4.1 Introduction

- Significant level of outsourcing
- Many leading brand OEMs outsource complete manufacturing and design of their products
- More outsourcing has meant
  - Search for lower cost manufacturers
  - Development of design and manufacturing expertise by suppliers
- Procurement function in OEMs becomes very important
- OEMs have to get into contracts with suppliers
  - For both strategic and non-strategic components

4.2 Strategic Components

Supply Contract can include the following:
- Pricing and volume discounts.
- Minimum and maximum purchase quantities.
- Delivery lead times.
- Product or material quality.
- Product return policies.

2-Stage Sequential Supply Chain

- A buyer and a supplier.
- Buyer’s activities:
  - generating a forecast
  - determining how many units to order from the supplier
  - placing an order to the supplier so as to optimize his own profit
  - Purchase based on forecast of customer demand
- Supplier’s activities:
  - reacting to the order placed by the buyer.
  - Make-To-Order (MTO) policy
Swimsuit Example

- 2 Stages:
  - a retailer who faces customer demand
  - a manufacturer who produces and sells swimsuits to the retailer.

- Retailer Information:
  - Summer season sale price of a swimsuit is $125 per unit.
  - Wholesale price paid by retailer to manufacturer is $80 per unit.
  - Salvage value after the summer season is $20 per unit.

- Manufacturer Information:
  - Fixed production cost is $100,000
  - Variable production cost is $35 per unit

What Is the Optimal Order Quantity?

- Retailer marginal profit is the same as the marginal profit of the manufacturer, $45.
- Retailer’s marginal profit for selling a unit during the season, $45, is smaller than the marginal loss, $60, associated with each unit sold at the end of the season to discount stores.
- Optimal order quantity depends on marginal profit and marginal loss but not on the fixed cost.
- Retailer optimal policy is to order 12,000 units for an average profit of $470,700.
- If the retailer places this order, the manufacturer’s profit is $440,000

Sequential Supply Chain

- FIGURE 4-1: Optimized safety stock

Risk Sharing

- In the sequential supply chain:
  - Buyer assumes all of the risk of having more inventory than sales
  - Buyer limits his order quantity because of the huge financial risk.
  - Supplier takes no risk.
  - Supplier would like the buyer to order as much as possible
  - Since the buyer limits his order quantity, there is a significant increase in the likelihood of out of stock.
- If the supplier shares some of the risk with the buyer
  - it may be profitable for buyer to order more
  - reducing out of stock probability
  - increasing profit for both the supplier and the buyer.
- Supply contracts enable this risk sharing
Buy-Back Contract

- Seller agrees to buy back unsold goods from the buyer for some agreed-upon price.
- Buyer has incentive to order more
- Supplier’s risk clearly increases.
- Increase in buyer’s order quantity
  - Decreases the likelihood of out of stock
  - Compensates the supplier for the higher risk

Buy-Back Contract Swimsuit Example

- Assume the manufacturer offers to buy unsold swimsuits from the retailer for $55.
- Retailer has an incentive to increase its order quantity to 14,000 units, for a profit of $513,800, while the manufacturer’s average profit increases to $471,900.
- Total average profit for the two parties = $985,700 (= $513,800 + $471,900)
- Compare to sequential supply chain when total profit = $910,700 (= $470,700 + $440,000)

Revenue Sharing Contract

- Buyer shares some of its revenue with the supplier
  - in return for a discount on the wholesale price.
- Buyer transfers a portion of the revenue from each unit sold back to the supplier

FIGURE 4-2: Buy-back contract
Revenue Sharing Contract
Swimsuit Example

- Manufacturer agrees to decrease the wholesale price from $80 to $60
- In return, the retailer provides 15 percent of the product revenue to the manufacturer.
- Retailer has an incentive to increase his order quantity to 14,000 for a profit of $504,325
- This order increase leads to increased manufacturer’s profit of $481,375
- Supply chain total profit = $985,700 (= $504,325+$481,375).

Other Types of Contracts

- **Quantity-Flexibility Contracts**
  - Supplier provides full refund for returned (unsold) items
  - As long as the number of returns is no larger than a certain quantity.
- **Sales Rebate Contracts**
  - Provides a direct incentive to the retailer to increase sales by means of a rebate paid by the supplier for any item sold above a certain quantity.

Global Optimization Strategy

- What is the best strategy for the entire supply chain?
- Treat both supplier and retailer as one entity
- Transfer of money between the parties is ignored
Global Optimization and Supply Contracts

- Unbiased decision maker unrealistic
  - Requires the firm to surrender decision-making power to an unbiased decision maker
- Carefully designed supply contracts can achieve as much as global optimization
- Global optimization does not provide a mechanism to allocate supply chain profit between the partners.
  - Supply contracts allocate this profit among supply chain members.
- Effective supply contracts allocate profit to each partner in a way that no partner can improve his profit by deciding to deviate from the optimal set of decisions.

Implementation Drawbacks of Supply Contracts

- **Buy-back contracts**
  - Require suppliers to have an effective reverse logistics system and may increase logistics costs.
  - Retailers have an incentive to push the products not under the buy-back contract.
    - Retailer’s risk is much higher for the products not under the buy-back contract.
- **Revenue sharing contracts**
  - Require suppliers to monitor the buyer’s revenue and thus increases administrative cost.
  - Buyers have an incentive to push competing products with higher profit margins.
    - Similar products from competing suppliers with whom the buyer has no revenue sharing agreement.
4.3 Contracts for Make-to-Stock/Make-to-Order Supply Chains

- Previous contracts examples were with Make-to-Order supply chains
- What happens when the supplier has a Make-to-Stock situation?

Supply Chain for Fashion Products Ski-Jackets

Manufacturer produces ski-jackets prior to receiving distributor orders

- Season starts in September and ends by December.
- Production starts 12 months before the selling season.
- Distributor places orders with the manufacturer six months later.
- At that time, production is complete; distributor receives firms orders from retailers.
- The distributor sales ski-jackets to retailers for $125 per unit.
- The distributor pays the manufacturer $80 per unit.
- For the manufacturer, we have the following information:
  - Fixed production cost = $100,000.
  - The variable production cost per unit = $55
  - Salvage value for any ski-jacket not purchased by the distributors= $20.

Profit and Loss

- For the manufacturer
  - Marginal profit = $25
  - Marginal loss = $60.
- Since marginal loss is greater than marginal profit, the distributor should produce less than average demand, i.e., less than 13,000 units.
- How much should the manufacturer produce?
  - Manufacturer optimal policy = 12,000 units
  - Average profit = $160,400.
  - Distributor average profit = $510,300.
- Manufacturer assumes all the risk limiting its production quantity
- Distributor takes no risk

Make-to-Stock Ski Jackets

![Expected Profit](image-url)

**FIGURE 4-5: Manufacturer's expected profit**
Pay-Back Contract

- Buyer agrees to pay some agreed-upon price for any unit produced by the manufacturer but not purchased.
- Manufacturer incentive to produce more units
- Buyer's risk clearly increases.
- Increase in production quantities has to compensate the distributor for the increase in risk.

Pay-Back Contract

Ski Jacket Example

- Assume the distributor offers to pay $18 for each unit produced by the manufacturer but not purchased.
- Manufacturer marginal loss = 55-20-18=$17
- Manufacturer marginal profit = $25.
- Manufacturer has an incentive to produce more than average demand.
- Manufacturer increases production quantity to 14,000 units
- Manufacturer profit = $180,280
- Distributor profit increases to $525,420.
  - Total profit = $705,400
- Compare to total profit in sequential supply chain = $670,000 (= $160,400 + $510,300)

Pay-Back Contract

Ski Jacket Example (cont)

FIGURE 4-6: Manufacturer's average profit (pay-back contract)

FIGURE 4-7: Distributor's average profit (pay-back contract)
Cost-Sharing Contract

- Buyer shares some of the production cost with the manufacturer, in return for a discount on the wholesale price.
- Reduces effective production cost for the manufacturer
- Incentive to produce more units

Cost-Sharing Contract
Ski-Jacket Example

- Manufacturer agrees to decrease the wholesale price from $80 to $62
- In return, distributor pays 33% of the manufacturer production cost
- Manufacturer increases production quantity to 14,000
- Manufacturer profit = $182,380
- Distributor profit = $523,320
- The supply chain total profit = $705,700
  *Same as the profit under pay-back contracts*
Implementation Issues

- Cost-sharing contract requires manufacturer to share production cost information with distributor
- Agreement between the two parties:
  - Distributor purchases one or more components that the manufacturer needs.
  - Components remain on the distributor books but are shipped to the manufacturer facility for the production of the finished good.

Global Optimization

- Relevant data:
  - Selling price, $125
  - Salvage value, $20
  - Variable production costs, $55
  - Fixed production cost.
- Cost that the distributor pays the manufacturer is meaningless
- Supply chain marginal profit, 70 = 125 – 55
- Supply chain marginal loss, 35 = 55 – 20
- Optimal production quantity = 14,000 units
- Expected supply chain profit = $705,700

**Same profit as under pay-back and cost sharing contracts**

4.4 Contracts with Asymmetric Information

- Implicit assumption so far: Buyer and supplier share the same forecast
- Inflated forecasts from buyers a reality
- How to design contracts such that the information shared is credible?
Two Possible Contracts

- **Capacity Reservation Contract**
  - Buyer pays to reserve a certain level of capacity at the supplier
  - A menu of prices for different capacity reservations provided by supplier
  - Buyer signals true forecast by reserving a specific capacity level

- **Advance Purchase Contract**
  - Supplier charges special price before building capacity
  - When demand is realized, price charged is different
  - Buyer's commitment to paying the special price reveals the buyer's true forecast

4.5 Contracts for Non-Strategic Components

- Variety of suppliers
- Market conditions dictate price
- Buyers need to be able to choose suppliers and change them as needed
- Long-term contracts have been the tradition
- Recent trend towards more flexible contracts
  - Offers buyers option of buying later at a different price than current
  - Offers effective hedging strategies against shortages

Long-Term Contracts

- Also called *forward or fixed commitment contracts*
- Contracts specify a fixed amount of supply to be delivered at some point in the future
- Supplier and buyer agree on both price and quantity
- Buyer bears no financial risk
- Buyer takes huge inventory risks due to:
  - uncertainty in demand
  - inability to adjust order quantities.

Flexible or Option Contracts

- Buyer pre-pays a relatively small fraction of the product price up-front
- Supplier commits to reserve capacity up to a certain level
- Initial payment is the *reservation price or premium*
- If buyer does not exercise option, the initial payment is lost.
- Buyer can purchase any amount of supply up to the option level by:
  - paying an additional price (*execution price or exercise price*)
  - agreed to at the time the contract is signed
  - Total price (reservation plus execution price) typically higher than the unit price in a long-term contract.
Flexible or Option Contracts

- Provide buyer with flexibility to adjust order quantities depending on realized demand.
- Reduces buyer’s inventory risks.
- Shifts risks from buyer to supplier
  - Supplier is now exposed to customer demand uncertainty.
- Flexibility contracts
  - Related strategy to share risks between suppliers and buyers
  - A fixed amount of supply is determined when the contract is signed.
  - Amount to be delivered (and paid for) can differ by no more than a given percentage determined upon signing the contract.

Spot Purchase

- Buyers look for additional supply in the open market.
- May use independent e-markets or private e-markets to select suppliers.
- Focus:
  - Using the marketplace to find new suppliers
  - Forcing competition to reduce product price.

Portfolio Contracts

- Portfolio approach to supply contracts
- Buyer signs multiple contracts at the same time
  - Optimize expected profit
  - Reduce risk.
- Contracts
  - Differ in price and level of flexibility
  - Hedge against inventory, shortage and spot price risk.
  - Meaningful for commodity products
    - A large pool of suppliers
    - Each with a different type of contract.

Appropriate Mix of Contracts

- How much to commit to a long-term contract?
  - Base commitment level.
- How much capacity to buy from companies selling option contracts?
  - Option level.
- How much supply should be left uncommitted?
  - Additional supplies in spot market if demand is high.
- Hewlett-Packard’s (HP) strategy for electricity or memory products
  - About 50% procurement cost invested in long-term contracts
  - 35% in option contracts
  - Remaining is invested in the spot market.
Risk Trade-Off in Portfolio Contracts

- If demand is much higher than anticipated
  - Base commitment level + option level < Demand,
  - Firm must use spot market for additional supply.
  - Typically the worst time to buy in the spot market
  - Prices are high due to shortages.

- Buyer can select a trade-off level between price risk, shortage risk, and inventory risk by carefully selecting the level of long-term commitment and the option level.
  - For the same option level, the higher the initial contract commitment, the smaller the price risk but the higher the inventory risk taken by the buyer.
  - The smaller the level of the base commitment, the higher the price and shortage risks due to the likelihood of using the spot market.
  - For the same level of base commitment, the higher the option level, the higher the risk assumed by the supplier since the buyer may exercise only a small fraction of the option level.

<table>
<thead>
<tr>
<th>Option level</th>
<th>Low</th>
<th>High</th>
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</thead>
<tbody>
<tr>
<td>Base commitment level</td>
<td>Inventory risk (supplier)</td>
<td>N/A*</td>
</tr>
<tr>
<td></td>
<td>Price and shortage risk (buyer)</td>
<td>Inventory risk (buyer)</td>
</tr>
</tbody>
</table>

*For a given situation, either the option level or the base commitment level may be high, but not both.