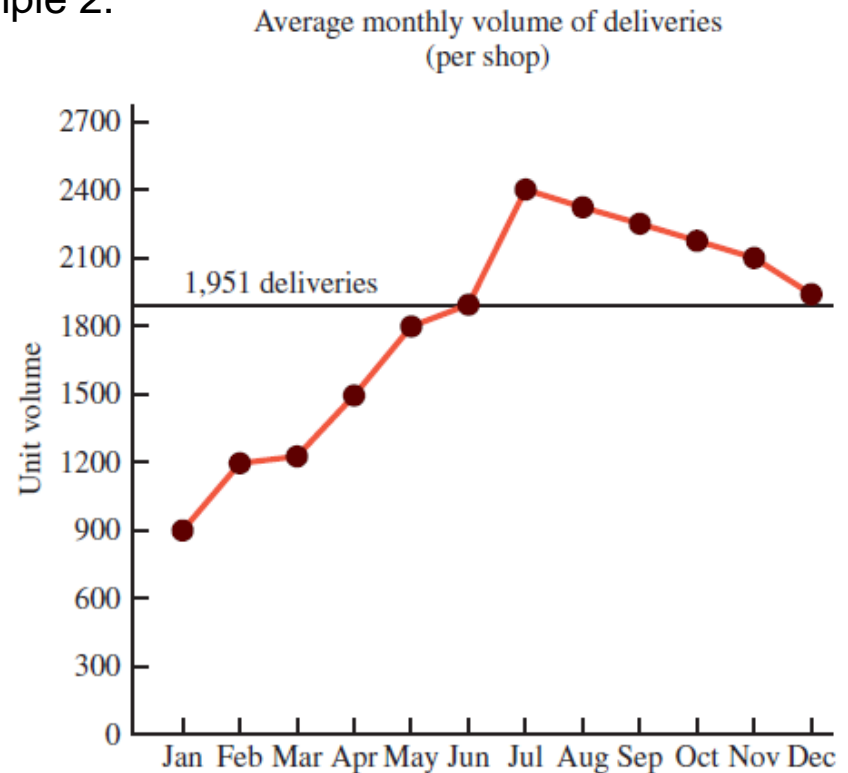
Run Chart

Example 1:



A simple run chart showing data collected over time. The median of the observed data (73) is also shown on the chart.

Example 2:



Source: From *The Memory Jogger*™II, 2001. Used with permission of GOAL/QPC.

Check sheet

Example 1:

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Wrong orders	///	###	### ### ### ###	/	//	///	### //
Reworked orders		/	//	///		/	//
Late deliveries	### ///	/	///	//		///	//
Shipping damage						### ### ### ###	### ///
Late payments		/					
Totals	11	8	27	6	2	28	19

Example 2:

Defines what data → Machine Downtime
are being collected (Line 13)

Operator: Wendy

Date: May 19

Reason	Frequency	Comments
Carton Transport	### ##	
Metal Check	///	
No Product	### I	
Sealing Unit	//	
Barcoding	///	
Conveyor Belt		
Bad Product	###	Burned flakes Low weight
Other	//	

Lists the characteristics or conditions of interest

Includes place to put the data

May want to add space for tracking stratification factors

Has room for comments

Pareto Chart

Measure

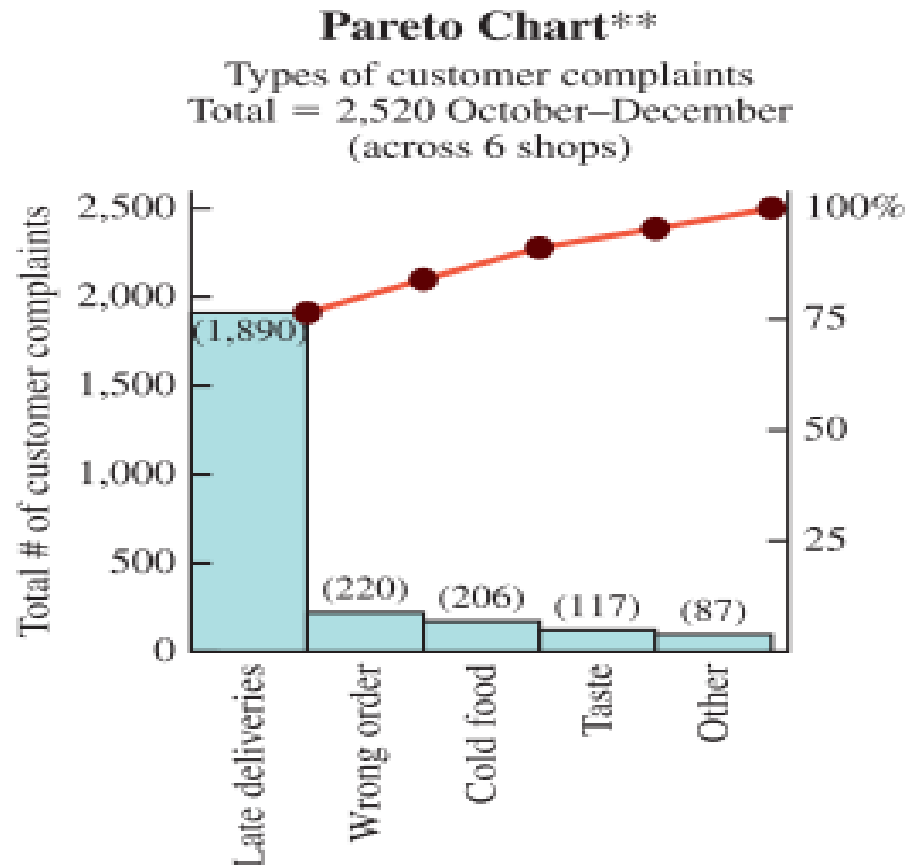
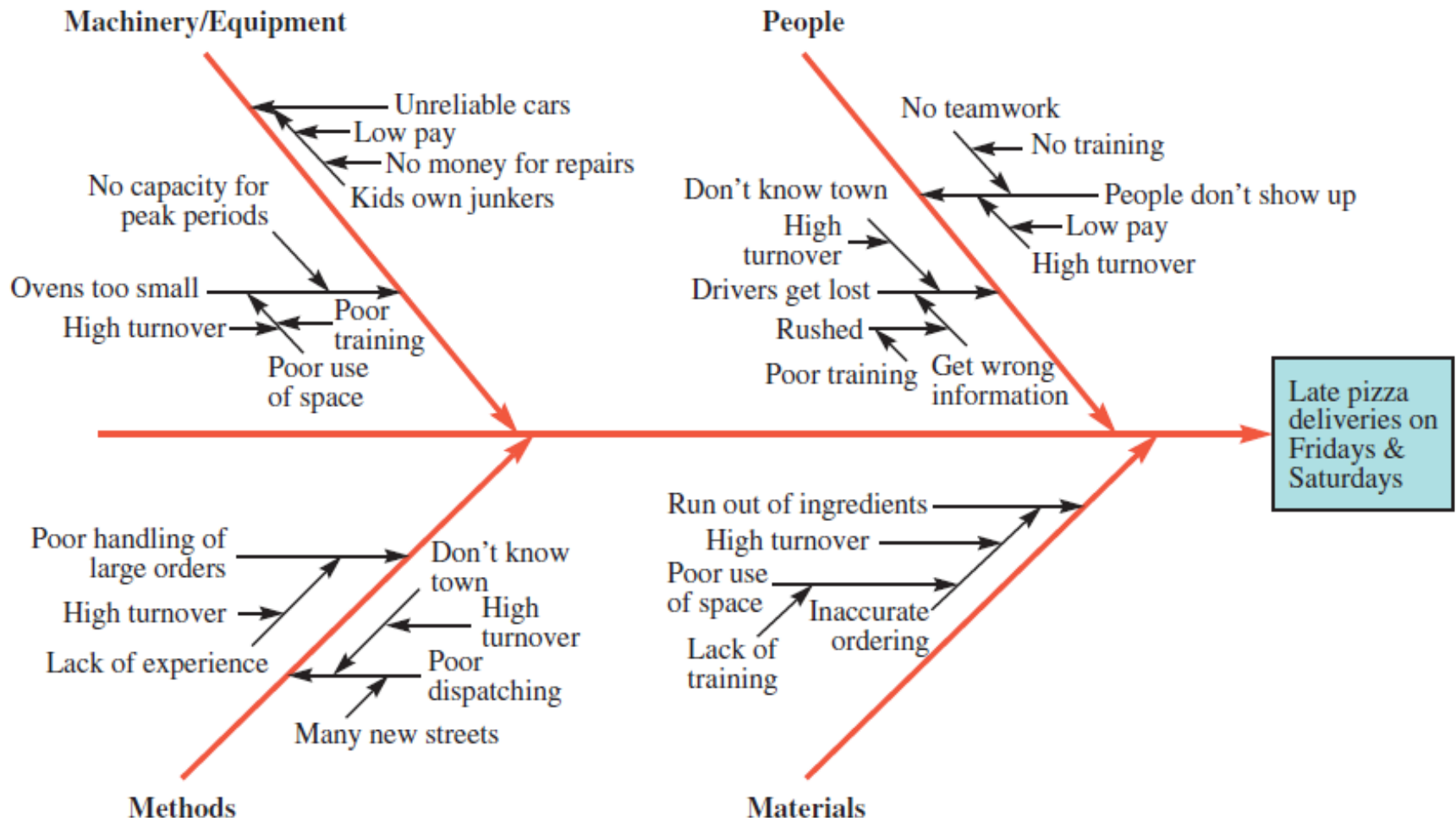


Illustration note: Delivery time was defined by the total time from when the order was placed to when the customer received it.

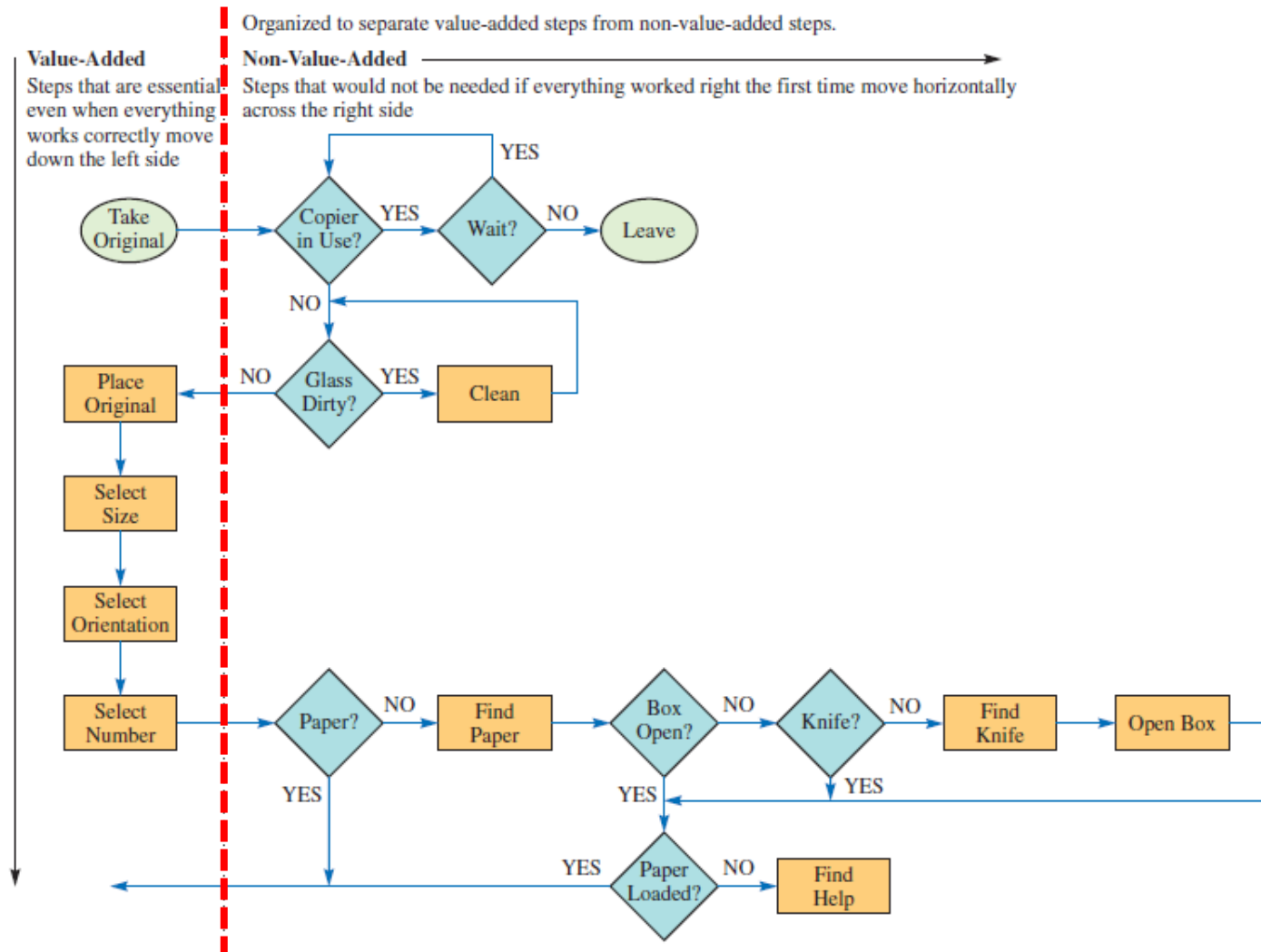
Cause-and-Effect Diagram (Fishbone Diagram)

Reasons for late pizza deliveries



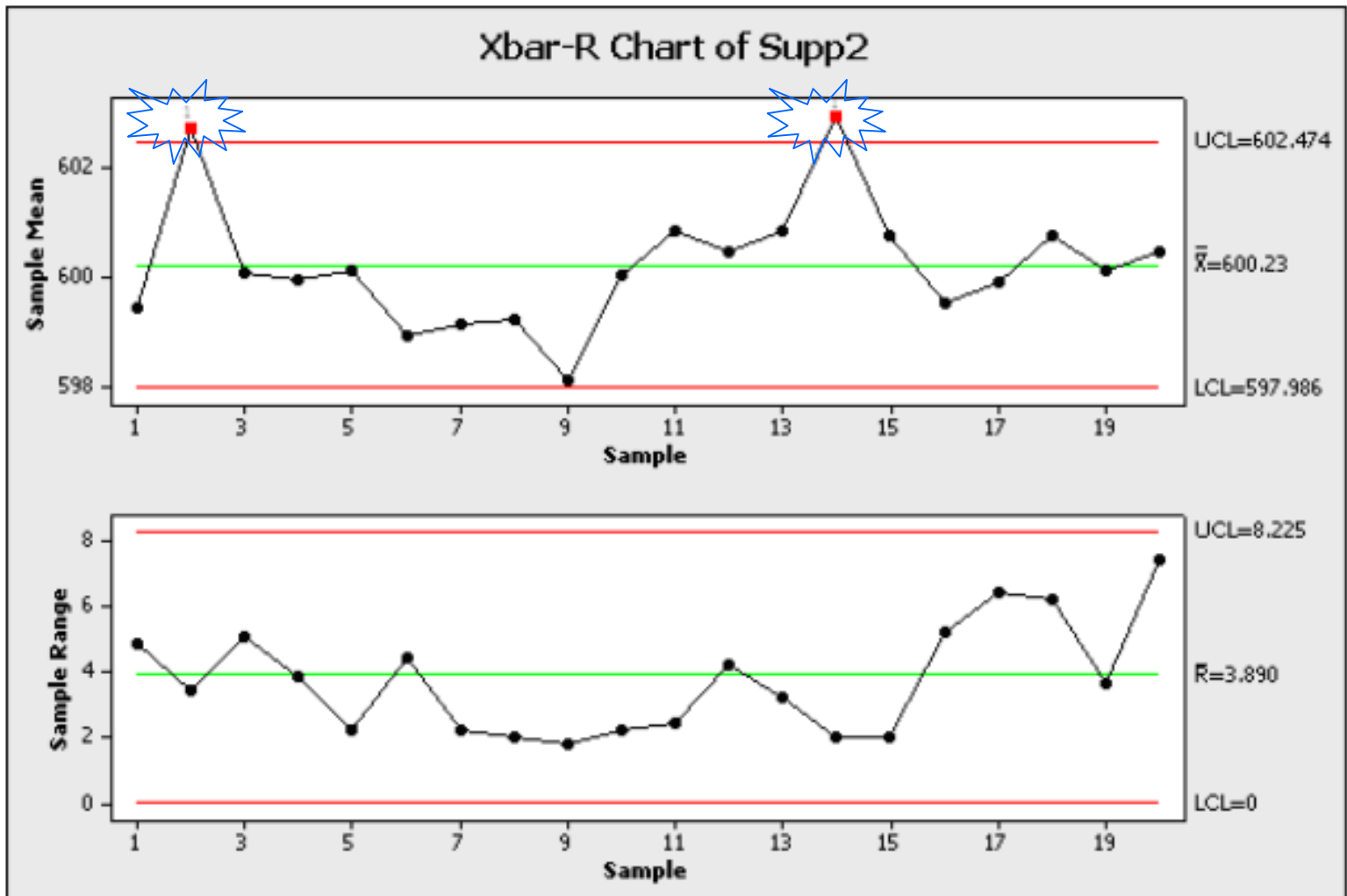
Source: From *The Memory Jogger*™II, 2001. Used with permission of GOAL/QPC.

Opportunity Flow Diagram



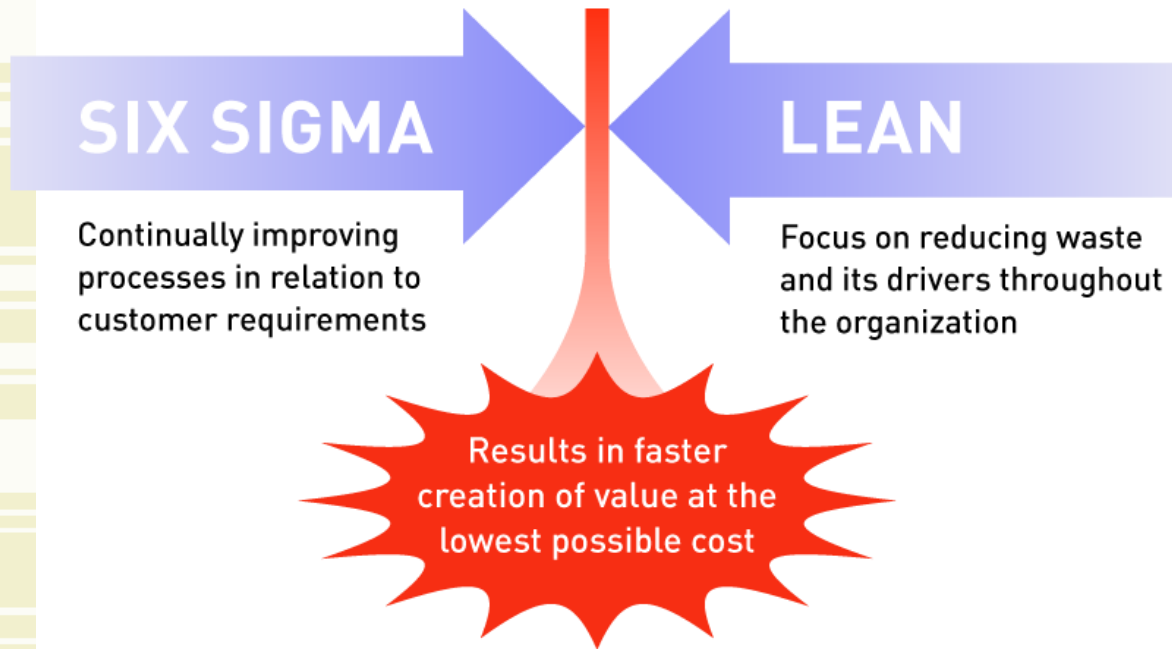
Source: Rath & Strong, *Rath & Strong's Six Sigma Pocket Guide*, 2001.

Process Control Chart



Source: Rath & Strong, *Rath & Strong's Six Sigma Pocket Guide*, 2001.

Driving Operations Excellence



Examples of Six Sigma Adopters



PHILIPS
sense and simplicity



Certified Professionals



Key Take Away

- JIT / lean operations
- Sources of waste
- Push / pull systems
- RATER & SERVQUAL model
- Six Sigma - DMAIC & 7 basic tools

