Lean Supply Chain Systems Engineering
LSCSE

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Systems Engineering Integrative Project
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Loyola Marymount University
Resources used for this project

• **Books** (The Machine that changed the world, Lean Six Sigma for Supply Chain, Supply Chain Management Strategy Planning and Operation)


• **Intensive course at CSULB** (SCM 414, Dr. Ming Chen)

• **LMU’s SE Lectures** (Lean Thinking I&II, Advanced SE)

• **Interviews with supply chain professionals** (Project Eng. Jon Hulse, SCS Eng. Prasanna Chilukamarri)
Agenda

1. Project Requirements
2. Introduction
3. Supply chain
4. Problems in the current Supply Chain
5. Solving some Supply Chain Issues using Lean principles
6. Applying Systems Engineering to SC
7. Lean Supply Chain Systems Engineering
8. Ethical issues related to this project
Requirements

1. The Lean Supply Chain Systems Engineering (LSCSE) shall minimize the time needed to deliver products to the customer.
2. The LSCSE shall minimize waste in the delivery of products to the customer.
3. The LSCSE shall operate following documented process standards.
4. The LSCSE shall follow documented industry product standards
5. The LSCSE shall develop systems thinking.
6. LSCSE shall minimize risks impact.
7. The LSCSE shall improve current supply chains and eliminate any supply chain problems once and for all.
Introduction

- The Growing interest in Supply Chain
- Complexity of SC systems
- Why Lean Systems Engineering for Supply Chain?
1 Understanding of Supply Chain System

- The evolution eras of SCM
- Definition and key Ideas of SCM
- Elements of Supply Chain (more details in my report)
- Push/ Pull of SC processes
### 1.1 The evolution eras of SCM

<table>
<thead>
<tr>
<th>Number</th>
<th>Era</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Creation Era</td>
<td>The term supply chain management was first coined by an American industry consultant in the early 1980s. However the concept of supply chain in management, was of great importance long before in the early 20th century, especially by the creation of the assembly line.</td>
</tr>
<tr>
<td>2</td>
<td>Integration Era</td>
<td>This era of supply chain management studies was highlighted with the development of Electronic Data Interchange (EDI) systems in the 1960s and developed through the 1990s by the introduction of Enterprise Resource Planning (ERP) systems.</td>
</tr>
<tr>
<td>3</td>
<td>Globalization Era</td>
<td>This era is characterized by the globalization of supply chain management in organizations with the goal of increasing competitive advantage, creating more value-added, and reducing costs through global sourcing.</td>
</tr>
<tr>
<td>4</td>
<td>Specialization Era Phase One - Outsourced Manufacturing &amp; Distribution</td>
<td>In the 1990s industries began to focus on &quot;core competencies&quot; and adopted a specialization model. Companies abandoned vertical integration, sold off non-core operations, and outsourced those functions to other companies.</td>
</tr>
<tr>
<td>5</td>
<td>Specialization Era Phase Two - Supply Chain Management as A Service</td>
<td>Specialization within the supply chain began in the 1980s with the inception of transportation brokerages, warehouse management, and non-asset based carriers and has matured beyond transportation and logistics into aspects of supply planning, collaboration, execution and performance management.</td>
</tr>
<tr>
<td>6</td>
<td>Supply Chain Management 2.0 (SCM 2.0)</td>
<td>Web 2.0 is defined as a trend in the use of the World Wide Web that is meant to increase creativity, information sharing, and collaboration among users.</td>
</tr>
</tbody>
</table>

Table 1: Evolution eras of SCM (IJEST. 2010)
### 1.2 Definitions and Key Ideas of SCM

<table>
<thead>
<tr>
<th>Authors</th>
<th>Definition of SCM</th>
<th>Key Ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scott and Brook, (1991)</td>
<td>The chain linking each element of the manufacturing and supply process from raw materials to the end user, encompassing several organizational boundaries.</td>
<td>Highlights the significance of coordination among constituent members.</td>
</tr>
<tr>
<td>Ellram, (1991)</td>
<td>The integration of the processes, systems, and organizations that control the movement of goods from the supplier to a satisfied customer without waste. Highlights the necessity of integration among the organizations, physical movement and the waste reduction principal of JIT.</td>
<td>Highlights the necessity of integration among the organizations, physical movement and the waste reduction principal of JIT.</td>
</tr>
<tr>
<td>Lee and Billington, (1992)</td>
<td>Networks of manufacturing and distribution sites that procure raw materials, transform them into intermediate and finished products, and distribute them to customers.</td>
<td>Attempts to show conventional functions of supply chain.</td>
</tr>
<tr>
<td>Christopher, (1992,1998)</td>
<td>The management of upstream and downstream relationships with suppliers and customers to deliver superior customer value at least cost to the supply chain as a whole.</td>
<td>Signifies the importance of relationships, customer focus and cost reduction</td>
</tr>
<tr>
<td>Ellram Cooper, (1993)</td>
<td>An integrating philosophy to manage the total flow of a distribution channel from supplier to ultimate customer.</td>
<td>Identifies the importance of integration within supply chain.</td>
</tr>
<tr>
<td>Berry (1994)</td>
<td>SCM aims at building trust, exchanging information on market needs, developing new products, and reducing the supplier base to particular original equipment manufacturer so as to release management resources for developing meaningful, long term relationship.</td>
<td>Highlights the importance of supplier relationships in achieving supply chain objectives.</td>
</tr>
<tr>
<td>Cox (1995)</td>
<td>The functions within and outside a company that enable value chain to make and provide products to the customer.</td>
<td>Attempts to identify strategic partners within supply chain.</td>
</tr>
<tr>
<td>Saunders, (1997)</td>
<td>Supply Chain is the total chain of exchange from original source of raw material, through various firms involved in extracting and processing raw materials, manufacturing, assembling, distributing, and retailing to end customers.</td>
<td>Network of firms interacting to deliver product or service to the end customer, linking flows from raw material supply to final delivery.</td>
</tr>
<tr>
<td>Patricia, (1996)</td>
<td>The physical network that begins with the supplier and ends with the customer.</td>
<td>Traces all the organizations within a supply chain including all tiers of suppliers and distribution.</td>
</tr>
<tr>
<td>Monczka and Morgan, (1997)</td>
<td>Integrated SCM is about going from the external customer and then managing all the processes that are needed to provide the customer with value in a horizontal way.</td>
<td>Highlights the necessity of flat organizational structure and customer focus.</td>
</tr>
<tr>
<td>Tun, (1998)</td>
<td>It is management philosophy that extends traditional intra-enterprise activities by bringing trading partners together with the common goal of optimization and efficiency.</td>
<td>Focuses on how firms utilize their suppliers' processes, technology and capability to enhance competitive advantage.</td>
</tr>
<tr>
<td>Houlihan and Houlihan (1999)</td>
<td>The integration of various functional areas within an organization to enhance the flow of goods from immediate strategic suppliers through manufacturing and distribution chain to the end user.</td>
<td>Considers strategically important suppliers and integration among constituent members</td>
</tr>
</tbody>
</table>
1.2 Definitions and key Ideas of SCM

- Definition I learned in the SCM Class:

"The sequence of organizations their facilities, functions, and activities that are involved in producing and delivering a product or service. It include All stages, all steps and activities involved, directly or indirectly, in fulfilling a customer request. SCM flow includes the flow and movement of products not only from suppliers to manufacturers to distributors, but also includes movement of information, funds, and goods in both directions."
Figure 1: (SCM Strategy Planning and Operation, Sunil Chopra, Peter Meindl).
1.3 Elements of Supply Chain

Supply Chain Business Processes

Supply Chain Management Components

Supply Chain Business Structure
Supply Chain Business Process

SRM
- Source
- Negotiate
- Buy
- Design Collaboration
- Supply Collaboration

ISCM
- Strategic Planning
- Demand Planning
- Supply planning
- Fulfillment
- Field Service

CRM
- Market
- Price
- Sell
- Call center
- Order Management
Figure 2: Supply Chain with different Links (Lambert and Cooper, 2000)
Figure 3: Management Aspects of Supply Chain Management (Lambert and Cooper, 2000)
Supply Chain Business Structure & Life Cycles

Customer Order Cycle

Replenishment Cycle

Manufacturing Cycle

Procurement Cycle

Customer

Retailer

Distributor

Manufacturer

Supplier
1.4 Push/ Pull of SC processes

- Pull Process (Reactive)
- Push Process (Speculative)
- Push/Pull boundary
- The goal
2 Challenges in the current Supply Chain

- Supply Chain Risks (SCR)
- Strategic insights
- Supply Chain Frameworks and Standards (SCFS)
- Performance measurement in SCM
- Supply Chain Informatization (SCI)
Supply Chain Risks

• Why I focus on SC Risks?
  – Today’s challenges
  – Kinds of Risks
    • Endogenous uncertainty
    • Exogenous uncertainty
      – Discrete events
      – Continuous risks
  – Sources of risks
Sources of Risks in SCM

Figure 5: Sources of risks (The Supply Chain Council Risk Research Team, 2008)
What is the benefit of Supply Chain Risk Management (SCRM)?

Aberdeen survey
Examples of Disruption is SC's

- Several Events (Earthquakes 1995, WTC in 2001, etc.)
- Effected Companies (Ericson, Hershey, Apple, Wal-Mart)
3 Lean Supply Chain

• What is Lean?
  - "Lean is a systematic approach to enhancing value to the customer by identifying and eliminating waste (of time, effort and materials) through continuous improvement, by flowing the product at the pull of the customer, in pursuit of perfection." (LEI)
Lean Supply Chain

"Is a set of organizations directly linked by upstream and downstream flows of products, services, finances and information that collaboratively work to reduce cost and waste by efficiently and effectively pulling what is required to meet the needs of the individual customer." (Association of Operation Management)
The Lean Supply Chain Components

1. Demand Management
2. Cost and Waste Reduction
3. Process Standardization
4. Industry Standardization
5. Cultural Change
6. Cross-Enterprise Collaboration

THE LEAN SUPPLY CHAIN

(Association of Operation Management)
Six steps to implement lean

Steps to implement lean in SC is by applying the 6 lean principles

- **Specify value**: Identify which features create value. Define value from the final customer
- **Map the value stream**: Identify the sequence of activities called the value stream
- **Flow**: Make the activities flow continuously through the remaining, value-created steps. Eliminate barriers and develop product-focused organizations that dramatically improve lead time.
- **Pull**: Let the customer pull product or service through the process, eliminating the need for a sales forecast
- **Perfect the process**: Manage the process so that the number of steps and the amount of time and information needed to serve the customer continually fall.
- **Respect people**: Respect people always and motivate them.
Lean Supply Chain Management Principles

- Focus on the supplier network value stream
- Eliminate waste
- Synchronize flow
- Minimize both transaction and production costs
- Establish collaborative relationships while balancing cooperation and competition
- Ensure visibility and transparency
- Develop quick response capability
- Manage uncertainty and risk
- Align core competencies and complementary capabilities
- Foster innovation and knowledge-sharing
# Lean Supply Chain Management Differs Sharply from Conventional Practices

<table>
<thead>
<tr>
<th>ILLUSTRATIVE CHARACTERISTICS</th>
<th>CONVENTIONAL MODEL</th>
<th>LEAN MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number &amp; structure</td>
<td>Many; vertical</td>
<td>Fewer; clustered</td>
</tr>
<tr>
<td>Procurement personnel</td>
<td>Large</td>
<td>Limited</td>
</tr>
<tr>
<td>Outsourcing</td>
<td>Cost-based</td>
<td>Strategic</td>
</tr>
<tr>
<td>Relationship focus</td>
<td>Transaction-focused</td>
<td>Mutually-beneficial</td>
</tr>
<tr>
<td>Selection length</td>
<td>Lowest price</td>
<td>Performance</td>
</tr>
<tr>
<td>Contract length</td>
<td>Short-term</td>
<td>Long-term</td>
</tr>
<tr>
<td>Pricing practices</td>
<td>Competitive bids</td>
<td>Target costing</td>
</tr>
<tr>
<td>Price changes</td>
<td>Upward</td>
<td>Downward</td>
</tr>
<tr>
<td>Quality</td>
<td>Inspection-intensive</td>
<td>Designed-in</td>
</tr>
<tr>
<td>Delivery</td>
<td>Large</td>
<td>Smaller quantities (JIT)</td>
</tr>
<tr>
<td>Inventory buffers</td>
<td>Large</td>
<td>Minimized, eliminated</td>
</tr>
<tr>
<td>Communication</td>
<td>Limited; task-related</td>
<td>Extensive; multi-level</td>
</tr>
<tr>
<td>Information flow</td>
<td>Directive; one-way</td>
<td>Collaborative; two-way</td>
</tr>
<tr>
<td>Role in development</td>
<td>Limited; build-to-print</td>
<td>Substantial</td>
</tr>
<tr>
<td>Production flexibility</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Technology sharing</td>
<td>Very limited; nonexistent</td>
<td>Extensive</td>
</tr>
<tr>
<td>Dedicated investments</td>
<td>Minimal-to-some</td>
<td>Substantial</td>
</tr>
<tr>
<td>Mutual commitment</td>
<td>Very limited; nonexistent</td>
<td>High</td>
</tr>
<tr>
<td>Governance</td>
<td>Market-driven</td>
<td>Self-governing</td>
</tr>
<tr>
<td>Future expectations</td>
<td>No Guarantee</td>
<td>Considerable</td>
</tr>
</tbody>
</table>
4 Applying Systems Engineering to Supply Chain (Risk Process)

- Why SE in SC
- Managing Risks in different industries
Characteristics of Successful SCRM Approaches

- Feasible, stable, and well understood user requirements
- Close partnership with user
- Developed, resourced, and implemented risk mitigation plans
- Continuous technical reviews
- Identified risks & completed analysis
- Established criteria for proactively implementing defined risk mitigation plans
- Continuous assessments of risks
Framework for Systems Engineering Supply Chain Risk Management

- Standard processes:
  - Risk identification
  - Risk analysis
  - Risk mitigation
  - Risk monitoring
DoD Risk Mitigation Process in SC's

Figure 6: DoD Risk Management Process
## Risk Identification & Mitigation Example

<table>
<thead>
<tr>
<th>Risk</th>
<th>Mitigating strategy</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global sourcing</td>
<td>Risk sharing contracts</td>
<td>Long term relationship.</td>
</tr>
<tr>
<td></td>
<td>Low-cost sourcing</td>
<td>Cost saving.</td>
</tr>
<tr>
<td>Diverse supplier base</td>
<td>Sustainable logistics model</td>
<td>Reduced transport delays.</td>
</tr>
<tr>
<td></td>
<td>Contract manufacturing</td>
<td>Risk transfer.</td>
</tr>
<tr>
<td>Volatile market</td>
<td>Make to order</td>
<td>Flexible production.</td>
</tr>
<tr>
<td></td>
<td>Postponement</td>
<td>Quick product configurations.</td>
</tr>
<tr>
<td></td>
<td>Strategic stock</td>
<td>Quick response to market demand.</td>
</tr>
<tr>
<td>Product complexity</td>
<td>Quality standardization</td>
<td>Lesser cost of quality.</td>
</tr>
</tbody>
</table>
Risk Analysis Example

- Boeing Dreamliner 787 Project
- Airbus in 2006
5 Lean Supply Chain Systems Engineering

- Supply Chain
- Lean Supply Chain
- Supply Chain Systems Engineering
- Lean Supply Chain Systems Engineering
Lean Supply Chain Systems Engineering

• Definition: “the Strategic achievement and integration of an organization’s social, environmental, and economic goals through the systemic coordination of key inter-organizational business processes to improve the long-term economic performance of the individual company and its value network” (Carter and Rogers, 2008).
6 Ethical issues related to this project

- Is Lean Supply Chain Systems Engineering Ethical?
- Why society is concerned about ethics within SCM?
  - Environmental effects
  - Health and Safety effects
  - Consumer Rights
Questions ?