MGT 528 – OPERATIONS: ECONOMICS & STRATEGY

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9. Sourcing Decisions & Contracting

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École Polytechnique Fédérale de Lausanne
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AGENDA

ROLE OF SOURCING DECISIONS

Definition. Sourcing comprises all the business processes in a supply chain ("sourcing processes") that are needed to procure goods and services (in view of producing a finished good or a service)

Chain of sourcing processes:

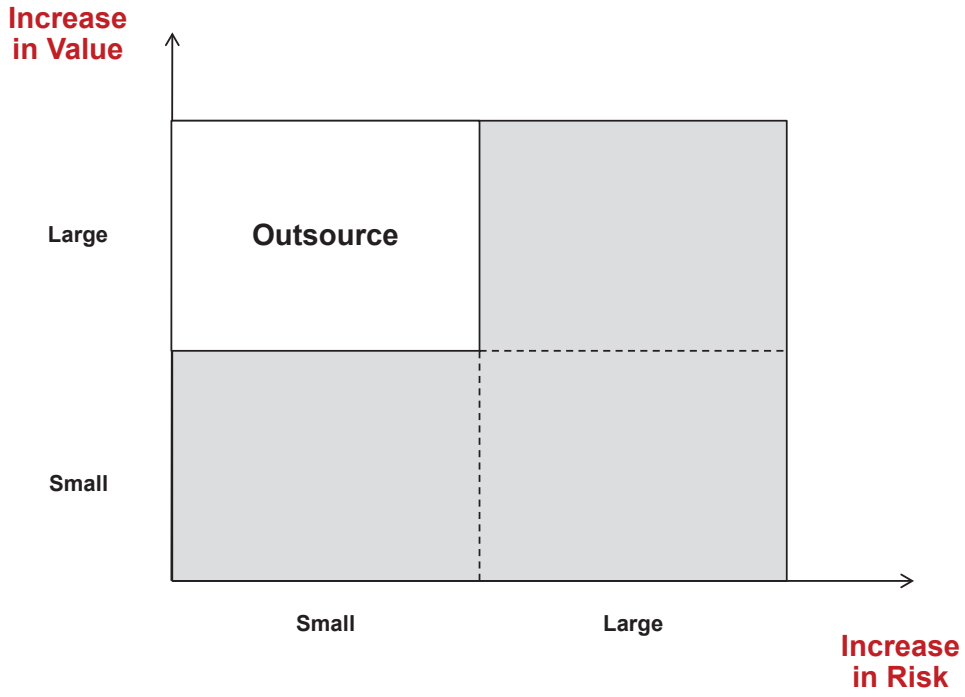
1. **Supplier scoring and assessment**
2. **Supplier selection and contract negotiation**
3. **Design collaboration**
4. **Procurement**
5. **Sourcing planning and analysis**

POTENTIAL BENEFITS OF OUTSOURCING

Most sourcing decisions have to do with realizing aggregation benefits, such as

- **Economies of scale (capacity aggregation in outside company)**
  - **Inventory**
  - **Production**
  - **Transportation**
  - **Warehousing**
  - **Procurement**
- **Information aggregation**
- **Lower cost and/or better quality**
- **Economies of scope (benefits of diversification in outside company)**
- **Experience-curve effects (related to economies of scale)**

OUTSOURCING VS. INSOURCING



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The Sourcing Decision

Sourcing Processes

Some Bargaining Basics

Sourcing Processes (Cont'd)

Key Concepts to Remember

1. SUPPLIER SCORING AND ASSESSMENT

- Supplier performance can be compared on the basis of impact on total cost
- Other factors besides procurement price influence total cost (which?)
- Relevant relationship-specific investments need to be assessed

1. SUPPLIER SCORING AND ASSESSMENT (Cont'd) Possible Factors

- Replenishment Lead Time
- On-Time Performance
- Supply Flexibility
- Delivery Frequency / Minimum Lot Size
- Supply Quality
- Inbound Transportation Cost
- Pricing Terms
- Information Coordination Capability
- Design Collaboration Capability
- Exchange Rates, Taxes, Duties
- Supplier Viability

Supplier evaluation can be based on expected net benefit (including the cost of the risk increase or benefit of risk decrease)

Supplier selection can be performed using competitive bidding (incl. reverse auctions) or direct negotiations

Some auction types:

- First-price (sealed bid)
- English
- Dutch
- Second-price (Vickery)

DIFFERENT CONTRACT FORMATS AND PURPOSES
Decisive for Supply Chain Performance

Possible Design Objectives:

A. Product Availability and Supply-Chain Profits
- Buyback Contracts
- Revenue-Sharing (or surplus sharing) Contracts
- Quantity-Flexibility Contracts

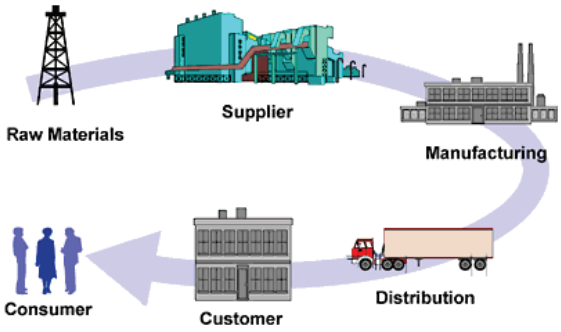
B. Coordinate Supply-Chain Costs

C. Increase Agent Effort

D. Induce Performance Improvement

A. PRODUCT AVAILABILITY & SUPPLY-CHAIN PROFITS

- Inefficiencies in supply-chain performance often arise because buyer and supplier are separate organizations and each tries to optimize its own profit
- Recall that double marginalization results in suboptimal order quantity because of a lack in coordination in the presence of inappropriate transfer contracts
- An approach to dealing with this problem is to internalize the externalities across the two parties, e.g., by designing a contract that encourages a buyer to purchase more and increase the level of product availability
- For effective coordination of the supply chain, the supplier must share some of the buyer's demand uncertainty



A. PRODUCT AVAILABILITY & SUPPLY-CHAIN PROFITS
Buyback Contract

A buyback contract allows a retailer to return unsold inventory up to a specified amount at a certain price.

Characteristics

- increases the optimal order quantity for the retailer, resulting in higher product availability and higher profits for both the retailer and the supplier
- most effective for products with low variable cost, such as music, software, books, magazines, and newspapers
- can also increase downside is that buyback contract results in surplus inventory that must be disposed of, which increases supply-chain costs
- information distortion because the supply chain reacts to retail orders, not actual customer demand

Example:

A. PRODUCT AVAILABILITY & SUPPLY-CHAIN PROFITS
Revenue-Sharing Contracts

- The buyer pays a minimal amount for each unit purchased from the supplier but shares a fraction of the revenue for each unit sold
- Decreases the cost per unit charged to the retailer, which effectively decreases the cost of overstocking
- Can result in supply-chain information distortion, however, just as in the case of buyback contracts

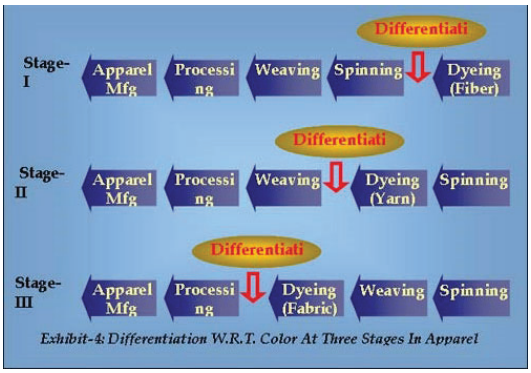
Example:

NETFLIX

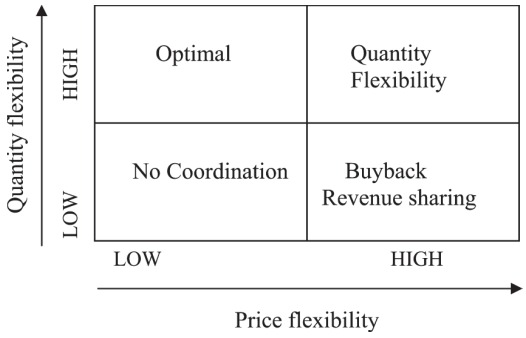
A. PRODUCT AVAILABILITY & SUPPLY-CHAIN PROFITS
Quantity-Flexibility Contracts

- **Buyer commits to purchase no less than certain percentage *under* forecast; supplier agrees to provide up to certain percentage *over* forecast**
- **Allows the buyer to modify the order (within limits) as demand visibility increases closer to the point of sale; it is used in "rolling-horizon" planning environments**
- **Better matching of supply and demand**
- **Increased overall supply chain profits if the supplier has flexible capacity**
- **Lower levels of information distortion than either buyback contracts or revenue-sharing contracts**

Illustration: Delayed Differentiation



Source: fibre2fashion.com



Source: Arshinder, K., Kanda, A., Deshmukh, S.G. (2008) "Development of a Decision Support Tool for Supply Chain Coordination Using Contracts," *Journal of Advances in Management Research*, Vol. 5, No. 2, pp. 20—41.

B. COORDINATE SUPPLY-CHAIN COSTS

Differences in costs at the buyer and supplier can lead to decisions that increase total supply chain costs.

- **Example: Replenishment-order size placed by the buyer. The buyer's EOQ does not take into account the supplier's costs.**
- **A quantity-discount contract may encourage the buyer to purchase a larger quantity (which would be lower costs for the supplier), which would result in lower total supply chain costs**
- **Quantity discounts lead to information distortion because of order batching**

C. INCREASE AGENT EFFORT

- There are many instances in a supply chain where an agent acts on the behalf of a principal and the agent's actions affect the reward for the principal.
- Example: A car dealer who sells the cars of a manufacturer, as well as those of other manufacturers
- Examples of contracts to increase agent effort include two-part tariffs and threshold contracts

Moral Hazard
(Example: rental car)

D. INDUCE PERFORMANCE IMPROVEMENT

A buyer may want performance improvement from a supplier who otherwise would have little incentive to do so

A shared-savings contract provides the supplier with a fraction of the savings that result from the performance improvement

- Particularly effective where the benefit from improvement accrues primarily to the buyer, but where the effort for the improvement comes primarily from the supplier

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Some Bargaining Basics

Sourcing Processes (Cont'd)

Key Concepts to Remember

AIM: FIND REASONABLE SOCIAL COMPROMISES
Bargaining Solution

Question: In the absence of a social planner, how can resources be "fairly" and "efficiently allocated between different agents, *taking their respective bargaining power into account*?

Answer: Introduce the concept of a "bargaining solution." Let for N economic agents $U \subset \Re^N$ be the set of attainable utility payoffs, such that(1)

- U **is convex and closed**
- $U - \Re^N_+ \subset U$ **(free disposal)**

The set U could be generated by a set of underlying alternatives X, as in our discussion on fairness. If any agent does not participate, then every agent obtains the default utility $d \in \text{int}(U)$

Definition: A bargaining solution is a *rule that assigns a solution vector* $f(U,d) \in U$ to any bargaining problem (U,d)

(1) For such a set to exist we assume that all agents' preferences can be represented in terms of smooth utility functions $u_i(\cdot), i \in \{1,...,N\}$.

NASH BARGAINING

Consider two agents with utility function $u_i(x_i)$ and possible bargaining outcomes $x = (x_1, x_2)$ so that the set of attainable utility allocations U is closed, convex and satisfies the free disposal property. We assume that if bargaining breaks down each agent can always get her default utility d_i

Under the following axiomatic assumptions (A1)—(A4), Nash (1950, 1953) (cf. also Roth (1979)) showed that there is a unique bargaining solution:[(1)]

- **A1: Independence of Equivalent Utility Representations (→ bargaining solution invariant with respect to positive linear transformation of agents' utilities)**
- **A2: Symmetry (→ If all players' utilities are the same, including the default outcomes, then they should all receive the same bargaining outcome)**
- **A3: Independence of Irrelevant Alternatives (→ Enlarging the bargaining set by adding non-chosen alternatives does not change the bargaining outcome)**
- **A4: Pareto-Optimality (can be replaced by "individual rationality"; Roth 1977)**

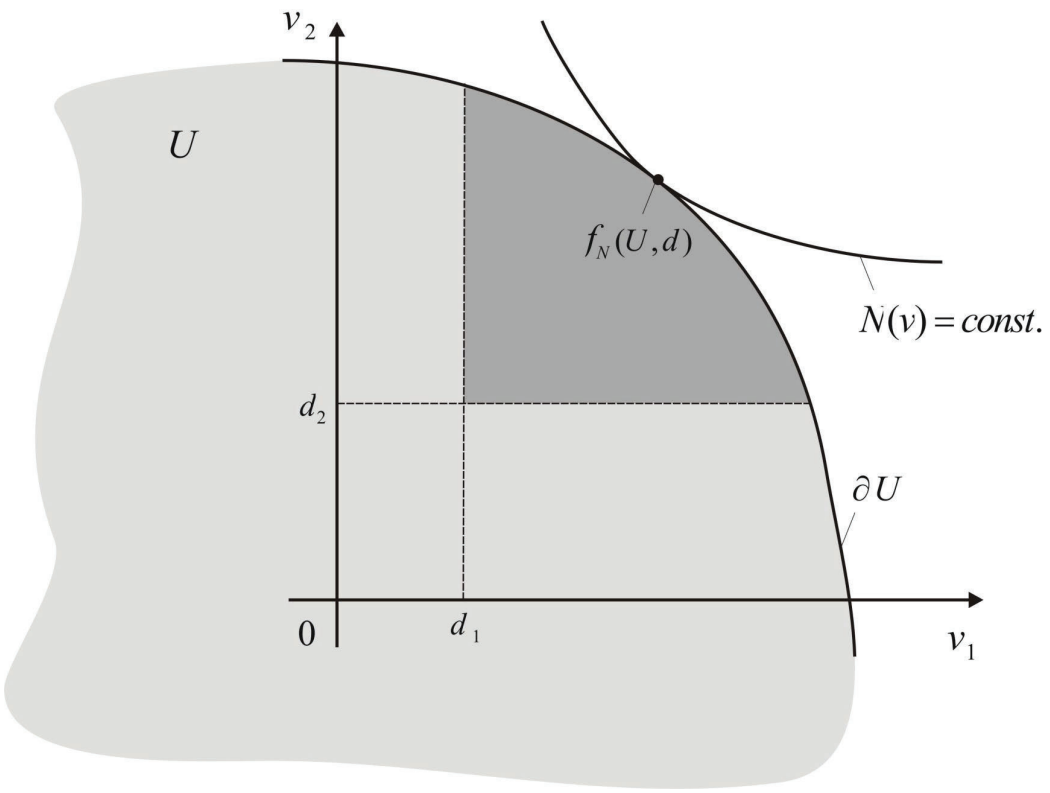
The bargaining solution can be determined by maximizing the "Nash function"

$$N(v) = (v_1 - d_1)(v_2 - d_2)$$

where $v = (v_1, v_2)$ and $v_i = u_i(x_i)$. Then the associated allocation (x_1, x_2) is optimal

(1) Note that all the results presented here generalize in a straightforward manner to a setting with N agents. For more details, see Roth, A. (1979) *Axiomatic Models of Bargaining*, Springer, New York, NY. Other references: Nash, J.F. (1950) "The Bargaining Problem," *Econometrica*, Vol. 18, No. 2, pp. 155—162. Nash, J.F. (1953) "Two-Person Cooperative Games," *Econometrica*, Vol. 21, No. 1, pp. 128—140.

NASH BARGAINING: GEOMETRIC INTERPRETATION



NASH BARGAINING: EXAMPLE

Two (risk-neutral) players bargain about investing in a fixed resource which gives them a positive benefit of b_1 and b_2 respectively. The resource costs F and if the players cannot agree, then both get the (smaller) default payoff of d_1 and d_2 respectively.

Question: How much would they each need to pay as an outcome of Nash bargaining?

"REAL" BARGAINING

Essential parameters:

- **BATNA: "Best Alternative To a Negotiated Agreement"**
- **"Patience" of players with respect to successive bargaining rounds**
- **"Size of the Pie"**
- **"Risk aversion"**
- **"Fairness"**
- **"Reputation"**
- **"Information Advantages"**

THERE IS A RICH LITERATURE ON "REAL" BARGAINING

Examples:

- **Fisher, R., Ury, W.L. (1983) *Getting to Yes: Negotiating Agreement Without Giving In*, Penguin, New York, NY.**
- **Raiffa, H. (1985) *The Art and Science of Negotiation*, Harvard University Press, Cambridge, MA.**
- **Shell, G.R. (2000) *Bargaining for Advantage*, Penguin, New York, NY.**

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Sourcing Processes (Cont'd)

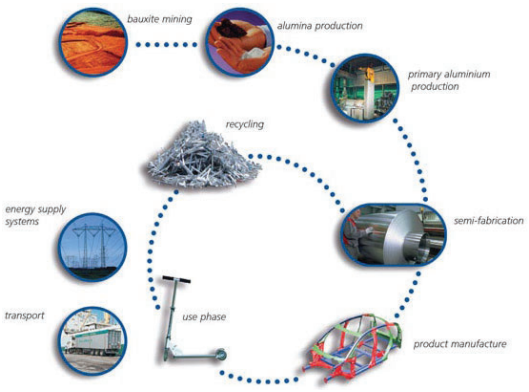
Key Concepts to Remember

3. DESIGN COLLABORATION

- 50-70 percent of spending at a manufacturer is through procurement
- 80 percent of the cost of a purchased part is fixed in the design phase
- Design collaboration with suppliers can result in reduced cost, improved quality, and decreased time to market
- Important to employ design for logistics, design for manufacturability
- Manufacturers must become effective design coordinators throughout the supply chain

Example:

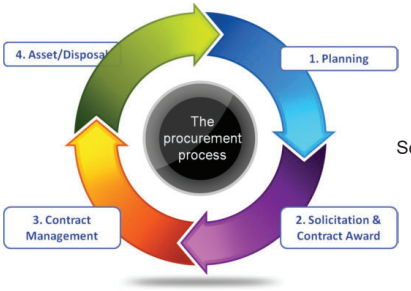
Design for sustainability



Source: alcoa.com

4. PROCUREMENT PROCESS

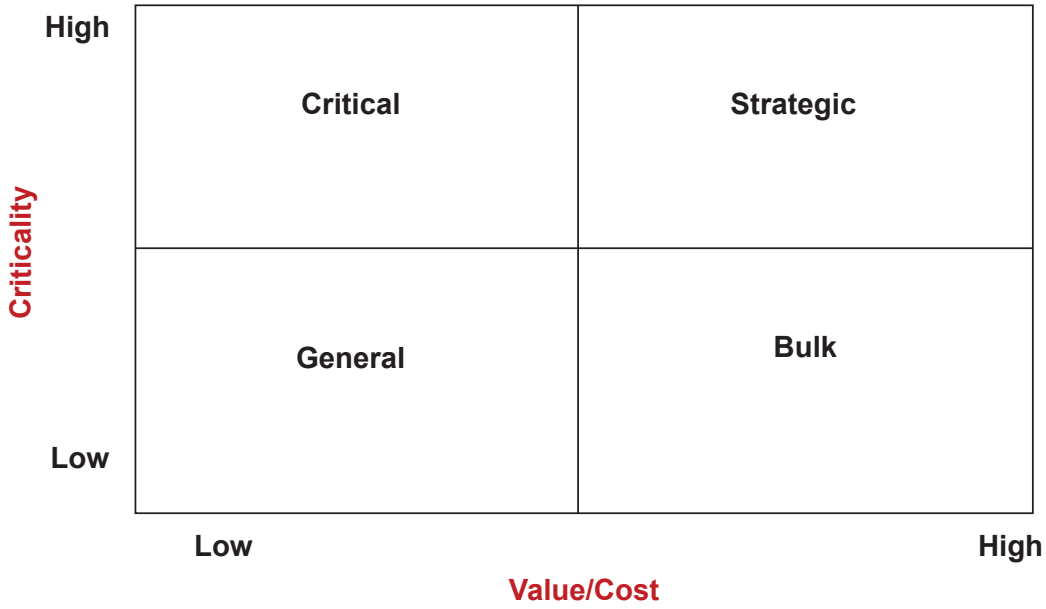
Definition. The procurement process specifies how supplier sends product in response to orders placed by the buyer.



Source: United Nations University, Bonn

- Goal is to enable orders to be placed and delivered on schedule at the lowest possible overall cost
- Two main categories of purchased goods:
  - Direct materials: components used to make finished goods
  - Indirect materials: goods used to support the operations of a firm
- Focus for direct materials should be on improving coordination and visibility with supplier
- Focus for indirect materials should be on decreasing the transaction cost for each order
- Procurement for both should consolidate orders where possible to take advantage of economies of scale and quantity discounts

VALUE VS. CRITICALITY
Product Categorization



5. SOURCING PLANNING AND ANALYSIS

- Periodically analyze procurement costs/benefits and score supplier performance and use both to update sourcing decisions
- Procurement spending should be analyzed by part and by supplier to ensure appropriate economies of scale
- Supplier performance analysis should be used to build a portfolio of suppliers with complementary strengths
  - Cheaper but lower performing suppliers should be used to supply base demand
  - Higher performing but more expensive suppliers should be used to buffer against variation in demand and supply shocks (in other source)

SOURCING DECISIONS: PRACTICAL CONSIDERATIONS

- Use multifunctional teams
- Ensure sufficient coordination across regions and business units
- Always evaluate the total cost of ownership
- Build in flexibility and redundancy to account for demand/supply uncertainties
- Build long-term relationships with key suppliers (→ relational contracting)

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Sourcing Processes (Cont'd)

Key Concepts to Remember

KEY CONCEPTS TO REMEMBER

- **Role of sourcing in a supply chain**
- **Dimensions of supplier performance and their effects on total cost**
- **Effects of contract design on supplier performance and information distortion**
- **Moral hazard**
- **Categories of purchased products and services**
- **Basics on bargaining**