Integration

Tight integration $\rightarrow$ (bad)
Light integration $\rightarrow$ (ok but not a good term)

Yields with one integrated entity

- Yields central decision making by homogeneous entity
- Requires resolving all potential inconsistencies ahead of time
- Fragile and must be repeated whenever components change

Obsolete way of thinking: tries to achieve consistency (and fails)

Interoperation : working together good
Integration : being one bad
Locality and Interaction

A way to maintain coherence in the face of openness

- Have each local entity look after its own
  - Minimize dependence on others
  - Continually have interested parties verify the components of the state that apply to them

- Approach: replace global constraints with protocols for interaction
  - Lazy: obtain global knowledge as needed
  - Optimistic: correct rather than prevent violations
  - Inspectable: specify rules for when, where, and how to make corrections
Interoperation

Ends up with the original number of entities working together

- Yields decentralized decision making by heterogeneous entities
- Resolves inconsistencies incrementally
- Potentially robust and easy to swap out partners as needed

Also termed “light integration” (bad terminology)
Example: Selling

Update inventory, take payment, initiate shipping

- Record a sale in a sales database
- Debit the credit card (receive payment)
- Send order to shipper
- Receive OK from shipper
- Update inventory
Potential Problems

Examples of Inconsistencies

- What if the order is shipped, but the payment fails?
- What if the payment succeeds, but the order was never entered or shipped?
- What if the payments are made offline, i.e., significantly delayed?
In a Closed Environment

- Transaction processing (TP) monitors ensure that all or none of the steps are completed, and that systems eventually reach a consistent state.

- But what if the user is disconnected right after he clicks on OK? Did order succeed? What if line went dead before acknowledgment arrives? Will the user order again?

- The TP monitor cannot get the user into a consistent state.
In an Open Environment: 1

- Reliable messaging (asynchronous communication, which guarantees message delivery or failure notification)
- Maintain state: retry if needed
- Detect and repair duplicate transactions
- Engage user about credit problems

Matter of policies to ensure compliance
In an Open Environment: 2

- Not immediate consistency (as traditional DBs promise)
- Eventual "consistency" (howsoever understood) or just coherence
- Sophisticated means to maintain shared state, e.g., conversations
Challenges

- Information system interoperation
- Business process management
- Exception handling
- Distributed decision-making
- Personalization
- Service selection (location and assessment)
Information System Interoperation

Supply chains: manage the flow of materiel among a set of manufacturers and integrators to produce goods and configurations that can be supplied to customers

- Requires the flow of information and negotiation about
  - Product specifications
  - Delivery requirements
  - Prices
  - Credit

Exception conditions: bigger challenge for automating

Still research into contracts
Business Processes

- Modeling and optimization
  - Inventory management
  - Logistics: how to optimize and monitoring flow of materiel

- Contains aspects internal to one party

- More interesting challenges are in cross-organizational aspects
Exception Conditions

Virtual enterprises to construct enterprises dynamically to provide more appropriate, packaged goods and services to common customers

- Requires the ability to
  - Construct teams
  - Enter into multiparty deals
  - Handle authorizations and commitments
  - Accommodate exceptions
- Real-world exceptions
- Compare with PL or OS exceptions
Distributed Decision-Making: 1

Manufacturing control: manage the operations of factories

- Requires intelligent decisions to
  - Plan inflow and outflow
  - Schedule resources
  - Accommodate exceptions
Distributed Decision-Making: 2

Automated markets as for energy distribution

- Requires abilities to
  - Set prices, place or decide on others' bids
  - Accommodate risks
- Pricing mechanisms for rational resource allocation (Rules of Encounter)

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Personalization

Consumer dealings to make the shopping experience a pleasant one for the customer

- Requires
  - Learning and remembering the customer’s preferences
  - Offering guidance to the customer (best if unintrusive)
  - Acting on behalf of the user without violating their autonomy
Service Selection

What are some bases for selecting the parties to deal with?

- Specify services precisely and search for them
  - How do you know they do what you think they do (ambiguity)?
  - How do you know they do what they say (trust)?
- Recommendations to help customers find relevant and high quality services
  - How do you obtain and aggregate evaluations?