Lecture 1
IEGR 459: Introduction to Logistics Management and Supply Chain

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Objectives

• Address Logistics in General
• Terms and definitions
• Describe the need for logistics in the context of current International and Global Environment
• Requirements for logistics
• Introduce System Engineering approach to Logistics and supply chain
Todays Environment Significance in Logistics

- The current environment

Today's Environment Significance in Logistics

• Characteristics of the current environment
  
  – **Constantly changing requirements** – Need for agile logistics and maintenance support capability
  
  – **More emphasis on systems** – Logistics systems must be effective, efficient and reliable throughout the lifecycle
  
  – **Increasing system complexities** – Logistics systems must accommodate extra complexities
  
  – **Extended system lifecycles - shorter technology lifecycles** – The system must be able to incorporate new technologies easily and efficiently
  
  – **Greater utilization of commercial off-the-shelf (COTS) products** – need for good design definition of requirements
  
  – **Increasing globalization** – Logistic systems must be highly responsive to rapid and improved communication, networking and turnarounds
  
  – **More outsourcing** – Need for well defined system-level requirements, integrated, and coordinated logistic system
  
  – **Greater international competition** – Highly responsive, effective, and efficient logistics with customer in mind
  
  – **Higher overall life-cycle costs** – Logistics system design must be justified on the basis of lifecycle cost
What is Supply Chain?

- Supply chain encompasses all activities associated with the flow of and transformation of goods and services from the raw materials stage to the end user as well as the associated information flow:

  Raw materials manufacturers
  ↓
  Component and intermediate manufacturers
  ↓
  Final product manufacturers
  ↓
  Wholesalers and distributors and
  ↓
  Retailers

- Connected by transportation and storage activities, and integrated through information, planning, and integration activities
What is Supply Chain?

Supply chain goods flow and transformation
What is Supply Chain?

Supply Chain

• “a set of three or more entities (organizations or individuals) directly involved in the upstream and downstream flow of products, services, finances, and or information flow from source to customers”

Supply chain management

• “Managing supply and demand, sourcing raw materials and parts, manufacturing and assembly, warehousing and inventory tracking, order entry and order management, distribution across all channels, and delivery to the customer”

The Supply Chain Council
What is Logistics?

Logistics:

- “Work required to move and position inventory throughout the supply chain”
- “is supply chain part that plans, implements, and controls the efficient, effective forward and reverses flow and storage of goods, services and related information between the point of origin and the point of consumption in order to meet customers' requirements”

Logistics activities

i. Identification and management of suppliers, procurement and order processing, and physical supply of materials/services from the sources of supply to the manufacturer or producer

ii. The materials handling and inventory management of materials/services during and throughout the manufacturing process

iii. The subsequent transportation and physical distribution of products from manufacture to ultimate consumer
What is Logistics?

Logistics activities in production process – forward flow

Logistics Network Flow

Product & service flow

Recycling & returns

Raw material suppliers
Intermediate component manufacturers
End-product manufacturer (or focal firm)
Wholesalers, distributors
Retailers

Transportation & storage activities

Information/planning/activity integration

Logistics forward and reverse process
How Many Countries Does It Take to Make a Coat?

To make this jacket for the U.S. market, Hong Kong garment producer Li & Fung ordered materials from factories in five countries and had them delivered to Thailand, where the jacket was stitched together. Using a network of Web sites, Li & Fung stays in touch with its worldwide suppliers and can compress the time it takes to get items into stores.

China, the world’s largest producer of cotton, made the liner.

Taiwan, which specializes in making material for outdoor clothing, produced the shell and fleece.

Thailand, a leading exporter of imitation fur, ringed the hood.

Japan, the globe’s biggest producer of stainless steel for zippers, put its teeth in this zipper.

Germany, which gave the world the snap fastener in the 1880s, sent the snaps.
Logistics Evolution in Defense Sector

Performance Based Logistics (PBL) concept

A multi-functional technical management discipline associated with the design, development, test, production, fielding, sustainment, and improvement modifications of cost-effectiveness systems that achieve the users peacetime and wartime readiness requirements. The principal objectives of acquisition logistics are to ensure that support considerations are integral part of the system’s design requirements, that the system can be cost-effectively supported throughout its lifecycle, and that the infrastructure elements necessary to the initial fielding and operational support of the system are identified and developed and acquired.

A disciplined, unified, and iterative approach to the management and technical activities necessary to (1) integrate support considerations into system and equipment design; (2) develop support requirements that are related consistently to readiness objectives, to design, and to each other; acquire the required support, and (4) provide the required support during the operational phase at minimum cost.

A composite of all support considerations necessary to assure the effective and economical support of a system or equipment at all levels of maintenance for its programmed lifecycle. It is an integral part if all other aspects if system acquisition and operation.
Logistics System Lifecycle Activities Flow

Elements of Logistics

Figure 1.5 The basic elements of logistics (functional).
Logistics in the System Life Cycle

• System Lifecycle phases

[Diagram showing System Lifecycle phases from Need to Conceptual Design, Preliminary System Design, Detail Design & Development, Production And/or Construction, Utilization And Support, Retirement And Disposal]

• Interrelationship of lifecycles in system development

[Diagram showing interrelationships between System/Product design and development, Production of System/Product, System/Product Utilization, System Retirement (Material Disposal), Design of Production Capability, Production operations (Manufacturing), Sustaining Maintenance and Support of System/Product, Design of Support Capability, System/Product Retirement (Sustaining Material Disposal and Recycling)]
**Logistics system Lifecycle phases**

<table>
<thead>
<tr>
<th>Customer Need Identify</th>
<th>Conceptual design constitutes the first step in the overall design process and is initiated in response to an identified customer need.</th>
<th>Identification of alternative system operational functions and sub-functions and maintenance functions.</th>
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<td>(i) Feasibility studies are accomplished; (ii) System operational requirements and the maintenance concept are defined and; (iii) A top-level functional analysis for the system may be completed, the system specification is prepared to describe the design requirements for the system.</td>
<td>(i) The allocation of requirements from the top-level system to the various subsystems in terms of performance and effectiveness requirements and system supportability; (ii) System optimization through evaluation of system alternatives involving reviewing the trade-offs within each system as compared with other systems, and; (iii) System synthesis and definition involving putting together the proposed system in analytical form or in a physical model based on detailed specifications.</td>
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<tr>
<td>Preliminary design</td>
<td>Full-scale development, involving:</td>
<td>Materials must flow from the acquisition stage on through to the delivery stage. The production phase involves</td>
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<td>(i) Detailed descriptions of subsystems and elements, etc., comprising the prime mission equipment and the elements of the logistics support system; (ii) Development of an engineering model or prototype that will allow testing and verification of design adequacy; (iii) Test and evaluation of mode, and; (iv) Redesign and retest of a system as necessary.</td>
<td>(i) Inventories, material acquisition and control provisions; (ii) Tooling and test equipment; (iii) Transportation and handling methods and; (iv) Facilities, personnel and data.</td>
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<td>Detailed design and development</td>
<td>The engineering done in the production phase must establish such as:</td>
<td>The delivery of the prime equipment is accomplished along with software and logistic support to the user. Retirement also occurs at the end of this phase.</td>
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<td>(i) Facilities for production, manufacturing processes, inventory requirements, spare tools for testing, transporting, work methods, time and cost standards, evaluation of production operations to assure that the system will perform and be maintained as desired.</td>
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Logistics in the System Lifecycle

- Major steps in system design and development

Diagram showing the lifecycle stages with detailed breakdowns for each phase.
Logistics in the System Lifecycle

- Interface relationships between system design activities and logistics functions

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Figure 1.9 The interface relationships between basic design and logistics functions.
Logistics in the System Lifecycle

Figure 1.10  System life cycle with new technology insertions.
Performance Based Logistics (PBL)

What is PBL?

“...an integrated, affordable, performance package designed to optimize system readiness and meet performance goals for a weapon system through long-term support arrangements with clear lines of authority and responsibility”.

- Emphasis on specifying performance requirements early in system lifecycle.
Importance of Early Phases

- **Cost Effectiveness**
  - The greatest impact on life-cycle cost and maintenance/support cost can be during the early phase of design and development.
  - Logistics and the design for supportability must be inherent within early system design and development process if the result are to be cost-effective.
Importance of Early Phases

- Early lifecycle planning
LOGISTICS RELATED TERMS AND DEFINITIONS
Terms and Definitions

• **The Logistics Support Analysis (LSA)**
  – An iterative analytical process by which the logistics support necessary for a new (or modified) system is identified and evaluated.

• **Concurrent/Simultaneous Engineering (CE).**
  – A Concept that refers to the participation of all the functional areas of the firm in the system engineering.
Terms and Definitions

• **Reliability (R)**
  - Probability that a system or a product will perform in a satisfactory manner for a given period of time when used under specified operating conditions.
  
  • Probability – fraction or percentage signifying the number of times an event occurs divided by number of trials
  
  • Satisfactory performance – Specific criteria that must be established that describes what is considered to be satisfactory system operation
  
  • Time - measure against which the degree of system performance can be related
  
  • Specified operating condition – e.g. geographical location, temperature, humidity, transportation, etc
Terms and Definitions

• **Maintainability (M)**
  - Measures of maintainability

1. MTBM: mean time between maintenance, which includes both preventive (scheduled) and corrective (unscheduled) maintenance requirements. It includes consideration of reliability MTBF and MTBR. MTBM may also be considered as a reliability parameter.
2. MTBR: mean time between replacement of an item due to a maintenance action (usually generates a spare-part requirement).
3. $\bar{M}$: mean active maintenance time (a function of $\bar{M}_{ct}$ and $\bar{M}_{pt}$).
4. $\bar{M}_{ct}$: mean corrective maintenance time. Equivalent to mean time to repair (MTTR).
5. $\bar{M}_{pt}$: mean preventive maintenance time.
6. $\tilde{M}_{ct}$: median active corrective maintenance time.
7. $\tilde{M}_{pt}$: median active preventive maintenance time.
8. $MTTR_g$: geometric mean time to repair.
9. $M_{max}$: maximum active corrective maintenance time (usually specified at the 90% and 95% confidence levels).
10. MDT: maintenance downtime (total time during which a system is not in condition to perform its intended function). MDT includes active maintenance time ($\bar{M}$), logistics delay time (LDT), and administrative delay time (ADT).
11. MLH/OH: maintenance labor hours per system operating hour.
12. Cost/OH: maintenance cost per system operating hour.
14. Turnaround time (TAT): that element of maintenance time needed to service, repair, and/or check out an item for recommitment. This constitutes the time that it takes an item to go through the complete cycle from operational installation through a maintenance shop and into the spares inventory ready for use.
15. Self test thoroughness: the scope, depth, and accuracy of testing.
16. Fault isolation accuracy: accuracy of system diagnostic routines in percent.
Terms and Definitions

Maintenance and Support

• Maintenance – all actions necessary for retaining a system or product in, or restoring it to, a serviceable condition
  – Corrective maintenance – unscheduled maintenance actions performed as a result of failure, to restore a system to a specified condition
  – Preventative maintenance – scheduled maintenance sections performed to retain system or a product in a specified condition

• Maintenance Level – Pertains to division of functions and tasks for each area where maintenance is performed

• Maintenance Plan – detailed plan specifying the methods and procedure to be followed for system support throughout its lifecycle

• Total Productive maintenance – integrated, top-down, system lifecycle approach to maintenance with the objective of maximizing productivity
Terms and Definitions

• **Producibility**
  
  – Measure of the relative ease and economy of producing a system or a product

• **Disposability**
  
  – Degree to which an item can be recycled for some other use or disposed without any environment degradation

• **Configuration management (CM)**
  
  – Management approach used to identify the functional and physical characteristics of an item in the early phase of its lifecycle, control changes to those characteristics, and record and report change processing, and implementation status
Terms and Definitions

- **Total quality management (TQM)**
  - Total integrated management approach that addresses system/product quality during all phases of the lifecycle and at each level in the overall system hierarchy

- **TQM Characteristics**
  - **Primary objective** - Customer satisfaction
  - More emphasis on iterative practice of continuous improvement as applied to engineering, production, and support processes.
  - Individual understanding of processes, the effects of variation, the application of process control methods, etc.
  - Emphasizes a total organizational approach, involving every group in the organization
Terms and Definitions

- **System Effectiveness (SE)**
  - Ability of a system to perform its intended functions(s)

- **Cost effectiveness**
  - Measure of a system in terms of mission fulfillment (system effectiveness) and total LCC

- **Life-cycle Cost (LCC)**
  - Design and development costs - Cost of feasibility studies; system analysis; detail design and development; fabrication, assembly, and test of engineering models; initial system test and evaluation; and associated documentation
  - Production and construction cost – the cost of fabrication, assembly, and test of operational systems; operation and maintenance of the production capability; and associated initial logistic support requirements.
Figure 1.17 Basic ingredients of cost-effectiveness.
Figure 1.18  Life-cycle cost and its major cost categories (example).