UNCERTAINTY AND DECISION-MAKING IN SUPPLY CHAIN MANAGEMENT
Uncertainty and Risk are Inherent in the Supply Chain

All supply chains suffer the effects of uncertainty:

- Customer demand
- Travel times
- Machines and vehicles will break down
- Outsourcing,
- Offshoring, and
- Lean manufacturing
- Emerging IT and
- Digital trends that put the end customer in direct contact with the actual supplier

all significantly increase the level of risk in the supply chain.
This tutorial will focus on:

- Uncertainty and risk
- Rational Decision-Making
Agenda

- The supply chain strategy, uncertainty and the uncertainty cycle
- How uncertainty impacts on the supply chain
- Forecasting and the Bullwhip effect
- The cost/quality supply chain dilemma
- Examples of supply chains affected by uncertainty
- Sources of uncertainty & using the PEST Analysis Tool
- Building blocks in supply chain management
- Managing risk
- Critical abilities to manage uncertainty
- The importance of decision-making
Agenda

• Key areas for decision-making:
  ✓ Distribution Network Configuration;
  ✓ Inventory Control;
  ✓ Production Sourcing;
  ✓ Supply Contracts;
  ✓ Distribution Strategies;
  ✓ Supply Chain Integration and Strategic Partnering;
  ✓ Outsourcing and Offshoring Strategies;
  ✓ Product Design;
  ✓ Information Technology and Decision Support Systems;
  ✓ Customer Value and
  ✓ Smart Pricing.
The Supply Chain Strategy and Uncertainty

Companies on the whole, cope better with uncertainty when they have an effective supply chain strategy that is regularly monitoring reviewed and updated to take into account changes and variations in the operating environment.
Supply Chain Uncertainty

Supply chain uncertainty refers to decision making situations in the supply chain in which the decision maker does not know definitely what to decide as s/he:

- Is indistinct about the objectives;
- Lacks information about (or understanding of) the supply chain or its environment;
- Lacks information processing capacities;
- Is unable to accurately predict the impact of possible control actions on supply chain behaviour; or,
- Lacks effective control actions (non-controllability).

Van der Vorst and Beulens (2002)
Supply Chain Uncertainty

Uncertainty in the supply chain is caused by many factors including:

• Changes in demand and demand variability,
• Seasonality,
• Transportation,
• Receiving variability, and
• Quality issues.

All of these factors impact on inventory levels.
Uncertainty Cycle
Uncertainty and the Supply Chain

Uncertainty primarily affects the supply chain in four ways:

• Adding cost;

• Increasing inventory levels;

• Increasing lead-times; and

• Reducing speed to market.
Forecasting

Forecasting is a predictive process which by its very nature carries an element of uncertainty.
However forecasting accuracy can be improved by reducing the uncertainty experienced within the supply chain especially via lead time reduction.
Companies who understand and cope with uncertainty can optimise their forecasting potential to produce internally competitive bottom-line performance.
The Bullwhip Effect

The bullwhip effect refers to a frustrating phenomenon that frequently starts with falling customer demand.

This fall prompts retailers to under-order so as to reduce their inventories.

Wholesalers, then under-order even further to reduce theirs

The effect amplifies up the supply chain until suppliers experience stock-outs and then over-order in response.
The Bullwhip Effect

http://lexicon.ft.com/Term?term=the%20bullwhip%20effect
The Bullwhip Effect

Producers of almost everything were left stranded when the global downturn took hold and retailers ran down inventories. On the way back up, the restocking of goods was so dramatic that most economists excluded the effect from their analysis.

An FT Lex report in July 2011 observed that the ‘whip might be cracking on the downside’.

Following a peak in February 2011, the European Purchasing Managers Index had fallen to about 50, the largest swing in a decade. The US saw a similar fall indicating that companies restocked too much and were now aggressively destocking.

http://lexicon.ft.com/Term?term=the%20bullwhip%20effect
The Supply Chain Dilemma

Every supply chain is constantly under pressure to:

- Deliver goods to the ultimate customer
- For a low price (in order to remain competitive) and
- With high quality service (again to remain competitive).
The Supply Chain Dilemma

Demand to increase services while reducing costs. This concept goes against the old fashioned or traditional inventory theory tells us that to increase service level, the firm must increase inventory and therefore cost.
The Supply Chain Dilemma

Each part of the supply chain must get better and be smarter at what it is doing to ensure that, at every point along the chain every entity is providing quality for low cost and so, companies are forced to do things differently and try new approaches to improve their service or product.

By its very nature this dilemma causes a level of uncertainty and risk that is always there, just below the surface that can cause things to go wrong.
The Supply Chain Dilemma

Companies forced to try new ideas i.e.

• Lean
• Just in Time
• Kanban
The Supply Chain Dilemma

To deliver low cost/ high value goods/services

Focus on the supply chain.
Examples of Successful Global Supply Chains

Dell, Wal-Mart, and Procter & Gamble success stories demonstrate not only that an integrated, globally optimal supply chain is possible, but that it can have a huge impact on the company’s performance and market share.
### Examples

<table>
<thead>
<tr>
<th>Company</th>
<th>Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boeing Aircraft</td>
<td>Raw material shortages, Internal and supplier parts shortages and productivity inefficiencies</td>
</tr>
<tr>
<td>$2.6 billion shortfall in sales and earnings</td>
<td></td>
</tr>
<tr>
<td>Surgical Corporation 2\textsuperscript{ND} Quarter</td>
<td>Larger than anticipated inventories on the shelves of hospitals</td>
</tr>
<tr>
<td>sales declined 25%</td>
<td></td>
</tr>
<tr>
<td>$22 million loss</td>
<td></td>
</tr>
<tr>
<td>EMC Corp.</td>
<td>discrepancy was due to higher than expected orders for the new DMX-3 systems over the DMX-2, which resulted in an inventory snafu</td>
</tr>
<tr>
<td>missed its revenue</td>
<td></td>
</tr>
<tr>
<td>guidance of $2.66 billion for the second quarter of 2006 by around $100 million</td>
<td></td>
</tr>
<tr>
<td>Intel</td>
<td>Stiff competition General slowdown in the personal computer market that caused inventories to swell.</td>
</tr>
<tr>
<td>reported a 38% decline in quarterly profit</td>
<td></td>
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</table>
Order variations in the Supply Chain
Sources of Uncertainty

- Demand
- Delivery lead times,
- Manufacturing yields,
- Transportation times, and
- Component availability
- Lean manufacturing,
- Outsourcing, and
- Offshoring
- Other External sources
Sources of Uncertainty

External Sources i.e.

• Political,
• Economic
• Social
• Technological
• Environmental,
and so on.

There are a number of new threats emerging that can cause a much higher level of uncertainty right across the supply chain.
Sources of Uncertainty

New threats that can cause a much higher level of uncertainty right across the supply chain. For example:

- Bangkok airport in Thailand was forced to close in 2008 due to protests, it cost the Thai economy US$ 8.5 billion.

  ✓ Thailand is the world’s leading orchid exporter with an 80% share of the global market. The closure of the airport cost the sector over US$9 million.

- Iceland eruption of a volcano. Caused a ripple effect around the world. The global airline industry (particularly carriers operating in Europe) lost an estimated US$ 1.7 billion in revenues when over 100,000 flights were cancelled in six days.
Sources of Uncertainty

Stanford university study on the combined human and economic costs of a terrorist attack through a specific example. The study shows that an attack on the US milk supply chain with only 10g of highly concentrated toxin would be enough to poison almost 500,000 people.

The human cost would clearly be catastrophic, and the economic impact would be too.

• Every 50,000 people who suffered from the poison would cost the US economy US$ 8.6 billion.
• Just one attack could potentially mean damage in excess of US$ 80 billion.
Sources of Uncertainty

Worldwide Incidents Tracking System (WITS) open-source database – tracks data related to terrorism.

Recent analysis of the database showed:

• The total number of supply chain related attacks has increased steadily over the past decade, reaching 3299 attacks in 2010 despite the sharp increase of security measures and control systems put into place after 9/11.
Sources of Uncertainty

Business Insider reports on:
‘A spate of daring high-seas attacks off South-East Asia with several tankers and cargo ships attacked by pirates hijacking the vessels and siphoning off hundreds of tonnes of valuable fuel, oil and other cargo’.¹

Interpol says that:
‘In recent years there has been a significant increase in the number of attacks on vessels by pirates in particular the Gulf of Aden, Somali Basin and the Indian Ocean. With vast areas of water affected as pirates attack the major shipping lanes.²

²www.interpol.int
Sources of Uncertainty

The risk of cyber-attack is a growing concern in supply chain management.

For example:

• Every two seconds, the German Internet is attacked.

Logistics, as driver of globalisation, will become the focus of these attacks in the years to come.
Sources of Uncertainty

Other Areas of Uncertainty for the supply chain include:

- Earthquake
- Nuclear Fallout
- Tsunami
- Port Strikes
- Weather Events
- Piracy
- Politics
- Economics
Top External Disruptors

- Natural Disasters
- Conflict and Political Unrest
- Sudden Demand Shocks
- Export/Import Restrictions
- Terrorism

PEST Analysis

A PEST analysis (also sometimes called a STEP, PESTLE or STEEP analysis) looks at the external business environment.

PEST stands for Political, Economic, Socio-cultural and Technological.

May also include:

Legal and Environmental
ACTIVITY 1

Download the PEST or PESTLE template from below this tutorial and complete it for your supply chain (and company).

1. What opportunities does this analysis uncover for your supply chain?

2. What threats does this analysis uncover for the SC?

3. Where are the uncertainties and future risks for your supply chain and/or business?
ACTIVITY 2

Consider the supply chain for a car made here in Australia or Thailand.

1. What are the components of the supply chain for the car?
2. What are the different firms involved in the supply chain?
3. What are the objectives of these firms?
4. Compare these objectives and provide examples of conflicting objectives in the supply chain.
5. How could this affect the supply chain?
6. What are the risks that rare or unexpected events pose to this supply chain?
Building Blocks in Supply Chain Management

An important building block in effective supply chain strategies is **strategic partnerships** between suppliers and buyers, partnerships that can help both parties reduce their costs.

Manufacturers such as Procter & Gamble and Kimberly-Clark and giant retailers like Wal-Mart have used strategic partnering as an important element in their business strategies.

Firms such as 3M, Dow Chemical, Time Warner, and General Motors turned over large portions of their logistics operations to third-party logistics providers.
Building Blocks in Supply Chain Management

Many supply chain partners engage in *information sharing* so that manufacturers are able to use retailers’ up-to-date sales data to better predict demand and reduce lead times.

This information sharing also allows manufacturers to control the variability or ‘bull whip effect’ in supply chains and by doing that reduce inventory and smooth out production.
Managing Risk in Supply Chain Management

A number of approaches have been applied by industry to manage risk in their supply chains for example:

- Building redundancy into the supply chain so that if one portion fails, for example, a fire at a warehouse or a closed port, the supply chain can still satisfy demand
- Using information to better sense and respond to disruptive events
- Incorporating flexibility into supply contracts to better match supply and demand
- Improving supply chain processes by including risk assessment measures as well as the more rigorous performance measures.
Critical Abilities to Manage Uncertainty

In order to be able to survive and thrive in the uncertainty of doing business in the 21st century there are three critical abilities that successful firms must possess:

1. The ability to match supply chain strategies with product characteristics.

2. The ability to replace traditional supply chain strategies, in which each facility or party in the chain makes decisions with little regard to their impact on other supply chain partners, by those that yield a *globally optimized* supply chain.

3. The ability to effectively manage uncertainty and risk and to make sound decisions based on all available evidence at the time.
Managing Uncertainties

In order to effectively and systematically manage uncertainties there are a number of requirements to follow:

1. The managing system should have an objective and corresponding performance indicators to manage the supply chain in the right direction.

2. To estimate future system states one has to have information on the environment and current supply chain state.

3. There should be enough information processing capacities to process information on the environment and supply chain state.
Managing Uncertainties

In order to effectively and systematically manage uncertainties there are a number of requirements to follow:

1. In order to direct the managed system in the right direction one should be able to estimate the impact of alternative actions. This requires a model of the system, presenting the relationships between available redesign variables and performance indicators.

2. There should be enough potential control actions. Each environment-supply chain state combination requires one or more different control actions to manage the system in the direction of the objectives.
Distribution Network Configuration

Reasons to reorganise/redesign the network include:

• Changing demand patterns

• The termination of a leasing contract for a number of existing warehouses

Changing demand patterns may require a:

• Change in plant production levels,
• Selection of new suppliers, and
• New flow pattern of goods throughout the distribution network.
Distribution Network Configuration

Distribution Network Configuration Decisions

How should management select:

• A set of warehouse locations and capacities,
• Determine production levels for each product at each plant, and
• Set transportation flows between facilities, either from plant to warehouse or warehouse to retailer,
• In such a way as to minimize total production, inventory, and transportation costs and
• Satisfy service level requirements?

This is a complex optimisation problem, and advanced technology and approaches are required to find a solution.
Inventory Control

A retailer maintains an inventory of a particular product.

Since customer demand changes over time, the retailer can use only historical data to predict demand.

Objective of the retailer is to:

• Decide at what point to reorder a new batch of the product, and

• how much to order so as to minimize inventory ordering and holding costs.
Inventory Control

Inventory control Decisions:
• Why should the retailer hold inventory in the first place?
• Is it due to uncertainty in customer demand, uncertainty in the supply process, or some other reasons?
• If it is due to uncertainty in customer demand, is there anything that can be done to reduce it?
• What is the impact of the forecasting tool used to predict customer demand?
• Should the retailer order more than, less than, or exactly the demand forecast?
• What inventory turnover ratio should be used?
• Does it change from industry to industry?
Production Sourcing

In many industries, there is a need to carefully balance transportation and manufacturing costs.

Reducing production costs typically implies that each manufacturing facility is responsible for a small set of products so that large batches are produced, hence reducing production costs - this may lead to higher transportation costs.

Reducing transportation costs typically implies that each facility is flexible and has the ability to produce most or all products, but this leads to small batches and hence increases production costs.

Finding the right balance between the two cost components is difficult but needs to be done monthly or quarterly.
Supply Contracts

In traditional supply chain strategies, each party in the chain focuses on its own profit and hence makes decisions with little regard to their impact on other supply chain partners.

Relationships between suppliers and buyers are established by means of supply contracts that specify:

- Pricing and volume discounts,
- Delivery lead times,
- Quality,
- Returns,
- And so forth.
Supply Contracts

Supply Contract Decisions

Can supply contracts also be used to replace the traditional supply chain strategy with one that optimises the entire supply chain performance?

In particular, what is the impact of volume discount and revenue-sharing contracts on supply chain performance?

Are there pricing strategies that can be applied by suppliers to provide incentives for buyers to order more products while at the same time increasing the supplier profit?
Distribution Strategies

Distribution Strategy Decisions

• Should the distribution system be centralised or decentralised?
• What is the impact of each strategy on inventory levels and transportation costs?
• What about the impact on service levels?
• When should products be transported by air from centralized locations to the various demand points?
• Should competing dealers selling the same brand share inventory?
• If so, what is their competitive advantage?
Supply Chain Integration and Strategic Partnering

Designing and implementing a globally optimal supply chain is quite difficult because of its dynamics and the conflicting objectives employed by different facilities and partners.

Examples of Success Stories in Strategic Partnering/integration

- Dell,
- Wal-Mart, and
- Procter & Gamble

All demonstrate not only that an integrated, globally optimal supply chain is possible, but that it can have a huge impact on the company’s performance and market share.
Supply Chain Integration and Strategic Partnering

In today’s competitive markets, most companies have no choice; they are forced to integrate their supply chain and engage in strategic partnering.

This pressure stems from both their customers and their supply chain partners.
Supply Chain Integration and Strategic Partnering

Strategic Partnering/SC Integration Decisions

• How can integration be achieved successfully?
• Information sharing and operational planning are the keys to a successfully integrated supply chain. But what information should be shared?
• How should it be used?
• How does information affect the design and operation of the supply chain?
• What level of integration is needed within the organisation and with external partners?
• What types of partnerships can be implemented, and which type should be implemented for a given situation?
Outsourcing and Offshoring Strategies

Outsourcing and Offshoring Strategic decisions

You must decide what to make internally and what to buy from outside sources i.e.:

- What manufacturing activities lie in a company’s set of core competencies, and so should be completed internally,
- What product and components should be purchased from outside suppliers, because these manufacturing activities are not core competencies?
- Is there any relationship between the answer to that question and product architecture?
- What are the risks associated with outsourcing and how can these risks be minimised?
Outsourcing and Offshoring Strategic decisions

You must decide what to make internally and what to buy from outside sources i.e.:

• When you do outsource, how can you ensure a timely supply of products?
• When should the firm keep dual sources for the same component?
• When does it make sense to move facilities offshore?
• What is the impact of offshoring on inventory levels and the cost of capital?
• What are the risks?
Product Design

Effective design plays several critical roles in the supply chain. Most obviously, certain product designs may increase inventory holding or transportation costs relative to other designs, while other designs may facilitate a shorter manufacturing lead time. Unfortunately, product redesign is often expensive.
Product Design

Product Design Decisions include:

• When is it worthwhile to redesign products so as to reduce logistics costs or supply chain lead times?
• Is it possible to leverage product design to compensate for uncertainty in customer demand?
• Can one quantify the amount of savings resulting from such a strategy?
• What changes should be made in the supply chain to take advantage of the new product design?
• What role does supply chain management play in the successful implementation of mass customisation?
Information Technology and Decision-Support Systems

Information technology is a critical enabler of effective supply chain management.

The primary issue in supply chain management is not whether data can be received, but what data should be transferred; that is, which data are significant for supply chain management and which data can safely be ignored?
Information Technology and Decision-Support Systems

IT and Decision Support Systems – key decisions include:

• How frequently should data be transferred and analysed?
• What is the impact of the Internet? What is the role of electronic commerce?
• What infrastructure is required both internally and between supply chain partners?
• Can information technology and decision-support systems be viewed as the main tools used to achieve competitive advantage in the market?
• If they can, then what is preventing others from using the same technology?
Customer Value

Customer value is the measure of a company’s contribution to its customer, based on the entire range of:

- Products,
- Services, and
- Intangibles

that constitute the company’s offerings.

In recent years, this measure has superseded measures such as quality and customer satisfaction.

Effective supply chain management is critical if a firm wishes to fulfil customer needs and provide value.
Customer Value

Key Decisions for Customer Value include:

• What determines customer value in different industries?
• How is customer value measured?
• How is information technology used to enhance customer value in the supply chain?
• How does supply chain management contribute to customer value?
• How do emerging trends in customer value, i.e. development of relationships and experiences, affect supply chain management?
• What is the relationship between product price and brand name in the conventional world and in the online world?
Smart Pricing

Revenue management strategies have been applied successfully in industries such as airlines, hotels, and rental cars.

In recent years, a number of manufactures, retailers, and carriers have applied a variation of these techniques to improve supply chain performance.

In this case, the firm:

• Integrates pricing and inventory (or available capacity) to influence market demand and improve the bottom line.

• How is this done?

• Can “smart” pricing strategies be used to improve supply chain performance?

• What is the impact of rebate strategies on the supply chain?
ACTIVITY 3

1. Can you think of an example of a supply chain that has evolved over time? Outline how this has occurred.

2. Think about the supply chain for canned peaches sold by a major food processing company. What are the sources of uncertainty in this supply chain?

3. Now, think about a firm redesigning its logistics network.
   a. What are the advantages to having a small number of centrally located warehouses?
   b. What are the advantages to having a larger number of warehouses closer to the end customers?
ACTIVITY 3

4. What are the advantages to a firm of high inventory levels?
5. What are the disadvantages?
6. What are the advantages of low inventory levels? The disadvantages?
See you next time!