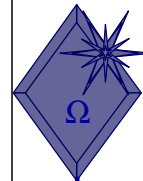


Lectures 3&4: Supply Chain Performance, Quality Attributes, and Metrics

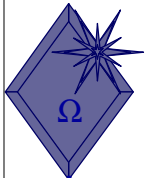
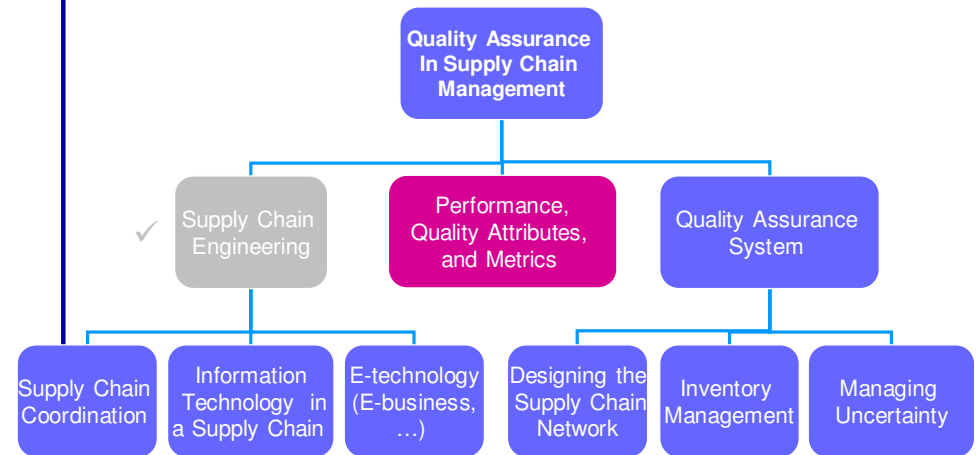


Quality Assurance in Supply Chain Management (INSE 6300/4-UU)

Winter 2011

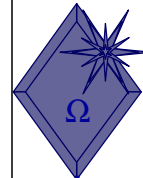


INSE 6300/4-UU

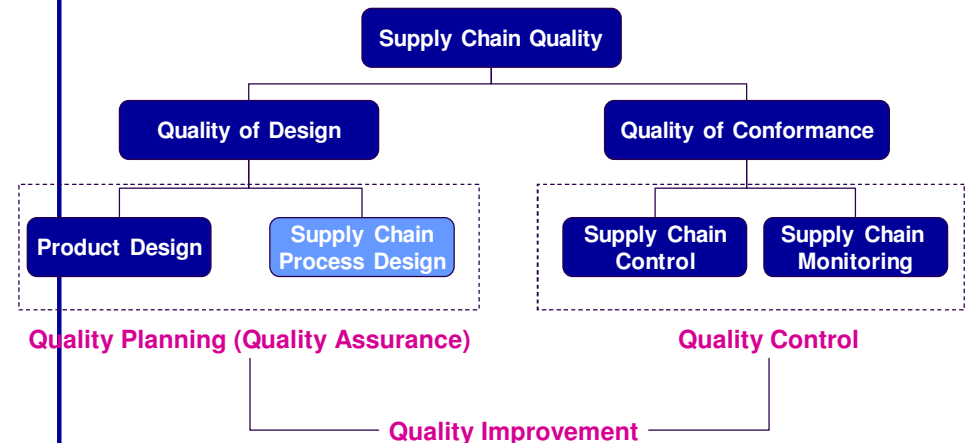


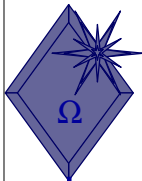
Overview

- ◆ Key Quality Issues and Attributes for Supply Chain
- ◆ Supply Chain Performance
- ◆ Customer Service and Uncertainty



Quality Management in Supply Chain

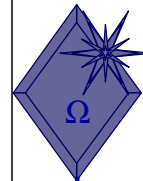




Supply Chain Process Design

- ◆ Quality issues
- ◆ Quality attributes
- ◆ Managing uncertainty
- ◆ Managing inventory
- ◆ Designing the supply chain network

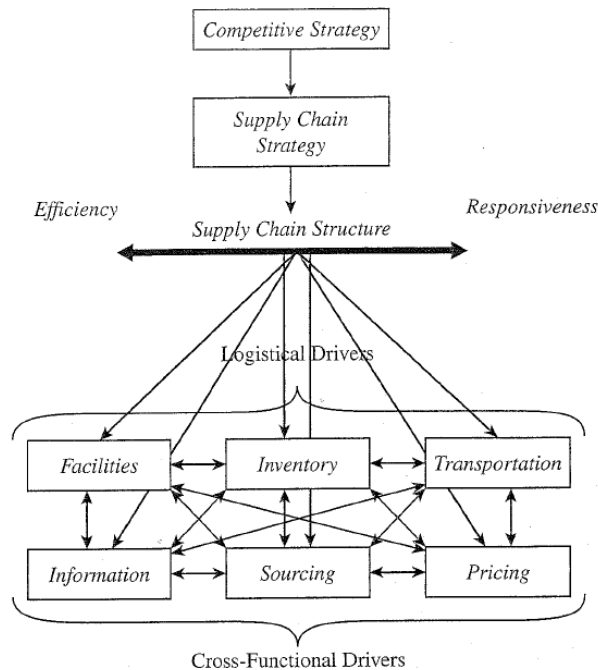
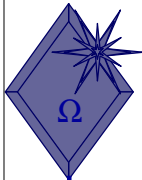
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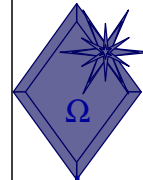
Drivers of Supply Chain Performance

- ◆ **Logistical drivers**
 - ◆ Facilities
 - ◆ Inventory
 - ◆ Transportation
- ◆ **Cross-Functional drivers**
 - ◆ Information
 - ◆ Sourcing
 - ◆ Pricing
- ◆ Drivers can be measured using metrics:
 - ◆ A *metric* is a standard of measurement of performance

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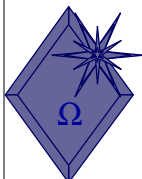
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Supply Chain Framework: Metrics

- ◆ **Facilities: flexibility, dedication or combination**
 - ◆ **Location:** Design and optimization problem
 - ◆ **Capacity:** the maximum amount a facility can process
 - ◆ **Utilization:** the fraction of capacity that is currently being used
 - ◆ **Production cost per unit**
 - ◆ **Quality losses:** fraction of production lost due to defects
 - ◆ **Production service level:** fraction of production orders completed on time

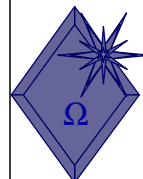
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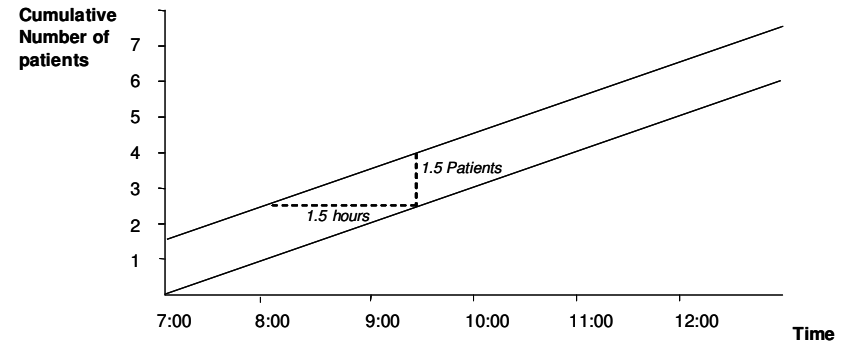
Inventory Classes

- ◆ Pipeline inventory
- ◆ Seasonal inventory
- ◆ Cycle inventory
- ◆ Safety inventory

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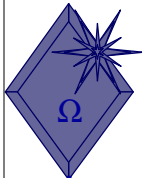


Pipeline Inventory



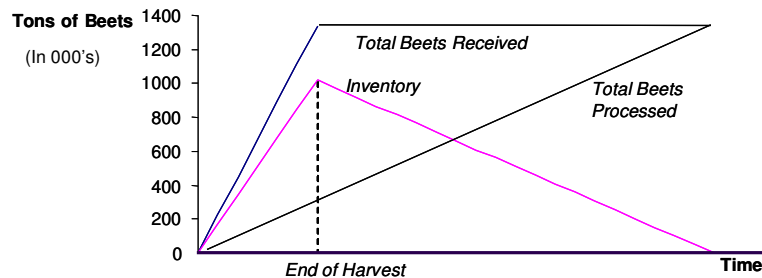
$$\text{Inventory} = 1[\text{patients/hour}] \times 1.5[\text{hours}] = 1.5 \text{ patients}$$

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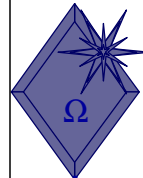


Seasonal Inventory

Capacity is rigid and demand is variable

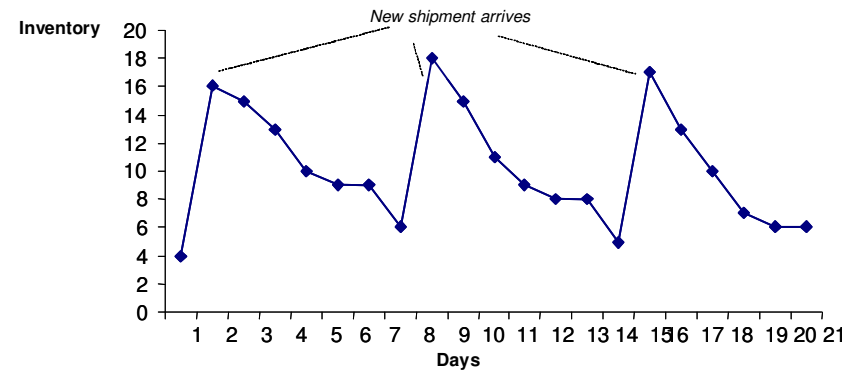


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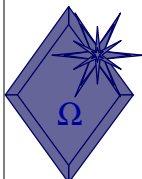


Cycle Inventory

Process several flow units collectively at a given moment in time

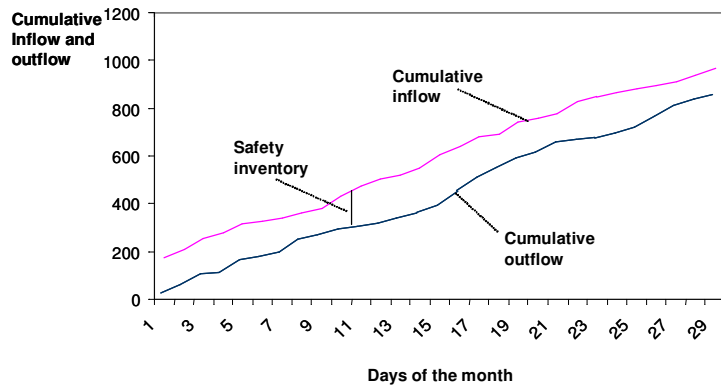


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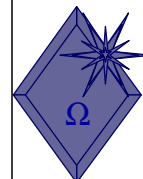


Safety Inventory

Stochastic demand: distinguishing predicted demand from the actual demand



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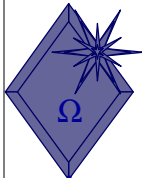


Supply Chain Framework: Metrics

◆ Inventory

- ◆ Average inventory
- ◆ Average safety inventory
- ◆ Average seasonal inventory
- ◆ Fraction of time out of stock

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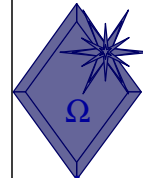


Supply Chain Framework: Metrics

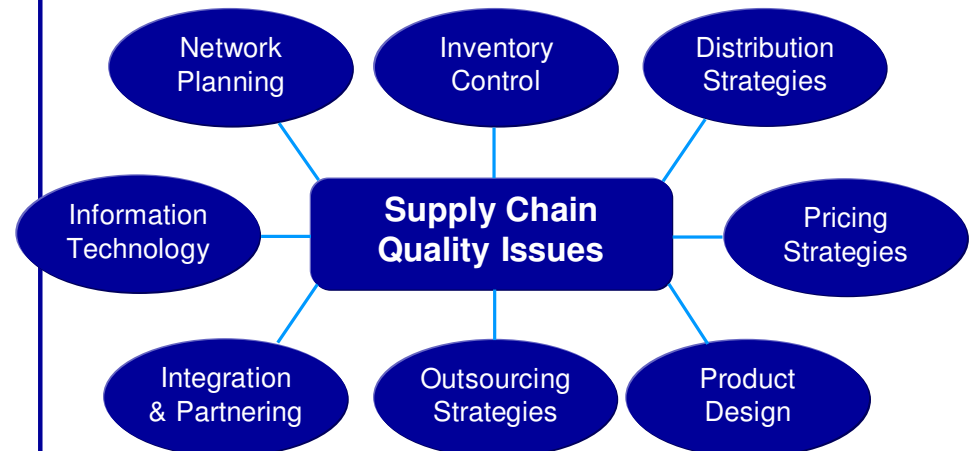
◆ Transportation

- ◆ Fraction transported by mode: the fraction of transportation (units or dollars) using each mode of transportation
- ◆ Average transportation cost: the cost of transportation as a percentage of sales or cost of goods sold
- ◆ Average shipment size

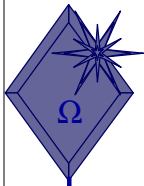
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Key Quality Issues



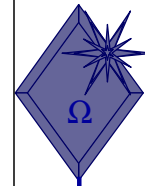
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Key Quality Issues

- ◆ **Network Planning:** optimization aspect
 - ◆ Reorganizing or redesigning the network
 - ◆ Determining the production level
 - ◆ Selecting new suppliers
 - ◆ Selecting warehouse locations and capacities

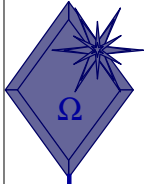
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Key Quality Issues

- ◆ **Inventory Control:** minimizing inventory ordering and holding cost
 - ◆ Predicting demand
 - ◆ Deciding at what point to reorder a new batch of the product
 - ◆ Deciding how much to reorder

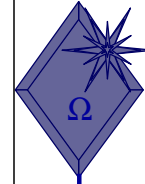
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Key Quality Issues

- ◆ **Distribution Strategies:** relationships between suppliers and manufacturers
 - ◆ The relevance of Wal-Mart's *cross-docking* strategy:
 - ◆ The stores are supplied by central warehouses: transshipment points for incoming orders
 - ◆ How many cross-dock points?
 - ◆ Is the cross-docking strategy better than the classical strategy in which warehouses hold inventory?

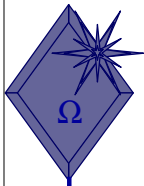
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Key Quality Issues

- ◆ **Supply Chain Integration and Strategic Partnering:**
 - ◆ Information sharing and operational planning are keys to successfully integrated supply chain
 - ◆ But what information will be shared?
 - ◆ How will it be used?
 - ◆ What level of integration is needed?
 - ◆ What partnerships can be implemented?

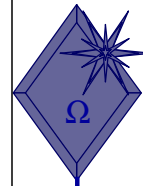
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Key Quality Issues

- ◆ **Product Design:** Effective design
 - ◆ Certain product designs may increase inventory holdings or transportation costs
 - ◆ Other designs may facilitate a shorter manufacturing lead time
 - ◆ Product redesign is often expensive

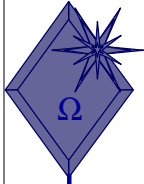
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Key Quality Issues

- ◆ **Customer Value:** the measure of a company's contribution to its customer
 - ◆ The entire range of products, services, and intangibles that constitute the company's offerings
 - ◆ Superseding classical measures: quality and customer satisfaction
 - ◆ How is customer value measured?
 - ◆ How is information technology used to enhance customer value?

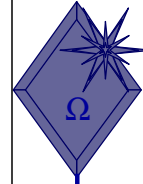
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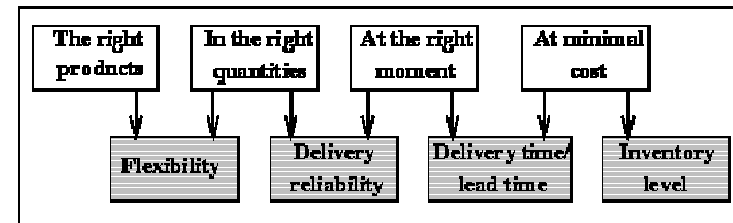
Key Quality Issues

- ◆ **Information Technology and Decision-Support Systems: management effectiveness**
 - ◆ Savings that can be achieved by sophisticated analysis of data
 - ◆ What data should be transferred?
 - ◆ Which data are significant?
 - ◆ How should data be analyzed and used?
 - ◆ Impact of the Internet?
 - ◆ What infrastructure is required internally and between partners?

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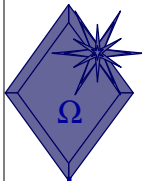


Main Quality Attributes for Supply Chain

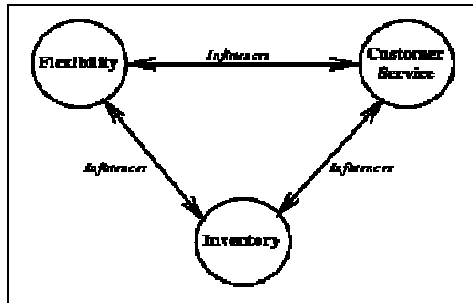


- ◆ The objective is to be able to have **the right products in the right quantities (at the right place) at the right moment at minimal cost.**

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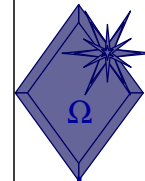


Main Quality Attributes for Supply Chain



- ◆ Delivery reliability, and delivery times, are both aspects of **customer service**

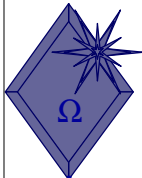
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Main Quality Attributes for Supply Chain

- ◆ Manufacturing entities have inventories for raw products, products in the production process, and finished products
- ◆ The holding cost inventories are often set as high as 30 - 40% of the inventory value
- ◆ it is desirable to avoid so-called **dead inventory**:
 - ◆ Inventory that is left when a product is no longer on the market
- ◆ it is in every company's interest to keep inventory levels at a minimum

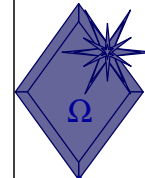
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Main Quality Attributes for Supply Chain

- ◆ Flexibility: the ability to respond to changes in the environment
- ◆ In the case of a manufacturer: the ability to change the output in response to changes in the demand
- ◆ In a supply chain: the flexibility of one entity is highly dependent on the flexibility of upstream entities
- ◆ The overall flexibility of a supply chain will therefore depend on the flexibility of all the entities in a supply chain, and their interrelations

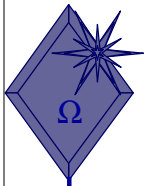
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Overview

- ◆ ✓ Key Quality Issues and Attributes for Supply Chain
- ◆ Supply Chain Performance
- ◆ Customer Service and Uncertainty

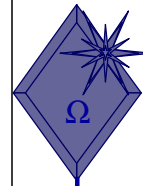
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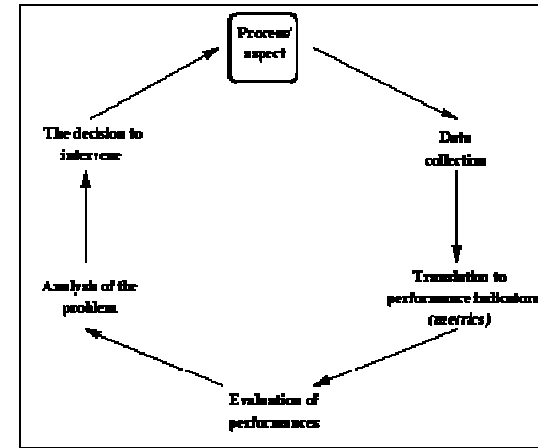
Supply Chain Performance

- ◆ Supply Chain performance depends on two key issues:
 - ◆ Matching supply with demand
 - ◆ Uncertainty and variability
 - ◆ Adjusting supply chain strategies with competitive strategy
 - ◆ Value chain and supply chain process

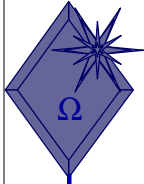
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Supply Chain Performance: Control Cycle



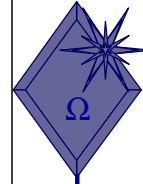
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Supply and Demand

- ◆ The Dilemma of Almost Every Firm: Supply Does Not Match Demand
 - ◆ Inventory results from a mismatch between supply and demand
 - ◆ Mismatch can take one of the following two forms
 - ◆ Demand waits for supply (inventory = waiting customers)
 - ◆ Supply waits for demand (inventory = goods or resources)

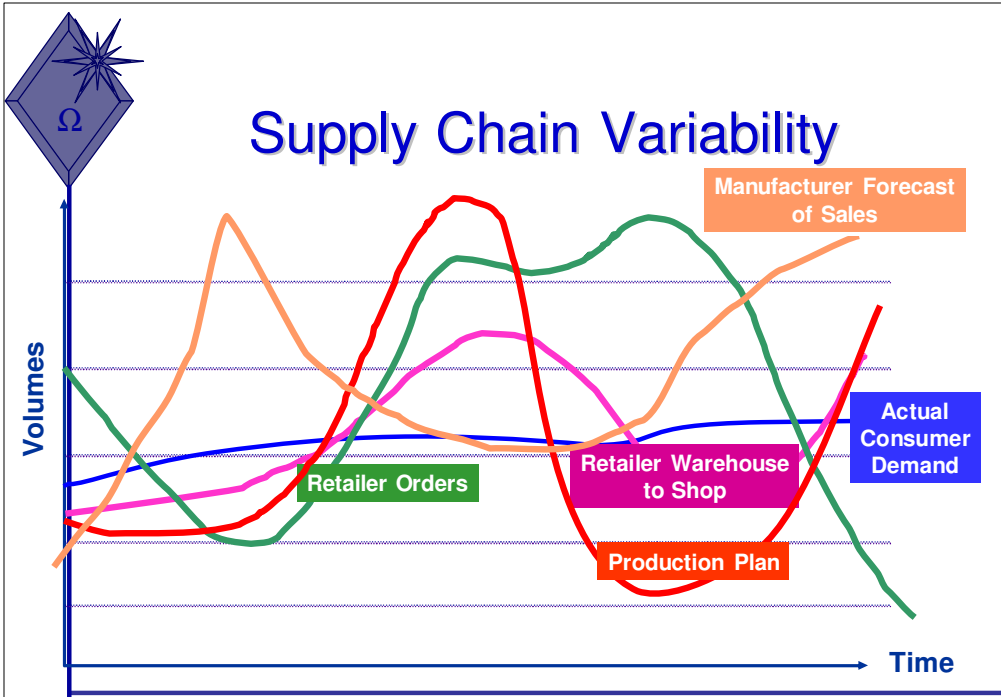
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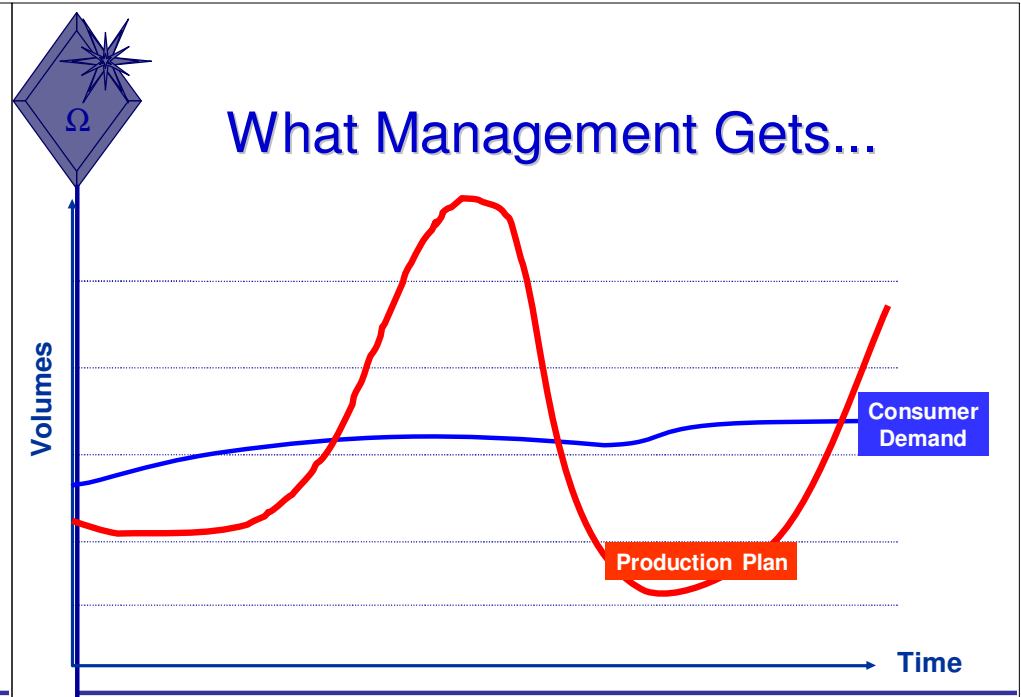
Supply-Demand Mismatch

- ◆ Why mismatch?
 - ◆ Mismatch reflects the fact that capacity is more rigid than demand
- ◆ Under which circumstances supply would always be able to meet demand?
 - ◆ Production/delivery were instantaneous (i.e. flow time = 0)
 - ◆ Capacity is unlimited (i.e. flow rate or throughput = infinity)
- ◆ If it is impossible to satisfy the above condition, what should the company do?
 - ◆ Hold inventory

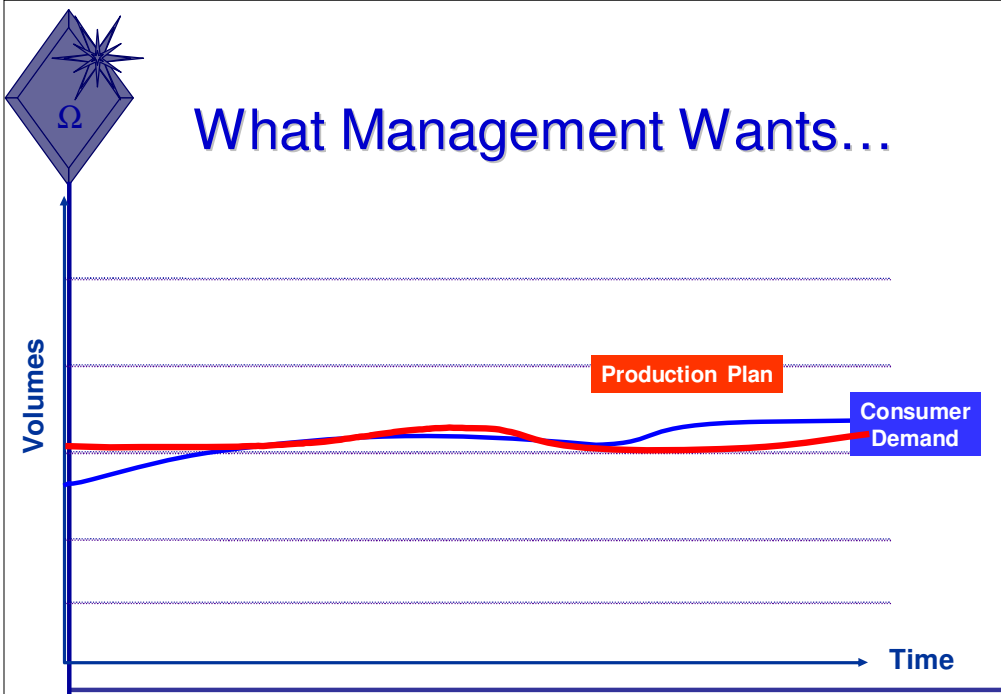
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Source: Tom Mc Guffry, Electronic Commerce and Value Chain Management, 1998 33



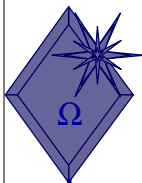
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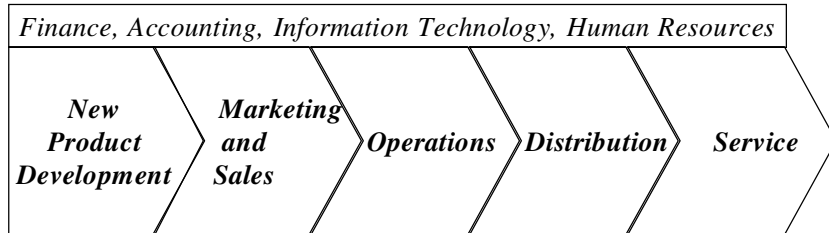
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- ## Competitive and Supply Chain Strategies
- ◆ Competitive strategy: defines the set of customer needs a firm seeks to satisfy, relative to its competitors, through its products and services
 - ◆ Supply chain strategies: defines the operations to be performed to improve the quality management
 - ◆ The value chain

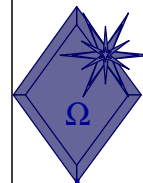
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The Value Chain



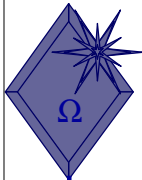
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Supply Chain Strategies

- ◆ Product development strategy: specifies the portfolio of new products that the company will try to develop
- ◆ Marketing and sales strategy: specifies how the market will be segmented and product positioned, priced, and promoted
- ◆ Supply chain strategy:
 - ◆ Determines the nature of material procurement, transportation of materials, manufacture of product or creation of service, distribution of product
 - ◆ Consistency and support between supply chain strategy, competitive strategy, and other functional strategies is important

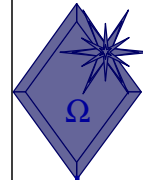
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Adjusting Supply Chain Strategies with Competitive Strategy

- ◆ Strategic fit:
 - ◆ Consistency between customer priorities of competitive strategy and supply chain capabilities specified by the supply chain strategy
 - ◆ Competitive and supply chain strategies have the same goals
- ◆ A company may fail because of a lack of strategic fit or because its processes and resources do not provide the capabilities to execute the desired strategy
- ◆ Example of strategic fit -- Dell

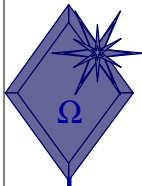
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How is Strategic Fit Achieved?

- ◆ Step 1: Understanding the customer and supply chain uncertainty
- ◆ Step 2: Understanding the supply chain
- ◆ Step 3: Achieving strategic fit

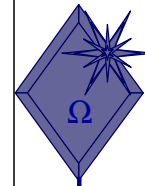
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Understanding the Customer and Supply Chain Uncertainty

- ◆ Identify the needs of the customer segment being served
- ◆ Quantity of product needed in each lot
- ◆ Response time customers will tolerate
- ◆ Variety of products needed
- ◆ Service level required
- ◆ Price of the product
- ◆ Desired rate of innovation in the product

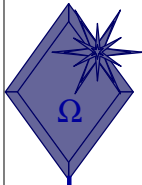
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Understanding the Supply Chain

- ◆ A dimension describing the supply chain performance is supply chain responsiveness
- ◆ Supply chain responsiveness: ability to
 - ◆ Respond to wide ranges of quantities demanded
 - ◆ Meet short lead times
 - ◆ Handle a large variety of products
 - ◆ Build highly innovative products
 - ◆ Meet a very high service level

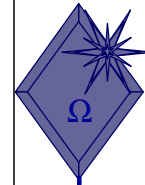
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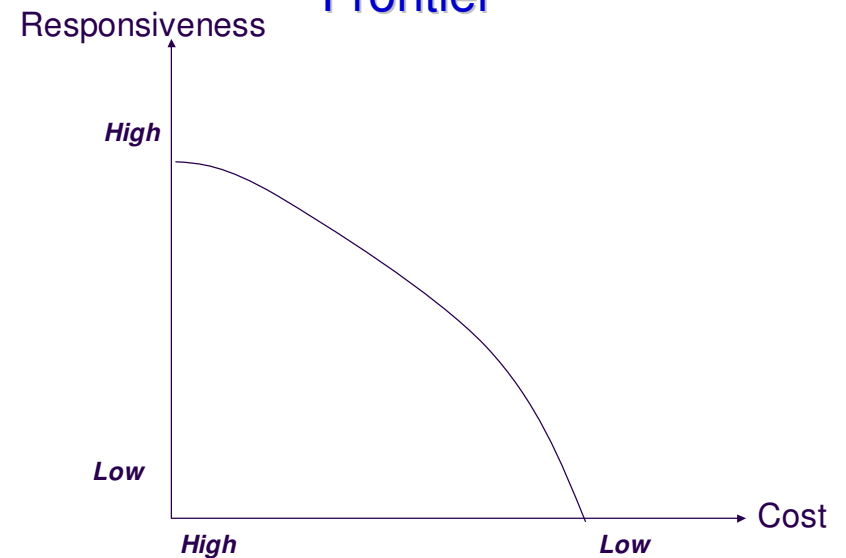
Responsiveness and Efficiency

- ◆ There is a cost to achieving responsiveness
- ◆ Supply chain efficiency: cost of making and delivering the product to the customer
- ◆ Increasing responsiveness results in higher costs that lower efficiency

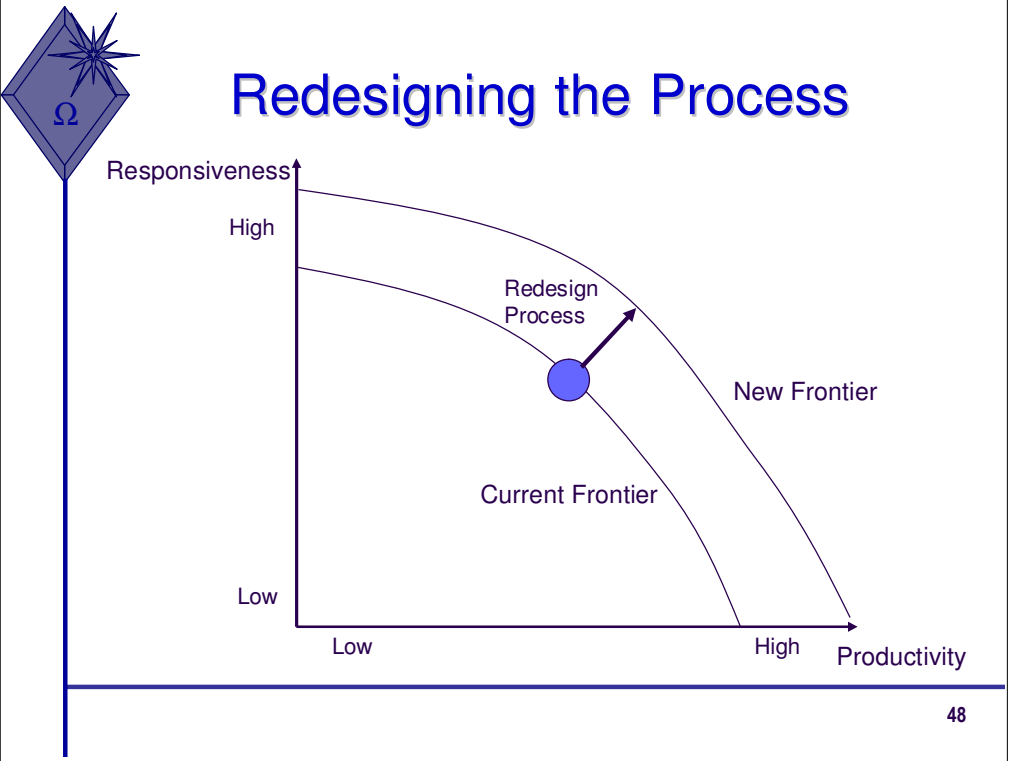
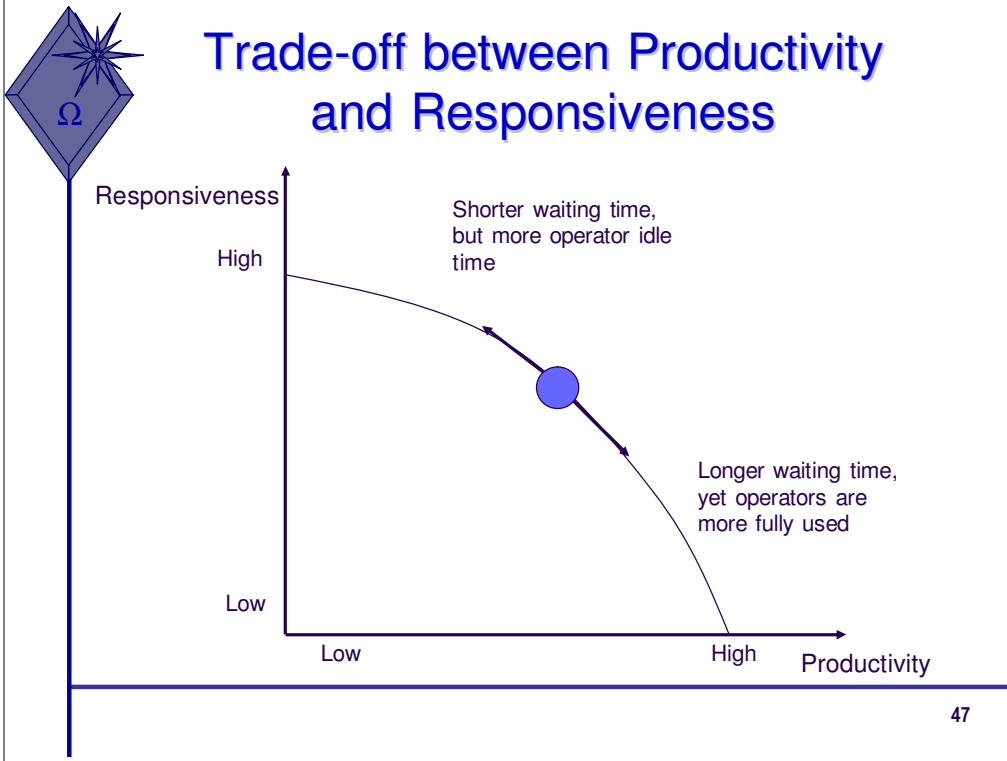
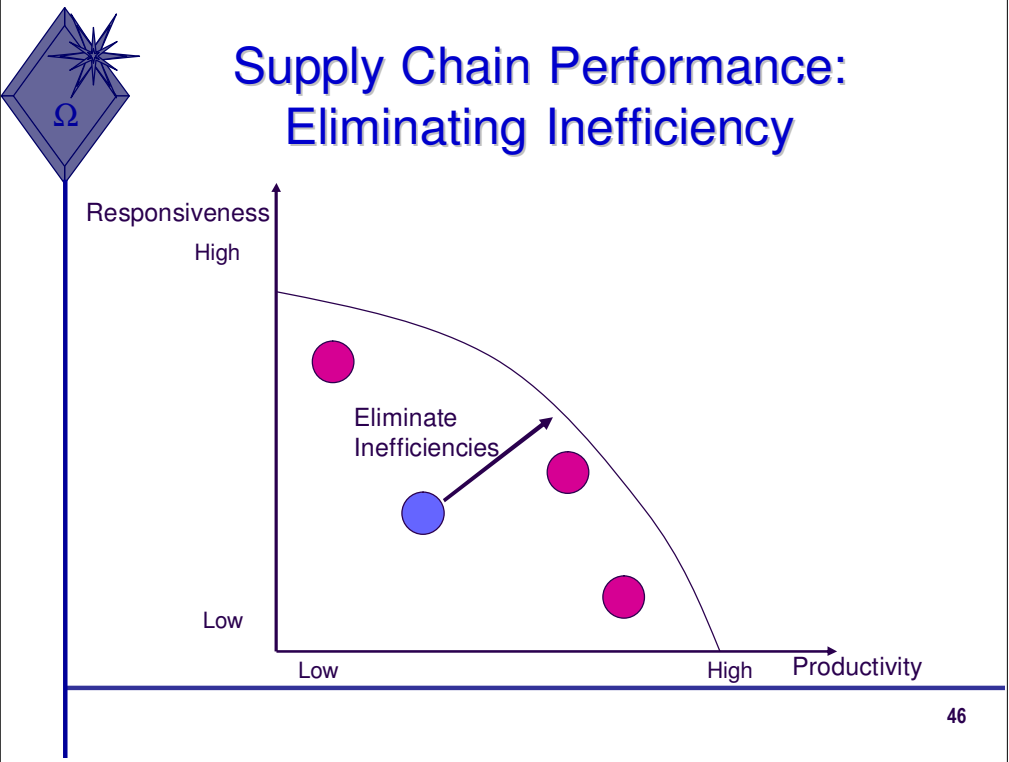
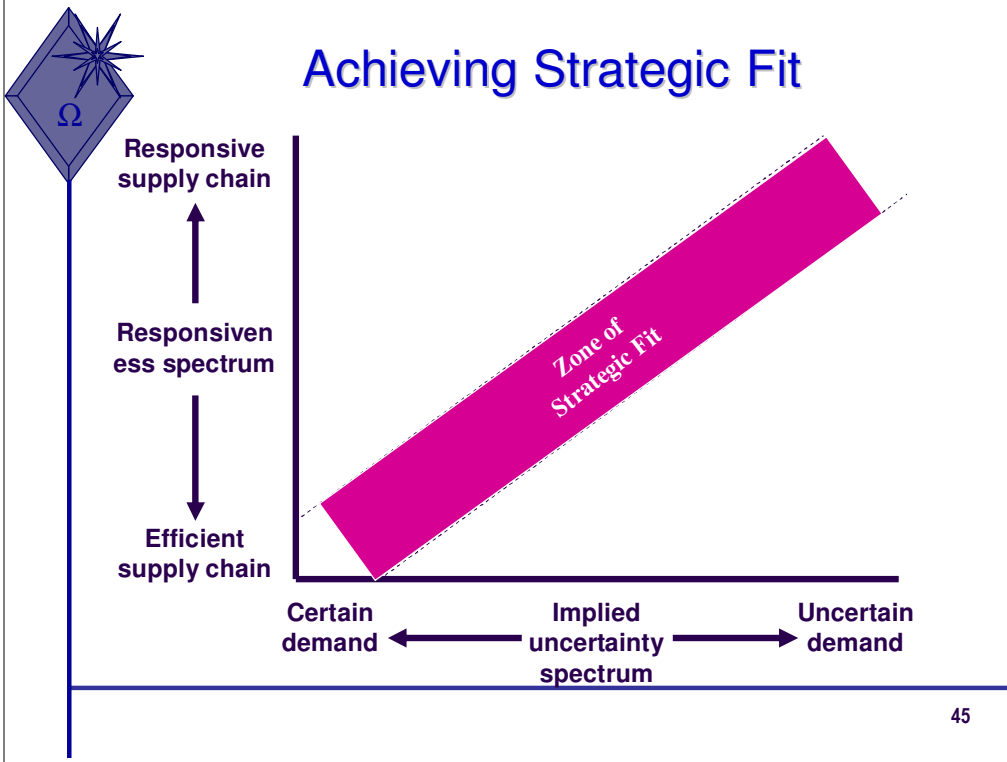
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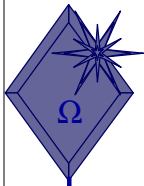


Cost-Responsiveness Efficient Frontier



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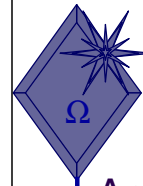




Performance: Process Analysis

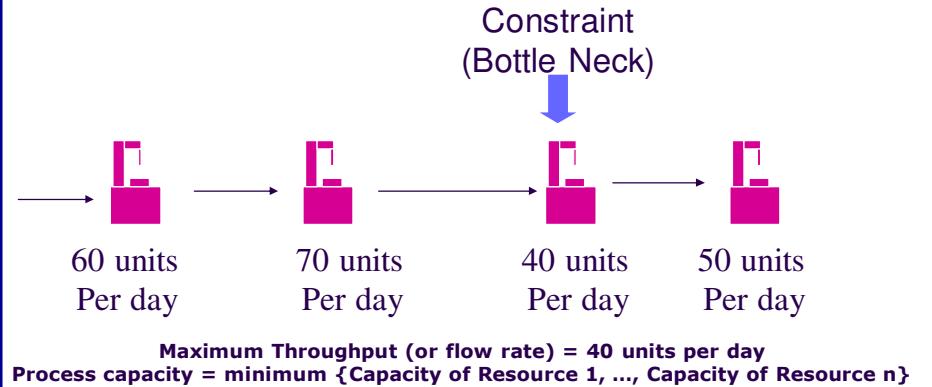
- ◆ Find the capacity (flow rate) of every resource
- ◆ Identify the bottleneck (i.e. the lowest capacity)
- ◆ Calculate the flow rate
 - ◆ $\text{Min} \{ \text{Available Input, Demand, Process Capacity} \}$

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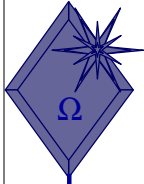


Constraint (Bottleneck)

Any system can produce only as much as its critically constrained resource



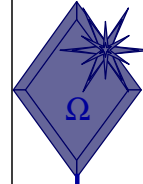
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Overview

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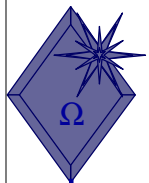
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Customer Service

- ◆ Typical measures of customer service are:
 - ◆ A company's ability to fill orders within due date (fill rate),
 - ◆ Its ability to deliver products to customers within the time quoted (on-time deliveries)
 - ◆ The delivery performance of orders that are *not* delivered on-time: the **average time from order to delivery**

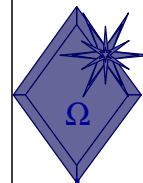
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Uncertainty

- ◆ **Demand uncertainty:** uncertainty of customer demand for a product
- ◆ **Implied demand uncertainty:** resulting uncertainty for the supply chain **given the portion of the demand the supply chain must handle** and attributes the customer desires

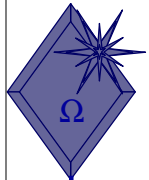
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Uncertainty

- ◆ **Understanding the Customer**
 - ◆ Lot size
 - ◆ Response time
 - ◆ Service level
 - ◆ Product variety
 - ◆ Price
 - ◆ Innovation
-  **Implied Demand Uncertainty**

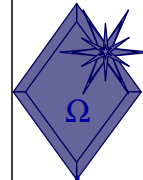
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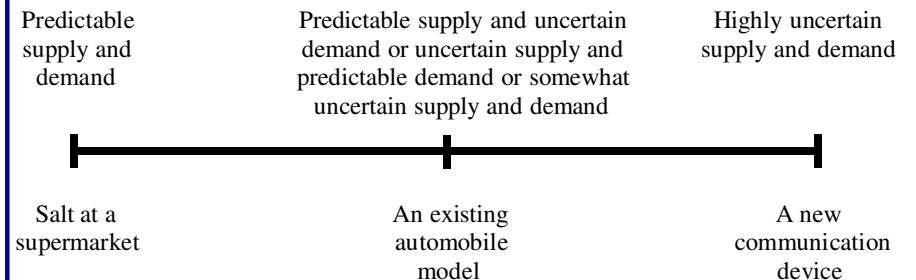
Uncertainty

- ◆ What is the relation between service level and Implied demand uncertainty?
- ◆ High service level
 - ⇒ satisfying a higher percentage of actual demand
 - ⇒ Increase the portion of the demand the supply chain must handle
 - ⇒ increase the implied demand uncertainty but not the demand uncertainty

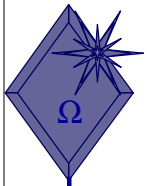
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Levels of Implied Demand Uncertainty



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Readings

- ◆ Lecture 4:
 - ◆ Chapter 5 of Supply Chain Management