INTRODUCTION OF THE COURSE

Rationale and logic

If your career path has already provided you with an opportunity to witness and be a part of the formulation and implementation of important strategies pursued by your enterprise you are already aware of the importance of customer requirements. On the other hand, if you are contemplating a strategic job after completing your MBA, you may have already started to notice in your lectures and text books that organizations pay attention to what the customers have to say. And, it should not come as a big surprise to you that in most of the cases the primary driver of these strategies is Customer Satisfaction. As a matter of fact, Customer Satisfaction is now a global strategic objective and should be aimed for at cost effectiveness. This strategy is contingent upon smooth coordinated flow of raw materials, transformed finished goods (services), information and off course Cash Flow. ***In other words a business can only be considered successful if it has a competitive supply chain that can result in Competitive Advantage.*** *It would be to your benefit to study this class with the same objective in mind. Please do understand that you are not alone in this regard,* ***business managers all over the globe whether working for any small or nascent, gigantic or established organization, are made to work relentlessly with the same aim and objective of cost effective based customer satisfaction through smooth coordinated Supply Chain****.*

Supply Chain Management has emerged, in the last 25 years or so, as a road map to Enterprise Success and Competitive advantage. Integration of functional areas of the enterprise is possible through proper management and control of Supply Chain Operations. Information Technology (IT) plays a vital role in seamless integration of Supply Chain.

Decisions in Supply Chain are mostly based on Information Technology (IT). This is possible due to IT ensuring access to real life data. The fine tuning of the information that is collected is processed and distributed at various decision making points along the supply chain.

If you are planning to become one or already working as a business manager in the functional areas of Marketing, Operations or Procurement, **the importance of SCM can be readily understood**. Supply Chain **encompasses all functional areas** of enterprise.

This course would help the business manager/ virtual university student or manager in training to develop the important skill of qualitative and quantitative analyses.

This means you would be applying directly or indirectly the four generic Supply Chain strategies of **optimization, customization, innovation and Rationalization**.

1. The current managerial perspective of competitive advantage entails that we do not carry out static comparison of an enterprise with another enterprise (or COMPARING its product or service being offered with the product or service of its competitor) rather we now carry out the **COMPARISON OF A SUPPLY CHAIN OF AN ENTERPRISE WITH THE SUPPLY CHAIN OF THE COMPETITOR'S ENTERPRISE.**
2. So for the whole semester the **VIRTUAL UNIVERSITY STUDENT SHOULD** try to identify and accept all those opportunities that would allow him or her to gain an in depth knowledge about Supply Chain's functioning with respect to its own enterprise and its competitor's firm.

The Learning Objectives are covered in the form of distinct and unique modules in each and every lecture. The modules are not of any fixed duration or length rather the duration is contingent to the length, depth, qualitative and quantitative based content. For this lecture number 1, the following modules have been designed to address the respective learning objectives.

Module 1: Why this Course

Module 2: Learning Objectives

Module 3: Text Books

Module 4: Learning Methodologies

Module 5: Generic Supply Chain

Module 6: Pakistan's place in Comity of Nations

MODULE 1: WHY THIS COURSE?

Supply Chain Management is an essential and indispensable area of management that business executives are bound to learn and practice.

1. The objective in this course is specifically to help the students understand, appreciate and, consequently, develop purchasing, logistics and supply chain strategies that contribute positively to overall business objectives of their organizations.
2. The same objective should ideally meet the routine and non-routine situations (with few exceptions), with practical, rigorous and thorough approach.
3. This course will introduce concepts and techniques which will enable the student to comprehend and make good use of, in his or her practical job engagements and assignments as purchasing, supply chain management, sourcing management, sourcing management and other similar titles like logistics or transportation managers.
4. Having an understanding of Sourcing, Logistics and Supply Chain Management is critical for today's business leaders.
5. After successful completion students of this course would be in a position to replicate (adopt) successful and avoid the failed supply chain strategies experienced by business enterprises, around the globe.

MODULE 2 LEARNING OBJECTIVES

At the end of the course, you (the virtual university student) should be able to accomplish the following objectives:

a. Develop an Understanding of the importance of Purchasing, Logistics and Supply Chain Management in the critical decision making process of any organization (manufacturing or services) and or for any government department.

b. Get familiarized with various production processes and service systems affected by Purchasing and SCM.

c. Develop an ability to identify what makes a specific issue important to contracting and procurement. Carry out research and analyze recognized or promising subject in the field of contracting and procurement.

d. Expand on the new issues related to strategic policy in contracting and procurement.

e. Develop Cognitive, Affective and Psychomotor approaches about Supply Chain Management with respect to building of a strategic framework, designing of the supply chain, planning demand and supply in the Supply Chain, Planning and Managing Inventories in the Supply Chain, Managing Cross functional drivers in a supply chain and applying all the same to the Pakistani Corporate and Government Departmental Environment

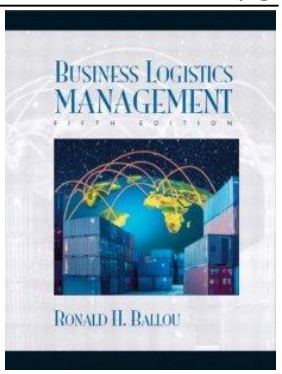
f. And last but not the least investigate theoretical and practical Supply Chain approaches that organizations have adopted or are planning to adopt with a point of view to enhance their business performance in the future.

MODULE 3: TEXT BOOKS

The first 9 Lectures have been developed from listed books; whereas Chapters 10 to 45 have been developed primarily using Chopra and Meindl's Supply Chain Management text.

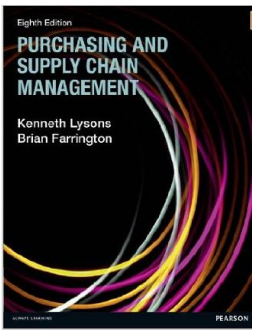
The content of the modules has been developed from the following textbooks as the source material.

BUSINESS LOGISTICS MANAGEMENT RONALD H BALLOU



Business Logistics Management textbook, by Ronald H Ballou, is an ideal resource for professionals who want to outshine in Business Logistics, Physical Distribution, Operations Management, Materials Management, and Supply Chain Management.

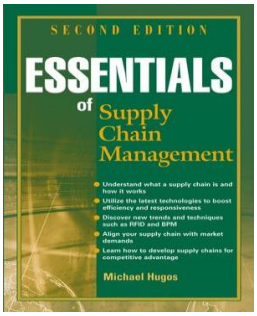
Students would learn the planning, organizing, and controlling of such activities as transportation, inventory maintenance, facility location, order processing, purchasing, warehousing, materials handling, packaging, customer service standards, and product scheduling-is specifically designed to help students solve actual challenges that they will encounter in today's marketplace. Practicing managers can make effective use of basic decision making tools; a lot of mathematical and quantitative support is available for cost reduction and strategic initiatives. Log ware software is also available on CD-ROM, which can be used by **SCM professionals in Pakistan to develop in house logistics solution with respect to Pakistani roads and means of transportation.**



PURCHASING & SUPPLY CHAIN MANAGEMENT

LYSONS AND FARRINGTON

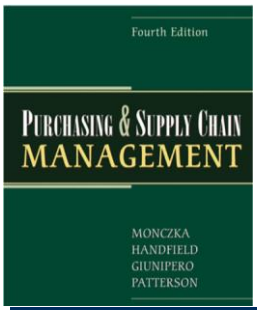
Lysons & Farrington is a fundamental purchasing knowledge resource. This book is an ideal source if the student is interested in opting for a Purchasing Sourcing and Procurement career in the UK or the Middle East. It is one of the more comprehensive textbooks on Purchasing & Supply Chain management currently available. Clearly written and covering a wide range of information, models and definitions, this book is an ideal overall resource for any course in Purchasing or Supply Chain Management. The contents clearly cover the syllabus of the Chartered Institute of Purchasing and Supply at both the Foundation and Professional stages and the text will provide a quick source of reference for practitioners on many aspects of purchasing and supply. Virtual University students working in the government departments may use this textbook to renew the old procurement procedures and transform them into current purchasing and supply chain management methods.



ESSENTIALS OF SUPPLY CHAIN MANAGEMENT

MICHAEL E HUGOS

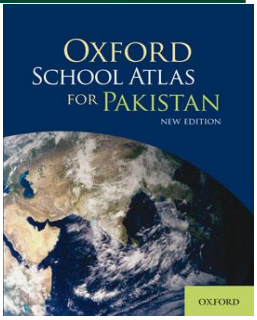
Essentials of Supply Chain Management, 2nd Edition, by Michael E Hugos, is focused on how supply chain managers can learn to utilize technology to boost efficiency and responsiveness, implement IT and adopt best practices available for supply chain management. The text also offers new cases. It helps the student in learning the strategies of creating an effective supply chain that is actually a key to staying ahead in today's complex business world.



PURCHASING & SUPPLY CHAIN MANAGEMENT

HANFIELD & GUINIPERO

This text book represents best practices and research with respect to purchasing and supply chain. It captures professional experience and research to further enhance managerial perspective of the core tasks and challenges required to effectively manage the purchasing function within the context of an integrated supply chain. Please do remember that the Purchasing function is now slowly, but surely assuming a strategic stature in the government departments of Pakistan. All these job opportunities would require you to master the art and science of purchasing, supply management and supply chain management.



OXFORD ATLAS PAKISTAN

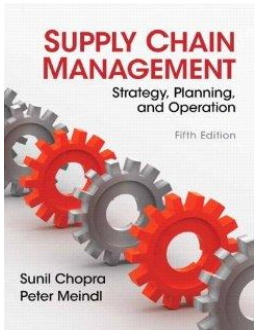
Every important aspect of Pakistan's geography is covered in detailed and clearly presented maps, including especially designed maps and graphs for crops, irrigation, energy, main industries, education and literacy, population, main cities, rural settlements, transport, natural hazards, and environmental damage.

It is also an indispensable source of reference for Supply Chain Managers; Transportation Managers who can integrate the Atlas maps, with various commercially available software's, to finalize their Supply Chain Network designs thus saving time and money for their enterprises through effective simulation techniques.

A word of caution: Virtual University Students are requested to comply with copy rights and proprietary information

SUPPLY CHAIN MANAGEMENT Strategy, Planning and Operation

CHOPRA & MEINDL



This book is targeted toward an academic as well as a practitioner audience. On the academic side, it should be appropriate for MBA students, engineering master's students, and senior undergraduate students interested in supply chain management and logistics.

It may also serve as a suitable reference for both concepts as well as methodology for practitioners in consulting and industry.

This textbook has become the most popular choice amongst the academia, consultants and business managers.

In addition, some of the modules have been prepared using Purchasing & Supply Management

By Leenders, Leenders, Anna Flynn, P. Fraser Johnson

MODULE 4: LEARNING METHODOLOGY

1. The course would focus on learning of important concepts and their judicious applications in this class and your life afterwards.
2. Remember it's an INTEGRATIVE LEARNING we are aiming for.
3. **Integrative Learning is integration of Virtual University Students academic learning and workplace or industry based best practices.** Integrative Learning is a learning theory, describing a movement toward integrated lessons helping students make connections across curricula. This higher education concept is distinct from the elementary and high school "integrated curriculum" movement.

Part I	Introduction to SCM, Logistics, Purchasing & Supply Management and Strategic Frame Work
Part II	Designing the Supply Chain
Part III	Planning and Managing Supply and Demand and Inventory levels in a Supply Chain
Part IV	Planning and Managing Inventories in a Supply Chain
Part V	Designing and Planning Transportation Networks
Part VI	Managing Cross Functional Drivers in a Supply Chain

Part I Introduction to SCM, Logistics, Purchasing & Supply Management and Strategic Frame Work

The goal of Part I is to provide a strategic framework (long term and should be viewed and treated as a long term CAPITAL ASSET) to analyze the design, planning, and operational decisions within supply chains. Such a framework helps clarify supply chain goals and identify managerial actions that improve supply chain performance in terms of the desired goals.

Lecture Plans

Lectures 1 to 15.

- Fundamental concepts/information about SCM, Logistics, Purchasing & Supply Management (Lectures 1- 9)
- Understanding the Supply Chain (Lectures 10 & 11)
- Supply Chain Performance: Achieving Strategic Fit and Scope (Lectures 12 & 13)

- Supply Chain Drivers and Metrics (Lectures 14 & 15)

Part II Designing the Supply Chain

The plan of Part II is to discuss a set of frameworks and tools used to design supply chain networks. Network design decisions are among the most important supply chain decisions, as their implications are significant and long lasting. In designing a supply chain, we need to consider how all supply chain drivers--facilities, transportation, inventory, information, sourcing, and pricing—should be used together to support the competitive strategy of an enterprise and maximize supply chain profits.

Lecture Plans

- Designing Distribution Networks and Applications to on line Sales (Lectures 16 & 17)
- Network Design in the Supply Chain (Lectures 18 to 21)
- Designing Global Supply Chain Networks (Lectures 22 &23)

Ideally at this point in time, the students are ready to take their MIDTERM exams.

Part III Planning and Managing Supply and Demand and Inventory levels in a Supply Chain

The purpose of the Part III is to explain the significance of demand and supply planning in a supply chain, identify decisions that are part of the planning process, and discuss tools that supply chain managers can use for planning.

Planning allows a supply chain manager to be proactive and manage demand and supply to ensure that profits are maximized.

Lecture Plans

- Demand Forecasting in a Supply Chain (Lectures 24 & 25)
- Aggregate Planning in a Supply Chain (Lectures 26 & 27)
- Sales and Operations Planning: Planning Supply and Demand in a Supply Chain (Lectures 28 & 29)
- Coordination in a Supply Chain (Lectures 30 & 31)

Part IV Planning and Managing Inventory levels in a Supply Chain

The goal of Part IV is to describe the role that inventory plays in a supply chain and discuss actions that managers can take to decrease inventories without increasing cost or hurting the level of product availability.

Lecture Plans

- Managing Economies of Scale in a Supply Chain: Cycle Inventory (Lectures 32-33)
- Managing Uncertainty in a Supply Chain Safety Inventory (Lectures 34-35)
- Determining the Optimal Level of Product Availability (Lectures 36-37)

Part V Designing & Planning Transportation Networks

Part V deals specifically with the supply chain driver of transportation, the last of the three logistical drivers. In these two lectures, we discuss the strengths and weaknesses of various modes of transportation and different options for designing transportation networks.

We also discuss trade-offs among transportation cost, inventory cost, and responsiveness that must be considered when designing a supply chain

Lecture Plans

- Transportation in a Supply Chain (Lecture 38-39)

Part VI Managing Cross Functional Drivers in a Supply Chain

The aim of Part VI is to facilitate the student in discussing the impact of the traditional logistical drivers of supply chain performance-facilities, inventory, and transportation to the cross-functional drivers of sourcing, pricing, and information.

These drivers have grown in importance over the past decade and serve as an important point of differentiation between supply chain management and logistics.

Lecture Plans

- Sourcing Decisions in a Supply Chain (Lectures 40-41)
- Pricing & Revenue Management in a Supply Chain (Lectures 42-43)
- Information Technology in a Supply Chain (Lecture 44)
- Sustainability in a Supply Chain (Lecture 45)

STUDENTS LOG / JOURNAL BOOK

Virtual University students are encouraged to initiate their journal book. First Assignment is **LEARN** to study the map of Pakistan and identify the geographic relevance of the country with respect to International Trade by identifying roads, seaports, airports etc.

A series of maps are being presented here, these maps may require verification from different authentic sources like the Atlas of Pakistan etc. Students are requested to ensure that they are on board as far as the strategic infrastructure assets (roads, airports, seaports, railways etc.) are concerned

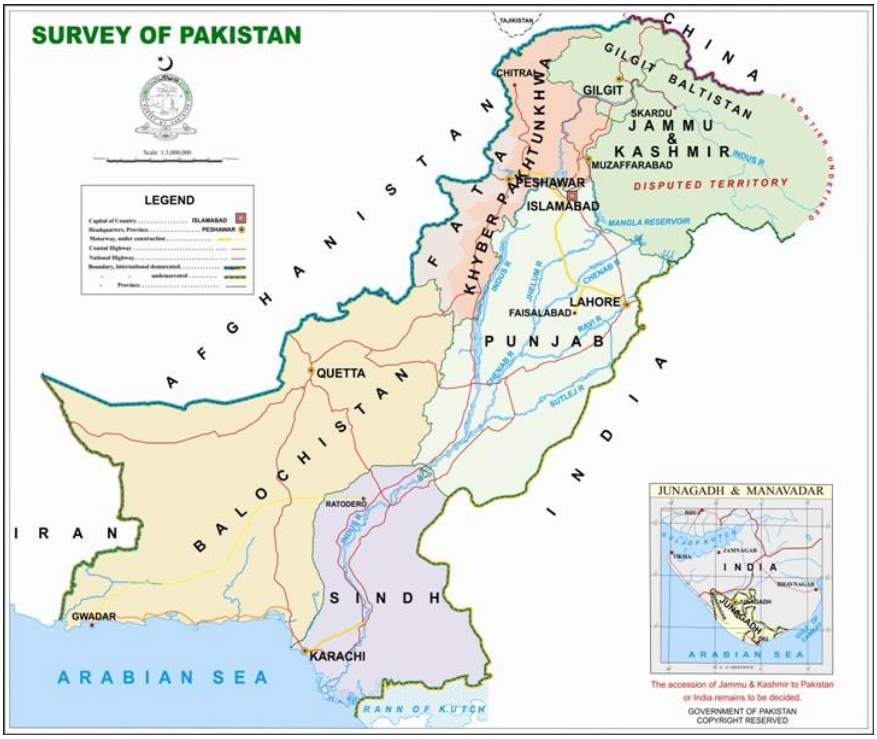
Ideally the students should in their journal book, write their own experience about the topic under discussion with respect to the Pakistani and International contemporary perspective.

Special emphasis should be placed on what the students have learnt.

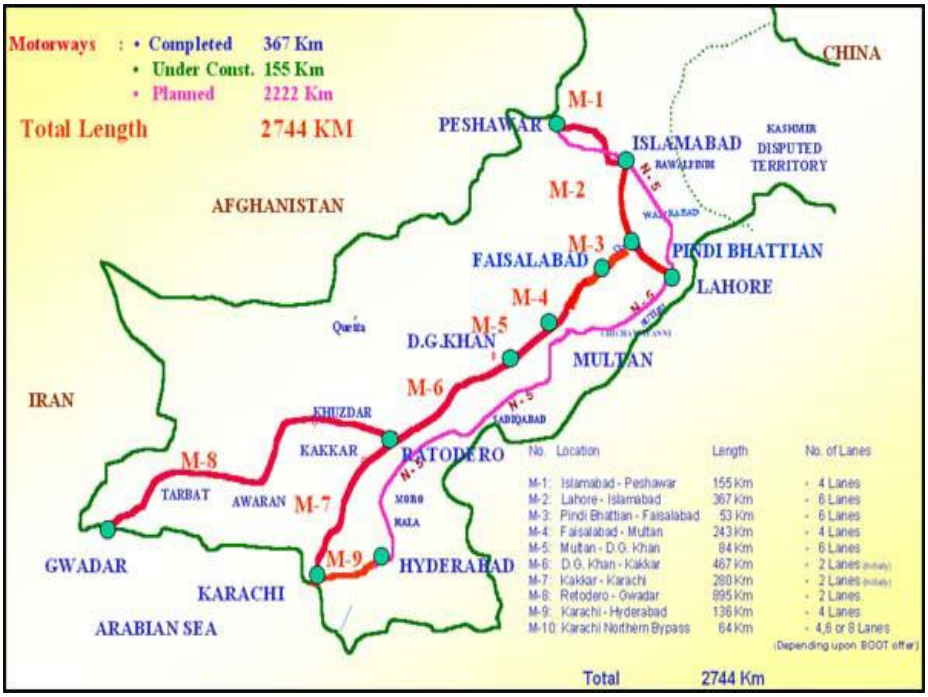
Students should identify the topics which they feel require further studying and clarification.

At the end of the semester the journal book should have at least 50 plus pages of information gathered, as per instructions laid out in these hand-outs with focus on Pakistani perspective faced by Supply Chain Professionals. This journal book is student's information treasure for times to come.

OFFICIAL MAP OF PAKISTAN



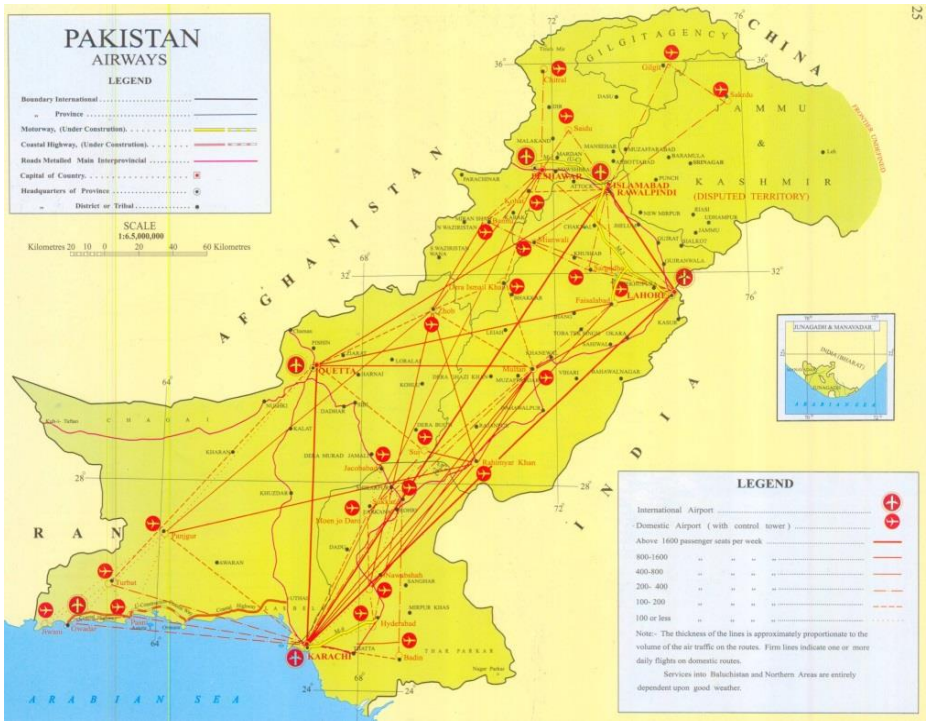
MAP OF PAKISTAN ROADS



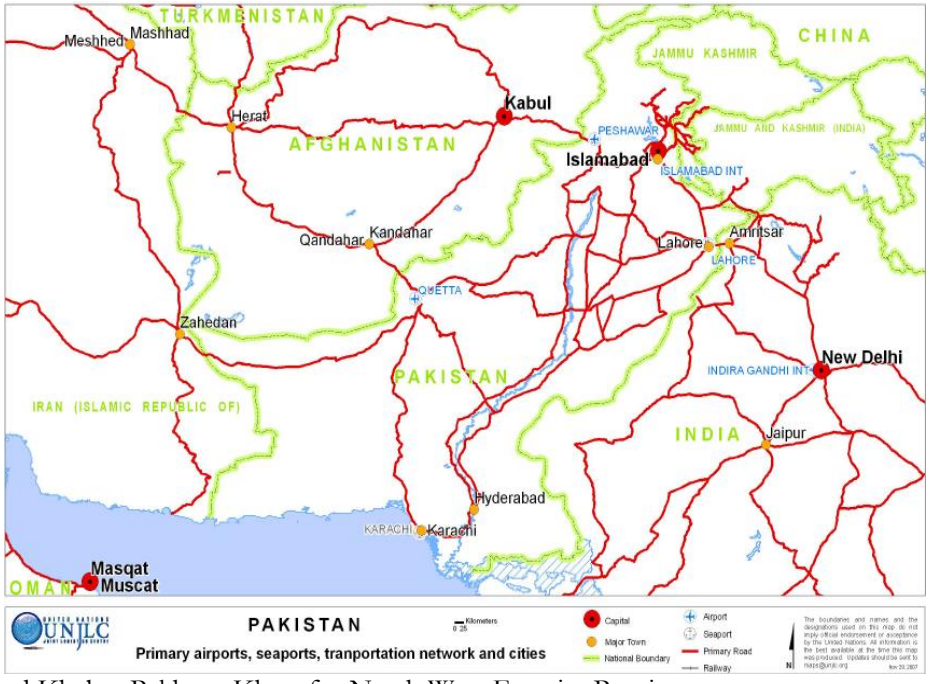
MAP OF PAKISTAN CAPTURING AIRPORTS

Note to the student's journal: these maps do not show the airports of Skardu & Sialkot; can you identify any other missing airport?

MAP OF PAKISTAN CAPTURING AIRWAYS



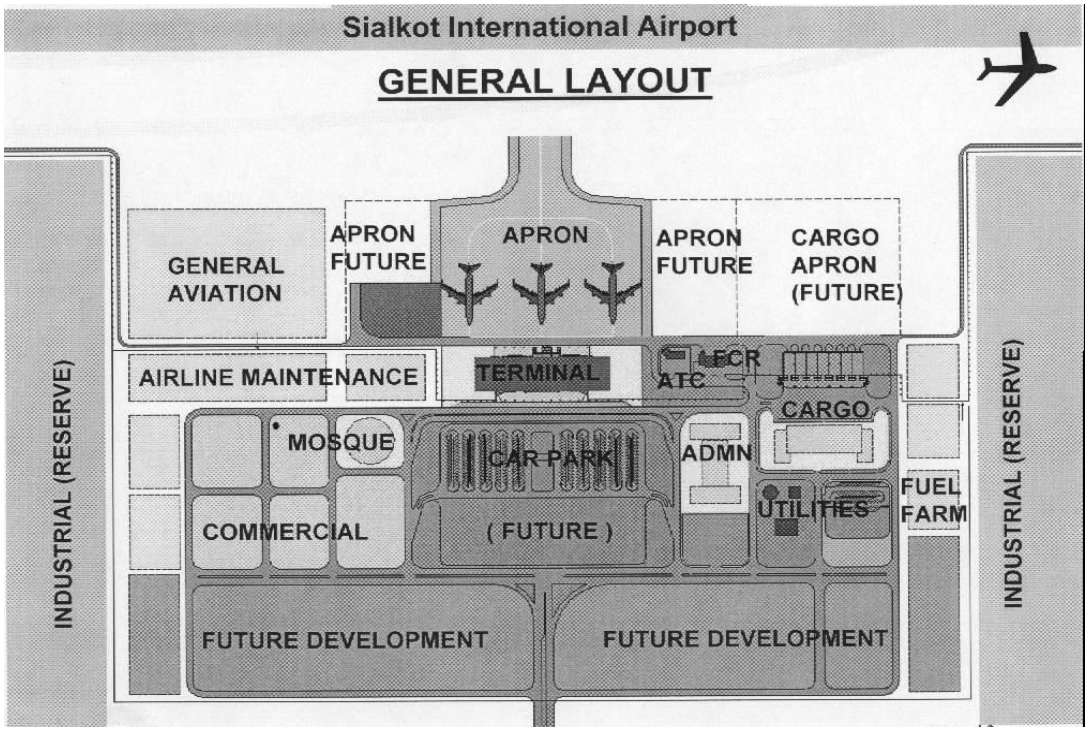
ANOTHER MAP IDENTIFYING THE MODES OF TRANSPORTATION IN PAKISTAN FROM THE PERSPECTIVE OF GLOBAL SUPPLY CHAIN



* For all maps read Khyber Pakhtun Khwa for North West Frontier Province

SIALKOT AIRPORT

The Sialkot Airport is unique in a sense that it was set up under the collaboration of Government and Private sector. The Airport actually highlights the potential of a lot of pragmatic strategies from the field of finance, operations and supply chain.



As a student of supply chain, identify the logistics, cargo, commercial & passenger areas?

PIPE LINE PROJECTS

In the subsequent modules on popular modes of transportation you would learn about Pipelines being a source of transportation of goods. It is an opportunity to write a summary of 1 paragraph in your log books about the supply chain perspective of these two projects.

- IRAN PAKISTAN INDIA PIPE LINE NOW ONLY IRAN PAKISTAN
- TURKMENISTAN PAKISTAN INDIA PIPE LINE

ECONOMIC CORRIDOR PROJECT

The China–Pakistan Economic Corridor (CPEC) is a development megaproject that plans to connect Gwadar Port in southwestern Pakistan to China's northwestern autonomous region of Xinjiang, via a network of highways, railways and pipelines to transport oil and gas.

The economic corridor is considered central to China–Pakistan relations and will run about 3,000 km from Gwadar to Kasghar. Overall construction costs are estimated at $46 billion, with the entire project expected to be completed in several years. The Corridor is an extension of China's proposed 21st century Silk Road initiative.

The main megaproject when broken up in series of smaller

projects would not only bring prosperity for Pakistan but would develop the Supply Chain Infrastructure of the Country.

These projects if completed would bring an improvement in infrastructure of Supply Chain as well as increase the trade volume for Pakistan not only with China but with other countries of the world. The list also includes Pak-Iran Gas line project as well.

A total of 51 memorandums of understanding were signed in diverse sectors between China and Pakistan during visit of Chinese president to Pakistan on 20 April 2015.

Source: Dawn, 21st April 2015.

END OF LECTURE 1: GIST AND CRUX

1. *Supply Chain Management and Logistics involve optimizing the delivery of goods, services and information from supplier to customer or vice versa in case of reverse supply chain. Information can flow from the supplier to customer and off course from the customer to the supplier.*
2. *An effective supply chain makes companies competitive and profitable.*
3. *Information is essential to making optimal supply chain decisions because it provides the global scope needed to make optimal decisions.*
4. *Information technology (IT) provides the tools together this information and analyses it to make the best supply chain decisions.*
5. *Latest and the state of art technologies and management tools ERP, CRM, and SRM along with auto ID technique RFID have to be used for improving the performance of Supply Chain Management and Logistics in Pakistan.*

SUPPLEMENT TO LECTURE 2

MODULE: SUPPLY CHAINS AND VALUE CHAINS

Over time, researchers and practitioners have developed dozens of definitions to describe supply chains and supply chain management. One group of researchers has indicated that defining supply chain management both as a philosophy and as a set of operational activities creates confusion not only for students but also practicing managers. **These researchers break down the concept into three areas and separate supply chain orientation from supply chains and from supply chain management**. These three areas are Supply Chain Orientation, Supply Chain and Supply Chain Management respectively.

A **supply chain orientation** is a higher-level recognition of the strategic value of managing operational activities and flows within and across a supply chain. A **Supply Chain** is a set of three or more organizations linked directly by one or more of the upstream or downstream flows of products, services, finances, and information from a source to a customer. **Supply Chain Management**, then, endorses a supply chain orientation and involves proactively managing the two-way movement and coordination of goods, services, information, and funds (i.e., the various flows) from raw material through end user. According to this definition, supply chain management requires the coordination of activities and flows that extend across boundaries. Organizations that endorse a supply chain orientation are likely to emphasize supply chain management. (Source: Purchasing & Supply Management, 5th Edition, Giunipero and Handfield)

Regardless of the definition or supply chain perspective used, the **virtual university students should recognize that supply chains are composed of interrelated activities that are internal and external to an enterprise.** These activities are diverse in their scope; the participants who support them are often located across geographic boundaries and often come from diverse cultures.

a. **PROCESS APPROACH**: Although many activities are part of supply chain management, an improved perspective visualizes supply chains as composed of processes rather than discrete, often poorly aligned activities and tasks. A process consists of a set of interrelated tasks or activities designed to achieve a specific objective or outcome. New-product development (NPD), customer-order fulfillment, supplier evaluation and selection, and demand and supply planning are examples of critical organizational processes that are part of supply chain management.

b. **REVERSE SUPPLY CHAIN**: Recent product recalls of consumer products such as toys, peanut butter, and dog food have placed increasing emphasis on a new supply chain concept: the reverse supply chain; its goal is to rapidly identify and return these tainted products back through the supply chain.

Recognizing supply chains as a series of methodical procedure (systematic processes) makes sense for a number of reasons. Almost by definition, processes usually move across a functional boundary, which aligns well with a supply management and supply chain orientation.

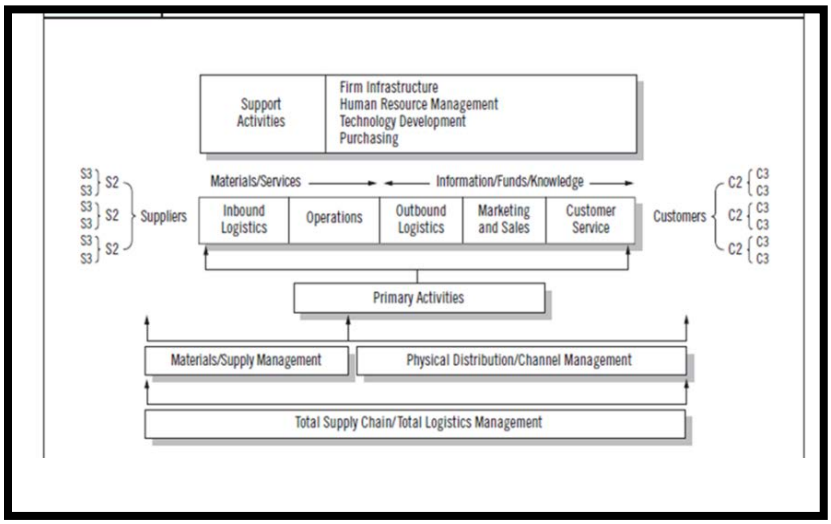
c. **BUILT IN AND DOCUMENTATIONS:** Well-communicated processes also accelerate learning as participants become familiar with a defined process. Furthermore, formal supply chain processes can "build in" best practices and knowledge that enhance the likelihood of success. Perhaps most importantly, organizations can document, measure, and improve their supply chain processes.

d. **PORTERS VALUE CHAIN MODEL:** The Supply Chain Professionals often feel perplexed while identifying the difference between a value chain and a supply chain. Michael Porter, who first presented the value chain concept in the 1980s, suggests that an enterprise's value chain is composed of primary and support activities that can lead to competitive advantage when configured properly. One way to think about the difference between a value chain and supply chain is to conceptualize the supply chain as a subset of the value chain. All personnel within an organization are part of a value chain. The same is not true about supply chains. The primary activities, or the horizontal flow across the above figure, represent the operational part of the value chain, or what some refer to as the supply chain.

e. **INTERNAL AND EXTERNAL FOCUS:** At an organizational level, the value chain is broader than the supply chain, because it includes all activities in the form of primary and support activities. Furthermore, the original value chain concept focused primarily on internal participants, whereas a supply chain, by definition, is both internally and externally focused.

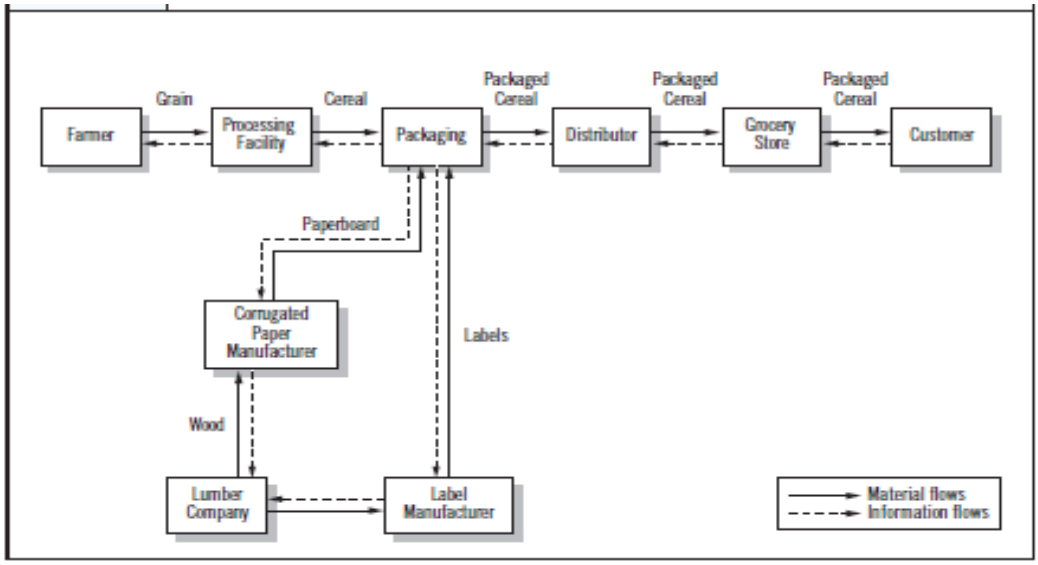
Figure on the left, presents a modified version of Porter's value chain model. This exhibit also defines some important supply chain–related terms and places them in their proper context.

f. **MULTI TIER SYSTEM OF SUPPLIERS AND CUSTOMERS:** To reflect current thinking, we must expand the original value chain model, which focused primarily on internal participants, to include suppliers and customers who reside well upstream and downstream from the focal organization. Multiple levels of suppliers and customers form the foundation for the extended value chain or the extended enterprise concept, which states that success is a function of effectively managing a linked group of enterprises past first-level suppliers or customers. In fact, progressive enterprises understand that managing cost, quality, and delivery requires attention to suppliers that reside several tiers from the producer. The extended enterprise concept recognizes explicitly that competition is no longer between enterprises but rather between coordinated supply chains or networks of enterprises.



Virtual University students are encouraged to go through Giunipero and Handfield text to understand a more thorough knowledge about Extended Value Chain with two diverse examples of supply chains like the Cereal Manufacturers and Automotive Manufacturers.

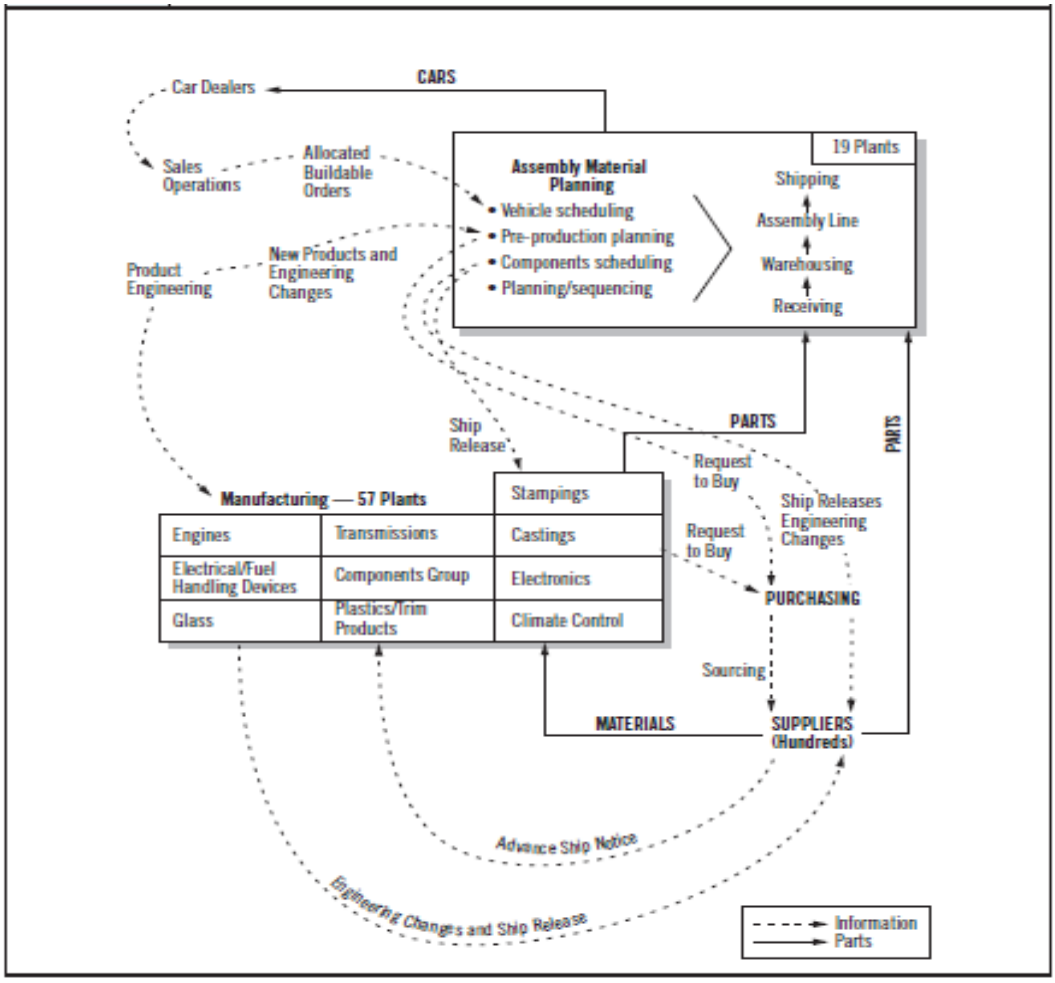
g. The right-hand side of the model illustrates the customer, or downstream, portion of the supply



chain. Because meeting or exceeding customer expectations is the lifeblood of any organization, it should become the focal point of supply chain activities. Exhibit presents a relatively straightforward and linear view of the value and supply chain, which is often not the case. First, the flows of materials, information, funds, and knowledge across a supply chain are often fragmented and uncoordinated. The "hand-off" points from one group to the next or from one organization to the next usually provide opportunity for improvements.

h. Second, the value chain model shows suppliers linking with inbound logistics and then operations. Although this is usually the case with direct materials, indirect items and finished goods sourced externally can result in suppliers delivering to any part of the supply chain.

i. Notice that the Figure identifies purchasing as a support activity. This means that purchasing



provides a service to internal customers. Although purchasing is the central link with suppliers that provide direct materials, which is the upstream or left hand side of the figure

j. Purchasing can support the materials and service requirements of any internal group. Direct materials are those items provided by suppliers and used directly during production or service delivery. Purchasing is becoming increasingly responsible for sourcing indirect goods and services required by internal groups. Examples of indirect items include personal computers, office and janitorial supplies, health care contracts, transportation services, advertising and media, and travel. Although indirect items are not required for production, they are still vital to the effective running of an organization.

SUPPLEMENT TO LECTURE 3

MODULE: TYPES OF PURCHASE ORDERS (CONTRACTS)

There are different types of purchase orders; due to our scope curtailments we will only identify the two fundamental types the Fixed Price Contract and Cost Based Contract. Virtual University Students are requested to study this module in conjunction with Contract Management Modules (covered in Lecture 7) to ensure that are able to comprehend purchase orders and contracts.

1. **Fixed-price contracts**: The most basic contractual pricing mechanism is called an enterprise fixed price. In this type of purchase contract, the price stated in the agreement does not change, regardless of fluctuations in general overall economic conditions, industry competition, levels of supply, market prices, or other environmental changes.

This contract price can be obtained through any number of pricing mechanisms: price quotations, supplier responses to the buying organization's requests for proposal, negotiations, or any other method. Fixed-price contracts are the simplest and easiest for purchasing to manage because there is no need for extensive auditing or additional input from the purchasing side. Are normally used for repetitive jobs where financial risk (market fluctuations), competition and technology risk are already known and taken into consideration.

If market prices for a purchased good or service rise above the stated contract price, the seller bears the brunt of the financial loss. However, if the market price falls below the stated contract price due to outside factors such as competition, changes in technology, or raw material prices, the purchaser assumes the risk or financial loss.

Cost-based contracts: Cost-based contracts are appropriate for situations in which there is a risk that a large contingency fee might be included using a fixed-price contract. Cost-based contracts typically represent a lower level of risk of economic loss for suppliers, but they can also result in lower overall costs to the purchaser through careful contract management. It is important for the purchaser to include contractual terms and conditions that require the supplier to carefully monitor and control costs. The two parties to the agreement must agree what costs are to be included in the calculation of the price of the goods or services procured.

Cost-based contracts are generally applicable when the goods or services procured are expensive, complex,

TYPE OF CONTRACT	DESCRIPTION	BUYER RISK	SUPPLIER RISK
Firm fixed price	Price stated in the agreement does not change, regardless of any type of environmental change.	Low	High
Fixed price with escalation/ de-escalation	Base prices can increase or decrease based on specific identifiable changes in material prices.	↑	↑
Fixed price with redetermination	Initial target price based on best-guess estimates of labor and materials, then renegotiated once a specific level or volume of production is reached.		
Fixed price with incentives	Initial target price based on best-guess estimates of labor and materials, then cost savings due to supplier initiatives are shared at a predetermined rate for a designated time period.		
Cost plus incentive fee	Base price is based on allowable supplier costs, and any cost savings are shared between the buyer and supplier based on a predetermined rate for a designated time period.		
Cost sharing	Actual allowable costs are shared between parties on a predetermined percentage basis and may include cost productivity improvement goals.		
Time and materials contract	Supplier is paid for all labor and materials according to a specified labor, overhead, profit, and material rate.		
Cost plus fixed fee	Supplier receives reimbursement for all allowable costs up to a predetermined amount, plus a fixed fee, which is a percentage of the targeted cost of the good or service.	High	Low

and important to the purchasing party or when there is a high degree of uncertainty regarding labor and material costs. Cost-based contracts are generally less favorable to the purchasing party because the threat of financial risk is transferred from the seller to the buyer.

a. Risk of large contingency fee

b. Need to identify and monitor relevant supplier costs

Another important point worth sharing with the Virtual University Students is the difference among the critical terms like Request for Information, Request for Proposal, Request for Quotation and Request for Comments etc. which are necessary part of contract management and often serve as a precursor to contract management and Terms of reference associated with the Contract Management.

2. **Request for information** (**RFI**) is a standard business process whose purpose is to collect written information about the capabilities of various suppliers. Normally it follows a format that can be used for comparative purposes.

An RFI is primarily used to gather information to help make a decision on what steps to take next. RFIs are therefore seldom the final stage and are instead often used in combination with the following: request for proposal (RFP), request for tender (RFT), and request for quotation (RFQ). In addition to gathering basic information, an RFI is often used as a solicitation sent to a broad base of potential suppliers for the purpose of conditioning suppliers' minds, developing strategy, building a database, and preparing for an RFP, RFT, or RFQ.

3. **Request for proposal (RFP)** is a solicitation made, often through a bidding process, by an agency or company interested in procurement of a commodity, service or valuable asset, to potential suppliers to submit business proposals. It is submitted early in the procurement cycle, either at the preliminary study, or procurement stage. The RFP process brings structure to the procurement decision and is meant to allow the risks and benefits to be identified clearly up front.

4. **Request for Tenders (RFT)** is an official, structured application (invitation) to suppliers to bid to supply products or services. In the public sector, such a process may be required and determined in detail by law to ensure that such competition for the use of public money is open, fair and free from illegal practices like bribery and nepotism. As a consequence of the scale of the tender process the majority of RFTs are published by the government sector, but companies in the infrastructure and utilities sectors may also publish RFTs.

5. **Request for Quotation (RFQ)** is a standard business process whose purpose is to invite suppliers into a bidding process to bid on specific products or services. RFQ generally means the same thing as IFB (Invitation for Bid). An RFQ typically involves more than the price per item. Information like payment terms, quality level per item or contract length are possible to be requested during the bidding process.

6. **Request for Comments (RFC)** is a publication of the Internet Engineering Task Force (IETF) and the Internet Society, the principal technical development and standards-setting bodies for the Internet. An RFC is authored by engineers and computer scientists in the form of a memorandum describing methods, behaviors, research, or innovations applicable to the working of the Internet and Internet-connected systems. It is submitted either for peer review or simply to convey new concepts, information, or (occasionally) engineering humor. The IETF adopts some of the proposals published as RFCs as Internet standards.

7. **Reverse Auction:** A reverse auction is a type of auction in which the roles of buyer and seller are reversed. In an ordinary auction (also known as a forward auction), buyers compete to obtain a good or service by offering increasingly higher prices. In a reverse auction, the sellers compete to obtain business from the buyer and prices will typically decrease as the sellers undercut each other.

8. **Terms of reference** describe the purpose and structure of a Contract, Project, Committee, Meeting, Negotiation, or any similar collection of people who have agreed to work together to accomplish a shared goal. The terms of reference of a project are often referred to as the project charter.

MODULE: TYPES OF PURCHASES

A purchase manager may be responsible for purchase of raw materials, semi-finished products and components, finished products, Maintenance, repair, and operating supplies (MRO), production support items, services, capital equipment and transportation and third-party logistics providers.

A point of special concern for Purchase Managers is the special significance of MRO Purchasing. Most organizations do not track MRO items like they do production items and these increases the responsibility of the maintenance as well as the purchase department. There are typically too many MRO suppliers. There are too many small orders which take up too much time. All these factors make it MRO purchasing very critical yet least talked about by the senior management.

MODULE: HOW TO IMPROVE PURCHASING PROCESS

Improving the Purchasing Process is necessary; all organizations place a special emphasis on the importance of the critical purchase of MRO items and should not be neglected. An organization or enterprise can improve its purchase process by:

1. Implementing and making use of Online requisitioning systems
2. Issuing Procurement cards to end users
3. Using internet based E-commerce for reverse auction, b2b buying etc.
4. Developing longer-term purchase agreements
5. Employing Online ordering systems
6. Redesigning the Purchasing process
7. Making use of Electronic data interchange (EDI)
8. Referring to Online ordering and electronic catalogs
9. Managing Direct user-supplier contact

The aforementioned steps are neither sequential nor compulsory but depend on the informational assets and procedural systems of the organization.

BENEFITS OF e-PROCUREMENT SYSTEMS

Virtual University students are requested to identify benefits of e-Procurement Systems at their work place or make use of the internet to study e-Procurement Systems, currently in use.

Primary benefits of *e*-procurement are cost savings and increased available time to concentrate on core business.

1. *E-procurement* systems allow enterprises to concentrate large volumes of small purchases with a few suppliers, using e- catalogues, available to the organization's users.
2. Reverse auctions is a specialized application of e-Procurement Systems. Pre-qualified suppliers enter Web site and at pre-designated time & date, try to underbid competitors, monitoring bid prices until the session is over.

ASSESSING & IMPROVING THE ENTERPRISE'S PURCHASING FUNCTION

The purchasing function is one of the most value-enhancing functions in any organization. If continuous online or e-audit is not possible then it is preferable to periodically

1. Monitor the purchasing function's performance against set standards, goals, and/or industry benchmarks.
2. Surveys or audits can be administered as self-assessments among purchasing staff as part of the annual evaluation process.

Skill set requirements of purchasing professionals has been changing. Purchasing personnel must today exhibit world-class skills such as Interpersonal communication, ability to make decisions, ability to work in teams, analytical skills, negotiation skills, customer focus, ability to manage change, influencing & persuasion skills, strategic skills and understanding business conditions

The **Assessment criteria include** a host of important facts, some of the more critical aspects are:

1. Participating in and leading multifunctional teams ,
2. Participating in value engineering efforts.
3. Optimizing supply base.
4. Creating ESI initiatives
5. Utilizing e-procurement
6. Integrating supplier addition and cooperation
7. Contributing to new product development
8. Improving time to market
9. Initiating supplier cost reduction programs
10. Creating strategic alliances

SUPPLEMENT TO LECTURE 4

ETHICAL AND SUSTAINABLE PURCHASING INITIATIVES

Ethical and Sustainable Framework of purchasing includes numerous initiatives like Supply Base Rationalization Program and Supplier Certification Programs.

Supply base rationalization Also Known As (AKA) **supply base reduction** or **supply base optimization** is often the initial supply chain management effort.

Buyer-supplier partnerships are easier with a rationalized supply base & result in –

1. Reduced purchase prices
2. Fewer supplier management problems
3. Closer & more frequent interaction between buyer & supplier
4. Greater levels of quality & delivery reliability

Supplier certification programs are used to identify **strategic supplier alliance** candidates

Enterprises use in-house formal certification programs, & most require **ISO 9000/ 14000** or similar certifications as part of the certification process

Buyers can monitor quality assurance methods & specify the type of **acceptance sampling** & **statistical process control** methods used

Outsourcing Products and Services

Virtual University Students are already aware of the benefits of outsourcing for the sake of easy reference we list the benefits or advantages. **Outsourcing** allows an enterprise to –

1. Concentrate on core capabilities
2. Reduce staffing levels
3. Accelerate reengineering efforts
4. Reduce management problems
5. Improve manufacturing flexibility.

Outsourcing Products and Services decision carries inherent risk. Risks associated with outsourcing, include:

a. Loss of control both with respect to production decisions & intellectual property
b. Increased undue reliance on suppliers
c. Increased need for supplier management

The two common types of Outsourcing of Products and Services include In-sourcing and Co-sourcing.

1. **In-sourcing (back sourcing):** Reverting to in-house production when quality, delivery, and services do not meet expectations
2. **Co-sourcing (selective sourcing):** The sharing of a process or function between internal staff and an external provider & provides flexibility to decide what areas to outsource, when, and for how long.

Early Supplier Involvement, Value Engineering & Vendor Managed Inventories

Early supplier involvement (ESI) is one of the highly effective supply chain integrative techniques. Key suppliers become more involved in the internal operations of the enterprise, particularly with respect to **new product & process design**, **concurrent engineering design for manufacturability** techniques.

Value Engineering activities help the enterprise to **reduce cost, improve quality & reduce new product development time**

Vendor Managed Inventory (VMI): Suppliers manage buyer inventories to reduce inventory carrying costs & avoid stock-outs for buyer

Selecting quality and capable suppliers

Selecting supplier is not an easy process. Many different formulas and techniques can be used. One effective method assigns suppliers to four basic categories based upon their level of performance in key areas, such as

delivery, quality and responsiveness. This should ideally address the common problems of stock out and bull whip effect.

From the buyer-enterprise's perspective –

1. Supplier tracks inventories
2. Determines delivery schedules and order quantities
3. Buyer can take ownership at stocking location

From the supplier's perspective –

1. Avoids ill-advised customer orders
2. Supplier decides inventory set up & shipments
3. Opportunity for supplier to educate customers about other products

Electronic data interchange (EDI)

1. Allows a supplier to profile demand & determine accurate forecasts
2. EDI also provides reorder point data to permit timely deliveries

Supplier co-location or JIT II

Supplier's employee is embedded in buyer's purchasing department to forecast demand, monitor inventory & place orders with access to sensitive files & records

Early Supplier Involvement and Early Buyers Involvement

1. **Reduce costs and product development collaboration:** For a lot of enterprises, the cost of purchased materials accounts for more than half of their expenses, so it's a good place to try to reduce costs. As well as increased use of suppliers, the future promises the earlier involvement of the supplier in the product development process.

2. **Product Development Process as set of Parallel Activities:** Previously, suppliers weren't involved early in the process. The activities of the product development process were carried out in series, and suppliers were only involved near the end of the process. A typical product would go through many activities – it might start life in the marketing function, and then go through conceptual design, engineering design and analysis, testing, detailed design, manufacturing engineering, process planning, tooling, production planning, purchasing, machining, assembly, testing, packaging, installation and maintenance.

3. **Barriers to Optimal Supplier Base:** In some cases, suppliers were only brought into the process to compete against each other on pricing. As a result the company finished up working with a large number of suppliers, and even with different suppliers on similar products. It was impossible to build up the stable, long-term quality-generating relationships that lead to client satisfaction. The product development process needs to be re-organized in order to:-

    1. respond to the need to get products to market faster,
    2. reduce the cost of developing products
    3. make sure the product provides customer satisfaction

In team-oriented matrix based enterprises, employees from different functions will work together on the upstream activities, effectively taking the major decisions about the entire product development process in the initial design phase. The team will need to know in detail at an early stage about the different parts of the product, and the way the parts fit together. The team will want to make the best possible use of suppliers with the aim of getting a customer-satisfying product to market as quickly as possible. This will probably mean involving the supplier right at the beginning of the process, when the major modules of the product are being defined. The supplier will then be given the job of designing and manufacturing a complete sub-assembly.

In the re-organized process, suppliers will be expected to respond quickly, to be responsible and to be reliable. They will be expected to have excellent skills, knowledge and experience concerning particular parts or activities. The company will want to have long-term relationships with a small group of highly competent, knowledgeable and trusted suppliers. (**Please refer to Modules in Lecture 5**)

In enterprises that don't have early supplier involvement, improvement initiatives in the Engineering Department will be limited to expected improvements in the performance of the product development process; engineering productivity whereas the quality features due to lack of involvement of the supplier may be compromised.

Early Buyers Involvement

Ideally sellers want a qualified buyer to pay very close to maximum value for their business. In addition to high range value, sellers consistently prefer to deal with a buyer whom they like and can trust with the future of their business and its employees. What attitude attracts and retains a qualified buyer through the closing?

At the same time buyers hope to find a bargain, but expect to pay a fair price. In addition to a fair price, buyers always prefer to deal with a willing and cooperative seller, whom they like and can trust. What attitude encourages open dialog and bonding?

Proactive and cooperative sellers set the tone for fair value negotiations. Proactive buyers always respond favorably to a seller's cooperative tone. When a seller's cooperation is sincere, a buyer generally tries harder to meet a seller's needs. In the best transactions a special rapport builds, which results in an extra effort by the seller to help the buyer succeed.

The most successful buyers actively communicate with the seller and follow-up with a fax or letter. Successful buyers have conversations with the seller about post-acquisition issues. Personal involvement is critical. Most sellers want to sell to a buyer who both shares the seller's vision and will preserve the existing corporate culture. The price paid is very important, but the winning buyers are those who establish rapport, a shared vision, and a personal bonding with the seller.

Remember, intermediaries bring buyers, advice, and assist. Sellers must actively sell their business. The term "Buyer" is reserved for those who have pulled the trigger and closed. Others are just "Prospective Buyers".

Successful closings, a high commitment for direct personal involvement is required between the seller and the buyer.

Supplier Management Team: Supplier management team is a discipline of working collaboratively with those suppliers that are vital to the success of your organization, to maximize the potential value of those relationships.

Strategic Alliance Development

Alliance development, an extension of **supplier development** refers to increasing a key or strategic supplier's capabilities.

Supplier alliances result in better market penetration access to new technologies & knowledge, & higher return on investment

Alliance development eventually extends to an enterprise's second-tier suppliers, as the enterprise's key suppliers begin to form their own alliances.

Rewarding Supplier Performance

Rewarding suppliers provides an incentive to surpass performance goals

Punishment is a negative reward, may be to reduce future business; or a bill-back amount equal to the incremental costs resulting from a late delivery or poor quality

Strategic supplier agreements can reward suppliers by allowing –

1. A share of the cost reductions
2. More business and/or longer contracts
3. Access to in-house training seminars & other resources
4. Company & public recognition

Benchmarking Successful Sourcing Practices

Benchmarking measures what other businesses do best and matching their performance is an effective approach to improving supply chain performance. Benchmarking data regarding sourcing practices can be obtained in any number of ways, both formal & informal.

Resources for learning about & implementing sourcing practices:-

1. The Center for Advanced Purchasing Studies.
2. Supply-Chain Council.

Using Third-Party Supply Chain Management Services

Third-party logistics (3PL): A growing industry that involves managing an enterprise's sourcing or materials &/or product distribution responsibilities

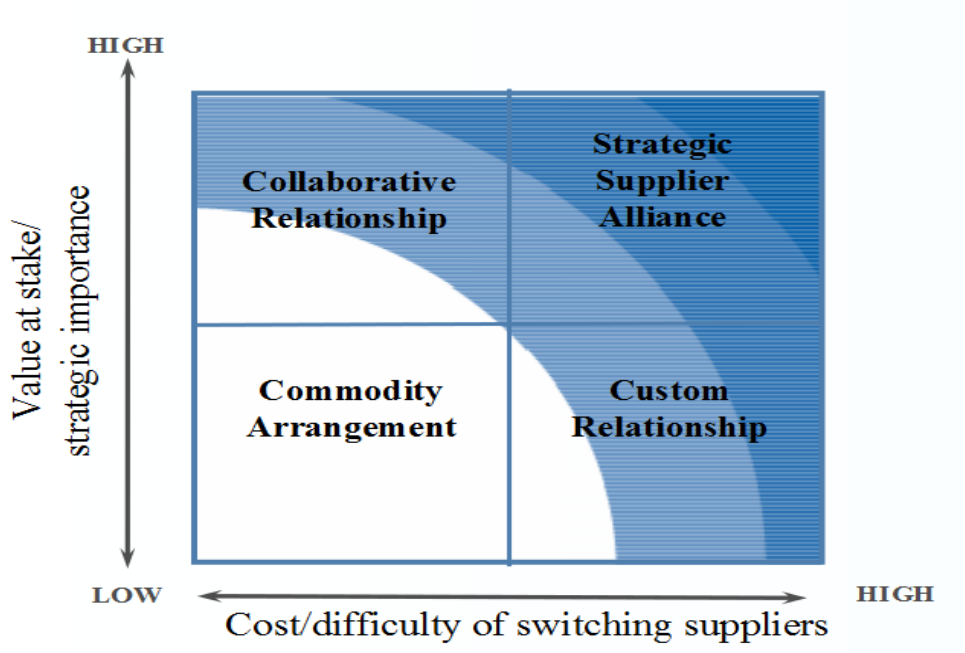
3PL providers charge a fee for services for an estimated savings of 10 to 20% of total logistics costs; benefits include improved service, quality, & profits for their clients.

1. **Vendor-managed inventory (VMI) services –** One of the more popular roles of 3PL.
2. **Lead logistics provider (LLP), aka 4PL –** A primary 3PL provider; one that oversees other 3PL's

SUPPLEMENT TO LECTURE 5

Segmentation Model can allow the Virtual University student's enterprise to make best use of available source of suppliers as the enterprise would be able to identify the value at stake as well as the difficulty of switching suppliers.

SEGMENTATION MODEL



Outsourced Logistics Services

	NORTH AMERICA	EUROPE	ASIA-PACIFIC	LATIN AMERICA
Transportation	83%	95%	95%	90%
Warehousing	74	74	74	54
Customs Clearance and Brokerage	74	54	84	64
Forwarding	54	54	64	14
Freight Bill Audit and Payment	54	24	14	14
Shipment Consolidation	44	54	54	34
Cross-Docking	34	44	34	14
Reverse Logistics	24	44	34	34
Transportation Management	24	34	44	14
Product Labeling, Packaging, Assembly, Kitting	24	44	34	24
Supply Chain Consulting Services Provided by 3PLs	24	14	14	14
Order Entry, Processing, and Fulfillment	14	14	14	14
Fleet Management	14	24	24	34
LLP/4PL Services	14	14	4	14
Customer Service	4	4	14	14

Rationale for not using 3 PL

Virtual University Students are requested to revisit these facts; as they are still valid after 10 years down the road though some of the positions have changed especially with respect to service level commitments and logistics expertise.

	OVERALL	NORTH AMERICA	EUROPE	ASIA-PACIFIC
Logistics is a core competency at our firm	38%	51%	30%	42%
Cost reductions would not be experienced	34	34	24	24
Control over outsourced function(s) would diminish	24	44	14	24
Service level commitments would not be realized	24	24	14	24
We have more logistics expertise than 3PL providers	24	24	14	34
Logistics too important to consider outsourcing	14	14	24	14
Corporate philosophy excludes outsourcing logistics	14	14	14	14
Global capabilities of 3PLs need improvement	4	14	14	4
Inability of 3PL providers to form meaningful and trusting relationships	4	4	14	4
Issues relating to security of shipments	4	4	4	4

Source: *2006 Eleventh Annual 3PL Study*, Georgia Tech and Capgemini LLC. Used with permission.
*Latin America results insufficient for meaningful analysis.

Chapter 4 - Supply Chain Relationships

IT BASED SERVICES

Functionality	Currently Used	Future Needs
Warehouse/Distribution Center Management	65%	17%
Web-Enabled Communications (3PL—User)	61	28
Visibility Tools (e.g., tracking/tracing; event management)	60	29
Transportation Management (Execution)	55	21
Transportation Management (Planning)	31	32
Supplier Relationship Management (e.g., procurement; payables)	30	26
Customer Order Management	25	21
Collaboration Tools (e.g., inventory levels; production schedules)	25	35
Internet-Based Transportation/Logistics Exchanges	23	31
Yard Management	22	16
Supply Chain Planning (e.g., forecasting; inventory planning)	19	30
Customer Relationship Management	17	25
RFID (radio-frequency identification and asset tracking)	13	57

Expectation Setting to 3 PL Relation Management

Virtual University students may like to compare this set of expectations with their own expectation as well as the expectations of 3 PL service providers with respect to their customers. Hint visit the local offices of any 3 PL company in your city.

CUSTOMERS' EXPECTATIONS OF 3PL PROVIDERS	3PL PROVIDERS' EXPECTATIONS OF CUSTOMERS
• Superior service and execution (proven results and performance)	• Mutually beneficial, long-term relationship with company
• Trust, openness, and information sharing	• Trust, openness, and information sharing
• Solution innovation and relationship reinvention	• Dedicating the right resources at the right levels, including executives
• Ongoing executive-level support	• Clearly defined service-level agreements
• Service offering aligned with customer strategy and deep industry knowledge	• Fiduciary responsibility and overall fairness relative to pricing

Average Customer Results from use of 3 PL

Virtual University Students can conduct this at their enterprise or within their circle of friends and family to identify with a simple questionnaire.

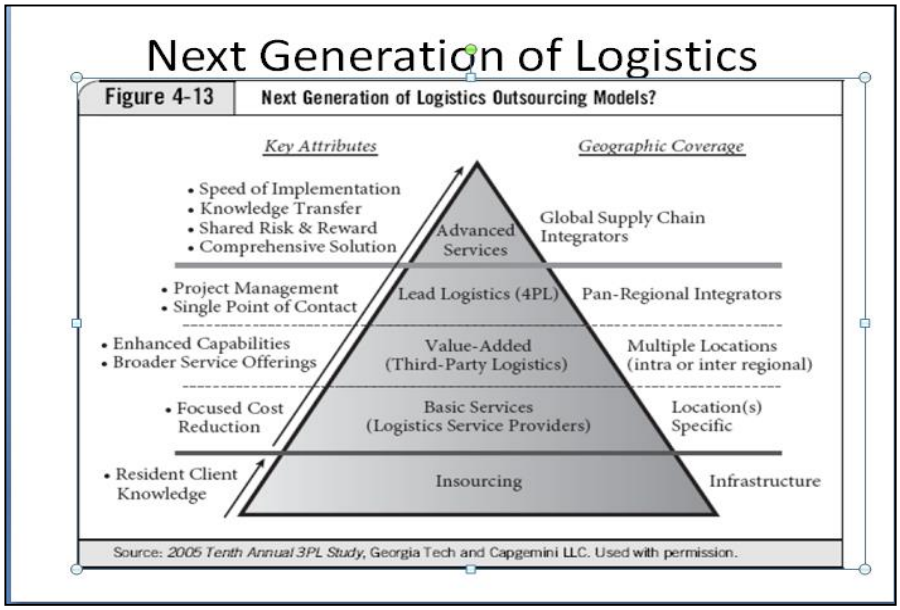
Table 4-8 Average Customer Results from Use of Third-Party Logistics Providers

Cost/Benefit	North America	Western Europe	Asia-Pacific	Latin America
Logistics cost reduction	10%	11%	14%	12%
Fixed logistics asset reduction	13%	22%	22%	37%
Average order-cycle length change (days)	From 11.0 to 8.4	From 10.1 to 6.5	From 15.7 to 13.9	From 14.9 to 10.0
Service level improvement (percent "yes")	62%	67%	64%	77%

Source: *2006 Eleventh Annual 3PL Study*, Georgia Tech and Capgemini LLC. Used with permission. Service-level improvement figures taken from 2005 Tenth Annual 3PL Study, Georgia Tech and Capgemini LLC. Used with permission.

Next Generation of Logistics:

This is an important concept to look forward to especially for Supply Chain / Logistics managers of tomorrow



Future 3PL Industry Trends

Pakistan appears to have embraced a continued expansion, acquisition and consolidation of 3PL industry in line with expansion of global markets and needed services.

Continued broadening of service offerings across supply chain and broad-based business process outsourcing has led to widespread of Two-tiered relationship models both strategic as well as tactical models. As a matter of fact, an expanding range of "strategic" services offered by 3PLs and 4PLs is only possible because of ever expanding IT Capabilities. These IT capabilities have become an even greater differentiator

Increased efforts to update, enhance, and improve 3PL provider-user relationships are now the very tool for survival. Quite recently emphasis has been on relationship reinvention, mechanisms for continual improvement, and solution innovation etc.

MODULE: FUTURE TRENDS

1. The two most basic types of supply chain relationships are "vertical" (e.g., buyer-seller) and "horizontal" (e.g., parallel or cooperating).

2. In terms of intensity of involvement, inter enterprise relationships may span from transactional to relational and may take the form of vendor, partner, and strategic alliances.

3. There are six steps in the development and implementation of successful relationships. These six steps are critical to the formation and success of supply chain relationships.

4. Collaborative relationships, both vertical and horizontal, have been identified as highly useful to the achievement of long-term supply chain objectives. The "Seven Immutable (undeniable and indisputable) Laws of Collaborative Logistics" provide a framework for the development of effective supply chain relationships.

5. Third-party logistics providers may be thought of as an "external supplier that performs all or part of a company's logistics functions." It is desirable that these suppliers provide multiple services, and that these services are integrated in the way they are managed and delivered.

6. The several types of 3PLs are transportation-based, warehouse/distribution-based, forwarder-based, financial-based, and information-based suppliers.

7. Based on the results of a comprehensive study of users of 3PL services, over 70 percent of the enterprises studied were, to some extent, users of 3PL services.

8. User experience suggests a broad range of 3PL services utilized; the most prevalent are warehousing, outbound transportation, and freight bill payment and auditing.

9. While nonusers of 3PL services have their reasons to justify their decision, these same reasons are sometimes cited by users as justification for using a 3PL.

10. Customers have significant IT-based requirements of their 3PL providers, and they feel that the 3PLs are attaching a priority to respond to these requirements.

11. Approximately two-thirds of the customers suggest 3PL involvement in their global supply chain activities.

12. Although most customers indicate satisfaction with existing 3PL services, there is no shortage of suggestions for improvement.

13. Customers generally have high aspirations for their strategic use of 3PLs and consider their 3PLs as keys to their supply chain success.

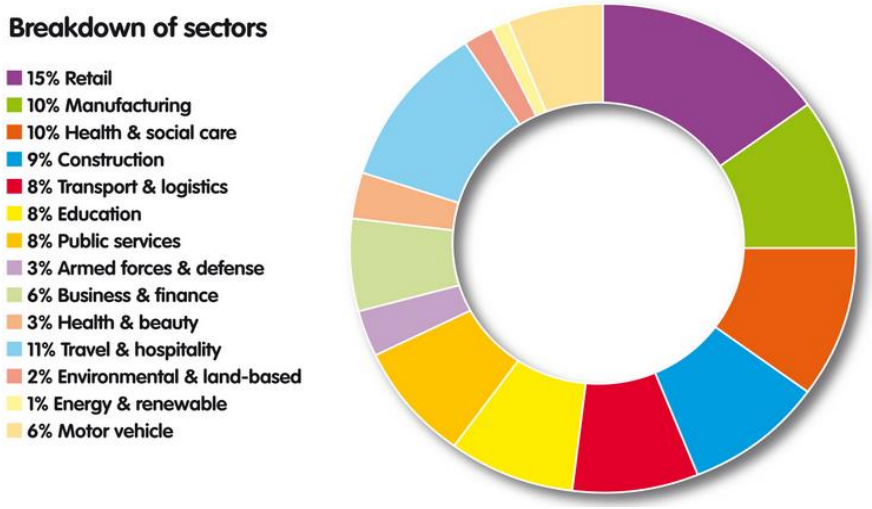
14. There is a growing need for fourth-party logistics relationships that provide a wide range of integrative supply chain services.

LOGISTICS

Lecture 6 identifies some fundamental concepts related to Logistics; Logistics relationship with Supply Chain, some International logistical infrastructure and Logistical Performance Index

Rationale and Logic

Logistics enjoy a special status among different sectors of an economy for any country. It is important to identify the relevance and importance of Logistics. Pakistan is no different; it has government, semi government and private players working exclusively for the field of logistics. Pakistan is poised to make best use of its available resources and infrastructure. At the same time a point of caution being the lack of human resource development in this particular sector of the economy. It is envisioned by training its human resource the country can not only recognize its full potential but also evolve as a great player in the world of logistics.



INTRODUCTION: The Pakistan economy is now part of the integrated global economy. We are marketing and distributing numerous products in foreign nations, locating plants and other facilities internationally, and are in turn buying even more from foreign companies & countries. There are a host of factors associated with this increased globalization that touch upon almost every aspect of supply chain management.

The primary objective of this module is for the Virtual University Student to gain a broad overview of supply chain management from an international perspective. This overview will include international logistics and the role of international logistics systems in global supply chain management.

Learning Objectives

The learning objectives are covered in the form of three modules namely: -

Module 1: Logistics basics and fundamentals,

Module 2 International Logistics Infrastructure and

Module 3 Logistics Performance Index

MODULE 1: LOGISTICS BASICS AND FUNDAMENTALS

This module would help the Virtual University Student gain an insight to the relevance and significance of Logistics or more pertinently how it adds value to the operation and ultimately profit to the enterprise as well as its supply chain partners and at the same time helping the customers.

At the same time this module will address the important difference between Logistics and Supply Chain. This module will also capture the definition of Logistics. This module will explain the logistics mix, goals of logistics and functions of logistics.

Students should also pay attention to the decision hierarchy and the concept of reverse logistics which is discussed in detail later in Lecture 8.

First of all, the important thing that Virtual University students must know is how logistics add value to a supply chain?

A. HOW DOES LOGISTICS ADD VALUE?

Logistics deliver value to customer through following three stages in the Supply Chain

1. **Inbound Logistics:** Include movements of all raw materials and components for processing (operations from Suppliers) to the Enterprise.
2. **In process Logistics:** Includes storage and movements of raw materials and components with in the manufacturing premises as per the manufacturing schedules.
3. **Outbound Logistics:** Includes the warehousing, transportation and inventory management and distribution of finished products to customers.

The total logistics cost as percentage of the sales differs with the categories of products. With proper control, the logistical cost can be reduced by way of value addition through a combination of price, quality and service.

B. DIFFERENCE BETWEEN LOGISTICS & SUPPLY CHAIN MANAGEMENT

Supply Chain is a relationship among three tiers Suppliers, Enterprise and Customers while Logistics relates to flow of materials and information.

The efficiency and effectiveness of inventory management across the supply chain is greatly dependent on the capability of the logistics management. Also, integration of Supply Chain is not possible without the efficient **"Logistics Operations"** like warehousing, material handling, inventory control, packaging and transportation.

Supply Chain and Logistics cannot be separated from each other and form a part and parcel of customer service solution. Even for an enterprise that does not have supply chain relationship, LOGISTICS would be there

Success of Supply Chain depends on effectiveness of Logistics.

Supply Chain and Logistics can only be successful if and only if there is: -

1. Effective Coordination with Suppliers
2. Reduction of Inventory Levels
3. Speed, Reliability and Consistency in Inventory Management
4. Faster Replenishment cycle
5. Shorter Performance Cycle
6. Asset Utilization and Productivity
7. Innovation for value addition in Customer Service

Information and Communication act as enables for integration between Supply Chain and Logistics.

Logistics today is considered to be the key to Supply Chain because of.

1. Globalization
2. Hyper Competitive Environment
3. Decrease in Profits
4. Decrease in Product Life cycle
5. Shorter Technological Life
6. Supply and Demand functions depending heavily on effective Logistical movement

Ideally, Logistics fill the gap between supply and demand

If the gap is huge the enterprise needs its supply chain management to analyze demand and adjust the execution of the supply chain either through push and pull strategies or Just in Time Philosophy.

C. DEFINITION OF LOGISTICS:

We will discuss the commonly referred definitions for Logistics along with the origin of the words from Greek and Latin Language. In Greek language, the word is "Logistikos" and in Latin language the word is "**Logisticus**". Both the words mean the science of computing and calculating. In Urdu language the word is "**رسد**" (rasad).

Let us now consider the important definitions of Logistics as presented by American Council of Logistics Management. The new name for this organization is Institute of Supply Chain Professionals

> *"The process of planning, implementing, and controlling the efficient, cost effective flow and storage of raw materials, in process inventory, finished goods and related information from point of origin to point of consumption for the purpose of confirming to customers' requirements."*

We take up another definition attributed to Marketing Professor Phillip Kotler

> *"Planning, implementing, and controlling the physical flows of materials and finished goods from point of origin to point of use to meet the customers need at a profit."*

We also present what Martin Christopher says about Logistics: -

> *"Logistics is essentially a planning process and an information based activity."*

D. LOGISTICS MIX

Martin Christopher has also presented logistics mix as well

Logistics Mix is the sum total of Information Flow, Warehousing, Inventory Control Packaging and Transportation. For the sake of clarity and easy understanding we present the Logistics Mix in the form of a table: -

Sr. #	*MIX*	*Logic*
1	Information	Information Flow takes into account Order registration, Order checking and editing, Order processing and Coordination.
2	Warehousing	Warehousing focuses on material storage, load unitizing and material handling, site selection and network planning, order picking and 2filling and dispatched documentation
3	Inventory Control	Inventory Control relates to Material Requirement Planning (MRP) and inventory level decisions for customer service objectives
4	Packaging	Packaging centers on the idea of handling the product safely and damage prevention, also for communicating critical instructions and for intermodal transportation.
5	Transportation	Transportation considers route planning, mode selection and vehicle scheduling.

Students are advised to identify and understand the logistics goals which are

Goals of Logistics

1. Product Movement
2. Information Movement
3. Time and Service
4. Cost
5. Internal Integration

Similarly, the Virtual University Students should take a minute or two to identify the functions of logistics.

Functions of Logistics

1. Order processing
2. Warehousing
3. Transportation
4. Material Handling
5. Logistics Packaging
6. Inventory control
7. Information flow

Logistics Decisions Hierarchy

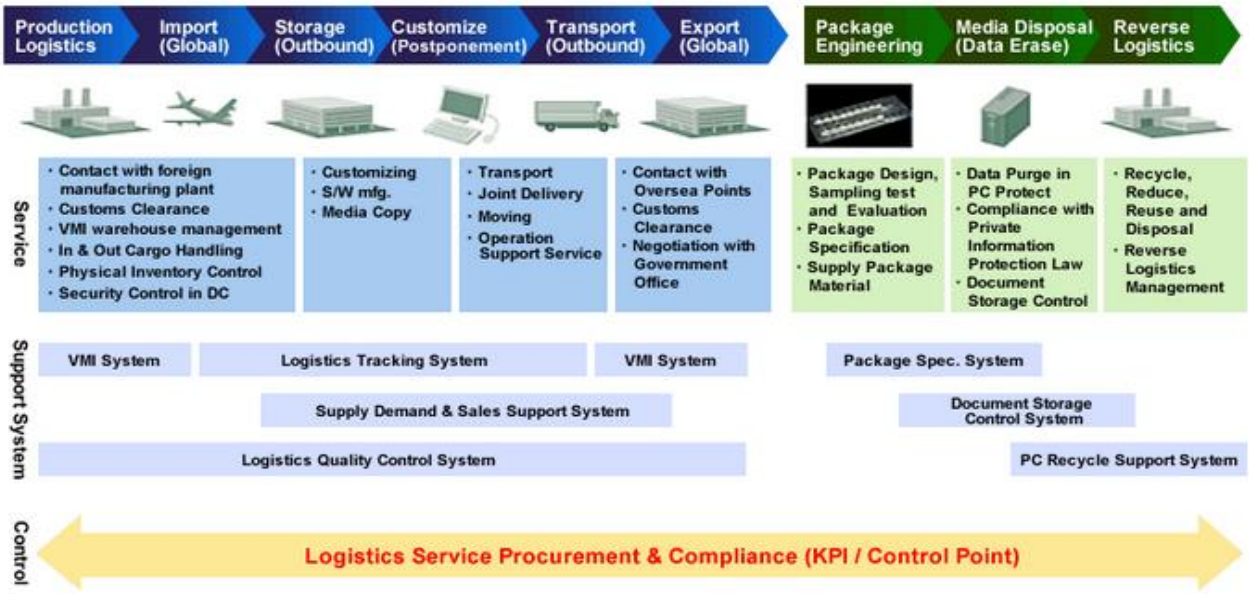
Virtual University Students are already aware of the hierarchy of decision making in a top down manner. At the top most level is the Strategic Level, the basic intent is to provide customers with the product they require. The decision makings tangible output more or less depends upon the implementation.

a. Strategic Level focuses on Customer Service
b. Structural Level focuses on channel design and network strategy
c. Functional Level takes into account warehousing design, transportation and materials management
d. Implementation encompasses policy and procedures, information flow, facilities and equipment and change management

We can now represent this module in a summarized manner in the form of a pictorial by identifying the service, support systems, and controls along with production logistics, storage, customization, transportation, package, and reverse logistics for an enterprise.

A point of caution being that only that mature enterprise is best suited to exploit the various strategies like VMI, Logistics Tracking System or Package specific system.

Virtual University students try to focus on the idea of media disposal, which is one strategy most of the 4 PL companies employ to get rid of ever increasing database.



MODULE 2: INFRASTRUCTURE

The discussion here specifically focuses on what is infrastructure and what type of infrastructure are we to be aware of:

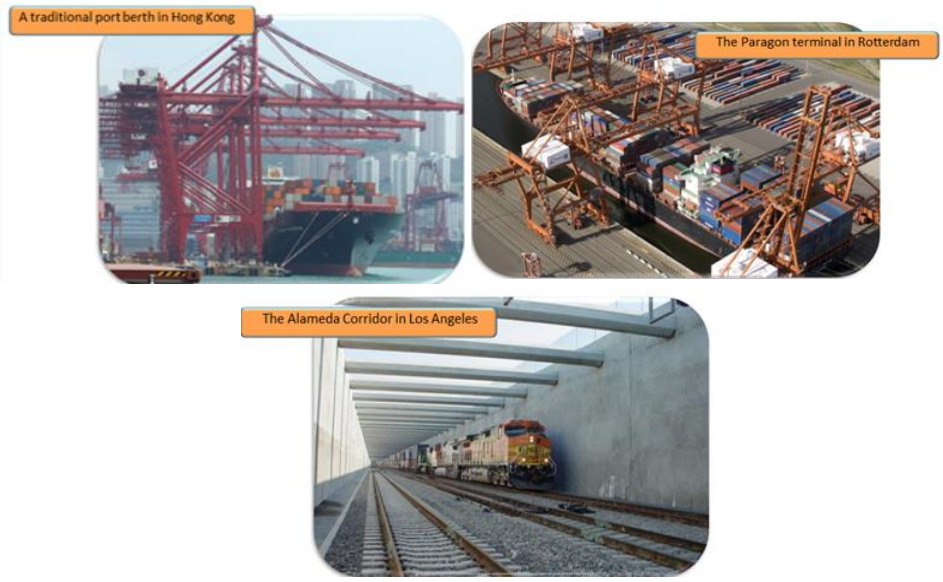
Infrastructure in logistics refers to the elements that allow goods, documents, money and information to move between businesses. Infrastructure includes the elements of Transportation, Communication, Public utilities, Banking services, Business services, Distribution channels, Court system, Intellectual property rights and Existence of standards.

Types of Infrastructure:

We now describe the various types of infrastructure using elements just mentioned above.

A. The **Transportation Infrastructure** allows goods to move efficiently within a country and between countries. This requires well-maintained seaports, airports, railways, and roads. We will discuss these important types of transportation infrastructure briefly.

1. **Port Infrastructure**: This particular type of transportation infrastructure identifies the important requirements of: -
   i. **Water draft:** The depth of water determines the size of ships that can call.
   ii. **Air draft:** Bridge clearances also determine which ships can call.
   iii. **Cranes:** Post-Panamax ships need wider/taller cranes than Panamax ships.
   iv. **Port operations:** Many ports have strong unions which limit operations.
   v. **Space limitations:** The location of some ports limits their ability to expand.
   vi. **Warehouse space:** Availability of reliable storage space for goods in transit.



   vii. **Connections to land-based transportation:** Ports need to have reliable access to roads and/or rail lines to keep cargo moving.

2. **Canals and Waterways Infrastructure:** Maritime transportation is dependent on the existence of reliable canals.
   i. The Suez Canal in Egypt (North Africa) and the Panama Canal in Central America are particularly important. The current trend of building ships too large to fit through these canals is creating new challenges for the industry.
   ii. Other key waterways include the Bosporus Strait in Turkey which connects the Black Sea with

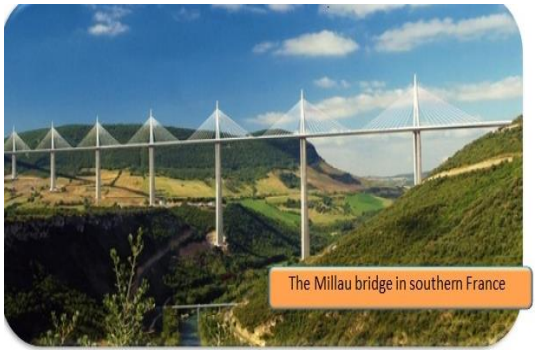
   the Mediterranean and the Saint Lawrence Seaway in North America which connect the Great
   iii. Lakes with the Atlantic Ocean.
   iv. Other canals are less frequently used, such as the Corinth Canal in Greece.

3. **Airport Infrastructure:** This particular type of transportation infrastructure identifies the significant prerequisites: -
   i. **Runways:** The lengths of runways determine whether or not airports can handle large cargo planes, and the number of runways determines the capacity of an airport.
   ii. **Space:** Most airports are landlocked and cannot expand.

   iii. **Hours of operation**: Noisy "cargo airports" need to be located outside of major cities if they are going to operate at night. Many airports do not meet this requirement.
   iv. **Warehouse space**: Airports need have proper storage facilities to protect cargo from the elements.

4. **Railroad Infrastructure:** This particular type of transportation infrastructure recognizes the noteworthy fundamentals: -

   i. **Gauge**: When railroads were first built, countries installed unique railroad track gauges to prevent rival armies from using them. Now these gauge differences do not allow trains to travel quickly between multiple countries or demand the construction of dual-gauge railroads.
   ii. **Multi-modal**: Cargo rail transport has shifted from traditional railcars to multi-modal cars, carrying either containers or truck trailers.
   iii. **Land bridges**: Containers are shipped from Asia to Europe through the U.S. railroad network; they arrive in a port on the west coast, and are transported to an east-coast port by rail.
5. **Road Infrastructure**: This specific type of transportation infrastructure distinguishes the notable essentials
   i. **Quality:** The existence of high quality roadways is important to the continuous flow of goods.
   ii. **Congestion:** In many countries traffic congestion is stifling and prevents goods from moving



   quickly.
   iii. **Civil Engineering Structures:** Structures such as bridges and tunnels need to be built in many places in order to conveniently navigate the landscape.

B. The **Communication Infrastructure** allows businesses to communicate clearly and quickly. This requires reliable phone lines, cell phone networks, internet service, and mail delivery. The communication infrastructure involves both Telecommunication infrastructure and mail services infrastructure.

1. The **Telecommunication Infrastructure** includes: -
   i. **Land lines:** While some countries have reliable, inexpensive phone lines, others do not have good landline telecommunication networks.
   ii. **Cellular phones:** Some countries built cellular phone networks quickly, often because they did not have a good landline network. They leapfrogged the landline technology, often offering better cellular access than developed countries with reliable landline networks.
   iii. **Internet:** Access to the internet is still limited or cost prohibitive in some areas. In others, internet access is fast and inexpensive.


Telecommunication wires in India

2. The **Mail Services infrastructure** includes: -
   i. **Speed:** In some countries, mail will be delivered quickly. But in others, mail delivery can be very slow. Pakistan has regular, express and same day delivery postal services. Pakistan Posts International Parcel Service is competitive, reliable and regular and makes its delivery before then the global players.
   ii. **Reliability:** In some countries, not all mail is delivered: it is lost, abandoned, or sometimes pilfered.
   iii. **Delays:** In some countries, postal unions have a lot of power and strikes can delay the delivery of important documents.
   iv. **Competition:** Firms such as TCS, FedEx, UPS, and DHL help make up for shortcomings in this area. However, while these services are very reliable, they are generally much more expensive than the public postal services.


A high-speed postal train in France

C. The **Utilities Infrastructure** allows businesses to sustain their daily operations. This requires reliable electricity, energy (natural gas), water, and sewer services. This type of infrastructure would be considered adequate only if it is geared up to provide future demands.

   i. **Electricity:** Unreliable electricity grids and insufficient production capacity can cause blackouts or brownouts, limiting productivity.
   ii. **Water and sewer:** Access to clean water (and sewer) is fundamentally important for many manufacturing processes. It can even be an issue in more developed countries where older infrastructure is inefficient.
   iii. **Energy:** Reliable pipelines have to be available to deliver natural gas or oil products to the locations where they can be used.
   iv. **Theft:** In some areas, theft of utilities is also common, making it difficult for utility companies to earn a profit and invest in new infrastructure.


The Russia-European Union pipeline

D. The **Banking Infrastructure** allows businesses to move funds and documents quickly and reliably, both within a country and between countries. This requires a network of bank branches and well-trained bank employees. This type of infrastructure includes: -

   i. **Foreign currency payments:** The ability to quickly purchase and sell foreign currencies, either through wire transfers or currency purchases, is important to firms engaged in international trade.
   ii. **Methods of payment:** The ability of the banking partners to support alternative means of payment and to provide assistance to firms engaged in international trade is very important.

iii. **Document exchanges:** Banks play a fundamental role in the exchange of trade documents between an exporter and an importer.

iv. **Branch infrastructure:** The existence of branches and/or access to Automated Teller Machines provides a higher level of service to firms.

E. The **Business Services Infrastructure** allows businesses to find additional competent logistics help quickly. This includes freight forwarders, couriers, carriers, delivery services, packing services, and so on.

i. **Freight forwarders:** Freight forwarders provide significant assistance to firms engaged in international trade by helping determine the best shipping alternatives.

ii. **Customs brokers:** Brokers provide assistance to importers when clearing Customs.

iii. **Couriers:** Couriers allow firms to ship documents and small parts using the "next available flight."

iv. **Packing services:** Packing services allow exporters to rely on professionals to pack goods destined for export.

v. **Multiple other services:** Carriers, delivery services, etc. are fundamental to implement good international trade practices, and must exist for exporters to be successful.

F. The **Distribution Infrastructure** allows businesses to find agents and distributors, to develop wholesale and retail channels, and promote their products. The distribution infrastructure is evaluated on the presence as well as performance of the following: -

i. **Agents and distributors:** A strong network of agents and distributors allows an exporter to enter new markets and expand abroad.

ii. **Retail distribution:** Efficient access to consumers is important to a manufacturer of consumer goods, and is not available in all countries.

iii. **Advertising and promotion:** The existence of advertising agencies and media that allow promotional activities (newspapers, magazines, television, and radio) is critical to the success of many products and services.

iv. **Trade shows:** For most industries, trade shows present an unequaled opportunity to reach potential customers and trade partners.

G. The **Court Infrastructure** allows businesses to settle disputes quickly and fairly. This includes not only an efficient court system, but also a network of mediators and arbitrators, and the existence of clear jurisprudence. This infrastructure actually gives comfort and provides encouragement to both national and foreign investors interested in conducting business in the country. The court infrastructure would be considered optimum if it dispenses justice and settles disputes with characteristics of speed, arbitration, mediation and fairness.

i. **Speed:** Speedy resolution of lawsuits allows businesses to "move on." Some countries have slow and cumbersome court processes.

ii. **Arbitration:** Disputes can be resolved faster through arbitration. The existence of experienced arbitrators is important to the conduct of business.

iii. **Mediation:** Disputes can also be resolved through mediation, and therefore a group of mediators is often useful to resolve disputes.

iv. **Fairness:** In some countries, the court system is perceived as corrupt or unfair, and that hinders good business relationships.

H. The **Intellectual Property Infrastructure** allows businesses to protect their intellectual property (copyrights, patents, and trademarks) with law enforcement services intent on enforcing intellectual property laws. This is a very important type of infrastructure and takes into account both protection and international agreements.

i. **Protection:** Businesses with intellectual property (patents, copyrights, trade secrets) want to make sure that the countries in which they operate will protect intellectual property. In some countries, competitors, police, and courts do not respect nor protect intellectual property, often considering that intellectual property laws favor big foreign corporations over the local entrepreneur trying to earn a living.

ii. **International Agreements:** Some countries have not ratified international agreements on intellectual property and therefore do not recognize some aspects of foreign patents and copyrights.

I. The **Standard Infrastructure** allows businesses to determine the requirements that their products and operations must meet. This includes safety, design, and performance standards.

Countries have different standards for products and services offered for sale; these standards should be specific and clear so that they can be followed. The three universally acceptable standards include

i. **Safety:** Safety requirements often differ from country to country. Such is the case for vehicles, appliances, and hotels, for example.
ii. **Design:** Product designs are often dictated by local conventions (electrical supply and plugs, plumbing sizes and pressures, and telecommunication standards, for example).
iii. **Performance:** Several countries have performance standards for products, dictating what can be called "natural," "organic," "premium," and so forth.

Tire Pressure Monitoring System on a Brazilian truck

PAKISTANI CONTEXT

Internationally recognized Pakistani Seaports include Port of Gwadar, Port of Karachi, Port of Kati, Port of Pansy and Port of Qasim.

Virtual University Students studying for Supply Chain Management may try to remember these details if not able to learn it. Over and above VU students are requested to write 500 words write up in their journal about the Logistics Infrastructure with very brief views about the different types of infrastructure in Pakistan in view of what was covered in this module.

GAWADAR PORT SALIENT FEATURES

CURRENT PORT FACILITIES	
Water location	Arabian Sea (Sea)
Anchorage depth	9.4m - 10m
Cargo pier depth	9.4m - 10m
Oil terminal depth	12.5m - 13.7m
Dry dock	Large
Harbor size	Medium
Port Area	64,000 sq-m
Container stacking area	48,278 sq-m
Reefer Cargo space	(400 points)367sq-m
Empty container stacking area	6,875 sq-m
Storage yard	28,669 sq-m
Transit shed	3,750 sq-m
Hazardous cargo storage yard	1,800 sq-m
Control tower (foot print only)	1,536 sq-m
Buoy yard	1,500 sq-m
Generator building	593 sq-m
Maintenance workshop (general)	1,440 sq-m
Vehicles Servicing Garage	450 sq-m
Security Building	65 sq-m
Common offices for GPA, Customs,	Immigration Several floors, per floor: 4 ,144 sq-m
Mosque	324 sq-m
Operations office and canteen. Per floor	1,742 sq-m
Lorry car park	1,125 sq-m
Future development area	118,575 sq-m
Oil recovery system	1 complete set
Communication	
VHF/DSC including INMARSAT-B	Complete system

Gawadar Port development would form the very basis of Pakistan China Economic Corridor and would translate into savings of cost by shortening the distance for Chinas' trade with Europe and the middle east considerably. The factual savings are yet to be seen but the saving in distance is about Europe – Western China (9535 miles) and with Middle East – Western China (10242 miles).

MODULE 3: LOGISTICS PERFORMANCE INDEX

BASIS: The LPI provides a simple, global benchmark to measure logistics performance, filling gaps in datasets by providing systematic, cross-country comparisons. A joint venture of the World Bank, logistics

service providers, and academics, the LPI is built around a survey of logistics professionals. This survey asks freight forwarders to rate countries on key logistics issues such as customs clearance efficiency, infrastructure quality, and the ability to track cargo. It captures a broad set of elements that affect perceptions of the efficiency of trade logistics in practice. It is a "fundamental" indicator that shows where a country stands and that could motivate researchers to take on a deeper, finer, country-specific assessment of the determinants of logistics performance.

EDITIONS FOR THE YEAR 2012 & 2014: We are referring to 2012 edition which focused on the LPI measures on-the-ground trade logistics performance in 155 countries helping national leaders, key policymakers, and private sector traders understand the challenges they and their trading partners face in reducing logistical barriers to international commerce.

For the first time, the LPI 2012 included a focus on the environmental impacts of logistics practices.

The LPI is an interactive benchmarking tool created to help countries identify the challenges and opportunities they face in their performance with respect to trade logistics and what they can do to improve their performance. The LPI 2014 allows for comparisons across 160 countries. The World Bank has published every two years since 2007.

The capacity of developing countries to efficiently move goods and connect manufacturers and consumers with international markets is improving all be it slowly. But much more is needed to close the existing "performance gap" between high and low performers.

Supply chains are only as good as their weakest link, and sustainable improvements require complex changes in a range of policy dimensions in areas including infrastructure, trade facilitation and services.

THE ROLE OF GOVERNMENT AND PRIVATE SECTOR: Logistics, organizing the movement of goods over time and space, has evolved from its 19th century military roots to today's international supply chains. As the backbone of international trade, logistics encompasses freight transportation, warehousing, border clearance, payment systems, and many other functions.

These functions are performed mostly by private service providers for private traders and owners of goods, but logistics is also important for the public policies of national governments and regional and international organizations. Primarily, because global supply chains are so varied and complex, the **efficiency** of logistics **depends on government services, investments, and policies**.

Building infrastructure, developing a regulatory regime for transport services, and designing and implementing efficient customs clearance procedures are all areas where governments play an important role.

The improvements in global logistics over the past two decades have been driven by **innovation** and a great **increase in global trade**.

While policies and investments that enable good logistics practices help modernize the best-performing countries, logistics still lags in many developing countries. Indeed, the "**logistics gap**" evident in the first two editions of this report remains.

The tremendous importance of logistics performance for **economic growth, diversification**, and **poverty reduction** has long been widely recognized.

Countries have improved their logistics performance by implementing strategic and sustained interventions, mobilizing actors across traditional sector silos (storage towers) and involving the private sector. The national governments can facilitate trade through investments in both "hard" and "soft" infrastructure.

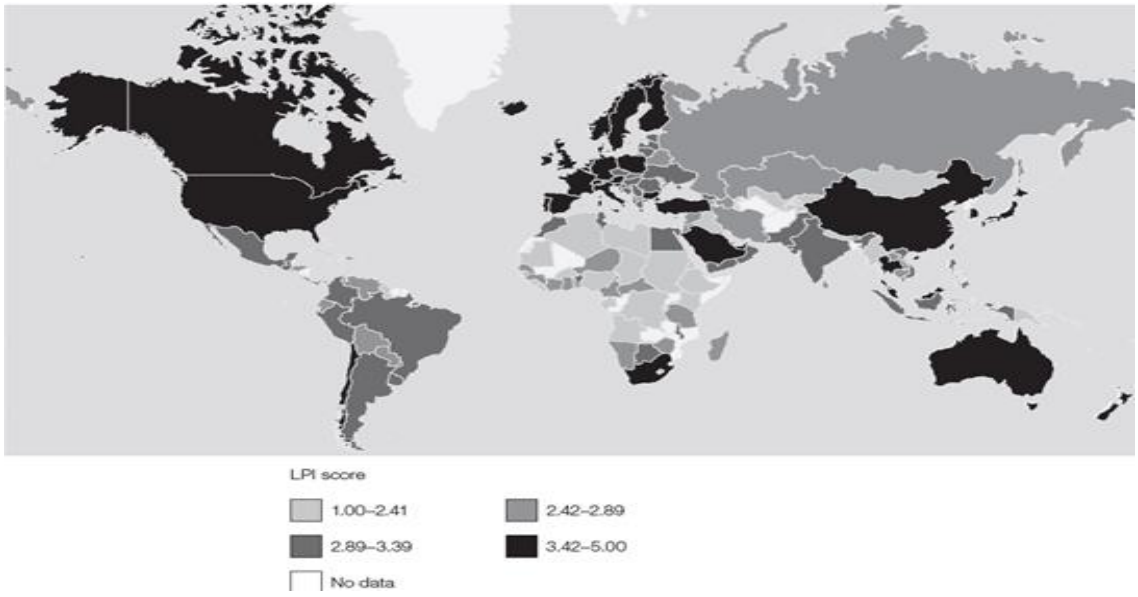
PRAGMATIC APPROACH: LPI scores should not be overvalued, a country's LPI score is less relevant than its quintile (whether it is among the best or worst performing countries or is somewhere in the middle).

The authors use confidence intervals to examine the sensitivity of each country's LPI score. As per 2012 report Pakistan was ranked 71 and Singapore was ranked 1 and now in 2014 it is ranked 72 and Singapore is ranked 2. Germany enjoys the 1st ranking now.

The reason why countries like Poland and Oman are ahead of Pakistan is the failure of the country on the soft infrastructure.

Human Capital limitations, policies, procedures and bureaucratic weakness all add up to depict a poor performance of the country in this particular sector.

NEW JOB FOR PAKISTANIS*: Supply Chain and Logistics is virtually ready for creating thousands of jobs which would eventually lead to industrial and technological revolution in Pakistan improving the quality of life and ensuring fulfillment of social responsibility. This becomes of prime importance with the newly announced Economic Corridor Project.*



There are many museums in the world which cover various aspects of practical logistics. These include museums of transportation, customs, packing, and industry-based logistics. However, only the following museums are fully dedicated to logistics:

General logistics:

1. Museum of Logistics (Tokyo, Japan)
2. Logistics Museum (Saint Petersburg, Russia)

Military logistics:

1. Royal Logistic Corps Museum (Surrey, England, United Kingdom)
2. The Canadian Forces Logistics Museum (Montreal, Canada)

The discussion on logistics often includes historical quotes from men who were considered top class strategists, leaders and logisticians. We are including only three just to make you realize the importance of logistics from the archives of history.

FAMOUS LOGISTICS QUOTES

1. "Gentlemen, the officer who doesn't know his communications and supply as well as his tactics is totally useless." Gen. George S. Patton, USA
2. "The amateurs discuss strategies, dilettantes discuss tactics: the professionals discuss logistics." Napoleon Bonaparte
3. "My logisticians are a humorless lot … they know if my campaign fails, they are the first ones I will slay." Alexander the Great
4. "The supreme excellence is not to win a hundred victories. The supreme excellence is to subdue the armies of your enemies without even having to fight them." Sun Tzu, The Art of War

END OF LECTURE 6: GIST AND CRUX:

1. *Latest concept about the origin of Logistics is that it originated in the French Language, and the word owes its origin to the French word "Logistique". All business strategists agree that logistics add value to the supply chain.*
2. *There is a difference and distinction between Logistics and Supply Chain. Logistics is the process of planning, implementing, and controlling the effective and efficient flow of goods and services from the point of origin to the point of consumption.*
3. *Logistics Infrastructure can make or break not only the supply chain intent and performance of a country and can seriously question the incentives that country can provide to both business logistics as well as its own military logistics.*
4. *Logistics Performance Index The tremendous importance of logistics performance for economic growth, diversification, and poverty reduction has long been widely recognized. It has been only since 2007 that World Bank has taken an initiative to conduct a survey that identifies the placement of a country with respect to its Logistics Performance.*
5. *Logistics has increasingly become important for sustainability.*

CONTRACT MANAGEMENT

Modules

- Module 1: What you already know, What is a contract and What is Contract Management.
- Module 2: Types of International Contract.
- Module 3: Elements of a contract.
- Module 4: Why Contract Management is important for Supply Chain Management.
- Module 5: Incoterms 2010.

WHAT IS A CONTRACT

- **Contracts are the foundation of nearly all business relationships.**

Current Situation

- **Manual processes and fragmented business systems result in:**
  - **Increased costs**
  - **Poor collaboration**
  - **Poor compliance**

Current Situation

- **Overcharging by suppliers**
- **Diminished negotiation leverage**
- **Missed rebates and savings opportunities**
- **Lost revenue opportunities**
- **Dissatisfied and lost customers**

Inadequate Compliance Monitoring

- **Maverick buying**
- **Pricing variance and rebates**
- **Evergreen renewals**
- **Policy and regulatory non-compliance**

Contract

- **A contract is an agreement having a lawful object entered into voluntarily by two or more parties, each of whom intends to create one or more legal obligations between them.**

Contract

- **A contract is a legally enforceable promise or undertaking that something will or will not occur.**

Pakistan Contract Law 1872

- **The general law of contract in Pakistan is contained in the Contract Act 1872. English decision's (where relevant) are also cited in the courts.**

Pakistan Contract Law 1872

- **The Act defines "contract" as an agreement enforceable by law. The essentials of a (valid) contract are:**

  (a) Intention to create a contract

  (b) Offer and acceptance

Pakistan Contract Law 1872

- **(c) Consideration**
- **(d) Capacity to enter into a contract**
- **(e) Free consent of the parties**
- **(f) Lawful object of the agreement**

Steps in Contract Management

- **The process of managing contracts is known as Contract Management. The process involves 8 steps namely:**
- **1.Orientation**
- **2.Plan**
- **3.Personnel**

Steps in Contract Management

- **4.Process**
- **5.Training**
- **6.Standards**
- **7.Measurements**
- **8.Auditing**

Steps in Contract Management

1.Orientation

- **A meeting should be held with the department that is incharge of the contract management work and those impacted by the contract management process.**

Steps in Contract Management

2.Plan

- **A comprehensive plan should be developed to implement a contract management system.**

Steps in Contract Management

3.Personnel

- **One person in the organization should be assigned the responsibility for contract management. This often is the Contracts/ Supply Chain/ purchasing/manager.**

Steps in Contract Management

4.Process

- **Documenting a contract management process assures that everyone in the company handles contracts in the same way.**

Steps in Contract Management

5.Training

- **Members of the department responsible for contract management should be trained in the company's contract management process, terms used and guidelines for the function.**

Steps in Contract Management

- **6.Standards**
- **Develop contract management standards.**
- **Standards should include maintaining accurate documentation for the start and end date of a contract.**

Steps in Contract Management

7.Measurement

- **Establish metrics to measure and assess the effectiveness of the contract management function within an organization.**

Steps in Contract Management

8.Auditing

- **The contract management function should be audited periodically using an audit checklist for reference.**

Contract Management Software

- **A typical Contract management software includes the 9th step in the contract management as "RENEWAL".**

TYPES OF INTERNATIONAL CONTRACT

1. *Lex Mercatoria*
2. International Sales Contracts
3. Agency vs. Distributorship
4. Distribution Contracts
5. Termination
6. Arbitration
7. Mediation

ELEMENTS OF A CONTRACT

Contract Elements

Contract Language	Good Faith	*Force Majeure*
Scope of Appointment	Territory	Corporate Accounts
Term of Appointment	Choice Law	Choice of Form or Venue
Arbitration Clause	Mediation Clause	Profitability or Commission

RELEVANCE AND IMPORTANCE OF CONTRACT MANAGEMENT

Importance of Contract Management

- In considering the challenges around contracts, Louis Brown, the father of preventive law, who wrote the now-famous Manual of Preventive Law, noted the following:
  - **It usually costs less to avoid getting into trouble than to pay for getting out of trouble**.

INCOTERMS

CONTRACT MANAGEMENT

Lecture 7 is primarily focused on Contacts and management of contracts. Contract management directly as well as indirectly relates to supply chain management. Contract is a legal document that spells out the mutually agreed upon goals and objectives between the enterprise as well as the supply chain partners. Incidentally these mutually agreed goals are actually mission critical objectives not only for the enterprise but also for the distributors, retailers and the suppliers. This lecture aims to equip the virtual university student in the cognitive, affective and psychomotor domain and covers critical objectives in 5 modules. Ideally after completing these five modules, the Virtual University student would be more conscientious towards the importance of contract management in the effective administration of the supply chain. Effective contract management allows a SC manager to enhance uniformity along the entire supply chain. Contract management is an evolving science as it focuses on contracts which are continuously being modified, fine-tuned or refined to ensure that none of the three critical interfaces of supply chain feel that they are losing profits. Also contracts should incorporate an important factor of flexibility that ensures that any change in environmental condition does not affect the benefits of any of the three critical supply chain interfaces.

Effective management of contracts requires the primary responsibility of boundary identification or scope of the contract. Scope refers to that boundary or simply what is included in the contract and what is excluded. Many contracts fall a prey to scope creep that is responsibilities or deliverables not specified in the documented contract become a part of the implementation or the practical side of the contract.

The five modules are as follows:

Module 1: What is a contract and what is Contract Management: Business students normally have access to documents called contracts at their work place or even the document they signed at the time of enrollment at their respective institution.

Module 2: Types of International Contract: Supply Chain boundaries normally extend beyond the physical boundaries of a country or a region, Pakistan is no exception. This module is aimed to ensure that the contract managers or supply chain managers working on contracts is aware of the important terms that help in the governance and implementation of operations of a supply chain.

Module 3: Elements of a contract: This module provides the student to gather all the pertinent technical knowledge jargon that is used in different organizations of the world. Sometimes a term used by one company may not be used with the same relevance at the other company which has been joined by a contract. This would allow any professional working as a supply chain manager process to be at the same level of awareness with respect to the scope of the contract be it the supply chain manager itself or the purchasing manager for that matter.

Module 4: Why Contract Management is important for Supply Chain Management. This module allows overcoming the inertia of ignoring the documented contract agreement. We often see organizations putting away their documented contracts either in archives or their info centers and only referred to on completion of a certain mile stone or entire completion. This defeatist mindset can actually cause the profits of the entire supply chain to be seriously compromised and often leading the entire supply chain to fail or crash. Unfortunately, a perspective found globally is that most of the enterprises face the situation that their managers do not refer to the details of the contract.

Module 5: Inco terms 2010

Contract Management: Rationale and Logic

The fundamental rationale behind contract management within the supply chain management framework is to ensure the effective, efficient and cost-effective delivery of contracting and procurement services, while complying with legal, regulatory and ethical obligations set forth by the governments, third party regulatory and international governing bodies. After completing this lecture, the virtual university students would be able to carry out a basic if not a comprehensive audit of the contract management process at their enterprise also they can set up a monitoring system to ensure that the contract management process complies with the inter-organizational agreed Service Level Agreements (SLAs) and agreed goals.

MODULE 1: WHAT IS A CONTRACT?

Most of the virtual University students already know that "Contracts" are the foundation of nearly all business relationships. Various studies indicate that about 80% of business-to-business transactions are governed by contractual agreements.

The typical Fortune 1000 company maintains between 20,000 and 40,000 active contracts. If Billions of Rupees are being lost by government of Pakistan to IPPS every year the situation is not that different in other countries and as a common observation, companies are losing billions of dollars each year. The reason why IPPS are having an upper hand is primarily because of mishandling of the contract both at the time of development of the contract as well as at the implementation. It goes without saying that the absence of the audit of these IPP contracts is also causing financial loss to the country.

Business consultants and academia identify the reasons due to which businesses and government organization incur losses. Some of the common reasons are contract leakage, unredeemed rebates, inefficient processes and suboptimal contract terms

CHALLENGES

There are certain common Challenges observed in the domain of contract management. Companies lack formalized contract management procedures and controls for creating and managing agreements throughout the contract lifecycle. The majority of organizations manage their contracts in a fragmented or ad-hoc manner. Most large companies manage their contracts by division rather than on an enterprise-wide basis. Fragmented procedures result in insufficient collaboration during the contract-creation process, limited visibility into active contracts, and a higher degree of risk.

CURRENT SITUATION

The current situation is sadly more or less having a direct negative impact from "**The Invisible Contract**". This term refers to "where is the contract or more appropriately where it has been placed". More than 80% of companies report that even locating a contract is difficult. **AGAIN THIS IS A GENERIC COMMENT NOT AIMED AT THE PAKISTANI CONTEXT**.

Many customer and supplier contracts are stored in filing cabinets or on the hard drives of individual (and often inaccessible) Personal Computers across the enterprise. Manual processes and fragmented business systems result in:

1. Increased costs
2. Poor collaboration
3. Poor compliance
4. Current Situation
5. Overcharging by suppliers
6. Diminished negotiation leverage
7. Missed rebates and savings opportunities
8. Lost revenue opportunities
9. Dissatisfied and lost customers
10. Inadequate Compliance Monitoring
11. Compliance is the most challenging aspect of the contract lifecycle
12. Inadequate Compliance Monitoring

Most companies only monitor compliance on a monthly, quarterly or ad hoc basis, exposing them to cost, performance, and regulatory risk, including:

1. Inadequate Compliance Monitoring
2. Maverick buying
3. Pricing variance and rebates
4. Evergreen renewals
5. Policy and regulatory non-compliance

We are now in a position to answer the question "WHAT IS A CONTRACT?"

A contract is **an agreement** having a lawful object entered into voluntarily by two or more parties (would be governed by laws related to party), each of whom intends to create one or more legal obligations between them.

The elements of a contract are "**offer**" and "**acceptance**" by "**competent persons**", having legal capacity, who exchanges "**consideration**" to create "**mutuality of obligation**."

Contract should carry a proof of some or all of these elements may be done in writing, though contracts may be made entirely orally or by conduct. The remedy for breach of contract can be "damages" in the form of compensation of money or **specific performance** enforced through an **injunction**.

Thus a contract is a legally enforceable promise or undertaking that something will or will not occur. The word promise can be used as a legal synonym for contract, although care is required as a promise may not have the full standing of a contract, as when it is an agreement without **consideration**.

Supply Chain Managers while handing Contracts **should remember** that:

1. Both of these remedies award the party at loss the "benefit of the bargain" or **expectation damages**, which are greater than mere **reliance damages**, as in promissory estoppel. The parties may be natural persons or **juristic persons**
2. Contract law varies greatly from one jurisdiction to another, including differences in **common law** compared to **civil law**, the impact of **received law**, particularly from England in common law countries, and of law codified in regional legislation

PAKISTAN CONTRACT LAW 1872

The general law of contract in Pakistan is contained in the Contract Act 1872. English decision's (where relevant) are also cited in the courts. The Act defines "Contract" as an agreement enforceable by law. The essentials of a (valid) contract are:

(a) Intention to create a contract;

(b) Offer and acceptance;

(c) Consideration;

(d) Capacity to enter into a contract;

(e) Free consent of the parties;

(f) Lawful object of the agreement;

Writing is not essential for the validity of a contract, except where a specific statutory provision requires writing. An arbitration clause must be in writing.

MODULE 1 B: WHAT IS CONTRACT MANAGEMENT (STEPS IN CONTRACT MANAGEMENT)

This module should be more or less used to answer the important Steps in Contract Management. The process of managing contracts is known as "**Contract Management**". The process involves 8 steps, which are, Orientation, Plan, Personnel, Process, Training, Standards, Measurements and Auditing.

1. **Orientation**: A meeting should be held with the department that is in charge of the contract management work and those impacted by the contract management process. At the meeting, the reason for contract management should be explained along with the fact that the program is fully endorsed by senior management. Where feasible, a member of senior management should lead the meeting.

2. **Plan**: A comprehensive plan should be developed to implement a contract management system. This would ensure that all affected departments in an organization focus on delivering a cost-effective approach to managing contracts.

3. **Personnel**: One person in the organization should be assigned the responsibility for contract management. This often is the Contracts/ Supply Chain/ purchasing/manager. A project plan for implementing a contract

management system should be developed by someone assigned responsibility for seeing that a system gets implemented correctly and on time and on budget. The plan should designate tasks to be accomplished, who is responsible for the task and the targeted completion date.

4. **Process**: Documenting a contract management process assures that everyone in the company handles contracts in the same way. Specify a work flow, what person or department is responsible for completing each step in the work flow and how work flow exceptions are handled.

5. **Training**: Members of the department responsible for contract management should be trained in the company's contract management process, terms used and guidelines for the function.

6. **Standards**: Develop contract management standards. Standards should include maintaining accurate documentation for the start and end date of a contract. Keep complete contract addendums, noting any changes in the contractual arrangement, such as renewal of a service contract.

7. **Measurement**: Establish metrics to measure and assess the effectiveness of the contract management function within an organization. Measurement metrics would include accuracy in contract preparation and time to retrieve and reference contracts when required.

8. **Auditing**: The contract management function should be audited periodically using an audit checklist for reference. The checklist should be specific what to audit and specifically what to inspect with expected results that are in compliance with contract audit standards.

CONTRACT MANAGEMENT SOFTWARE APPLICATION

Typical Contract management software includes the 9th step in the contract management as "**RENEWAL**", which often goes unnoticed in the manual Contract Management Process and acts as a matter of pain point for Supply Chain Partners in general and Supply Chain Manager in particular.

MODULE 2: TYPES OF INTERNATIONAL CONTRACT:

Some of the more important types of International Contracts that should a Supply Chain Manager should know include:

1. Lex Mercatoria
2. International Sales Contracts
3. Agency vs. Distributorship
4. Distribution Contracts
5. Termination
6. Arbitration
7. Mediation

Virtual University Students are requested to pay special attention to this concept by going through the International Contract Manual. The Manual is divided into three parts; the first part covers common and important contract terms, and the second and the third parts cover the relevant laws of a number of selected countries and the United Nations Convention on Contracts for the International Sale of Goods (CISG). Also students can identify the level of expertise in contract management for any enterprise by following the criterion for Contract Management Maturity Model (CMMM)

MODULE 3: ELEMENTS OF A CONTRACT

Elements of a Contract: There are significant differences in the specific wording and details of contracts employed by supply managers for sourcing products, processes, and services, the structures of contracts used in purchasing products and services are fairly standard and have a number of common attribute. Although, there are significant differences in the specific wording and details of contracts, employed by supply managers for sourcing products, processes, and services. In general, these attributes are established by an enterprise's legal counsel and then are modified for different types of suppliers, products, and services. The important point to remember is that contracts establish the terms and conditions by which two parties agree to conduct business. They define the type of relationship and pave the way for ensuring that both parties come away with mutual benefits.

A contract typically begins with an introduction of the parties who will be engaged in the contract. For example, it might begin with the following:

> THIS AGREEMENT IS MADE this day of 2016, BETWEEN ABC COMPANY LIMITED, a company registered in Pakistan and having its registered office at 44 ABC Street, University Road, Quetta (the "**Buyer**") and
>
> XYZ, INC., a corporation duly organized under the laws of the State of Sharjah, of United Arab Emirates and having its principal place of business at 123 Cricket Road, Hockey Plaza, Dubai, UAE (The "**Supplier**").

Following the introduction, there are several numbered sections (called "**Clauses**") that describe the different sets of conditions that the parties agree to follow in their conduct of their business relationship. These clauses in the first part of the contract may also refer to a series of "**Schedules**" that provide specific details behind the clauses.

These schedules may provide additional information on the method of manufacture, the statement of work, how to calculate specific measures, health and safety requirements, pricing schedules, and other important details. The schedules (which are typically contained in the appendices at the end of the contract) are where the real "meat" of the negotiations has often taken place. The following example of a specific contract between two companies (a large Fortune 500 company and a mid-sized service supplier) is used to illustrate typical contract structures with clauses and schedules.

Virtual University Student, please bear in mind that there will be major variations in the details of a contract, but the contract structure that follows is fairly representative of what most supply management students will use in contract negotiations.

1. Definitions. This section defines all of the important terms contained within the contract and is important so everyone understands exactly what each term means. It is better to get this clear up front, to avoid confusion later on. Some of the typical terms might include the product or service definition and terms such as raw materials, purchase orders (POs), on-time delivery, and price. Although these might seem obvious to some people, if it is in writing, it is clear.

2. Scope of Agreement. This section defines what is in and out of scope. This might include the geographical limitations, the validity or invalidity of prior contracts, preferential treatment by the supplier, or other elements.

3. Purchase Orders. This section outlines the relationship between the Agreement and any other purchase orders issued by the company to the supplier. For example, it might state that "any Purchase Order for Products submitted by a Buyer affiliate during the term of this Agreement shall be deemed to be on the terms and conditions set out in this Agreement." This also stipulates what happens if a purchase order is cancelled and what happens if terms conflict between the PO and the Agreement, and which document supersedes which.

4. Supply and Delivery. This clause specifies the terms for supply and delivery of the product or service. For instance, if there is a 10-day lead time stipulated between order placement and delivery, what happens if the supplier does not deliver in time? This clause may also reference an appendix that provides additional details on how delivery is measured, what is considered on-time delivery, what are the penalties for late delivery, and other details.

5. Specifications, Quality, and Health, Safety, Environment. This clause describes method of manufacture and quality requirements, and may include language specific to terms of quality (e.g., "The Products delivered under this Agreement shall be manufactured in conformity with any mandatory requirements of applicable law in the country of origin or supply and any international standards relevant to such Products."). Charges for delivery of off-specification products or services may also be identified in the appendix. For services, a Statement of Work contained in the appendix will provide details of the exact scope of work to be performed and the service quality expectations. Finally, elements associated with safety, health, and environmental standards are identified in terms of expectations from the supplier.

6. Payment. This section may specify terms such as "current price," "prior price," and other criteria that determine how or if prices will be adjusted over the course of the contract. Again, details of how often prices

will change and any indices associated with pricing change agreements or related to cost-savings sharing are identified in a schedule in the appendix.

7. Liability. This can sometimes be a contentious clause and may often contain language such as "The Supplier shall assume entire responsibility for and shall defend, indemnify and hold Buyer and Buyer's Affiliates harmless against all losses, liabilities, costs and expenses arising directly or indirectly out of or in connection with this Agreement or any Purchase Order and arising from injury or damage to the property of the Supplier." The clause generally specifies who is responsible if there are injuries or damage, over the course of the contract, and any damages to be paid. This may also include insurance requirements and sub-supplier issues as they arise.

8. Force Majeure. This clause describes the course of events that occurs if there are unforeseen events such as earthquakes or hurricanes that prevent a supplier from fulfilling its obligations to the buyer. Generally, this clause includes language such as "The party whose performance of this Agreement is so affected shall notify the other party as soon as is reasonably practicable giving the full relevant particulars and shall use its reasonable efforts to remedy the situation immediately."

9. Effective Date and Termination. This clause states when the contract becomes effective, when it terminates, and any agreements relating to conditions when the contract can be extended beyond the termination date. It also stipulates whether either party has the ability to terminate the contract at any time, and how much advance notice must be given.

10. Intellectual Property. This clause specifies conditions regarding who owns any intellectual property (IP) that comes out of the agreement, and who owns what IP going into the agreement. If an innovation comes out of the agreement, there may also be stipulations as to who owns the "residuals" of that IP.

11. Assignment and Contracting. This clause stipulates whether the supplier can assign its rights described in the agreement to another party, and whether subcontracting is permissible.

12. Technology Improvements. If the buyer becomes aware of any technology or cost improvements of other products in the market, this section may specify whether they can share this information with the supplier, and how the supplier should act on this information.

13. Most Favored Customer. This clause states whether the buyer can expect to receive preferential status over the supplier's other customers. This is not only difficult to measure, but also difficult to enforce, so it is not always used in practice.

14. Confidentiality. This clause ensures that all information, technology, and so on shared between the parties' remains confidential and is not shared with other customers or suppliers.

15. Statistics. This clause provides guidelines regarding what type of reporting statistics and measures the supplier must provide to the buyer on a regular basis, defined clearly. Additional details may be in a schedule in the appendix.

16. Key Performance Indicators and Compensation. This clause provides specific details on how the supplier's performance will be measured and if any compensation will be awarded by the supplier to the buyer if these defined levels of performance are not maintained. For example, if delivery falls below 90%, there may be a penalty the supplier will need to pay.

17. Notices. This clause establishes where bills, invoices, notices, and other documents should be sent, as well as the key contact person at the buying and supplying company to whom to direct all questions and issues concerning the relationship.

18. Severability. This clause describes how an issue will be addressed if a portion of the agreement is void or unenforceable, and which court of law will resolve the difference.

19. Third-Party Rights. This clause stipulates that any benefits attributed to a third party (other than the buyer and supplier) identified in the contract must be enforced. For example, if there is a bank that handles transactions between the two and charges a fee, this fee must be paid by the parties according to the agreement.

20. Free Trade Areas. This clause identifies any free trade issues and benefits, and how to share the benefits.

21. Minority- or Women-Owned Business Enterprises. This clause stipulates that the supplier agrees to use its best efforts to support MWBE (Minority- and Women-Owned Business Enterprises) purchasing or that a certain percentage of its business must be awarded to MWBE enterprises.

22. General. Any other general business principles.

23. Governing Law. This clause stipulates the court of law where any disputes will be settled. This clause contains language such as "Mandatory application of local law or a statement to the contrary in the relevant Purchase Order, which is agreed to by the Supplier, shall be exclusively governed by the laws of Pakistan."

This clause may also stipulate the use of arbitration or other forms of conflict resolution (described later in this chapter).

24. Signatures

IN WITNESS WHEREOF this Agreement has been duly executed by the parties hereto, the day and year first above written.

ABC COMPANY LIMITED

By: _____

Name: _____

Title: _____

XYZ, INC.

By: _____

Name: _____

Title: _____

An example of schedules that may be used in the appendices include the following:

Schedule 1: Product/process/service specifications, statement of work, or scope of work

Schedule 2: Prices and price adjustment mechanisms

Schedule 3: Health, safety, and environment guidelines and requirements

Schedule 4: Packaging materials

Schedule 5: Approved method of manufacture, delivery, or service deployment

Schedule 6: Delivery targets and lead times

Schedule 7: Supplier's hours of operation

Schedule 8: Storage and inventory control

The Contract Elements captured above may be supplemented and complemented by some other important Contract Elements like good faith, scope of appointment, territory, corporate accounts, and term of appointment, choice of law, choice of forum or venue, arbitration, mediation, profitability or commission, termination.

(Module prepared after taking into account the textbook "Purchasing and Supply Chain Management", **HANFIELD &GUINIPERO** as the primary Source)

MODULE 4: RELEVANCE & IMPORTANCE OF CONTRACT MANAGEMENT

The Contract Management Modules are designed for individuals who are involved in contract administration or procurement activities in the private, public, and not-for-profit sector Supply Chains. These modules provide a foundation for understanding both the strategic and operational aspects of the contract management function.

IMPORTANCE OF CONTRACT MANAGEMENT

Effective Contract Management is one of the prime instruments of managing supply chain effectively. Unfortunately, instead of being a solution the poor and ineffective contract management becomes a source of problems for the supply chain. Many companies seek to resolve issues through a process known as "preventive contracting," which involves spending more time in the initial contracting stages to fully understand stakeholder requirements, expectations, and repeated communication of expectations, in order to gain a full understanding of elements.

The importance of contract management is not limited to contract managers or supply chain managers rather it influences decision makings of insurers and parties to international trade. Enterprises can achieve competitive advantage resulting from a mature contracting process.

Organizations that experience protracted contract development and negotiation cycles, improper contract approvals, limited contract visibility and control, normally end up having an inability to ensure supplier compliance

with contract terms.1 The use of maturity models has emerged as a successful method for

measuring and improving organizational critical core processes. This presentation will discuss

a case study on the development and application of the Contract Management Maturity Model

(CMMM) as a method for assessing and improving an organization's contract management

Another important element is the need for flexibility in contractual terms and clauses, in order to facilitate mutual benefit for the sustenance of the relationship, in considering the challenges around contracts, **Louis Brown, the father of preventive law**, who wrote the now-famous Manual of Preventive Law, noted the following:

It usually costs less to avoid getting into trouble than to pay for getting out of trouble.

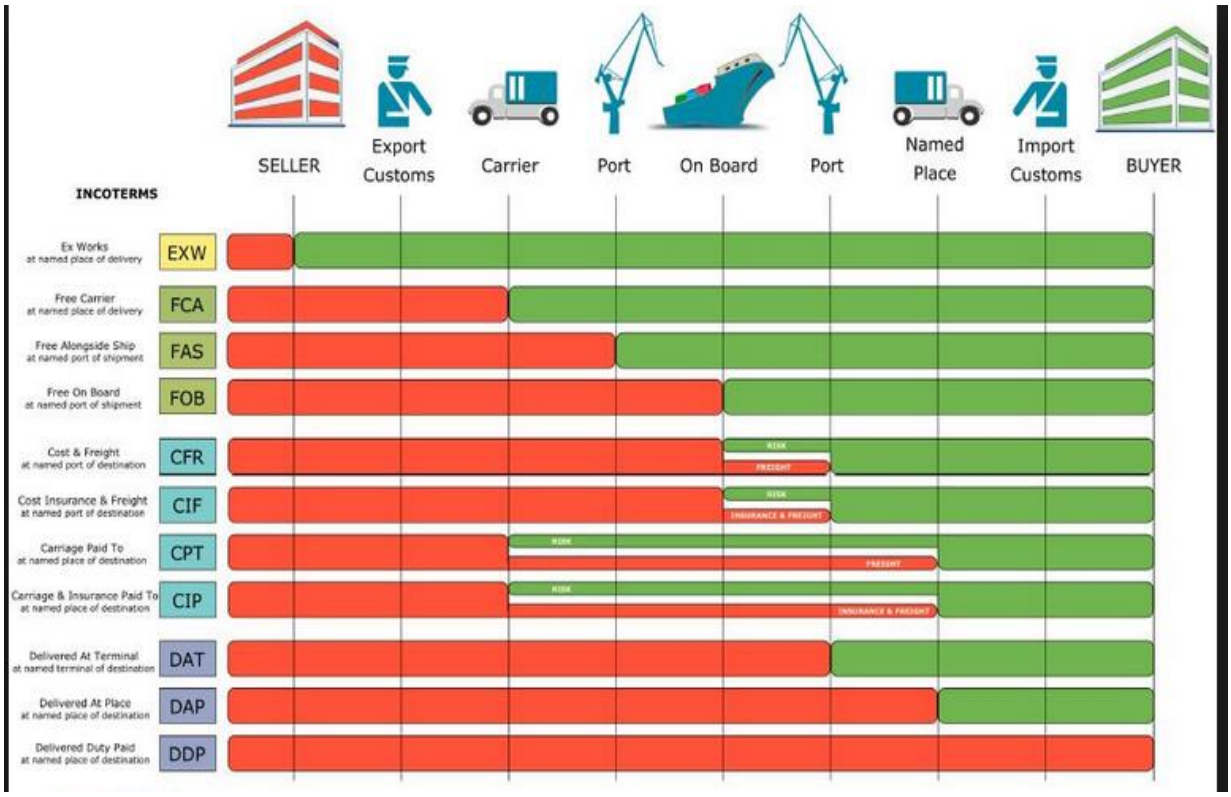
MODULE 5: INCOTERMS 2010

The **Incoterms rules or International Commercial** terms are a series of pre-defined commercial terms published by the **International Chamber of Commerce (ICC)** that are widely used in **International commercial transactions.**

1. A series of three-letter trade terms related to common contractual sales practices, the Incoterms rules are intended primarily to clearly communicate the tasks, costs, and risks associated with the transportation and delivery of goods.
2. The Incoterms rules genesis can be traced to 1921, with the formation of the idea by the International Chamber of Commerce.
3. In 1936, the first set of the Incoterms rules was published. The first set remained in use for almost 20 years, before the second publication in 1953.
4. Additional amendments and expansions followed in 1967, 1976, 1980, 1990, and 2000.
5. The eighth published set of pre-defined terms, *Incoterms 2010* defines 11 rules, reducing the 13 used in Incoterms 2000 by introducing two new rules ("Delivered at Terminal", DAT; "Delivered at Place", DAP) that replace four rules of the prior version ("Delivered at Frontier", DAF; "Delivered Ex Ship", DES; "Delivered Ex Quay", DEQ; "Delivered Duty Unpaid", DDU).

In the prior version, the rules were divided into four categories, but the 11 pre-defined terms of *Incoterms 2010* are subdivided into two categories based only on method of delivery.

The larger group of seven rules applies regardless of the method of transport, with the smaller group of four being applicable only to sales that solely involve transportation over water, that define the respective roles of the buyer and seller in the arrangement of transportation and other responsibilities and clarify when the ownership of the merchandise takes place. They are used in conjunction with a sales agreement or other method of transacting the sale.



The red color represents the **"Seller"** while green reflects the **"Buyer"** obligations respectively.

The success of Trade and commerce in Japan is attributed to effective and efficient Contract Management a philosophy if implemented in true sprit would do wonders for Pakistan in the comity of nations with respect to Supply Chain Management

END OF LECTURE 7: GIST AND CRUX:

1. *Successful Contract Management is synonymous with Successful Supply Chain Management. Most of the organizations fall a victim to the gap between contract management and actual supply chain management practice. With the availability of continuous monitoring software, contract management has become relatively acceptable and fulfills the contractual obligation of all parties.*
2. *Supply Chain Managers who are unable to make judicious of International Contracts often force their enterprise as well as supply chain partners to incur losses. Contract Manuals are updated on a periodic basis with new regulatory requirements identified for various regions at the International level.*
3. *Elements of a contract are subject to periodic review by a cross functional team comprising of supply chain managers, marketing, finance, accounts, operations and legal managers. A lot of contractual disputes can be minimized if not avoided if the legal team pays due attention to the variation of terms and its interpretation between the contractual parties.*
4. *The importance of Contract management for Supply Chain management can be gauged by the successful completion of various projects and milestones as identified by the supply chain partners.*
5. *The Incoterms rules should be made available to the entire supply chain participants. Incoterms 2010 and subsequently Incoterms 2015 have been incorporated in contracts for the sale of goods and services globally. Incoterms provide rules and guidance to importers, exporters, lawyers, transporters, insurers and students of international trade. Enterprises can achieve competitive advantage resulting from a mature contracting process. The number of contracts/agreements/memorandum of understanding between China and Pakistan would be a test of professional excellence of contract managers*

REVERSE SUPPLY CHAIN

Learning Objectives

Module 1: Forward and Reverse Supply Chain

Module 2: Need/ Scope of Reverse Supply Chain

Module 3: Design of Reverse Supply Chain

Module 4: Strategic Points of Reverse Supply Chain

Module 5: Advantages and Challenges of Reverse Supply Chain

Module 6: Pakistani Context –Gadding Seaport

Rationale and Logic

The design of supply chain is the norm of supply chain engineers on the advice of supply chain managers and supply chain consultants. The design is subservient to the need and scope of both forward and reverse supply chains. There are certain advantages which if not availed can lead to unaddressed issues and thus profits are compromised. This lecture ensures that the Virtual University Student is able to understand the scope, the advantages as well as the challenges pertaining to forward and reverse supply chains.

MODULE 1: Forward and Reverse Supply Chain

Customers often feel that their needs have not been fulfilled from the purchased product and thus return that product. World class Automobile manufacturers/ Electronic consumers have recalled products in the past to ensure that their brand image and name is protected. For this they use Reverse Supply Chain Infrastructure. The reverse supply chain is used to allow forward channel participants such as whole sellers and retailers to reduce risk of buying products that are slow moving. The resellers are allowed to return the goods within a reasonable time period using finely tuned reverse supply Chain which is in place. For this they use Reverse Supply Chain Infrastructure

The examples are Pharmaceuticals, Consumer Electronics and Automobiles. According to regulatory compliance requirements a lot of companies often have to have relevant interfaces like Collection, Inspection, Recycle and Waste Disposal. Reverse Supply Chain Infrastructure may be used for Reuse/Rework, Warranty Claims & Settlements and Returns

BULL WHIP EFFECT RISK

In certain industries, goods are distributed to downstream members in the supply chain with the understanding that the goods may be returned for credit if they are not sold. Newspapers and magazines serve as examples. This acts as an incentive for downstream members to carry more stock, because the risk of obsolescence is borne by the upstream supply chain members.

However, there is also a distinct risk attached to this logistics concept. The downstream member in the supply chain might exploit the situation by ordering more stock than is required and returning large volumes.

In this way, the downstream partner is able to offer high level of service without carrying the risks associated with large inventories. The supplier effectively finances the inventory for the downstream member. It is therefore important to analyze customers' accounts for hidden costs.

REFUSAL OF THE PRODUCTS IN THE CASH ON DELIVERY PROCESS (COD)

In case of e-commerce business, many websites offer the flexibility of Cash on Delivery (COD) to the customer. Sometimes customer refuses the product at the time of delivery, as there is no commitment to take the product. Then the logistics service providers follow the process of "Reverse logistics" on the refused cargo. This is quite popular in Pakistan as well, although shopping networks have complained that the courier services either just leave the product at the doorstep or there are thefts and pilferages leading to supply chain profits being compromised.

It is also known as **Return to Origin (RTO).** In this process the e-commerce company adds the refused cargo to its inventory stock again, after proper quality checks as per the company's rules.

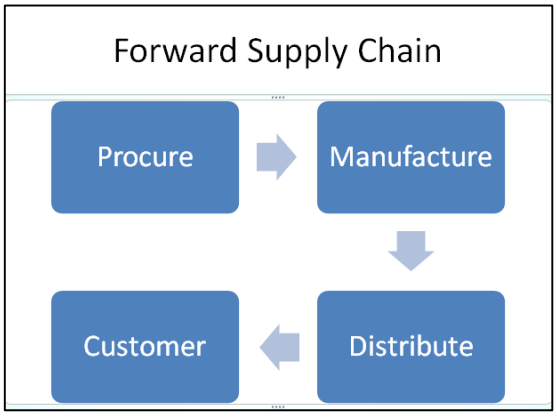
FORWARD SUPPLY CHAIN

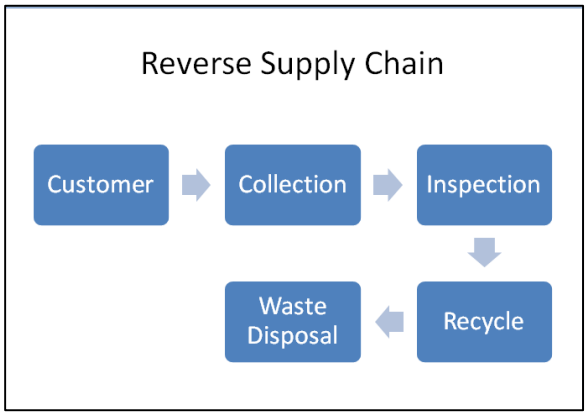
Can the Virtual University student identify the difference between supply chain and a forward supply chain? Is Forward Supply Chain same as the Generic Supply Chain discussed before?

The Student is requested to write down the answer in his log book. Ideally the answer should be in affirmative.

REVERSE SUPPLY CHAIN

Supply Chain Authorities like Dr. Dale S. Rogers and Dr. Ronald S. Tibben Lembke are of the view that "Reverse Supply Chain is the Process of Planning, Implementing, Controlling the efficient, cost effective flow of raw materials, in process inventory, finished goods and related information from the point of consumption to point of origin for the purpose of recapturing value or proper disposal".





MODULE 2: NEED FOR REVERSE SUPPLY CHAIN

About 20 % of products sold in USA are returned. The leading Technology consultancy Gartner in 2004 reported that "Improperly Handled returns erode 32-35% of potential profits of the business organizations. That number has improved after 11 years but still around 22 %.

Enterprises need Reverse SC for replacing defective goods, repairing the used products, refurbishing the returned product, calling back substandard or harmful goods, disposal of product waste. There can be other direct reasons like government or third party regulatory compliance. As a matter of fact, there are more reasons like environmental awareness, government regulations on product recycling and waste disposal, growing consumerism and stiff competition

Another important need being the return of new product launched. It is a sad situation that often businesses receive the setup of the customer returning the product on the pretext as the product did not deliver what it had promised to deliver.

DRIVERS OF REVERSE LOGISTICS: The common drivers of reverse logistics include but are not limited to Economics, Legislation, Corporate Social Responsibility, Consumerism, and Competitiveness

DISPOSITION CHOICE THROUGH REVERSE LOGISTICS: Green supply chains and environmental issues have come in cohesion and provide the following disposition choices

1. Reconditioning: when a product is cleaned and repaired to return it to a "like new" state.
2. Refurbishing: Similar to reconditioning, except with perhaps more work involve in repairing the product.
3. Remanufacturing: Similar to refurbishing but requiring more extensive work; often requires completely manufacturing disassembling the product
4. Resell: When a returned product may be sold again as new
5. Recycle: When a product is reduced to its basic elements, which are reused-also referred to as "asset recovery"

SCOPE FOR REVERSE SC

The scope for reverse supply chain is immense and it can play an important role in FMCGs, Pharmaceutical, Oil & Gas companies, Newspaper and publication industry like refilling, repairs and refurbishing, product recall, recycling and waste disposal and remanufacturing

1. **Refilling**: Refilling is probably one of the more easily recognized scopes and applications of reverse supply chains for instance Sui Gas / Natural Gas for Industrial & Consumer use Oxygen, Nitrogen & other gases for Health and Industrial Usage, FMCGs like soft drinks, empty cans, and containers. No extra costs are involved and are mostly use Hub and Spoke distribution system in reverse flow.

2. **Repairs and Refurbishing**: This type is more suitable for Service Based Products like Consumable products like Television sets, Audio Systems, DVD, PC, Machines, and Fans etc. For consumer durables and engineering products manufacturers in general keep in place the reverse logistics systems for extending the service within warranty period and beyond warranty period on a chargeable basis

3. **Product Recall**: Is calling back products from the customers or requesting the customers to return the products. The common reasons being safety concerns, design defects or labeling errors, so on and so forth. Product recall becomes a matter of life and death in the pharmaceutical companies where if the customers are identifiable through a finite database e.g. Glaxo (Glaxo SmithKline Beecham).

Numerous companies like Johnson & Johnson, Toyota, Nokia, IBM/Sony have recalled various products in the past due to one reason or another.

The reasons for product recall may include damage control, safety concern for all users or accidents, design defects in product which may deteriorate the image of the company, avoid litigations for costly settlements.

4. **Recycling and waste disposal:** This is probably one of the more important ones directly affecting the businesses, consumers and the governments. The reasons more or less include the same to protect environment, used products, polythene bags and wrapper wastes.

Virtual University Students must remember that government regulations are subservient to International awareness and United Nations backed environmental compliance. Germany has introduced responsibility for manufacturer for taking back pallets, cardboard boxes, wrappers, strapping etc. which are used for protecting the products during transit. The indication is a green dot that it needs recycling. There is a three stage packaging ordinance.

1. In the first stage, the wrappers or packaging wastes are collected from households by the retailers
2. In the second stage, the retailers send it to manufacturers who
3. In the third stage send it to packaging manufacturers for recycling or disposal
4. **Remanufacturing:** The manufacturers new strategy is to replace worn out parts with new parts so that the remanufactured product performs up to the same level. The opponents of Remanufacturing suggest that remanufacturing will land the remanufactured products in less developed countries so a means to dispose of waste to poor economies.

MODULE 3: DESIGN OF REVERSE SUPPLY CHAIN

Network design is important for both forward and reverse supply chains. The critical considerations for reverse flow of material include location of channel members, warehouses, company's manufacturing plant, refurbish /repair centers and the capacity of transportation services to handle the reverse flow of the material.

Many enterprises handle the reverse flow of the material through their forward supply chain. Their forward supply is designed to take up the reverse flow of the material/product. This helps the enterprise to achieve economies of scale with respect to information and logistics support.

Supply Chain Practitioners are able to differentiate the configuration of reverse network in two segments i.e. convergent and divergent segments.

The first segment is a convergent one where the enterprises collect the returned material at some convenient place or location and transfer the accumulated material to reworking/recovery facility

The second segment is a divergent one where in there a linkage with customers to collect reusable material is. It is integrated with forward supply chain of the enterprise.

MODULE 4: STRATEGIC POINTS OF REVERSE SUPPLY CHAIN

There are four readily identifiable strategic points of reverse supply chain namely collection of returned /used Products, testing/grading process, reprocessing and redistribution.

1. **Collection of Returned /Used Products**: The major cost component of Reverse Supply Chain is product collection. In case of High value products, the channel partners have records to trace the end user. In low value products like those of the FMCG industry, the collection of defective material after it leaves the channel network becomes difficult. Locating the end user is difficult due to lack of record /information. In reverse supply chain, retailers and distributors are deployed for collection of returns

2. **Testing/ Grading Process**: In this stage only products can be assigned for recovery opinion. Hence, the location of testing or grading operation is important as it decides the flow of goods. The cost of transportation may be significant as a percentage of the value of the used product.

In many cases, the testing and grading of recovered product is done at some central location as special equipment and skilled workforce is required. Geographically decentralized testing facility is used to avoid transportation cost for unwanted useless returns

3. **Reprocessing**: In this stage there is a high capital need for setting up a reprocessing facility. Capital investment is required for recycling or product recovery. The facility can work profitably only on economies of scale. The recovery facility should be integrated with regular manufacturing line of the new products so as to make use of available labor and machine resources.

4. **Redistribution**: The redistribution of reworked products can be completed by integrating with forward supply chain. Consolidation and responsiveness in transportation are required to achieve efficiencies. Redistribution can also be done along with new products.

MODULE 5A: ADVANTAGE OF REVERSE SUPPLY CHAIN

Recovery of value from Products, which were initially considered unfit for use, is probably one of the most commonly, understood advantages of supply chain. It also identifies means to reduce waste or at times prevent the generation of waste. This is possible with the help of following decision points like collection, Inspection/Testing, selection, sorting and recovery. One over looked aspect of Reverse Supply Chain is the increase in customer satisfaction by addressing customer problems and giving voice to the customers concern. This ensure the customer returns to buy the new product as after sales service team ensures that the customer safety as well as product utility provides customer the satisfaction he or she paid for. In all honesty Reverse Supply Chain is another face of Customer Relationship Management.

MODULE 5B: CHALLENGES OF REVERSE SUPPLY CHAIN

Designing and organizing a reverse Supply Chain often gives rise to subsequent challenges like Channel Member-Manufacturer Conflict, Responsiveness, Information Systems, Problems related to returns, Reverse Supply Chain Need recognition, Product Life Cycle Management, Data Collection and Information System, Web Based Systems and Third Party Engagement.

A good supply chain design should ideally be prepared to take care of these challenges or at least should have a direction to address these challenges. A supply chain manager should ideally report these challenges on a periodic basis to the senior manager in the form of a risk profile.

MODULE 6: PAKISTANI CONTEXT

Companies in Pakistan are in the business of exporting various products to markets outside Pakistan. They pay attention to forward supply chains but ignore reverse supply chains leading to poor customer relationship management. Forward and Reverse Supply Chain are different and have different dynamics

Most of the forward Supply Chains are not designed to handle reverse flow of materials. Pakistani Textile, Leather, Apparel often pay a price for ignoring the Reverse Supply Chain. Reverse Supply Chain is the Process which can help the Pakistani suppliers the recapture value or fulfill proper disposal as required by regulatory bodies of different trade zones.

Foreign businesses making headways in Pakistan are promptly gaining customer loyalty with the help of Reverse Supply Chains.

GADANI SHIP-BREAKING YARD: A case for making good use of disposed items. It is an ideal place to plan and salvage exotic materials, valves, instrumentation, piping, fittings and machineries which can be used again both by industrial as well as domestic consumers. Gadani acts as a new market of salvaged material, which can be reclaimed and put to use.

What is being done in a fragmented manner should be done in a consolidated and effective manner with business strategy for global partnership. It would make more business acumen for the Government of Pakistan to develop Gadani ship breaking yard as a reverse engineering hub where reverse supply chain can be used to feed the infrastructure and equipment hungry industry of Pakistan.

The highly expert work force has shown that it enjoys a very high efficiency of breaking down ships in 40 to 45 days. This means this workplace can achieve in 6 weeks which other ship breaking zones do in 6 months.

Gadani ship-breaking yard is the world's third largest ship breaking yard.

The yard consists of 132 ship-breaking plots, located across a 10 km long **beachfron**t at **Gadani**, Pakistan, about 50 kilometers northwest of **Karachi**. Till 1983, Gadani was the largest ship-breaking yard in the world, with more than 30,000 direct employees.

However, competition from newer facilities in **Alang, India and Chittagong, Bangladesh** resulted in a significant reduction in output.

Gadani, today, producing less than one fifth of the scrap it produced in the 1980s. The recent reduction in taxes on scrap metal has led to a modest resurgence of output at Gadani, which now employs around 6,000 workers. Over 1 million tons of steel is scavenged per year, and much of it is sold domestically.

In the 2009-2010 fiscal year, a record 107 ships, with a combined light displacement tonnage (LDT) of 852,022 tons, were broken at Gadani whereas in the previous 2008-2009 fiscal year, 86 ships, with a combined LDT of 778,598 tons, were turned into scrap.

Gadani currently has an annual capacity of breaking up to 125 ships of all sizes, including supertankers, with a combined LDT of 1,000,000 tons. Although Gadani ranks as the world's third largest ship breaking yard after Alang and Chittagong in terms of volume, it is the world's leading ship breaking yard in terms of efficiency.

At Gadani, a ship with 5,000 LDT is broken within 30 to 45 days, whereas in India and Bangladesh, it takes, on average, more than six months for breaking a vessel of the same size.

How Gadani Operates: Ships to be broken up are run aground on the beach under their own power, then gradually dismantled. As the weight of the ship lessens, it is dragged further onto the beach until completely scrapped. Scrapping ships at Gadani uses large amounts of cheap, local labor with minimal mechanical assistance. Workers may earn as little as $4 a day, and are exposed to many dangers. In 2001, the Government of Pakistan reduced ship-breaking duties from 15% to 10% and offered further incentives if industry activity improved.[3] The measures have been effective, with a modest increase in employment to a total of around 6,000 workers.

In words of Napoleon Bonaparte

The amateurs discuss strategies, dilettantes discuss tactics: the professionals discuss logistics."

Enterprises continue to spend more and more money on forward supply chain but they can no longer afford to ignore Reverse Supply Chain as efficient and effective reverse supply chains continue to bring benefits, increased customer loyalty and competitive advantage.

END OF LECTURE 8: GIST AND CRUX:

1. *Forward and Reverse Supply Chain Management tests the cost and revenue management of a supply chain strategies of the entire supply chain. Contracts are comprehensive coordination mechanisms used in both theory and practice to coordinate various supply chain structures. By focusing on the coordination by contracts of the forward and reverse supply chains, supply chain partners can register sustainable long term profits.*
2. *Need/Scope of Reverse Supply Chain is primarily because of green supply chains. It addresses the environment concern which was never really addressed by traditional supply chain models. Reverse Supply Chain allows any business to pursue its recycling, remanufacturing and reengineering needs. Closed loop supply chains are treated as total system and can thus help an enterprise exploit both its forward and reverse supply chains to register sustainable long term supply chain profits.*
3. *Design of reverse supply chain entails all the important aspects that cover the flow of materials, information from the point of consumption to point of origin. Ideally reverse supply chain should follow a design that can be integrated with the forward supply chain resulting in effective cost and revenue management along with lean reverse logistics.*
4. *Strategic points of reverse supply chain Advantages and challenges of reverse supply chain differ from industry to industry. Reverse supply chains have become strategic as often regulatory compliance with respect to customer protection and environment sustainability have forced various manufacturers of automobiles or electronic goods to overcome the challenges of labour costs, logistic costs and infrastructure limitations. Global leaders in automobile industry have certain strategic business units that maintain risk profiles with respect to a product return and serviceability is not compromised while overcoming the critical challenges of efficiency and responsiveness.*
5. *Reverse Supply Chains in Pakistan are in their nascent phase. Most of the discussion focuses on FMCG, Automobile and Cell phone manufacturers with glaring omission being the very first place of Reverse Supply Chain. Pakistan has underutilized Gaddani ship breaking yard for reasons best known to the bureaucracy of the country. If made good use of the Gaddani facility, a lot of reengineering and reverse engineering industry can be utilized to beef up the weakened heavy and light engineering industry of the country. With the Economic Corridor project about to take off, making best use of Gaddani facility would result in reverse supply chain surplus for the country.*

LEAN SUPPLY CHAIN MANAGEMENT

Modules

1. Lean Supply Chain Management
2. Six Sigma
3. Agile Supply Chain Management
4. E Marketing
5. SCOR Model

Rationale and Logic

This lecture takes into account the important concepts relating to lean as well as agile supply chain management which have gained recognition as acceptable form of supply chain that brings competitive advantage to the enterprises. Supply chain management (SCM) has been a major component of competitive strategy to enhance organizational productivity and profitability. The virtual university student should be able to gain an insight and preferably a management strategy in place to link these important modules and formulate a road map for supply chain maturity model for their enterprise and its partners.

MODULE 1: LEAN SUPPLY CHAIN MANAGEMENT

In the 1990s, supply chain management professional experts combined 4 important strategies and management philosophies like Quick Response, Efficient Consumer Response, Just In Time, and Kerietsu Relationships. For the sake of easy reference, the special characteristics related to each strategy and philosophy is represented in the form of a table below

SR. #	*NAME/CONCEPT*	*CHARACTERISTIC*
1	Quick response(QR)	Speed & flexibility
2	Efficient Consumer Response (ECR)	Speed & flexibility
3	Just in Time	Continuous reduction of waste
4	Keiretsu Relationships	Including suppliers in JIT/TQM efforts

These approaches have emerged as philosophies & practices known as Lean Production (or Lean Manufacturing) & Six Sigma. A very common example readily identifiable and acceptable to both Academia and Practitioners is the synonymous Lean Production & the Toyota Production System.

Virtual University students are reminded that JIT emphasizes: Reduction of waste, continuous improvement, synchronization of material flows within the organization /enterprise and finally channel integration by extending partnerships in the supply chain.

If the Supply Chain Management Department wants to adopt a Lean Production or more correctly the Toyota Production System, there would be more or less four stages which in sequential order are presented in the form of the table below: -

STAGES	*CHARACTERISTICS*
Stage 1	Enterprise is internally focused & functions managed separately. Silo effect is reactive & short-term goal oriented.
Stage 2	Enterprise integrates efforts & resources among internal functions.
Stage 3	Enterprise links suppliers/customers with enterprise's processes.
Stage 4	Enterprise broadens supply chain influence beyond immediate or first-tier suppliers & customers.

Lean Production: ***is an operating philosophy of waste reduction & value enhancement & was originally created as Toyota Production System (TPS) by key Toyota executives***. Early versions were based on Ford assembly plants & U.S. supermarket distribution systems. The key concepts incorporated in TPS are Muda (waste in all aspects of production), Kanban (signal card & part of JIT), and Statistical process control (SPC) as part of TQM efforts and Poka-Yoke - error or mistake-proofing. Supply chain management (SCM) seeks to incorporate Lean elements using cross-training, satisfying internal customer demand, quickly moving products in the production system, communicating demand forecasts & production schedules up the supply chain and optimizing inventory levels across the supply chain

Lean Production & Supply Chain Management often considers the important concept of Channel integration which describes extending alliances to suppliers' suppliers & customers' customers. However, the silo effect works against channel integration.

Stage 1 ***Internal Focused***	*Stage 2* ***Functional Integration***	*Stage 3* ***Internal Integration***	*Stage 4* ***External Integration***
Functional Silos	Internal flow of goods	Integration of flow in firm	Integration with suppliers and customers
Top-down management	Emphasis on cost reduction	Lean activities for goods and information	Integration explored with 2nd & 3rd tier suppliers and customers
Internal performance measures	Efficiencies gained by Internal Integration	Measurement of supplier performance and customer service	Alliance Development
Reactive, Short term planning			
No internal integration			

The Elements of Lean Production

The constituents of Lean Production are waste reduction, lean supply chain relationships, lean layouts, inventory & setup time reduction, small batch scheduling, continuous improvement and workforce Empowerment.

Waste (Muda) Reduction

Enterprises reduce costs & add value by eliminating waste from the productive system. Supply Chain and Operation Managers already know that waste encompasses wait times, inventories,

material & people movement, processing steps, variability, any other non-value-adding activity. Japanese expert, Taiichi Ohno described the seven wastes as follows: -

Sr. #	***Wastes***	***Description***
1	Overproducing	Unnecessary production to maintain high utilizations
2	Waiting	Excess idle machine & operator & inventory wait time
3	Transportation	Excess movement of materials & multiple handling
4	Over-processing	Non-value adding manufacturing & other activities
5	Excess Inventory	Storage of excess inventory
6	Excess Movement	Unnecessary movements of employees
7	Scrap & Rework	Scrap materials & rework due to poor quality

For the sake of academic interest, Virtual University Students are also invited to observe the 5 –S associated with lean production, which are of extreme value when dealing with Japanese and global companies.

We are now in a position to identify the most common of ***Lean Supply Chain Relationships*** *and the important concept of lean layouts. Virtual University students are already aware of Inventory reduction, set up time reduction and Just in Time concepts. All these are important concepts and are considered to a logical part of lean supply chains.*

Virtual University students should remember that: -

1. SCM partners (Suppliers & customers) as well as enterprise need to work to remove waste, reduce cost, & improve quality & customer service
2. JIT purchasing includes delivering smaller quantities, at right time, delivered to the right location, in the right quantities
3. Enterprises develop lean supply chain relationships with key customers. Mutual dependency & benefits occur among these partners.

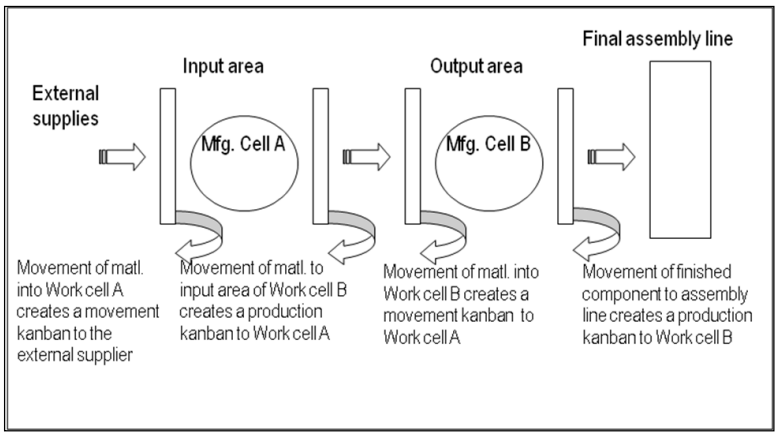
Supply Chain network designs should comply with "Lean Layouts" requirements especially the following reasons

1. Move people & materials when & where needed, ASAP
2. Lean layouts are very visual (lines of visibility are unobstructed) with operators at one processing center able to monitor work at another
    a. Manufacturing cells by processing similar parts or components saving duplication of equipment & labor
    b. Also are often U-shaped to facilitate easier operator & material movements

Supply Chain Managers often over emphasize **Inventory & Setup Time Reduction** primarily because of the fact that these are the sources where cost cutting can improve controls over movement of products, services, information and cash flow and reduction of unfavorable risks. Student are requested to remember that

1. Excess inventory is a waste
2. Reducing inventory levels causes production problems
3. Once problems are detected, they can be solved.
4. The end result is a smoother running organization with less inventory investment.

Students are also recommended that they pay special attention to the relationship between JIT & Supply Chain Management. The picture more or less explains this critical relationship by identifying the movement of material from manufacturing cell A to cell B and to final assembly line as a finished component. It also shows the production of Kanbans.



Virtual University students already know that why incremental or **Small Batch Scheduling** is always considered a favorable strategy by supply chain managers. A very fundamental reason being that Small batch scheduling drives down costs by –

1. Reducing purchased, WIP, & finished goods inventories
2. Makes the enterprise more flexible to meet customer demand

Also Small production batches are accomplished with the use of ***KANBANS***. Remember that Kanbans generate demand for parts at all stages of production creating a "pull" system

Another important dimension with respect to JIT & Supply Chain Management is the continuous improvement and workforce commitment. Again for the sake of reference, the two concepts are being presented

Continuous Improvement (*Kaizen*): Is the continuous approach to reduce process, delivery, & quality problems, such as machine breakdown problems, setup problems, & internal quality problems

Workforce Commitment: Supply Chain as well as other managers must support Lean Production by providing subordinates with the skills, tools, time, & other necessary resources to identify problems & implement solutions

We know take a more strategic concept by considering the relationship between Lean Production & the Environment. Student are reminded that

Lean green practices help the supply chain as well as the environment and the enterprise in the following ways

1. Reducing the cost of environmental management
2. Leading to improved environmental performance.
3. Increasing the possibility that enterprises will adopt more advanced environmental management

Most of the supply chains are now facing regulatory compliance for carbon footprint. Virtual University students are also aware of the problems faced in the field of energy management in Pakistan where International pressures and investors do not show favorable response for Coal based power plants because of this. Remember it is very vital that either the enterprises operations are Carbon-neutral or interventional programs are in place to offset the *carbon footprint* of an enterprise's operations.

Supply Chain managers often employ Six Sigma strategies to ensure that there is no wastage and even if waste is generated it is one a time instance and through learning curves the process is improved. Students already know that Six Sigma relates to near quality perfection (the statistical likelihood of non-defects 99.99966% of the time); this concept was pioneered by Motorola in 1987. Six Sigma is in reality a statistics-based decision-making framework designed to make significant quality improvements in value-adding processes.

Six Sigma Metrics

# of std dev above the mean	% of defect-free output	DPMO
2	69.15	308,537
2.5	84.13	158,686
3	93.32	66,807
3.5	97.73	22,750
4	99.38	6,210
4.5	99.865	1,350
5	99.977	233
5.5	99.9968	32
6	99.99966	3.4

Note: standard deviations include 1.5 sigma "drift"

Lean Six Sigma (Lean Six σ) describes the assimilation of lean production and Six Sigma quality practices. At the same time both the concepts use

a. High quality input materials, WIP, and finished goods
b. Continuous Improvement (Kaizen)

Lean and Six Sigma use complementary tool sets and are not competing philosophies

Virtual University students are suggested that not only they should be able to remember and convey these important concepts at their enterprise level but also share it with the enterprise supply chain partners.

1. Process integration & communication lead to fewer negative chain reactions along the supply chain, such as greater levels of safety stock, lost time & less productivity
2. Six Sigma is an enterprise and supply chain-wide philosophy, that emphasizes a commitment toward excellence & encompasses suppliers' employees, and customers

Elements of Six Sigma are more or less based on Deming's 14 points

1. Create constancy of purpose to improve product & service.

2. Adopt the new philosophy.
3. Cease dependence on inspection to improve quality.
4. End the practice of awarding business on the basis of price.
5. Constantly improve the production & service system.
6. Institute training on the job.
7. Institute leadership.
8. Drive out fear.
9. Break down barriers between departments.
10. Eliminate slogans & exhortations.
11. Eliminate quotas.
12. Remove barriers to pride of workmanship.
13. Institute program of self-improvement
14. Put everyone to work to accomplish the transformation

Elements of Six Sigma also make use of concepts developed by Crosby's, which are also known as four Absolutes of Quality

1. The definition of quality is conformance to requirements
2. The system of quality is prevention.
3. Performance standard is zero defects.
4. The measure of quality is the price of nonconformance

Elements of Six Sigma can be understood better by following Juran's concept of quality planning, quality control and quality improvement.

1. **Quality Planning:** Identify internal/external customers & their needs; develop products that satisfy those needs. Mangers set goals, priorities, & compare results
2. **Quality Control:** Determine what to control, establish standards of performance, measure performance, interpret the difference, & take action
3. **Quality Improvement:** Show need for improvement, identify projects for improvement, implement remedies, and provide control to maintain improvement.

We will now elaborate our discussion on Elements of Six Sigma by considering the objectives and categories measured in order to identify the enterprise and supply chain for **Malcolm Baldrige National Quality Award.** This award has a criterion which requires fulfillment of definite objectives relating to quality achievement and improvement with respect to certain categories measured.

Objectives: Some of the most objectives that are pursued include:

1. Stimulate enterprises to improve
2. Recognize enterprises for quality achievements,
3. Establish guidelines so that organizations can evaluate their improvement & provide guidance to others

Categories Measured

1. Leadership
2. Strategic planning
3. Customer & market focus
4. Information & analysis

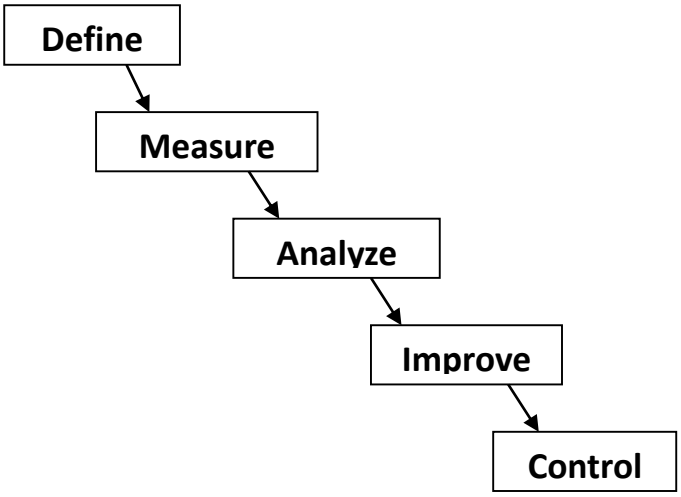
5. Human resource focus
6. Process management
7. Business Results

ISO 9000 and ISO 14000 Families of Management Standards are a must for most of the manufacturing and service based enterprises

1. International Organization for Standardization (ISO) located in Switzerland has total of 163 member countries, with few other countries in the process of becoming members.
2. ISO 9000 and 14000 govern quality and environmental certification standards of production, respectively.
3. The ISO 9000 standards were adopted in the US by ANSI and ASQ.

The DMAIC Improvement Cycle is very important and shows an information based system that helps an organization to design its system and after careful analysis improve the output or performance. DMAIC is an abbreviation that represents the important concepts of Define, Measure, Analyze, Improve and Control. It can be used for improvement projects even outside the domain of Six Sigma.

Another important concept is DFSS which refers to Design for Six Sigma and is a business-process management "methodology" related to traditional Six Sigma. It is applicable in different industries, like finance, marketing, basic engineering, process industries, waste management, and electronics.



Six Sigma Training Levels

It is important that Supply Chain Managers be aware of the importance of Black Belt certification and quality elements of Six Sigma. This has become an industrial standard and followed religiously at leading organizations like General Electric Corporation.

Levels	***Description***
Yellow Belt	Basic understanding of Six Sigma Methodology and tools in the DMAIC problem solving process. Team member on process improvement project.
Green Belt	A trained team member allowed to work on small, carefully defined Six Sigma projects, requiring less than a Black Belt's full-time commitment.
Black Belt	Thorough knowledge of Six Sigma philosophies and principles. Coaches successful project teams. Identifies projects and selects project team members.
Master Black Belt	A proven mastery of process variability reduction, waste reduction and growth principles and can effectively present training at all levels

Statistical Tools of Six Sigma

Methods, Tools & Techniques are vital to the success of any Six Sigma project. Every stage of a Six Sigma project recipe requires a mix of these methods, tools & techniques. Let us in a few words appraise what we mean by these keywords.

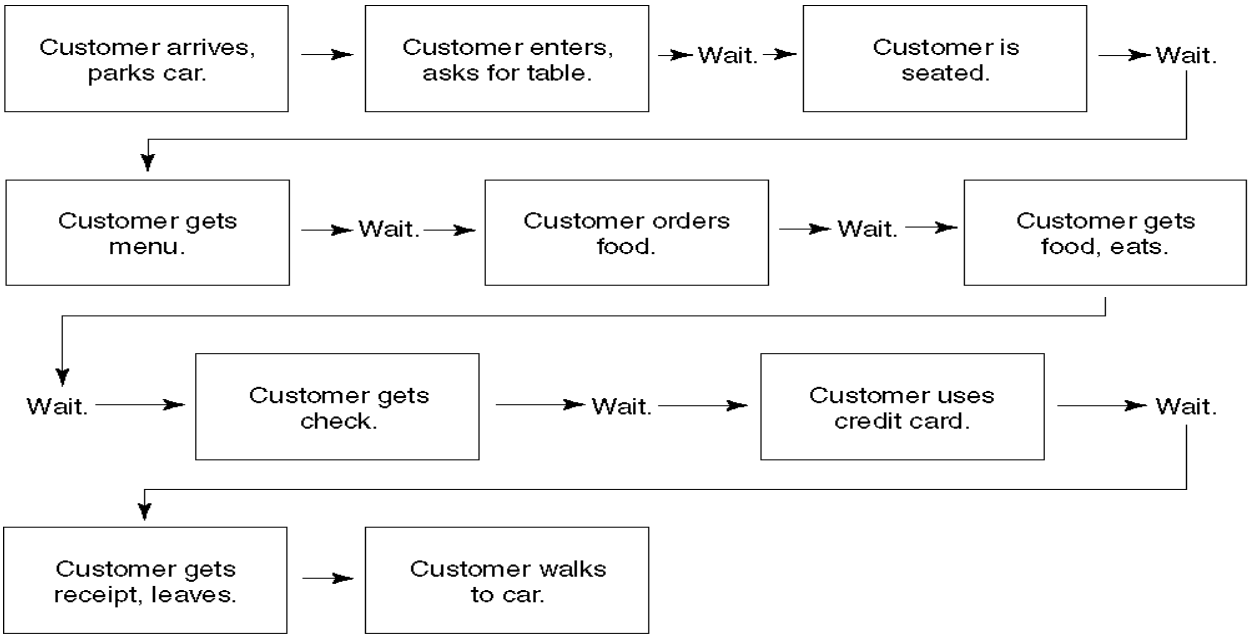
1. Method is a way of doing something in a systematic way. The word "systematic" implies an orderly logical sequence of steps or tasks.
2. Tool provides a mechanical or mental advantage in accomplishing a task.

3. Technique is a specific approach to efficiently accomplish a task in a manner that may not be immediately obvious.

Some of the statistical tools used in six sigma methodology include brainstorming, affinity diagrams, flow diagrams, scatter plot, box plot, fish bone, sampling, SIPOC (Statistical Process Control) so and so forth.

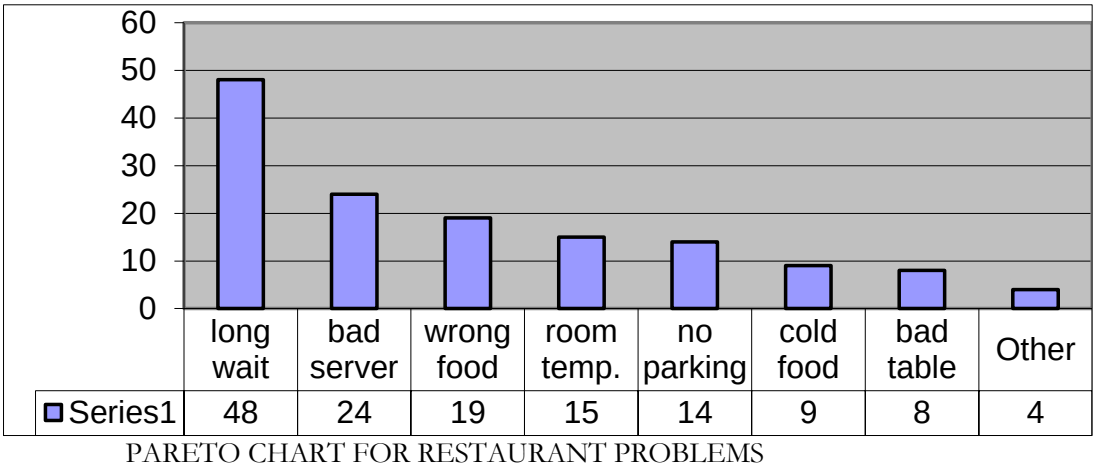
A few of these commonly used statistical tools are represented here

1. **Flow Diagrams:** Annotated boxes representing process to show the flow of products or customers. We represent the case of a patron visiting a restaurant and the whole process is captured in the form of a flow diagram.



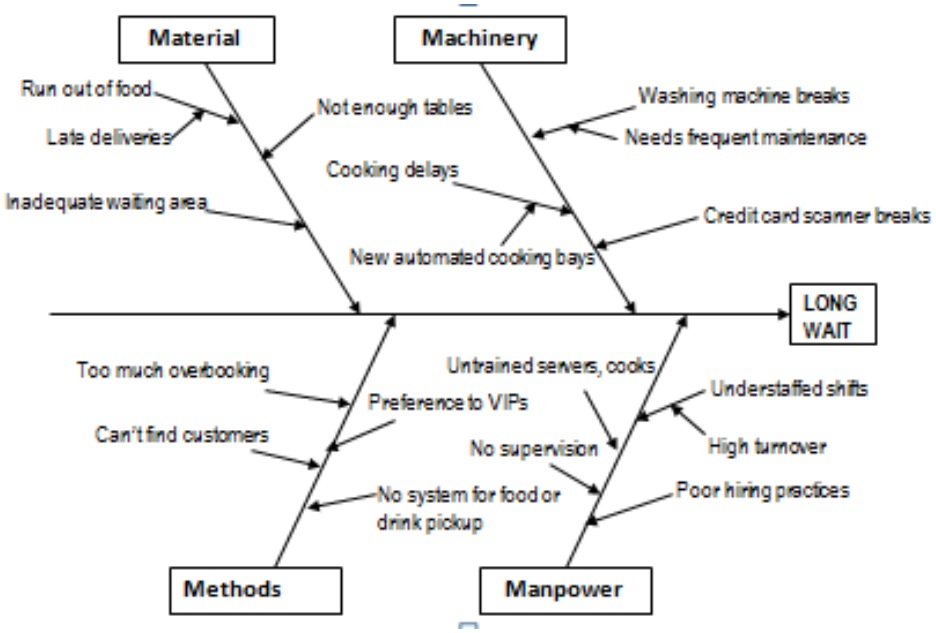
2. **Check Sheets:** used to determine frequencies for specific problems

3. **Pareto Charts:** used for presenting data in an organized fashion, indicating process problems from most to least severe.



PARETO CHART FOR RESTAURANT PROBLEMS

4. **Cause and Effect Diagrams (Fishbone or Ishikawa diagrams):** used to aid in brainstorming & isolating the causes of a problem. You have already seen a Pareto chart representing problems in service at a restaurant now let us construct a fish bone diagram



5. **Statistical Process Control:** Allows enterprises to visually monitor process performance, compare the performance to desired levels or standards and take corrective action.

Enterprises normally gather process performance data, create control charts to monitor process variability and then collect sample measurements of the process over time and plot on charts.

Statistical Process Control normally takes into account the following type of measurements

1. Natural variations: expected and random (can't control)
2. Assignable variations: have a specific cause (can control)
3. Variable data: continuous, (e.g., weight)
4. Attribute data: indicate some attribute such as color & satisfaction, or beauty.

Statistical Process Control makes use of two types of Variable Control Charts namely:

1. x-bar chart tracks central tendency of sample means
2. R-chart tracks sample ranges

The following steps are involved in Statistical Process Control (SPC)

1. Gather data when the process is in control.
2. Calculate the mean & the range for each sample.
3. Calculate the overall mean and average range of all the samples. Use the x-means to calculate the upper & lower control limits.
4. Use the means & control limits to construct x-bar and R control charts.
5. Collect samples over time and plot.

$$\bar{\bar{x}} = \frac{\sum_{i=1}^{k} \bar{x}_i}{k} \qquad \bar{R} = \frac{\sum_{i=1}^{k} R_i}{k}$$

Some of the common formulas used in the statistical process control charts both for x-bar chart and R charts are presented.

$$UCL_{\bar{x}} = \bar{\bar{x}} + A_2 \bar{R} \qquad UCL_R = D_4 \bar{R}$$

$$LCL_{\bar{x}} = \bar{\bar{x}} - A_2 \bar{R} \qquad LCL_R = D_3 \bar{R}$$

Acceptance Sampling technique can be best used by a supply chain if it is able to set agreed upon quality criteria both for the suppliers as

well as for the consumer's side. This actually takes into account both the producer's risk as well as the consumer's risk.

1. When shipments are received from suppliers, samples are taken and measured against the quality acceptance standard. Shipment is assumed to have the same quality.
2. Sampling is less time-consuming than testing every unit but can result in errors

Producer's risk: A buyer rejects a shipment of good quality units because the sample quality level did not meet standards (type I error)

Consumer's risk: Buyer accepts a shipment of poor-quality units because the sample falsely provides a positive answer (type II error)

MODULE 3: THE AGILE SUPPLY CHAIN

This module addresses the key concept of Agile Supply Chain and briefly explains what the dimensions of the Agile Supply Chain are.

The concept of Agility is represented by the fact that a supply chain is said to be agile if possesses one or more of the characteristics of Market Sensitive, Virtual, Network based and Process Integration. The characteristics are briefly discussed as follows.

1. Market sensitive: Supply chain is capable of reading and responding to real demand
2. Virtual: Information-based supply chain, rather than inventory-based.
3. Network based: EDI and internet enable partners in the supply chain to act upon the real demand
4. Process integration: Collaborative working between buyers and suppliers, joint product development, common systems and shared information

Demand characteristics and supply capabilities are represented in a tabular form

THE CONCEPT OF AGILITY IN TERMS OF LEAN AND AGILE SUPPLY CHAIN MANAGEMENT

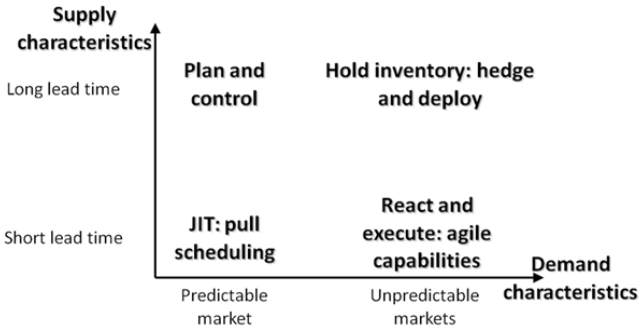
Distinguishing attributes	***Lean supply***	***Agile supply***
Typical products	Commodities	Fashion goods
Marketplace demand	Predictable	Volatile
Product variety	Low	High
Product life cycle	Long	Short
Customer drivers	Cost	Availability
Profit margin	Low	High
Dominant costs	Physical costs	Marketability costs
Stock out penalties	Long-term contractual	Immediate and volatile
Purchasing policy	Buy materials	Assign capacity
Information enrichment	Highly desirable	Obligatory
Forecasting mechanism	Algorithmic	Consultative

Characteristic	*Lean*	*Agile*
Logistics focus	Eliminate waste	Customers and markets
Partnerships	Long-term, stable	Fluid clusters
Key measure	Output measure such as productivity and cost	Measure capabilities, and focus on customer satisfaction
Process focus	Work standardization, conformance to standards	Focus on operator self-management to maximize autonomy
Logistics planning	Stable, fixed period	Instantaneous response

THE CONCEPT OF AGILITY IN TERMS OF MARKET WINNERS AND MARKET QUALIFIERS

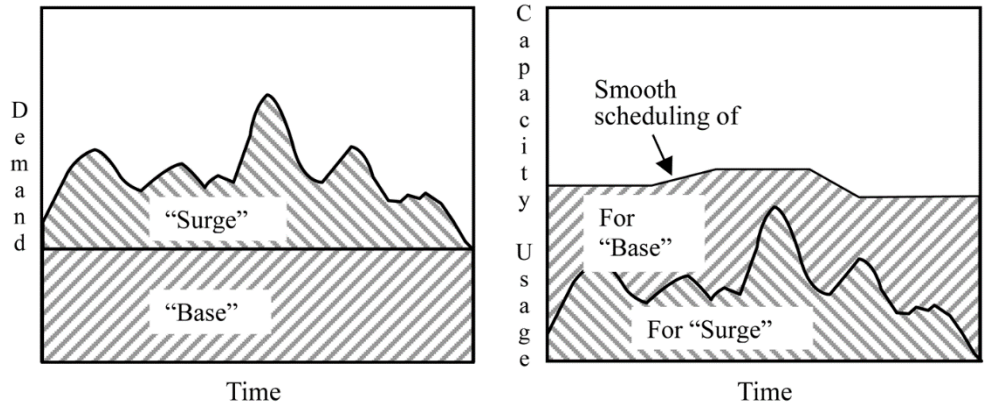
	Market Qualifiers	Market Winners
Agile Supply	1. Quality 2. Cost 3. Lead Time	1. Service Level
Lean Supply	1. Quality 2. Lead Time 3. Service Level	1. Cost

THE CONCEPT OF AGILITY IN TERMS OF DEMAND CHARACTERISTICS AND SUPPLY CAPABILITIES



LEAD TIMES AND PREDICTABILITY OF MARKETS

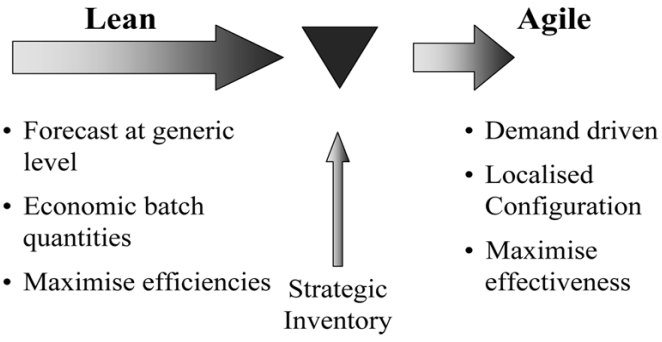
APPLICATION OF LEAGILITY: SEPARATION OF 'BASE' AND 'SURGE' DEMANDS



(a) Total **(b)** Level Scheduling Solution

Agility reflects making use of market knowledge and a virtual corporation to exploit profitable opportunities in a *volatile* market place. Leanness refers to developing a value stream to eliminate all waste, including time, and to ensure a *level* schedule.

The decoupling point is also the point at which strategic stock is often held as a buffer between fluctuating customer orders and/or product variety and smooth production output.

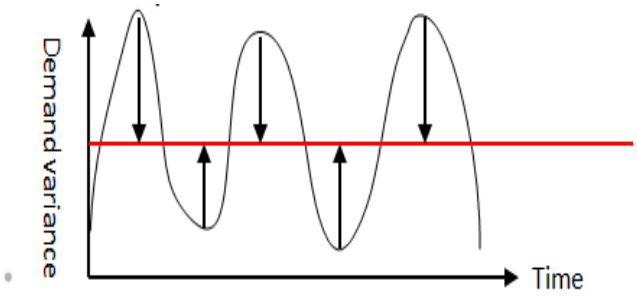


Preconditions for successful agile practice include enterprise-level reality check and cost of complexity sanity check. Lowering the cost of complexity focuses on avoiding overly expensive agility. Forecasts help to reduce the need for last minute crises either in an external and internal

way. External demand forecast focuses on demand for the product or service and internal forecast focuses on financial forecast, asset forecast or capability to complete the supply chain requirements.

Three characteristics of supply chain operations related to agile

1. Mastering and benefiting from variation in demand;
2. Very fast response to market opportunities;
3. Unique or low volume response.

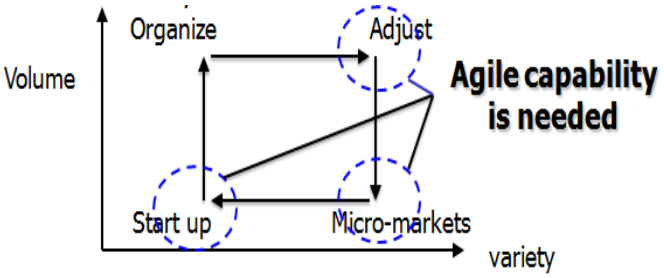


Agile practices benefiting from variance is possible if the supply chain manager is able to identify the three sources of demand uncertainty of Seasonality, Product life cycles and End-customer demand.

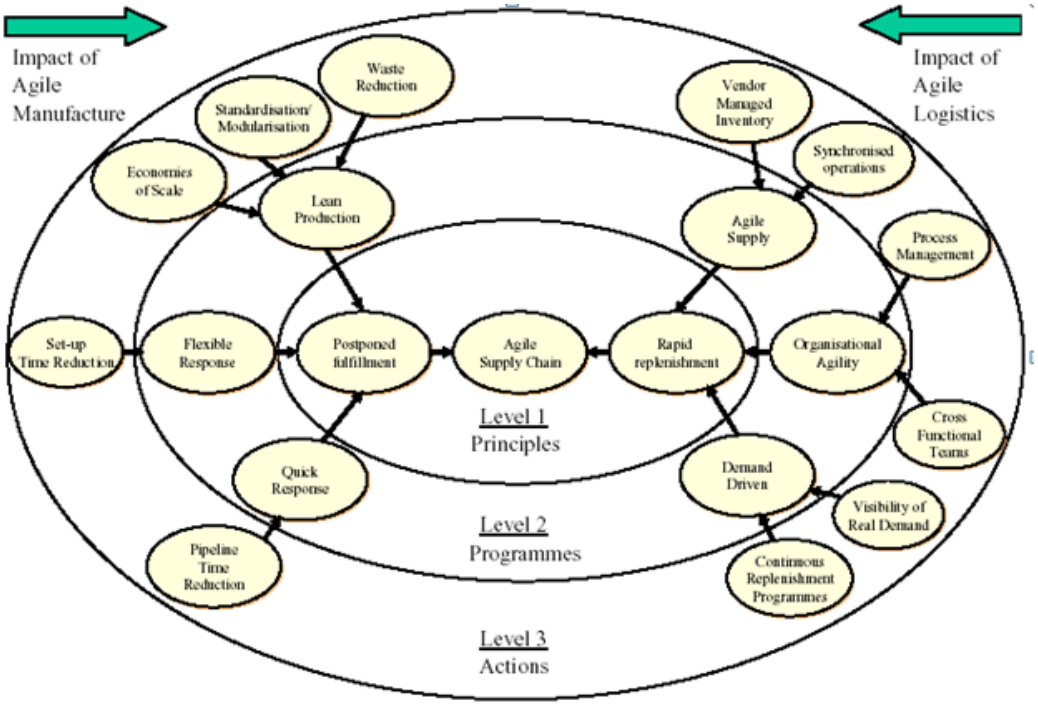
End-customer demand is more towards shift in tastes than agile practices while product life cycle is represented in the figure below which identifies the need for agile capability.

Quite often enterprises benefit from short time windows. The decreased D-time requires different levels of agility (Vendor Maintained Inventory "VMI" & Quick Response "QR") through speed of replenishment, upstream time sensitivity and information dissemination and alignment.

Another popular agile practice is to benefit from small volume. The small volume is a result of micro-markets, customization and rapid responsiveness. Three common approaches of agile strategy related to small volume are the changeover flexibility, modularity at the network level and service-based and information-based solutions.



Benefiting from small volume is represented graphically as Variety decrease



AN INTEGRATED MODEL FOR ENABLING THE AGILE SUPPLY CHAIN

MODULE 4: E-marketing

E-marketing means using digital technologies to help an enterprise and its supply chain partners to sell its goods or services. These technologies are a valuable complement to traditional marketing methods whatever be the size of the enterprise or its business model.

The basics of marketing remain the same – creating a strategy to deliver the right messages to the right people. What has changed is the number of options the enterprises have. Though businesses will continue to make use of traditional marketing methods, such as advertising, direct mail and PR, e-marketing adds a whole new element to the marketing mix.

Many businesses are producing great results with e-marketing and its flexible and cost-effective nature makes it particularly suitable for small businesses.

THE BENEFITS OF E-MARKETING

E-marketing gives businesses of any size access to the mass market at an affordable price and, unlike TV or print advertising, it allows truly personalized marketing. Specific benefits of e-marketing include:

CHARACTERISTICs	*DESCRIPTION*
1 Global reach	A website can reach anyone in the world who has internet access. This allows business to find new markets and compete globally for only a small investment.
2. Lower cost	A properly planned and effectively targeted e-marketing campaign can reach the right customers at a much lower cost than traditional marketing methods.
3 Trackable, measurable results	Marketing by email or banner advertising makes it easier to establish how effective your campaign has been. Businesses can obtain detailed information about customers' responses to their advertising.
4 24-hour marketing	With a website, customers can find out about products even if the business display center or office is closed.
5 Personalization	If the customer database is linked to the enterprise website, then whenever someone visits the site, they can be greeted with targeted offers. The more they buy from the enterprise, the more the website can refine the customer profile and market effectively to them.
6 One-to-one Marketing	e-marketing lets the business reach people who want to know about their products and services instantly. For example, many people take mobile phones and PDAs wherever they go. Combine this with the personalized aspect of e-marketing, and you can create very powerful, targeted campaigns.
7 More interesting Campaigns	e-marketing helps create interactive campaigns using music, graphics and videos.
8 Better conversion rate	If a business has a website, then customers are only ever a few clicks away from completing a purchase. Unlike other media which require people to get up and make a phone call, post a letter or go to a shop, e-marketing is seamless.

Shifting to Brand Management by Building a Modular E-business

With the strategy and tactics for e-Marketing available to electronic business systems, the logical conclusion is a shift to modular business. A company could concentrate solely on managing its brand, outsourcing all physical aspects of the business to others. As these activities are moved to specialist third parties, the core management activities will change

The truth of e-business is that it changes businesses and merges industries. It destroys industries and appears unstoppable when taken in the traditional context. E-marketing over comes the traditional business barriers.

Lean Supply Chain: Management Principles and Practices

As E-marketing enables an enterprise to overcome traditional business limitation, we are now in a position to elaborate our discussion on Lean supply chain. Lean supply chain management represents a new way of thinking about supplier networks. Lean principles require cooperative supplier relationships while balancing cooperation and competition. Cooperation involves collaborative relationships & coordination mechanisms. Supplier partnerships and strategic alliances represent a key feature of lean supply chain. Also the point that makes the discussion worthwhile is that **E-marketing makes the simultaneous application of lean and agile principles** without compromising the robustness of the supply chain as well as the long term sustainable potential profits.

Theory: Lean represents a "Hybrid" Approach to Organizing Inter enterprise relationships.

1. "Markets" (Arm's Length): Lower production costs, higher coordination costs
    a. Enterprise buys (all) inputs from outside specialized suppliers
    b. Inputs are highly standardized; no transaction-specific assets
    c. Prices serve as sole coordination mechanism
2. "Hierarchies" (Vertical Integration): Higher production costs, lower coordination costs
    a. Enterprise produces required inputs in-house (in the extreme, all inputs)
    b. Inputs are highly customized, involve high transaction costs or dedicated investments, and require close coordination
3. "Lean" (Hybrid): Lowest production and coordination costs; economically most efficient choice--new model
    a. Enterprise buys both customized & standardized inputs
    b. Customized inputs often involve dedicated investments
    c. Partnerships & strategic alliances provide collaborative advantage

IMPORTANT NOTE

Lean Supply Chain Management Principles more or less are derived from basic lean principles. Some of these common principles are

1. Focusing on the supplier network value stream
2. Eliminating waste
3. Synchronizing flow
4. Minimizing both transaction and production costs
5. Establishing collaborative relationships while balancing cooperation and competition
6. Ensuring visibility and transparency
7. Developing quick response capability
8. Managing uncertainty and risk
9. Aligning core competencies and complementary capabilities
10. Fostering innovation and knowledge-sharing

Another important observation being that **synchronized production and delivery throughout the Supplier Network is a central lean concept** and is possible through: -

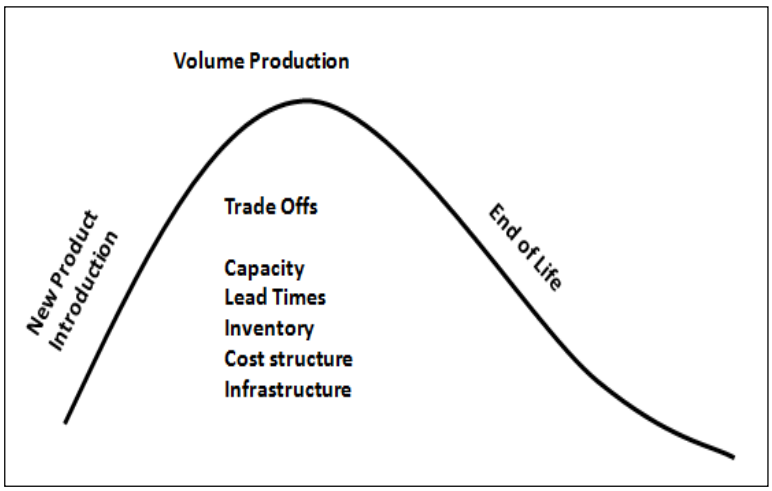
1. Integrated supplier lead times and delivery schedules
2. Flows from suppliers pulled by customer demand by making use of concepts of time, load leveling, line balancing and single piece flow.
3. Minimized inventory through all tiers of the supply chain
4. On-time supplier delivery to point of use
5. Minimal source or incoming inspection

6. Effective two-way communication links to coordinate production & delivery schedules
7. Striving for zero quality defects essential to success
8. Greater efficiency and profitability throughout the supplier network

It is worth noting that **supplier partnerships and strategic alliances ensure substantial performance improvements** through Long-term relationships and mutual commitments, intensive and regular sharing of technical and cost information and mutual assistance and joint problem-solving strategies. Also Incentives for increased innovation are possible through cost- sharing, risk-sharing and knowledge-sharing strategies. Increased mutual commitment to improving joint long- term competitive performance is possible by providing leadership.

Lean Supply Chain Leadership is normally achieved through sales and operations planning, supply chain management, new product design, end of life exit, replenishment trade-offs and material flow and assessing efficiency and yields

Product Life Cycle Planning incorporates cradle to grave approach and is represented in the figure below



Future in Lean Supply Chain

Lean Supply Chain in the future would be characterized by the following

1. Would be driven by effective sales and operations planning
2. Would allow effective supply chain planning
3. Would ideally balance new and current products and services
4. Would employ timely, effective replenishment. Would enable timely success measurement by employing MES, ERP generate data/analysis/correction.

Effective sales and operations planning relates to integrating enterprise orders and forecast. It also incorporates preliminary business plan which include new products, current models, end of life details. Management also urges the supply chain manager to check the capacity, on hand, and on order. Enterprise also focuses on its production schedules, ensures on time delivery/completions and scheduled shipment to customers and measure results. These not only maximize the leadership but also minimize risk.

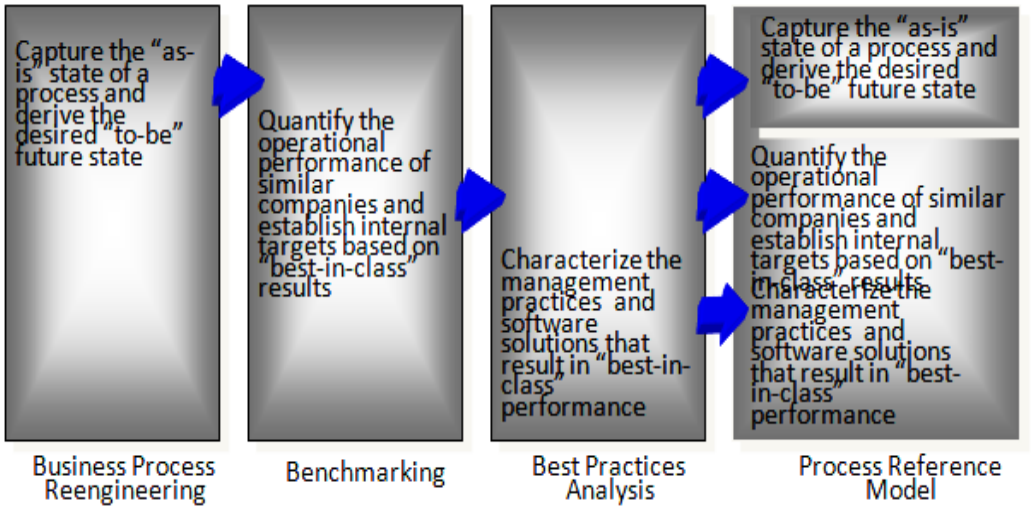
Lean supply chain of the future may be displaying the characteristics of agile supply chain and it is possible that the agile supply chain would be displaying the characteristics of the lean supply. This conundrum would be addressed by the future trends in E-marketing and how E-marketing would help the inter-firm relationships to avoid losses and register sustainable profits.

Module 5: SUPPLY CHAIN OPERATIONS REFERENCE (SCOR) MODEL

Supply-chain operations reference-model (SCOR) is a process reference model for supply chain management. This reference model allows user to address, improve, and communicate supply chain management practices

within and between all the organizations in the extended enterprise. It was developed by Supply Chain Council (SCC). SCC is an independent, not-for-profit corporation organized in 1996 by Global management-consulting enterprise, Pittiglio Rabin Todd & McGrath (PRTM) and Market research enterprise, Advanced Manufacturing Research (AMR) in Cambridge, Massachusetts.

The Supply Chain Council (SCC) started with 69 voluntary companies; now close to 1400 members. The SCC objective is to develop a standard supply-chain process reference model enabling effective communication among the supply chain partners, by using standard terminology to better communicate and learn the supply chain issues. It also uses standard metrics to compare and measure the supply chain performances. Supply Chain Operations Reference Model (SCOR) Integrates **Business Process Reengineering**, Benchmarking, and **Process Measurement (Best Practices)** into a cross-functional framework.



The Primary Use of SCOR model is to describe measure and evaluate supply chain configurations. The SCOR model contains standard descriptions of management processes, a framework of relationships among the standard processes, standard metrics to measure process performance, management practices that produce best-in-class performance

Supply Chain Operations Reference Model (SCOR) enables the companies to evaluate and compare their performances with other companies effectively, identify and pursue specific competitive advantages and identify software tools best suited to their specific process requirements

Scope (Boundaries) of SCOR Model: Supply Chain Operations Reference Model (SCOR) spans:

a. All customer interactions, from order entry through paid invoice.

b. All product (physical material and service) transactions, from supplier's supplier to customer's customer, including equipment, supplies, spare parts, bulk product, software, etc.

c. All market interactions, from the understanding of aggregate demand to the fulfillment of each order

SCOR does not attempt to describe every business process or activity, including:

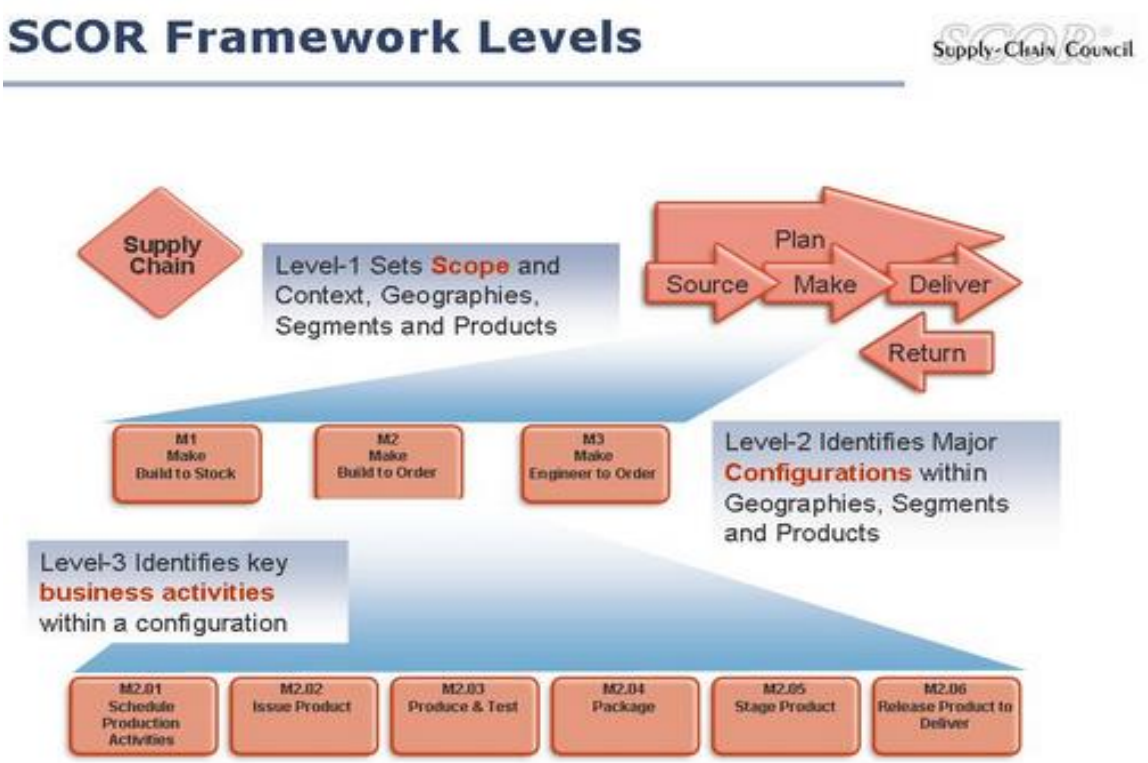
a. Sales and marketing (demand generation)

b. Research and technology development

c. Product development

d. Some elements of post-delivery customer support

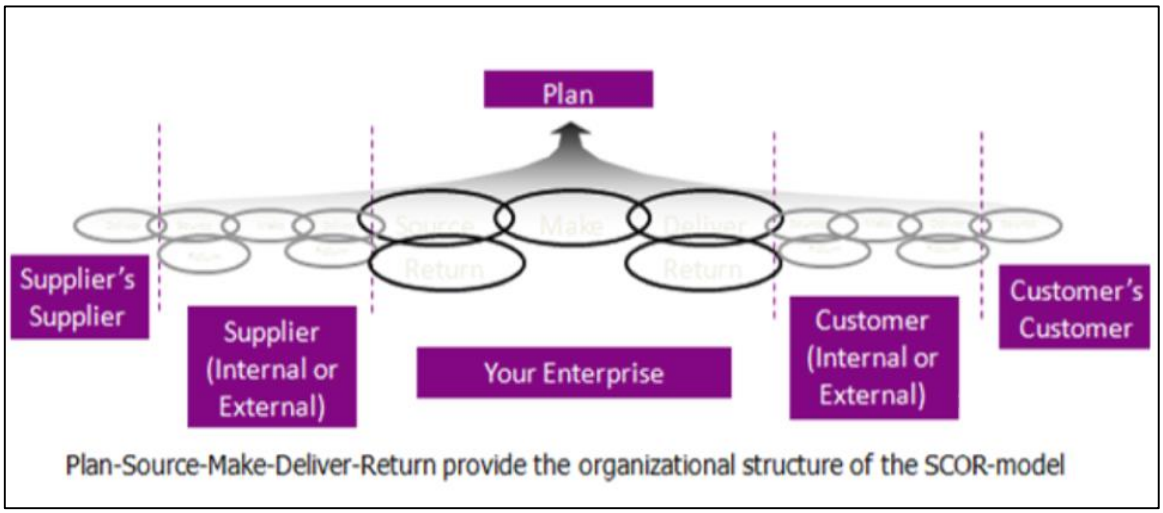
Supply Chain Operations Reference Model (SCOR): Basic management processes are represented to identify desired objectives and the set of activities.



Scope of Basic Management Processes

1. Plan refers to the processes that balance aggregate demand and supply to develop a course of action which best meets sourcing, production and delivery requirements. It allows the supply chain managers (and the enterprise) to balance resources with requirements and establish as well as communicate plans for the whole supply chain.

2. Source identifies the processes that procure goods and services to meet planned or actual demand as well as schedule deliveries (receive, verify and transfer).

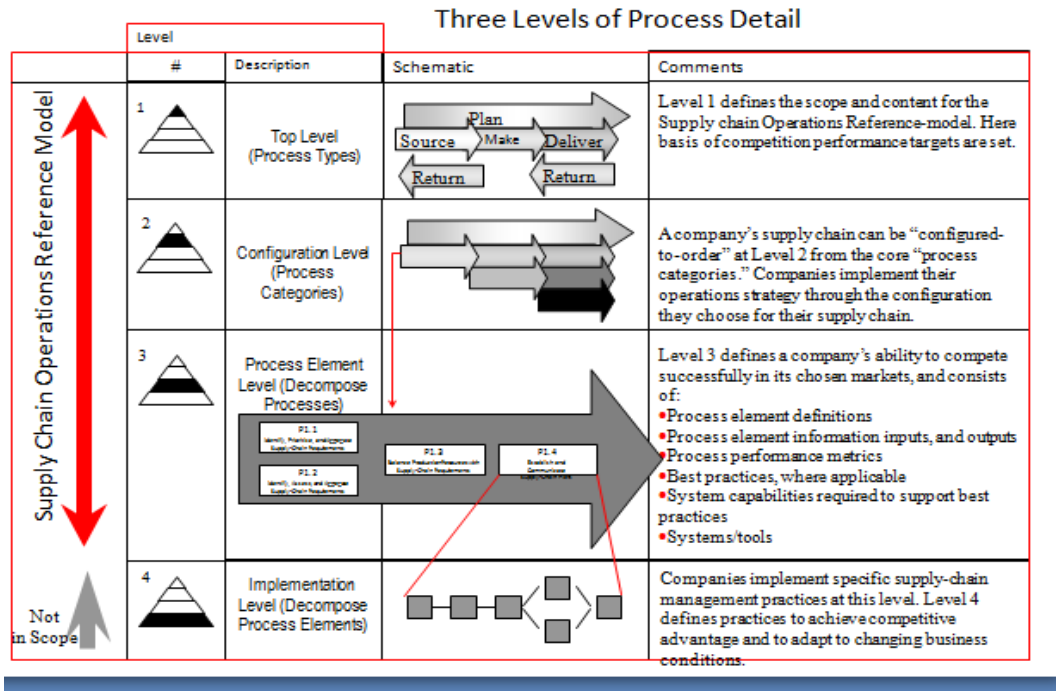


Plan-Source-Make-Deliver-Return

3. Make relates to the processes that transform product to a finished state to meet planned or actual demand through schedule production.

4. Deliver focuses on processes that provide finished goods and services to meet planned or actual demand, typically including order management, transportation management, and distribution management. Warehouse management from receiving and picking product to load and ship product.

5. Return concentrates on processes associated with returning or receiving returned products) and manages return business rules

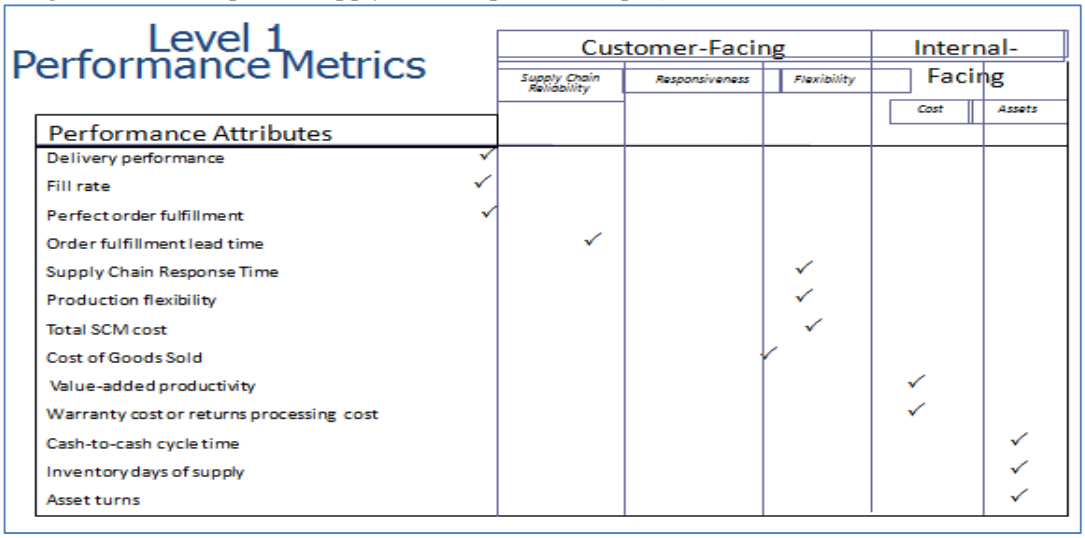


The three levels are considered the most important when focusing on SCOR Model.

SCOR applets available to supply chain professionals using android devices

SCOR QUICK REFERENCE GUIDE (Version 11)

The Supply Chain Operations Reference (SCOR®) model explains the business behavior related with all phases of satisfying a customer's demand. The model itself is controlled around the six primary management processes of Plan, Source, Make, Deliver, Return and Enable. Using these process building blocks, the SCOR model can be used to illustrate supply chains that are very simple or very complex using a common set of definitions across disparate industries. Today public and private organizations and companies around the world use the model as a foundation for global and site-specific supply chain improvement projects.



END OF LECTURE 9: GIST AND CRUX:

1. *Lean Supply Chain Management ideally results in lower productive costs and coordination costs. Lean Supply Chain Management focuses on long-term relationships and mutual commitments, intensive and regular sharing of technical and cost information along with mutual assistance and joint problem-solving. Pre-sourcing and Early Supplier Involvement can lead to Lean Supply Chain Management.*
2. *Six Sigma also helps in Lean Supply Chain Management implementation. Six Sigma is a fact (data) based approach to improving a process or function for the purpose of increasing customer satisfaction and thereby achieving significant sustainable supply chain benefits. Six Sigma's DMAIC process can be achieved through the application of industry benchmarking and broader frame works like Supply Chain Operations Reference (SCOR) Model.*
3. *Agile Supply Chain Management is implemented by enterprises so the organization can quickly adjust their sourcing, logistics and sales. Agile supply chain is constructed to be highly flexible for the purpose of being able to quickly adapt to changing situations. This methodology is considered important for organizations that want to be able to adapt to unanticipated external economic changes, such as economic swings, changes in technology or changes to customer demand.*
4. *E Marketing plays a number of important behind the scenes roles both in coordinating long term plans and controlling the daily physical flow of goods throughout the supply chain. Supply chain managers normally place a special emphasis on the important aspect of relationship building in order to ensure that E marketing helps the supply chain partners to optimize their sustainable long term profits.*
5. *SCOR Model provides strategic benefits to partners of the Supply Chain enterprise. It is a process reference model which integrates well known and proven concepts of business process reengineering, bench marking and process measurements into cross functional framework.*

UNDERSTANDING THE SUPPLY CHAIN PROCESS

Rationale and logic

Lecture 10 & 11 introduces the concept of a supply chain from a strategic framework perspective. We will not try to challenge the popular saying that "**Amateurs Talk about Strategy, dilettantes Talk about Tactics, and Professionals Talk about Logistics.**" Rather we will judiciously present the case that amateurs, dilettantes and professionals all need to have a thorough knowledge of Strategic framework

The goal of the next 6 lectures is to provide a strategic framework (also known as structure, template, skeleton, support, frame, scope, outline or agenda) that can be used to analyze design, planning, and operational decisions in a supply chain. These modules would help us establish the framework in the next two lectures. This development of the framework will also help to understand strategic goals and structure of various popular corporations with trend setting strategies for supply chains. The managers should learn the difference between firm and enterprise. The word firm is used for consultancy and Enterprise for corporations in the domain of Supply Chain

Learning Objectives

1. Identify the Supply Chain Process with Strategic Framework Perspective
2. Recognize the flows within and across a Supply Chain
3. Discuss the objective of a supply chain and the impact of supply chain decisions on the success of an Enterprise.
4. Classify the three key supply chain decision phases and explain the significance of each one (covered in Lecture 11)
5. Describe the cycle and push/pull views of a supply chain (covered in Lecture 11).
6. Categorize the supply chain macro processes in an Enterprise (covered in Lecture 11).

MODULE 1: IDENTIFY SUPPLY CHAIN PROCESSES WITHIN A STRATEGIC FRAMEWORK

The first step in any task associated with the development of a framework pertains to the drawing up of boundaries, what to include and what not to include. Virtual University students are already aware of the term, SCOPE. SCM is now readily identifiable to products and services or more correctively to Productive Systems.

Supply Chain Managers of the future, i.e. the Virtual University students can use SCM concept for commodities like bread, detergent or FMCGs. The items they buy in a routine. The students can also identify supply chain processes involved in a variety of products, for example, consumer durable products such as a television, automobile, etc. Building upon the same concept of SCM, the students can take this discussion into Services, global, galactic space travel, space research and beyond the solar system all relate to management of Supply Chains

Supply Chain Processes are identified by briefly stating these six steps

Step I: Identify the Supply Chain and its stages.

Step II: Identify Supply Chain Objective.

Step III: Identify supply chain surplus or supply chain profitability.

Step IV: Identify real supply chain improvement (involves increasing the total surplus in the supply chain as well as the profits of each party. At this stage, the importance of managing supply chains effectively needs to be emphasized in order to maximize the total surplus).

Step V: Identify the three decision phases (, i.e., supply chain strategy or design, supply chain planning, and supply chain operations)

Step VI: Identify the importance of the decisions made in each of these phases with respect to profitability. Examples (we have covered this throughout the semester in various modules) from manufacturing and services side. For example, supply chain strategy or design phase involves network configuration decisions (plant and warehouse location, transportation decisions, etc.)

Supply planning involves effectively matching demand and supply through aggregate planning, inventory management, etc.

Finally, supply chain operation focuses on a variety of operational decisions that include scheduling of shipments, satisfying customer orders, and specific activities relating to operations at plants and warehouses.

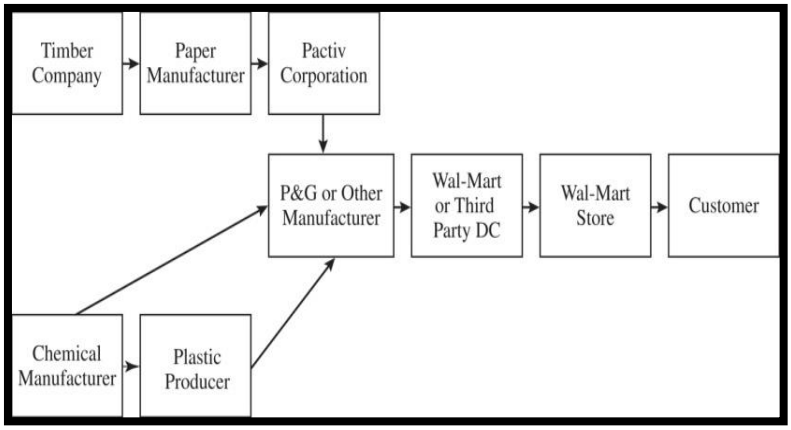
MODULE 2: FLOWS IN A SUPPLY CHAIN

Before we discuss the flows in a supply chain, recall what is a supply chain? Simply said, all stages involved, directly or indirectly, in fulfilling a customer request is a supply chain. It includes manufacturers, suppliers, transporters, warehouses, retailers, and customers

Within each enterprise (company), the supply chain includes all functions involved in fulfilling a customer request i.e. product development, marketing, operations, distribution, finance, customer service. Customer is an integral part of the supply chain and probably the sole reason why a supply chain exists, as it's the customer's requirement of a product or service that is taken up as a mission by the enterprise to fulfill and complete.

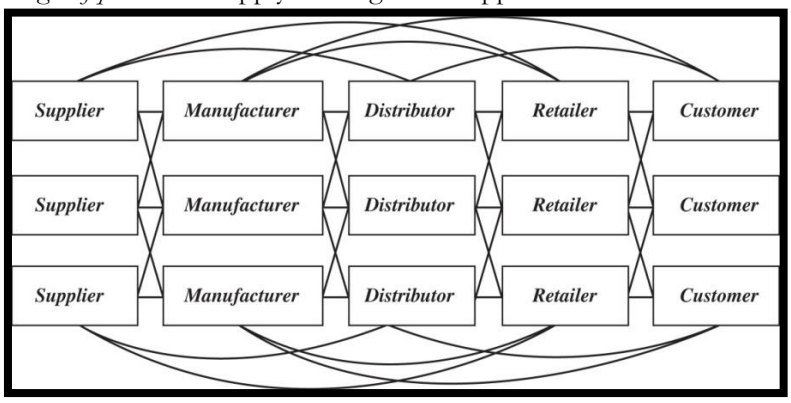
Supply Chain includes movement of products from suppliers to manufacturers to distributors and information, funds, and products in both directions. Consultants and practitioners often use the term "supply network" or "supply web". To be more judicious supply chain involves everybody, from the customer all the way to the last supplier. The key flows in the supply chain are - information, product, and cash. It is through these flows that a supply chain fills a customer order. The management of these flows is key to the success or failure of a firm. Comparative examples of Dell & Compaq, Amazon & Borders bring out the fact that all supply chain interaction is through these flows.

Typical supply chain stages include: customers, retailers, distributors, manufacturers, suppliers.



All stages may not be present in all supply chains e.g., no retailer or distributor for Dell Direct Marketing Model. Take for example the supply chain of a detergent in the figure here.

The primary purpose of any supply chain is to satisfy customer needs and, in the process, generate profit for itself. The term *supply chain invokes images of product* or supply moving from suppliers to manufacturers to distributors to retailers to customers along a chain. This is certainly part of the supply chain, but it is also important to visualize information, funds (cash/revenue), and product flows along both directions of this chain.



The term *supply chain may also imply that only one player is involved at each stage. In* reality, a manufacturer may receive material from several suppliers and then supply several distributors. Thus, most supply chains are actually networks. It may be more accurate to use the term *supply network or supply web to describe the structure of* most supply chains, as shown in Figure, above.

LOGIC: WHY THESE FLOWS ARE IMPORTANT?

Supply chain flows are important, because there is a close connection between the design and management of supply chain flows (product, information, and cash) and the success of a supply chain. The success of many

companies can be directly traced to the design and management of an appropriate supply chain. The failure of many businesses can be linked directly to their inability to effectively design and manage supply chain flows. Supply Chain Managers in training are requested to write a paragraph on Comparison between apple and gateway supply chains in their log books.

MODULE 3: THE OBJECTIVE OF A SUPPLY CHAIN

The objective of any supply chain is more or less very much the same **TO MAXIMIZE OVERALL VALUE CREATED.** This alone can be used as the logic to explain the mission critical state of being for a **NOT FOR PROFIT ENTERPRISE (ORGANIZATION)**. Similarly, the business students are well aware that this concept is the logic for all the **FOR PROFIT PRODUCTIVE SYSTEMS.**

Example: A customer purchases a cell phone from Best cell mobile for Rs.10 K (revenue). Supply chain incurs costs (information, storage, transportation, components, assembly, etc.). Difference between 10K and the sum of all of these costs is the supply chain profit. Supply chain profitability is total profit to be shared across all stages of the supply chain.

Success should be measured by total supply chain profitability, not profits at an individual stage. Also remember Customer is the only source of revenue. Sources of cost include flows of information, products, or funds between stages of the supply chain. Effective supply chain management is the management of flows between and among supply chain stages to maximize total supply chain surplus.

Importance of Supply Chain Decisions

Virtual University students are urged to observed and appreciate escalation of profits for Wal-Mart ($1 billion sales in 1980 to $408 billion in 2010) and Seven-Eleven Japan (¥1 billion sales in 1974 to ¥3 trillion in 2009). At the same time, they are advised to observe the sad failures of Supply Chains like the enterprise Webvan folded in two years, Book Sellers Borders, recorded a decline in sales and profits $4 billion in 2004 to $2.8 billion in 2009.

Supply Chain strategies successful in one point in time may not be successful for all times, a concept pioneer by Dell, which adopted retail based supply chain strategy in addition to its Dell Direct Marketing Approach.

END OF LECTURE 10: GIST AND CRUX:

1. *Supply Chain Framework helps in the design, implementation, operation and control of supply chain.*
2. *Identification of supply chain flows like product, information and revenue is of prime importance to identify the supply chain reliability, responsiveness, transparencies, flexibilities, costs and asset management.*
3. *Supply Chain Management also warrants the management of supply chain surplus.*
4. *All interventions from the senior, tactical and operational management should ideally result in enhancement of supply chain surplus*
5. *Various business models pursued by different enterprises are dependent upon on critical supply chain decisions.*

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Step VI: Identify the importance of the decisions made in each of these phases with respect to profitability. Examples (we have covered this throughout the semester in various modules) from manufacturing and services side. For example, supply chain strategy or design phase involves network configuration decisions (plant and warehouse location, transportation decisions, etc.)

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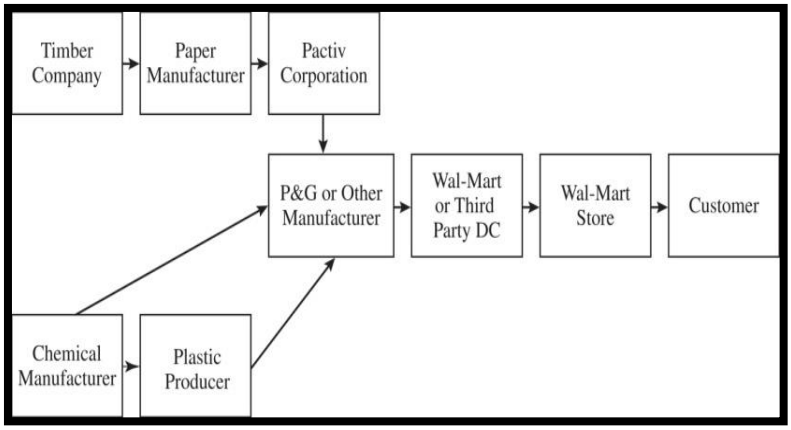
Within each enterprise (company), the supply chain includes all functions involved in fulfilling a customer request i.e. product development, marketing, operations, distribution, finance, customer service. Customer is an integral part of the supply chain and probably the sole reason why a supply chain exists, as it's the customer's requirement of a product or service that is taken up as a mission by the enterprise to fulfill and complete.

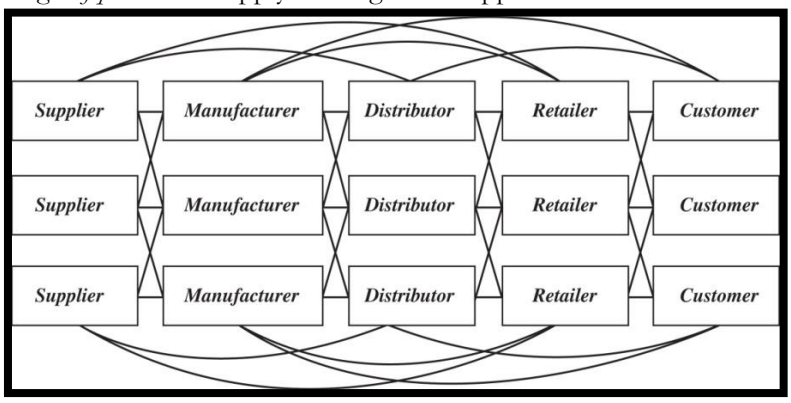
Supply Chain includes movement of products from suppliers to manufacturers to distributors and information, funds, and products in both directions. Consultants and practitioners often use the term "supply network" or "supply web". To be more judicious supply chain involves everybody, from the customer all the way to the last supplier. The key flows in the supply chain are - information, product, and cash. It is through these flows that a supply chain fills a customer order. The management of these flows is key to the success or failure of a firm. Comparative examples of Dell & Compaq, Amazon & Borders bring out the fact that all supply chain interaction is through these flows.

Typical supply chain stages include: customers, retailers, distributors, manufacturers, suppliers.



All stages may not be present in all supply chains e.g., no retailer or distributor for Dell Direct Marketing Model. Take for example the supply chain of a detergent in the figure here.

The primary purpose of any supply chain is to satisfy customer needs and, in the process, generate profit for itself. The term *supply chain invokes images of product* or supply moving from suppliers to manufacturers to distributors to retailers to customers along a chain. This is certainly part of the supply chain, but it is also important to visualize information, funds (cash/revenue), and product flows along both directions of this chain.



The term *supply chain may also imply that only one player is involved at each stage. In* reality, a manufacturer may receive material from several suppliers and then supply several distributors. Thus, most supply chains are actually networks. It may be more accurate to use the term *supply network or supply web to describe the structure of* most supply chains, as shown in Figure, above.

LOGIC: WHY THESE FLOWS ARE IMPORTANT?

Supply chain flows are important, because there is a close connection between the design and management of supply chain flows (product, information, and cash) and the success of a supply chain. The success of many

companies can be directly traced to the design and management of an appropriate supply chain. The failure of many businesses can be linked directly to their inability to effectively design and manage supply chain flows. Supply Chain Managers in training are requested to write a paragraph on Comparison between apple and gateway supply chains in their log books.

MODULE 3: THE OBJECTIVE OF A SUPPLY CHAIN

The objective of any supply chain is more or less very much the same **TO MAXIMIZE OVERALL VALUE CREATED.** This alone can be used as the logic to explain the mission critical state of being for a **NOT FOR PROFIT ENTERPRISE (ORGANIZATION)**. Similarly, the business students are well aware that this concept is the logic for all the **FOR PROFIT PRODUCTIVE SYSTEMS.**

Example: A customer purchases a cell phone from Best cell mobile for Rs.10 K (revenue). Supply chain incurs costs (information, storage, transportation, components, assembly, etc.). Difference between 10K and the sum of all of these costs is the supply chain profit. Supply chain profitability is total profit to be shared across all stages of the supply chain.

Success should be measured by total supply chain profitability, not profits at an individual stage. Also remember Customer is the only source of revenue. Sources of cost include flows of information, products, or funds between stages of the supply chain. Effective supply chain management is the management of flows between and among supply chain stages to maximize total supply chain surplus.

Importance of Supply Chain Decisions

Virtual University students are urged to observed and appreciate escalation of profits for Wal-Mart ($1 billion sales in 1980 to $408 billion in 2010) and Seven-Eleven Japan (¥1 billion sales in 1974 to ¥3 trillion in 2009). At the same time, they are advised to observe the sad failures of Supply Chains like the enterprise Webvan folded in two years, Book Sellers Borders, recorded a decline in sales and profits $4 billion in 2004 to $2.8 billion in 2009.

Supply Chain strategies successful in one point in time may not be successful for all times, a concept pioneer by Dell, which adopted retail based supply chain strategy in addition to its Dell Direct Marketing Approach.

END OF LECTURE 10: GIST AND CRUX:

1. *Supply Chain Framework helps in the design, implementation, operation and control of supply chain.*
2. *Identification of supply chain flows like product, information and revenue is of prime importance to identify the supply chain reliability, responsiveness, transparencies, flexibilities, costs and asset management.*
3. *Supply Chain Management also warrants the management of supply chain surplus.*
4. *All interventions from the senior, tactical and operational management should ideally result in enhancement of supply chain surplus*
5. *Various business models pursued by different enterprises are dependent upon on critical supply chain decisions.*

UNDERSTANDING THE SUPPLY CHAIN PROCESS (II)

This lecture would allow us to complete the Supply Chain Strategic Framework discussion initiated in last lecture. Ideally after this lecture the students would be able to develop a strategic supply chain framework perspective. Lecture 11 covers three important modules pertaining to decision phases, process view and supply chain macro processes and at the same time covers the 4 critical learning objectives: -

1. Discuss the objective of a supply chain and explain the impact of supply chain decisions on the success of a firm.
2. Identify the three key supply chain decision phases and explain the significance of each one.
3. Describe the cycle and push/pull views of a supply chain.
4. Classify the supply chain macro processes in a firm.

The three modules below form the very basis for Supply Chain with respect to design strategy, planning and operation.

Module 4: **Decision Process (Phases) of a Supply Chain**. This is a minor module as we have dedicated lectures on these decision phases.

Module 5: **Process View of a Supply Chain**. This is more critical than modules 4 and 6 as this module actually would be cross referred directly as well as indirectly, however this fact does not take away the importance of modules 4 and 6.

Module 6: **Supply Chain Macro Processes**. This module is probably a revisit of important concepts already known to the virtual university students.

Savvy Supply Chain Managers Register Supply Chain Profit: Savvy supply chain managers always aim to identify the three levels of decision making. In other words, if they are trained to carry out strategic, tactical and operational supply chain decision making then can ensure the enterprise as well as the supply chain partners (suppliers as well as retailers/distributors) to register supply chain surplus called supply chain profit.

Decisions as opportunities to register supply chain profit: Virtual University students are requested to develop a supply chain strategy that would provide opportunities for them as well as the enterprise to register profits in the operational, tactical and strategic time horizons. This is contingent to the critical fact that supply chain design, planning and operations have goals, aims and objectives aligned to achieve this.

The supply chain managers should be ready to understand that when they are making decisions in the strategic (design) phase the nature of the decisions relates to structure (or infrastructure) of the supply chain over a long period of time.

These structure decisions pertaining to **either the entire supply chain or only the distribution network design** are actually "**long term capital budgeting irreversible decisions"** which cannot be reversed or changed in the short term time frame. Reversing such decisions would warrant additional costs. This additional cost if transferred to the customer would lead to the customer changing his preference to your competitors' product or service eventually resulting in lowering of supply chain surplus or lowering of the value of the product in the eyes of your customer. If you have a weak supply chain strategy or supply chain design it will amplify problems and losses in the operational phase.

Cost Minimization or Profit Maximization: Virtual University students are already aware of important concepts of services blueprint and concurrent engineering, where 80 percent of the costs can be actually locked in at the design phase. The same concepts actually allow the supply chain to lock in costs to achieve the perspective or objective of "**cost minimization or profit maximization"**. A supply chain can actually offer its product at a competitive rate as well as an attractive option to the potential customers.

In contrast to the above, absence of a proper design would **create a never ending story** in which the supply chain manager would be compelled to run around and fine tune the cost structure. This can eventually lead

to supply chain disruptions and supply chain profits being compromised. Quite often this is unacceptable for any enterprise to pursue such a tactic.

Another important phase of Supply Chain ideally following the supply chain design is the supply chain planning. Normally planning is a critical activity that often occupies the pivotal position in the phases of the supply chain. Some supply chain analysts suggest that supply chain design is a part and parcel of supply chain planning where as there are others who clearly distinguish that supply chain

MODULE 4: DECISION PHASES OF A SUPPLY CHAIN

Supply chain management requires many decisions relating to the flow of information, product, and funds. These decisions fall into three groups or phases, depending on the frequency of each decision and the time frame over which a decision phase has an impact. Please refer to the table on the next page which presents the sample senior management question with respect to the three phases of design, planning and operation Virtual University students are requested to formulate their own questions in view of their enterprises product offering, market and location of warehouses, distribution centers, distributor and retailer relationships.

IF THE ENTERPRISE IS IN THE	*SAMPLE SENIOR MANEGEMNT QUESTIONS*
Supply chain Strategy or Design Phase	How to structure the supply chain over the next several years?
Supply chain Planning	Decisions over the next quarter or year
Supply Chain Operation	Daily or weekly operational decisions

MODULE 4A: SUPPLY CHAIN DESIGN PHASE

An important phase of supply chain is the supply chain design phase. This module presents the basis for Supply Chain design, planning and operation. This module would always be important for any enterprise in the quest to answer its design, planning and operation questions.

During this phase, a company decides how to structure the supply chain over the next several years. It decides what the chain's configuration will be, how resources will be allocated, and what processes each stage will perform.

Strategic Decisions: Strategic decisions made by companies include the location and capacities of production and warehouse facilities, the products to be manufactured or stored at various locations, the modes of transportation to be made available along different shipping legs, and the type of information system to be utilized.

An enterprise must ensure that the supply chain configuration supports its strategic objectives during this phase.

Take the universal supply chain example of Dell. Dell's decisions regarding the location and capacity of its manufacturing facilities, warehouses, and supply courses are all supply chain design or strategic decisions. Supply chain design decisions are typically made for the long term (a matter of years) and are very expensive to alter on short notice. Consequently, when companies make these decisions, they must take into account uncertainty in anticipated market conditions over the next few years.

Decisions about the structure of the supply chain and what processes each stage will perform

Strategic supply chain decisions normally include verdict about

1. Locations and capacities of facilities
2. Products to be made or stored at various locations
3. Modes of transportation
4. Information systems

Supply chain design must support strategic objectives and face the most important constraint that is that the supply chain design decisions are long-term and expensive to reverse. The decision must take into account market uncertainty.

Businesses of today are focused on real life data and interested in real time information and willing to pay for this real life information.

This brings us to another important concept that when you deal your supply chain as strategic perspective you should treat them as strategic assets. Supply chain design should provide support to, it should complement and supplement

MODULE 4 B: SUPPLY CHAIN PLANNING

Virtual University students or supply chain managers in training should pay attention to the important concept of supply chain planning. This phase pertains to decisions made for the time frame considered to be a quarter to a year. Therefore, the supply chain's configuration determined in the strategic phase is fixed. The configuration establishes constraints within which planning must be done.

Enterprises start the planning phase with a forecast for the coming year (or a comparable time frame) of demand in different markets. Planning includes decisions regarding which markets will be supplied from which locations, the subcontracting of manufacturing, the inventory policies to be followed, and the timing and size of marketing promotions. Dell's decisions regarding markets a given production facility will supply and target production quantities at different locations are classified as planning decisions. Planning establishes parameters within which a supply chain will function over a specified period of time. In the planning phase, companies must include uncertainty in demand, exchange rates, and competition over this time horizon in their decisions.

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MODULE 4C: SUPPLY CHAIN OPERATION

The time horizon here is weekly or daily, and during this phase companies make decisions regarding individual customer orders. At the operational level, supply chain configuration is considered fixed and planning policies are already defined. The goal of supply chain operations is to handle incoming customer orders in the best possible manner. During this phase, firms allocate inventory or production to individual orders, set a date that an order is to be filled, generate pick lists at a warehouse, allocate an order to a particular shipping mode and shipment, set delivery schedules of trucks, and place replenishment orders. Because operational decisions

are being made in the short term (minutes, hours, or days), there is less **uncertainty about** demand information.

Virtual University students are requested to identify the constraints established by the configuration and planning policies, **the goal during the operation phase is to exploit the reduction of uncertainty and optimize performance**.

The design, planning, and operation of a supply chain have a powerful impact on overall profitability and success. Continuing with the ever famous Dell Computer supply chain example, in the early 1990s, Dell management began to focus on improving the supply chain performance. Both profitability and the stock price have soared and Dell stock has had outstanding returns over this period.

MODULE 5: PROCESS VIEW OF A SUPPLY CHAIN

Virtual University students are requested to develop the process view of a supply chain as a bare minimum requirement of understanding the supply chain.

There are two views of a supply chain, i.e., the cycle view and the push/pull. These views are introduced and explained in this critical module. The dilemma associated with this concept is that supply chain managers either bring it down to the nuts and bolts (micro level) of discussing minute activities or keep it at the macro level of the organization. This leads to an inadequate development of the understanding of this important concept. Supply Chain managers of tomorrow are requested to view the supply chain as a cycle or combination of push and pull views.

The main aspects that need to be covered in the cycle view primarily include the **activities** and **responsibilities** involved in each cycle and to some extent an introduction to what decision models are applicable in each of these cycles.

Supply chain managers often fall a victim to paying undue importance to production schedule in order to maintain the inventory level that they over stock and lead to higher levels of inventory level which increase upstream leading to "Bull Whip Effect". However, the best strategy is to make judicious use of simple techniques such as Economic Order Quantity (EOQ), etc., can be mentioned as tools in replenishment order cycle, and similarly be aware of the production planning and scheduling models **as a part** of the manufacturing cycle. Also the concept of EOQ as a part of the inventory management for the enterprise has now been extended to the entire supply chain as we already know that we know compare the supply chain with another supply chain and do not merely compare the products.

A supply chain is a sequence of processes (please refer to other module handouts) and flows that take place within and between different supply chain stages and combine to fill a customer need for a product.

In discussing push/pull view of a supply chain, it would be useful for the supply chain manager to provide examples of their own companies should set their push/pull boundary. The Dell and paint industry examples in the text provide an excellent means to make this point.

The relationship between the two process views and the three supply chain macro processes, i.e., Customer Relationship Management (CRM), Internal Supply Chain Management (ISCM) and Supplier Relationship Management (SRM) can be established.

Also "*Cycle View"* is the processes in a supply chain are divided into a series of cycles, each performed at the interfaces between two successive supply chain stages. At the same time *Push/Pull View* represent the processes in a supply chain are divided into two categories depending on whether they are executed in response to a customer order (*pull*) or in anticipation of a customer order (*push*). They key difference is the uncertainty during the two phases.

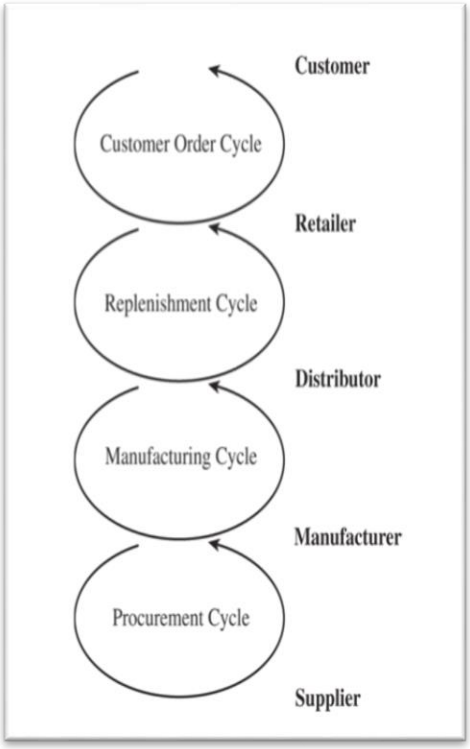
The **cycle view** divides the supply chain into a series of **4 cycles** between the **5 different stages** of a supply chain. The cycles are the customer order cycle, replenishment cycle, manufacturing cycle and procurement cycle. The supply chain is a concatenation of cycles with each cycle at the interface of two successive stages in the supply chain. Each cycle involves the customer stage placing an order and receiving it after it has been supplied by the supplier stage.

- One difference is in size of order. Second difference is in predictability of orders - orders in the procurement cycle are predictable once manufacturing planning has been done.

- This is the predominant view for ERP systems. It is a transaction level view and clearly defines each process and its owner.

Cycle View of Supply Chain Process has following cycles

1. Customer order cycle
2. Replenishment cycle (at retailer/distributor)
3. Manufacturing cycle (distributor/manufacturer)
4. Procurement cycle (manufacturer/supplier)



The information flows from top to bottom and the products flow from bottom to top.

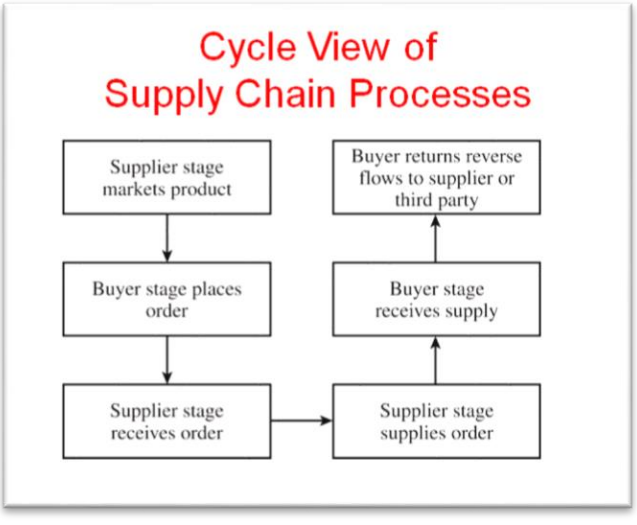
1. The customer order cycle occurs at the customer/retailer interface and includes all processes directly involved in receiving and filling the customer.
2. The replenishment cycle occurs at the retailer/distributor interface and includes all processes involved in replenishing retailer inventory.
3. The manufacturing cycle typically occurs at the distributor/manufacturer (or retailer/manufacturer) interface and includes all processes involved in replenishing distributor (or retailer) inventory.
4. The procurement cycle occurs at the manufacturer/supplier interface and includes all processes necessary to ensure that the materials are available for manufacturing according to schedule.

Inventory levels are build up to the acceptable levels through the replenishment cycle. The acceptable levels are more than the safety stock levels to ensure undisrupted supply chain operation within the important parameters of supply chain design and planning.

The take away from this discussion is to identify the six processes which can be identified at each stage as shown below

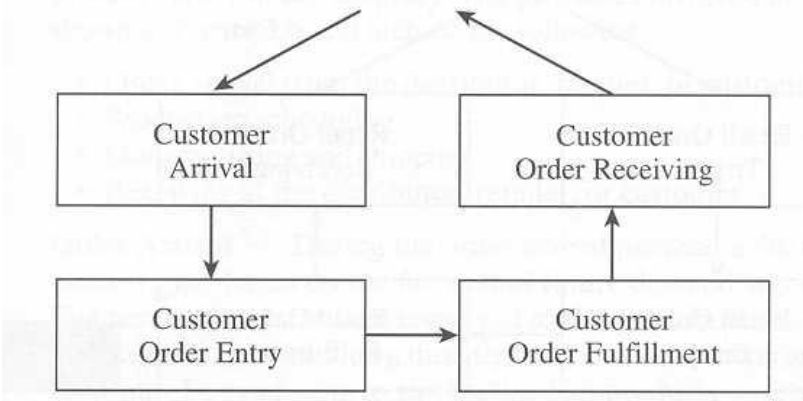
Cycle View of Supply Chain Processes

1. Supplier stage markets product.
2. Buyer stage places order
3. Supplier stage receives order
4. Supplier stage supplies order
5. Buyer stage receives supplies
6. Buyer returns reverse flows to supplier or third party

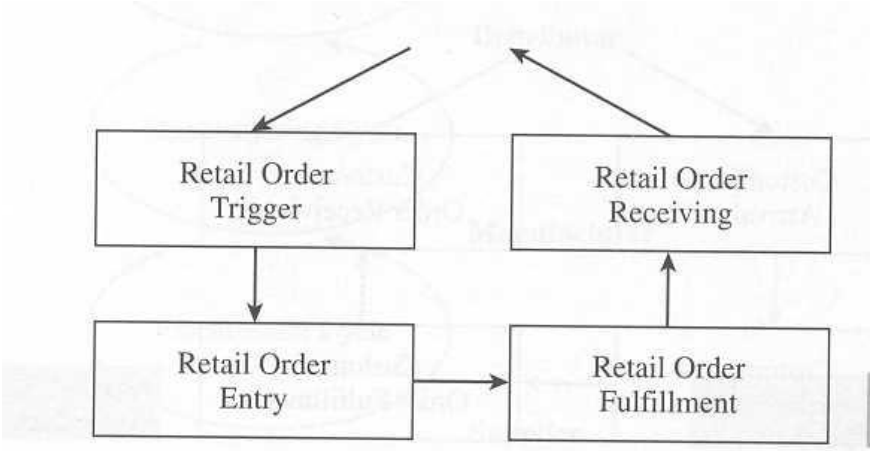


These steps hold value and some of them become of critical nature especially when dealing with a reverse supply chain. Virtual University students are already aware of a supply chain failure example in the form of Webvan. This company mishandled the concept of reverse supply chain. This is in reality a potential failure for all supply chains. If customer needs are not properly fulfilled the entire knowledge system would not be able to rescue the supply chain. The noblest of supply chain designs will result in supply chain loss if they are poorly executed.

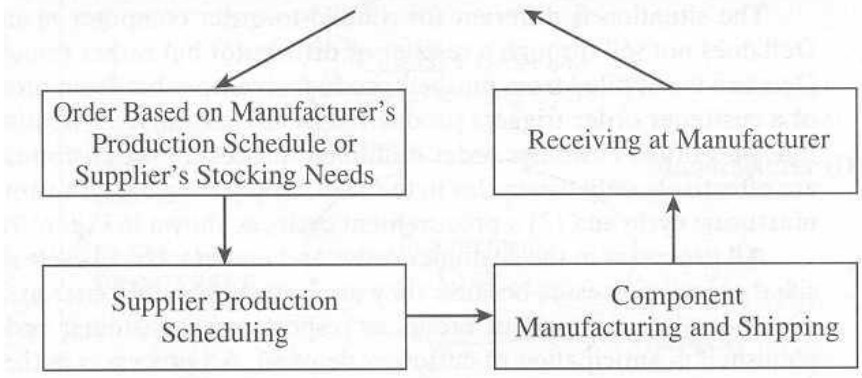
Customer Order Cycle



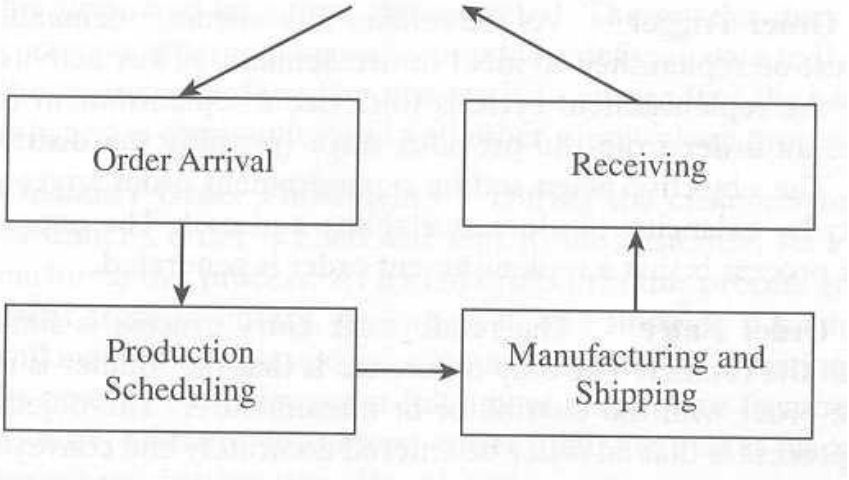
Replenishment Cycle



Manufacturing Cycle



Procurement Cycle



Virtual University students are requested to learn the critical concept of 4 cycles, 5 interfaces and 6 processes at each interface in order to develop a clear perspective about supply chains cycle view

This completes our discussion on the cycle view of the supply chain; let us now focus our attention on the push/pull view of the supply chain process.

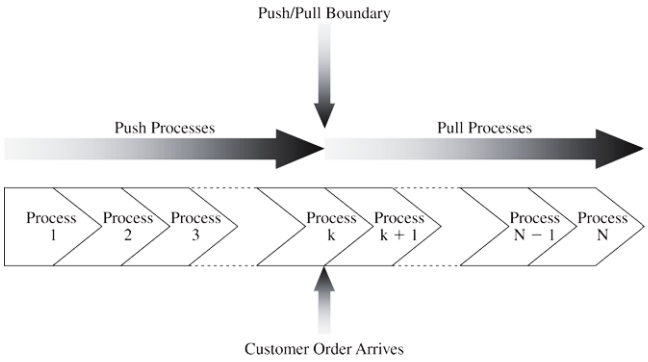
PUSH/PULL VIEW OF SUPPLY CHAIN PROCESSES

Simply said virtual university would be aware of the simplest form of pushed strategy, that is the manufacturer manufacturers the product and pushes the product to the customer. Another case being that the manufacturer only makes the product on receipt of the order, which signifies pull strategy. This often allows the enterprise to add in those innovative features which would ensure the enterprise to be declared "order winner" and attain competitive advantage.

Supply chain processes fall into one of two categories depending on the timing of their execution relative to customer demand i.e. pulls and push.

Pull process is the reactive execution. In other words, it is initiated in response to a customer order. Similarly Push process is a speculative execution or in other words it is initiated in anticipation of customer orders.

Push/Pull Boundary: Push/pull boundary separates push processes from pull processes.



The push/pull view of the supply chain divides supply chain processes into two categories based on whether they are executed in response to a customer order or in anticipation of customer orders. Pull processes are initiated in response to a customer order. Push processes are initiated and performed in anticipation of customer orders. The push/pull boundary separates push processes from pull processes.

This view is very useful when considering strategic decisions relating to supply chain design, because it forces a more global consideration of supply chain processes as they relate to the customer orders.

Dell religiously pursued its Dell Direct Marketing Supply Chain strategy till 2006 when it decided to opt for the retail stores probably to counter the increase in sales and revenue after Compaq/HP merger.

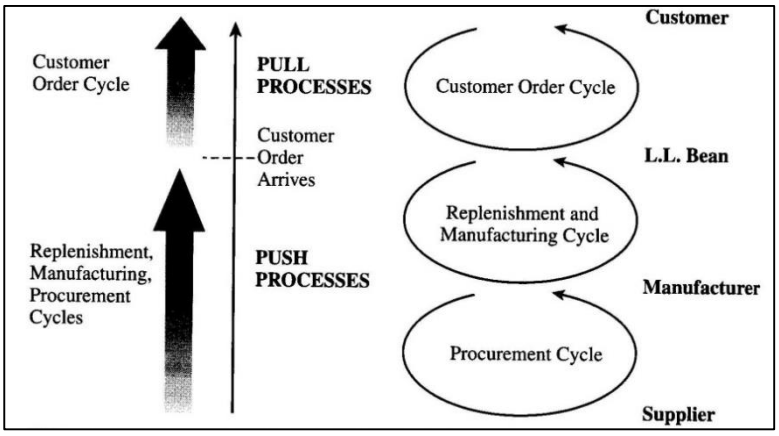
Virtual University students are requested to understand that we can combine the push/pull and cycle views; we have two obvious examples in the form of L.L. Bean and Dell. Virtual University students are

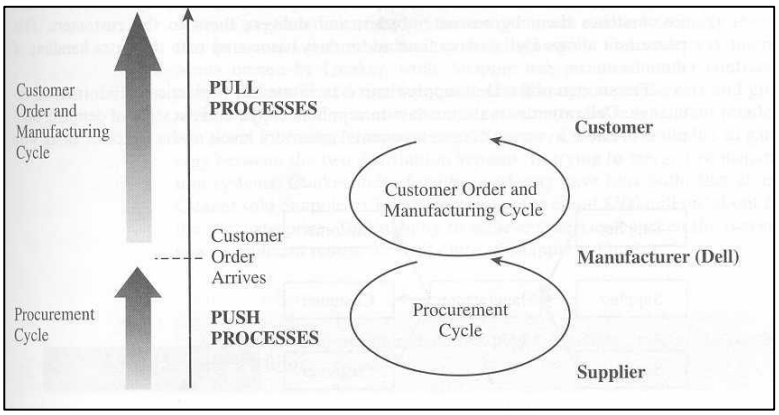
recommended to understand that the relative proportion of push and pull processes can have an impact on supply chain performance

Some supply chain has both push and pull in its chain and we can identify this push/pull process boundary. Here is an example of LL Beans supply chain. L.L.Bean, Inc. branded as L.L.Bean, is an American privately held mail-order, online, and retail company founded in 1912 by Leon Leonwood Bean and currently based in Freeport, Maine, United States. It specializes in clothing and outdoor recreation equipment. The customer order cycle is a pull process and replenishment, manufacturing and procurement cycles are push process. Here the push processes are large as compared to pull processes.

The Dell Computer's Supply Chain Example

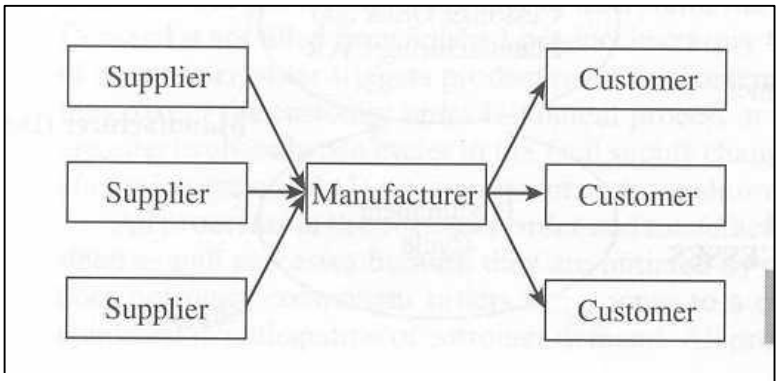
In this company, the customer order and manufacturing cycles are pull process and only the procurement cycle is push process. Thus number of pull processes is large as compared to number of pull processes. There is a close connection between the design and management of supply chain flows and the success of a supply chain. VU students are already aware of the DELL story. Dell has only 10 days of inventory contrast to other pc makers of 80 to 100 days. The success of the Dell supply chain is facilitated by sophisticated information exchange. (Customized web pages) and outsourcing.





There are certain business logics which allow any enterprise to plan push and pull strategy under a specific circumstance. It is the test of expertise of the supply chain management team or senior management where they draw the boundary between push and pull strategy application.

A simple paint job at home would expose the Virtual University Student to a skilled painter probably not educated but well aware of using paint additives to paint different walls of the same room. The same strategy is exploited by the global paint industry. The paint industry makes use of concept of processing the chemical paint to a basic color to the retail outlet as a push strategy. At the retail store special shades are added to provide the customer with different shades of paints as a part of pull strategy. This pull strategy is based on induced demand of the customer.



Dell Computer's Supply Chain Stages

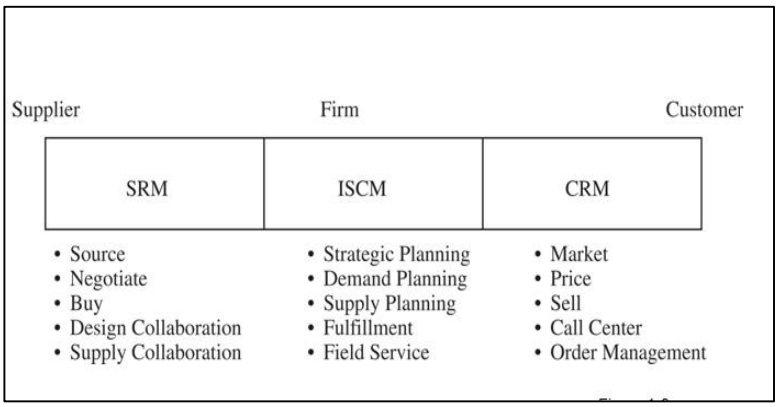
MODULE 6: SUPPLY CHAIN MACRO PROCESSES

Virtual University Students are already aware of the fact that all processes within a supply chain can be classified into three macro processes, which are:

1. Customer Relationship Management (CRM)
2. Internal Supply Chain Management (ISCM)
3. Supplier Relationship Management (SRM)

Some textbooks call ISCM as Integrated Supply Chain Management but we are more comfortable with the term Internal Supply Chain Management, as we are dealing supply chain processes, concept, and terms from the Enterprise perspective. Integration among the above three macro processes and the different interfaces is critical for effective and successful supply chain management.

Supply Chain Macro Processes of Supplier Relationship Management was covered in earlier lectures and normally include Source, Negotiate, Buy, Design and Supply Collaboration. Similarly, Integrated Supply Chain Management Processes include Strategic Planning, Demand Planning, Supply Planning, Fulfillment and field service. Customer Relationship Management includes market, price, sell, call center and Order Management.



Customer Relationship Management (CRM) includes all processes that focus on the interface between the firm and its customers such as marketing, sales, call center management and order management.

Virtual University students must have reached a stage in their education endeavor where they are already aware that enterprises pay special attention for orientation and training of their workforce for Customer Relationship Management.

Internal Supply Chain Management (ISCM) includes all processes that are internal to the enterprise such as

1. Finalization of demand & supply plans,
2. Preparation of inventory management policies,
3. Order fulfillment and planning of capacity.

Inventory management policy is normally finalized by senior management but you as a supply chain manager can play an effective part. Also for order fulfillment and planning of capacity, not only the new machines' capacities are considered but existing machines are also considered.

Supplier Relationship Management (SRM) includes all processes that focus on the interface between a firm and its suppliers such as

1. Evaluation and selection of suppliers,
2. Negotiation of supply terms and
3. Communication regarding new products and orders

Suppliers' loyalty depends on the relationship the enterprise pursues with the supplier.

EXAMPLES OF SUPPLY CHAINS

Virtual University Students are suggested to appreciate the following important points about the different companies which are normally taken up as case studies. Even though the same enterprises, have been known to have pursued different supply chain strategies in different periods of time. These points appear in the form of questions to give an insight to students who want to pursue a career as a supply chain professional.

These enterprises represent different industries and in one way or another provide an opportunity to the supply chain manager to be aware of the design, operation and management of a supply chain under certain as well as uncertain environmental conditions.

The questions below are just of academic interest and may not be seriously tackled but they do give an excellent clue about the point of difference **between the two companies** being **compared.**

Gateway and Apple: Tech Industry focusing on Electronic Gadgets, laptops and cells

1. The difference in business models due to which Gateway choose not to carry any finished-product inventory at its retail stores. While at the same time Apple choose to carry inventory at its stores.
2. How positively the supply chain is influenced by investment in retail stores which carry finished-goods inventory. What are the characteristics of products that are most suitable to be carried in finished-goods inventory? What characterizes products that are best manufactured to order?
3. How does product variety affect the level of inventory a retail store must carry?
4. Is a direct selling supply chain without retail stores always less expensive than a supply chain with retail stores?
5. What factors explain the success of Apple retail and the failure of Gateway country stores?

Zara: Apparel Industry

1. What advantage does Zara gain against the competition by having a very responsive supply chain?
2. Why has Inditex chosen to have both in-house manufacturing and outsourced manufacturing? Why has Inditex maintained manufacturing capacity in Europe even though manufacturing in Asia is much cheaper?
3. Why does Zara source products with uncertain demand from local manufacturers and products with predictable demand from Asian manufacturers?
4. What advantage does Zara gain from replenishing its stores multiple times a week compared to a less frequent schedule? How does the frequency of replenishment affect the design of its distribution system?
5. Do you think Zara's responsive replenishment infrastructure is better suited for online sales or retail sales?

W.W. Grainger and McMaster-Carr: Catalogue

1. How many Distributor Centers (DCs) should be built and where should they be located?
2. How should product stocking be managed at the DCs? Should all DCs carry all products?
3. What products should be carried in inventory and what products should be left with the supplier to be shipped directly in response to a customer order?
4. What products should W.W. Grainger carry at a store?
5. How should markets be allocated to DCs in terms of order fulfillment? What should be done if an order cannot be completely filled from a DC? Should there be specified backup locations? How should they be selected?
6. How should replenishment of inventory be managed at the various stocking locations?
7. How should Web orders be handled relative to the existing business? Is it better to integrate the Web business with the existing business or to set up separate distribution?
8. What transportation modes should be used for order fulfillment and stock replenishment?

Toyota: Automobile Industry

1. Where should plants be located, what degree of flexibility should each have, and what capacity should each have?
2. Should plants be able to produce for all markets?
3. How should markets be allocated to plants?
4. What kind of flexibility should be built into the distribution system?
5. How should this flexible investment be valued?
6. What actions may be taken during product design to facilitate this flexibility?

Amazon and Independent Merchants

1. Why did Amazon decide to allow other merchants to use its supply chain expertise?
2. What advantages do merchants have when partnering with Amazon?
3. Should Amazon stock every product it sells?
4. What advantage can bricks-and-mortar players derive from setting up an online channel? How should they use the two channels to gain a maximum advantage?
5. What advantages or disadvantages do large book retailers gain by letting Amazon manage their supply chain?
6. For which products does the online channel offer the greatest advantage relative to retail stores? What characterizes these products?

SUMMARY OF LEARNING OBJECTIVES

1. Discuss the objective of a supply chain of an enterprise

A. The objective of a supply chain should be to maximize overall supply chain profitability.

B. Supply chain profitability is the difference between the revenue generated from the customer and the total cost incurred across all stages of the supply chain.

C. Supply chain decisions have a large impact on the success or failure of each enterprise because they significantly influence both the revenue generated and the cost incurred.

D. Successful supply chains manage flows of product, information, and funds to provide a high level of product availability to the customer while keeping costs low.

2. 2. Identify the three key supply chain decision phases

A. Supply chain decisions may be characterized as strategic (design), planning, or operational, depending on the time period during which they apply.

B. Strategic decisions relate to supply chain configuration. These decisions have a long-term impact lasting several years.

C. Planning decisions cover a period of a few months to a year and include decisions such as production plans, subcontracting, and promotions over that period. Operational decisions span from minutes to days and include sequencing production and filling specific orders.

D. Strategic decisions define the constraints for planning decisions, and planning decisions define the constraints for operational decisions.

3. Describe the cycle and push/pull views of a supply chain.

A. A cycle view of a supply chain divides processes into cycles, each performed at the interface between two successive stages of a supply chain.

B. Each cycle starts with an order placed by one stage of the supply chain and ends when the order is received from the supplier stage.

C. A push/pull view of a supply chain characterizes processes based on their timing relative to that of a customer order.

D. Pull processes are performed in response to a customer order, whereas push processes are performed in anticipation of customer orders.

4. Classify the supply chain macro processes in an enterprise.

A. All supply chain processes can be classified into three macro processes based on whether they are at the customer or supplier interface or are internal to the enterprise.

B. The CRM macro process consists of all processes at the interface between the enterprise and the customer that work to generate, receive, and track customer orders.

C. The ISCM macro process consists of all supply chain processes that are internal to the enterprise and work to plan for and fulfill customer orders.

D. The SRM macro process consists of all supply chain processes at the interface between the enterprise and its suppliers that work to evaluate and select suppliers and then source goods and services from them.

Virtual University students have already understood the concept of supply chain and logistics, we will close our lecture discussion on a popular proverb attributed King Richard III which spells out the critical aspect of Supply Chain with respect to strategic, tactical and operational points of view. A popular version goes like this and traces the importance of supply chain, where a simple loss of nail means a loss of kingdom.

For Want of a Nail

For want of a nail the shoe was lost.
For want of a shoe the horse was lost.
For want of a horse the rider was lost.
For want of a rider the message was lost.
For want of a message the battle was lost.
For want of a battle the kingdom was lost.
And all for the want of a horseshoe nail.

END OF LECTURE 11: GIST AND CRUX:

1. *Supply Chain process is directly linked to various levels of decision making with Supply Chain design, planning and operation reflecting Strategic, Tactical and Operational decision. Supply chain management involves the management of flows between and among stages in a supply chain to maximize total profitability.*
2. *Supply Chain managers are trained to identify the cycle view and push/pull concepts. Different enterprises use different strategies to exploit the different cycles to achieve supply chain surplus. The business models/ supply chains of Dell and Compaq/HP comes to mind.*
3. *Push and pull strategies enjoy a unique status both in traditional business models as well as E Marketing based business models.*
4. *Push and pull boundaries actually help Supply Chain Managers to formulate a strategy that help them to smoothly operate the supply chain and increase its revenues.*
5. *Supply Chain Macro processes have attained the status of a mature subject in business with different specialization studies in place to help enterprises hire the trained and business savvy managers. VU students can identify some of the classes they have already studied in their MBA program which focus on these macro processes.*

Supply Chain Management

- *Supply Chain*: The sequence of organizations - their facilities, functions, and activities - that are involved in producing and delivering a product or service.

Sometimes referred to as **value chains or Extended Value Chains**

What is Supply Chain Management?

- Managing supply chain flows and assets, *to maximize supply chain surplus*
- What is *supply chain surplus*?
  - Supply chain surplus refers to what the customer has paid - total cost expended by supply chain in filling order.

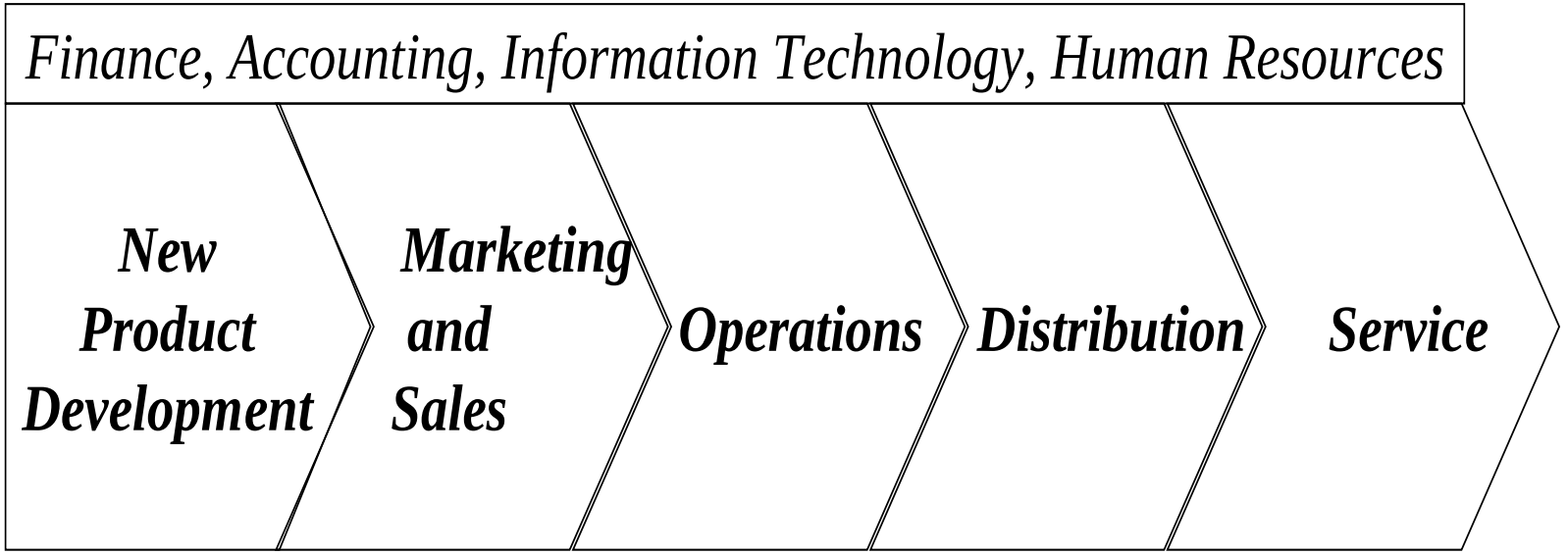
Mission-Strategy-Tactics-Decisions

- **Mission**, Mission statement
  - The reason for existence of an organization
- Strategy
  - A plan for achieving organizational goals
- Tactics
  - The actions taken to accomplish strategies
- Operational decisions
  - Day to day decisions to support tactics

Decision Levels

- Strategic:
  - Long term, permanence of many years
- Tactical
  - Intermediate time range, usually three months to a year
- Operational
  - Short range, week or less

The Value Chain: Linking Supply Chain and Business Strategy



Product Development strategy

Strategies

- **Marketing and sales strategy** relates to positioning, pricing and promotion of products/services
  - e.g. Never offer more than 40% discount
  - e.g. EDLP = every day low price
    - At Wal-Mart
  - e.g. Demand smoothing via time based coupons
    - BestBuy

- **Supply chain management** strategy relates to procurement, transportation, storage and delivery
  - e.g. Never use more than 1 supplier for every input
  - e.g. Never expedite orders just because they are late
  - e.g. Always use domestic suppliers within the sales season not in advance.

2.2. Achieving Strategic Fit

- Introduction
- How is strategic fit achieved?
- Other issues affecting strategic fit

Success or Failure for Strategic Fit

- All processes and functions that are part of an organization's value chain contribute to its success or failure:
  - These processes and functions do not operate in isolation.
  - No one process or function can ensure the chain's success.
  - Failure at any one process or function can lead to failure of over chain.

Success or Failure for Strategic Fit

- The success or failure is thus linked to 3 reasons:

1. The competitive strategy and all the functional strategies must fit together to form a coordinated over all strategy. Each functional strategy must support other functional strategies and help a firm reach its competitive strategy goal

Success or Failure for Strategic Fit

- The success or failure is thus linked to 3 reasons:

2. The different functions in a company must appropriately structure their processes and resources to be able to execute these strategies successfully

Success or Failure for Strategic Fit

- The success or failure is thus linked to 3 reasons:

3. The design of the overall supply chain and the role of each stage must be aligned to support the supply chain strategy.

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

Step 1: Understanding the customer and supply chain uncertainty

- A firm must understand the customer needs for each targeted segment and the uncertainty these needs impose on supply chain.
- These needs help the company define the desired cost and requirements.
- The supply chain uncertainty helps the organization to identify the extend of unpredictability of demand, disruption and delay that the supply chain must be prepared for.

Step 1: Understanding the Customer and Supply Chain Uncertainty

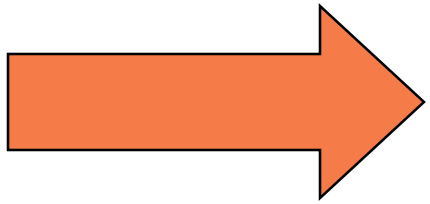
- Requires identifying:
  - **The needs of the customer segment being served**
  - **Quantity of product needed in each lot**
  - **Response time customers will tolerate**
  - **Variety of products needed**
  - **Service level required**
  - **Price of the product**
  - **Desired rate of innovation in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

Step 1: Understanding the Customer and Supply Chain Uncertainty

- Overall attribute of customer demand
- Demand uncertainty
- 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.

Achieving Strategic Fit

- Understanding the Customer
  - Lot size
  - Response time
  - Service level
  - Product variety
  - Price
  - Innovation



Implied Demand Uncertainty

Impact of Customer Needs on Implied Demand Uncertainty

Customer Need	Causes implied demand uncertainty to increase because …
Range of quantity increases	Wider range of quantity implies greater variance in demand
Lead time decreases	Less time to react to orders
Variety of products required increases	Demand per product becomes more disaggregated
Number of channels increases	Total customer demand is now disaggregated over more channels
Rate of innovation increases	New products tend to have more uncertain demand
Required service level increases	Firm now has to handle unusual surges in demand

Levels of Implied Demand Uncertainty

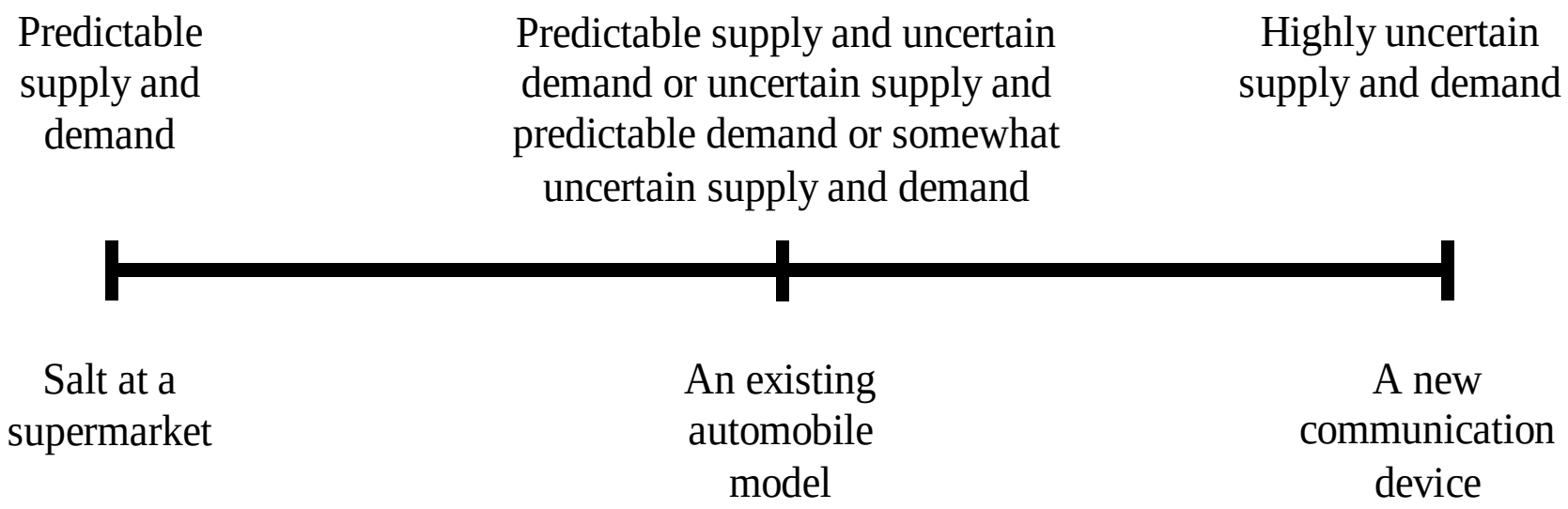


Figure 2.2: The Implied Uncertainty (Demand and Supply)

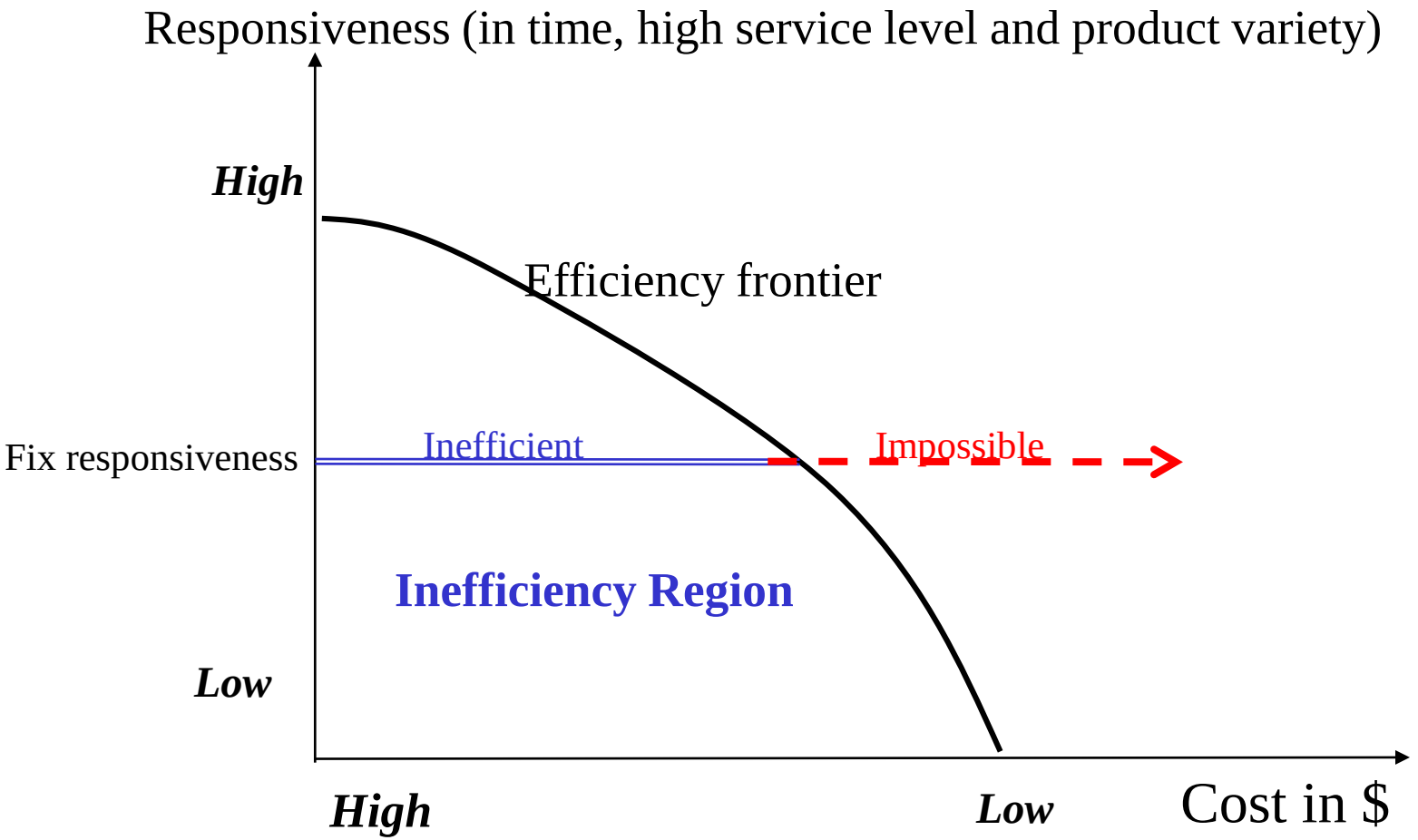
Correlation Between Implied Demand Uncertainty and Other Attributes

Attribute	Low Implied Uncertainty	High Implied Uncertainty
Product margin	Low	High
Avg. forecast error	10%	40%-100%
Avg. stockout rate	1%-2%	10%-40%
Avg. forced season-end markdown	0%	10%-25%

Step 2: Understanding the Supply Chain

- How does the firm best meet demand?
- Dimension describing the supply chain 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

Understanding the Supply Chain: Cost-Responsiveness Tradeoff



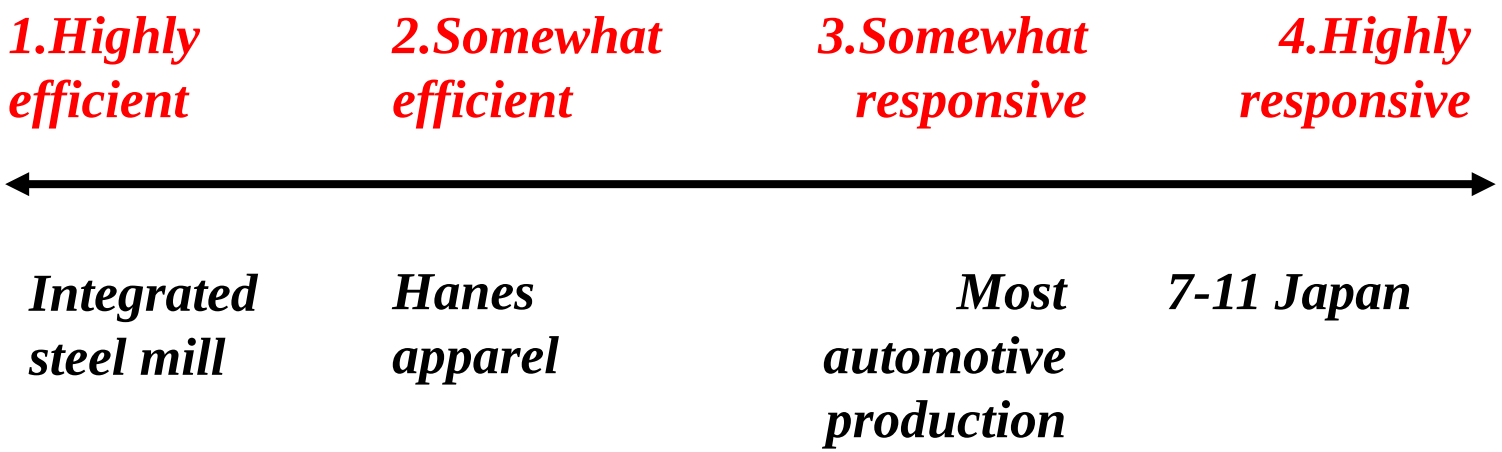
Why decreasing slope (concave) for the efficiency frontier?

Step 3: Achieving Strategic Fit

- **If a mismatch exists between what the supply chain does particularly well and the desired customer needs, the company will either need to restructure the supply chain to support the competitive strategy or alter its competitive strategy.**

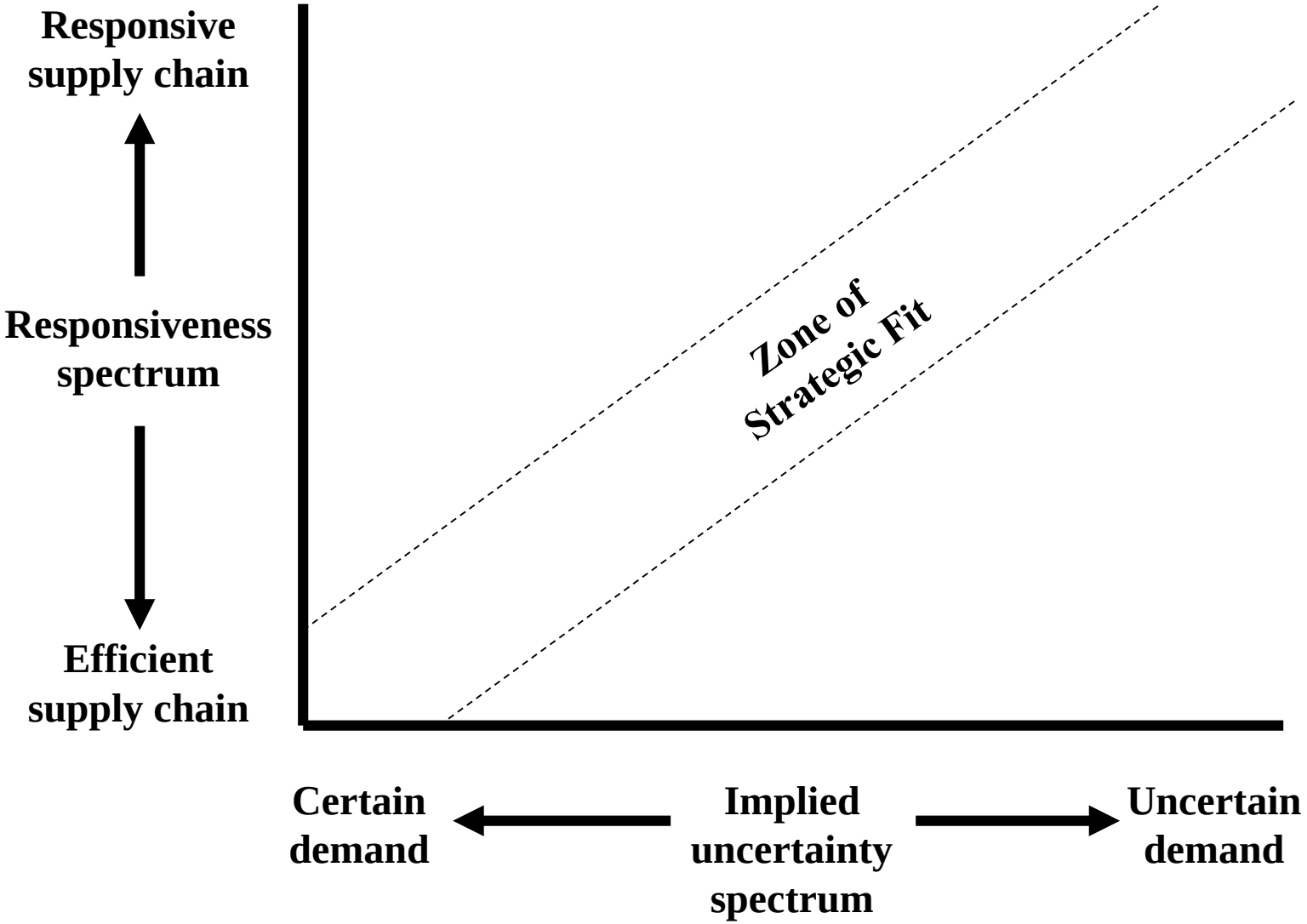
Responsiveness Spectrum

1. *Production scheduled ahead in months with little flexibility.*
2. *A make to stock manufacturer with production lead time of several weeks.*



3. *Delivering a large variety of products in a couple of weeks.*
4. *Changing merchandize mix by location and time of day.*

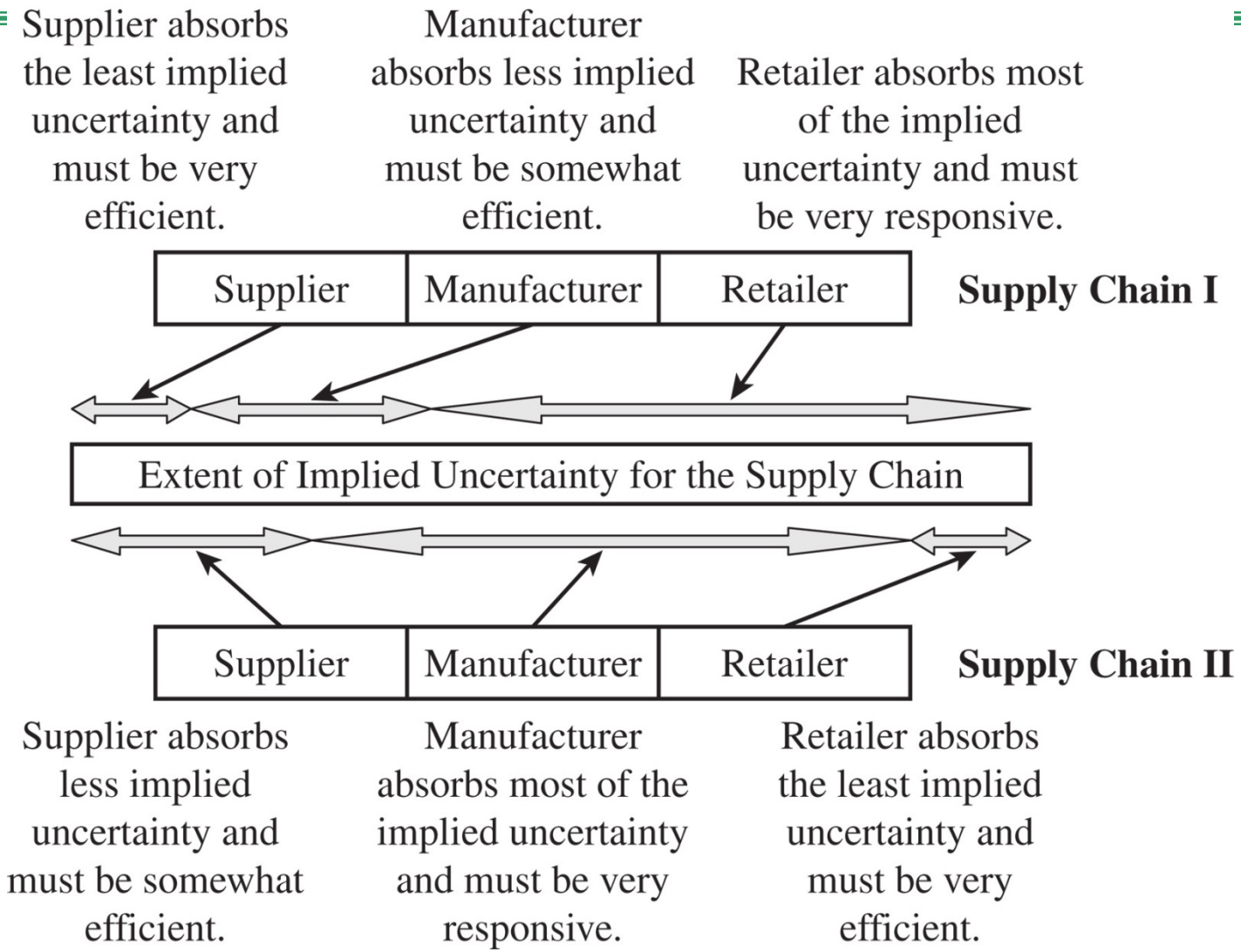
Achieving Strategic Fit Shown on the Uncertainty/Responsiveness Map (Fig. 2.5)



Step 3: Achieving Strategic Fit

- Two key points:
  - There is *no* right supply chain strategy independent of competitive strategy.
  - There *is* a right supply chain strategy for a given competitive strategy.

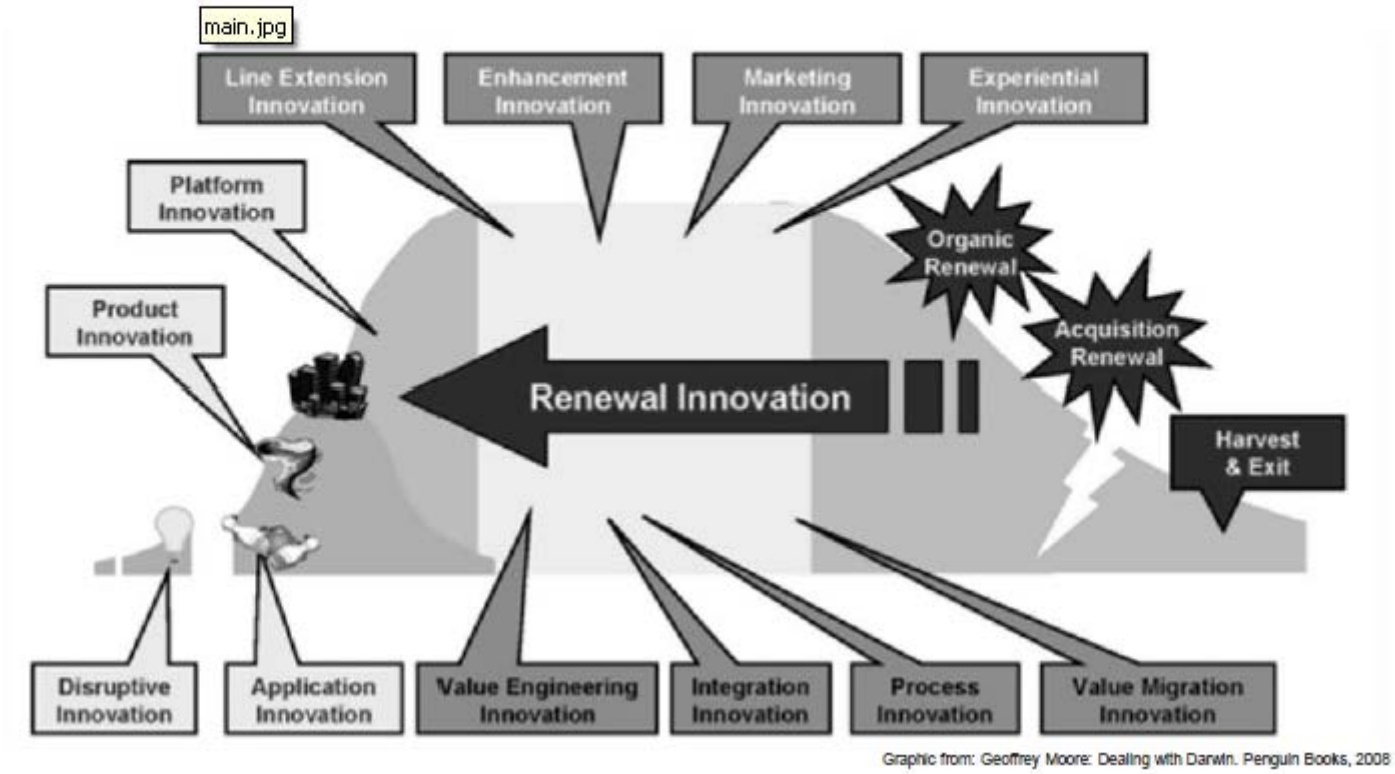
Roles and Allocations



Product Life Cycle

- The demand characteristics of a product and the needs of a customer segment change as a product goes through its life cycle.
- Supply chain strategy must evolve throughout the life cycle.
- Early: Uncertain demand, high margins (time is important), product availability is most important, cost is secondary.
- Late: Predictable demand, lower margins, price is important.

Relationship between SCM and PLC



Expanding Strategic Scope

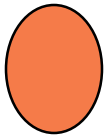
- Scope of strategic fit
  - The functions and stages within a supply chain that devise an integrated strategy with a shared objective.
  - One extreme: Each function at each stage develops its own strategy.
  - Other extreme: All functions in all stages devise a strategy jointly.
- Five categories:
  - Intra-company intra-operation scope
  - Intra-company intra-functional scope
  - Intra-company inter-functional scope
  - Inter-company inter-functional scope
  - Flexible inter-functional scope

Intra-company – *Intra-operation scope*

Intra-operation scope – Minimize local cost view

- Each stage of the supply chain devises strategy independently.
- The resulting collection of strategies normally do not align.
- This was the popular strategy of 1950s and 1960s, with cost minimization for each operation with in each stage of supply chain.

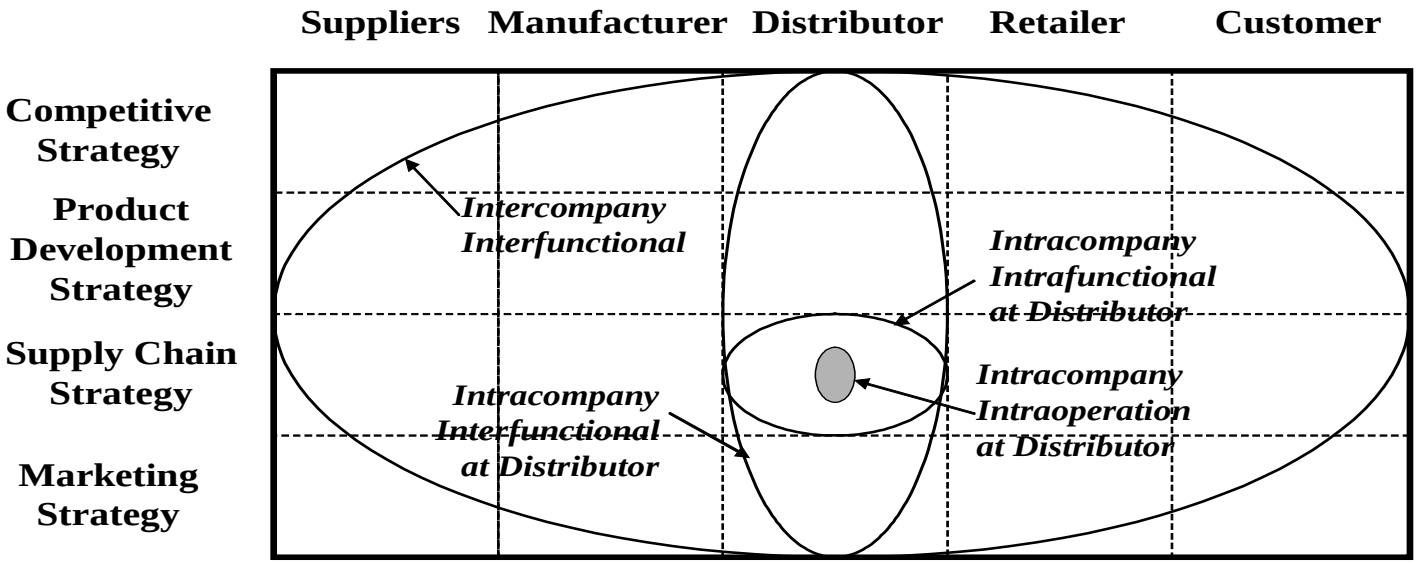
Strategic Scope: Intracompany Intraoperation Scope

	Suppliers	Manufacturer	Distributor	Retailer	Customer
Competitive Strategy					
Product Dev. Strategy					
Supply Chain Strategy					
Marketing Strategy					

Intracompany-Intrafunctional view Scope

- *Intra-functional* view – Minimize total functional cost
  - This came as a result of recognition of failure of Intra-company Intra-operation strategy.
  - **Firms align all operations within a function.**
  - **For instance, the use of air freight could only be justified if the resulting savings in inventories and improved responsiveness would justify the increase in transportation costs.**

Different Scopes of Strategic Fit Across a Supply Chain



Inter-company Inter-functional Scope

Intercompany scope – **Maximize supply chain surplus**

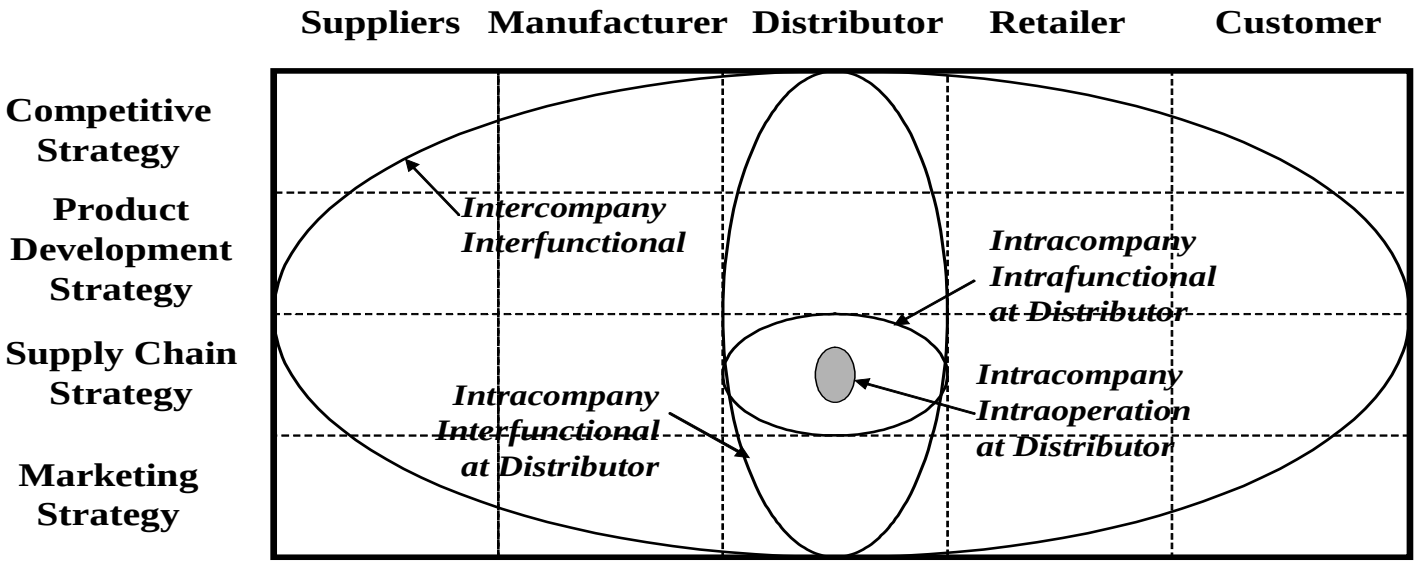
- The goal of only maximizing company profits can sometime lead to conflict between stages of supply chain.
- A common conflict being that supplier or the manufacturer. may want the other party to hold more profit so as to safe guard their own profits.
- The supply chain surplus can be compared to the pie, if the parties fight, the stronger party will have more share of the pie while reducing the size of the pie.

Intercompany Interfunctional Scope

Intercompany scope – **Proposes a different approach**

- Supplier and customer work together and share information to reduce total cost and grow supply chain surplus.
- By working together and sharing info they can reduce the inventories and total cost thus growing supply chain surplus.
- Higher the supply chain surplus, the more competitive the supply chain is.

Different Scopes of Strategic Fit Across a Supply Chain



Agile inter-company Scope

- *Agile intercompany scope* – A firm's ability to achieve strategic fit when partnering with supply chain stages that change over time.
- Dynamics exits – Product life cycle get shorter and companies try to satisfy the changing needs of individual customers.

Agile inter-company Scope

- In such situations, a company may have to partner with many different firms depending on the product being produced and the customer being served – strategic fit should have agile intercompany scope.

Quaid-e-Azam Strategy

- **"My message to you all is of hope, courage and confidence. Let us mobilize all our resources in a systematic and organized way and tackle the grave issues that confront us with grim determination and discipline worthy of a great nation."**

- **Eid-ul-Azha Message to the Nation**

October 24, 1947

Learning Objectives

1. Impellers of the Supply Chain
    1. Empowered Customers
    2. IS and IT Tools Development
    3. Globalization
2. Supply Chain Concepts
    1. Systems Concept
    2. Total Cost Concept
    3. Trade off Concept
3. Identify the major drivers of supply chain performance

Learning Objectives

4. Describe key financial measures of firm performance.
5. Discuss the role of each driver in creating strategic fit between the supply chain strategy and the competitive strategy.
6. Define the key metrics that track the performance of the supply chain in terms of each driver.
7. SCOR Model.

Impellers of the Supply Chain

- Impellers of supply chain development include those forces that are reshaping the businesses of today in a hyper competitive environment.

1. Empowered Customers:
2. IS and IT Tools Development
3. Globalization

Supply Chain Concepts

1. Systems Concept
2. Total Cost Concept
3. Trade off Concept

Total Cost Concept

1. Businesses should be viewed as Integrated systems and Interconnected chains with multiple links
2. Value delivered to the customer can only be increased if the total cost of the entire supply chain is reduced.

Why Financial Measures

Why Financial Measures

- While there is no right or wrong answer regarding the exact definition of supply chain management, the underlying effect of such a diversity of opinions is that the supply chain becomes a set of functionally dispersed ‘islands of power’.

Financial Measures Of Performance

- From a shareholder perspective, return on equity (ROE) is the main summary measure of a firm's performance.

$$ROE = \frac{\text{Net Income}}{\text{Average Shareholder Equity}}$$

Financial Measures Of Performance

- Return on assets (ROA) measures the return earned on each dollar invested by the firm in assets.

$$ROA = \frac{\text{Earnings before interest}}{\text{Average Total Assets}}$$

$$= \frac{\text{Net Income} + \left[\text{Interest expense} \times (1 - \text{tax rate})\right]}{\text{Average Total Assets}}$$

Financial Measures Of Performance

- An important ratio that defines financial leverage is **ACCOUNTS PAYABLE TURNOVER** (APT).

$$APT = \frac{\text{Cost of goods sold}}{\text{Accounts Payable}}$$

Financial Measures Of Performance

- ROA can be written as the product of two ratios – **PROFIT MARGIN** and **ASSET TURNOVER.**

$$ROA = \frac{\text{Earnings before interest}}{\text{Sales Revenue}} (\text{Profit Margin})$$

$$\times \frac{\text{Sales Revenue}}{\text{Total Assets}} (\text{Asset Turnover})$$

Financial Measures Of Performance

- Cash-to-cash (C2C) cycle roughly measures the average amount time from when cash enters the process as **COST** to when it returns as **COLLECTED REVENUE.**

C2C = – days payable (1/APT)
+ days in inventory (1/INVT)
+ days receivable (1/ART)

Cash 2 Cash as a Measurement of Lean Operations

Desired Results of Cash-to-Cash Cycle

Drivers of Supply Chain Performance

There are two types of SC performance drivers namely:

1. Logistical Drivers
2. Cross Functional Drivers

Drivers of Supply Chain Performance

The three logistical drivers are:

- Facilities
- Inventory
- Transportation

Drivers of Supply Chain Performance

The three cross functional drivers are:

- Pricing
- Information
- Sourcing

Drivers of Supply Chain Performance

- **Pricing**
  - **How much a firm will charge for the goods and services that it makes available in the supply chain.**

A Framework for Structuring Drivers

A Framework for Structuring Drivers

- What is a Framework?
  - **The structure that forms a support or frame for Supply Chain Drivers.**

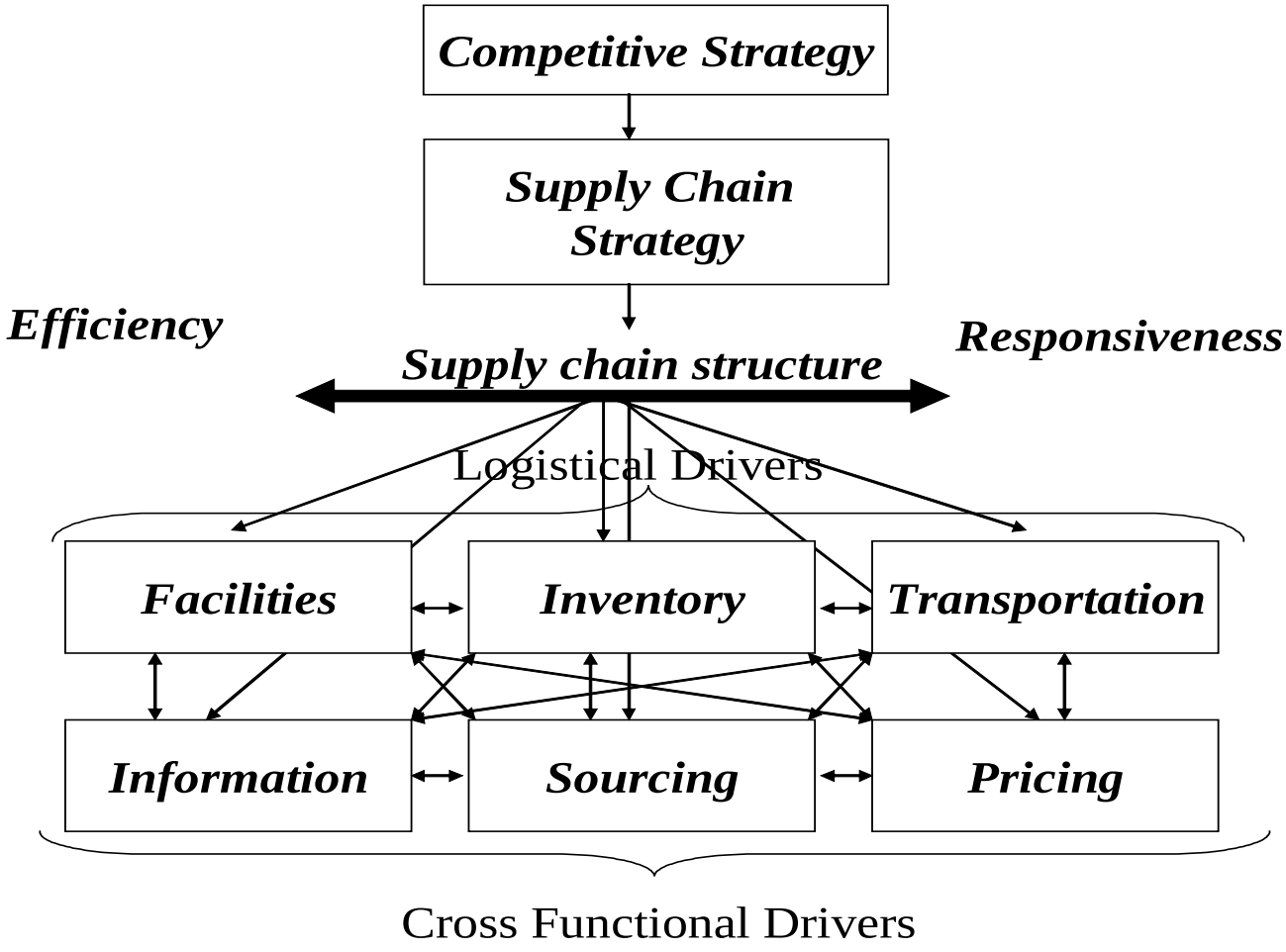
A Framework for Structuring Drivers

- **Role in the Competitive Advantage**
  - **It actually provides competitive advantage in two dimensions namely:**
    - **Economies of scale (efficiency priority)**
    - **Larger number of smaller facilities (responsiveness priority)**

A Framework for Structuring Drivers

- **Role in the competitive strategy**
  1. **Competitive Strategy**
  2. **Supply Chain Strategy (should balance between Efficiency and Responsiveness through SC Structure)**
  3. **Supply Chain Structure**
  4. **Logistical Drivers**
  5. **Cross Functional Drivers**

A Framework for Structuring Drivers



Facilities: Role in the supply chain

- The “where” of the supply chain
- **Manufacturing or storage (warehouses)**

Facilities: Role in the competitive strategy

Components of Facilities Decisions

- 1. Location
  - Centralization (efficiency) vs. decentralization (responsiveness)
  - Other factors to consider (e.g., proximity to customers)
- 2. Capacity (flexibility versus efficiency)
- 3. Manufacturing methodology (product focused versus process focused)

Components of Facilities Decisions

- **4.Warehousing methodology (SKU storage, job lot storage, cross-docking)**

- **5.Overall trade-off: Responsiveness versus efficiency**

Inventory: Role in the Supply Chain

- 1. Inventory exists because of a mismatch between supply and demand
- 2. Source of cost and influence on responsiveness

Inventory: Role in the Supply Chain

- 3. Impact on:
  - **Material flow time: time elapsed between when material enters the supply chain to when it exits the supply chain**
  - **Throughput**
    - **rate at which sales to end consumers occur**
    - **I = DT (Little's Law)**
    - **I = inventory; D = throughput; T = flow time**

Example – Nordstrom

Components of Inventory Decisions

- 1.Cycle inventory
  - Average amount of inventory used to satisfy demand between shipments
  - Depends on lot size
- 2.Safety inventory
  - Inventory held in case demand exceeds expectations
  - Costs of carrying too much inventory versus cost of losing sales

Components of Inventory Decisions

- **3.Seasonal inventory**
  - **Inventory built up to counter predictable variability in demand**
  - **Cost of carrying additional inventory versus cost of flexible production**
- **4.Overall trade-off: Responsiveness versus efficiency**
  - **More inventory: Greater responsiveness but greater cost**
  - **Less inventory: Lower cost but lower responsiveness**

Transportation: Role in the Supply Chain

- Moves the product between stages in the supply chain
- Impact on responsiveness and efficiency
- Faster transportation allows greater responsiveness but lower efficiency
- Also affects inventory and facilities

- Example: Laura Ashley

Components of Transportation Decisions

- Mode of transportation:
  - Air, truck, rail, ship, pipeline, electronic transportation
  - Vary in cost, speed, size of shipment, flexibility
- Route and network selection
  - Route: path along which a product is shipped
  - Network: collection of locations and routes
- In-house or outsource
- Overall trade-off: Responsiveness versus efficiency

Information: Role in the Supply Chain

- The connection between the various stages in the supply chain – allows coordination between stages.

Information: Role in the Competitive Strategy

- Allows supply chain to become more efficient and more responsive at the same time (reduces the need for a trade-off)
- Information technology
- What information is most valuable?
- Example: Andersen Windows

Components of Information Decisions

- Push (MRP) versus pull (demand information transmitted quickly throughout the supply chain)
- Coordination and information sharing
- Forecasting and aggregate planning
- Enabling technologies
  - EDI
  - Internet
  - ERP systems
  - Supply Chain Management software
- Overall trade-off: NONE!

Sourcing: Role in the Supply Chain

- Set of business processes required to purchase goods and services in a supply chain
- Supplier selection, single vs. multiple suppliers, contract negotiation

Components of Sourcing Decisions

- In-house versus outsource decisions
- Supplier evaluation and selection
- Procurement process
- Overall trade-off: Make vs. Buy

Pricing: Role in the Supply Chain

- Pricing determines the amount to charge customers in a supply chain
- Pricing strategies can be used to match demand and supply

Pricing: Role in the Competitive Strategy

- Firms can utilize optimal pricing strategies to improve efficiency and responsiveness
- Low price and low product availability; vary prices by response times
- Example: Amazon.com

Components of Pricing Decisions

- Pricing and economies of scale
- Everyday low pricing versus high-low pricing
- Fixed price versus menu pricing
- Overall trade-off: Increase the firm profits vs. customer retention/value

Challenges/Obstacles to Achieving Strategic Fit

- Increasing variety of products
- Decreasing product life cycles
- Increasingly demanding customers
- Fragmentation of supply chain ownership
- Globalization
- Difficulty executing new strategies

Learning Objectives

1. Identify the key factors to be considered when designing a distribution network.
2. Discuss the strengths and weaknesses of various distribution options.
3. Understand how online sales have affected the design of distribution networks in different industries.
4. Distribution Network in practice.

The Role of Distribution in the Supply Chain

- *Distribution* – The steps taken to move and store a product from the supplier stage to the customer stage in a supply chain.
- Drives profitability by directly affecting supply chain cost and the customer experience.
- Choice of distribution network can achieve supply chain objectives from low cost to high responsiveness.

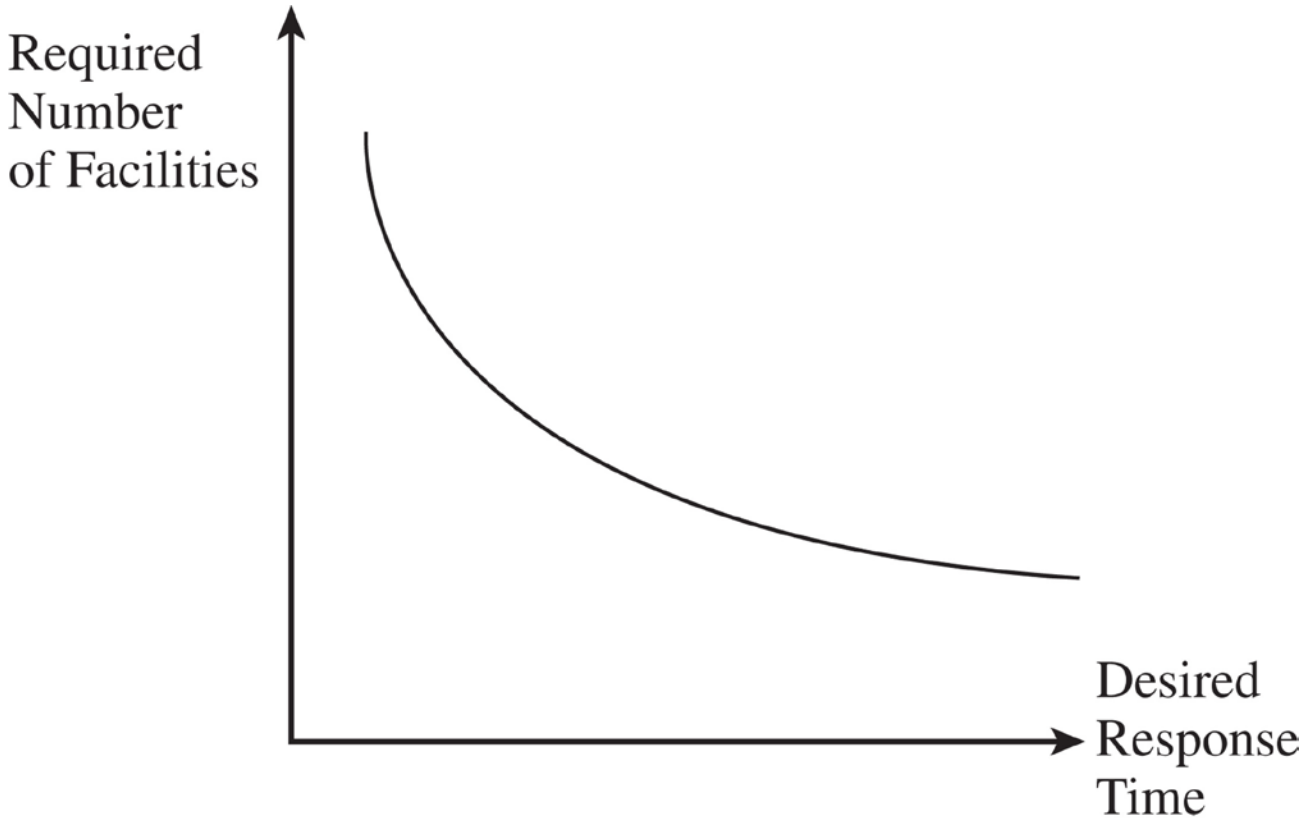
Factors Influencing Distribution Network Design

- Distribution network performance is evaluated along two dimensions:
  1. Customer needs that are met.
  2. Cost of meeting customer needs.
- Evaluate the impact on customer service and cost for different distribution network options.
- Profitability of the delivery network determined by revenue from met customer needs and network costs.

Factors Influencing Distribution Network Design

- Elements of customer service influenced by network structure:
  - Response time
  - Product variety
  - Product availability
  - Customer experience
  - Order visibility
  - Returnability

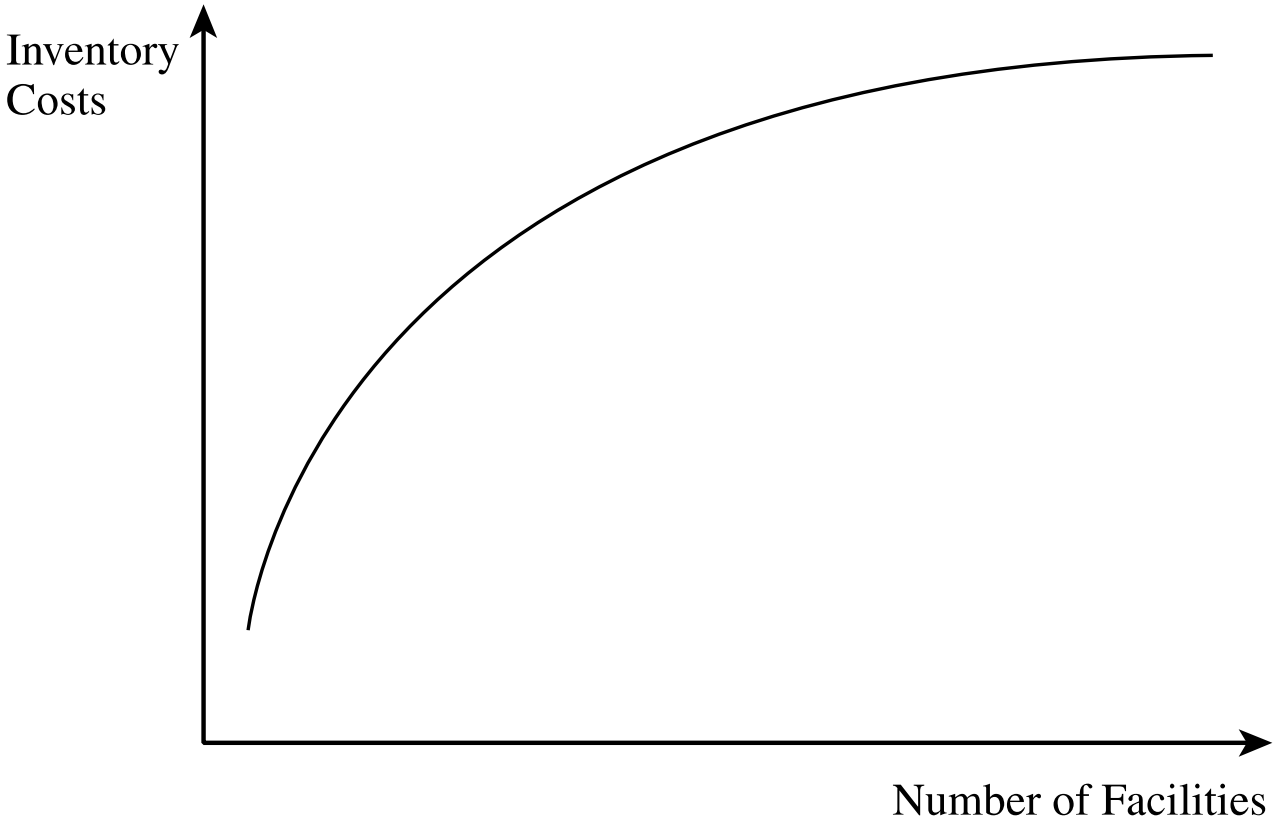
Desired Response Time and Number of Facilities



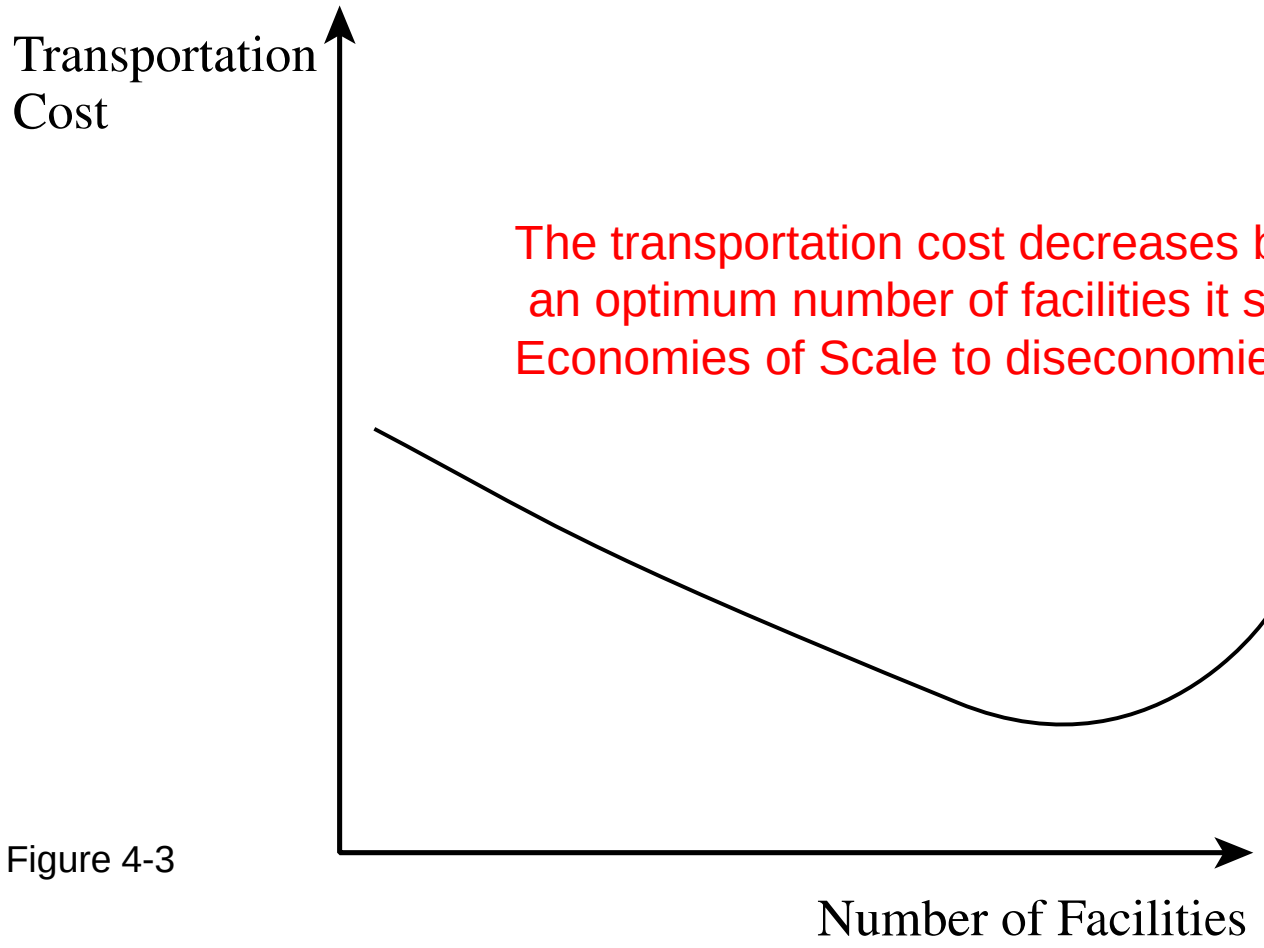
Desired Response Time and Number of Facilities

Firms that target customers who can tolerate a long response time require only.

Inventory Costs and Number of Facilities



Transportation Costs and Number of Facilities



The transportation cost decreases but after reaching an optimum number of facilities it starts increasing Economies of Scale to diseconomies of Scale

Figure 4-3

Facility Costs and Number of Facilities

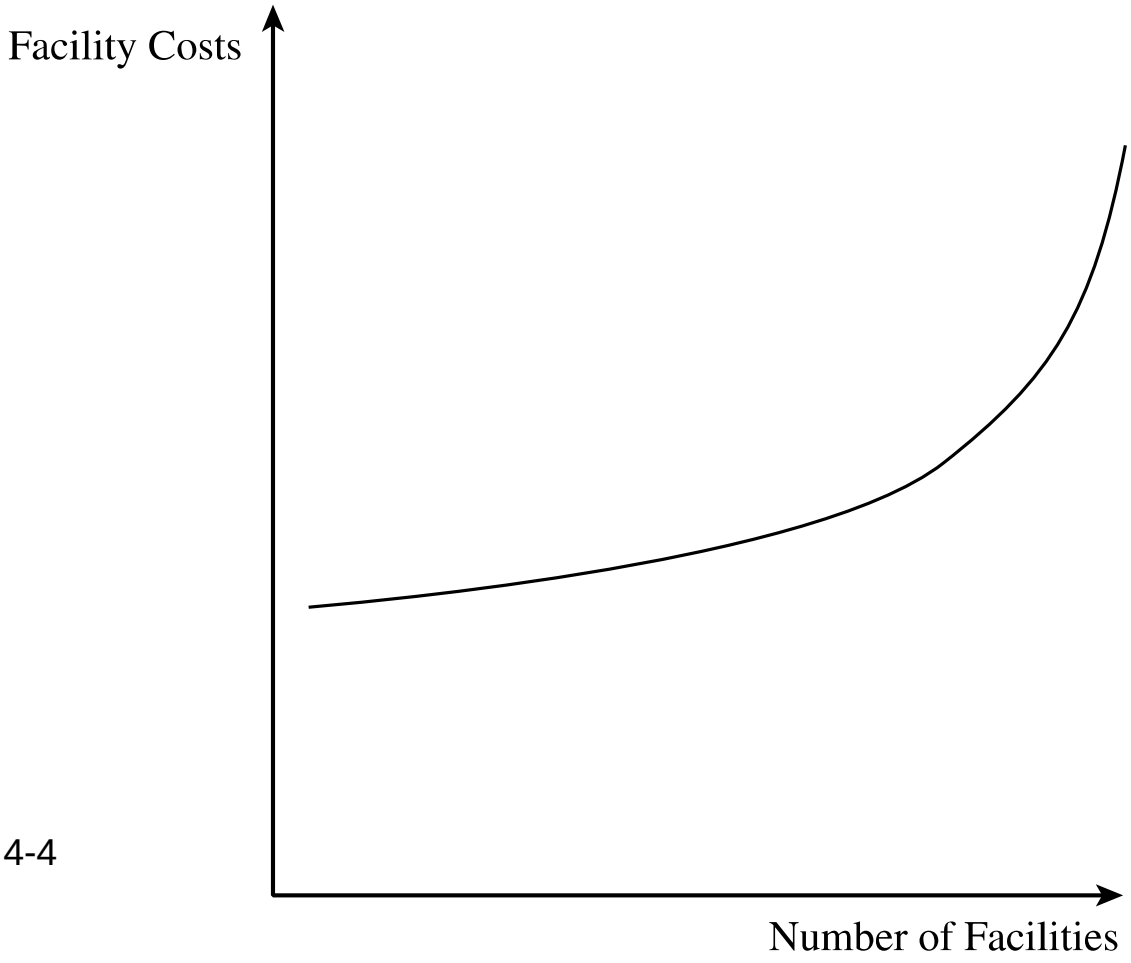


Figure 4-4

Logistics Cost, Response Time, and Number of Facilities

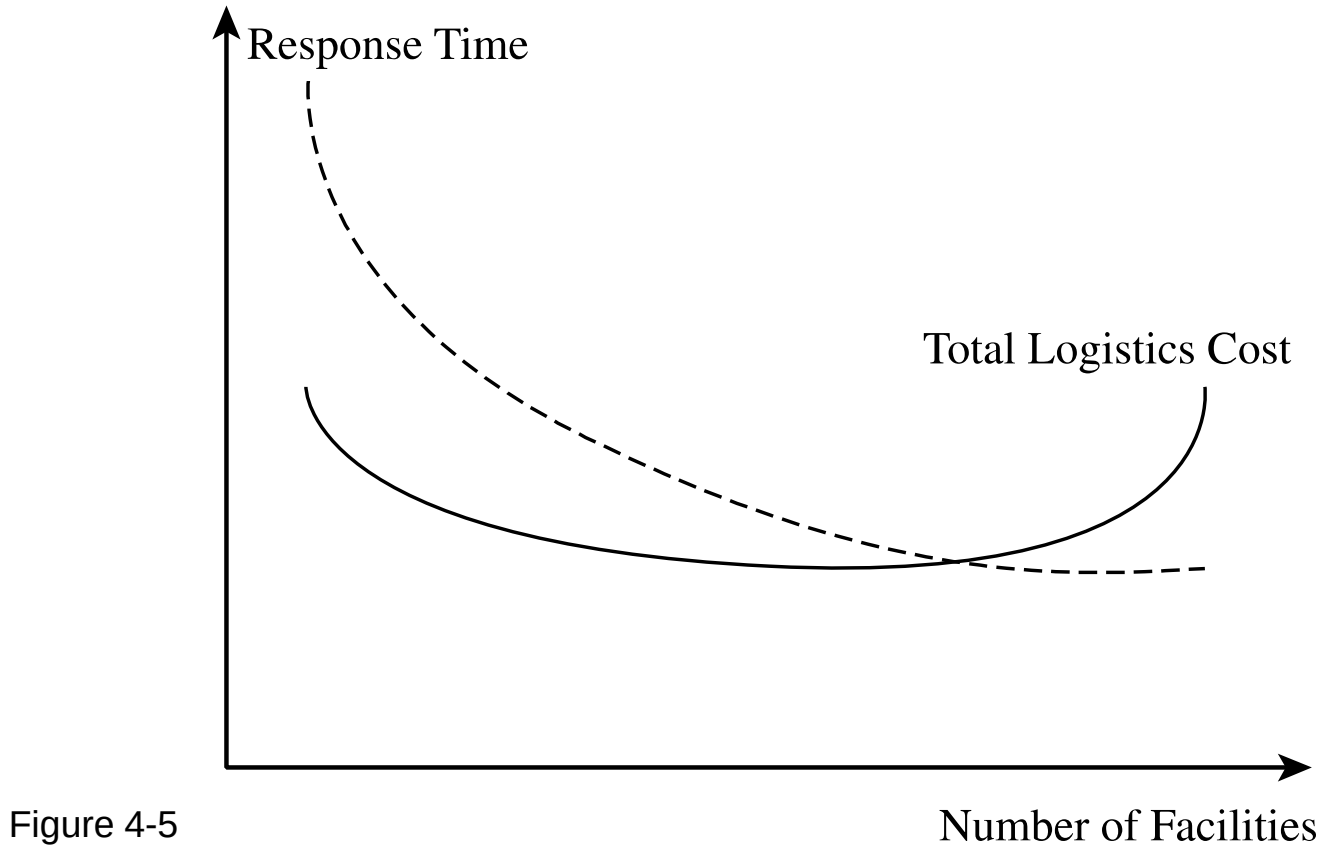


Figure 4-5

Design Options for a Distribution Network

- Distribution network choices from the manufacturer to the end consumer.
- Two key decisions:
  1. Will product be delivered to the customer location or picked up from a prearranged site?
  2. Will product flow through an intermediary (or intermediate location)?

Design Options for a Distribution Network

- One of six designs may be used:
  1. Manufacturer storage with direct shipping
  2. Manufacturer storage with direct shipping and in-transit merge
  3. Distributor storage with carrier delivery
  4. Distributor storage with last-mile delivery
  5. Manufacturer/distributor storage with customer pickup
  6. Retail storage with customer pickup

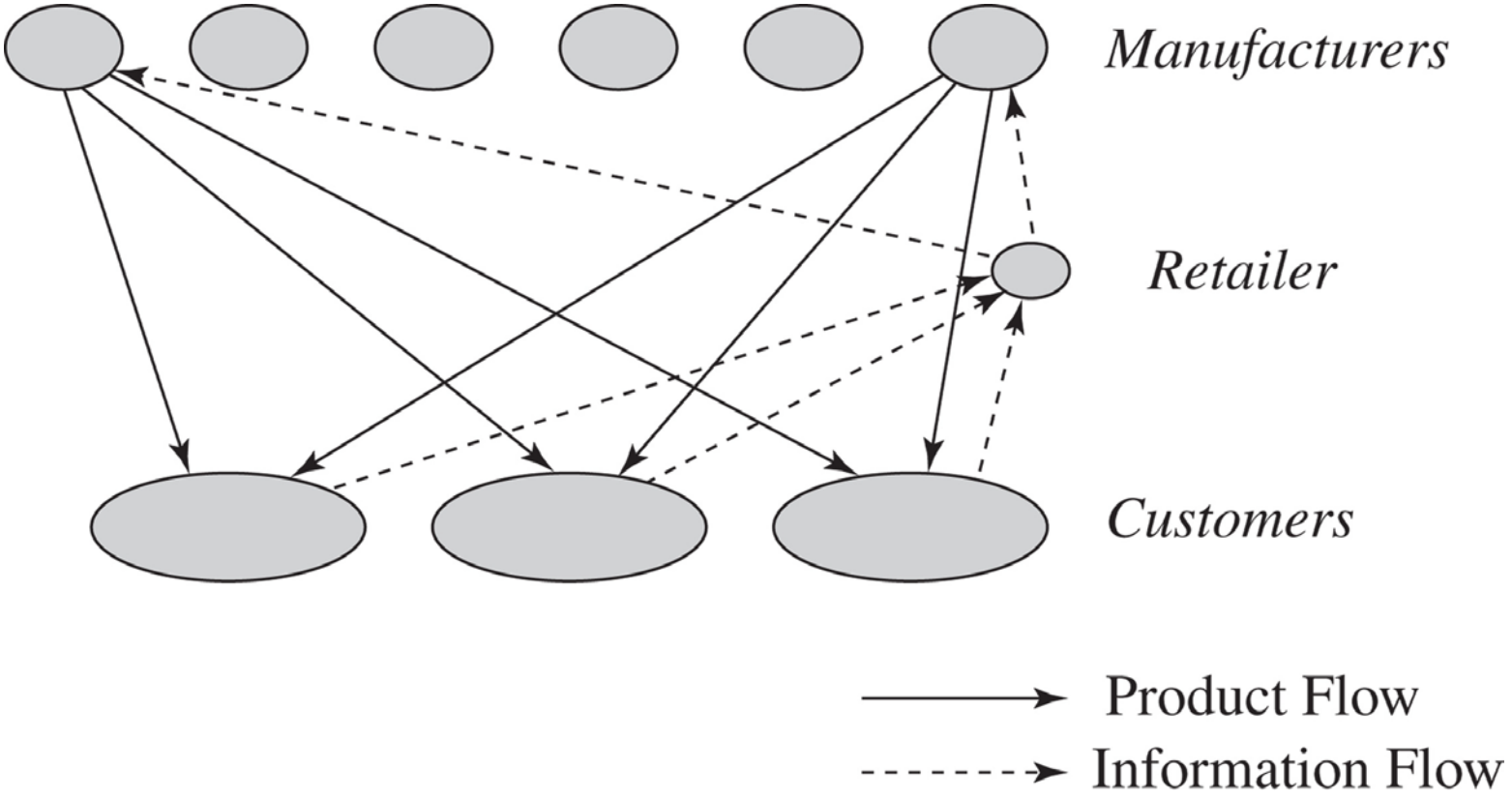
Manufacturer Storage with Direct Shipping

- In this option, product is shipped directly from the manufacturer to the end customer, bypassing the retailer (who takes the order and initiates the delivery request). This option is also referred to as drop shipping.

Manufacturer Storage with Direct Shipping

- Online retailers such as e-bags and Nordstrom.com use drop shipping to deliver goods to the end consumer. e-bags does not hold any inventory of bags and has them drop shipped directly from the manufacturer to the customer.

Manufacturer Storage with Direct Shipping



Manufacturer Storage with Direct Shipping

- The biggest advantage of drop shipping is the ability to centralize inventories at the manufacturer.
- A manufacturer can aggregate demand and provide a high level of product availability with lower levels of inventory than individual retailers.
- The benefits from centralization are highest for **high value, low volume items** with unpredictable demand.
- The decision of Nordstrom to drop-ship low volume shoes satisfies these criteria.

Manufacturer Storage with Direct Shipping

- Also, bags sold by e-bags tend to have **high value and low relatively volume** per SKU.
- The inventory benefits of aggregation are small for items with predictable demand and low value. Thus, drop shipping would not offer a significant inventory advantage to an online grocer selling a staple item like detergent.

Manufacturer Storage with Direct Shipping

- Transportation costs are high with drop shipping because the average outbound distance to the end consumer is large and package carriers must be used to ship the product.
- Package carriers have high shipping costs per unit compared to truckload(TL) or less-than-truckload (LTL) carriers.
- With drop shipping, a customer order with items from several manufacturers will involve multiple shipments to the customer. This loss in aggregation in outbound transportation further increases cost.

Manufacturer Storage with Direct Shipping

- Supply chains save on the **fixed cost** of storage facilities when using drop shipping because all inventories are centralized at the manufacturer.
- There can be some **savings of handling costs** as well because the transfer from manufacturer to retailer no longer occurs.
- **Handling costs** can be significantly reduced if the manufacturer has the capability to ship orders directly from the production line.

Manufacturer Storage with Direct Shipping

- A good **information infrastructure** is needed so that the retailer can provide product availability information to the customer even though the inventory is located at the manufacturer.
- The customer should also have visibility into **order processing** at the manufacturer even though the order is placed with the retailer.
- Drop shipping will generally require significant investment in the **information infrastructure**. The information infrastructure requirement is somewhat simpler for direct sellers like Dell because two stages (retailer and manufacturer) do not need to be integrated.

Manufacturer Storage with Direct Shipping Network

Cost Factor	Performance
Inventory	Lower costs because of aggregation. Benefits of aggregation are highest for low-demand, high-value items. Benefits are large if product customization can be postponed at the manufacturer.
Transportation	Higher transportation costs because of increased distance and disaggregate shipping.
Facilities and handling	Lower facility costs because of aggregation. Some saving on handling costs if manufacturer can manage small shipments or ship from production line.
Information	Significant investment in information infrastructure to integrate manufacturer and retailer.

Manufacturer Storage with Direct Shipping Network

Service Factor	Performance
Response time	Long response time of one to two weeks because of increased distance and two stages for order processing. Response time may vary by product, thus complicating receiving.
Product variety	Easy to provide a high level of variety.
Product availability	Easy to provide a high level of product availability because of aggregation at manufacturer.
Customer experience	Good in terms of home delivery but can suffer if order from several manufacturers is sent as partial shipments.
Time to market	Fast, with the product available as soon as the first unit is produced.
Order visibility	More difficult but also more important from a customer service perspective.
Returnability	Expensive and difficult to implement.

In-Transit Merge

Cost Factor	Performance
Inventory	Similar to drop-shipping.
Transportation	Somewhat lower transportation costs than drop-shipping.
Facilities and handling	Handling costs higher than drop-shipping at carrier; receiving costs lower at customer.
Information	Investment is somewhat higher than for drop-shipping.

In-Transit Merge

Service Factor	Performance
Response time	Similar to drop-shipping; may be marginally higher.
Product variety	Similar to drop-shipping.
Product availability	Similar to drop-shipping.
Customer experience	Better than drop-shipping because only a single delivery has to be received.
Time to market	Similar to drop-shipping.
Order visibility	Similar to drop-shipping.
Returnability	Similar to drop-shipping.

Manufacturer Storage with Direct Shipping & In-Transit Merge

- Under this option, inventory is not held by manufacturers at the factories but is held by distributors / retailers in intermediate warehouses and package carriers are used to transport products from the intermediate location to the final customer.
- Information and product flows when using distributor storage with delivery by a package carrier.

Distributor Storage with Carrier Delivery

Cost Factor	Performance
Inventory	Higher than manufacturer storage. Difference is not large for faster moving items but can be large for very slow-moving items.
Transportation	Lower than manufacturer storage. Reduction is highest for faster moving items.
Facilities and handling	Somewhat higher than manufacturer storage. The difference can be large for very slow-moving items.
Information	Simpler infrastructure compared to manufacturer storage.

Distributor Storage with Carrier Delivery

Service Factor	Performance
Response time	Faster than manufacturer storage.
Product variety	Lower than manufacturer storage.
Product availability	Higher cost to provide the same level of availability as manufacturer storage.
Customer experience	Better than manufacturer storage with drop-shipping.
Time to market	Higher than manufacturer storage.
Order visibility	Easier than manufacturer storage.
Returnability	Easier than manufacturer storage.

Distributor Storage with Last Mile Delivery

Cost Factor	Performance
Inventory	Higher than distributor storage with package carrier delivery.
Transportation	Very high cost given minimal scale economies. Higher than any other distribution option.
Facilities and handling	Facility costs higher than manufacturer storage or distributor storage with package carrier delivery, but lower than a chain of retail stores.
Information	Similar to distributor storage with package carrier delivery.

Distributor Storage with Last Mile Delivery

Service Factor	Performance
Response time	Very quick. Same day to next-day delivery.
Product variety	Somewhat less than distributor storage with package carrier delivery but larger than retail stores.
Product availability	More expensive to provide availability than any other option except retail stores.
Customer experience	Very good, particularly for bulky items. Slightly higher than distributor storage with package carrier delivery.
Time to market	Less of an issue and easier to implement than manufacturer storage or distributor storage with package carrier delivery.
Order visibility	Easier to implement than other previous options.
Returnability	Harder and more expensive than a retail network.

Manufacturer or Distributor Storage with Customer Pickup

Cost Factor	Performance
Inventory	Can match any other option, depending on the location of inventory.
Transportation	Lower than the use of package carriers, especially if using an existing delivery network.
Facilities and handling	Facility costs can be high if new facilities have to be built. Costs are lower if existing facilities are used. The increase in handling cost at the pickup site can be significant.
Information	Significant investment in infrastructure required.

Manufacturer or Distributor Storage with Customer Pickup

Service Factor	Performance
Response time	Similar to package carrier delivery with manufacturer or distributor storage. Same-day delivery possible for items stored locally at pickup site.
Product variety	Similar to other manufacturer or distributor storage options.
Product availability	Similar to other manufacturer or distributor storage options.
Customer experience	Lower than other options because of the lack of home delivery. Experience is sensitive to capability of pickup location.
Time to market	Similar to manufacturer storage options.
Order visibility	Difficult but essential.
Returnability	Somewhat easier given that pickup location can handle returns.

Retail Storage with Customer Pickup

Cost Factor	Performance
Inventory	Higher than all other options.
Transportation	Lower than all other options.
Facilities and handling	Higher than other options. The increase in handling cost at the pickup site can be significant for online and phone orders.
Information	Some investment in infrastructure required for online and phone orders.

Retail Storage with Customer Pickup

Service Factor	Performance
Response time	Same-day (immediate) pickup possible for items stored locally at pickup site.
Product variety	Lower than all other options.
Product availability	More expensive to provide than all other options.
Customer experience	Related to whether shopping is viewed as a positive or negative experience by customer.
Time to market	Highest among distribution options.
Order visibility	Trivial for in-store orders. Difficult, but essential, for online and phone orders.
Returnability	Easier than other options because retail store can provide a substitute.

Comparative Performance of Delivery Network Designs

	Retail Storage with Customer Pickup	Manufacturer Storage with Direct Shipping	Manufacturer Storage with In-Transit Merge	Distributor Storage with Package Carrier Delivery	Distributor Storage with Last-Mile Delivery	Manufacturer Storage with Pickup
Response time	1	4	4	3	2	4
Product variety	4	1	1	2	3	1
Product availability	4	1	1	2	3	1
Customer experience	Varies from 1 to 5	4	3	2	1	5
Time to market	4	1	1	2	3	1
Order visibility	1	5	4	3	2	6
Returnability	1	5	5	4	3	2
Inventory	4	1	1	2	3	1
Transportation	1	4	3	2	5	1
Facility and handling	6	1	2	3	4	5
Information	1	4	4	3	2	5

Key: 1 corresponds to the strongest performance and 6 the weakest performance.

Delivery Networks for Different Product/ Customer Characteristics

	Retail Storage with Customer Pickup	Manufacturer Storage with Direct Shipping	Manufacturer Storage with In-Transit Merge	Distributor Storage with Package Carrier Delivery	Distributor Storage with Last-Mile Delivery	Manufacturer Storage with Pickup
High-demand product	+2	–2	–1	0	+1	–1
Medium-demand product	+1	–1	0	+1	0	0
Low-demand product	–1	+1	0	+1	–1	+1
Very low-demand product	–2	+2	+1	0	–2	+1
Many product sources	+1	–1	–1	+2	+1	0
High product value	–1	+2	+1	+1	0	+2
Quick desired response	+2	–2	–2	–1	+1	–2
High product variety	–1	+2	0	+1	0	+2
Low customer effort	–2	+1	+2	+2	+2	–1

Key: +2 = very suitable; +1 = somewhat suitable; 0 = neutral; –1 = somewhat unsuitable; –2 = very unsuitable.

Distribution Networks in Practice

1. The ownership structure of the distribution network can have as big as an impact as the type of distribution network.
2. It is important to have adaptable distribution networks.
3. Product price, commoditization, and criticality affect the type of distribution system preferred by customers.
4. Integrate the Internet with the existing physical network.

Learning Objectives

1. Understand the role of network design in a supply chain.
2. Identify factors influencing supply chain network design decisions.
3. Develop a framework for making network design decisions.
4. Use optimization for facility location and capacity allocation decisions.
5. Effect of IT /IS on SCM Network Design
6. Practical Issues

Network Design Decisions

- Searches for answers for Facility Role, Facility location,Capacity allocation, Market and supply allocation, Strategic factors, Technological factors, Macroeconomic factors, Political, Infrastructure factors, Competitive factors,Customer response time and local presence and Logistics / facility costs **in a supply chain.**

Network Design Decisions

- Supply Chain Network Design Decisions include the assignment of Facility role, location of manufacturing, storage or transportation related facilities and the allocation of capacity and markets to each facility.

Network Design Decisions Classification

- Facility role
  - What role should each facility play?,
  - What processes are to be performed at each facility?
- Facility location
  - Where should facilities be located?
- Capacity allocation
  - How much capacity should be allocated at each facility?
- Market and supply allocation
  - What markets should each facility serve?
  - Which supply sources should feed each facility?

Network Design Decisions :Significance and Impact

- Network Design decisions have a significant impact on performance because they determine the supply chain configuration and set constraints within which other supply chain drivers can be used either to decrease supply chain cost or increase responsiveness.

Facility role : Significance and Impact

- Decisions concerning the role of each facility are significant because they determine the amount of flexibility the supply chain has in changing way it meets the demand.

Facility Location: Significance and Impact

- Facility location decisions have a strong and long term impact on the performance of supply chain because it is strategically expensive to shutdown a facility or move it to a different location.
- A good location decision should keep the costs down with reasonable high responsiveness.

Facility Location: Significance and Impact

- In contrast a poorly located facility makes it very difficult for a supply chain to perform close to the efficient frontier.

Capacity allocation : Significance and Impact

- Capacity Allocation decisions also have significant impact on supply chain performance.
- Capacity allocation can be easily altered as compared to location, capacity allocation tends to stay stable for years.
- Allocating too much capacity would lead to poor utilization and idle inventory as a result higher costs. Allocating too little capacity would lead to poor responsiveness and if demand is filled from distant facility than higher costs.

Conclusion: Significance and Impact

- Network design decisions must be revisited as a firm grows or when two companies merge.
- **As redundancies and differences in markets served by either of the two separate firms consolidation some facilities and changing the location and role of others can help reduce cost and improve responsiveness.**

Possible strategic roles

Kasra Ferdows suggests possible strategic roles for various facilities in a global supply chain network.

1. Off shore Facility: Low cost facility for export production.
2. Source Facility: Low cost facility for global production.
3. Server Facility: Regional Production Facility.

Possible strategic roles

4. Contributor Facility: Regional production facility with development skills.
5. Output Facility: Regional production facility built to gain local skills.
6. Lead Facility: Facility that leads in development and process technologies.

Factors Influencing Network Design Decisions

1. Strategic factors
2. Tactical & Operational factors
3. Technological factors
4. Macroeconomic factors
   - Tariffs and tax incentives
   - Exchange-rate and demand risk
   - Freight and fuel costs
5. Political

Factors Influencing Network Design Decisions

6. Infrastructure factors
7. Competitive factors
   - Positive externalities between firms
   - Locating to split the market
8. Customer response time and local presence
9. Logistics and facility costs

1. Strategic Factors

- A firms competitive strategy has a significant impact on network design with in supply chain e.g.
  - Apparel and manufacturing to china, Zara has apparel facility in Portugal and Spain to provide quick response.
- Convenience stores aim to provide easy access to customers as a part of competitive strategy.

1.Strategic Factors

- Firms focusing on cost leadership (Efficiency) tend to find the lowest cost location for their manufacturing facilities, even if that means locating very far from the markets they serve.
- Firms focusing on responsiveness (Agility) tend to locate facilities closer to the market and may select a high-cost location if this choice allows the firm to quickly react to changing market needs.

1.Strategic Factors

- Global Supply Chain networks can best support their strategic objectives with facilities in different countries playing different roles.e.g.
  - Nike has mass production facilities in china and indonesia and innovative-high responsivenes and high priced facilities in korea and taiwan.
- Kisra Ferdows suggests possible strategic roles for various facilities in a global supply chain network.

2. Operational & Tactical

- Market Advertisement and Progressive campaign
- Market Reach
- Product Type
- Network Size
- Transportation Costs
- Seasonal effects

3. Technological Factors

- If production technology displays significant economies of scale, a few high-capacity locations are the most effective.
- In contrast, if facilities have lower fixed costs, many local facilities are preferred because this helps lower transportation costs.

4. Macro Economic Factors

- **Macroeconomic Factors.** *Macroeconomic factors* include:
  - Taxes, tariffs, exchange rates, and other economic factors that are not internal to an individual firm.
  - If a country has very high tariffs, companies either do not serve the local market or set up manufacturing plants within the country to save on duties.
- High tariffs lead to more production locations within a supply chain network, with each location having a lower allocated capacity.

5. **Political Factors**

- Companies prefer to locate facilities in politically stable countries where the rules of commerce are well defined.
- Countries with independent and clear legal systems allow firms to feel that they have recourse in the courts should they need it.
- This makes it easier for companies to invest in facilities in these countries. Political stability is hard to quantify, so a firm makes an essentially subjective evaluation when designing its supply chain network.

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- This makes it easier for companies to invest in facilities in these countries. Political stability is hard to quantify, so a firm makes an essentially subjective evaluation when designing its supply chain network.

6. **Infrastructure Factors**

- The availability of good infrastructure is an important prerequisite to locating a facility in a given area.
- Poor infrastructure adds to the cost of doing business from a given location.
- Key infrastructure elements to be considered during network design include availability of sites, labor availability, proximity to transportation terminals, rail service, proximity to airports and seaports, highway access, congestion, and local utilities.

7. **Competitive Factors**

- Companies must consider competitors' strategy, size, and location when designing their supply chain networks.
- A fundamental decision firms make is whether to locate their facilities close to competitors or far from them.
- How the firms compete and whether external factors such as raw material or labor availability force them to locate close to each other influence this decision.

Competitive Factors

– Positive externalities between firms:

- Collocation benefits all as it increases demand and benefits all the players like the mechanics workshops along the highways.
- Convenience stores, apparel outlets in the city.
- What positive externalities you can think of in the Pakistani Context with respect to Global Supply Chains or any local SC?
- Suzuki developed Supply Chain of Vendors in Pakistan followed by other automobile manufacturers.

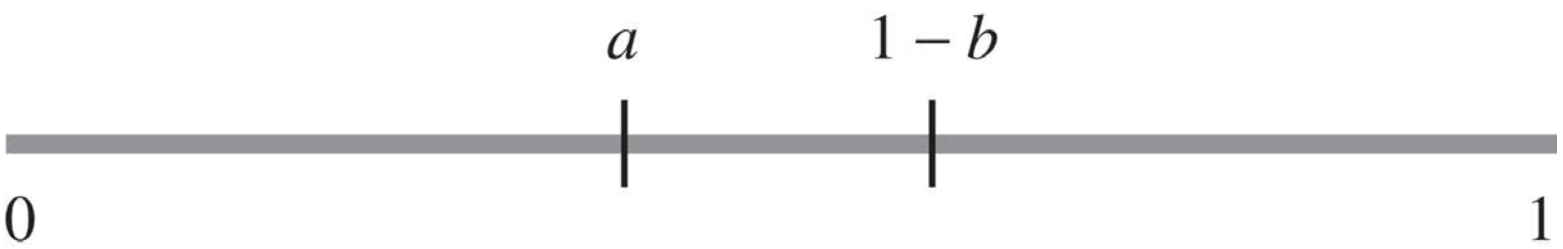
Competitive Factors

- In the absence of Positive externalities between firms, firms opt to capture the largest share of the market.
  - Collocation benefits all

- Locating close to each other to split the market , market segment is between line 0 and 1, customer closest to the firm and the equidistant customer is split evenly between the two firms.
  - Locate to capture largest market share

Competitive Factors

Figure 5-1



– Locating to split the market

- Locate to capture largest market share.
- If total demand is 1, Firm 1 locates at point a, Firm 2 locates at point b, the demand at the two firms, d1 and 2 is given by:

$$d_1 = a + \frac{1 - b - a}{2} \quad \text{and} \quad d_2 = \frac{1 + b - a}{2}$$

8. **Customer Response Time & Local Presence**

- Firms that target customers who value a short response time must locate close to them.
- If a firm is delivering its product to customers, use of a rapid means of transportation allows it to build fewer facilities and still provide a short response time.
- This option, however, increases transportation costs. Moreover, there are many situations where the presence of a facility close to a customer is important.

9. Logistics and Facility Costs.

- **Logistics and facility costs incurred within a supply chain change as the number of facilities, their location, and capacity allocation is changed.**
- **Companies must consider inventory, transportation, and facility costs when designing their supply chain networks. Inventory and facility costs increase as the number of facilities in a supply chain increase.**
- **Transportation costs decrease as the number of facilities is increased.**

9. **Logistics and Facility Costs.**

- Increasing the number of facilities to a point where inbound economies of scale are lost increases transportation cost.
- The supply chain network design is also influenced by the transformation / Operation occurring at each facility.
- When there is a significant reduction in material weight or volume as a result of processing, it may be better to locate facilities closer to the supply source rather than the customer.

9. **Logistics and Facility Costs.**

- Total logistics costs are a sum of the inventory, transportation, and facility costs.
- The facilities in a supply chain network must at least equal the number that minimizes total logistics costs.
- A firm may increase the number of facilities beyond this point to improve the response time to its customers.
- This decision is justified if the revenue increase from improved response outweighs the increased cost from additional facilities.

Framework for Network Design Decisions

- **The** four phases in the framework for network design decisions:
  - **Phase I: Define a Supply Chain Strategy/Design**
  - **Phase II: Define the Regional Facility Configuration**
  - **Phase III: Select Desirable Sites**
  - **Phase IV: Location Choices**

Phase I: Define a Supply Chain Strategy

- The objective of the first phase of network design is to define a firm's supply chain strategy.
- The supply chain strategy specifies what capabilities the supply chain network must have to support a firm's competitive strategy.
- Phase I starts with a clear definition of the firm's competitive strategy as the set of customer needs that the supply chain aims to satisfy.

Phase I: Define a Supply Chain Strategy

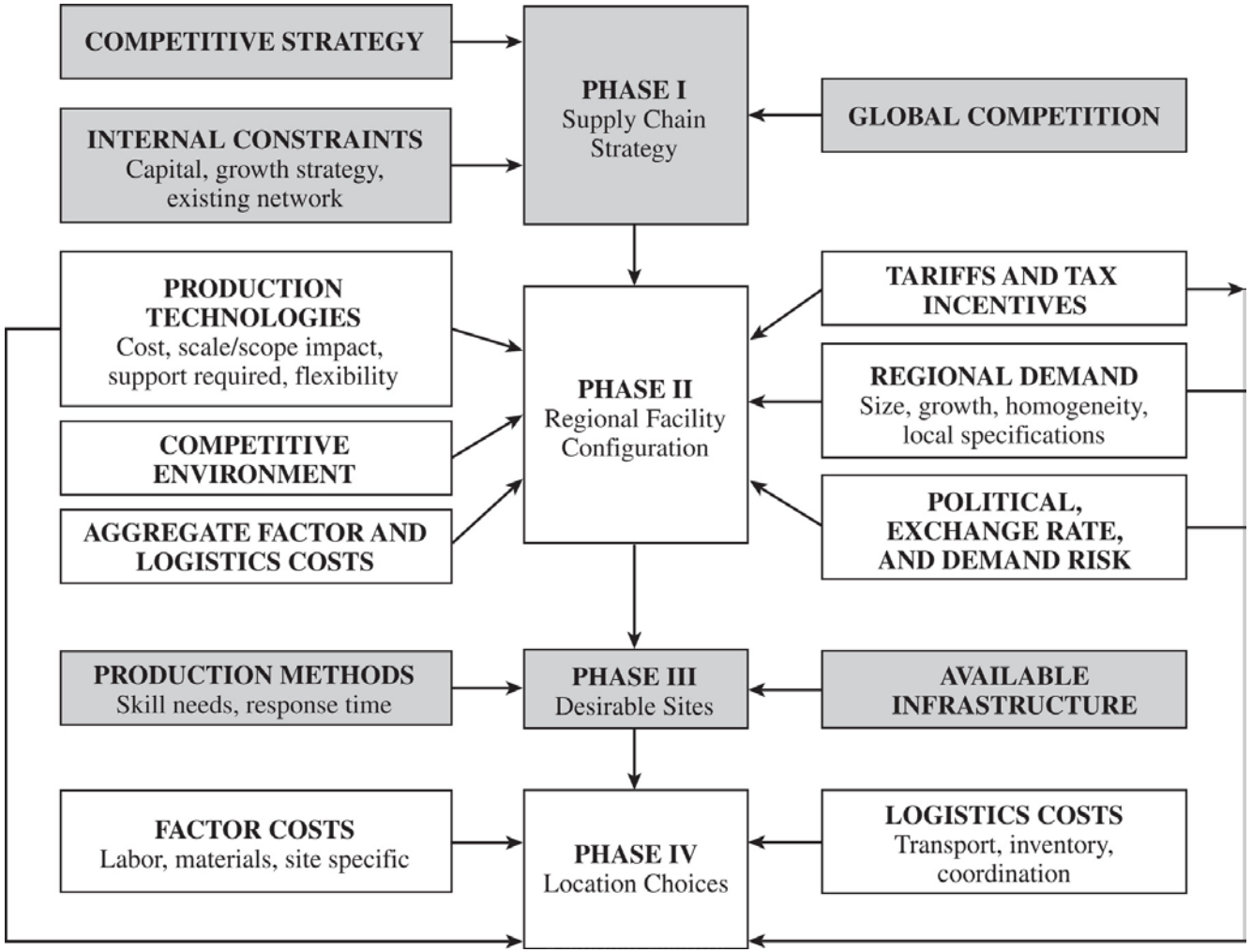
- Based on the competitive strategy of the firm, an analysis of the competition, any economies of scale or scope, and any constraints, managers must determine the supply chain strategy for the firm.

Framework for Network Design Decisions

- **Phase I: Define a Supply Chain Strategy/Design**
  - Clear definition of the firm's competitive strategy
  - **Forecast the likely evolution of global competition**
  - Identify constraints on available capital
  - Determine growth strategy

Framework for Network Design Decisions

Figure 5-2



Phase II: Define the Regional Facility Configuration

- The objective of the second phase of network design is to identify regions where facilities will be located, their potential roles, and their approximate capacity. An analysis of Phase II is started with a forecast of the demand by country.
- Such a forecast must include a measure of the size of the demand as well as a determination of whether the customer requirements are homogenous or variable across different countries.

Phase II: Define the Regional Facility Configuration

- The next step is for managers to identify whether economies of scale or scope can play a significant role in reducing costs given available production technologies.
- Next, managers must identify demand risk, exchange rate risk, and political risk associated with different regional markets.
- They must also identify regional tariffs, any requirements for local production, tax incentives, and any export or import restrictions for each market.

Phase II: Define the Regional Facility Configuration

- The next step is for managers to identify whether economies of scale or scope can play a significant role in reducing costs given available production technologies.
- Next, managers must identify demand risk, exchange rate risk, and political risk associated with different regional markets.
- They must also identify regional tariffs, any requirements for local production, tax incentives, and any export or import restrictions for each market.

Phase II: Define the Regional Facility Configuration

- The regional configuration defines the approximate number of facilities in the network, regions where facilities will be set up, and whether a facility will produce all products for a given market or a few products for all markets in the network.

Framework for Network Design Decisions

- **Phase II: Define the Regional Facility Configuration**
  - Forecast of the demand by country or region.
  - Economies of scale or scope.
  - Identify demand risk, exchange-rate risk, political risk, tariffs, requirements for local production, tax incentives, and export or import restrictions.
  - Identify competitors.

Phase III: Select a Set of Desirable Potential Sites

- The objective of Phase III is to select a set of desirable sites within each region where facilities are to be located.
- The set of desirable sites should be larger than the desired number of facilities to be set up so that a precise selection may be made in Phase IV.
- Sites should be selected based on an analysis of infrastructure availability to support the desired production methodologies.

Phase III: Select a Set of Desirable Potential Sites

- *Hard infrastructure requirements* include the availability of suppliers, transportation services, communication, utilities, and warehousing infrastructure**.**
- *Soft infrastructure requirements* include the availability of skilled workforce, workforce turnover, and the community's receptivity to business and industry.
- **In Pakistani context what do you see which is your strength? Or we have balance between hard and soft infrastructure?**

Phase IV: Location Choices

- The objective of this phase is to select a precise location and capacity allocation for each facility.
- Attention is restricted to the desirable sites selected in Phase III.
- The network is designed to maximize total profits, taking into account the expected margin and demand in each market, various logistics and facility costs, and the taxes and tariffs at each location.

Models for Facility Location and Capacity Allocation

- The aim of the SC Manager should be to Maximize the overall profitability of the supply chain network while providing customers with the appropriate responsiveness.
- Revenues comes from the sale of the product, where as costs arise from facilities, labor, transportation, material and inventory.

Models for Facility Location and Capacity Allocation

- The profits of the firm are also affected by taxes and tariffs. IDEALLY, PROFITS after TAX should be maximized when designing a Supply Chain Networks.
- Many trade-offs during network design e.g, building many facilities to serve local markets reduces transportation costs and provides a faster response time , but increases the facility and inventory costs.

Network Design Models

- Managers use network design models in two different situations.
- First, these models are used to decide on locations where facilities will be established and the capacity to be assigned to each facility.
- Managers must make this decision considering a time horizon over which locations and capacities will not be altered (typically in years).

Network Design Models

- Second, these models are used to assign current demand to the available facilities and identify lanes along which product will be transported.
- Managers must consider this decision at least on an annual basis as demand, prices, and tariffs change.
- **In both cases, the goal is to maximize the profit while satisfying customer needs.**

Models for Facility Location and Capacity Allocation

- Network design models used to decide on locations and capacities and to assign current demand to facilities.

Models for Facility Location and Capacity Allocation

- Important information **required and should be available for making design decision**

1. Location of supply sources and markets
2. Location of potential facility sites
3. Demand forecast by market
4. Facility, labor, and material costs by site
5. Transportation costs between each pair of sites
6. Inventory costs by site and as a function of quantity
7. Sale price of product in different regions
8. Taxes and tariffs
9. Desired response time and other service factors

Models for Facility Location and Capacity Allocation

- Given the above 9 important information factors **either GRAVITY MODELS or NETWORK OPTIMIZATION MODELS MAY BE USED TO DESIGN THE NETWORK.**
- **WE DESIGN THE MODELS ACCORDING TO THE PHASE OF THE NETWORK DESIGN FRAMEWORK AT WHICH EACH MODEL IS LIKELY TO BE USEFUL.**

Models for Facility Location and Capacity Allocation

- ***Installing the Solver add-in***
- To follow the exercises from this part of the presentation, you will need to use the “Solver” add-in for Microsoft.
- Excel. When installed, it appears in the “Analysis” toolbar under the “Data” tab.

Uncertainty

- **Uncertainty** is a term used in subtly different ways in a number of fields, including physics, philosophy, statistics, economics, finance, insurance, psychology, sociology, engineering, and information science.
- It applies to predictions of future events, to physical measurements already made, or to the unknown.

Uncertainty Concepts

1. Although the terms are used in various ways among the general public, many specialists in decision theory, statistics and other quantitative fields have defined uncertainty, risk, and their measurement as:
    1. **Uncertainty**: The lack of certainty, A state of having limited knowledge where it is impossible to exactly describe the existing state, a future outcome, or more than one possible outcome.
    2. **Measurement of Uncertainty**: A set of possible states or outcomes where probabilities are assigned to each possible state or outcome – this also includes the application of a probability density function to continuous variables.

Uncertainty Concepts

4. **Risk**: A state of uncertainty where some possible outcomes have an undesired effect or significant loss.
   - Pure Risk : negative outcome
5. **Business risks** implies uncertainty in profits or danger of loss and the events that could pose a risk due to some unforeseen events in future, which causes business to fail.
   - Business risks can be classified by the influence by two major risks: **internal risks** & e**xternal risks.**

- As the title indicates, you would be taking into account :

1. globalization
2. international trade, commerce
3. exchange rates
4. strategic planning and financial planning along with Impact of Globalization on Supply Chain Networks
5. The Off-shoring Decision: Total Cost

Discounted Cash Flow Analysis

$$\text{Discount factor} = \frac{1}{1+k}$$

$$NPV = C_0 + \sum_{t=1}^{T} \left(\frac{1}{1+k} \right)^t C_t$$

where

$C_0, C_1, ..., C_T$ is a stream of cash flows over T periods

NPV = the net present value of this stream of cash flows

k = rate of return

- Compare NPV of different supply chain design options
- The option with the highest NPV will provide the greatest financial return

NPV Example: Naimatkada Logistics

- How much space to lease in the next three years for Demand = 100,000 units.
- Requires 1,000 sq. ft. of space for every 1,000 units of demand or 1 unit of demand needs 1 sq, ft, of space
- Revenue = Rs14 per unit of demand
- Decision is whether to sign a three-year lease or obtain warehousing space on the spot market
- Three-year lease: cost = Rs.10 per sq. ft.
- Spot market: cost = Rs12 per sq. ft.

  k = 0.1=10%

NPV Example: Trips Logistics

For leasing warehouse space on the **spot** market:

Expected annual profit = Revenue-Cost

=100,000 x Rs14 – 100,000 x Rs 12 = Rs200,000

Cash flow = Rs.200,000 in each of the next three years

$$NPV(\text{no lease}) = C_0 + \frac{C_1}{1+k} + \frac{C_2}{(1+k)^2}$$

$$= 200{,}000 + \frac{200{,}000}{1.1} + \frac{200{,}000}{1.1^2} = Rs.547{,}107.4 = Rs.547{,}107$$

NPV Example: Naimatkada Logistics

For leasing warehouse space with a three-year lease:

Expected annual profit = 100,000 x Rs14 – 100,000 x Rs 10 = Rs.400,000.

Cash flow = $200,000 in each of the next three years.

$$NPV(\text{no lease}) = C_0 + \frac{C_1}{1+k} + \frac{C_2}{(1+k)^2}$$

$$= 400{,}000 + \frac{400{,}000}{1.1} + \frac{400{,}000}{1.1^2} = Rs.10{,}94{,}215$$

The NPV of signing the lease is Rs 10,94,215- Rs547,107=Rs Rs.547,108 higher; therefore, the manager decides to sign the lease.

However, uncertainty in demand and costs may prompt the manager to rethink his decision.

Representations of Uncertainty

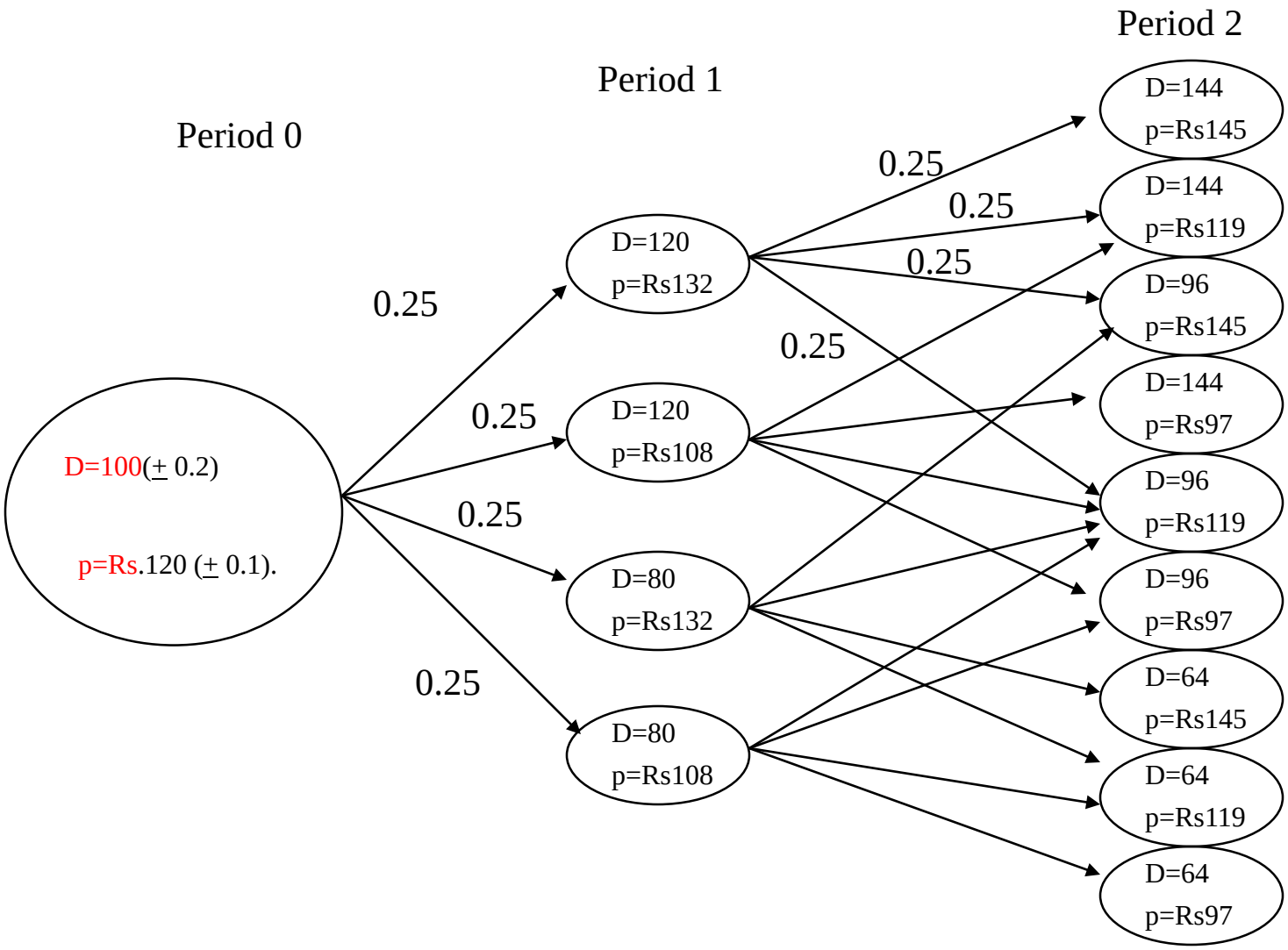
- A set of possible states or outcomes where probabilities are assigned to each possible state or outcome – this also includes the application of a probability density function to continuous variables.
- Probability: Theory from which we consider the Binomial Representation of Uncertainty.
  - Additive
  - Multiplicative
- Other Representations of Uncertainty
  - Classical Set Theory, Fuzzy set theory, Fuzzy measure theory, Rough Set theory

Binomial Representations of Uncertainty

- When moving from one period to the next, the value of the underlying factor (e.g., demand or price) has only two possible outcomes – up "u" or down "d".
- The underlying factor moves up by a factor or $u > 1$ with probability p, or down by a factor $d < 1$ with probability 1-p.
- Assuming a price P in period 0, for the multiplicative binomial, the possible outcomes for the next four periods:
  - Period 1: Pu, Pd
  - Period 2: Pu^2, Pud, Pd^2
  - Period 3: Pu^3, Pu^2d, Pud^2, Pd^3
  - Period 4: Pu^4, Pu^3d, Pu^2d^2, Pud^3, Pd^4

Binomial Representations of Uncertainty

- In general, for multiplicative binomial, period T has all possible outcomes $Pu^t d^{(T-t)}$, for t = 0,1,…,T.
- From state $Pu^a d^{(T-a)}$ in period t, the price may move in period t+1 to either:
  - $Pu^{a+1} d^{(T-a)}$ with probability p, or
  - $Pu^a d^{(T-a)+1}$ with probability (1-p)



Binomial Representations of Uncertainty

- For the additive binomial, the states in the following periods are:
  - Period 1: P+u, P-d
  - Period 2: P+2u, P+u-d, P-2d
  - Period 3: P+3u, P+2u-d, P+u-2d, P-3d
  - Period 4: P+4u, P+3u-d, P+2u-2d, P+u-3d, P-4d
- For mathematically inclined, in general for the additive binomial, period T has all possible outcomes P+tu-(T-t)d, for t=0, 1, …, T

- The degree of demand and price uncertainty has a significant influence on the appropriate portfolio of long- and short-term warehousing space that a firm should carry.
- If price and demand vary over time in a global network, flexible production capacity can be reconfigured to maximize profits in the new environment.
- In reality, demand and prices are highly uncertain and are likely to fluctuate during the life of any supply chain decision.
- The multiplicative binomial cannot take on negative values and can be used for factors like demand, price, and exchange rates that cannot become negative.

- If uncertainty is ignored, a manager will always sign long-term contracts because they are typically cheaper and avoid all flexible capacity because it is more expensive.
- Decision trees with DCFs can be used to evaluate supply chain design decisions given uncertainty in prices, demand, exchange rates, and inflation.
- In a complex decision tree, there are thousands of possible paths that may result from the first period to the last.
- Simulation models require a higher setup cost to start and operate compared to decision tree tools.

Evaluating Network Design Decisions Using Decision Trees

- A manager must make many different decisions when designing a supply chain network.
- Many of them involve a choice between a long-term (or less flexible) option and a short-term (or more flexible) option.
- If uncertainty is ignored, the long-term option will almost always be selected because it is typically cheaper.
- Such a decision can eventually hurt the firm, however, because actual future prices or demand may be different from what was forecasted at the time of the decision.
- **A *decision tree* is a graphic device that can be used to evaluate decisions under uncertainty.**

Decision Tree Methodology

1. Identify the duration of each period (month, quarter, etc.) and the number of periods T over the which the decision is to be evaluated.
2. Identify factors such as demand, price, and exchange rate, whose fluctuation will be considered over the next T periods.
3. Identify representations of uncertainty for each factor; that is, determine what distribution to use to model the uncertainty.
4. Identify the periodic discount rate k for each period.
5. Represent the decision tree with defined states in each period, as well as the transition probabilities between states in successive periods.
6. Starting at period T, work back to period 0, identifying the optimal decision and the expected cash flows at each step. Expected cash flows at each state in a given period should be discounted back when included in the previous period.

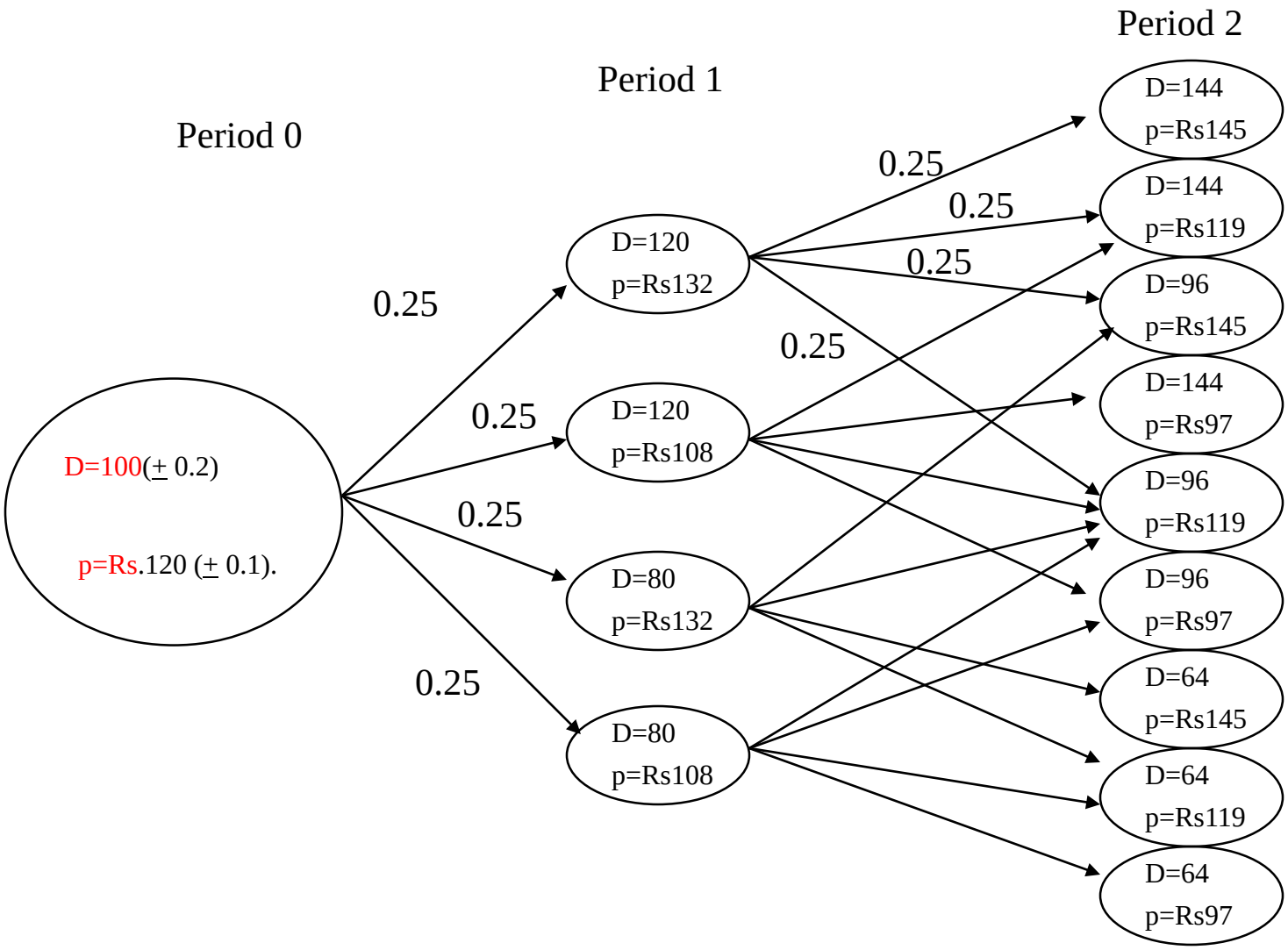
Decision Tree Methodology: Subakraftar Rasad Logistics

- Decide whether to lease warehouse space for the coming three years and the quantity to lease.
- Long-term lease is currently cheaper than the spot market rate.
- The manager anticipates uncertainty in demand and spot prices over the next three years.
- Long-term lease is cheaper but could go unused if demand is lower than forecast; future spot market rates could also decrease.
- Spot market rates are currently high, and the spot market would cost a lot if future demand is higher than expected.

Subakraftar Rasad Logistics: Three Options

1. Get all warehousing space from the spot market as needed.
2. Sign a three-year lease for a fixed amount of warehouse space and get additional requirements from the spot market.
3. Sign a flexible lease with a minimum change that allows variable usage of warehouse space up to a limit with additional requirement from the spot market.

Subakraftar Logistics Decision Tree (Fig. 6.2) :SPOT PRICE



Subakraftar Rasad Logistics Example

Node	Revenue	Cost	Profit
D=144,p=145	Rs.1,75,68,000	144,000X145 =2,08,80,000	Rs.-33,12,000
D=144,p=119	Rs.1,75,68,000	144,000X119 =1,71,36,000	Rs.432,000
D=144,p=97	Rs.1,75,68,000		Rs.36,00,000
D=96, p=145	Rs. 1,17,12,000		Rs.22,08,000
D=96,p=119	Rs. 1,17,12,000		
D=96,p=97	Rs. 1,17,12,000		
D=64,p=145	Rs.78,08,000		
D=64,p=119	Rs.78,08,000		
D=64,p=97	Rs.78,08,000		

Evaluating Flexibility Using Decision Trees

- Decision tree methodology can be used to evaluate flexibility within the supply chain
- Suppose the manager at **Subakraftar Rasad** Logistics has been offered a contract where, for an upfront payment of Rs.10,00,000, the company will have the flexibility of using between 60,000 sq. ft. and 100,000 sq. ft. of warehouse space at Rs100 per sq. ft. per year. Trips must pay Rs60,00,000 for the first 60,000 sq. ft. and can then use up to 40,000 sq. ft. on demand at Rs100 per sq. ft. as needed.
- Using the same approach as before, the expected profit of this option is Rs.56,72,500 (DO NOT READ FIGS)
- The value of flexibility is the difference between the expected present value of the flexible option and the expected present value of the inflexible options
- The three options are listed in Table 6.7, where the flexible option has an expected present value Rs.836,100 greater than the inflexible lease option (including the upfront Rs.10,00,000 payment)

PakBangla Road Vehicle: Evaluation of Supply Chain Design Decisions Under Uncertainty

- Dedicated Capacity of 1,000 in the Pakistan and 500 in Bangladesh
  - Period 2 Evaluation
  - Period 1 Evaluation
  - Period 0 Evaluation
- Flexible Capacity of 1,000 in the Pakistan and 500 in Bangladesh
  - Period 2 Evaluation
  - Period 1 Evaluation
  - Period 0 Evaluation

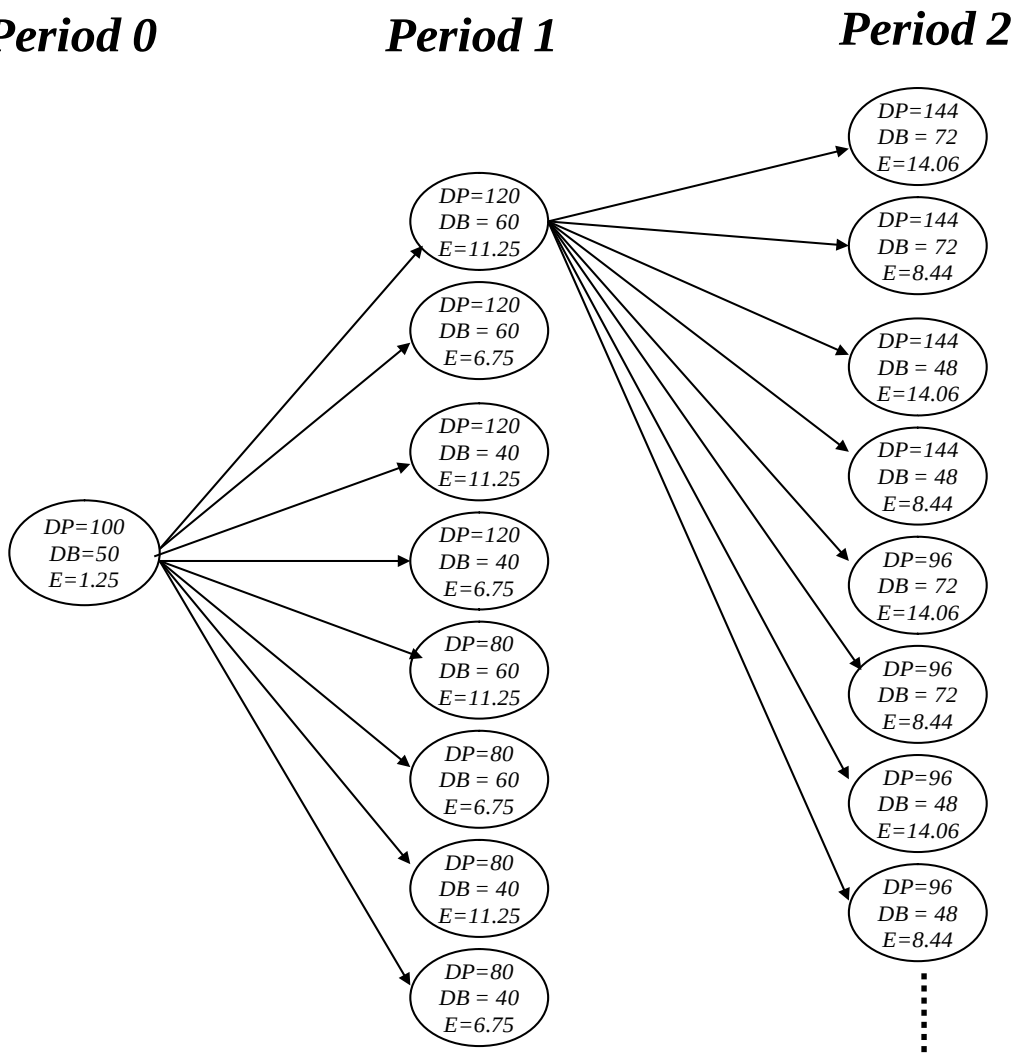
Evaluating Facility Investments: Road Vehicles

Plant	Dedicated Plant		Flexible Plant	
	Fixed Cost	Variable Cost	Fixed Cost	Variable Cost
PK 100,000	Rs 10 million/yr.	Rs 1500 / tire	Rs100 million / year	Rs 150 / tire
BD 50,000	4 million Takas / year	1200 takas / tire	40 million takas / year	120 takas / tire

PK. Expected Demand = 100,000;
BD Expected Demand = 50,000
1 BD TK = 1.25 PK RS

Demand goes up or down by 20 percent with probability 0.5 and exchange rate goes up or down by 25 per cent with probability 0.5.

Road Vehicles



Making Global Supply Chain Design Decisions Under Uncertainty in Practice

1. Combine strategic planning and financial planning during global network design.
2. Use multiple metrics to evaluate global supply chain networks.
3. Use financial analysis as an input to decision making, not as the decision-making process.
4. Use estimates along with sensitivity analysis.

Learning Objectives

1. Understand the role of forecasting for both an enterprise and a supply chain.
2. Identify the components of a demand forecast.
3. Forecast demand in a supply chain given historical demand data using time-series methodologies.
4. Analyze demand forecasts to estimate forecast error.

Role of Forecasting in a Supply Chain

- The basis for all planning decisions in a supply chain
- Used for both push and pull processes
  - Production scheduling, inventory, aggregate planning
  - Sales force allocation, promotions, new production introduction
  - Plant/equipment investment, budgetary planning
  - Workforce planning, hiring, layoffs
- All of these decisions are interrelated

Characteristics of Forecasts

1. Forecasts are always inaccurate and should thus include both the expected value of the forecast and a measure of forecast error.
2. Long-term forecasts are usually less accurate than short-term forecasts.
3. Aggregate forecasts are usually more accurate than disaggregate forecasts.
4. In general, the farther up the supply chain a company is, the greater is the distortion of information it receives.

Components and Methods

1. Qualitative
   - Primarily subjective
   - Rely on judgment
2. Time Series
   - Use historical demand only
   - Best with stable demand
3. Causal
   - Relationship between demand and some other factor
4. Simulation
   - Imitate consumer choices that give rise to demand

Components of an Observation

Observed demand (O) = systematic component (S)
+ random component (R)

- Systematic component – expected value of demand
  - ***Level*** (current deseasonalized demand)
  - ***Trend*** (growth or decline in demand)
  - ***Seasonality*** (predictable seasonal fluctuation)
- Random component – part of forecast that deviates from systematic component
- Forecast error – difference between forecast and actual demand

Basic Approach to Effective Forecasting

The following basic, six-step approach helps an organization perform effective forecasting:

- **1.** Understand the objective of forecasting.
- 2. Integrate demand planning and forecasting throughout the supply chain.
- 3. Understand and identify customer segments.
- 4. Identify the major factors that influence the demand forecast.
- 5. Determine the appropriate forecasting technique.
- 6. Establish performance and error measures for the forecast.

Time-Series Forecasting Methods

- Three ways to calculate the systematic component:
  - ***Multiplicative***

    S = level x trend x seasonal factor
  - ***Additive***

    S = level + trend + seasonal factor
  - ***Mixed***

    S = (level + trend) x seasonal factor

Static Methods

$$\text{Systematic component} = (\text{level} + \text{trend}) \times \text{seasonal factor}$$

$$F_{t+l} = [L + (t + l)T]S_{t+l}$$

where

L = estimate of level at $t = 0$
T = estimate of trend
S_t = estimate of seasonal factor for Period t
D_t = actual demand observed in Period t
F_t = forecast of demand for Period t

Estimate Level and Trend

Periodicity $p = 4$, $t = 3$

$$\bar{D}_t = \begin{cases} \left[D_{t-(p/2)} + D_{t+(p/2)} + \sum_{i=t+1-(p/2)}^{t-1+(p/2)} 2D_i \right] / (2p) \text{ for } p \text{ even} \\ \sum_{i=t-[(p-1)/2]}^{t+[(p-1)/2]} D_i / p \text{ for } p \text{ odd} \end{cases}$$

$$\bar{D}_t = \left\lfloor D_{t-(p/2)} + D_{t+(p/2)} + \sum_{i=t+1-(p/2)}^{t-1+(p/2)} 2D_i \right\rfloor / (2p)$$

$$= D_1 + D_5 + \sum_{i=2}^{4} 2D_i / 8$$

Estimating Seasonal Factors

$$S_i = \frac{\sum_{j=0}^{r-1} \overline{S}_{jp+1}}{r}$$

Adaptive Forecasting

- The estimates of level, trend, and seasonality are adjusted after each demand observation.
- Estimates incorporate all new data that are observed.

Adaptive Forecasting

$$F_{t+1} = (L_t + lT_t)S_{t+1}$$

where

L_t = estimate of level at the end of Period t

T_t = estimate of trend at the end of Period t

S_t = estimate of seasonal factor for Period t

F_t = forecast of demand for Period t (made Period t – 1 or earlier)

D_t = actual demand observed in Period t

E_t = F_t – D_t = forecast error in Period t

Steps in Adaptive Forecasting

- Initialize
  - Compute initial estimates of level (L_0), trend (T_0), and seasonal factors ($S_1,\ldots,S_p$)
- Forecast
  - Forecast demand for period t + 1
- Estimate error
  - Compute error $E_{t+1} = F_{t+1} - D_{t+1}$
- Modify estimates
  - Modify the estimates of level (L_{t+1}), trend (T_{t+1}), and seasonal factor (S_{t+p+1}), given the error E_{t+1}

Moving Average

- Used when demand has no observable trend or seasonality.

  Systematic component of demand = level

Time Series Models

Forecasting Method	Applicability
Moving average	No trend or seasonality
Simple exponential smoothing	No trend or seasonality
Holt's model	Trend but no seasonality
Winter's model	Trend and seasonality

Selecting the Best Smoothing Constant

	A	B	C	D	E	F	G	H
1	Period t	Demand D_t	Level L_t	Forecast F_t	Error E_t	Squared Error	Absolute Errror A_t	% Error
2	0		2017.9					
3	1	2024	2021.2	2017.9	-6.1	37	6.1	0.3%
4	2	2076	2050.8	2021.2	-54.8	3003	54.8	2.6%
5	3	1992	2019.0	2050.8	58.8	3463	58.8	3.0%
6	4	2075	2049.3	2019.0	-56.0	3135	56.0	2.7%
7	5	2070	2060.5	2049.3	-20.7	429	20.7	1.0%
8	6	2046	2052.7	2060.5	14.5	210	14.5	0.7%
9	7	2027	2038.8	2052.7	25.7	658	25.7	1.3%
10	8	1972	2002.7	2038.8	66.8	4459	66.8	3.4%
11	9	1912	1953.6	2002.7	90.7	8218	90.7	4.7%
12	10	1985	1970.6	1953.6	-31.4	985	31.4	1.6%
13		2017.9			87	2,460	42.5	2.1%
14	α =	0.54						

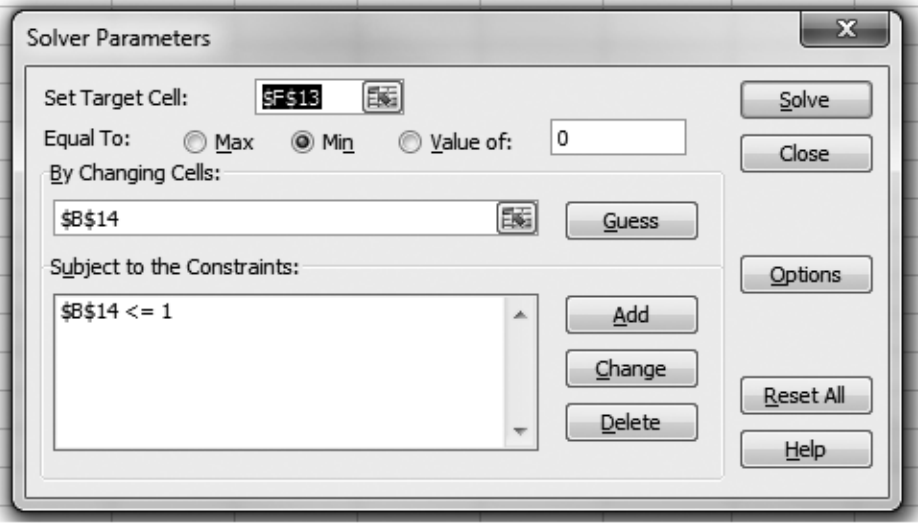


Figure 7-5

Forecasting Demand at Tahoe Salt

- Moving average
- Simple exponential smoothing
- Trend-corrected exponential smoothing
- Trend- and seasonality-corrected exponential smoothing

Learning Objectives

1. Understand the role of forecasting for both an enterprise and a supply chain.
2. Identify the components of a demand forecast.
3. Forecast demand in a supply chain given historical demand data using time-series methodologies.
4. Analyze demand forecasts to estimate forecast error.

Aggregate Planning (AP)

1. **Understand the Role of Aggregate Planning in Supply Chain**.
2. Understand the importance of aggregate planning as a supply chain activity.
3. Describe the information needed to produce an AP (**Aggregate Plan Problem**).
4. Explain the basic trade-offs to consider when creating an aggregate plan (**AP Strategies**).
5. Formulate and solve basic aggregate planning problems using Microsoft Excel.

Learning Objectives 1

1. Identify the decisions that are best solved by aggregate planning.

Role of Aggregate Planning in a Supply Chain

- Capacity has a cost and lead times are often long.
- So a company needs to decide about :
  - Capacity levels, production levels, outsourcing and promotions well before demand is known.
  - Anticipate demand and Determine how to meet this demand.
  - Invest in a plant with large capacity for peak demand. or
  - Invest in a plant with small capacity with large inventory warehouses to continue production in low demand.
- These types of questions are answered by Aggregate planning.

Role of Aggregate Planning in a Supply Chain

- Aggregate planning:
  - Is a process by which a company determines **ideal** levels of capacity, production, subcontracting, inventory, stock-outs, and pricing over a specified time horizon.
  - Goal is to maximize profit, while fulfilling demand.
  - Decisions made at an aggregate or a product family (not SKU) level for example an AP in an automobile plant would determine the total production level in plant the total number of autos not the units of individual SKU (**STOCK KEEPING UNIT**).
  - How can a firm best use the facilities it has?

Role of Aggregate Planning in a Supply Chain

- Aggregate planning:
  - Traditionally AP was limited to the ENTERPRISE.
  - Currently AP includes Supply Chain Management.
  - It requires inputs from entire Supply Chain and the results impact the entire Supply Chain.
  - Collaborative Demand Forecasts forms one of the most important inputs for AP.
  - Constraints of the Upstream Supply Chain Partners the suppliers directly impact the Supply Chain.
  - Has a direct influence and consequence on production plans and helps to plan supply and demand in a Supply Chain.

Role of Aggregate Planning in a Supply Chain

- The AP ‘s main objectives is to specify operational parameters over the time horizon.
  - Production rate: The number of units to be completed per unit time (such as per week per month).
  - Workforce: The number of workers/units of capacity needed for production.
  - Overtime: amount of over production planned.
  - Machine capacity level: the number of units of machine capacity needed for production.

Role of Aggregate Planning in a Supply Chain

- The AP ‘s main objectives is to specify operational parameters over the time horizon.
  - Subcontracting: The subcontracted capacity required over the planning horizon.
  - Backlog: Demand not satisfied in the period in which it arises but carried over to future periods.
  - Inventory on hand: The planned inventory carried over the various periods in the planning horizon.
- AP serves as a broad blueprint for operations and establishes the parameters within which short term production & distribution decisions are made.

Role of Aggregate Planning in a Supply Chain

- The AP allows the Supply Chain to alter capacity allocations and change supply contracts.
  - Ideally whole Supply Chain Process should be coordinated with the planning process.
  - If a manufacturer has planned to increase in production over a given period of time then the supplier, transporter and warehouse must be informed about this plan so as to update their own plans.
  - Ideally, all stages of the Supply Chain should work together on an aggregate plan.
  - If all stages plan independently then supply chain results in shortages and oversupply in the supply chain.

Module 2: The Aggregate Planning Problem

- The objective of the AP is to satisfy demand in a way that maximizes the profit for the firm. We can formally state the problem.
- Given the demand forecast for each period in the planning horizon, determine the production level, inventory level, and the capacity level for each period that maximizes the firm's (supply chain's) profit over the planning horizon.
- **To create an aggregate plan a company must specify the planning horizon for the plan.**

Mod 2: The Aggregate Planning Problem

- Specify the planning horizon (typically 3-18 months).
- Specify the duration of each period.
- Specify key information required to develop an aggregate plan.
- In general, aggregate planning takes place over months or quarters.
- The company specifies key required information to produce an aggregate plan.

Information Needed for an Aggregate Plan

An aggregate **planner** requires the following:

- Aggregate demand forecast F_t for each Period t over T periods
- Production costs:
  - Labor costs, regular time (Rs./hr) and overtime (Rs./hr)
  - Subcontracting costs (Rs./hr or Rs./unit)
  - Cost of changing capacity – hiring or layoff (Rs./worker), adding or reducing machine capacity (Rs./machine)
- Labor/machine hours required per unit
- Inventory holding cost (Rs./unit/period)
- Stock out or backlog cost (Rs./unit/period)
- Constraints – overtime, layoffs, capital available, stockouts, backlogs, from suppliers

Outputs of Aggregate Plan

- Production quantity from regular time, overtime, and subcontracted time: Used to determine number of workers and supplier purchase levels.
- Inventory held: Used to determine customer service levels.
- Backlog/stockout quantity: Used to determine customer service levels.
- Machine capacity increase/decrease: Used to determine if new production equipment should be purchased or idled.

Outputs of Aggregate Plan

- The quality of an AP has a significant impact on the profitability of a firm.
- A poor aggregate plan can result in lost sales and lost profits if the available inventory and capacity are unable to meet demand.
- A poor aggregate plan can result in lost sales, lost profits, excess inventory, or excess capacity there by raising costs.
- Therefore, AP is a very important tool in helping a Supply Chain maximize profitability.

Module 3: Aggregate Planning Strategies

- Trade-off between capacity, inventory, backlog/lost sales.
- Chase strategy – using capacity as the lever.
- Time flexibility from workforce or capacity strategy – using utilization as the lever.
- Level strategy – using inventory as the lever.
- Tailored or hybrid strategy – a combination of strategies.

Chase Strategy

1. Vary machine capacity or hire and lay off workers as demand varies.
2. Often difficult to vary capacity and workforce on short notice.
3. Expensive if cost of varying capacity is high.
4. Negative effect on workforce morale.
5. Results in low levels of inventory.
6. Used when inventory holding costs are high and costs of changing capacity are low.

Time Flexibility Strategy

1. Use excess machine capacity.
2. Workforce stable, number of hours worked varies.
3. Use overtime or a flexible work schedule.
4. Flexible workforce, avoids morale problems.
5. Low levels of inventory, lower utilization.
6. Used when inventory holding costs are high and capacity is relatively inexpensive.

Level Strategy

1. Stable machine capacity and workforce levels, constant output rate.
2. Inventory levels fluctuate over time.
3. Inventories carried over from high to low demand periods.
4. Better for worker morale.
5. Large inventories and backlogs may accumulate.
6. Used when inventory holding and backlog costs are relatively low.

Lecture 27

1. Aggregate Planning Using Linear Programming
2. Aggregate Planning in Excel
3. Role of IT in Aggregate Planning
4. Implementing Aggregate Planning in Practice
5. Summary of Learning Objectives & Modules

Module 4. Aggregate Planning Using Linear Programming

- ABCXYZ COOLERS
  - Highly seasonal demand
  - Develop a forecast

Month	Demand Forecast
January	1,600
February	3,000
March	3,200
April	3,800
May	2,200
June	2,200

Table 8-2

ABC XYZ COOLERS

Family	Material Cost/ Unit (Rs.)	Revenue/ Unit (Rs.)	Setup Time/Batch (hour)	Average Batch Size	Production Time/ Unit (hour)	Net Production Time/Unit (hour)	Percentage Share of Units Sold
A	150	540	8	500	5.60	5.76	10
B	70	300	6	1500	3.00	3.04	25
C	90	390	8	1000	3.80	3.88	20
D	120	490	10	500	4.80	5.00	10
E	90	360	6	1000	3.60	3.66	20
F	130	480	5	750	4.30	4.37	15

Table 8-1

Module 4. Aggregate Planning Using Linear Programming

- STEP I: Identify set of decision variables
- STEP II: Define the Objective function
- STEP III: Specify Constraints (then use EXCEL)
- STEP IV: Use Average Inventory
- STEP V: Optimize the objective function
- STEP VI: Identify forecast errors

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Table 8-2

ABC XYZ COOLERS

Item	Cost
Material cost	Rs.100/unit
Inventory holding cost	Rs.20/unit/month
Marginal cost of stockout/backlog	Rs.50/unit/month
Hiring and training costs	Rs.3000/worker
Layoff cost	Rs.5000/worker
Labor hours required	4/unit
Regular time cost	Rs.40/hour
Overtime cost	Rs.60/hour
Cost of subcontracting	Rs.300/unit

Table 8-3

ABC XYZ COOLERS: STEP I

Decision Variables (SLIDE INSERT)

For $t = 1, ..., 6$

W_t =Workforce size for month t

H_t =Number of employees hired at the beginning of month t

L_t =Number of employees laid off at the beginning of month t

P_t =Production in month t

I_t =Inventory at the end of month t

S_t =Number of units stocked out at the end of month t

C_t =Number of units subcontracted for month t

O_t =Number of overtime hours worked in month t

ABC XYZ COOLERS: STEP II

Objective Function

- Minimize

(Regular-time labor cost + Overtime labor cost + Cost of hiring and layoffs + Cost of holding inventory + Cost of stocking out + Cost of subcontracting + Material cost)

$$Min \sum_{t=1}^{6} 640W_t + \sum_{t=1}^{6} 6O_t + \sum_{t=1}^{6} 300H_t + \sum_{t=1}^{6} 500L_t$$

$$+ \sum_{t=1}^{6} 2I_t + \sum_{t=1}^{6} 5S_t + \sum_{t=1}^{6} 10P_t + \sum_{t=1}^{6} 30C_t$$

ABC XYZ COOLERS : STEP III: Constraints

All for t = 1,..., 6

1. Workforce, hiring, and layoff constraints

$$W_t = W_{t-1} + H_t - L_t$$

2. Capacity constraints

$$P_t \leq 40W_t + \frac{O_t}{4}$$

3. Inventory balance constraints

$$I_{t-1} + P_t + C_t = D_t + S_{t-1} + I_t - S_t$$

4. Overtime limit constraints

$$O_t \leq 10W_t$$

: STEP IV: USE AVERAGE INVENTORY

$$\text{Average inventory} = \frac{(I_0 + I_T)/2 + \left(\sum_{t=1}^{T-1} I_t\right)}{T}$$

$$\text{Average time in inventory} = \left[\frac{(I_0 + I_T)/2 + \left(\sum_{t=1}^{T-1} I_t\right)}{T}\right] \Big/ \left[\frac{\left(\sum_{t=1}^{T-1} D_t\right)}{T}\right]$$

ABC XYZ COOLERS

Total cost over planning horizon = Rs.422,275 Revenue over planning horizon = 40 x 16,000 = Rs.640,000

Period, t	No. Hired, H_t	No. Laid Off, L_t	Workforce Size, W_t	Overtime, O_t	Inventory, I_t	Stock out, S_t	Subcontract, C_t	Total Production, P_t
0	0	0	80	0	1,000	0	0	
1	0	15	65	0	1,983	0	0	2,583
2	0	0	65	0	1,567	0	0	2,583
3	0	0	65	0	950	0	0	2,583
4	0	0	65	0	0	267	0	2,583
5	0	0	65	0	117	0	0	2,583
6	0	0	65	0	500	0	0	2,583

Table 8-4

ABC XYZ COOLERS

Average seasonal inventory $= \dfrac{(I_0 + I_6)/2 + \left(\sum_{t=1}^{5} I_t\right)}{T} = \dfrac{5{,}367}{6} = 895$

$$\text{Average flow time} = \frac{895}{2{,}667} = 0.34 = 0.34 \text{ months}$$

Step VI: Forecast Error in Aggregate Plans

- Forecast errors must be considered
- *Safety inventory*
- *Safety capacity*
  - Use overtime as a form of safety capacity
  - Carry extra workforce permanently as a form of safety capacity
  - Use subcontractors as a form of safety capacity
  - Build and carry extra inventories as a form of safety inventory
  - Purchase capacity or product from an open or spot market as a form of safety capacity

MOD5. Aggregate Planning In Excel

Step I = Build a table containing each decision variable.

Step II= Construct a table of constraints

Step III= Create a cell containing the Objective function

Step IV= Invoke the Solver application

- With in the Solver parameters click on Options and then select ASSUME LINEAR MODEL (this will speed up the calculations as it uses faster algorithms) and then click on SOLVE.

Step V= The optimal Solution should be returned

If it does not return the optimal solution, safe this answer and then repeat this step, often a number of multiple repetitions or iterations is required, a built in limitation of EXCEL.

Aggregate Planning In Excel;

Create a table containing following decision variables

For $t = 1, ..., 6$

W_t = Workforce size for Month t

H_t = Number of employees hired at the beginning of Month t

L_t = Number of employees laid off at the beginning of Month t

P_t = Production in Month t

I_t = Inventory at the end of Month t

S_t = Number of units stocked out at the end of Month t

C_t = Number of units subcontracted for Month t

O_t = Number of overtime hours worked in Month t

Aggregate Planning In Excel

	A	B	C	D	E	F	G	H	I	J
1	*Aggregate Plan Decision Variables*									
2		H_t	L_t	W_t	O_t	I_t	S_t	C_t	P_t	
3	*Period*	*# Hired*	*# Laid off*	*# Workforce*	*Overtime*	*Inventory*	*Stockout*	*Subcontract*	*Production*	*Demand*
4	0	0	0	80	0	1,000	0	0		
5	1	0	0	0	0	0	0	0	0	1,600
6	2	0	0	0	0	0	0	0	0	3,000
7	3	0	0	0	0	0	0	0	0	3,200
8	4	0	0	0	0	0	0	0	0	3,800
9	5	0	0	0	0	0	0	0	0	2,200
10	6	0	0	0	0	0	0	0	0	2,200

Also note column J contains the actual demand. the demand information is required to calculate aggregate plan.

Figure 8-1

STEP II: Construct a table of constraints (WORKFORCE, CAPACITY, INVENTORY & OVERTIME) . COLUMN M CONTAINS……

	M	N	O	P
1	*Constraints*			
2				
3	*Workforce*	*Capacity*	*Inventory*	*Overtime*
4				
5	-80	0	-600	0
6	0	0	-3000	0
7	0	0	-3200	0
8	0	0	-3800	0
9	0	0	-2200	0
10	0	0	-2200	0

Cell	Cell Formula	Equation	Copied to
M5	=D5 - D4 - B5 + C5	8.2	M6:M10
N5	=40*D5 + E5/4 -I5	8.3	N6:N10
O5	=F4-G4+I5+H5-J5-F5+G5	8.4	O6:O10
P5	=-E5 + 10*D5	8.5	P6:P10

Figure 8-2

Create a cell containing the Objective function, which is how each solution is judged / **checked**. the seclected cell, C22 represents the total cost & contains the sum of cells from B15 to I 20.

	A	B	C	D	E	F	G	H	I
12	*Aggregate Plan Costs*								
14	*Period*	*Hiring*	*Layoff*	*Regular time*	*Overtime*	*Inventory*	*Stockout*	*Subcontract*	*Material*
15	1	0	0	0	0	0	0	0	0
16	2	0	0	0	0	0	0	0	0
17	3	0	0	0	0	0	0	0	0
18	4	0	0	0	0	0	0	0	0
19	5	0	0	0	0	0	0	0	0
20	6	0	0	0	0	0	0	0	0
22	*Total Cost =*		$ -						

Figure 8-3

STEP IV:

Set target cell: C22
Equal to :select *Min*
By changing cells: B5 :I10
Subject to constraints
B5:I10≥0 { All decision variables are non negative}
F10≥500{ Inventory at end of Period 6 is at least 500}
G10=0{Stock out at end of Period 6 equals 0}
M5:M10=0{$W_t - W_{t-1} - H_t + L_t = 0$ *for* $t = 0,1,2,3\ldots6$}
N5:M10≥0{$40W_t + O_t/4 - P_t \geq 0$ *for* $t = 0,1,2,3\ldots6$}
O5:O10=0{$I_{t-1} - S_{t-1} + P_t + C_t - D_t - I_t + S_t = 0$ *for* $t = 0,1,2,3\ldots6$}
P5:P10≥0{$10W_t - O_t \geq 0$ *for* $t = 0,1,2,3\ldots6$}

Step IV= Invoke the Solver application

With in the Solver parameters click on Options and then select ASSUME LINEAR MODEL (this will speed up the calculations as it uses faster algorithms) and then click on SOLVE.

Figure 8-4

Step IV: Aggregate Planning In Excel

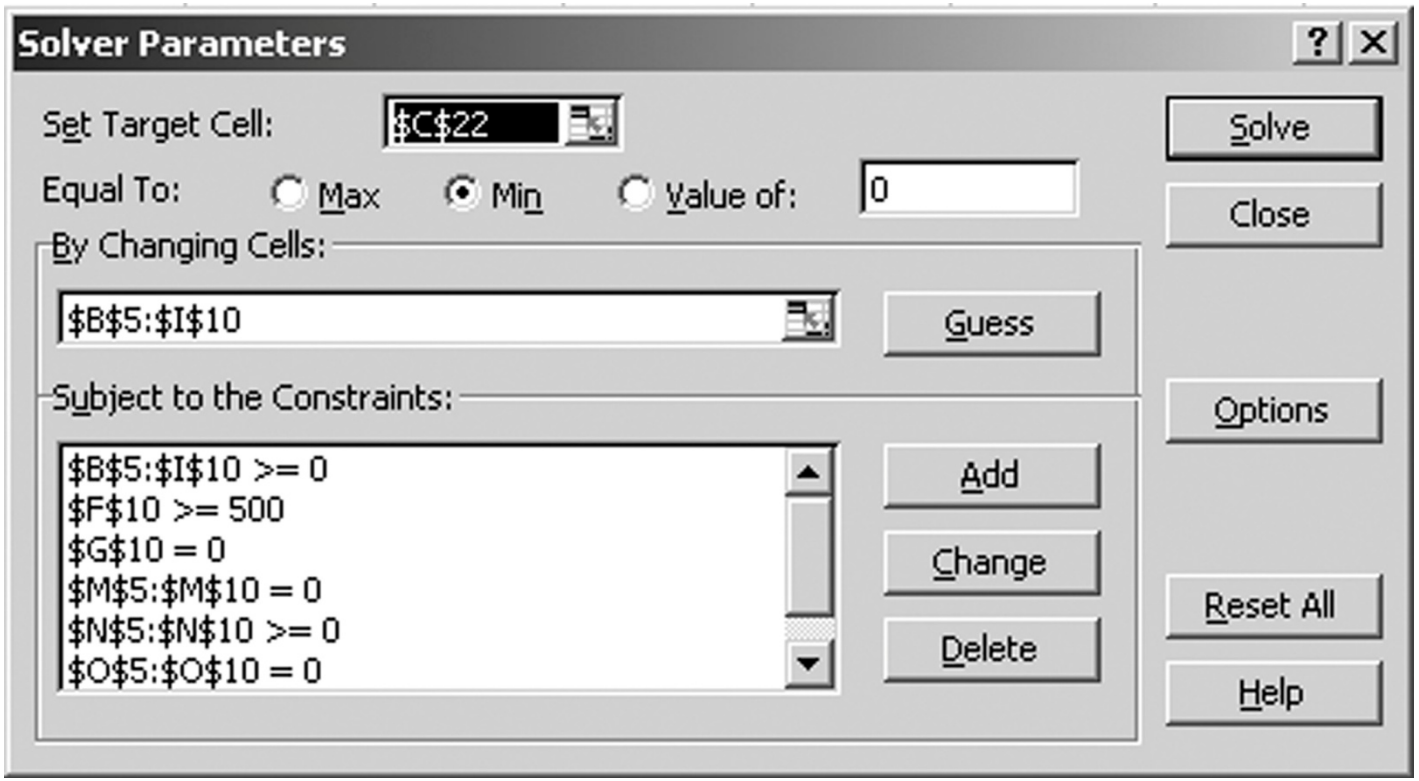


Figure 8-4

Step V

- The optimal Solution should be returned.
- If it does not return the optimal solution, save this answer and then repeat this step, often a number of multiple repetitions or iterations is required, a built in limitation of EXCEL.

Module 6: The Role of IT in Aggregate Planning

- The ability to handle large problems
- The ability to handle complex problems (through either nonlinear optimization or linear approximations)
- The ability to interact with other core IT systems such as inventory management and sourcing

Module 7:Implementing Aggregate Planning in Practice

1. Think beyond the enterprise to the entire supply chain
2. Make plans flexible because forecasts are always inaccurate
3. Re-run the aggregate plan as new data emerge
4. Use aggregate planning as capacity utilization increases

SIGNING OFF NOTE

- In words of James A Tompkins:
  - Supply chain excellence cannot be achieved without synthesized supply chain. supply chain synthesis requires design, planning & execution.

Learning Objectives

1. Manage supply to improve **synchronization (organization, harmonization, management, bringing together)** in a supply chain in the face of predictable variability.
2. Manage demand to improve synchronization in a supply chain in the face of predictable variability.
3. Use sales and operations planning to maximize profitability when faced with predictable variability in a supply chain.

Question:

- Discuss how a firm can respond to predictable variability of demand in the supply chain?

Discuss how a firm can respond to predictable variability of demand in the supply chain.

- Faced with predictable variability, a company's goal is to respond in a manner that maximizes profitability. A firm must choose how to handle predictable variability by utilizing techniques in two broad categories:
- **1.** Manage supply using capacity, inventory, subcontracting, and backlogs.
- **2.** Manage demand using short-term price discounts and trade promotions.

Discuss how a firm can respond to predictable variability of demand in the supply chain.

- 1. One way to meet seasonal demand requires carrying enough manufacturing capacity to meet demand in any period.

Discuss how a firm can respond to predictable variability of demand in the supply chain.

- 2. Another approach to meeting demand would be to build up inventory during the off season to keep production stable year round.
- 3. A third approach would be for a firm to work with their retail partners in the supply chain to offer a price promotion during periods of low demand.

Discuss how a firm can respond to predictable variability of demand in the supply chain.

- Therefore, maximizing profitability depends on these decisions being made in a coordinated fashion and requires supply chain partners to work together across enterprises.

QUESTION

Discuss the approaches that can be used to manage capacity to meet predictable variability of demand?

Answer: Capacity

1. *Time flexibility from workforce*
2. *Use of seasonal workforce*
3. *Use of subcontracting*
4. *Use of dual facilities—dedicated and flexible:*
5. *Designing product flexibility into the production processes*

Discuss the approaches that can be used to manage capacity to meet predictable variability of demand

- The capacity on each line can be varied by moving the workforce from one line to the other.

Responding to Predictable Variability in a Supply Chain

- Predictable variability is change in demand that can be forecasted.
- Can cause increased costs and decreased responsiveness in the supply chain.
- Two broad approaches:
  1. Manage supply using capacity, inventory, subcontracting, and backlogs.
  2. Manage demand using short-term price discounts and trade promotions.

Managing Supply

- Managing capacity
  - Time flexibility from workforce
  - Use of seasonal workforce
  - Use of subcontracting
  - Use of dual facilities – specialized and flexible
  - Designing product flexibility into production processes
- Managing inventory
  - Using common components across multiple products
  - Build inventory of high demand or predictable demand products

- Discuss the approaches a firm can use to manage inventory to meet predictable variability of demand.
- Discuss the importance of collaboration within a supply chain when performing aggregate planning.
- Promotion on Supply within a Supply Chain.
- Discuss the impact of promotion on demand within a supply chain.

Info 1: Inventory/Capacity Trade-off

- Leveling capacity, forces inventory to build up in anticipation of seasonal variation in demand.
- Carrying low levels of inventory requires capacity to vary with seasonal variation in demand or enough capacity to cover peak demand during season.

Question

- Discuss the approaches a firm can use to manage inventory to meet predictable variability of demand.

Inventory

1. *Using common components across multiple products.*
2. *Build inventory of high demand or predictable demand products.*

Inventory

- As more is known about demand closer to the selling season, production of more uncertain items should take place.
- This strategy helps the supply chain better synchronize supply and demand.

Question

- Discuss the importance of collaboration within a supply chain when performing aggregate planning.

Collaboration Means

1. Relationship
2. Partnership
3. Teamwork
4. Group Effort
5. Association
6. Alliance
7. Cooperation

Organizational Relationships

- Types of Relationships (COLLABORATION)
- Vertical relationships: These refer to the traditional linkages between firms in the supply chain such as retailers, distributors, manufacturers, and parts and materials suppliers.
- Horizontal relationships: Includes those business agreements between firms that have “parallel” or cooperating positions in the logistics process.

Collaboration

- The retailer sets the price and runs promotions to generate demand. This is regularly done without taking into account the impact on the rest of the supply chain.
- Therefore, the combination of pricing and aggregate planning (both demand and supply management) can be used to maximize supply chain profitability.

Managing Demand @ ABCXYZ Water Coolers. FICTIOUS CASE

- Promotion at ABCXYZ Coolers

Item	Cost
Material cost	Rs100/unit
Inventory holding cost	Rs20/unit/month
Marginal cost of stockout/backlog	Rs5o/unit/month
Hiring and training costs	Rs300/worker
Layoff cost	Rs500/worker
Labor hours required	4/unit
Regular time cost	Rs4/hour
Overtime cost	Rs6/hour
Cost of subcontracting	Rs30/unit

Managing Demand

- Promotion at Red Tomato and Green Thumb

Item	Cost
Material cost	Rs10/unit
Inventory holding cost	Rs2/unit/month
Marginal cost of stockout/backlog	Rs5/unit/month
Hiring and training costs	Rs300/worker
Layoff cost	Rs500/worker
Labor hours required	4/unit
Regular time cost	Rs4/hour
Overtime cost	Rs6/hour
Cost of subcontracting	Rs30/unit

Managing Demand

	A	B	C	D	E	F	G	H	I	J	K
1	***Aggregate Plan Decision Variables***										
2		H_t	L_t	W_t	O_t	I_t	S_t	C_t	P_t		
3	***Period***	***# Hired***	***# Laid off***	***# Workforce***	***Overtime***	***Inventory***	***Stockout***	***Subcontract***	***Production***	***Demand***	***Price***
4	0	0	0	80	0	1,000	0	0			
5	1	0	15	65	0	1,983	0	0	2,583	1,600	40
6	2	0	0	65	0	1,567	0	0	2,583	3,000	40
7	3	0	0	65	0	950	0	0	2,583	3,200	40
8	4	0	0	65	0	0	267	0	2,583	3,800	40
9	5	0	0	65	0	117	0	0	2,583	2,200	40
10	6	0	0	65	0	500	0	0	2,583	2,200	40
22	***Total Cost =***		$422,275								
23								Base Price	$ 40		
24	***Total Revenue =***	$640,000		Promote? (0/1	0			Consumption	0.10		
25	***Profit =***	$217,725		Month (1/4)	1			Forward buy	0.20		

Managing Demand

Total cost over planning horizon = Rs. 422,275

Revenue over planning horizon = Rs. 640,000

Profit over planning horizon = Rs. 217,725

$$\text{Average seasonal inventory} = \frac{(I_0 + I_6)/2 + \left(\sum_{t=1}^{5} I_t\right)}{T} = \frac{5{,}367}{6} = 895$$

$$\text{Average flow time} = \frac{\text{average inventory}}{\text{average sales}} = \frac{895}{2{,}667} = 0.34 \text{ months}$$

The Timing of a Promotion

- Impact of the promotion on demand
- Cost of holding inventory
- Cost of changing the level of capacity
- Product margins
- Increase in demand from
  - Market growth
  - Stealing share
  - Forward buying

When to Promote

- Is it more effective to promote during the peak period of off-peak?
- Analyze the impact of a promotion on demand and the resulting optimal aggregate plan.

Promotion in January

Total cost over planning horizon = Rs. 421,915

Revenue over planning horizon = Rs. 643,400

Profit over planning horizon = Rs. 221,485

- Lower seasonal inventory
- A somewhat lower total cost
- A higher total profit

Promotion in April

Total cost over planning horizon = Rs. 438,857

Revenue over planning horizon = Rs. 650,140

Profit over planning horizon = Rs. 211,283

- Higher seasonal inventory
- A somewhat higher total cost
- A slightly smaller total profit

QUESTION

- Discuss the impact of promotion on demand within a supply chain.

PROMOTION

- Companies want to explore if and when to potentially offer a promotion. **Four** key factors influence the timing of a trade promotion:

1. Impact of the promotion on demand
2. Product margins
3. Cost of holding inventory
4. Cost of changing capacity

PROMOTION

- 1. *Market growth:* An increase in consumption of the product, either from new or existing customers.
- 2. *Stealing share:* Customers substituting the firm's product for a competitor's product.
- 3. *Forward buying:* Customers move up future purchases to the present.

PROMOTION

- In general, as the fraction of increased demand coming from forward buying grows, offering the promotion during the peak demand period becomes less attractive.
- Offering a promotion during a peak period that has significant forward buying creates even more variable demand than before the promotion.
- Product that was once demanded in the slow period is now demanded in the peak period, making this demand pattern even more costly to serve.
- Average inventory increases if a promotion is run during the peak period and decreases if the promotion is run during the off-peak period.

- When faced with seasonal demand, a firm should use a combination of pricing (to manage demand) and production and inventory (to manage supply) to improve profitability.
- The precise use of each lever varies with the situation. This makes it crucial that enterprises in a supply chain coordinate both their forecasting and planning efforts. Only then are profits maximized.

Conclusions on Promotion

1. Average inventory increases if a promotion is run during the peak period and decreases if the promotion is run during the off-peak period .
2. Promoting during a peak-demand month may decrease overall profitability if there is a small increase in consumption and a significant fraction of the demand increase results from a forward buy.

Implementing Sales and Operations Planning in Practice

1. Coordinate planning across enterprises in the supply chain.
2. Take predictable variability into account when making strategic decisions.
3. Design Sales &Operations Planning to understand and manage the drivers of demand usage.
4. Ensure that the Sales &Operations Planning process modifies plans as the reality or forecasts change.

1. *Coordinate planning across enterprises in the supply chain.*
2. *Take predictable variability into account when making strategic decisions.*
3. *Preempt, do not just react to, predictable variability.*

Modules Basis

- **1. Supply chain coordination requires all stages to take actions that maximize total supply chain profits.**

Objectives

- Module1:Describes supply chain coordination, the bullwhip effect, and their impact on performance
- Module 2:Identifies obstacles to coordination in a supply chain
- Module 3:Discusses managerial levers that help achieve coordination in a supply chain
- Module 4: Explains actions that facilitate the building of strategic partnerships and trust within a supply chain
- Module 5 :Understands the different forms of collaborative planning, forecasting and replenishment possible in a supply chain

Bullwhip Effect

- Fluctuations in orders increase as they move up the supply chain from retailers to wholesalers to manufacturers to suppliers
- Distorts demand information within the supply chain, where different stages have very different estimates of what demand looks like
- Results in a loss of supply chain coordination

The Effect on Performance

- Supply chain lacks coordination if each stage optimizes only its local objective
- Reduces total profits
- Performance measures include
  - Manufacturing cost
  - Inventory cost
  - Replenishment lead time
  - Transportation cost
  - Labor cost for shipping and receiving
  - Level of product availability
  - Relationships across the supply chain

Causes and Counter-measures of the Bullwhip Effect

Table 1 The Causes and Counter-Measures of the Bullwhip Effect

Causes	Contributing factors	Counter-measures	State of practice
Demand signaling	• No visibility of end demand	• Access sell-thru or POS data	• Sell-thru data in contracts (e.g., HP, Apple, IBM)
	• Multiple forecasts	• Single control of replenishment	• VMI (P&G and WalMart)
	• Long lead-time	• Lead-time reduction	• Quick Response mfg strategy
Order batching	• High order cost	• EDI & CAO	• McKesson, Nabisco
	• FTL economics	• Discount on assorted truckload, consolidation by 3rd party logistics	• 3rd party logistics in Europe, emerging in the US
	• Random or correlated ordering	• Regular delivery appointment	• P&G
Fluctuating prices	• High-low pricing	• EDLP	• P&G (resisted by some retailers)
	• Delivery & purchase asynchronized	• Special purchase contract	• Under study
Shortage game	• Proportional rationing scheme	• Allocate based on past sales	• Saturn, HP
	• Ignorance of supply conditions	• Shared capacity & supply information	• Scheduling sharing (HP, Motorola)
	• Unrestricted orders & free return policy	• Flexibility limited over time, capacity reservation	• HP, Sun, Seagate

Lee, Padmanabhan, and Whang: *The Bullwhip Effect*
Management Science 50(12S), pp. 1875–1886, © 2004 INFORMS

Obstacles to Coordination in a Supply Chain

1. Incentive Obstacles
2. Information Processing Obstacles
3. Operational Obstacles
4. Pricing Obstacles
5. Behavioral Obstacles

2.Information Processing Obstacles

- When demand information is distorted as it moves between different stages of the supply chain, leading to increased variability in orders within the supply chain
- Forecasting based on orders, not customer demand
  - Forecasting demand based on orders magnifies demand fluctuations moving up the supply chain from retailer to manufacturer (e.g. beer game)
- Lack of information sharing
  - Mis-interpretation of fluctuations in demand

3.Operational Obstacles

- Rationing and shortage gaming (common in the computer industry because of periodic cycles of component shortages and surpluses).

Managerial Levers to Achieve Coordination

- 1. Aligning Goals and Incentives
- 2. Improving Information Accuracy
- 3. Improving Operational Performance
- 4. Designing Pricing Strategies to Stabilize Orders
- 5. Building Strategic Partnerships and Trust

2.Improving Information Accuracy

- Sharing point of sale data, inventory info, etc.
- Collaborative forecasting and planning
  - e.g. manufacturer need to know retailer's promotion plans
- Single stage control of replenishment
  - Continuous replenishment programs (CRP)
  - Vendor managed inventory (VMI)

- Module 4: Explains actions that facilitate the building of strategic partnerships and trust within a supply chain
- Module 5 :Understands the different forms of collaborative planning, forecasting and replenishment possible in a supply chain
- Module 6: Future trends
- Module 7 : False Failure Rates

Building Strategic Partnerships and Trust in a Supply Chain

Each party is interested in the others' welfare and will not act without considering impact on others.

Cooperation and trust improve SC performance because:

- 1.Alignment of incentives and goals.
- 2.Actions to achieve coordination

IA.Building Trust into a Supply Chain Relationship

How to initiate and sustain a trust relationship?

- 1.Deterrence-based view
- 2. Process-based view

IIA. Building Trust into a Supply Chain Relationship

- 1. Trust improves by:
  - Information sharing
  - Aligning incentives
  - Operational improvements
  - Stabilisation of prices

How to initiate and sustain a trust relationship?

Managing Supply Chain Relationships for Cooperation and Trust

- Effective management of a relationship is important for its success

Continuous Replenishment and Vendor-Managed Inventories

- A single point of replenishment
  - Ensures visibility
  - One common forecast drives orders across the supply chain

MODULE 5 :UNDERSTANDS THE DIFFERENT FORMS OF COLLABORATIVE PLANNING, FORECASTING AND REPLENISHMENT POSSIBLE IN A SUPPLY CHAIN

Collaborative Planning, Forecasting, and Replenishment (CPFR)

- Sellers and buyers in a supply chain may collaborate along any or all of the following:
  - Strategy and planning
  - Demand and supply management
  - Execution (production, shipping, receiving, stocking)
  - Analysis (identifying exceptions, performance metrics, trends)

Common CPFR Scenarios

CPFR Scenario	Where Applied in Supply Chain	Industries Where Applied
Retail event collaboration	Highly promoted channels or categories	All industries other than those that practice EDLP
DC replenishment collaboration	Retail DC or distributor DC	Drugstores, hardware, grocery
Store replenishment collaboration	Direct store delivery or retail DC-to-store delivery	Mass merchants, club stores
Collaborative assortment planning	Apparel and seasonal goods	Department stores, specialty retail

Table 10-2

Collaborative Planning, Forecasting, and Replenishment (CPFR)

- 1.Retail Event Collaboration
- 2.DC Replenishment Collaboration
- 3.Store replenishment collaboration
- 4. Collaborative assortment planning (for seasonal goods)

The Role of IT in Coordination

- Enablement of coordination the ultimate goal
- IT's role:
  - Information availability
  - Use of information available to make decisions
  - Facilitate sharing of forecasts and historical information, and enable revisions
  - Enterprise systems that record all the supply-chain transactions
- Pitfalls/Challenges:
  - Systems integration
  - Co-ordinating operational procedures
  - trust

Achieving Coordination in Practice

- 1.Quantify the bullwhip effect
- 2.Get top management commitment for coordination
- 3.Devote resources to coordination
- 4.Focus on communication with other stages
- 5.Try to achieve coordination in the entire supply chain network
- 6.Use technology to improve connectivity in the supply chain
- 7.Share the benefits of coordination equitably

Future Trends

FALSE FAILURE RETURNS

- **False failure returns are products that are returned by consumers to retailers with no functional or cosmetic defect.**

Learning Objectives

1. **Fundamentals of Cycle Inventory**
2. **Balance the appropriate costs to choose the optimal lot size and cycle inventory in a supply chain.**

Objective

- The models help illustrate how buyers or sellers react to various inventory situations leading to the buildup of cycle and safety inventory.

- **Cost comparisons can be performed between ordering and delivering lots independently for each product, joint ordering and delivering, and joint ordering and delivering of a subset of products.**

- The concept of quantity discounts can be introduced by discussing lot size based discounts (all unit and marginal unit discounts), volume based discounts, and short-term discounts (trade promotions).

- Cycle inventory exists because producing or purchasing in large lots allows a stage of the supply chain to exploit economies of scale and thus lower cost.

FUNDAMENTALS

- 1. Inventory costs are of great concern to the management.
- 2. The inventory requires investments and hence excess inventories will tend to lower the profit margins.
- 3. The inventory shortage will close down the enterprise factory or lead to lose of market and customers.

PERFORMANCE MEASUREMENT AND CONTROLS

- The supply chain performance metrics are developed on various parameters. The key parameters amongst them are:
- 1. Cycle Time
- 2. Fill Rates

CYCLE TIME

- 1. Order Fulfilment cycle
- 2. Inventory replenishment cycle time
- 3. Manufacturing Cycle time
- 4. Cash to Cash Cycle time

CYCLE TIME

- 1. Order Fulfillment cycle: It is the time period required to supply the product after it is ordered. Customer will pick up the product from retail shelf if it is available there. For other products, it is the time till the product is in customers hand after he places an order.

CYCLE TIME

- 2. Inventory replenishment cycle time: It is the time taken to replenish the product at retail store or dealer showroom after it is delivered to the customer.
- The replenishment is done from the company's depot or regional distribution center or from manufacturing plant depending on the physical distance between source and the place of delivery.

CYCLE TIME

- 3. Manufacturing Cycle time: It is measured from the time firm planned order until the final production is done. It is time taken for converting raw material and components into finished product in usable form.

CYCLE TIME

- 4. Cash to Cash Cycle time: It is the time required for getting the raw material and components after it is ordered to the vendors. For imported material the procurement cycle time is longer.

CYCLE TIME

- 5.Cash-to-Cash cycle time: The number of days between paying for raw materials and getting paid for the product. It is calculated by inventory days of supply plus days of sales outstanding minus average payment period for material.

FILL RATES

- 1.Line Fill Rate: This means amount of order lines shipped on the initial shipment versus the amount of lines ordered. This measure may or may not take into consideration as per the requested delivery date.

FILL RATES

- A customer orders 5 products one each from 5 product lines. The manufacturer dispatches 4 products from 4 product lines. In this case, the line fill rate is 80 percent.

FILL RATES

- 2.SKU Fill rate: This represents the number of SKU(Stock Keeping Units) ordered and shipped as against the ordered.

FILL RATES

- 3.Case Fill rate: This represents the amount of cases shipped on the initial shipment versus the amount ordered.

Role of Cycle Inventory in a Supply Chain

- The primary role of cycle inventory is to allow different stages in the supply chain to purchase product in lot sizes that minimize the sum of the material, ordering, and holding cost.

Role of Cycle Inventory in a Supply Chain

- Ideally, cycle inventory decisions should be made considering the total cost across the entire supply chain.

Role of Cycle Inventory in a Supply Chain

- Ideally, cycle inventory decisions should be made considering the total cost across the entire supply chain.

Role of Cycle Inventory in a Supply Chain

- **1. A fixed cost is incurred each time an order is placed or produced.**
- **2. The supplier offers price discounts based on the quantity purchased per lot.**
- **3. The supplier offers short-term discounts or holds trade promotions.**

Role of Cycle Inventory in a Supply Chain

- ***Lot* or *batch size* is the quantity that a stage of a supply chain either produces or purchases at a time.**

Role of Cycle Inventory in a Supply Chain

- ***Cycle inventory*** is the average inventory in a supply chain due to either production or purchases in lot sizes that are larger than those demanded by the customer.

Q: Quantity in a lot or batch size

D: Demand per unit time

Inventory Profile

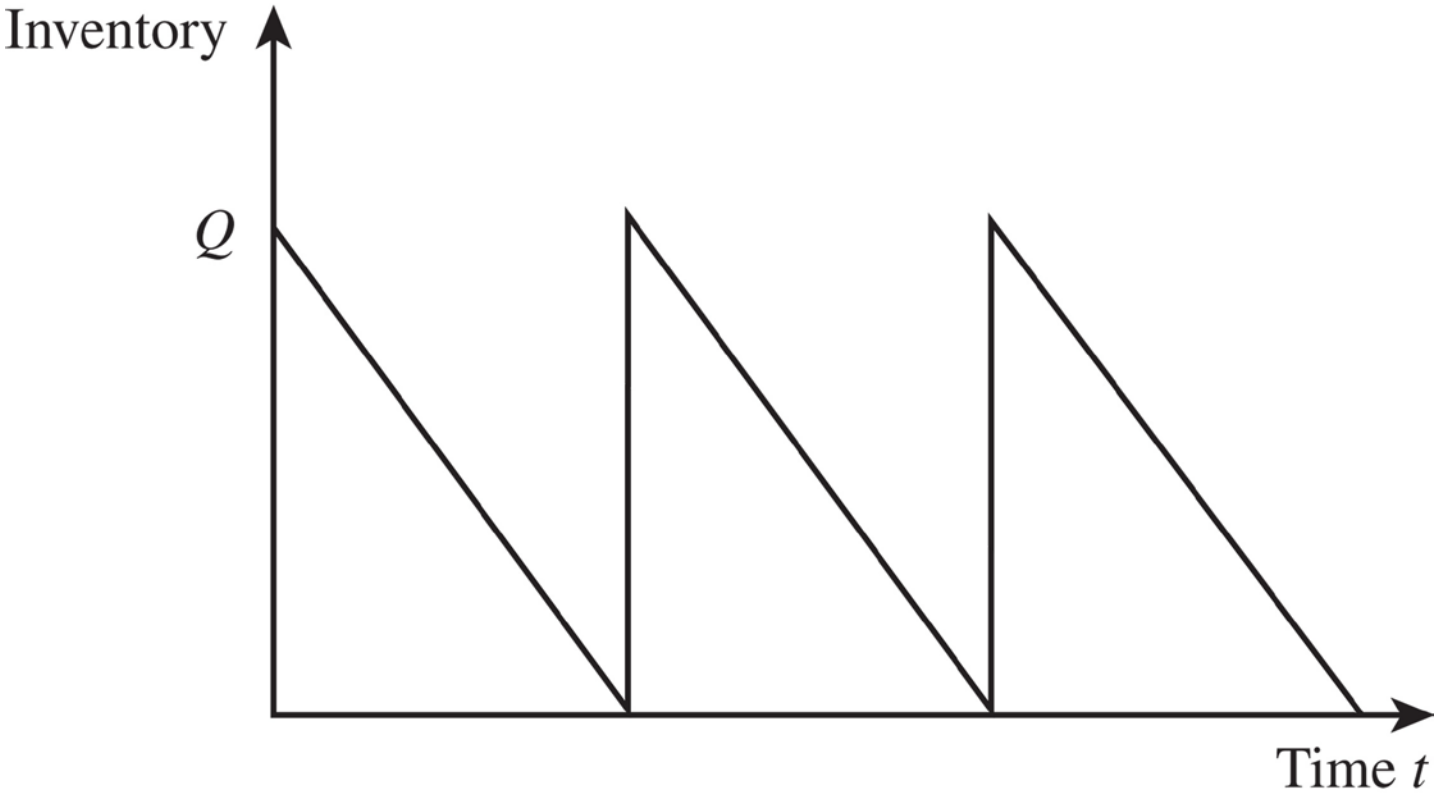


Figure 11-1

Role of Cycle Inventory in a Supply Chain

$$\text{Cycle inventory} = \frac{\text{lot size}}{2} = \frac{Q}{2}$$

$$\text{Average flow time} = \frac{\text{average inventory}}{\text{average flow rate}}$$

Average flow time resulting from cycle inventory

$$= \frac{\text{cycle inventory}}{\text{demand}} = \frac{Q}{2D}$$

Role of Cycle Inventory in a Supply Chain

- *Average price paid per unit purchased* is a key cost in the lot-sizing decision.

  Material cost = C

Role of Cycle Inventory in a Supply Chain

- ***Holding cost "H"* is the cost of carrying one unit in inventory for a specified period of time.**

Holding cost = $H = hC$

Role of Cycle Inventory in a Supply Chain

- **Primary role of cycle inventory is to allow different stages to purchase product in lot sizes that minimize the sum of material, ordering, and holding costs.**

Estimating Cycle Inventory Related Costs in Practice

- **Inventory Holding Cost**
  - **Cost of capital**

$$WACC = \frac{E}{D+E}(R_f + \beta \times MRP) + \frac{D}{D+E} R_b(1-t)$$

where

E = amount of equity
D = amount of debt
R_f = risk-free rate of return
β = the firm's beta
MRP = market risk premium
R_b = rate at which the firm can borrow money
t = tax rate

Estimating Cycle Inventory Related Costs in Practice

- **Inventory Holding Cost**
  - **Obsolescence cost**
  - **Handling cost**
  - **Occupancy cost**
  - **Miscellaneous costs**
    - **Theft, security, damage, tax, insurance**

Estimating Cycle Inventory Related Costs in Practice

- **Ordering Cost**
  - **Buyer time**
  - **Transportation costs**
  - **Receiving costs**
  - **Other costs**

- A few of the key goals (from the manufacturer’s perspective) of a trade promotion are as follows:
- 1. Induce retailers to use price discounts, displays, or advertising to spur sales.

- 2. Shift inventory from the manufacturer to the retailer and the customer.
- 3. Defend a brand against competition.

Economies of Scale to Exploit Fixed Costs

- **Lot sizing for a single product (EOQ)**

D = **Annual demand of the product**

S = **Fixed cost incurred per order**

C = **Cost per unit**

H = **Holding cost per year as a fraction of product cost**

Economies of Scale to Exploit Fixed Costs

- **Basic assumptions:**
  - **Demand is steady at D units per unit time**
  - **No shortages are allowed**
  - **Replenishment lead time is fixed**

Economies of Scale to Exploit Fixed Costs

- Minimize:
  - –Annual material cost
  - –Annual ordering cost
  - –Annual holding cost

Lot Sizing for a Single Product

$$\text{Annual material cost} = CD$$

$$\text{Number of orders per year} = \frac{D}{Q}$$

$$\text{Annual ordering cost} = \left(\frac{D}{Q}\right)S$$

$$\text{Annual holding cost} = \left(\frac{Q}{2}\right)H = \left(\frac{Q}{2}\right)hC$$

$$\text{Total annual cost, } TC = CD + \left(\frac{D}{Q}\right)S + \left(\frac{Q}{2}\right)hC$$

Lot Sizing for a Single Product

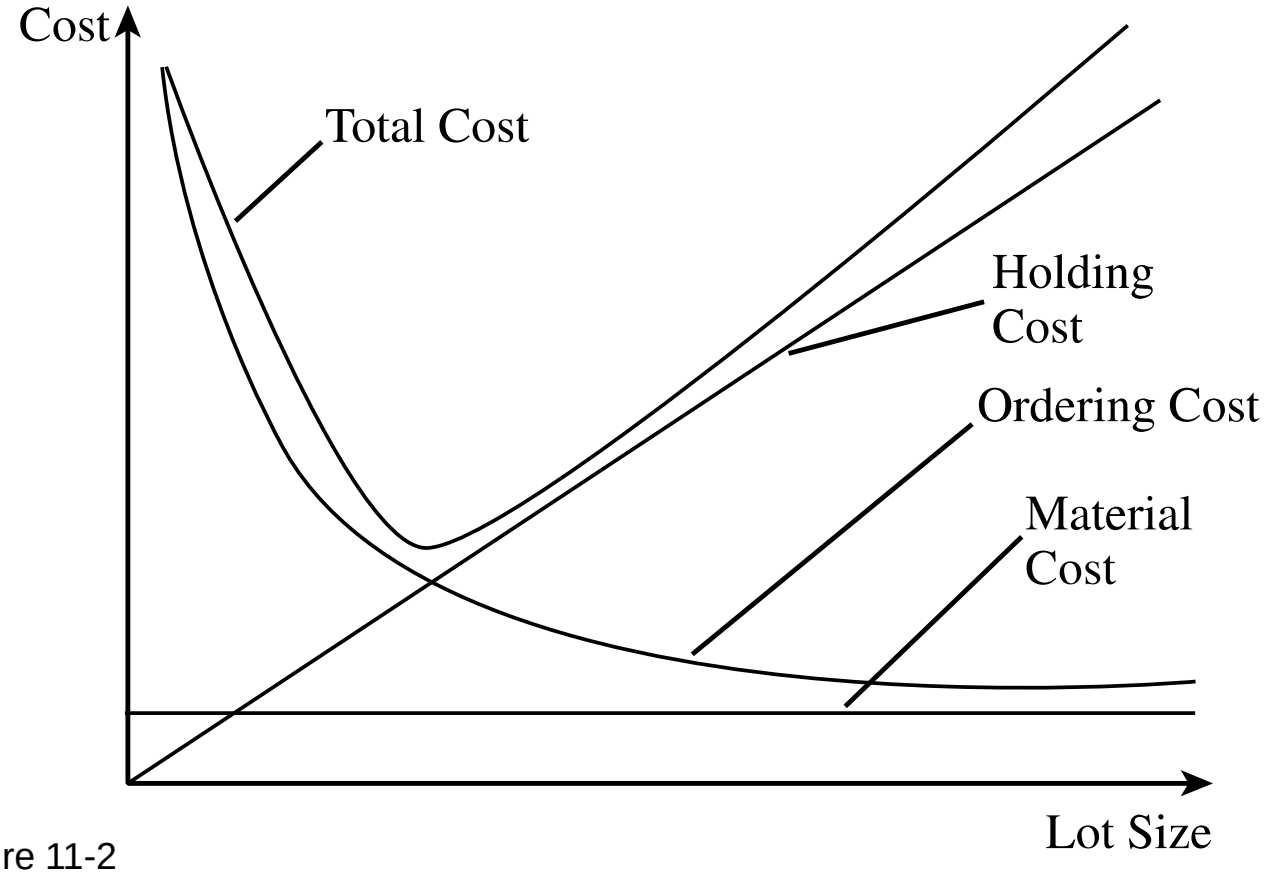


Figure 11-2

Lot Sizing for a Single Product

- The *economic order quantity* (*EOQ*)

$$\text{Optimal lot size, } Q^* = \sqrt{\frac{2DS}{hC}}$$

- **The optimal ordering frequency**

$$n^* = \frac{D}{Q^*} = \sqrt{\frac{DhC}{2S}}$$

Learning Objectives

1. **Aggregate Multiple orders, Lots ordered and delivered jointly**
2. **Understand the impact of quantity discounts on lot size and cycle inventory.**
3. **Lessons learnt from discounting schemes for a supply chain.**
4. **Understand the impact of trade promotions on lot size and cycle inventory.**
5. **Managing Multi-Echelon Cycle Inventory.**

Lot Sizing with Multiple Products or Customers

- **Lot sizes and ordering policy that minimize total cost**

D_i: **Annual demand for product i**

S: **Order cost incurred each time an order is placed, independent of the variety of products in the order**

s_i: **Additional order cost incurred if product i is included in the order**

Lot Sizing with Multiple Products or Customers

- **Three approaches:**
  1. **Each product manager orders his or her model independently.**
  2. **The product managers jointly order every product in each lot.**

Lots Ordered and Delivered Jointly for a Selected Subset

Step 1: Identify the most frequently ordered product assuming each product is ordered independently, **n_i is the ordering frequency**

$$\bar{n}_i = \sqrt{\frac{hC_iD_i}{2(S+s_i)}}$$

Step 2: For all products $i \neq i^*$, evaluate the ordering frequency

$$= \\ n_i = \sqrt{\frac{hC_iD_i}{2s_i}}$$

Lots Ordered and Delivered Jointly for a Selected Subset

Step 3: For all $i \neq i^*$, evaluate the frequency of product i relative to the most frequently ordered product i^* to be m_i

$$m_i = \left| \bar{n} / \bar{\bar{n}}_i \right|$$

Step 4: Recalculate the ordering frequency of the most frequently ordered product i^* to be n

$$n = \sqrt{\frac{\sum_{i=1}^{l} hC_i m_i D}{2\left(S + \sum_{i=1}^{l} s_i / m_i\right)}}$$

Lots Ordered and Delivered Jointly for a Selected Subset

Step 5: Evaluate an order frequency of $n_i = n/m_i$ and the total cost of such an ordering policy

$$TC = nS + \sum_{i=1}^{l} n_i s_i + \sum_{i-1}^{l} \left(\frac{D_i}{2n_i} \right) hC_1$$

Tailored aggregation **– higher-demand products ordered more frequently and lower-demand products ordered less frequently.**

QUANTITY DISCOUNTS

Economies of Scale to Exploit Quantity Discounts

- *Lot size-based discount* – Discounts based on quantity ordered in a single lot.
- *Volume based discount* – Discount is based on total quantity purchased over a given period.
- Two common schemes:
  - All-unit quantity discounts
  - Marginal unit quantity discount or multi-block tariffs

Quantity Discounts

- Two basic questions
  1. What is the optimal purchasing decision for a buyer seeking to maximize profits? How does this decision affect the supply chain in terms of lot sizes, cycle inventories, and flow times?
  2. Under what conditions should a supplier offer quantity discounts? What are appropriate pricing schedules that a supplier seeking to maximize profits should offer?

All-Unit Quantity Discounts

- Objective is to decide on a lot size that will minimize the sum of material, order, and holding costs.

All-Unit Quantity Discounts

Step 1: Evaluate the optimal lot size for each price $C_i, 0 \leq i \leq r$ as follows

$$Q_i = \sqrt{\frac{2DS}{hC_i}}$$

All-Unit Quantity Discounts

Step 2: We next select the order quantity Q^*_i for each price C_i

1. $q_i \leq Q_i < q_{i+1}$
2. $Q_i < q_i$
3. $Q_i \geq q_{i+1}$

- Case 3 can be ignored as it is considered for Q_{i+1}
- For Case 1 if $q_i \leq Q_i < q_{i+1}$, then set $Q^*_i = Q_i$
- If $Q_i < q_i$, then a discount is not possible
- Set $Q^*_i = q_i$ to qualify for the discounted price of C_i

All-Unit Quantity Discounts

Step 3: Calculate the total annual cost of ordering Q^*_i units

$$\text{Total annual cost, } TC_i = \left(\frac{D}{Q_i^*}\right)S + \left(\frac{Q_i^*}{2}\right)hC_i + DC_i$$

All-Unit Quantity Discounts

Step 4: Select Q^*_i with the lowest total cost TC_i

- Cutoff price

$$C^* = \frac{1}{D}\left(DC_r + \frac{DS}{q_r} + \frac{h}{2}q_r C_r - \sqrt{2hDSC_r}\right)$$

Marginal Unit Quantity Discounts

- *Multi-block tariffs* – the *marginal cost* of a unit that decreases at a breakpoint.

For each value of i, $0 \le i \le r$, let V_i be the cost of ordering q_i units

$$V_i = C_0(q_1 - q_0) + C_1(q_2 - q_1) + \ldots + C_{i-1}(q_i - q_{i-1})$$

Why Quantity Discounts?

1. **Improved coordination to increase total supply chain profits**
2. **Extraction of surplus through price discrimination**

Two-Part Tariff

- Manufacturer charges its entire profit as an up-front franchise fee *ff*
- Sells to the retailer at cost
- Retail pricing decision is based on maximizing its profits
- Effectively maximizes the coordinated supply chain profit

Volume-Based Quantity Discounts

- Design a volume-based discount scheme that gets the retailer to purchase and sell the quantity sold when the two stages coordinate their actions.

DISCOUNTING SCHEMES

Lessons from Discounting Schemes

- Quantity discounts play a role in supply chain coordination and improved supply chain profits.
- Discount schemes that are optimal are volume based and not lot size based unless the manufacturer has large fixed costs associated with each lot.
- Even in the presence of large fixed costs for the manufacturer, a two-part tariff or volume-based discount, with the manufacturer passing on some of the fixed cost to the retailer, optimally coordinates the supply chain and maximizes profits.

Lessons from Discounting Schemes

- Lot size–based discounts tend to raise the cycle inventory in the supply chain.
- Volume-based discounts are compatible with small lots that reduce cycle inventory.
- Retailers will tend to increase the size of the lot toward the end of the evaluation period, the *hockey stick phenomenon.*
- With multiple retailers with different demand curves optimal discount continues to be volume based with the average price charged to the retailers decreasing as the rate of purchase increases.

Price Discrimination to Maximize Supplier Profits

- Firm charges differential prices to maximize profits.
- Setting a fixed price for all units does not maximize profits for the manufacturer.
- Manufacturer can obtain maximum profits by pricing each unit differently based on customers' marginal evaluation at each quantity.
- Quantity discounts are one mechanism for price discrimination because customers pay different prices based on the quantity purchased.

TRADE PROMOTIONS

Short-Term Discounting: Trade Promotions

- Trade promotions are price discounts for a limited period of time
- Key goals:
  1. Induce retailers to use price discounts, displays, or advertising to spur sales.
  2. Shift inventory from the manufacturer to the retailer and the customer.
  3. Defend a brand against competition.

Short-Term Discounting: Trade Promotions

- Impact on the behavior of the retailer and supply chain performance.
- Retailer has two primary options:
  1. Pass through some or all of the promotion to customers to spur sales.
  2. Pass through very little of the promotion to customers but purchase in greater quantity during the promotion period to exploit the temporary reduction in price (*forward buy*).

Forward Buying Inventory Profile

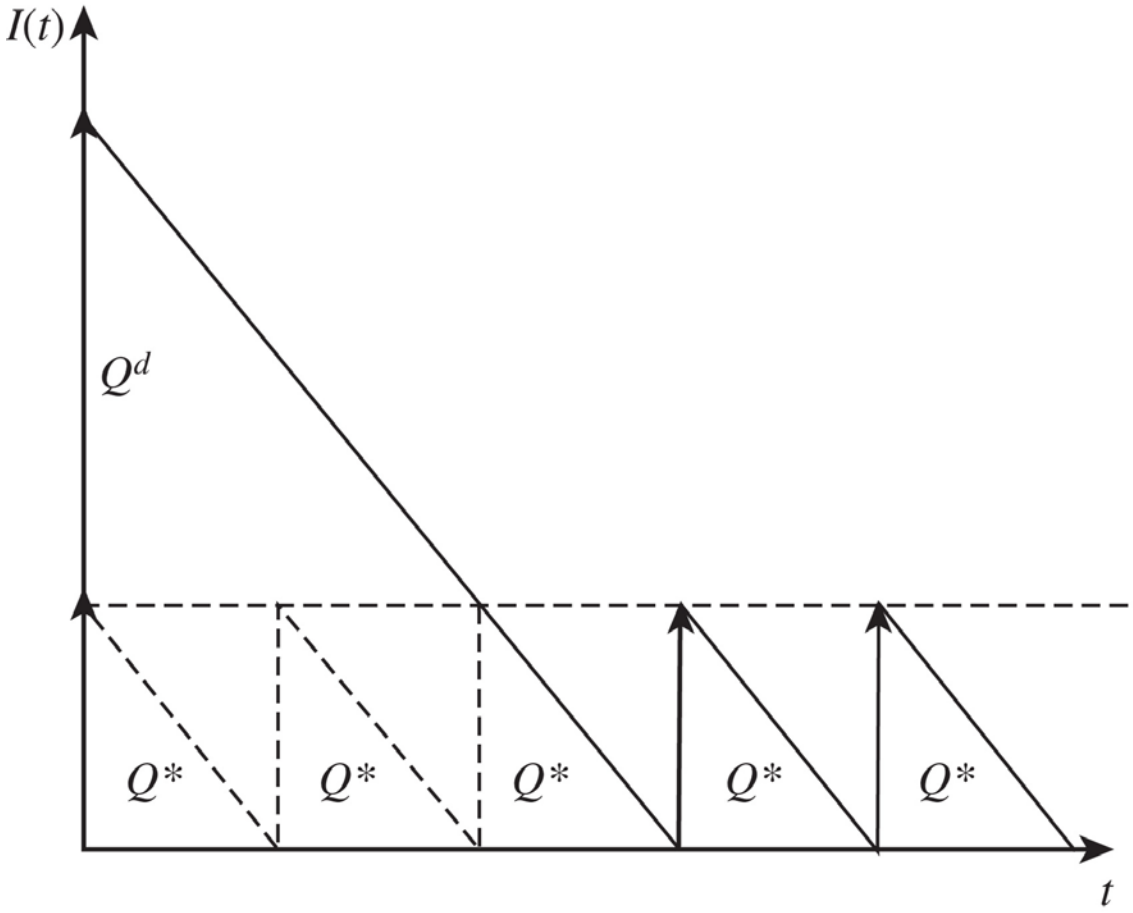


Figure 11-5

Forward Buy

- Costs to be considered – material cost, holding cost, and order cost
- Three assumptions
  1. The discount is offered once, with no future discounts
  2. The retailer takes no action to influence customer demand
  3. Analyze a period over which the demand is an integer multiple of Q^*

Trade Promotions

- **Trade promotions generally increase cycle inventory in a supply chain and hurt performance.**

Trade Promotions

- Counter measures:
  - –EDLP (every day low pricing)
  - **–Discount applies to items sold to customers (sell-through) not the quantity purchased by the retailer (sell-in)**
  - –Scan based promotions

MANAGING MULTI-ECHELON INVENTORY

QUESTION

- Discuss the characteristics of a successful multi-echelon supply chain.
- ***Answer:*** For such a multi-echelon distribution supply chain, a good replenishment policy has the following characteristics:

QUESTION

- 1 All parties within a stage are divided into groups such that all parties within a group order simultaneously from the same supplier.
- 2.When a party receives a replenishment order, the receipt should be synchronized with the shipment of a replenishment order to at least one of its customers.

QUESTION

- 3. In other words, a portion of any replenishment order at a stage should be cross-docked onto the next stage.
- 4 If a customer replenishes less frequently than its supplier, the supplier replenishment frequency should be an integer multiple of the customer replenishment frequency and replenishment at both stages should be synchronized to facilitate cross-docking.

QUESTION

- 5. In other words, a supplier should cross-dock all orders from customers who reorder less frequently than the supplier himself.
- 6.If a customer replenishes more frequently than its supplier, the customer's replenishment frequency should be an integer multiple of the supplier's replenishment frequency and replenishment at both stages should be synchronized to facilitate cross-docking.

QUESTION

- 7. In other words, a supplier should cross-dock one out of every *k* shipments to a customer who orders more frequently than himself, where *k* is an integer.

QUESTION

- 8.The relative frequency of reordering will depend upon the setup cost, holding cost, and demand at different parties.

QUESTION

- 9.Replenishment orders in multi-echelon supply chains should be synchronized to keep cycle inventory and order costs low. In general, each stage should attempt to coordinate orders from customers who order less frequently and cross-dock all such orders.

QUESTION

- 10. Some of the orders from customers that order more frequently should also be cross-docked.

Managing Multiechelon Cycle Inventory

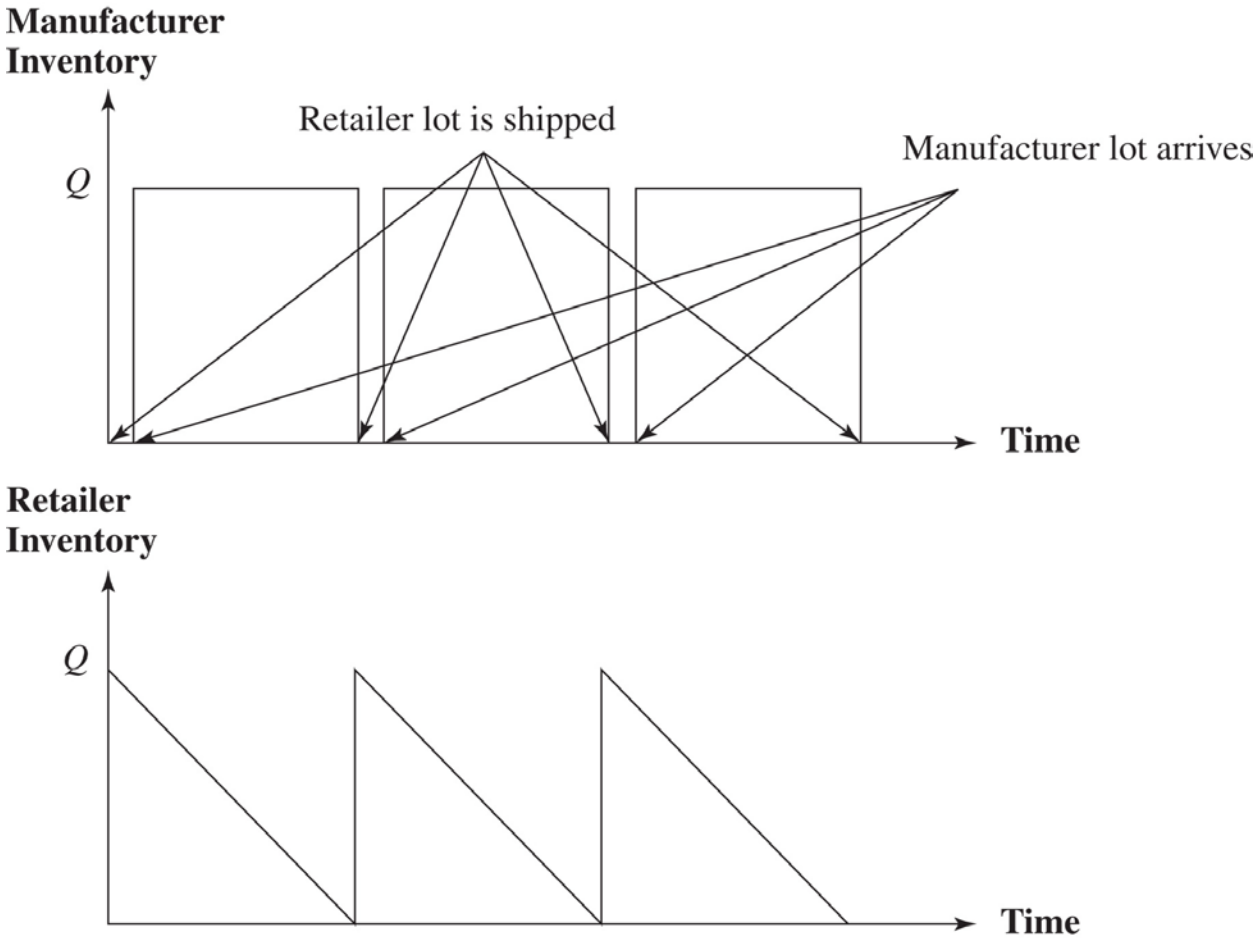


Figure 11-6

Integer Replenishment Policy

- **For customers with a longer reorder interval than the supplier, make the customer's reorder interval an integer multiple of the supplier's interval and synchronize replenishment at the two stages to facilitate cross-docking.**

Integer Replenishment Policy

- **For customers with a shorter reorder interval than the supplier, make the supplier's reorder interval an integer multiple of the customer's interval and synchronize replenishment at the two stages to facilitate cross-docking.**

Integer Replenishment Policy

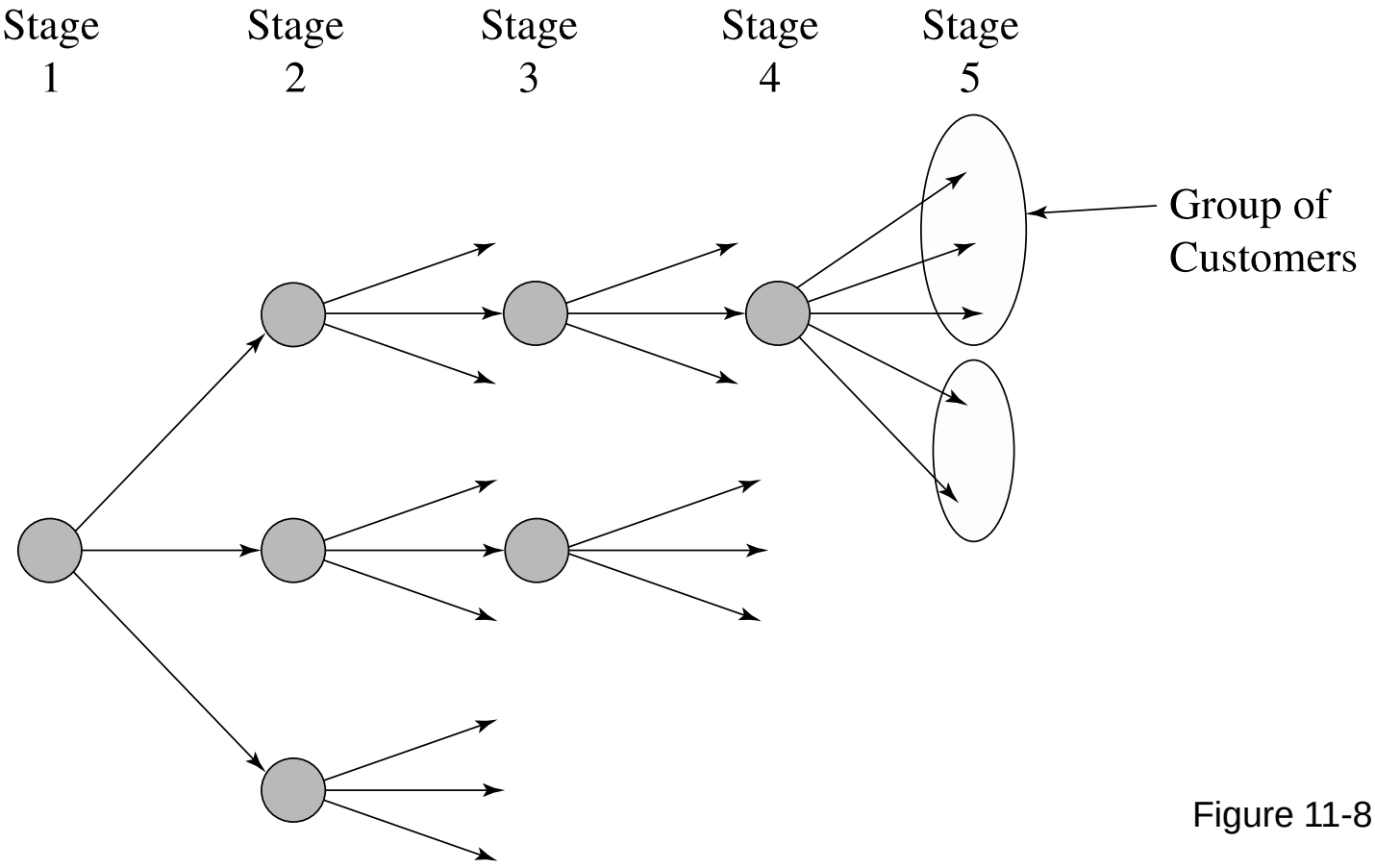
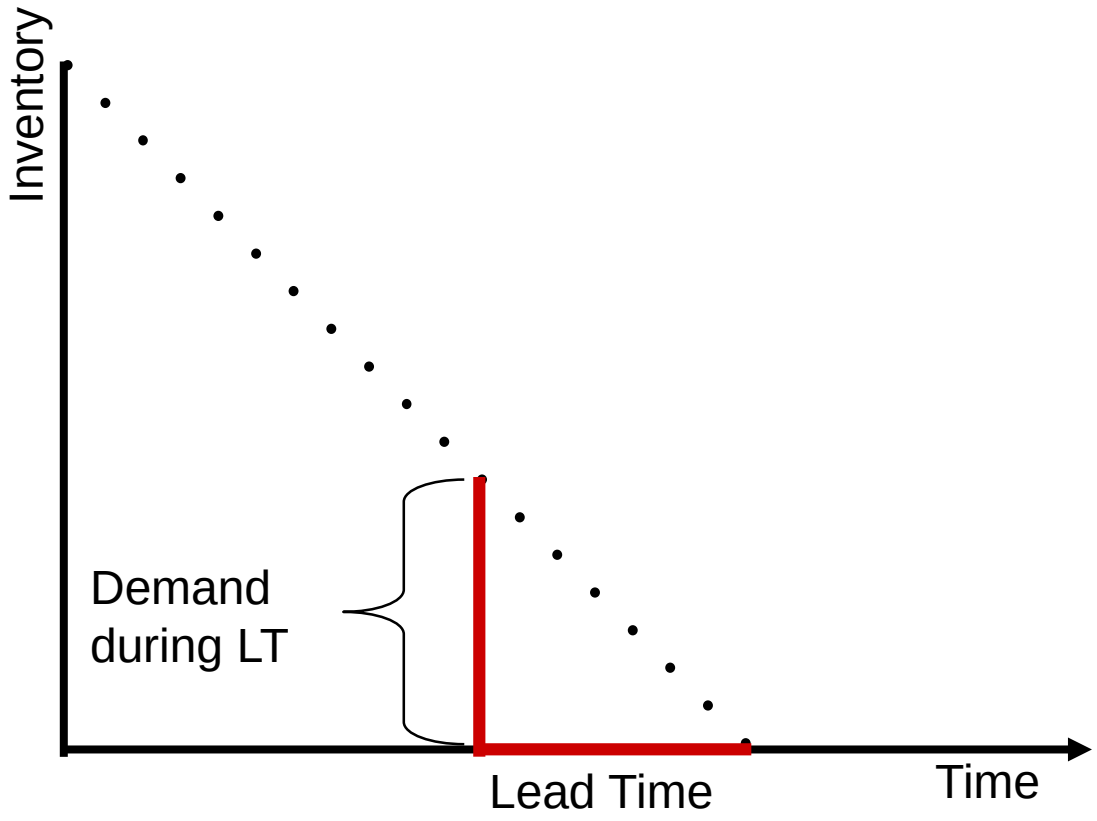
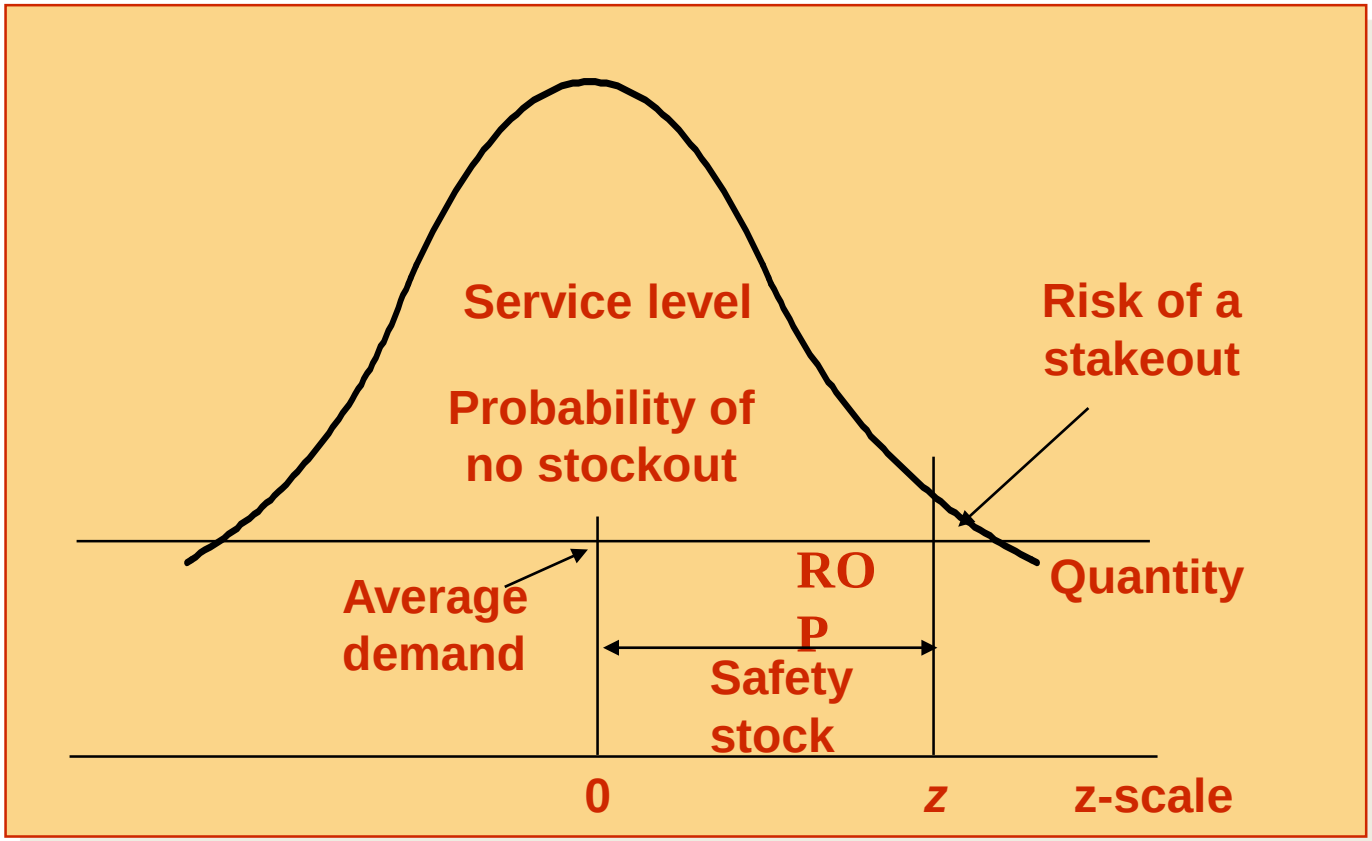


Figure 11-8

Learning Objectives

- 1.Understand the role of safety inventory in a supply chain.
- 2.Identify factors that influence the required level of safety inventory.
- 3.Describe different measures of product availability.
- 4.Determine the appropriate level of safety inventory.



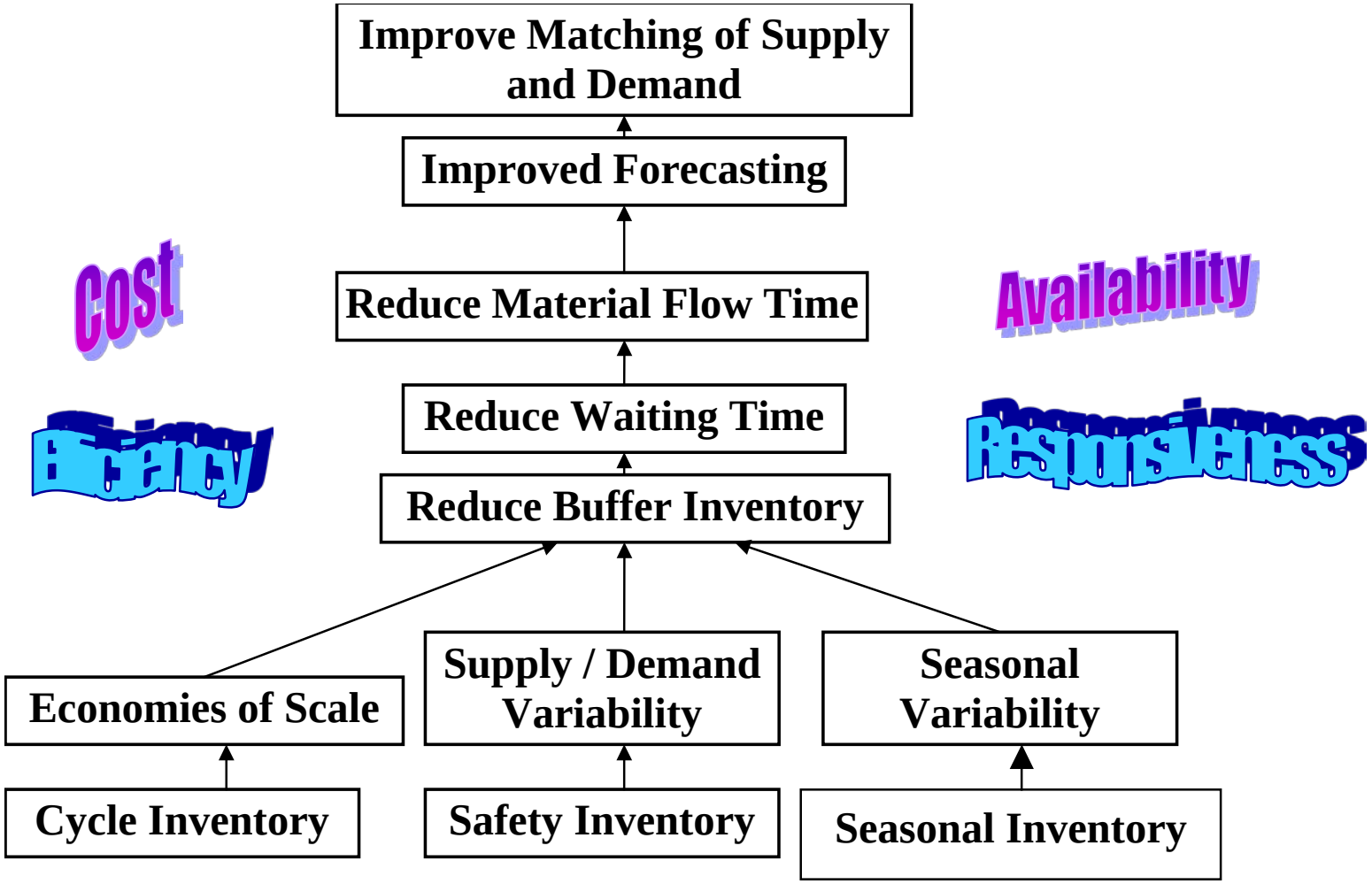


LTD = Lead Time Demand

ROP = Average LTD +z (Standard Deviation of LTD)

ROP = $LTD + z\sigma_{LTD}$ ➔ ROP = $LTD + I_{safety}$

Role of Inventory in the Supply Chain



The Role of Safety Inventory in a Supply Chain

- Safety inventory:

Inventory carried for the purpose of satisfying demand that exceeds the amount forecasted in a given period.

The Role of Safety Inventory in a Supply Chain

- Safety inventory:

  The average inventory remaining when the replenishment lot arrives.

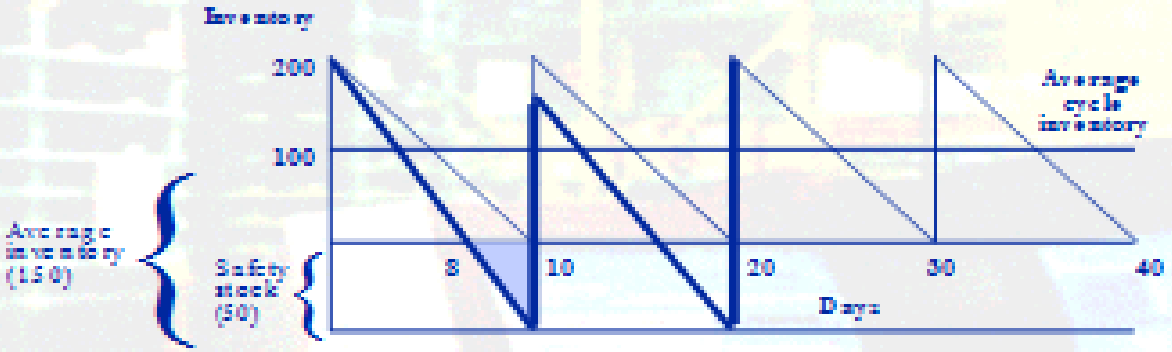
The Role of Safety Inventory in a Supply Chain

- Safety inventory:
- To manage :
  - Demand uncertainty
  - Supply uncertainty

Raising the level of safety inventory

- –Increases :
  - –Product availability
  - –Inventory holding costs

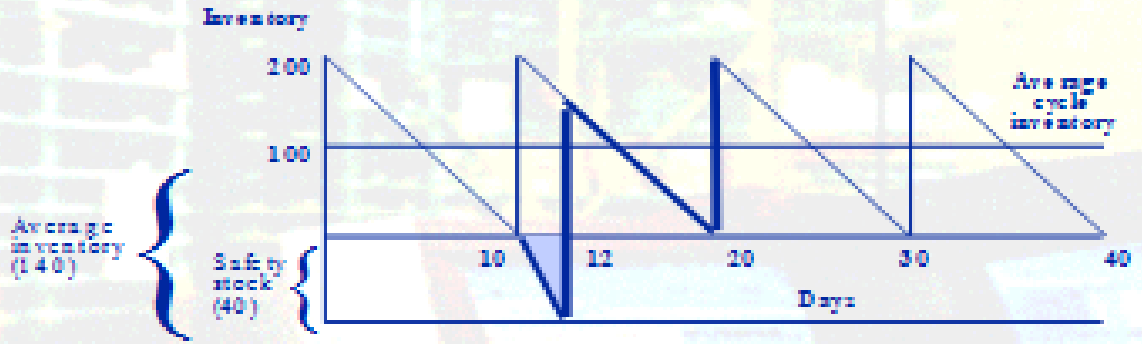
(A) With variable demand



- The average inventory would be 100 units when demand (20/d) and lead time (1Day) were constant
- If demand was actually 25/d, inventory would be depleted by 8 (200/25). And there would be a stockout of 50 units.
- A safety stock of 50 units would prevent a stockout due to variation in demand

11. 3

(B) With variable lead time



- The lead time can vary by plus or minus two days
- When the order arrived 2 days late, on day 12, the firm would experience stockouts for 2 days (40 units)
- If the management believed that shipments would never arrive more than two days late, a safety stock of 40 units would ensure a stockout would not occur. This would require holding an average inventory of 140 units

11-

The Role of Safety Inventory

- Three key questions
  1. What is the appropriate level of product availability?
  2. How much safety inventory is needed for the desired level of product availability?
  3. What actions can be taken to improve product availability while reducing safety inventory?

The Role of Safety Inventory

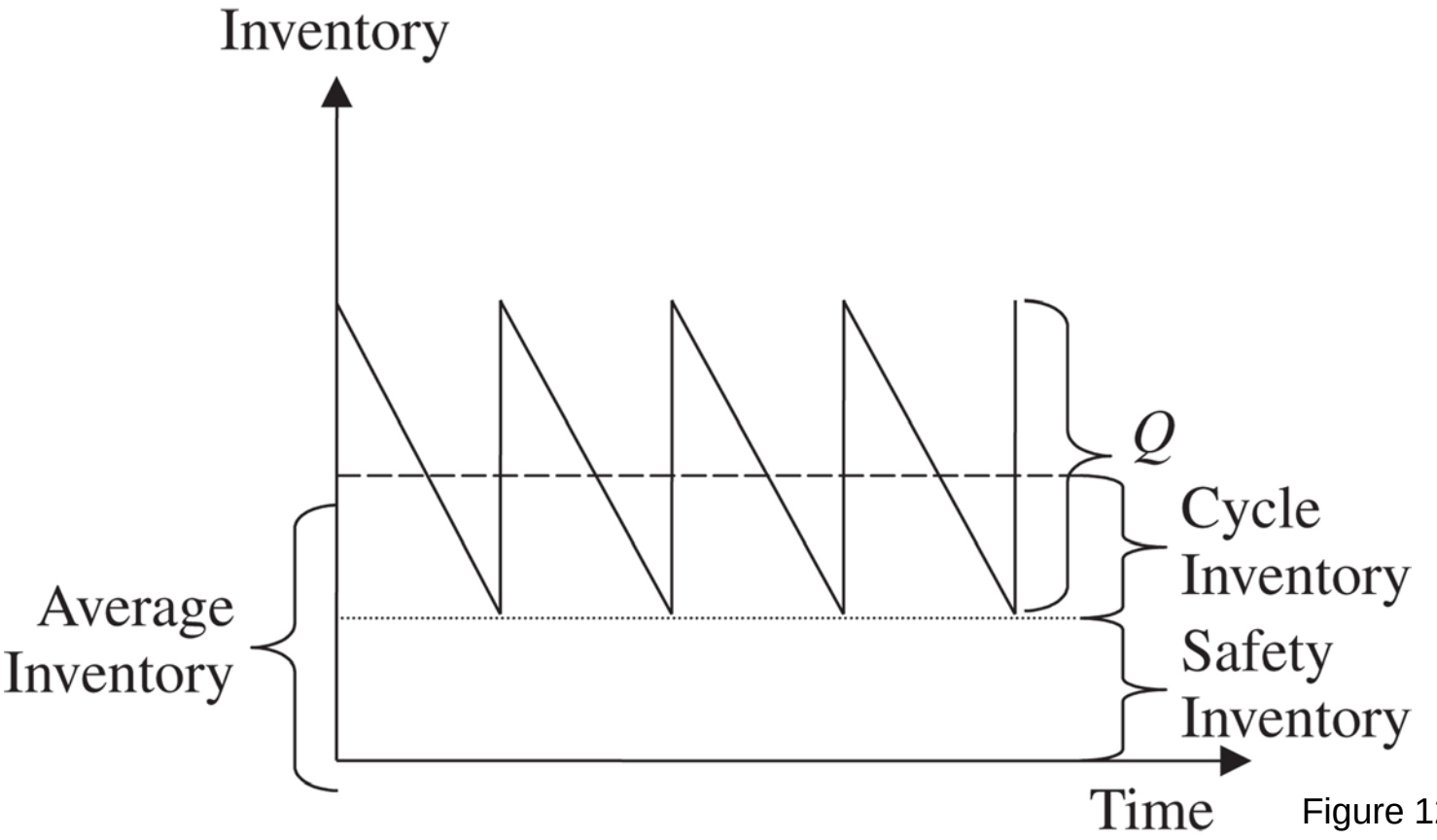


Figure 12-1

Determining the Appropriate Level of Safety Inventory

- Measuring demand uncertainty
- Measuring product availability
- Replenishment policies
- Evaluating cycle service level and fill rate
- Evaluating safety level given desired cycle service level or fill rate
- Impact of required product availability and uncertainty on safety inventory

Determining the Appropriate Level of Demand Uncertainty

- Appropriate level of safety inventory determined by:
  - supply or demand uncertainty
  - desired level of product availability
- Higher levels of uncertainty require higher levels of safety inventory given a particular desired level of product availability.
- Higher levels of desired product availability require higher levels of safety inventory given a particular level of uncertainty.

Measuring Demand Uncertainty

- Demand has a systematic component and a random component
- The estimate of the random component is the measure of demand uncertainty
- Random component is usually estimated by the standard deviation of demand
- Notation:

  D = Average demand per period

  σ_D = standard deviation of demand per period

  L = lead time = time between when an order is placed and when it is received
- Uncertainty of demand during lead time is what is important

Evaluating Demand Distribution Over *L* Periods

$$D_L = \sum_{i=1}^{L} D_i \qquad \sigma_L = \sqrt{\sum_{i=1}^{L} \sigma_i^2 + 2\sum_{i>j} \rho_{ij}\sigma_i\sigma_j}$$

$$D_L = DL \qquad \sigma_L = \sqrt{L\sigma_D}$$

The *coefficient of variation*

= size of uncertainty relative to demand

$$cv = \sigma / \mu$$

Measuring Product Availability

- Product availability: A firm's ability to fill a customer's order out of available inventory.
- Stockout: A customer order arrives when product is not available.
- Product fill rate (*fr*): Fraction of demand that is satisfied from product in inventory.
- Order fill rate: Fraction of orders that are filled from available inventory.
- Cycle service level (*CSL*): Fraction of replenishment cycles that end with all customer demand met.

Replenishment Policies

Replenishment policy: Decisions regarding when to reorder and how much to reorder.

- Continuous review: Inventory is continuously monitored and an order of size Q is placed when the inventory level declines to the reorder point ROP.
- Periodic review: Inventory is checked at regular (periodic) intervals and an order is placed to raise the inventory to a specified threshold (the "order-up-to" level).

Evaluating Cycle Service Level and Fill Rate

- Evaluating Safety Inventory Given a Replenishment Policy.

Expected demand during lead time = DL

Safety inventory, ss = ROP – DL

Evaluating Cycle Service Level and Fill Rate

- Evaluating Cycle Service Level Given a Replenishment Policy.

$$CSL = Prob(\text{ddlt of } L \text{ weeks} \leq ROP)$$

$$CSL = F(ROP, D_L, \sigma_L) = NORMDIST(ROP, D_L, \sigma_L, 1)$$

(ddlt = demand during lead time)

Evaluating Fill Rate Given a Replenishment Policy

$$ESC = \int_{x=ROP}^{\infty} (x - ROP) f(x)\, dx$$

$$ESC = -ss\left[1 - F_s\left(\frac{ss}{\sigma_L}\right)\right] + \sigma_L f_s\left(\frac{ss}{\sigma_L}\right)$$

$$ESC = -ss[1 - NORMDIST(ss / \sigma_L, 0, 1, 1)]$$
$$+\sigma_L NORMDIST(ss / \sigma_L, 0, 1, 0)$$

- A continuous random variable *X has a normal distribution with M*ean Meo and standard deviation *Sigma > 0 if the probability* density function *f(x, f.L, a) of the random varible is* given by:

$$f(x, \mu, \sigma) = \frac{1}{\sigma\sqrt{2\pi}} \exp\left[\frac{(x - \mu)^2}{2\sigma^2}\right] \qquad \textbf{(11.18)}$$

- The *cumulative normal distribution function is* denoted by *F(x, f.L, a) and is the probability that a normally* distributed random variable with mean *f.L and standard.*

Impact of Desired Product Availability and Uncertainty on Safety Inventory

- Managerial levers …
  - **Reduce supplier lead time, L (better relationships with suppliers).**
  - **Reduce uncertainty in demand, σ_L (better forecasts, better information collection and use).**

Benefits of Reducing Lead Time

- Returns the inverse of the standard normal cumulative distribution.
- The distribution has a mean of zero and a standard deviation of one.

- **Syntax : NORMSINV(probability)**

- **Probability** is a probability corresponding to the normal distribution.

IMPACT OF SUPPLY UNCERTAINTY ON SAFETY INVENTORY

Impact of Supply Uncertainty on Safety Inventory

- We incorporate supply uncertainty by assuming that lead time is uncertain.

D: Average demand per period

σ_D: Standard deviation of demand per period

L: Average lead time for replenishment

σ_L: Standard deviation of lead time

$$D_L = DL \qquad \sigma_L = \sqrt{L\sigma_D^2 + D^2 s_L^2}$$

IMPACT OF AGGREGATION ON SAFETY INVENTORY

Impact of Aggregation on Safety Inventory

- Supply chains have varying degree of inventory aggregation.

Impact of Aggregation on Safety Inventory

- Consider k regions with demand in each region normally distributed with the following characteristics:

  D_i: Mean weekly demand in region i, $i = 1,\ldots, k$

  σ_i: Standard deviation of weekly demand in region i, $i = 1,\ldots, k$

  ρ_{ij}: Correlation of weekly demand for regions i, j, $1 \le i \ne j \le k$

Impact of Aggregation on Safety Inventory

As per the accepted definition of Inverse Normal F^{-1} Function obtained through the aid of MS Excel.

Total safety inventory in decentralized option $= \sum_{i=1}^{k} F_S^{-1}(CSL) \times \sqrt{L} \times \sigma_i$

Impact of Aggregation on Safety Inventory

- If all inventories are aggregated in a central location, we need to evaluate the distribution of aggregated demand.
- The aggregate demand is normally distributed, with a mean of D^c, Standard deviation of Sigma Superscript C subscript D and variance of var ($D^{c)}$ as follows:

Impact of Aggregation on Safety Inventory

$$D^C = \sum_{i=1}^{k} D_i; \qquad \text{var}\left(D^C\right) = \sum_{i=1}^{k} \sigma_i^2 + 2\sum_{i>j} \rho_{ij}\sigma_i\sigma_j;$$

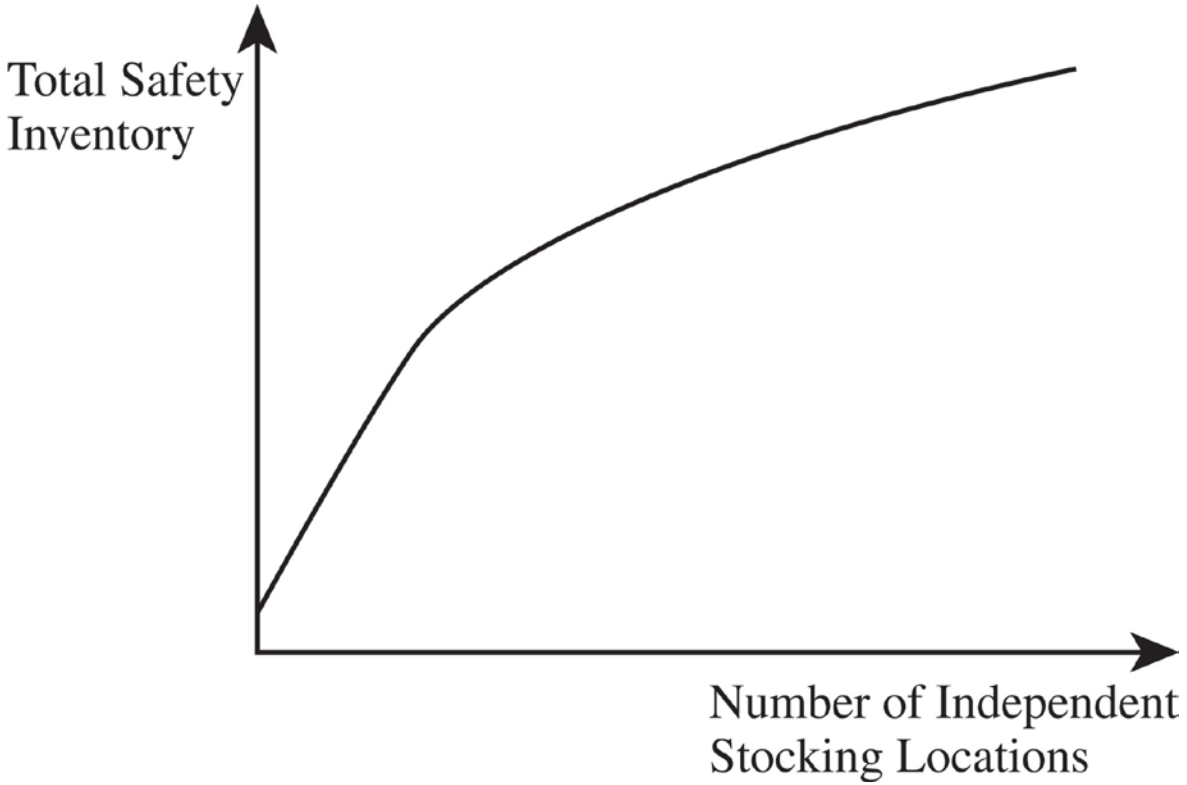
$$\sigma_D^C = \sqrt{\text{var}\left(D^C\right)}$$

Impact of Aggregation on Safety Inventory

- The safety inventory savings on aggregation increase with the desired cycle service level CSL.
- The safety inventory savings on aggregation increase with the replenishment lead time L.
- The safety inventory savings on aggregation increase with the holding cost H.
- The safety inventory savings on aggregation increase with the coefficient of variation of demand.
- The safety inventory savings on aggregation decrease as the correlation coefficients increase.

Impact of Aggregation on Safety Inventory

- The Square-Root Law



Impact of Correlation on Value of Aggregation

- Two possible disadvantages to aggregation:
  1. Increase in response time to customer order.
  2. Increase in transportation cost to customer.

Information Centralization

Specialization

- **Stock all items in each location or stock different items at different locations?**

Specialization

- **Benefits of aggregation can be affected by:**
  - **Coefficient of variation of demand (higher cv yields greater reduction in safety inventory from centralization).**
  - **Value of item (high value items provide more benefits from centralization).**

Product Substitution

The use of one product to satisfy demand for a different product.

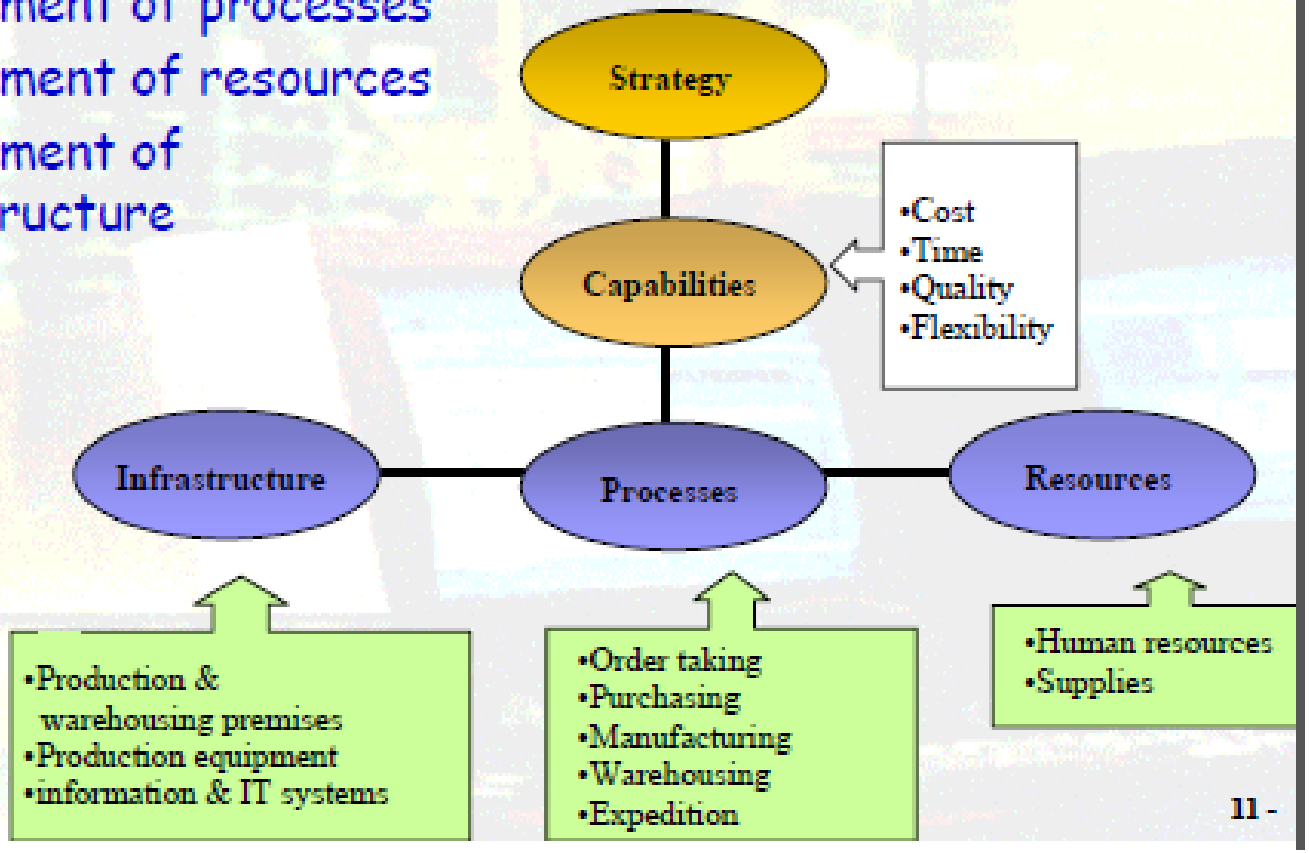
1. ***Manufacturer-driven substitution***
   - **Allows aggregation of demand**
2. ***Customer-driven substitution***

Postponement

- Also known as delayed differentiation.

Postponement implementation

- Realignment of processes
- Realignment of resources
- Realignment of infrastructure



Postponement

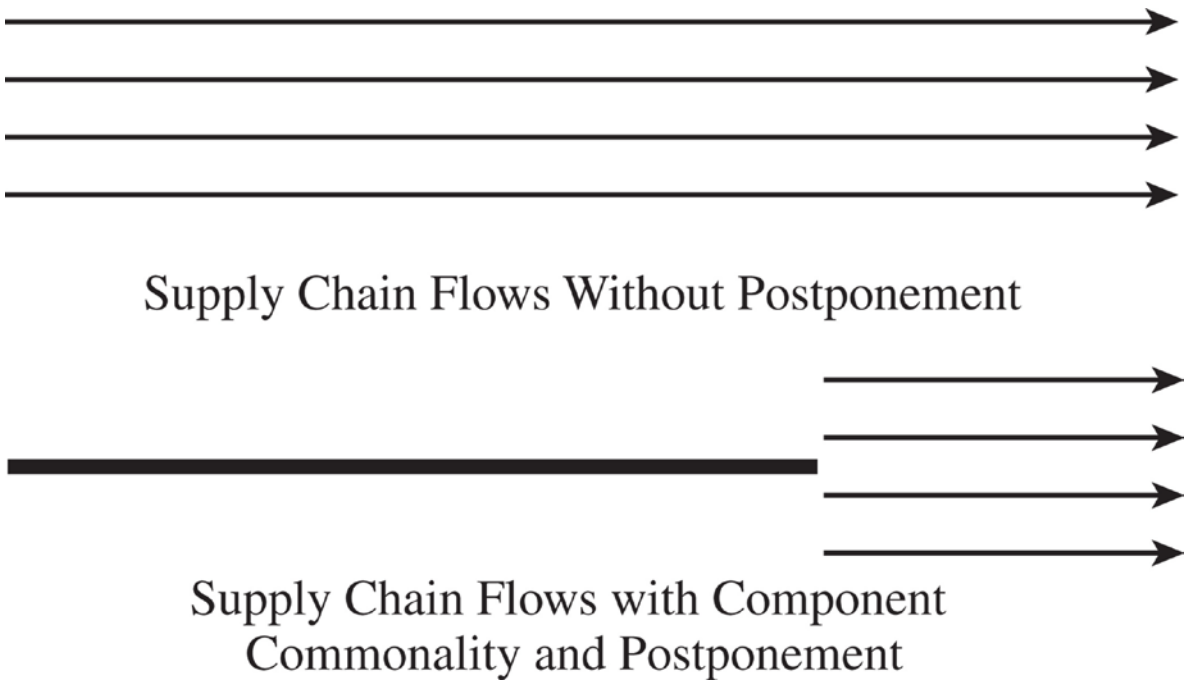


Figure 12-5

IMPACT OF REPLENISHMENT POLICIES ON SAFETY INVENTORY

Impact of Replenishment Policies on Safety Inventory

- Continuous Review Policies

D: Average demand per period

σ_D: Standard deviation of demand per period

L: Average lead time for replenishment

Mean demand during lead time, $D_L = DL$

Standard deviation of demand during lead time, $\sigma_L = \sqrt{L}\sigma_D$

$$ss = F_S^{-1}(CSL) \times \sigma_L = NORMSINV(CSL) \times \sqrt{L}\sigma_D, ROP = D_L + ss$$

Managing Safety Inventory in a Multi-echelon Supply Chain

- **Ech·e·lon pronounced as** [Esh-uh-lon]
- Echelon comes from the French échelon, a word whose literal meaning is “rung of a ladder.” Initially it was confined to military use, to refer to a step-like formation of troops.

Managing Safety Inventory in a Multi-echelon Supply Chain

- In multi-echelon supply chains stages often do not know demand and supply distributions.
- Inventory between a stage and the final customer is called the *echelon inventory.*
- Reorder points and order-up-to levels at any stage should be based on echelon inventory.
- Decisions must be made about the level of safety inventory carried at different stages.

BEER GAME

- The **Beer Distribution Game** (The Beer Game) is a simulation game created by a group of professors at MIT Sloan School of Management in early 1960s to demonstrate a number of key principles of supply chain management.

STRATEGY FOR THE LOGISTICAL DRIVER OF INVENTORY

1. **Reduce lead times**
2. **Improve reliability of supply**
3. **Order more frequently**
4. **Expedite more effectively**
5. **Forecast more accurately**
6. **Optimize stock over the range**
7. **Strangers strategy**
8. **Understand your customers: change your service proposition**
9. **For multi-tier operations, change the network configuration**
10. **For short season markets, back winners with stock (and shun losers)**

Learning Objectives

1. **Identify the factors affecting the optimal level of product availability and evaluate the optimal cycle service level.**
2. **Use managerial levers that improve supply chain profitability through optimal service levels.**
3. **Understand conditions under which postponement is valuable in a supply chain.**
4. **Setting optimal levels of product availability in practice.**

Lee & Billington Suggests

- **1. No Supply Chain Metrics**
- **2. Inadequate definition of customer service**
- **3.Inaccurate delivery status data**
- **4.Inefficient Information Systems**

Lee & Billington Suggests

- **5.Ignoring the impact of uncertainties**
- **6.Simplistic inventory stocking policies**
- **7.Discrimination against internal customers**

Lee & Billington Suggests

- 8.Poor coordination
- 9.Incomplete shipment method analysis
- 10. Incorrect assessment of inventory costs
- 11. Organizational barriers

Lee & Billington Suggests

- **12.Product process design without supply chain consideration**
- **13.separation of Supply Chain from Operational decisions**

Lee & Billington Suggests

- **14.Incomplete Supply Chain**

PRODUCT AVAILABILITY & SC PROFITABILITY

Two Key Factors

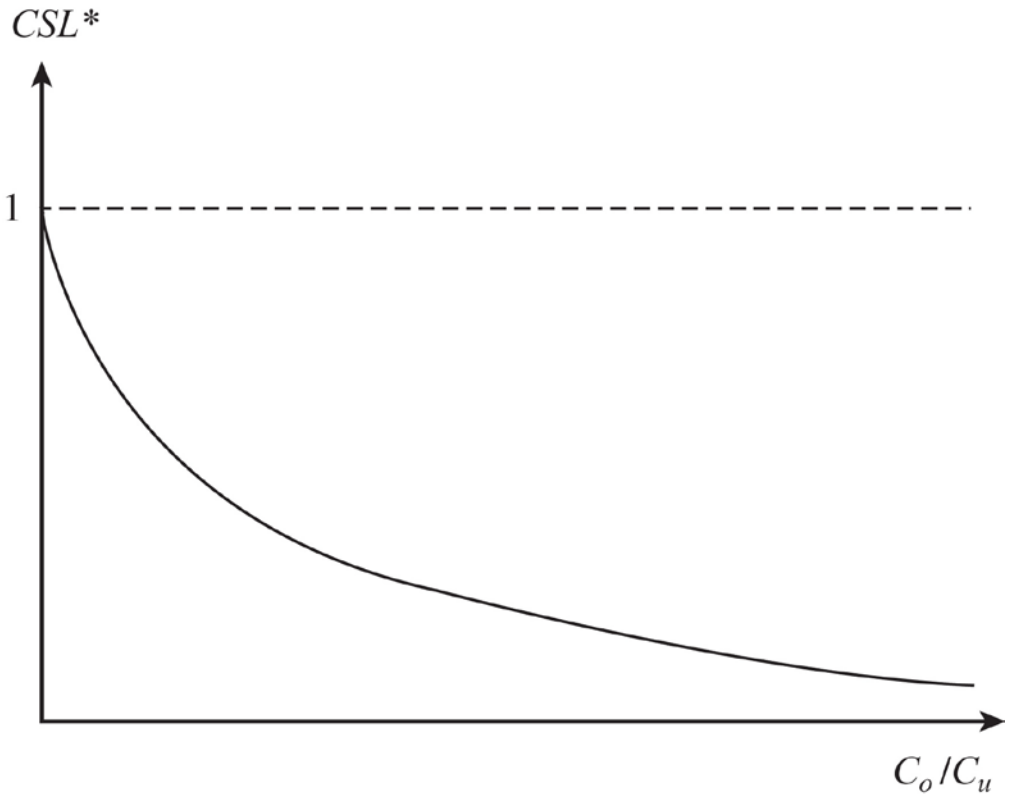
- **1. Cost of overstocking the product**
- **2.Cost of under-stocking the product**

MANAGERIAL LEVERS

Managerial Levers to Improve Supply Chain Profitability

- "Obvious" actions
  1. Increase salvage value of each unit
  2. Decrease the margin lost from a stockout
- Improved forecasting
- Quick response
- Postponement
- Tailored sourcing

Managerial Levers to Improve Supply Chain Profitability



Impact of Improved Forecasts

An importer of Petrol based electricity generators in Quetta is informed by her Supply Chain Manager with the following critical information:

Demand: μ = 350, σ = 150

Cost: c = Rs. 10,000, Price: p =Rs. 25,000, Salvage: s = Rs. 8,000

Impact of Improved Forecasts

In other words demand can vary from 200 to 500 generators.

$$\text{Cost of understocking} = C_u = p - c = Rs25000 - Rs10000 = Rs15000$$

$$\text{Cost of overstocking} = C_o = c - s = Rs10000 - Rs8000 = Rs2000$$

Quick Response: Multiple Orders Per Season

1. **The expected total quantity ordered during the season with two orders is less than that with a single order for the same cycle service level.**

Quick Response: Multiple Orders Per Season

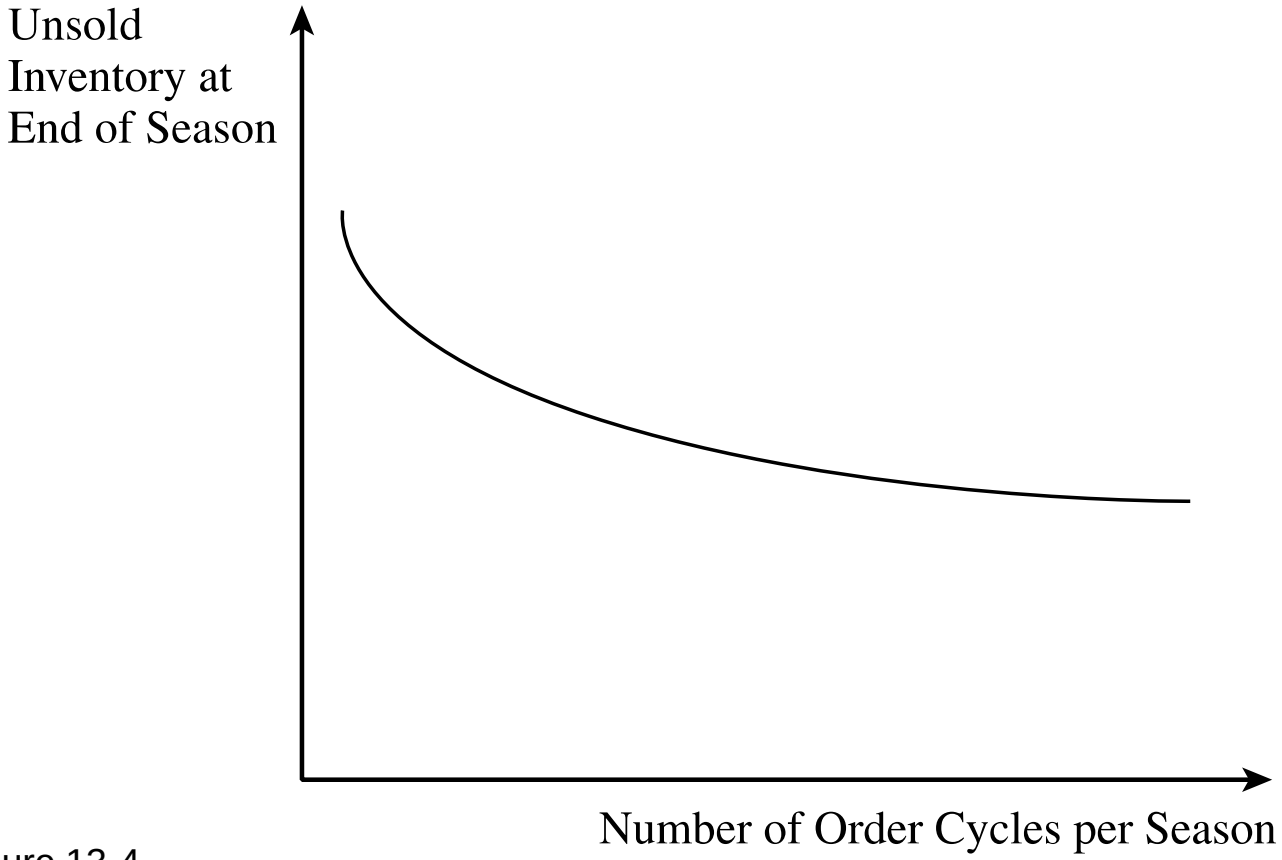


Figure 13-4

Quick Response: Multiple Orders Per Season

Figure 13-5

Managerial Levers

- **1. Increasing the salvage value of each unit increases profitability (as well as the optimal cycle service level).**

Managerial Levers

- **2. Decreasing the margin lost from a stock-out increases profitability.**
- **3. Reducing demand uncertainty.**

Managerial Levers

- **One strategy to increase the salvage value of an unsold product would be selling unsold product to an outlet store.**

Managerial Levers

- **The reduction of demand uncertainty is a significant managerial lever to improve supply chain profitability.**

Managerial Levers

- **A manager can reduce demand uncertainty via the following 4 ways:**
- **1. Improved forecasting**
- **2. Quick response**
- **3. Postponement**
- **4. Tailored sourcing**

Quick Response (Pros vs Cons)

- **1. The expected total quantity ordered during the season with two orders is less than that with a single order for the same cycle service level.**

TAILORED POSTPONEMENT & TAILORED SOURCING

Tailored Sourcing

- **In product-based tailored sourcing, low-volume products with uncertain demand are obtained from a flexible source, while high-volume products with less demand uncertainty are obtained from an efficient source.**

Numerical 1

- A cell phone manufacturer has introduced a new android phone. The anticipated demand is normally distributed with a mean of μ= 100 and a standard deviation of σ = 50.
- Each unit costs Rs. 17,500 to manufacture and the introductory price is to be Rs. 22,500 to achieve this level of sales.

Numerical

- Any unsold units at the end of the first year are unlikely to be very valuable and will be disposed of in a sale for Rs. 10,500 each.
- It costs Rs1000 to hold a unit in inventory for the entire year. What is the cost of overstocking? What is the cost of under stocking? What is the optimal cycle service level? How many units should be manufactured for sale?

Numerical

- Step I: Calculate Over Stocking Cost*:*

C_o = c – s

= Rs. 17,500 – Rs. 9,500

= Rs. 6,000

- Step II: Calculate Under Stocking Cost :

C_u= p – c

= Rs. 22,500- Rs.17,500

= Rs. 5,000

Numerical

- Step III: Calculate CSL

$$
\begin{aligned}
CSL^* &= C_u/(C_u + C_o) \\
&= 5000/(5000 + 6000) \\
&= 0.4545 \approx .45
\end{aligned}
$$

Numerical

- Step IV*:*

O^* = NORMINV(CSL^*, μ, σ)

= NORMINV(0.45, 100, 50)

= 93.71693

$\approx$ 94

Note: Cannot complete O* without access to Excel.

Numerical 2

- In the previous problem, the manufacturer performs additional market research. Based on this research, they determine that they can increase the price to Rs. 25,000 and are able to reduce the standard deviation of the forecast to $\sigma = 30$. At the same time, they have made an arrangement with an outlet store that will purchase unsold equipment for Rs.15,000 each.

NORMINV

- NORMINV (p, mu, sigma) returns the value x such that, with probability p, a normal random variable with mean mu and standard deviation sigma takes on a value less than or equal to x.

Numerical 2

- How will these changes affect the cost of over stocking, cost of under stocking, optimal cycle service level and optimal order size?

Numerical 2

- *Answer:*

Step I $C_o = c - s$

$= Rs.17,500 - Rs.15,000$

$= Rs.2500$

Step II $C_u = p - c$

$= Rs.25,000 - Rs.17,500$

$= Rs.7,500$

Numerical 2

- **The change in price increases the cost of under stocking.**
- **The increase in the salvage value reduces the cost of over stocking.**

Setting Product Availability for Multiple Products Under Capacity Constraints

$$MC_i(Q_i) = p_i\left[1 - F_i(Q_i)\right] + s_i F_i(Q_i) - c_i$$

1. Set quantity $Q_i = 0$ for all products i.
2. Compute the expected marginal contribution $MC_i(Q_i)$ for each product i.
3. If positive, stop, otherwise, let j be the product with the highest expected marginal contribution and increase Q_j by one unit.
4. If the total quantity is less than B, return to step 2, otherwise capacity constraint are met and quantities are optimal.

$$Max \sum_{i=1}^{n} \Pi_i(Q_i)$$

subject to:

$$\sum_{i=1}^{n} Q_i \le B$$

$$Q_i \ge 0$$

Setting Optimal Levels of Product Availability in Practice

1. Beware of preset levels of availability.
2. Use approximate costs because profit-maximizing solutions are quite robust.
3. Estimate a range for the cost of stocking out.
4. Ensure levels of product availability fit with Strategy.
5. Tailor your response to uncertainty.

Learning Objectives

- **Understand the role of transportation in a supply chain.**
- **Evaluate the strengths and weaknesses of different modes of transportation.**

Learning Objectives

- **Identify the relative strengths and weaknesses of various transportation network design options.**
- **Identify trade-offs that shippers need to consider when designing a transportation network.**

UNDERSTAND THE ROLE OF TRANSPORTATION

Understand the Role of Transportation in a Supply Chain

- **Transportation refers to the movement of product from one location to another within a supply chain.**

MODES OF TRANSPORTATION AND THEIR PERFORMANCE CHARACTERISTICS

Strength and Weakness of different modes

- **The various modes of transportation include water, rail, intermodal, truck, air, pipeline, and package carriers.**

Air

- **Cost components**
  - **Fixed infrastructure and equipment**
  - **Labor and fuel**
  - **Variable – passenger/cargo**

Air

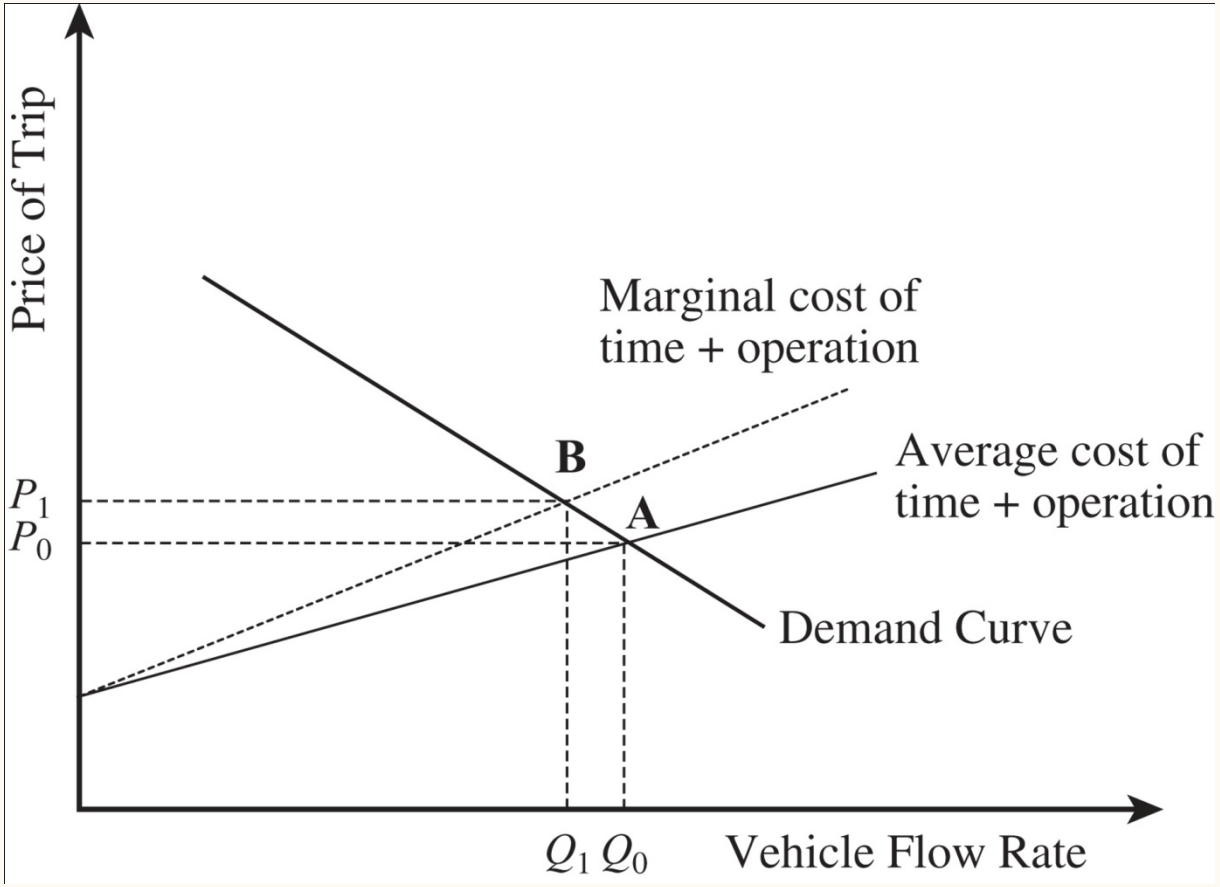
- Key issues
  - Location/number of hubs
  - Fleet assignment
  - Maintenance schedules
  - Crew scheduling
  - Prices and availability

Ropeways

- Environment friendly
- Shortest route possible through inaccessible terrain
- Considerably fast movement over short distance
- Most economical
- The obvious disadvantage being safety issues on poor maintenance and upkeep of the ropeway

TRANSPORTATION INFRASTRUCTURE POLICIES

Transportation Infrastructure and Policies



FREIGHT MANAGEMENT

DESIGN OPTIONS

Transportation Networks types

- **Point to Point Networks**
- **Multiple Delivery Points**
- **Trans-shipment Points**
- **Nodal Networks**
- **Hub and Spoke Network**

Design Options for a Transportation Network

- Should transportation be direct or through an intermediate site?
- Should the intermediate site stock product or only serve as a cross-docking location?

Direct Shipment Network to Single Destination

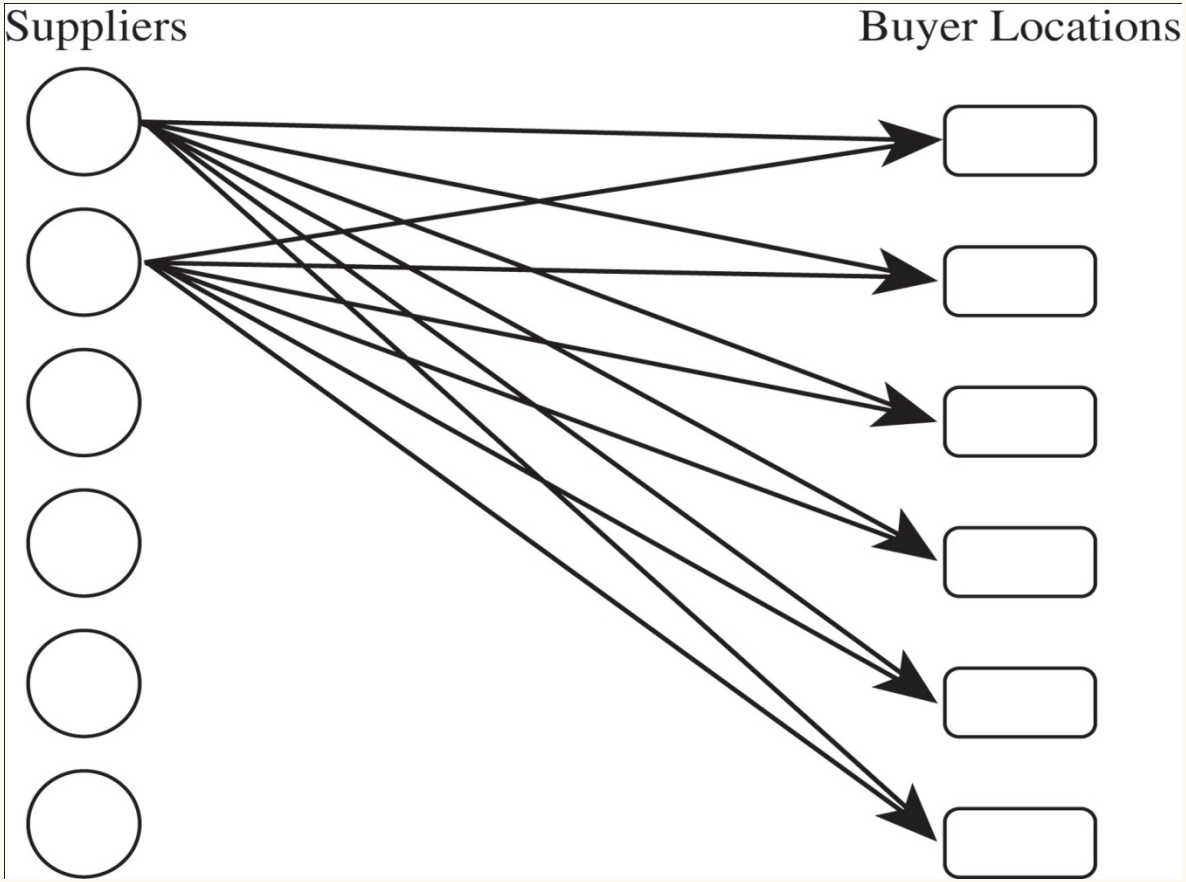


Figure 14-2

Direct Shipping with Milk Runs

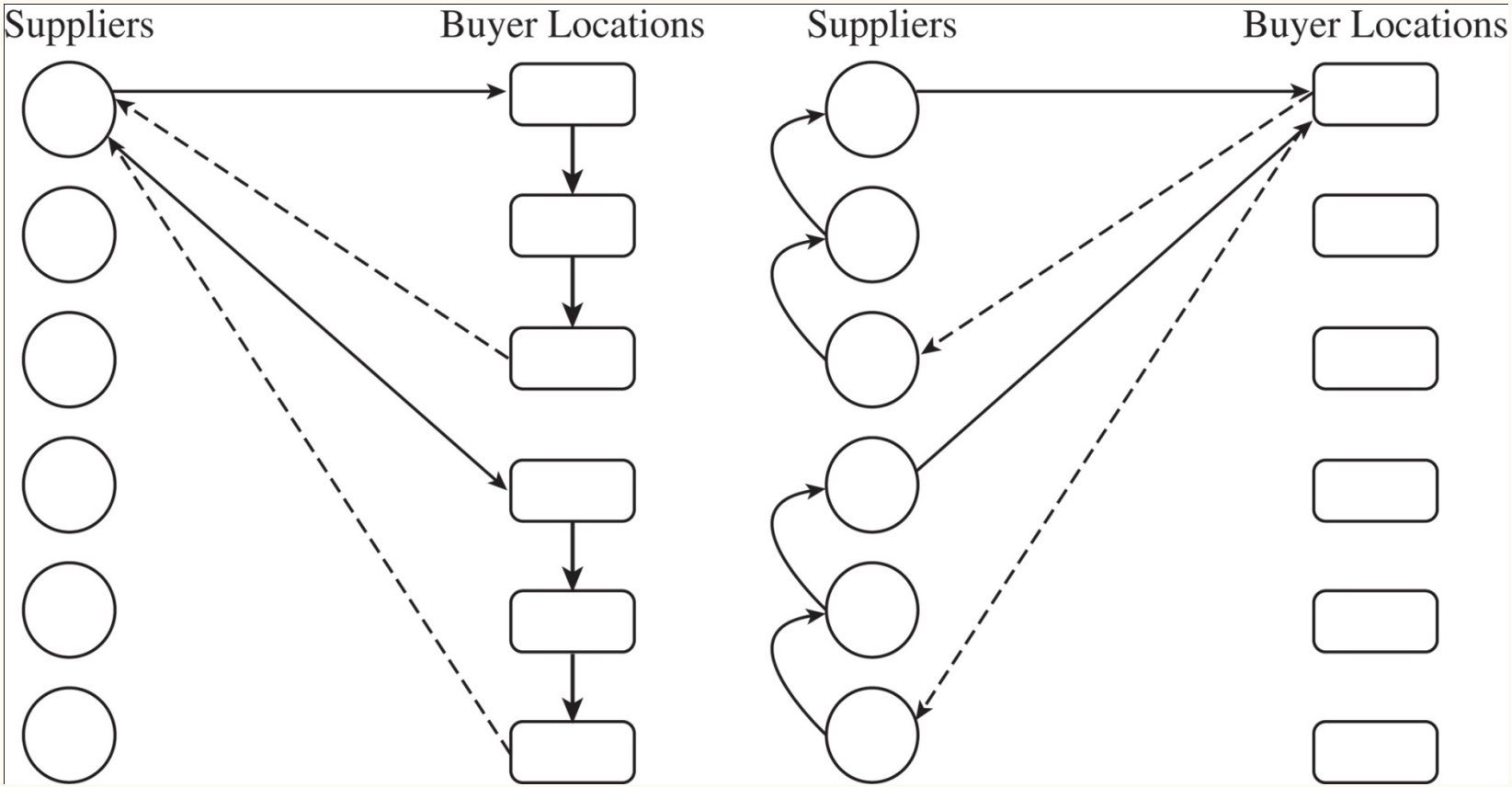


Figure 14-3

All Shipments via Intermediate Distribution Center with Storage

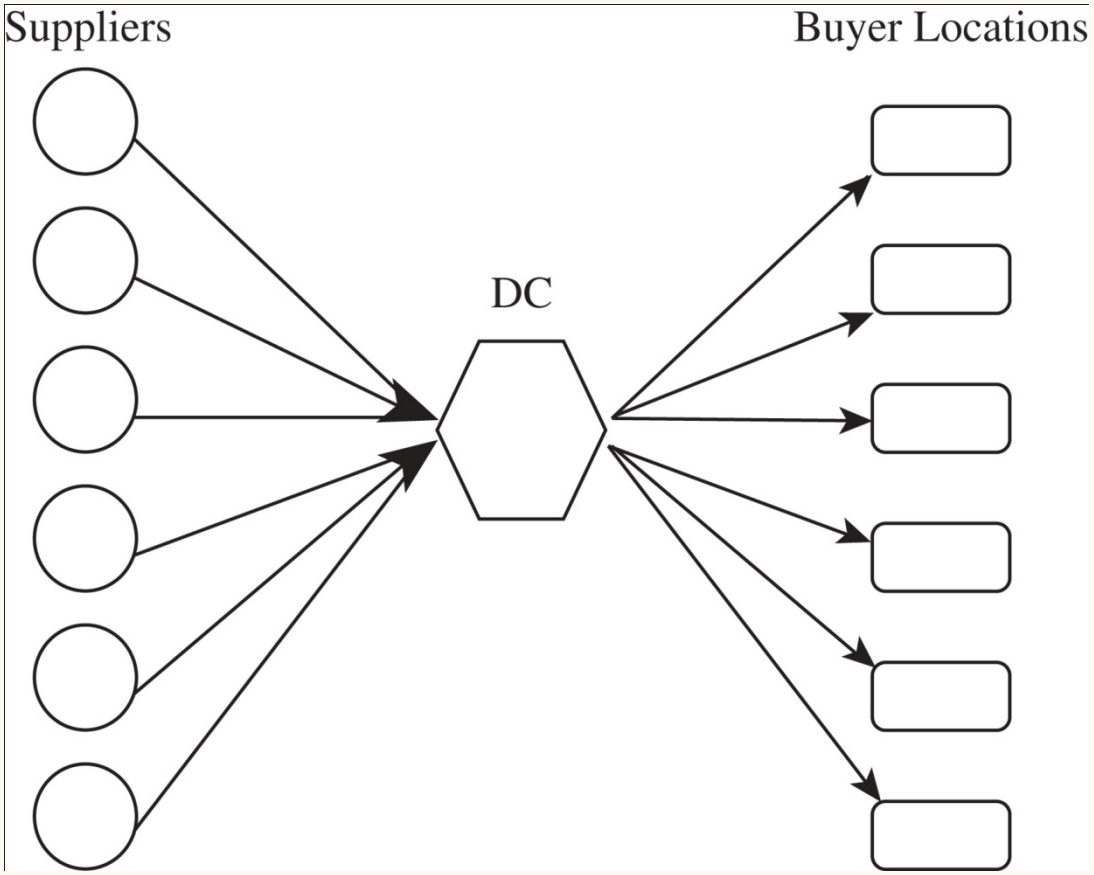


Figure 14-4

Tailored Network

Network Structure	Pros	Cons
Direct shipping	No intermediate warehouse Simple to coordinate	High inventories (due to large lot size) Significant receiving expense
Direct shipping with milk runs	Lower transportation costs for small lots Lower inventories	Increased coordination complexity
All shipments via central DC with inventory storage	Lower inbound transportation cost through consolidation	Increased inventory cost Increased handling at DC
All shipments via central DC with cross-dock	Low inventory requirement Lower transportation cost through consolidation	Increased coordination complexity
Shipping via DC using milk runs	Lower outbound transportation cost for small lots	Further increase in coordination complexity
Tailored network	Transportation choice best matches needs of individual product and store	Highest coordination complexity

Table 14-2

Selecting a Transportation Network

Annual sales = 960,000/store Direct shipping

- Batch size shipped from each supplier to each store

  = 40,000 units

- Number of shipments/yr from each supplier to each store

  = 960,000/40,000 = 24

Selecting a Transportation Network

- Annual trucking cost for direct network

  = 24 x 1,100 x 4 x 8 = $844,800

- Average inventory at each store for each product

  = 40,000/2 = 20,000 units

- Annual inventory cost for direct network

  = 20,000 x 0.2 x 4 x 8 = $128,000

- Total annual cost of direct network

  = $844,800 + $128,000 = $972,800

Selecting a Transportation Network

Annual sales = 960,000/store Milk runs

- Batch size shipped from each supplier to each store
  = 40,000/2 = 20,000 units
- Number of shipments/yr from each supplier to each store
  = 960,000/20,000 = 48
- Transportation cost per shipment per store (two stores/truck) = 1,000/2 + 100 = $600
- Annual trucking cost for direct network
  = 48 x 600 x 4 x 8 = $921,600
- Average inventory at each store for each product
  = 20,000/2 = 10,000 units
- Annual inventory cost for direct network
  = 10,000 x 0.2 x 4 x 8 = $64,000
- Total annual cost of direct network
  = $921,600 + $64,000 = $985,600

Selecting a Transportation Network

Annual sales = 120,000/store Direct shipping

- Batch size shipped from each supplier to each store

  = 40,000 units

- Number of shipments/yr from each supplier to each store

  = 120,000/40,000 = 3

- Annual trucking cost for direct network

  = 3 x 1,100 x 4 x 8 = $105,600

- Average inventory at each store for each product

  = 40,000/2 = 20,000 units

- Annual inventory cost for direct network

  = 20,000 x 0.2 x 4 x 8 = $128,000

- Total annual cost of direct network

Selecting a Transportation Network

Annual sales = 120,000/store Milk runs

- Batch size shipped from each supplier to each store
  = 40,000/4 = 10,000 units
- Number of shipments/yr from each supplier to each store
  = 120,000/10,000 = 12
- Transportation cost per shipment per store (two stores/truck)
  = 1,000/4 + 100 = $350
- Annual trucking cost for direct network
  = 12 x 350 x 4 x 8 = $134,400
- Average inventory at each store for each product
  = 10,000/2 = 5,000 units
- Annual inventory cost for direct network
  = 5,000 x 0.2 x 4 x 8 = $32,000
- Total annual cost of direct network
  = $134,400 + $32,000 = $166,400

TRADE OFF IN TRANSPORTATION DESIGN

Trade-offs in Transportation Design

- **The supply chain goal is to minimize the total cost while providing the desired level of responsiveness to customers.**

Tailored Transportation

- **The use of different transportation networks and modes based on customer and product characteristics.**

- **Factors affecting tailoring:**
  - **Customer density and distance**
  - **Customer size**
  - **Product demand and value**

ROLE OF IT IN TRANSPORTATION

Role of IT in Transportation

- **IT software can assist in:**
  - **Identification of optimal routes by minimizing costs subject to delivery constraints**
  - **Optimal fleet utilization**
  - **GPS applications**

RISK MANAGEMENT IN TRANSPORTATION

- **There are three main types of risk to consider when transporting a shipment between two nodes on the network:**
- **1. The risk that the shipment is delayed.**
- **2. The risk that the shipment does not reach its destination because intermediate nodes or links are disrupted by external forces.**
- **3. The risk of hazardous material.**

MAKING TRANSPORTATION DECISIONS IN PRACTICE

Learning Objectives

1. **Understand the role of sourcing in a supply chain.**
2. **Discuss factors that affect the decision to outsource a supply chain function.**
3. **Identify dimensions of supplier performance that affect total cost.**

Learning Objectives

4. **Structure successful auctions and negotiations.**
5. **Describe the impact of risk sharing on supplier performance and information distortion.**
6. **Design a tailored supplier portfolio.**

THE ROLE OF SOURCING IN A SUPPLY CHAIN

The Role of Sourcing in a Supply Chain

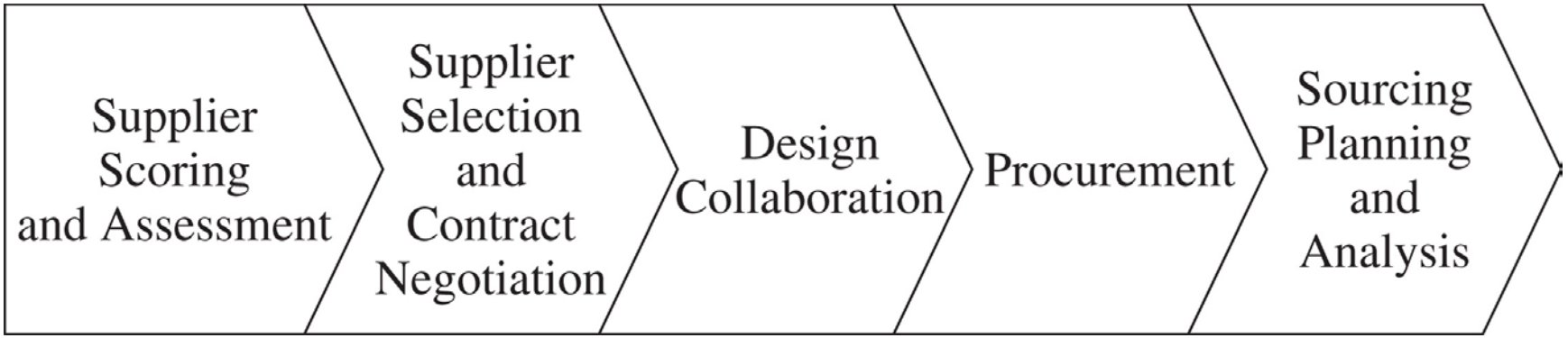
- Sourcing is the set of business processes required to purchase goods and services.
  - Outsourcing
  - Offshoring

The Role of Sourcing in a Supply Chain

- Outsourcing questions
  1. Will the third party increase the supply chain surplus relative to performing the activity in-house?
  2. How much of the increase in surplus does the firm get to keep?
  3. To what extent do risks grow upon outsourcing?

- A firm *off-shores a supply chain function if it maintains ownership* but moves the production facility offshore.
- In contrast, a firm *outsources if the firm* hires an outside firm to perform an operation rather than executing the operation within the firm.

The Role of Sourcing in a Supply Chain



Supplier Selection

- Identify one or more appropriate suppliers.
- Contract should account for all factors that affect supply chain performance.
- Should be designed to increase supply chain profits in a way that benefits both the supplier and the buyer.

Benefits of Effective Sourcing Decisions

- Better economies of scale through aggregated
- More efficient procurement transactions
- Design collaboration can result in products that are easier to manufacture and distribute
- Good procurement processes can facilitate coordination with suppliers
- Appropriate supplier contracts can allow for the sharing of risk
- Firms can achieve a lower purchase price by increasing competition through the use of auctions

IN HOUSE OR OUTSOURCE

In-House or Outsource

- Increase supply chain surplus through
  1. Capacity aggregation
  2. Inventory aggregation
  3. Transportation aggregation by transportation intermediaries
  4. Transportation aggregation by storage intermediaries
  5. Warehousing aggregation

In-House or Outsource

6. **Procurement aggregation**
7. **Information aggregation**
8. **Receivables aggregation**
9. **Relationship aggregation**
10. **Lower costs and higher quality**

Factors for making sourcing decisions

- **What factors should be considered when making sourcing decisions**?

Factors for making sourcing decisions

- Replenishment lead time
- On-time performance
- Supply flexibility
- Delivery frequency/minimum lot size
- Supply quality
- Inbound transportation cost
- Pricing terms

THIRD AND FOURTH PARTY LOGISTICS PROVIDERS

Numerical

- Green Thumb, a manufacturer of lawn mowers and snow blowers, has historically purchased a thousand bearings per week from a local supplier who charges $1.00 per bearing.
- The purchasing manager has identified another potential source willing to supply the bearings at $0.97 per bearing

Numerical

- Before making his decision, the purchasing manager evaluates the performance of the two suppliers. The local supplier has an average lead time of two weeks and has agreed to deliver the bearings in batches of 2,000.

Numerical

- Based on past on-time performance, the purchasing manager estimates that the lead time has a standard deviation of one week.
- The new source has an average lead time of six weeks with a standard deviation of four weeks.

Numerical

- The new source requires a minimum batch size of 8,000 bearings. Which supplier should the purchasing manager go with? Green Thumb has a holding cost of 25 percent. It currently uses a continuous review policy for managing inventory and aims for a cycle service level of 95 percent. Weekly demand has a mean of 1,000 and a standard deviation of 300.

SUPPLIER SELECTION- AUCTIONS & NEGOTITATIONS

Supplier Selection – Auctions and Negotiations

- Auctions:
  - Sealed-bid first-price auctions
  - English auctions
  - Dutch auctions
  - Second-price (Vickery) auctions

Negotiations

- **The difference between the values of the buyer and seller is referred to as the *bargaining surplus.***

BASIS AND RATIONALE

- **A supply chain contract specifies parameters governing the buyer-supplier relationship.**

Contracts, Risk Sharing, and Supply Chain Performance

1. How will the contract affect the firm's profits and total supply chain profits?
2. Will the incentives in the contract introduce any information distortion?
3. How will the contract influence supplier performance along key performance measures?

Contracts for Product Availability and Supply Chain Profits

- **Three contracts that increase overall profits by making the supplier share some of the buyer's demand uncertainty are:**
  1. **Buyback or returns contracts**
  2. **Revenue-sharing contracts**
  3. **Quantity flexibility contracts**

Buyback Contracts

- Allows a retailer to return unsold inventory up to a specified amount at an agreed upon price.
- The manufacturer specifies a wholesale price c and a buyback price b.
- The manufacturer can salvage $\$s_M$ for any units that the retailer returns.
- The manufacturer has a cost of v per unit produced and the retail price is p.

Expected manufacturing profit $= O^*(c - v) - (b - s_M)$
$\times$ expected overstock at retailer

Revenue-Sharing Contracts

- Manufacturer charges the retailer a low wholesale price c and shares a fraction f of the retailer's revenue.
  - Allows both the manufacturer and retailer to increase their profits.
  - Results in lower retailer effort.
  - Requires an information infrastructure.
  - Information distortion results in excess inventory in the supply chain and a greater mismatch of supply and demand.

Revenue-Sharing Contracts

$$CSL^* = \text{probability (demand } \le O^*) = \frac{C_u}{C_u + C_o} = \frac{(1-f)p - c}{(1-f)p - s_R}$$

$$\text{Expected manufacturers profits} = (c - v)O^* + fp(O^* - \text{expected overstock at retailer})$$

$$\text{Expected retailer profit} = (1-f)p(O^* - \text{expected overstock at retailer}) + s_R \times \text{ expected overstock at retailer} - cO^*$$

Quantity Flexibility Contracts

- **Allows the buyer to modify the order (within limits) after observing demand.**
- **Better matching of supply and demand.**
- **Increased overall supply chain profits if the supplier has flexible capacity.**
- **Lower levels of information distortion than either buyback contracts or revenue sharing contracts.**

Quantity Flexibility Contracts

- If the retailer orders 0 units, the manufacturer is committed to supplying *Q units.*
- As a result, we assume that the manufacturer produces *Q units. The retailer purchases q units if demand D is less than q, D units if demand D is between q and Q, and Q units.*
- if demand is greater than *Q. Note that in the following formulas, Fs is the standard normal* cumulative distribution function and *fs is the standard normal density function.*

DESIGN COLLABORATION

THE PROCUREMENT PROCESS

Product Categorization

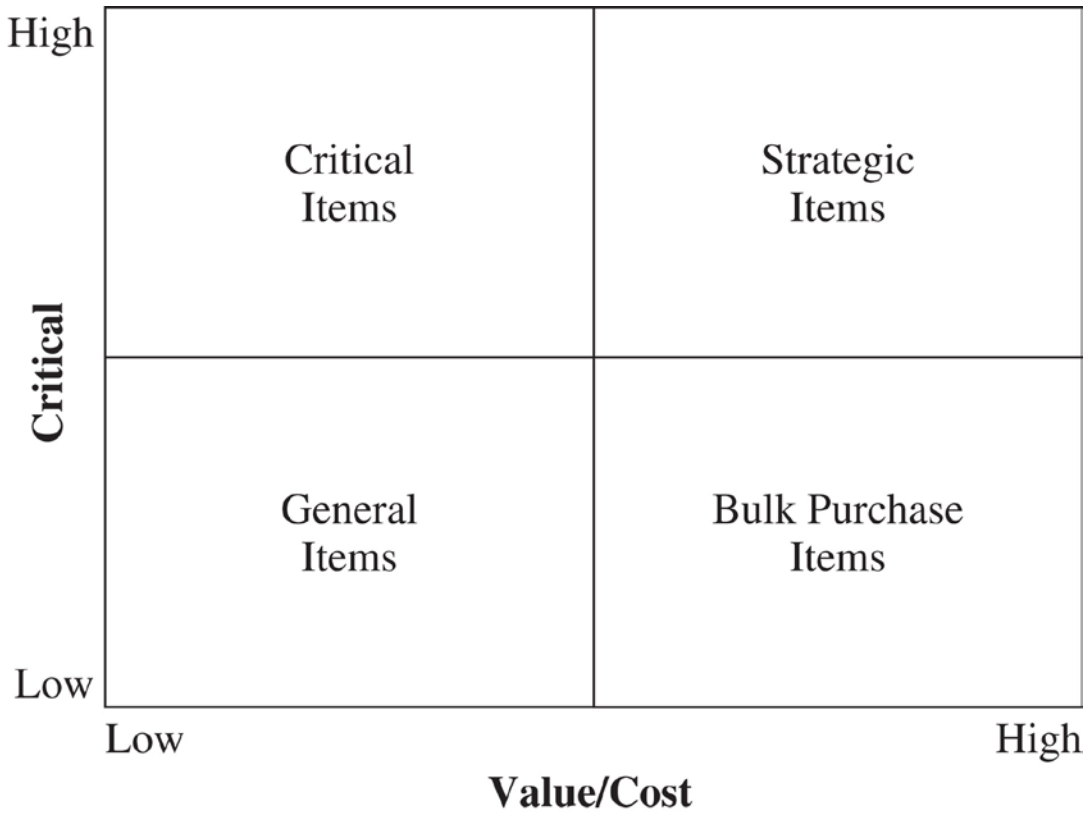


Figure 15-2

DESIGNING A SOURCING PORTFOLIO

Designing a Sourcing Portfolio: Tailored Sourcing

- **Tailor supplier portfolio based on a variety of product and market characteristics.**

THE ROLE OF IT IN SOURCING

The Role of IT in Sourcing

- Some of the of the major IT product areas within sourcing:
  - ***Design collaboration***
  - ***Source.***
  - ***Negotiate***
  - ***Buy.***
  - ***Supply collaboration***

RISK MANAGEMENT IN SOURCING

Risk Management in Sourcing

Sourcing risks may result in:

- Inability to meet demand on time
- An increase in procurement costs
- Loss of intellectual property

Quote

- **Develop a Sourcing Workbook**
- Put together a sourcing spreadsheet workbook. I like to create tabs for the;
- Sourcing schedule
- Supplier requirements and commercial terms
- Part data

Quote

- Quote template
- Contact information contacted suppliers
- Logistics cost estimate
- Quote analysis by part
- Quote analysis overview

Learning Objectives

- **1.Understand the role of revenue management in a supply chain.**

- **2. Identify conditions under which revenue management tactics can be effective.**

Learning Objectives

- **3. Describe trade-offs that must be considered when making revenue management decisions.**

Describe trade-offs that must be considered when making revenue management decisions (5/12

- **When overbooking, the trade-off is between not overbooking enough and wasting the available asset and overbooking too much and having to arrange for backup capacity at high cost.**

Describe trade-offs that must be considered when making revenue management decisions (7/

- **The trade-off is between the additional cost of serving the seasonal peak, and the impact on demand and thus revenue from offering an off-peak discount.**

THE ROLE OF PRICING AND REVENUE MANAGEMENT IN THE SUPPLY CHAIN

Role of Revenue Management

- ***Revenue management*** **is the use of pricing to increase the profit generated from a limited supply of supply chain assets.**
- **Supply chain assets exist in two forms—-capacity and inventory.**
- **Capacity assets in the supply chain exist for production, transportation, and storage.**

Role of Revenue Management

- **To increase the total margin, managers must use all available levers, including price.**
- **This is the primary role of revenue management. Traditionally, firms have often invested in or eliminated assets to reduce the imbalance between supply and demand.**

Benefits of Revenue Management

- **Revenue management has a significant impact on supply chain profitability when one or more of the following four conditions exist:**

Benefits of Revenue Management

- **1. The value of the product varies in different market segments.**
- **2. The product is highly perishable or product wastage occurs.**
- **3. Demand has seasonal and other peaks.**
- **4. The product is sold both in bulk and the spot market.**

Benefits from Differential Pricing

- **In theory, the concept of differential pricing increases total profits for a firm.**

Benefits from Differential Pricing

- **1. Price based on the value assigned by each segment.**
- **2. Use different prices for each segment.**
- **3. Forecast at the segment level.**

The Role of Pricing and Revenue Management in the Supply Chain

- **Revenue management is the use of pricing to increase the profit generated from a limited supply of supply chain assets.**

The Role of Pricing and Revenue Management in the Supply Chain

- 1. The value of the product varies in different market segments.
- 2. The product is highly perishable or product waste occurs.

The Role of Pricing and Revenue Management in the Supply Chain

- 3. Demand has seasonal and other peaks.
- 4. The product is sold both in bulk and on the spot market.

PRICING AND REVENUE MANAGEMENT FOR MULTIPLE CUSTOMER SEGMENTS

Pricing and Revenue Management for Multiple Customer Segments

- **Two fundamental issues must be handled in practice**
  - **1. How can the firm differentiate between the two segments and structure its pricing to make one segment pay more than the other?**

Pricing and Revenue Management for Multiple Customer Segments

- **2. How can the firm control demand such that the lower-paying segment does not utilize the entire availability of the asset?**

Pricing and Revenue Management for Multiple Customer Segments

Figure 16-1

Pricing and Revenue Management for Multiple Customer Segments

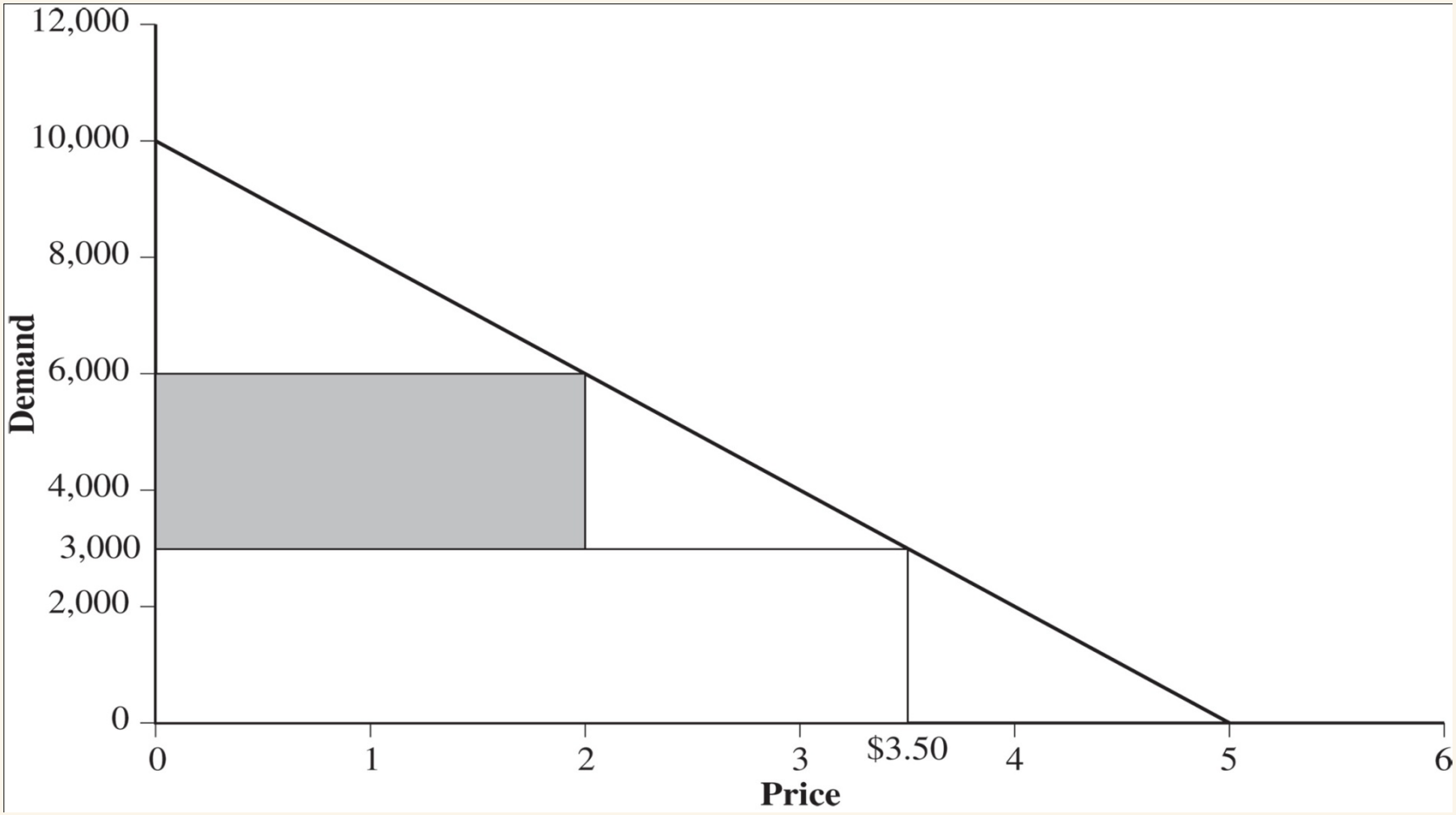


Figure 16-2

Pricing to Multiple Segments

Demand curve for segment $i = d_i = A_i - B_i p_i$

Supplier maximizes $\left(p_i - c\right)\left(A_i - B_i p_i\right)$

Optimal price $= p_i = \frac{A_i}{2B_i} + \frac{c}{2}$

Pricing to Multiple Segments

For capacity constrained by Q

$$\text{Max} \sum_{i=1}^{k} \left(p_i - c \right) \left(A_i - B_i p_i \right)$$

Subject to

$$\sum_{i=1}^{k} \left(A_i - B_i p_i \right) \leq Q$$

$$A_i - B_i p_i \geq 0 \quad \text{for} \quad i = 1, \ldots, k$$

Allocating Capacity to a Segment Under Uncertainty

$$R_H(C_H) = \text{Prob}(\text{demand from higher-price segment} > C_H) \times p_H$$

$$\text{Prob}(\text{demand from higher-price segment} > C_H) = p_L / p_H$$

$$C_H = F^{-1}(1 - p_L / p_H, D_H, \sigma_H) = NORMINV(1 - p_L / p_H, D_H, \sigma_H)$$

- **4. The Role of IT in Pricing and Revenue Management**
- **5. Using Pricing and Revenue Management in Practice**
- **6. Branding as a Price and Revenue Management Strategy**

PRICING AND REVENUE MANAGEMENT FOR PERISHABLE ASSETS

Pricing and Revenue Management for Perishable Assets

- Any asset that loses value over time is perishable

- Two basic approaches
  - Vary price dynamically over time to maximize expected revenue
  - Overbook sales of the asset to account for cancellations

PROBLEM OF PERISHABLE ASSETS

- **The basic trade-off to consider during overbooking is between having wasted capacity (or inventory) because of excessive cancellations and having a shortage of capacity (or inventory) because of few cancellations, in which case an expensive backup needs to be arranged.**

PRICING AND REVENUE MANAGEMENT FOR SEASONAL DEMAND

FORECASTING FOR REVENUE MANAGEMENT

PRICING AND REVENUE MANAGEMENT FOR BULK AND SPOT CONTRACTS

THE ROLE OF IT IN PRICING AND REVENUE MANAGEMENT

USING PRICING AND REVENUE MANAGEMENT IN PRACTICE

Using Pricing and Revenue Management in Practice

- 1. Evaluate your market carefully
- 2. Quantify the benefits of revenue management
- 3. Implement a forecasting process
- 4. Keep it simple
- 5. Involve both sales and operations

Using Pricing and Revenue Management in Practice

- **6. Understand and inform the customer**

- **7.Integrate supply planning with revenue management**

BRANDING AS A PRICE AND REVENUE MANAGEMENT STRATEGY

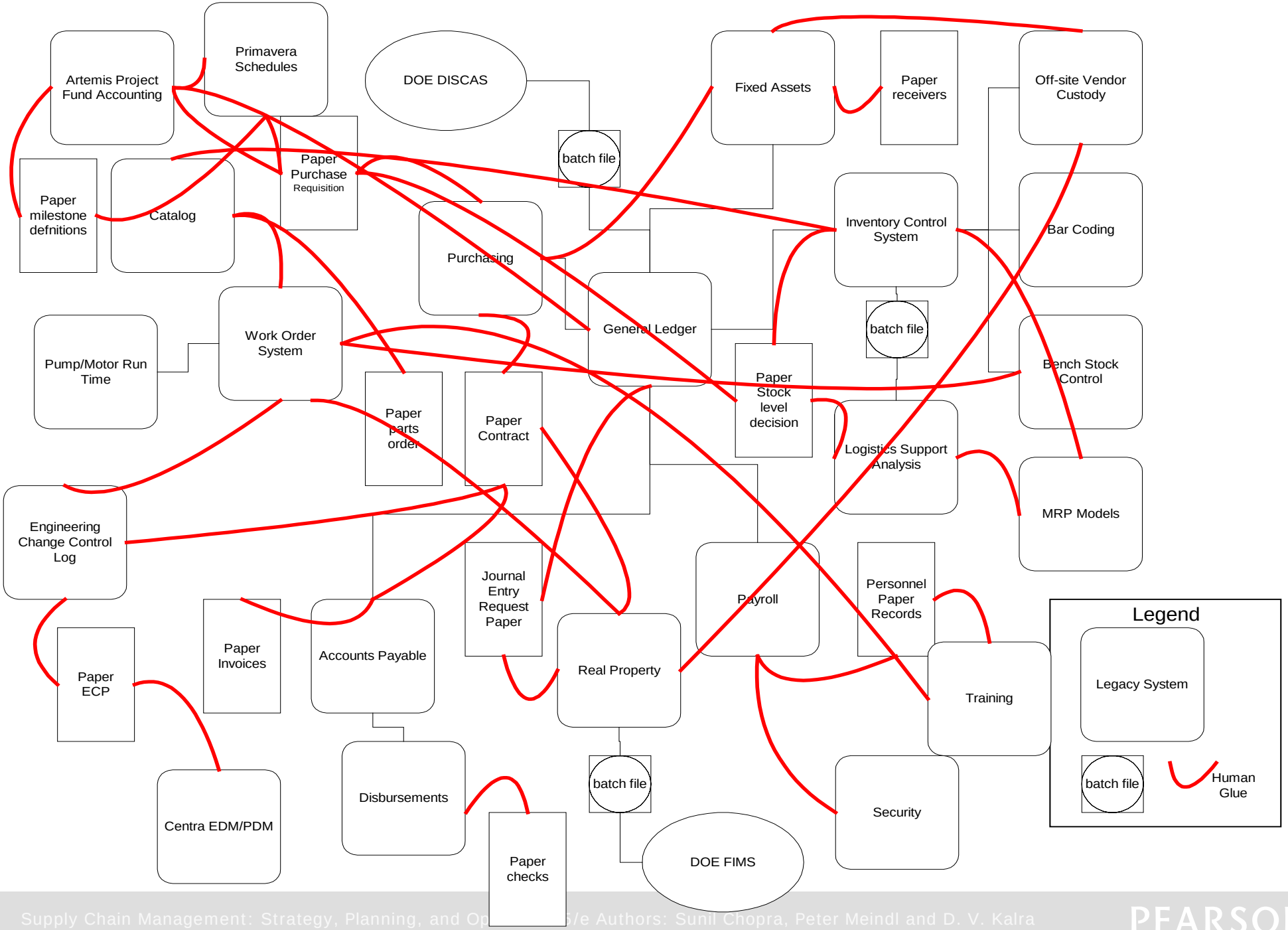
Learning Objectives

- **1. Understand the importance of information and information technology in a supply chain.**
- **2. Know at a high level how each supply chain driver uses information.**

Learning Objectives

- **3. Understand the major applications of supply chain information technology and the processes that they enable.**

ROLE OF IT IN SUPPLY CHAIN

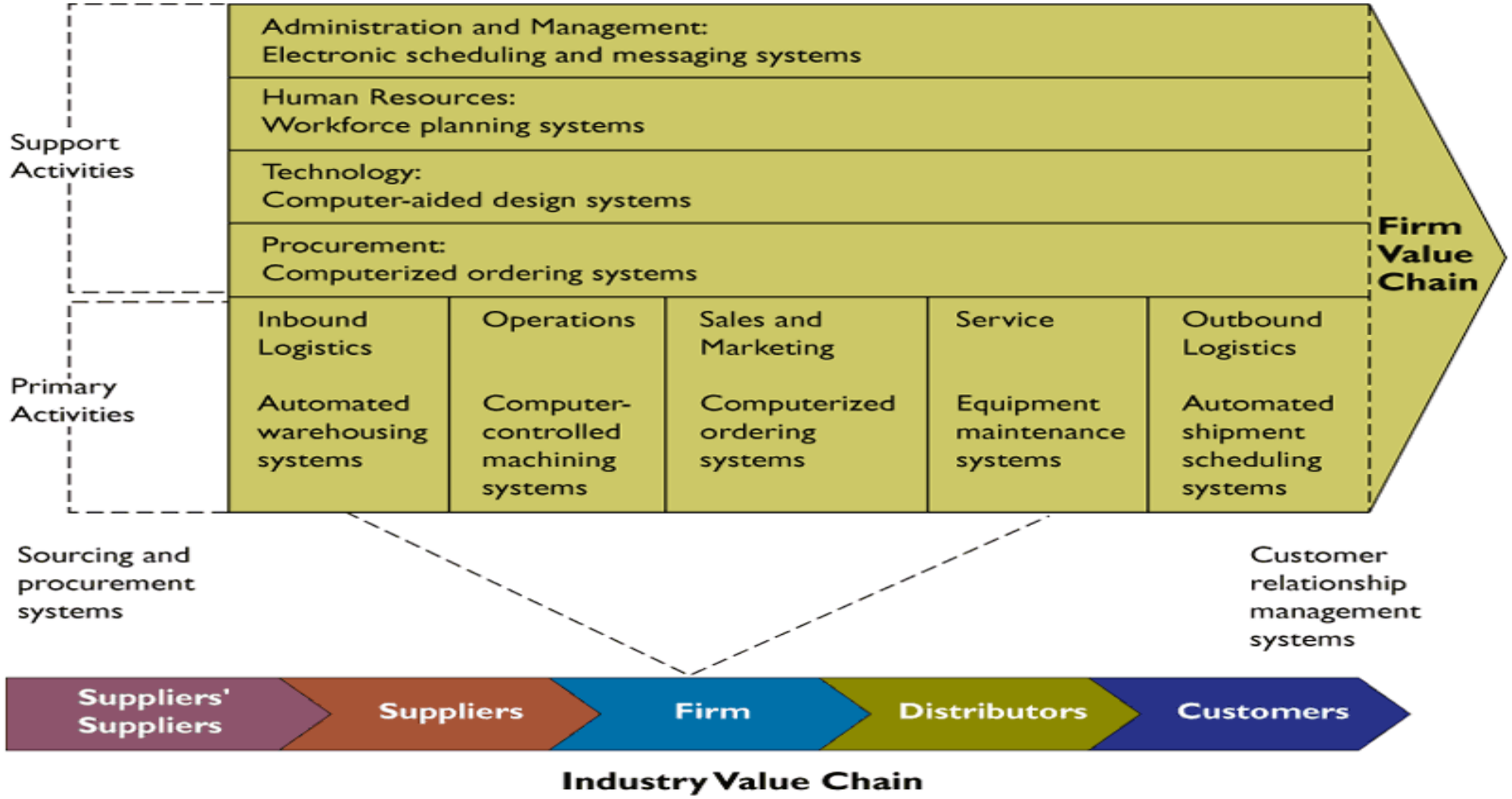


THE SUPPLY CHAIN IT FRAMEWORK

Supply Chain Management (SCM) Systems

- SCM is the process of effectively managing the components of an extended value chain--from suppliers, through manufacturing and distribution chain, and to the consumers.

Value Chain Analysis



The Supply Chain IT Framework

- **The Supply Chain Macro Processes**

–Customer Relationship Management (CRM)

–Internal Supply Chain Management (ISCM)

–Supplier Relationship Management (SRM)

–Plus: Transaction Management Foundation

The Supply Chain Macro Processes

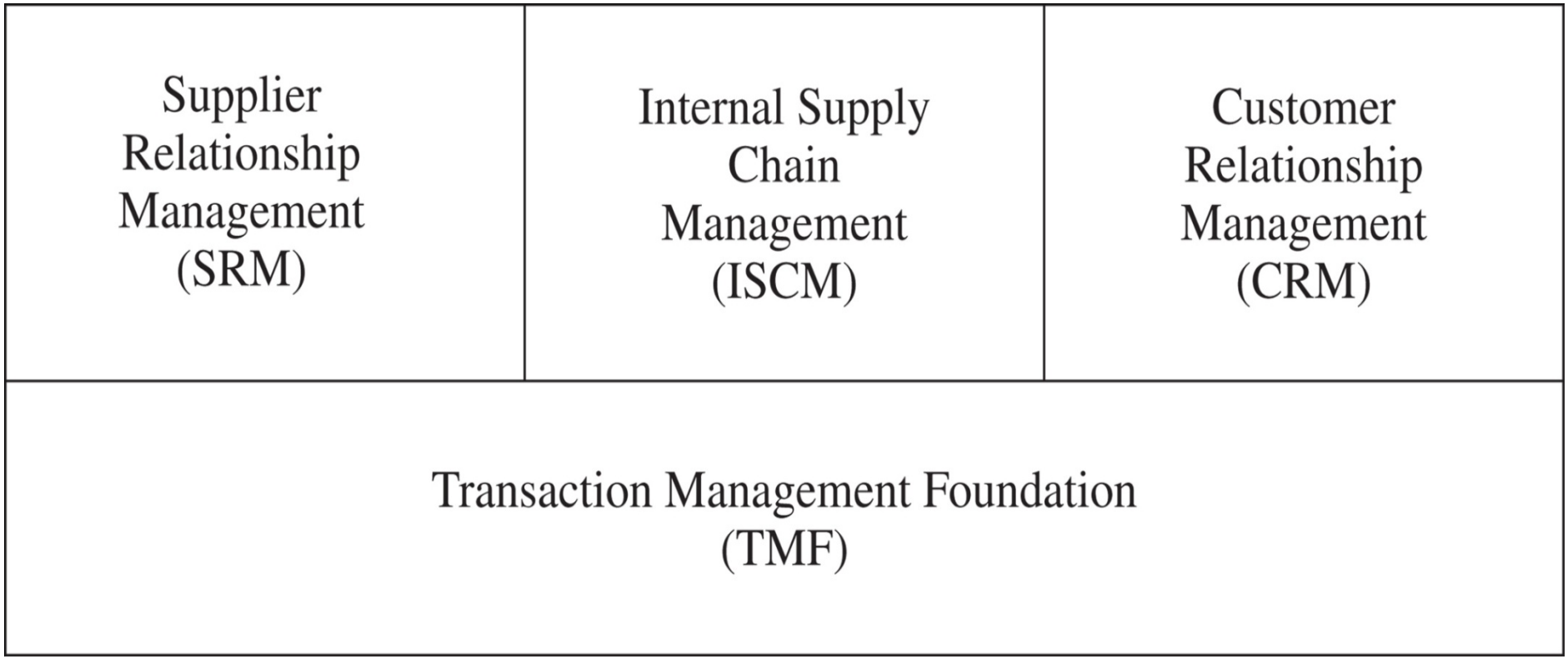


Figure 17-1

Customer Relationship Management

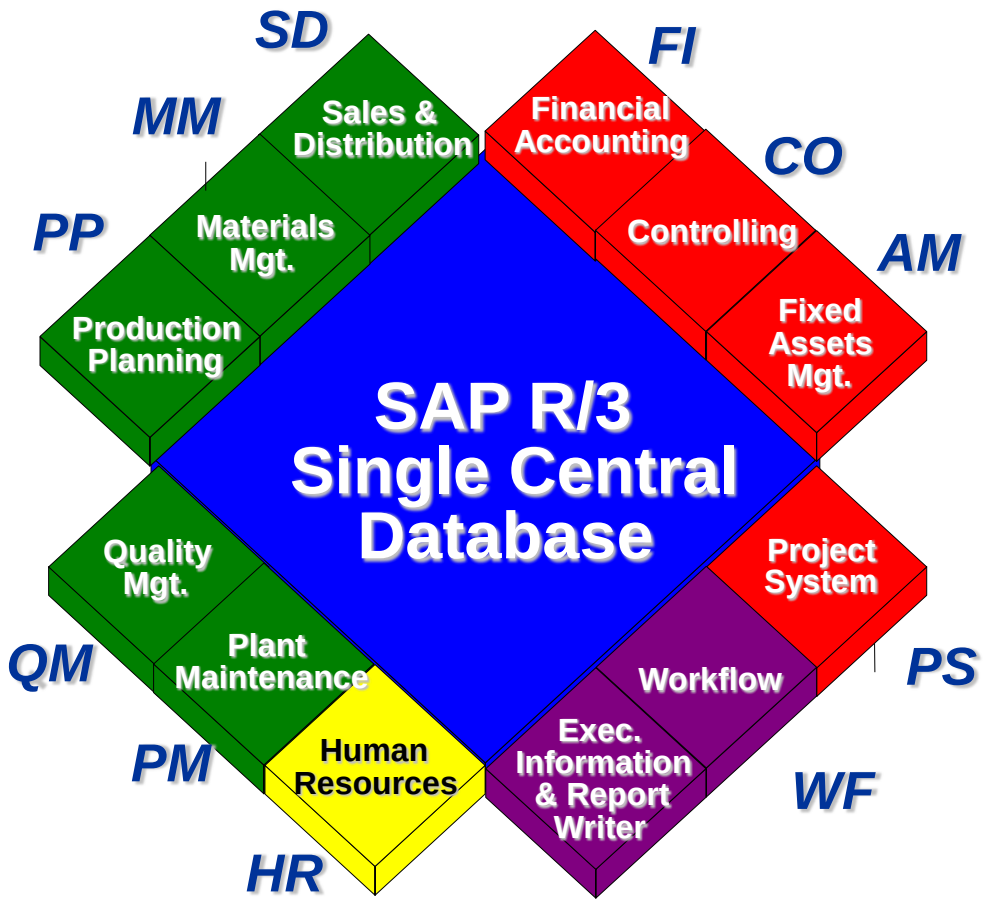
Internal Supply Chain Management

- **Strategic planning**
- **Demand planning**
- **Supply planning**
- **Fulfillment**
- **Field service**
- **There must be strong integration between the ISCM and CRM macro processes.**

RISK MANAGENT IN IT SCM

THE FUTURE OF IT IN A SUPPLY CHAIN

THE KEY ENABLER: ONE SYSTEM THE SYSTEM IS THE DATABASE THE DATABASE IS THE SYSTEM

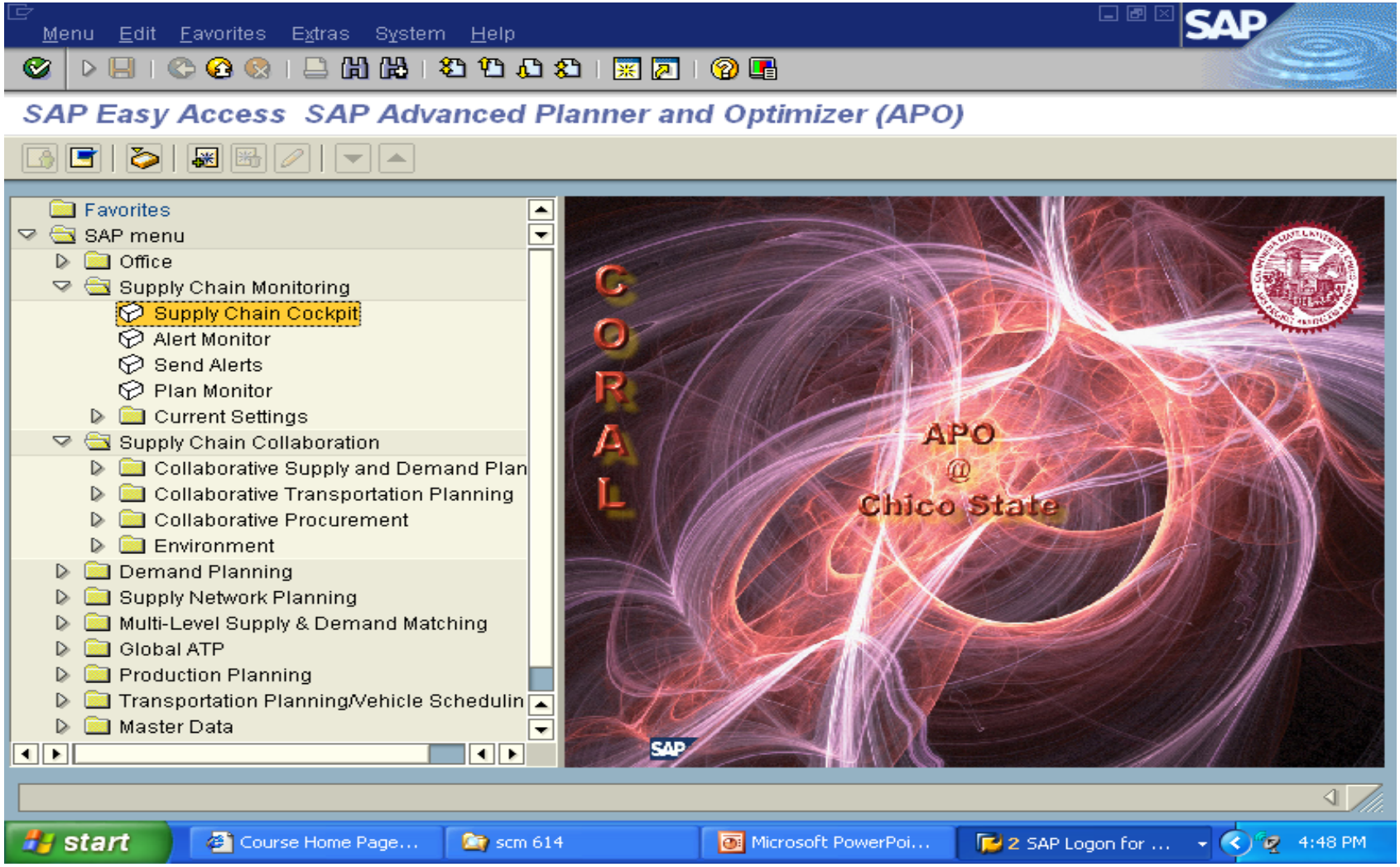


SAP R/3

- Omni-functional
- Fully integrated
- Process-oriented
- Off-the-shelf

1

SAP Advanced Planner and Optimizer (APO)



Levels of SAP APO

Supply Network Design (SND)

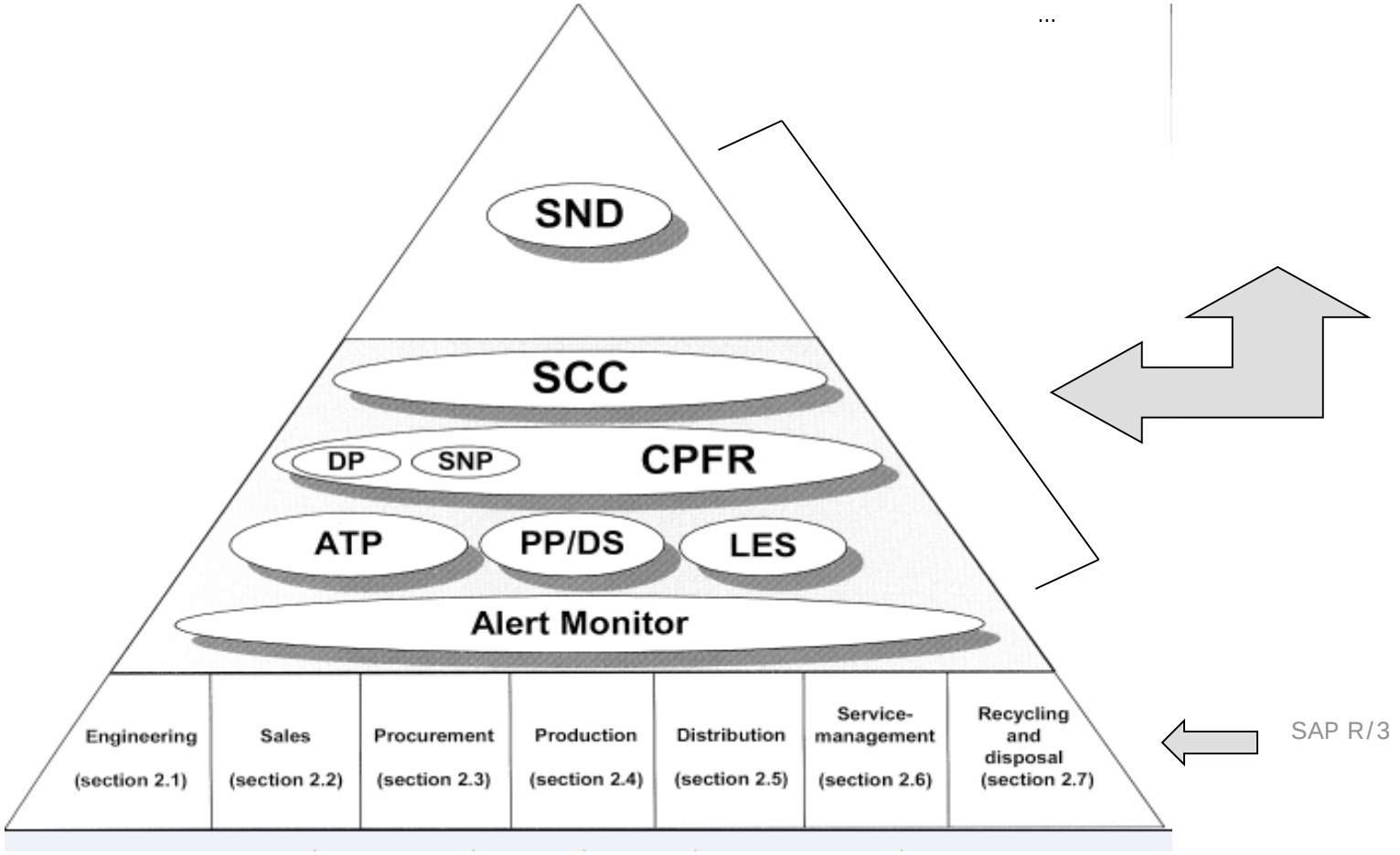
The Supply Chain Cockpit (SCC)

Demand Planning (DP)

Supply Network Planning (SNP)

Collaborative Planning, Forecasting, and Replenishment (CPFR)

...



The Future of IT in the Supply Chain

- **Three important trends:**
  - **The growth in software as a service (SaaS)**
  - **Increased availability of real-time data**
  - **Increased use of mobile technology**

SUPPLY CHAIN IT IN PRACTICE

Supply Chain IT in Practice

- **1.Select an IT system that addresses the company's key success factors**
- **2.Take incremental steps and measure value**
- **3.Align the level of sophistication with the need for sophistication**
- **4.Use IT systems to support decision making, not to make decisions**
- **5.Think about the future**