# Economic Analysis of B2B E-Commerce

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# Value of B2B E-Commerce

- Web-enabled B2B e-commerce can enhance inter-organizational coordination, resulting in lower transaction costs and business opportunities

- What is the value of B2B e-commerce to an enterprise? How to measure this value?

- What factors most affect the realization of the potential value of B2B e-commerce?

- This research presents an integrated framework of economic analysis and empirical study for the valuation of B2B e-commerce
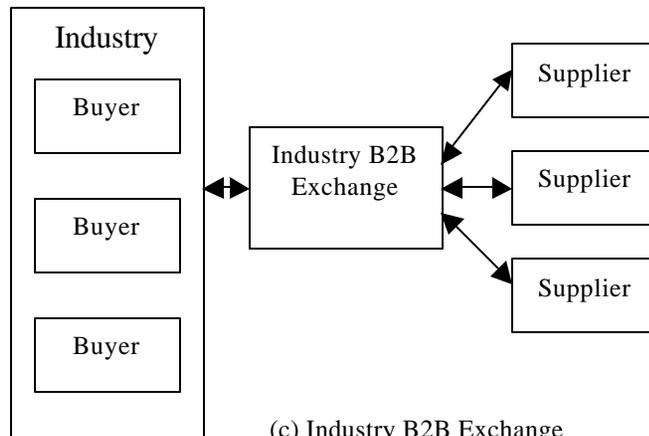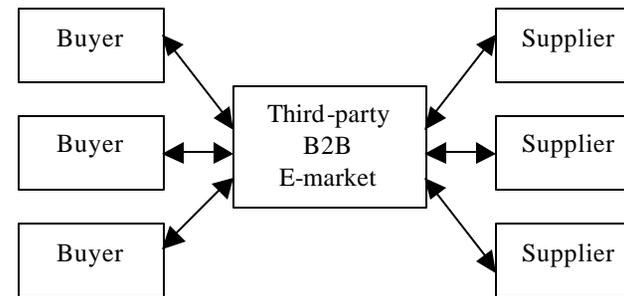
# Web-based Procurement Models
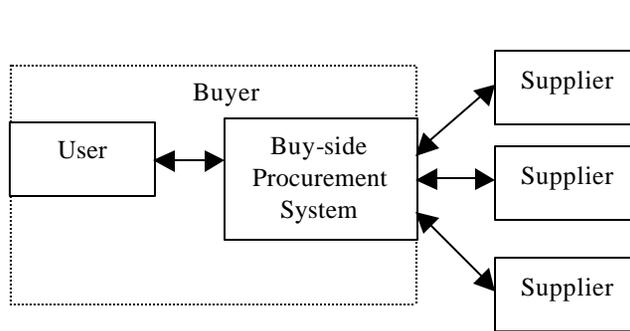


(a) Buy-side Procurement System
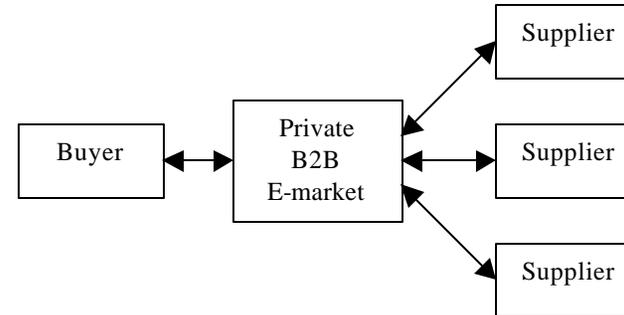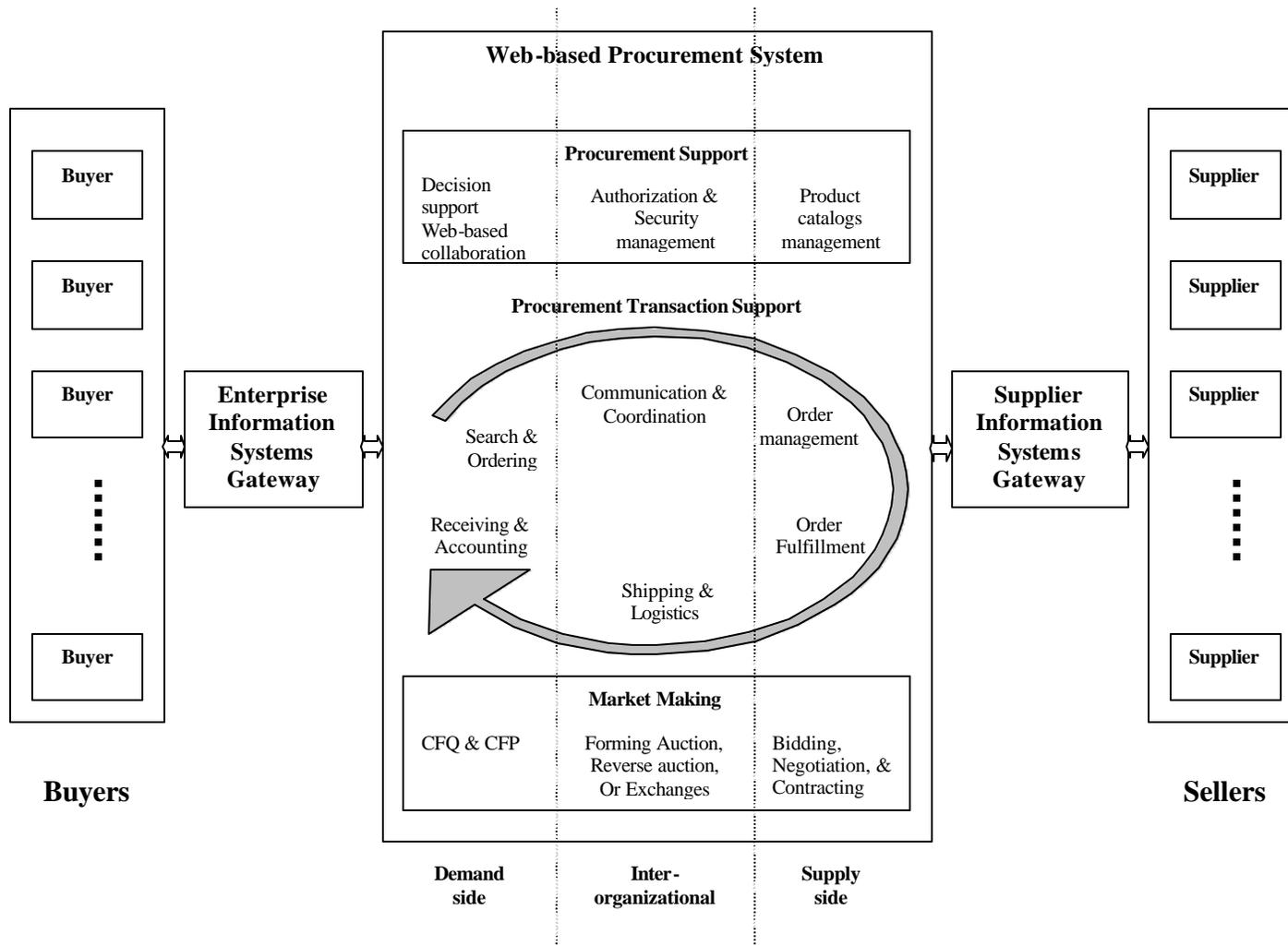
(b) Private B2B E-market

(c) Industry B2B Exchange

(d) Third-party B2B E-market

# Web-based Procurement System

**Web-based Procurement System**

### Procurement Support

Decision
support
Web-based
collaboration

Authorization &
Security
management

Product
catalogs
management

**Procurement Transaction Support**

Communication &
Coordination

Order
management

Search &
Ordering

Receiving &
Accounting

Order
Fulfillment

Shipping &
Logistics

### Market Making

CFQ & CFP

Forming Auction,
Reverse auction,
Or Exchanges

Bidding,
Negotiation, &
Contracting

**Buyer**

**Buyer**

**Buyer**

**Buyer**

**Enterprise
Information
Systems
Gateway**

**Buyers**

**Supplier
Information
Systems
Gateway**

**Supplier**

**Supplier**

**Supplier**

**Supplier**

**Sellers**

**Demand
side**

**Inter-
organizational**

**Supply
side**

# B2B Procurement Cycle

Requisition creation

Approval cycle

Search

P.O. generation

**B2B Procurement Infrastructure**

Supplier communication

Payment

Advance Ship Notice

Invoice

Receipt of Goods/Service

# Research Objectives and Setting

- **Objectives**
  - To study value of Web-based procurement, as a case of B2B e-commerce, using a theoretical framework
  - Integrating the theoretical analysis with empirical study to come up with a comprehensive valuation model
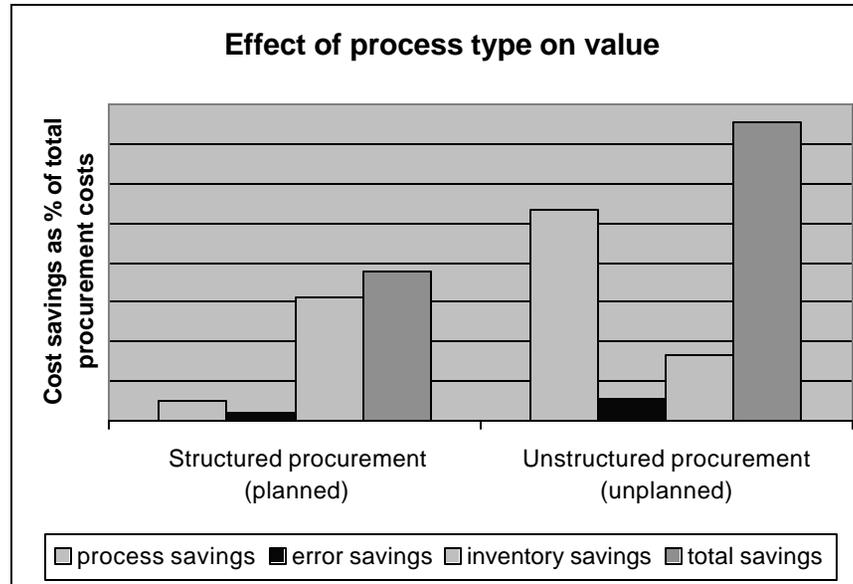
- **Setting**
  - A large organization proposing to implement a Web-based procurement system for its indirect purchases
  - Multinational enterprise, with several business units spread across the globe
  - Larger business units are highly decentralized with respect to their purchases
  - Organization deals with a large number of contracted suppliers with various generations of information technology and levels of integration
  - Need to motivate internal users and suppliers to participate in the Web-based system

# Research Questions

- What is the value of Web-based procurement to an organization? How do we measure this value?

- What conditions affect the realization of the value? What are the relative importance of each of these conditions?

- What implementation strategies are likely to increase the adoption of the Web-based system among the users and suppliers? What economic and other incentives need to provided to motivate adoption among users and suppliers?

# Observations from Field Study



**Effect of process type on value**

Cost savings as % of total procurement costs

Structured procurement (planned)    Unstructured procurement (unplanned)

□ process savings  ■ error savings  □ inventory savings  ■ total savings

**For unstructured processes, such as unplanned procurement, the most value of Web-based procurement comes from process savings**

**For structured processes, such as planned procurement, the most value of Web-based procurement comes from inventory savings**

# Observations from Field Study



**Effect of process complexity on value**
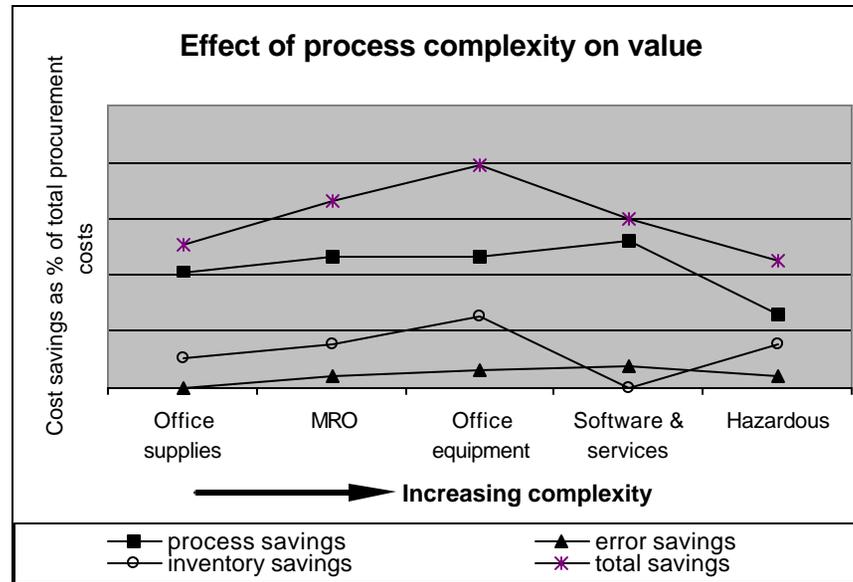
When the volume of complex transactions are low, Web-enabling moderately complex purchases provides the greatest value

# Propositions – Effects of B2B Process

**1 – Type of process**

Use of Web-based procurement for unstructured processes results in greater value than its use for structured processes

**2 – Complexity of process**

The value of Web-based procurement increases with the complexity of the process and the transaction volume

# Propositions – Effects of Business Units

**3 – Size of business unit**

Among business units with similar distributions of different types of B2B processes, larger business units realize higher values from implementing Web-based procurement

**4 – Dominant process type in the business unit**

Business units can derive higher value from Web-based procurement only by Web-enabling the dominant type of procurement process

**5 – Centralization of business unit procurement**

The value of Web-based procurement system will be higher for a business unit that achieves a greater *increase* in centralization due to the use of Web

# Propositions – Effect of Extended Enterprise

**6 – Integration of e-procurement with existing systems**

**a:** Web-based procurement systems that have greater integration with existing enterprise systems yield higher value than procurement systems with lower integration

**b:** Web-based procurement systems that are integrated with closely related systems result in higher value

**7 – Participation of business partners**

**a:** The value realized from Web-based procurement is low when a small number of business units participate, irrespective of the number of suppliers participating

**b:** The value realized from Web-based procurement is low when a small number of suppliers participate, irrespective of the number of business units participating

**c:** Participation in Web-based procurement by suppliers, who themselves have closer business relationships in the same product supply chain, results in higher value
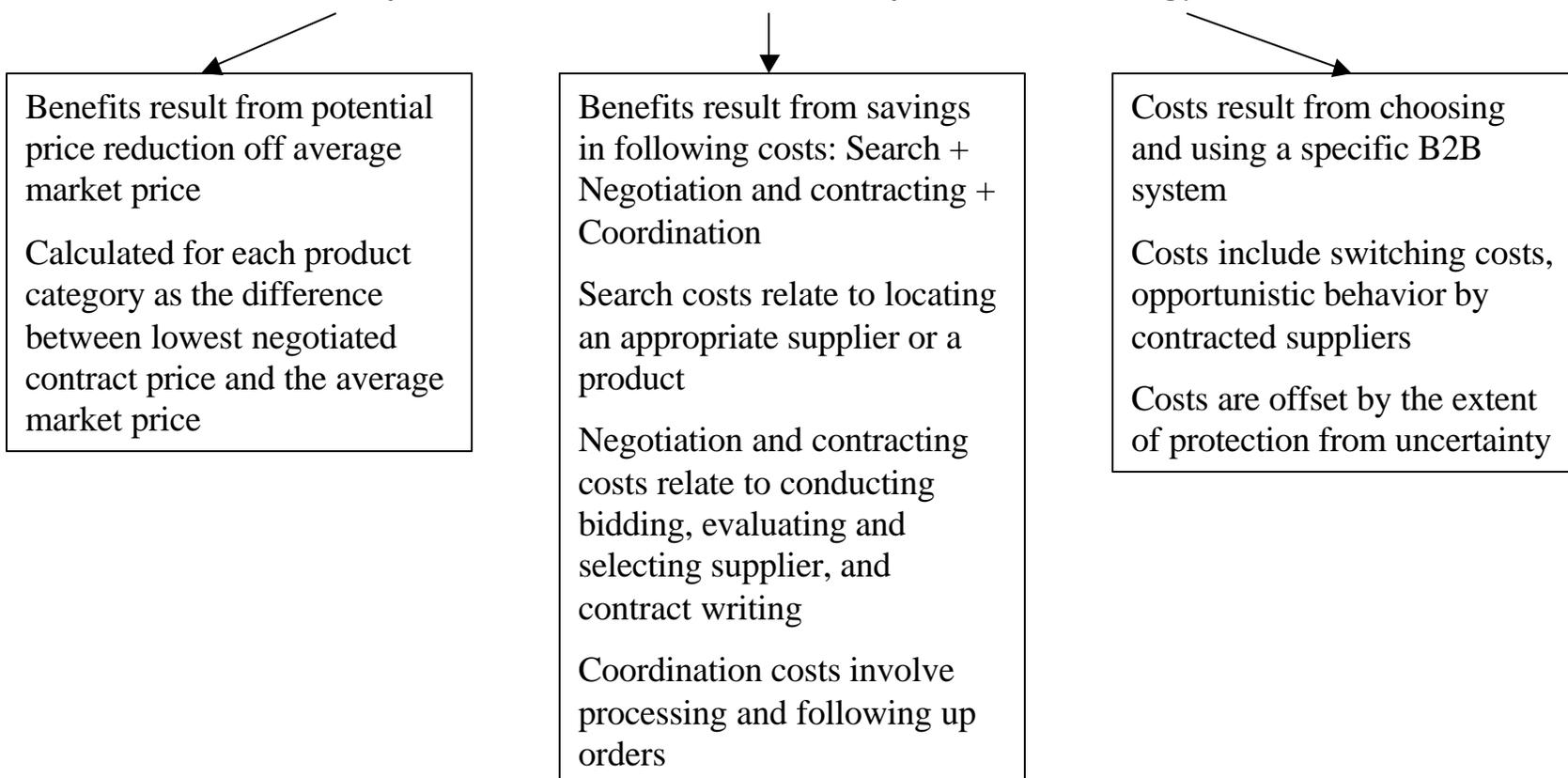
**8 – Fragmentation of existing supply chain**

The value of Web-based procurement is greater if the existing product supply chain is more fragmented on the demand, supply or both sides

# Economic Valuation Model

- ## Economic value is formalized as

*Price benefits + Transaction cost benefits – Technology lock-in costs*

Benefits result from potential price reduction off average market price

Calculated for each product category as the difference between lowest negotiated contract price and the average market price

Benefits result from savings in following costs: Search + Negotiation and contracting + Coordination

Search costs relate to locating an appropriate supplier or a product

Negotiation and contracting costs relate to conducting bidding, evaluating and selecting supplier, and contract writing

Coordination costs involve processing and following up orders

Costs result from choosing and using a specific B2B system

Costs include switching costs, opportunistic behavior by contracted suppliers

Costs are offset by the extent of protection from uncertainty

# Economic Valuation Model

- ## Price benefits (PB)
  - Derived from a downward sloping demand curve for product i (McGuire and Staelin, 1983; Trivedi, 1998)

$$PB = db\, \frac{(A_i - q_i)}{1 - q(1 - r)}\, q_i$$

  - $q_i$ is demand for product i
  - $A_i$ is a measure of demand when price is 0
  - $p_i$ is average price of product i
  - $\theta$ is the substitution factor, $0 \geq \theta \geq 1$
  - $\rho$ is the complexity of procurement process, $0 \geq \rho \geq 1$
  - $\beta$ is the change in the degree of centralization due to use of Web, $0 \geq \beta \geq 1$
  - ä is the rate of change of price with change in centralization, $0 \geq ä \geq 1$
  - $q_i$ and $p_i$ are normalized to be consistent with dimensions of $A_i$ and other parameters
  - Assumptions
    - All purchases are systematic and based on a contracted price
    - For a product, the price is assumed to be the same across the enterprise
    - For each product, there is a maximum of one substitutable product

# Economic Valuation Model

- ## Transaction cost benefits (TB)
  - *Search benefits + Negotiation benefits + Coordination benefits*
  - Let **k** be a constant cost of unit effort involved in each of the search, negotiation and contracting and coordination activities.
  - Search benefits
    - As the product becomes more customized (low $\theta$), more search efforts are required to identify the right supplier and match product specifications to needs.
    - Higher complexity ($\rho$) also increases the search costs.
    - A highly fragmented supply chain, indicated by the fragmentation (f), increases the search efforts on the part of the buyer, while a consolidated supply chain involves minimum search keeping the search efforts very low.

      **Search benefits = k(1- q)rf**
  - Negotiation benefits
    - The more complex a procurement process is, the more specifications need to be included in the contract, increasing the costs.
    - A highly centralized procurement system uses a single contract for the entire demand for the product in a given period, while in a highly decentralized system, each business unit may use its own contract for its demand of product i.
    - Greater fragmentation in the product supply chain increases the negotiation and contracting costs.

      **Negotiation benefits = kr(n+b(1-n))f**

# Economic Valuation Model

- ## Transaction cost benefits (TB)
  - Coordination benefits
    - These costs are incurred for every transaction and are a function of the complexity of process and supply chain fragmentation.
    - In addition, a centralized procurement system can help consolidate coordination efforts thus reducing the coordination costs.

      **Coordination benefits = k$r$(n+$b$(1-n))fq$_i$**

$$TB = kf\boldsymbol{r}((1-\boldsymbol{q}) + (1+q_i)(n + \boldsymbol{b}(1-n)))$$

- ## Technology lock-in costs (LC)
  - Let **r** represent a constant lock-in cost
    - The lock-in risks are greater for more customized products (low $\theta$) and complex procurement processes ($\rho$), thus increasing the lock-in costs.
    - The uncertainties are higher for more fragmented supply chains, thus locking-in is more beneficial

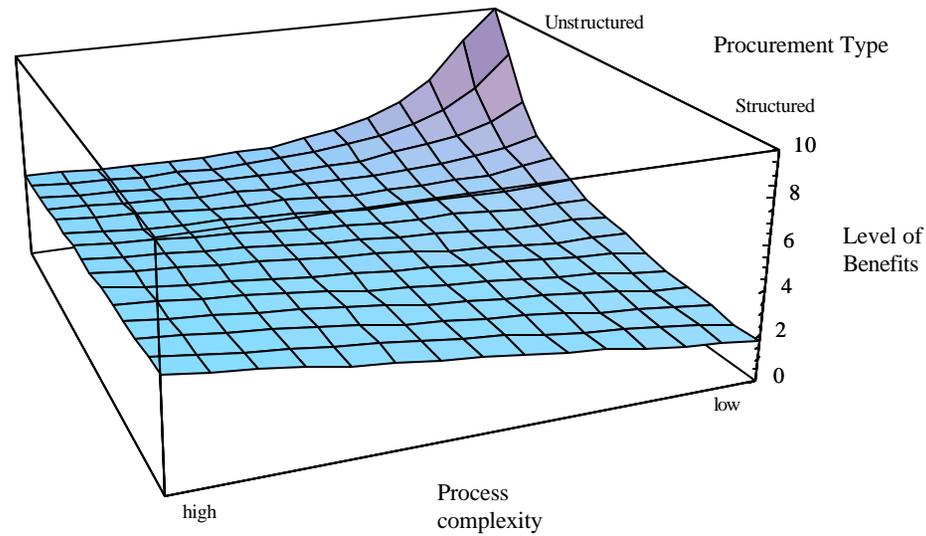      $LC = r(\rho\theta\text{-}f)q_i$

# Economic Valuation Model

- Total economic value (V) is given as

  *Price benefits + Transaction cost benefits – Technology lock-in costs*

$$V = \frac{(A_i - q_i)\boldsymbol{bd}q_i}{1 - \boldsymbol{q}(1 - \boldsymbol{r})} + kf\boldsymbol{r}((1 - \boldsymbol{q}) + (1 + q_i)(n + \boldsymbol{b}(1 - n))) - r(\boldsymbol{rq} - f)q_i$$
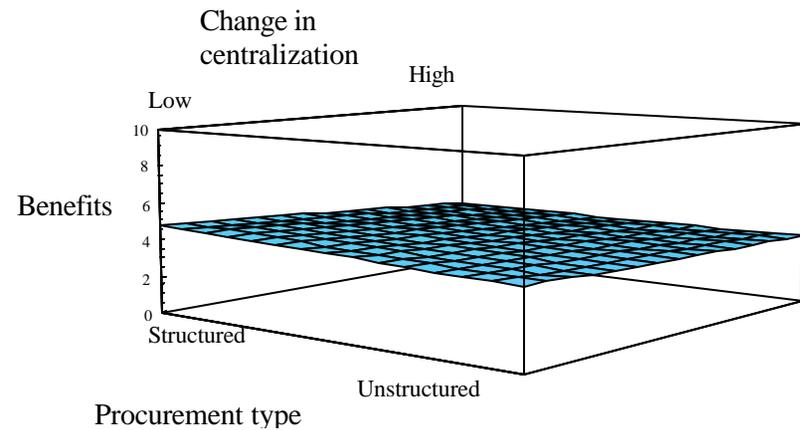
# Effects of B2B Process



- Among simple procurement processes, Web-enabling unstructured procurement provides greater benefits
- Among complex processes, Web-enabling structured procurement provides greater benefits

# Effects of B2B Process and Centralization
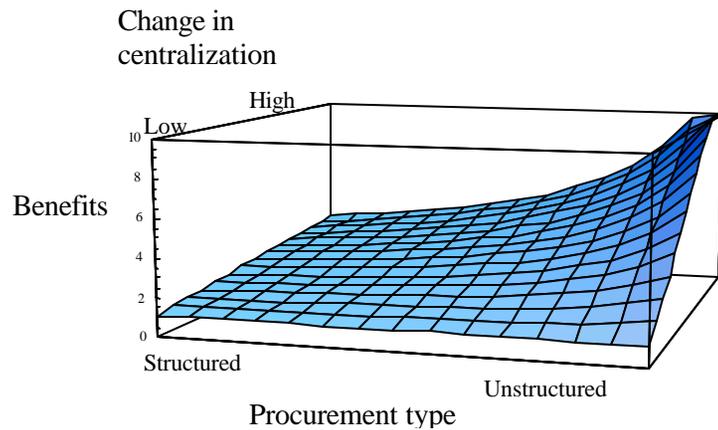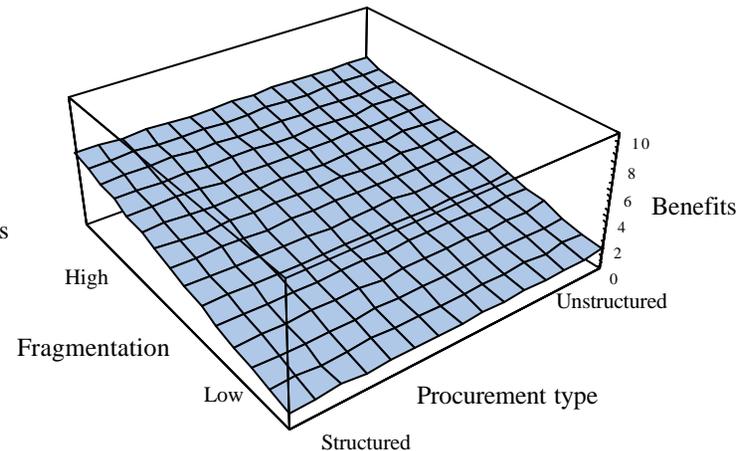


(a) Process complexity = low

(b) Process complexity = high

- At low complexity, change in centralization has a greater impact on unstructured procurement and almost no impact on structured procurement
- For more complex processes, neither the procurement type nor the change in centralization has any significant impact on the level of benefits

# Effects of B2B Process and Fragmentation
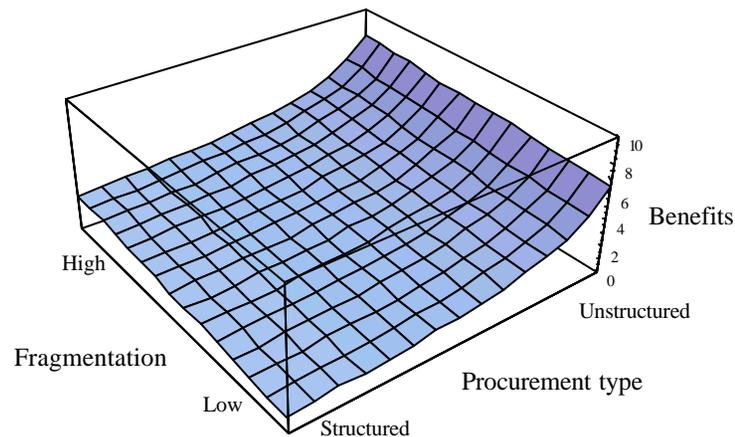


(a) Process complexity = low

(b) Process complexity = high

- When the process complexity is low, the Web benefits are significantly affected by the type of procurement, but not by the fragmentation
- When the process complexity is high, the Web benefits are significantly affected by fragmentation in the supply chain, but not by the type of procurement

# Implications for Adoption

| Process/Business unit characteristics | Procurement that are most suitable for Web-enabling to maximize benefits |
|---|---|
| Procurement involving low complexity items | Unstructured processes which have the greatest increase in centralization<br>*Examples: Office supplies, computer parts* |
| Procurement involving moderate and highly complex items | All processes which have the greatest fragmentation in the existing product supply chain<br>*Examples: Hazardous material, computer equipment* |
| Large business units with dominance of structured procurement | Complex processes with high fragmentation in the existing product supply chain<br>*Examples: Hazardous chemicals* |
| Business units with a dominance of complex purchases | Make the process more structured before Web-enabling<br>*Examples:  Machine parts, customized equipments* |
| Large or small business units with a dominance of unstructured procurement | Need for evaluating benefits of other Web-based procurement models |

# Conclusion

- Field study and economic analysis
  - **Observation:** One user dealing with unplanned procurement spent 80% of her time in resolving errors and mismatches, while another user dealing with planned procurement spent less than 20% of her time in error resolution
  - **Analysis results:** A Web-based procurement system is of more value to the first type of user than the second
  - **Observation:** A procurement manager at a large manufacturing facility was not convinced of the benefits of Web-based procurement as the existing processes were very streamlined and efficient
  - **Analysis results:** The value of Web-based procurement for this business unit lies in Web-enabling complex procurement dealing with fragmented supply chain, not by Web-enabling the planned processes
- An important contribution of this integrated approach is that the theoretical approach will provide stronger foundation for the empirical study design
- The empirical study will help validate the theoretical expectations and adds value by explaining the non-economic factors critical for user adoption