Facility Location and Strategic Supply Chain Management

Structure

I. Location Concepts

II. Location Theory

III. Strategic Supply Chain Management

   Chapter 7 – Logistics & Supply Chain Management
   Chapter 8 – Strategic Supply Chain Management
Facility Location and Strategic Supply Chain Management

Chapter 7 – Logistics & Supply Chain Management

Contents

• **Terms and definitions** about
  - Logistics
  - Supply Chain Management

• Supply Chain Characteristics
Logistics & Supply Chain Management

Terms and definitions

Logistics & SCM is one of the most important activities in modern societies. The total logistics costs incurred by USA correspond to approximately 11% of the Gross Domestic Product (GDP).
## Logistics & Supply Chain Management

### Similar to Europe

**Logistics costs** as percentage of GDP in EU countries

<table>
<thead>
<tr>
<th>Sector</th>
<th>Transportation</th>
<th>Warehousing</th>
<th>Inventory</th>
<th>Administration</th>
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<tr>
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</table>

Reference: Ghiani et al., Logistics Systems Planning and Control, 2003
# Terms and Definitions

## Historical development of logistics

<table>
<thead>
<tr>
<th>Period</th>
<th>Transportation Type</th>
<th>Equipment/Technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000 B.C.</td>
<td>local transportation</td>
<td>road construction, sailing-ships, caravans, pushcarts, wheels, hoists, pulleys, boats</td>
</tr>
<tr>
<td>0 B.C.</td>
<td>coasting</td>
<td>long-distance trade, seafaring, tracking, docks</td>
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<tr>
<td>1000</td>
<td>continental transports</td>
<td>trading center, trade routes, staple markets, cranes, materials handling equipment, tunnel and channel construction</td>
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<tr>
<td>1800</td>
<td>trading network</td>
<td>postal service, international trade, discovery of America (1492), Hanse (1100)</td>
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<tr>
<td>1900</td>
<td>global transportation</td>
<td>automobile (1890), electric motor (1870), railway (since 1825), steam boat (since 1800), freight forwarder, communication</td>
</tr>
<tr>
<td>2000</td>
<td>logistic networks</td>
<td>AGV systems (1970), high bay storage (1962), moon landing (1959), EDP systems (since 1950), forklift (since 1940), air transportation (since 1920), airplane (1900)</td>
</tr>
</tbody>
</table>

Reference: Gudehus, Logistik, 1999
Terms and Definitions

Origins and development of „Logistics“

The term originates on the one hand from the Ancient Greek logos (ratio, calculation) and on the other hand from the Germanic-French root loger (supply, support).

Military context:

The French general Jomini (1779 - 1869) established with the "maréchal de logis" a position with pivotal logistic importance in the Napoleonic army system.

initially: supply of troops
later on: planning the transportation of troops

For 40 years the term „Logistics“ has been used to describe complex commodity and information flows.
Terms and Definitions

Logistics Processes

Logistics processes or services in the narrow sense

- transportation (load and discharge, unloading)
- handling (setting and removal, storage, stock removal)
- warehousing
- picking

Can be characterized as

- bridging distance (transportation)
- bridging time (stocking)
- shift in the configuration (picking)

from objects.

Logistics processes or services in a broader sense

- production, acquisition, service
Terms and Definitions

Logistics Objects

material goods (material)
- commodities, food, consumer goods
- raw materials, intermediate products, semifinished products, finished goods
- manufacturing resources
- waste

people (material)
- passengers

information (immaterial)
- orders, information

Depending on the logistics objects one distinguishes:
- material goods logistics
- passenger traffic logistics
- information and communication logistics
Terms and Definitions

Logistics Systems

Used for the realization of logistics processes.

Have the structure of a network, consisting of a number of sources and sinks, which are linked by transportation connections and facilities.

Processes in logistics systems form a flow of
  • goods
  • information
Logistics Systems

Typical Logistics System

Logistics Systems

**Sources, suppliers or distribution centers**

provide objects
- raw material warehouses, factories
- storage warehouses, import warehouses, logistics centers

**Sinks or delivery points**

demand for objects
- retailer, markets, stores, costumers
- Incinerators

**Sources of goods** can themselves receive goods and commodities from other sources.

**Retailer and consumer** again are sources of empties, residues and packaging waste, which must be disposed.
Logistics Systems

Facilities

**Objects** can be *produced, processed, stored, transferred.*
- factories, plants, production facilities
- inventories, logistics centers, transshipment points
- management, call-center

Transportation links

**Means of transport ship** goods between **facilities** along defined routes.
- truck, van, train
- airplane, ship

Often, there are several different transportation links with different means of transport, costs and transportation times between two facilities.
Terms and Definitions

Specialized Logistics Systems

Handling systems, storage systems, order picking systems
ensure the flows of goods inside of facilities (e.g. logistic centers, transshipment points) between or at different stations (e.g. goods receipt and issue, high bay warehouse).

Transportation systems
serve the pure bridging of distance within or between facilities. Consist of transport connections and nodes.

Production systems
model structures for production and transformation processes from goods.
Terms and Definitions

**Logistics (management)** – definition of CLM (Council of Logistics Management)

Process of planning, implementing and controlling the efficient, effective, forward and reverse 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.

**Task of logistics**

Supply customers with the *right materials*, at the *right place*, at the *right time* while *optimizing* a given performance measure (e.g. minimizing total costs) and satisfying a given set of *requirements* (e.g. service level) and *constraints* (e.g. budget constraints).
Terms and Definitions

3 R’s of logistics:
• the right material, at the right place, at the right time

sometimes also 6 R’s:
• in the right amount, the right quality, to the right costs

Orientation of logistics

strategic
planning and realization of logistics systems

operational
management and control of the flow and storage of goods and information.

More precisely
• medium-term (tactical)
• short-term
Terms and Definitions

Orientation of Logistics

- corporate logistics
  - strategic logistics
    - logistics controlling
      - capture service and costs
      - cost planning and calculation
      - capability analysis
      - reporting system
      - consulting
    - logistics planning
      - network development
      - design of logistics supply chains
      - tendering
      - project management
      - logistics consulting
  - operational logistics
    - logistics disposition
      - order disposition
      - demand forecasts
      - inventory management
      - replenishment disposition
      - order tracking
    - logistics service provider
      - line operation
      - warehousing
      - transportation service
      - operating of logistics centers
      - administration logistics provider

Reference: Gudehus, Logistik, 1999
Terms and Definitions

Characteristics of Logistics

Main characteristics

• Information is a **logistics object** per se, but in particular essential assumption for the **trigger** and **control** of other **logistics processes**.

• **Holistic view of all logistics processes**
  
  *Simultaneous examination* of many processes as a **total flow** and their **matching** with regard to the total purpose.

• **Interdisciplinary character**
  
  *Uses and connects* the knowledge of the various disciplines:
  - economics and engineering
  - mathematics and informatics
Terms and Definitions

Differentiation of logistics systems from the economic point of view

**macro logistical** system – *macroeconomic* perspective
Denotes the transportation system of a region, national or global economy
• transportation network (street, rail, air, water)
• public and individual freight and passenger transportation

**micro logistical** system – *microeconomic* perspective
Logistical (sub-)system of a company
• transportation system, storage system and transshipment system
• third-party logistics: carrier, Deutsche Bahn, public transport

**meta logistical** system – *inter company* perspective
Cooperation between companies and their logistics systems
• industrial concerns, their suppliers, customers and the authorized third-party logistics
Terms and Definitions

Logistics supply chain

Is the logistics system of an industrial company.

Involves the total flow of goods from suppliers to companies, inside the companies and thence to the customers.

Business logistics

relates to flow of goods (logistics of goods) in micro logistical systems.

Flow of information only for the purpose of the control of processes.

Recently changes to the consideration of meta logistical systems (e.g. between industrial companies, trading concerns and third-party logistics).
Terms and Definitions

Subareas of Business Logistics

- procurement logistics
- production logistics
- distribution logistics

Material Logistics
- supplier
- raw materials
- intermediate products
- finished product
- external warehouse
- customers

Reverse Logistics
- waste
- external application, removal

External Transport
- production and internal transport
- warehouse

Reference: VDI Handbuch Logistik, 2004
Terms and Definitions

Subareas of Business Logistics

- **procurement logistics**
  Ensuring the supply with materials of the right amount, at the right time and in the right quality.

- **production logistics**
  Planning, management and control of the flow of goods between goods receipt, fabrication and shipment.

- **material logistics**
  Encompasses procurement logistics and production logistics of components.

- **distribution logistics**
  Planning and control of the distribution of finished goods to the customers.

- **reverse logistics**
  Tasks and processes of waste disposal in any part of the logistics supply chain.

- **transportation logistics**
  Concerns the pure transportation of goods, persons or information.
Terms and Definitions

Supply Chain

Complex, inter-company, inter-logistical system, which involves the procedures and tasks of the procurement, production, processing, warehousing and distribution of objects.

Describes flows, transformations and applications of materials, goods and resources, their initiating, managing and controlling order and information flows, as well as all necessary structures which are aimed to satisfy the customers demand.

In general: more global and broader view than in logistics

• Strategic Partnerships: company cooperation
• I&K – logistics: Customer Relationship Management (CRM), …
• Procurement & Outsourcing
• Product design
Terms and Definitions

Supply Chain Management (SCM) – Definition of CLM

Encompasses the planning, monitoring and control of all activities involved in funding, procurement, transformation and logistics management activities.

Includes coordination and collaboration with channel partners, e.g. suppliers, providers and customers.

SCM integrates supply and demand management within and across companies.

Goal of the SCM is the increase of the added value by efficient and cost-effective planning of the whole system and not of only several components.
Terms and Definitions

Supply Chain Management

**Methods** and **utilities** for the continuous and holistic **control** and **coordination** of logistic networks by

- Configuration of the **added value network**
  perception, definition and optimization of the added value relations between the organizational units.

- **Flow orientation** of single organizations
  grouping the material and information logistics respectively of the organizational units regarding to a process-orientated direction and definition of interfaces

- Integration of the **basis of information**
  extension of the basis for decision from the organizational units by linking (and thereby expansion) of the single horizons

- Collaboration in **planning** and **controlling processes**
  collaboration of the organizational units in comprehensive planning and controlling activities
Terms and Definitions

Sections of Supply Chain Management

Strategic – Supply Chain Configuration

Decisions with long-term effects and high capital cost

Examples

• number, location and capacity of facilities
• investments in factories and warehouses
• layout of facilities
• distribution strategies, allocation of customers to facilities
• outsourcing

Data: aggregated, based on forecasts, often incomplete or imprecise.
Terms and Definitions

**Tactical (medium-term operational) – Supply Chain Planning**

Decisions which concern the effective allocation of production and distribution resources. Usually scheduled quarterly or every 6 months.

**Examples**

- procurement and production decisions
- choice of transportation and shipping strategies
- inventory planning
- number of personnel, labor time

**Data**: detailed, based on forecasts.
Supply Chain Management

Operational (short-term) – Supply Chain Execution

Daily decisions, generates precise amount- and time-targets, which can be realized directly.

Examples
- scheduling, allocation of orders to machines
- operations planning, order processing
- vehicle-routing, truck-charging

Data: concrete and detailed.
Supply Chain Management

Sections of Supply Chain Management

- **Planning horizon**
  - Short
  - Medium
  - Long

- **Aggregation level**
  - High
  - Medium
  - Low

- **Management level**
  - Strategic
  - Tactical
  - Operational

- **Location decisions**
- **Inventory, distribution**
- **Routing, scheduling**

Reference: Günther/Tempelmeier 1997
Supply Chain Management

Planning areas in SCM

Strategic network planning
planning of the basic configuration of the complete supply chain.
For example
- storage capacity and location, production capacity and -location
- long-term sourcing and distribution strategies
- outsourcing of service to third-party logistics

Demand planning
(statistical) forecasts of future costs and trends of the demand.

Requirements planning (supply/master planning)
comprehensive and coordinated planning of procured, produced and distributed quantities in view of capacity requirements and supply by minimizing the total costs.
Supply Chain Management

**Material planning and procurement**
comprises the material procurement (disposition, order quantity, order point)

**Production planning and control**
generation of production plans for each machine for a day or shift.

**Inventory management, organization and planning**
layout and organization of warehouses. Planning of warehouse inventories

**Transportation and distribution planning**
cost effective planning of freight transports for production amounts and demands, subject to the available capacities.
Supply Chain Management

**Vehicle routing and scheduling**
- creation of routes to deliver or collect goods in time, based on targets from the distribution planning.

**Available to promise**
- identification of binding delivery date commitments at incoming orders in consideration of the capacity and material situation as well as costs.

**Information processing**
- coordination of order and information flows within the Supply Chain.

**Collaborative planning**
- planning and coordination of Supply Chain activities with cooperation partners.
Supply Chain Management

**mySAP® APO (Advanced Planning and Optimization)**

- **Network Design**
- **Supply Network Planning**
- **Procurement Planning**
- **Production Planning**
- **Distribution Planning**
- **Purchasing Workbench**
- **Detailed Scheduling**
- **Vehicle Scheduling**
- **Available to Promise**

**Source** — **Make** — **Deliver** — **Sell**
Supply Chain Management

IT – Applications in SCM

Material Requirement Planning (MRP I) – Systems

• Based on the demand of finished goods, the required amount of components is derived from the bill of materials.
• Restricted to quantitative and schedule planning without availability check for required resources.
• Supported by data bases and elementary spreadsheet software.
Supply Chain Management

Manufacturing Resource Planning (MRP II) – Systems

- Developed in the eighties as expansion of MRP I – Systems
- Capacity and schedule planning as well as integration of other functional areas (procurement, production, storage)
- Implement resource balancing with regard to personnel, machines and materials
- Manage data, initiating orders and monitoring
- Successive planning: separated in and solving of area specific sub-problems → long planning cycles and problems with short-term bottlenecks of resources
Supply Chain Management

Enterprise Ressource Planning (ERP) – Systems

- First developments **2-3 decades** ago, extension of **MRP – Systems**
- Integration of further **business functions**: purchasing, accounting and human resources department
- Highly **intra-organizational focus**, restricted **successive planning approach**
- Weakness in **data analysis** and in **data exchange** between subareas
- No **analysis** or **optimization** → APS

Provider & Tools: mySAP R3, Oracle, Baan
Supply Chain Management

Advanced Planning & Scheduling (APS) – Systems

- Modular structured systems for the integrated decision support of the inter-company planning, controlling and optimization of processes
- Bottleneck-orientated planning approach where any restriction (capacity, material, personnel) can be included in the optimization
- Intercompany production planning and logistics planning
- Obtain master and order data usually from an ERP – System
- Provider & Tools: mySAP SCM, i2 Six, Manugistics SCM, Peoplesoft
Chapter 6 – Logistics & Supply Chain Management

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• Terms and definitions about
  - Logistics
  - Supply Chain Management

• Supply Chain characteristics
Characteristics of a Supply Chain

Applicability

Characterize Supply Chains according to their applicability.

In-house
Sections of the process chain that are inside facilities
For example: production system, storage system

External or interplant
Sections of the Supply Chain between facilities
For example: transportation systems
Characteristics of a Supply Chain

Supply Chain Strategies

**Push – strategy:** make-to-stock, „planned economy“

Production and distribution decisions based on long-term demand forecasts. The production anticipates future demands. Inventories are build-up within the Supply Chain (e.g. at warehouses, retailers).

Decisions triggered by forecasts and not by orders.

**Advantages**
- high service level, short delivery time
- cost savings through – „economies-of-scale“
  e.g. in purchase, production or distribution

**Disadvantages**
- no short-term adaptation on changing market conditions
- highly complex planning and decision processes
Characteristics of a Supply Chain

Main weakness: imprecise forecasts

The three rules of forecasts are
1. forecasts are always wrong
2. the longer the forecast horizon, the worse the forecast
3. aggregated forecasts are more precise than detailed ones
   -> Risk Pooling Effect

Therewith for Push-Systems
   • redundant inventories of outdated products
   • long-term allocation of resources, production capacities, et cetera.
   • large safety stocks to prevent variability in demand or production bottlenecks

In practice still popular.
Characteristics of a Supply Chain

**Pull – strategy:** make-to-order, „free market economy“

**Products** are manufactured or sent only if customers require them.

**Advantages**
- no or low system inventory level
- little dependency on forecasts
- high flexibility and utilization of resources
- low system-wide costs
- easy planning

**Disadvantages**
- low service level
- long delivery time for products with high lead times (e.g. automobiles)

**Pull-based systems** are normally better, if one has short lead times, high production costs and low demand with high variability. Often difficult to implement.
Pull-Strategy

Example: OSRAM

Lamp market is characterized by
- very high variety of products (type of brand, type of packing) linked with a
- trend of the market for the end-products which is difficult to forecast (demand variability up to 250% about the mean)
- demand on light bulbs is nearly constant and easy to forecast

Shift from a push- to a cost-effective pull-based supply chain failed because of the relative high lead times at the factories for the
- planning
- procurement of material and personnel, as well as
- allocation of capacities

Customers were not willing to wait so long.

Goal: reduction of lead times and partial reorganization to pull-systems
Solution: intelligent variant management → Postponement
Characteristics of a Supply Chain

Postponement

The design of products and the manufacturing process is arranged in a way that decisions about the specific product that is being manufactured can be delayed as long as possible. This is possible by a shift to modular products and processes. Normally, at the expense of higher costs.

Main objective is the reduction of inventory and lead times.
Postponement

Examples

OSRAM

Decoupling of the current production of end packaged products into disjoint production and packaging processes.

From now on generic light bulbs are produced and stored temporarily. Afterwards fast assembly of goods in packaging areas.

Thereby
- reduced lead times for customer orders (packaging is very fast)
- lower safety stock for light bulbs (forecasts for the distribution of light bulbs very solid)
Postponement

**Benetton**

Lead times up to 7 months for the production of pullovers

→ it is not possible to react in short-term on new fashion trends and colors

Meanwhile production is changed to colorless pullovers. The final coloring according to trend and demand can be done very quickly in one process step.
Postponement

**Hewlett-Packard**

In the past
- Production of **ready packaged, country-specific printers** (inscription, instruction, power supply, …) in Vancouver
- Transportation to **regional logistics centers** (e.g. in Europe)
Postponement

• Problem
  - **Stock outs or overstocking** of **country-specific** printers at the European logistics center.

• Way out
  - Production of **country-unspecific** printers in Vancouver.
  - **Country-specific configuration locally** in regional logistics centers **according to demand**.
Characteristics of a Supply Chain

Risk Pooling – Effect

Due to the reduction of variability by aggregation, the demand forecasts are more accurate on an aggregate level.

Historic data for 2 customers

<table>
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<tr>
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<td>Customer 2</td>
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Combined data

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<td>Customer1</td>
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<td>Customer2</td>
<td>20905</td>
<td>3427</td>
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<tr>
<td>Aggregate</td>
<td>45142</td>
<td>6757</td>
</tr>
</tbody>
</table>

The average yearly deviation of the aggregate demand is smaller than the sum of the deviations of the single demands.
Characteristics of a Supply Chain

Push-Pull – Strategy: make-to-assemble

Advantageously combines the aspects of push and pull systems.

Production components and intermediate products are planned using a push-strategy based on forecasts. The completion is triggered by a pull-strategy.

Push-Pull – Boundary (Order Penetration Point)

The boundary between the push-based stages and the pull-based stages of the supply chain.

Determining the boundary

Utilize risk pooling and postponement.

Use the push-strategy on the stages of the supply chain, where forecasts are relatively reliable and generic products are produced or shipped and use a pull-strategy for the remaining stages.
Push-Pull – Strategy

Examples

**Dell, HP**: push-pull-boundary for computer at assembly point
- Based on forecasts the components are purchased
- Assembly of computers or printers is based on actual

**Benetton**: Boundary at the last production level, coloring
- Uncolored pullover production is based on forecasts
- Coloring occurs by demand and trend

**Furniture manufacturer**: Boundary at production
- Procurement of raw materials based on forecasts
- Production of furniture based on concrete demand
Push-Pull – Strategy

Strategic orientation at HP

- GLOBAL -

parts + assemblies

- REGIONAL -

final assembly
distribution

customer orders

PUSH

priorities:
- costs
- delivery time and flexibility

costs

inventory

time

PULL

priorities:
- customer satisfaction
- delivery time
- precision

Reference: Corsten/Gabriel, SCM erfolgreich umsetzen, 2004
## Push-Pull – Strategy

### Characteristics of the push- and pull-stages of the supply chain

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Push</th>
<th>Pull</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal</td>
<td>minimizing costs</td>
<td>maximizing service level</td>
</tr>
<tr>
<td>Complexity</td>
<td>high</td>
<td>low</td>
</tr>
<tr>
<td>Focus</td>
<td>allocation of resources</td>
<td>reliability in delivery</td>
</tr>
<tr>
<td>Lead times</td>
<td>long</td>
<td>short</td>
</tr>
<tr>
<td>Processes</td>
<td>SC planning and optimization</td>
<td>order fulfillment</td>
</tr>
</tbody>
</table>
Characteristics of a Supply Chain

**Just-in-Time (JiT)**

Developed in the eighties, to control the **flow of goods** and **materials**. Synchronizing **production** and **transportation processes**, such that each **process** provides the materials exactly at the time, when the respective **subsequent process** needs them.

**Control according to the pull-principle**

A process is activated only by the demand of the **consecutive process** and then production and transportation respectively, is done just in small quantities; maximally the daily requirement.

Can be used for **production**, **distribution** and **procurement** in (inter company) process chains.

Widely used in automobile industry.
E.g. by Toyota (keyword: Kanban)
Just-in-Time

Possible advantages

- Reduction of costs by reducing inventory level
- Decreasing delivery time
- Increasing service level

Risk of misusage

Unilateral shift of the inventory risk and costs onto suppliers.

→ Commitment to fair, integrated and optimized structures.

Disadvantages

- Lower reliability and higher risk-costs (missing items, price risk)
- Additional costs for the setup of the organizational structure and the process organization
Just-in-Time

Requirements of JiT - Control

• Standard material or products with steady demand and high volume
• Flow organization of the production with aligned capacity
• No significant set-up costs and times
• Capacity reserves and high reliability
• Short delivery deadlines at procurement
Characteristics of a Supply Chain

Flow of Objects

Goods and commodities

- **Products** flow from the *sources of goods* (supplier, production facility) to the *consumers* (customer, retailer).
- **Redundant or defect goods** flow for *disposal* or *repair* into the opposite direction from the *customers* back to the *sources*.

Information

- **Orders** move from the *purchasers* step-by-step to the *producers*, *suppliers*, and *providers*.
- **Information** about the *order* or *delivery status* flows into the opposite direction from the *producers* to the *customers* and *consumers*. 
Characteristics of a Supply Chain

**Velocity** of the flow of goods and information is influenced and slowed down by many factors.

**Transportation**
- long transportation time depending on the **means of transportation** (sprinter, truck, train, ship, plane)

**Production**
- long production time
- limited production capacities
- bottleneck resources

**Order and information processing**
- manual processing
- collecting and **periodical forwarding** of orders (twice a week, weekly, once a month)
- hierarchical transmission, e.g. customer → retailer → manufacturer → supplier
  → Bullwhip – Effect
Characteristics of a Supply Chain

Bullwhip – Effect

First identified in practice by Proctor & Gamble for the product „Pampers“.
Even though the demand for Pampers-diapers were fairly uniform over the months, they noticed that the orders placed by the retailers to the factory fluctuated much more than the demand.
The orders from the factories to the suppliers fluctuated even more.

Generally: bullwhip – effect

The more one goes through the supply chain from the customers to the suppliers, the higher the variability of orders on the one hand and inventory on the other hand. The Bullwhip-effect grows with increasing lead times for orders and material.

System-inherent problem of supply chains with push-strategy.
Bullwhip – Effect

The Computerized Beer Game

Developed at MIT in the sixties.

Bullwhip – Effect

Reasons for the variability of the order quantities

Demand forecasts with local information

Each member in the supply chain perceives an order from immediately preceding level as signal for future demand. Based on this signal the member locally updates his forecasts for demand with the new market situation and matches his safety stock and orders with respect to his suppliers, if necessary.

Order batching and order practices

• Due to high fixed ordering costs, cheap prices for full truck loads and periodically reviewing MRP-systems, the members place their orders to the suppliers only periodically (e.g. weekly, monthly).

• Because marketing staffs are assessed by their sales figures at certain times, they create shortly before the end unnecessarily high orders to meet their quota.

• Uncorrelated orders from consumers at their suppliers.
Bullwhip – Effect

**Lead times**

Lead time: time period between placing an order and the delivery of goods.

We have: safety stocks are correlated with lead times and demand variability.

Due to long lead times, marginally raised demand variability causes large changes in safety stocks and ordered quantities of the member.

**Price fluctuation**

If prices of (intermediate) products are low, companies will usually replenish their inventory and order high quantities.

**Shortage**

If it becomes known that a manufacturer can not produce the quantity which is required and therefore can not fulfill all orders, the customers will usually order in fact more than they actually need.
Bullwhip – Effect

Ways out

Centralization of information – EDI (Electronic Data Interchange)
  
  Provide each member with the actual point-of-sale data of the vendors (retailer).
  → forecasts on each stage are based on actual demand

  HP, IBM and Apple already require sell-through data as a part of the contract with their resellers.

Standardization of forecasting methods
  
  Even with identical data, different forecasting methods lead to different results.

Reduction of lead times
  
  Can be achieved through postponement, more efficient distribution (cross-docking, transshipment), quicker order execution (EDI).
Bullwhip – Effect

Break up order batching

- **Reduce fixed ordering costs** by using EDI → no „paperwork“ any more
  E.g. at General Electric, order processing costs without EDI: $50 and with: $5.23.

- „Reward“ **mixed full truck load orders** (FTL), i.e. full truck loads with different products, compared to the **classical practice** of FTLs with just one type of product.
  E.g. P&G grant reductions of prices for mixed FTL.

- **Reducing transportation costs** by employing **third-party logistics** → partial loads

- **Planning** and **controlling** of the **customer orders** by the **suppliers** → **VMS**

Stabilization of prices

Implementation of „Every Day Low Prices“ to avoid forward purchases.

Informing about shortage

Inform the customers about the production situation to avoid panic buying.

Reduces the **Bullwhip – Effect**, but cannot eliminate it.
Characteristics of a Supply Chain

**Strategic alliances**

Complex, goal-oriented and long-term *partnerships* between two companies, which share risks as well as benefits.

**Advantages of** strategic alliances very varied

- Increase of the *added value*
- Focusing on *core competencies*
- Improved *market presence*
- More efficient and streamlined *company processes*
- Combination of *technological strengths*
- Improved strategic *growth opportunities*
- Builtup of *financial strength*

**Main dangers**

- Loss of *core competencies*
- Loss of *control*
Strategic Alliances

Advantages and Risks of Outsourcing Core Competencies

In 1981 IBM decided to enter the market for personal computers. Since IBM did not have the infrastructure to design and build a personal computer and neither wanted to acquire these capabilities, they decided to outsource the development and production of all major components. For example, the microprocessor was designed and built by Intel and the operating system was provided by a small company in Seattle: Microsoft.

Thereby IBM was able to release this computer to the market within 15 months. Within three years IBM got ahead of Apple and after 4 years their market share was higher than 40%. But competitors, such as Compaq followed this strategy.
Strategic Alliances

When IBM tried to **regain the lost market share** through the own **development** of new products (PS/2 computer, OS/2) it proved to be a **failure**. Other **competitors** stuck to the **previous strategy** and therewith had more **success**.

By the end of **1995** the **market share** of **IBM** was almost less then **8%**, behind **market leader Compaq (10%)**.
Strategic Alliances

Vendor Managed Systems (VMS)

Important form of strategic alliances between customers and their suppliers.

Using vendor managed systems, the supplier is responsible for the availability of products in the inventory of the customer.

In return, customers provide him with all the necessary inventory and sales data.

The delivery of the replenishment depends no longer on the customer orders. The manufacturer computes the optimal replenishment in consideration of safety stocks and transportation times.
Vendor Managed Systems

Advantages
• Reduces the Bullwhip – Effect, since one stage of the supply chain cancels out
• Suppliers can bundle replenishment deliveries and plan routes
• Suppliers need no unnecessarily high safety stocks
• No planning effort for the customers

Risks of misusage
• Suppliers tend to increase the customers inventory as much as possible in order to reduce their own inventory and capital commitment costs.

Main problem
Companies do not want to lose control of their inventory planning completely.
Way out: systems with different degrees of control
Vendor Managed Systems

Specifications of VMS

Quick Response
Customers still have full control over their inventory. Suppliers only get actual sales figures, to plan inventory levels and production activities.

Continuous Replenishment (CRP)
Customers and suppliers agree on jointly arranged replenishment intervals and safety stocks.
The supplier has to plan the underlying replenishment.
Example: Reckitt & Colman and dm

Vendor Managed Inventory (VMI)
The supplier has full control and responsibility over replenishment quantities and intervals as well as safety stocks at customers.
Example: P&G and Wal-Mart
Vendor Managed Systems

Procter & Gamble – Process Flows for Continuous Replenishment

Reference:
Corsten/Gabriel, SCM erfolgreich umsetzen, 2004
Vendor Managed Systems

Sara Lee – Continuous Replenishment Project

Implementation of CRP at the customers (drugstores) from Sara Lee.

- Capital commitment reduced by 50%
- Continuous flow of products: Shipments reduced by 20%
- Determined by omission of subsequent delivery due to Out-of-Stock – situations

Reference: Corsten/Gabriel, SCM erfolgreich umsetzten, 2004
Vendor Managed Systems

Further **differentiation** concerns the **ownership** of the **inventory**. Classically the **goods** belong to the **customers** after **delivery**. With **CR** and **VMI** however, the **supplier** often remains the **owner until** the good is **sold**.

**Advantages for the customer**
- Lower **capital commitment** and **inventory costs**
- Higher **motivation** of the suppliers for **efficient, cost-effective** inventory planning due to arising costs by customers
  → no „pass on“ to the customers

**Disadvantages for the supplier**
- Longer **property** of inventory

**Reasons** for the acceptance of the supplier
- Customers **require** this (as acceptance to VMI). E.g. Wal-Mart
- Only **partial property**. E.g. Ace hardware: the customer has the responsibility if the product is damaged or destroyed.
Strategic Alliances

Third party logistics (3PL)

A supply chain is called vertically integrated, if all components of the logistics system belong to a single company. Normally there is more than one member within the supply chain. For a long time alliances were transaction-based or function-specific. E.g. procurement of raw materials, container transport, inventory management.

Modern alliances generally are long-term and extensive partnerships.

3PL – Third party logistics
Use of an external logistics provider to perform logistics tasks.

4PL – Fourth party logistics
Use of firms which perform all logistics tasks of a company using 3PL-provider. 4PLs have no own resources (e.g. trucks, warehouses).
Third-Party Logistics

3PL & 4PL

3PL A:
- procurement and transport of raw materials

3PL B:
- long haul freight transport
- operation of the logistics centers

3PL C:
- delivery (Routing) to the customers
- operation of the transshipment points

4PL:
- all logistics tasks

Factories of the company

Customers
Third-Party Logistics

Advantages

• Companies with **limited resources** can focus on their **core competences**
• Logistics providers (LP) have a **higher technological standard** because of their **specialization**
  (e.g. information technology, equipment)
• LPs enable the company to be **more flexible**

Geographical

Customers demand for **shorter delivery times**. Big LPs with a **wide-spread distribution network** can meet these requirements.

Services, resources & personnel

LPs offer **more comprehensive services**, e.g. door-to-door deliveries, or can react more flexible to **market fluctuations**.

Disadvantages

• **Losing control** by outsourcing
• **Losing market presence** in the eyes of customers which always just meet the LP
  → Appearance of the LP with the corporate design of the company.
Third-Party Logistics

Example

To focus on their core competences, BP and Chevron Corp. founded Altas Supply, a partnership of about 80 suppliers, for the replenishment of goods (spark plugs, tires, windscreen wipers,…) at their 6,500 service stations. Rather than using the distribution networks of BP or Chevron, all logistical functions were outsourced to GATX.

GATX is responsible for 5 distribution centers and maintains inventory for all 6,500 service stations. The service stations place their orders with their oil company, which forwards the order to Atlas and then to GATX. GATX determines appropriate routes from the logistics centers to the service stations, delivers orders and collects redundant goods. GATX electronically informs Atlas, Chevron and BP about the status of all deliveries.

The alliance is amortized by the saves on transportation costs. Furthermore the number of logistics centers could be reduced from 13 to 5. At the same time the service level could be improved.