
Channels in Chains:

ICT's Impact on the Coordination of Complex Networks

Ellen Christiaanse,
Associate Professor E-Business
University of Amsterdam,
Amsterdam, The Netherlands
echristiaanse@xs4all.nl

Agenda:

- Traditional design options --radical redesign
- ICT as driver for drastic changes in supply chain design choices (actors, governance, physical structure, information flow paths)
- from dyadic to chain/network optimization
- Case Example: Elemica
- e-channels connecting supply chains

Components of Supply Chains

- **Supply Chain Actors** - organizations in the chain
(Logistic, Manufacturers, Distributors, Retailers)
- **Supply Chain Connections** - Flows through the chain
 - Goods and Services - object of the chain (can be Physical or Digital)
 - Information
 - Money

How have Traditional Supply Chain Structures Emerged?

- “Natural” flow of production and logistics processes:
 - *Barley has to be grown before beer is brewed*
- Historical Reasons
 - “*For the last 50 years we have always cleared outgoing customs at the loading dock in Rotterdam and again at receiving dock in New York*”
- Based upon then-available limited Technologies
 - *Paper Bill of lading or weigh-bill accompanies the shipment on truck to the ship*

Synchronous Information and physical flows are highly inefficient:

- 78 % of time that aircargo is underway, it is waiting at airports for information flows to be handled (insurance, customs clearing, bills of lading)....

Source : IATA study (1997)

Traditional Research Perspectives in Supply Chains

- Take the existing supply chain as “**given**”
 - Production, Operations management, Logistics
 - Optimize Inventories and Costs through the chain
 - Marketing
 - Examine and Manage supply chain/ channel relationships
 - EDI
 - Automate information flows between adjacent parties in chain

Traditional Design Perspectives

- Supply Chain as GIVEN
- Classic Design Activities (OR perspective)
 - Optimize,
 - Sustain/forecast, and
 - Automate
- **All within the given structure** of supply chains

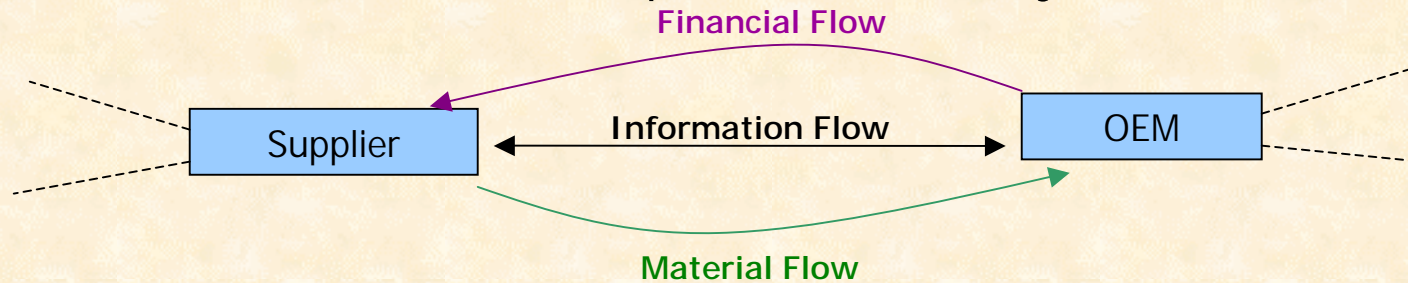
EMERGING POSSIBILITIES for RE-DESIGN

- New Organization Re-Design Concepts -
VIRTUAL ORGANIZATIONS
- Flexible and ubiquitous ICT
 - Internet, Intra and ExtraNets, WWW
 - Open-EDI
 - Intelligent Agents, GPS
 - E-Markets
- Possibilities for:

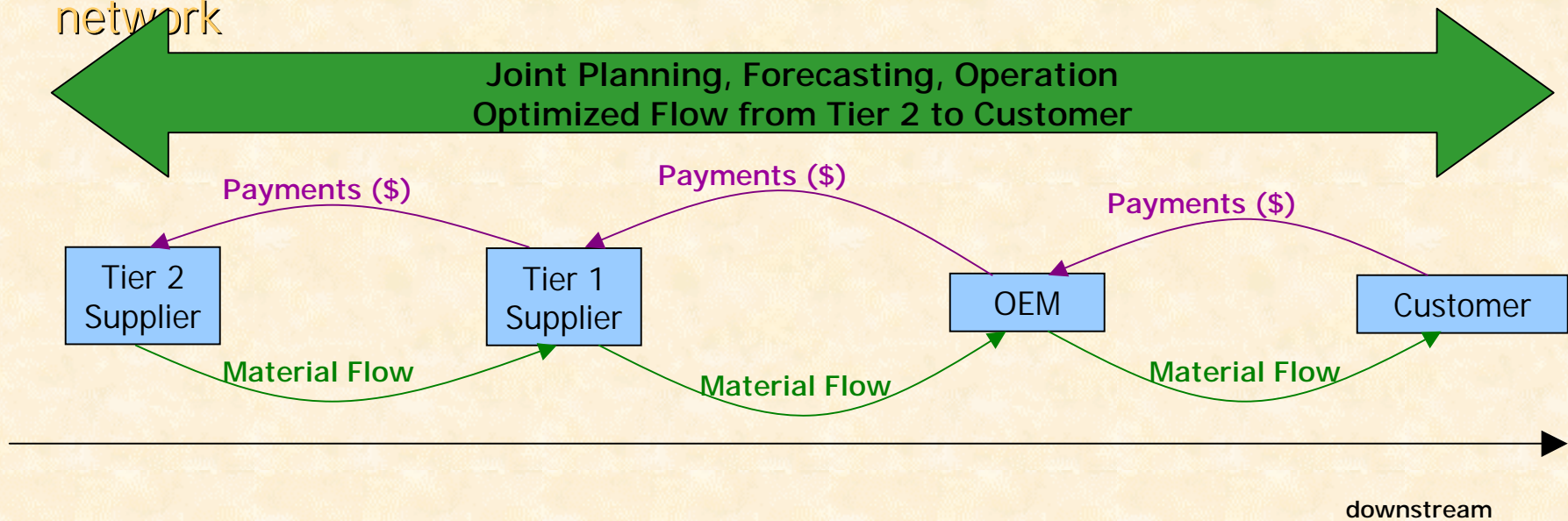
RADICAL - REDESIGN

Optimization Tomorrow

Point-to-Point Collaboration & Optimization Today

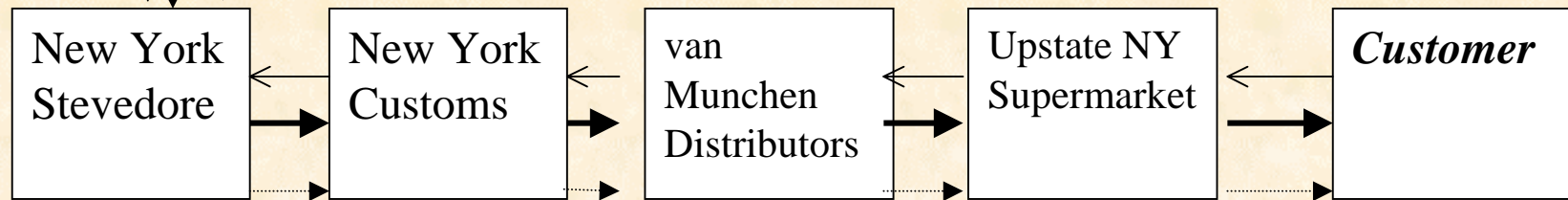
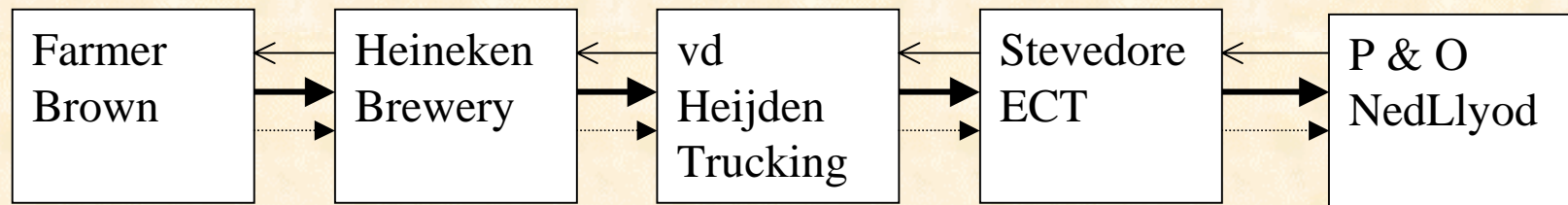


Multi-Tier Collaboration 'Tomorrow' – Optimize across supply network

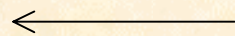


A Typical Supply Chain: Heineken Beer

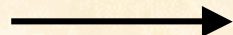
upstream



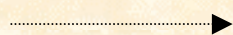
downstream



Order Flow

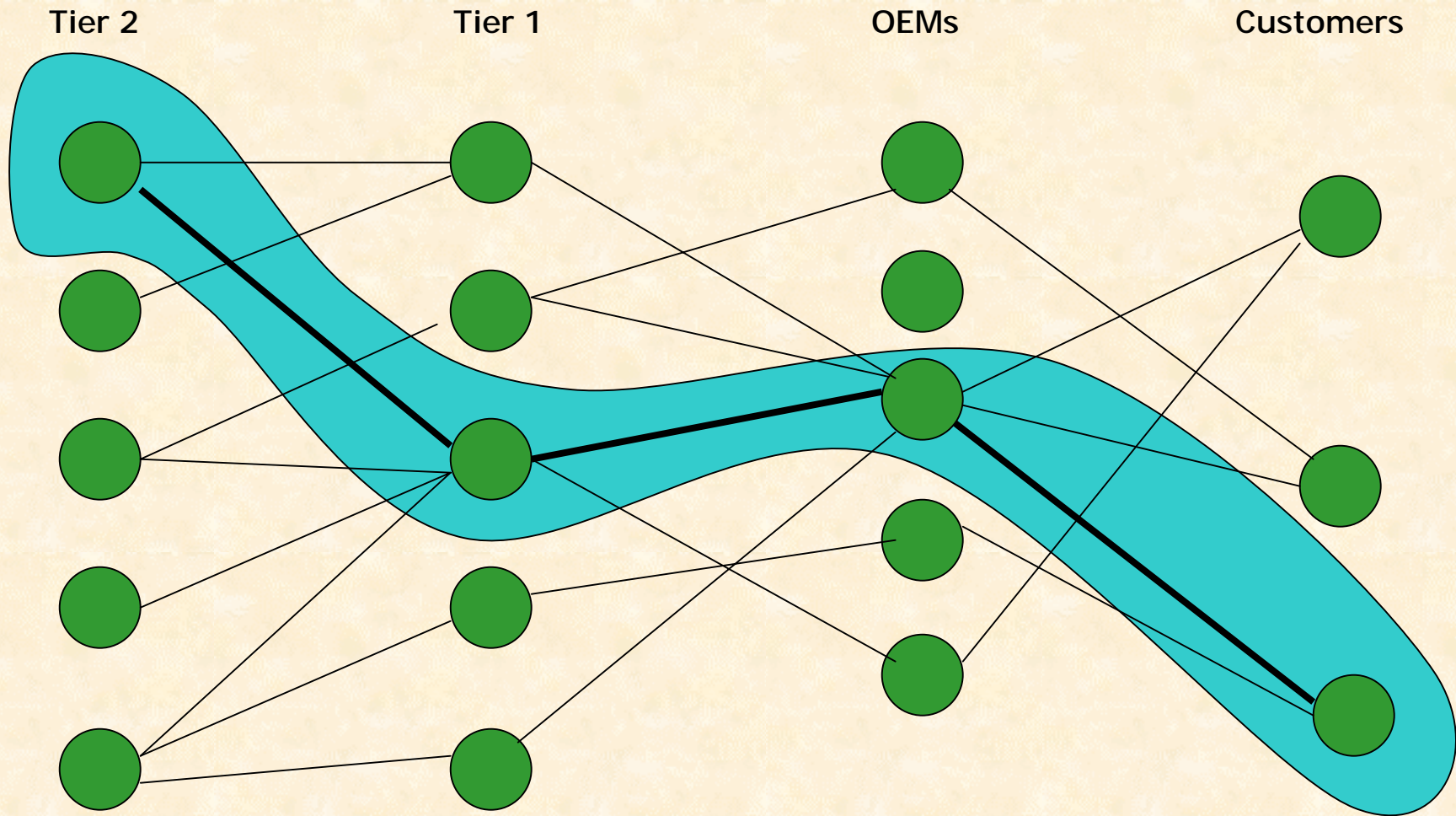


Physical Goods

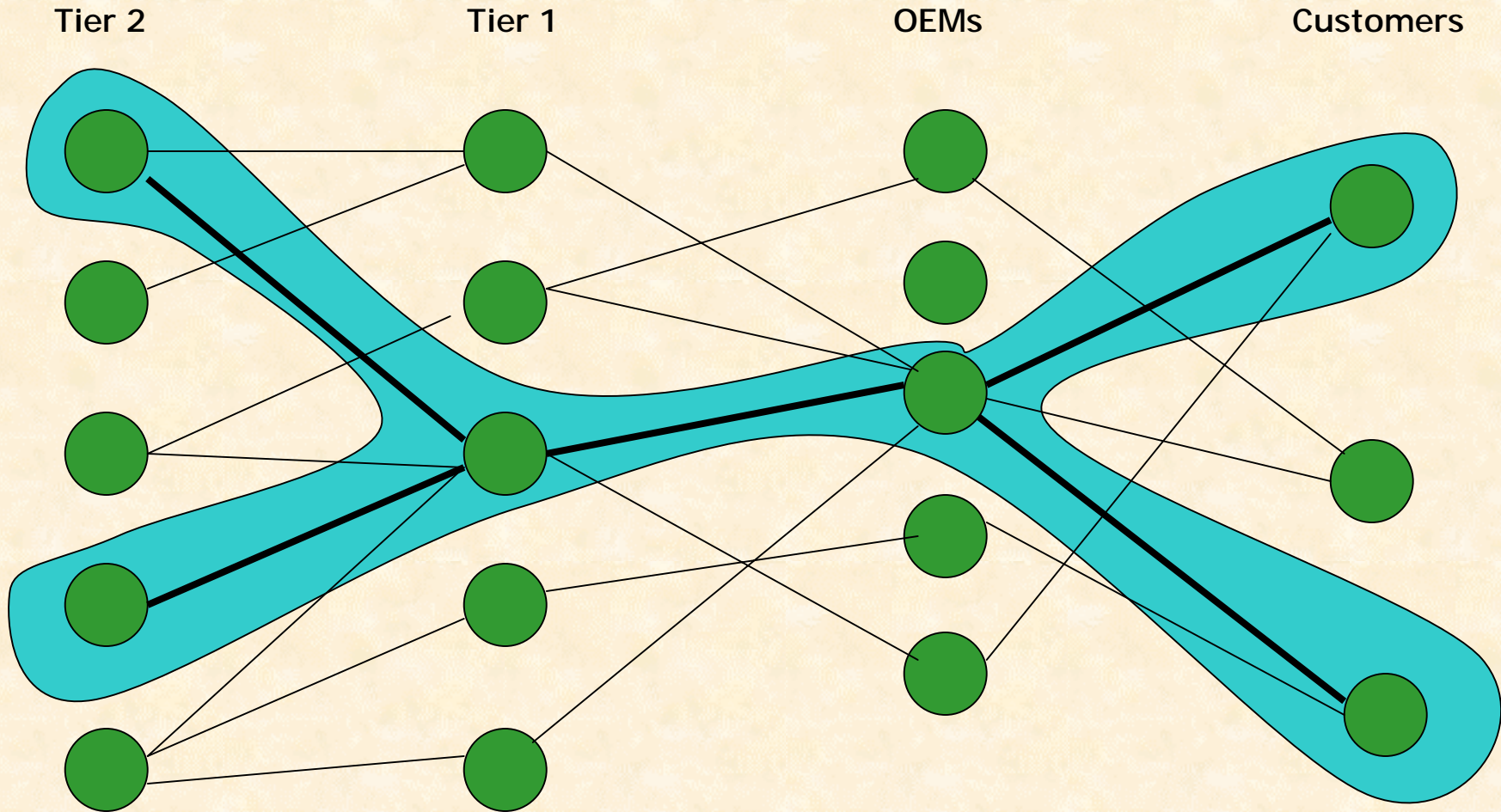


Notice of Shipment Flow

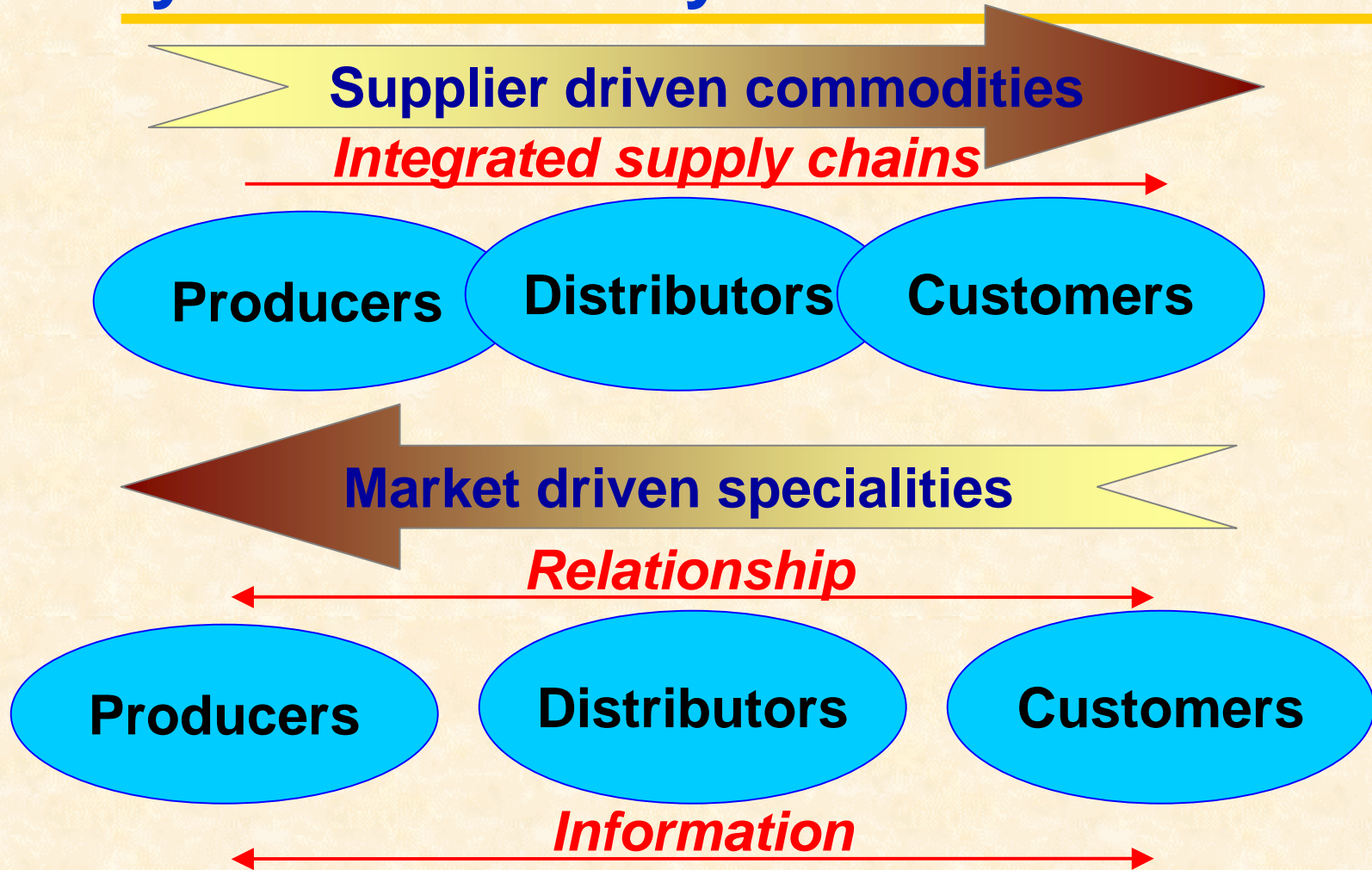
Supply Network – Selecting Partners



Supply Network – Selecting Partners alternative SN



Channels in Chains: Speciality Vs Commodity Chains:



Fieldwork:

- *“E Business for commodities is the integration of IT systems and supply chain optimisation programs and not only about Commerce”.*
Steve Holland Managing Director **Hays Chemicals**
- *“E Business for speciality chemicals is about industry and application management as well as information exchange to enhance the direct dialogue and relationship with customers”.*
Cor Van Dongen Sales Director **Huber Chemicals**

Design Variables for a Supply Chain

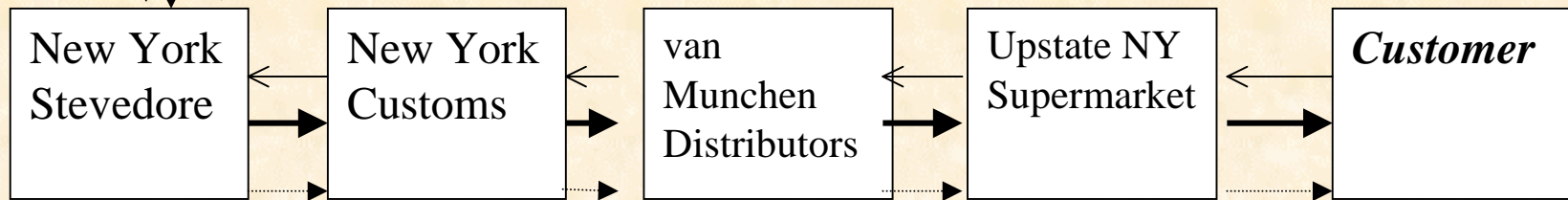
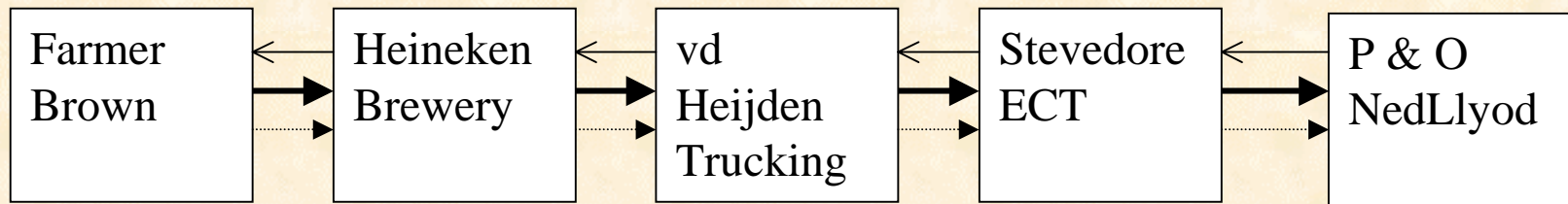
- Choice of Set of Actors - Fixed or Changing
- Governance - Vertically Integrated vs. Markets
- Structure of the Chain
 - structure of how the actors are connected to each other (order or sequencing)
 - fixed vs. variable
- Structure of Coordinating Information Flows
 - sequential dyadic vs. varying flow topologies

Surface Structure of a Supply Chain

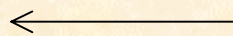
- A particular “Implementation Instance” of the chain
- Embodies a particular set of design decisions:
 - Specific choice of actors in the chain
 - Specific choice of governance mechanisms
 - Specific physical structure
 - Specific information flow paths
- A “PHYSICAL INSTANCE” of the SUPPLY CHAIN

A Typical Physical Instance

upstream



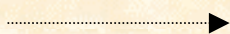
downstream



Order Flow



Physical Goods



Notice of Shipment Flow

Specific Choice of

Actors

Governance

Physical Structure

Information Flows

Static to Dynamic: From chains to webs/hubs

- Vertically Integrated
- Relatively Fixed set of Actors in the chain
- Arranged in a relatively fixed sequential order
- Dyadic sequential information flows
- Operating in a market
- Set of Actors is continuously changing
- The structure or order of connection is flexible - depending on requirements
- Variety of Information Flow Topologies

A Purchaser's opinion:

“We will divest many of our relationship with “manufacturer supplier” as they cannot offer the wide range of services we need. Instead, we will build one stop agreements with e-capable distributors in Europe and USA”.

Vince Hutchinson

BP Amoco Global Procurement Manager

Objective:

- The objective of this research is to develop and test *principles for IT-enabled supply chain re- design* that would:
 - reduce arbitrary constraints (imposed by past history, inflexible technologies, and pre-established structures and relationships)
 - thereby providing greater possibilities for designs (that can meet the supply chain objectives of reduced cost, reduced cycle-times, and increased responsiveness to customer requirements).

Strategy for meeting the Objective

- develop principles of abstraction that can be used to frame the re-design decisions
- These principles will provide the necessary framework for exploiting the re-design potential of the emerging and future technological advances.
- Exploratory testing the framework by conducting fieldwork

Principles of Abstraction

- Borrowed Wisdom from Information Systems Development (DeMarco 1978, McMennin and Palmer 1981)
- Separate the “Logical” and “Essential” from “Physical.”
- “ Viewing the systems as abstract (or “logical”) as opposed to concrete (or “physical”) systems frees the designer from arbitrary constraints on their creative processes that may arise due to the current physical structure of the system” .

Logicalization of Supply Chain Surface Structures

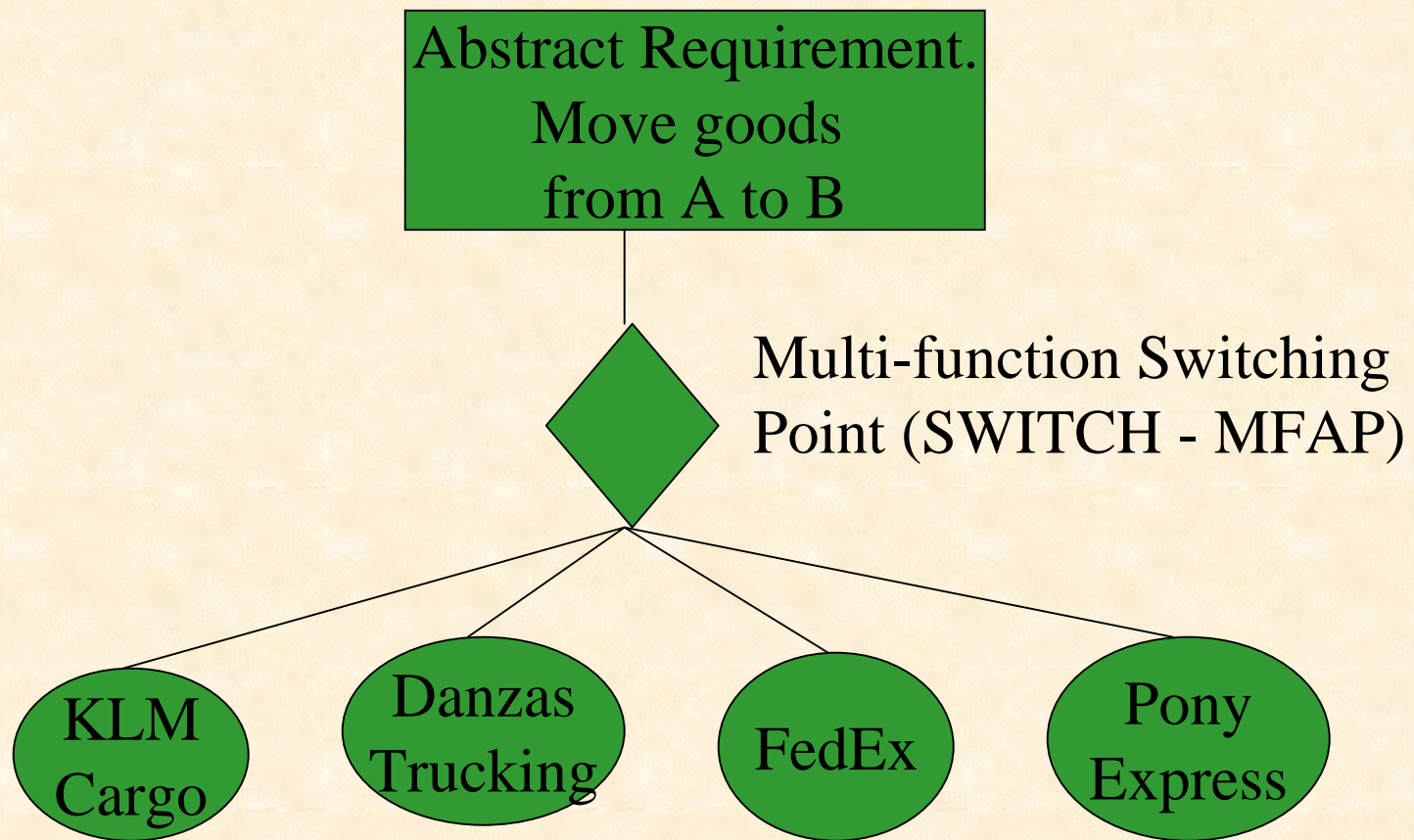
- Based upon two “Principles of Separation”:
 1. Separation of “Abstract Requirements” of work from “Concrete Satisfiers”
 - Abstract Requirements = Logical/Essential
 - Concrete Satisfiers = Specific Choice of Actors

– Moshowitz 1997
 2. Separation of Information Flows from Physical (Object) Flows

– Klobas 1998

Abstract Requirements and Concrete Satisfiers

(Mowshowitz)



Multi-Function Access Point

- Mowshowitz (1997) virtual organization:
 - separating requirements from satisficers
 - tracking and analysis of concrete satisficers;
 - dynamic assignment of concrete satisficers to abstract requirements based on explicit criteria;
 - and exploration and analysis of the assignment criteria
- Multi-Function Access Points (MFAP)
 - An ICT-based switch to do above

Information vs. Physical Flow

- Traditionally information flow is attached to physical object (bill of lading; shipping note, airbill). Information Flow *path* and *timing* same as Physical Flow path and timing
- If information flow is separated from physical flow it can flow independently of the flow of physical object.
- Information Carrier need not be the same as Physical Object Carrier

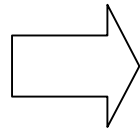
Separating Information Flows and Physical Flows

- **Timing:** Information Flow can travel ahead of physical flows - advance notification
- **Path:** Information Flow path may be different from physical flow paths:
 - Hierarchical or centralized flows
 - Leap frog actors in the chain

Logical Three-Layer Meta-Model of A Supply Chain

Surface Structure:
A particular instance
of the supply chain

*Logicalization
Abstraction*



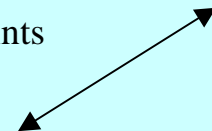
Logical Abstract
Requirements
Workflow Layer
(R-Layer)

Dynamic assignment
through Multi-Function
Access Points

Information Flow
Layer
I-Layer

Concrete Satisficers
Layer or Actor Layer
(A-Layer)

State Monitoring and Work
Triggering



Process: Using the 3-Layer Model

- Choice of Actors -
 - the Multi-Function Access point helps finding the most appropriate actors to fulfill abstract demand requirements
- Governance Decision -
 - Based upon the choice of actors and need for dynamic combination of vertical integration and markets, (buy) choices can be made
- Chain Physical Structure -
 - can now be designed based upon the essential chain requirements rather than arbitrary constraints

Process: Using the 3-Layer Model

- Information Flow Structure - Once the above decisions are in place design the information flow structure that is most appropriate to support triggering, tracking, and planning in the chain.
- Select the ICT Technology to support the information flow structure

ICT's Role in Radical redesign

Case:

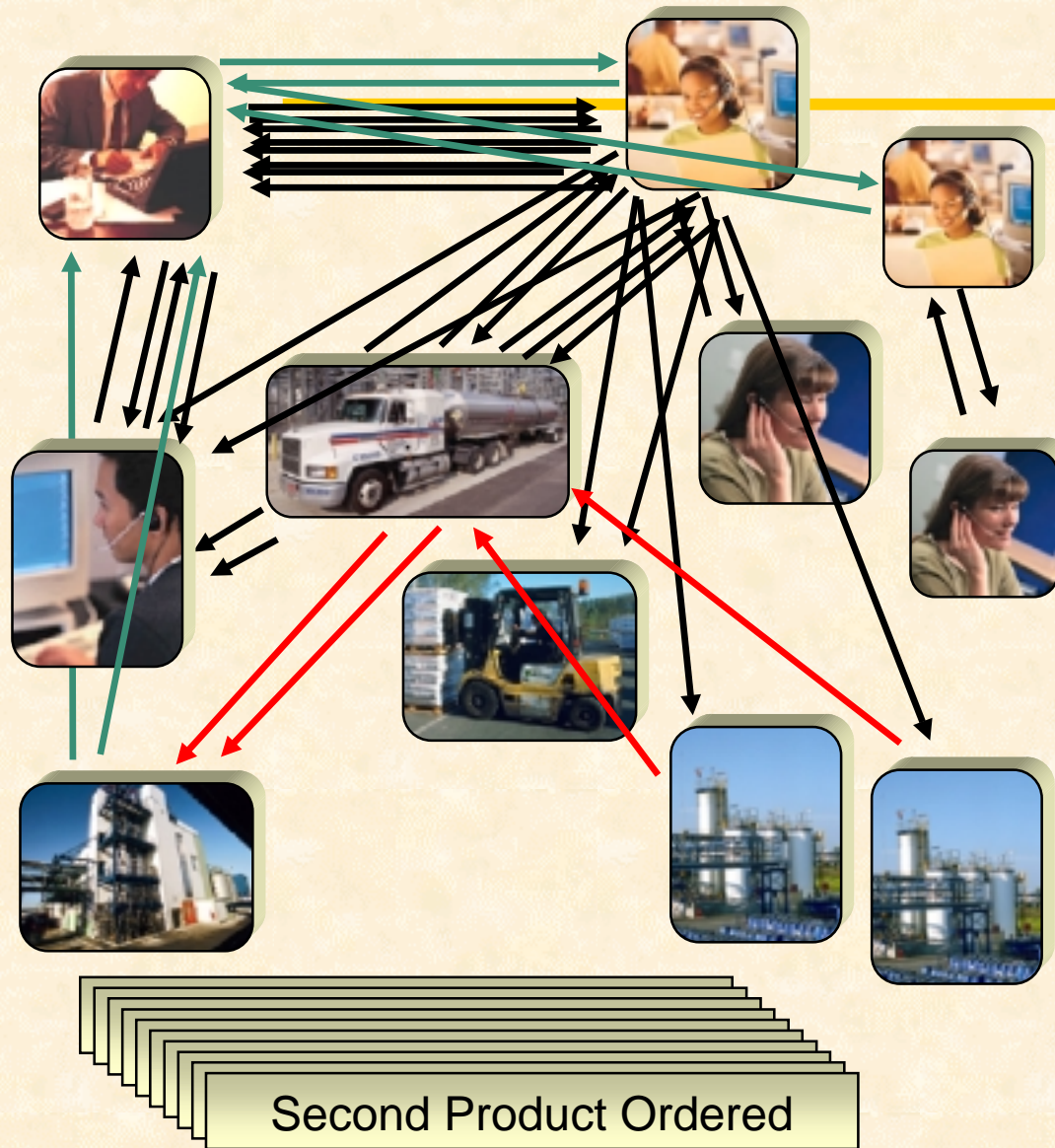


- from dyadic to network based coordination (EDI-ERP-B2B exchange solutions)
- Coordinating and Optimizing information flows across the chain (tracking and tracing)
- Governance: benevolent “ lord of the chain” or “ gorilla” ?

Rationale for Founding Elemica

- **Technology advances and new business models are transforming how business will be done**
- **Reduce transaction costs**
- **Reduce supply chain costs, and**
- **Eliminate duplicate technology spends**

Transaction Savings and Supply Chain Inefficiencies



The global chemical industry needs to:

- Eliminate slow, manual processing of routine transactions
- Streamline inefficient document flows
- Reduce excessive or redundant inventory used to cover forecasting difficulties
- Optimized logistics networks
- Eliminate redundant technology spends

Product push or product pull:

*“ Most producers designed their supply chains to “push” the products through to their customers and distributors. They hold minimum inventories along the supply chain. This explains why E-Channels and Portals offer limited product liquidity so far. To serve new E-Channels, producers must **redesign their supply chains** and increase their inventories, at least as long as they build sales through new E channels”*

Marc Fermont (Districonsult)

A Purchaser's opinion

“We will divest many of our relationship with manufacturers/ suppliers as they cannot offer the wide range of services we need. Instead, we will build one stop agreements with e- capable distributors in Europe and USA”.

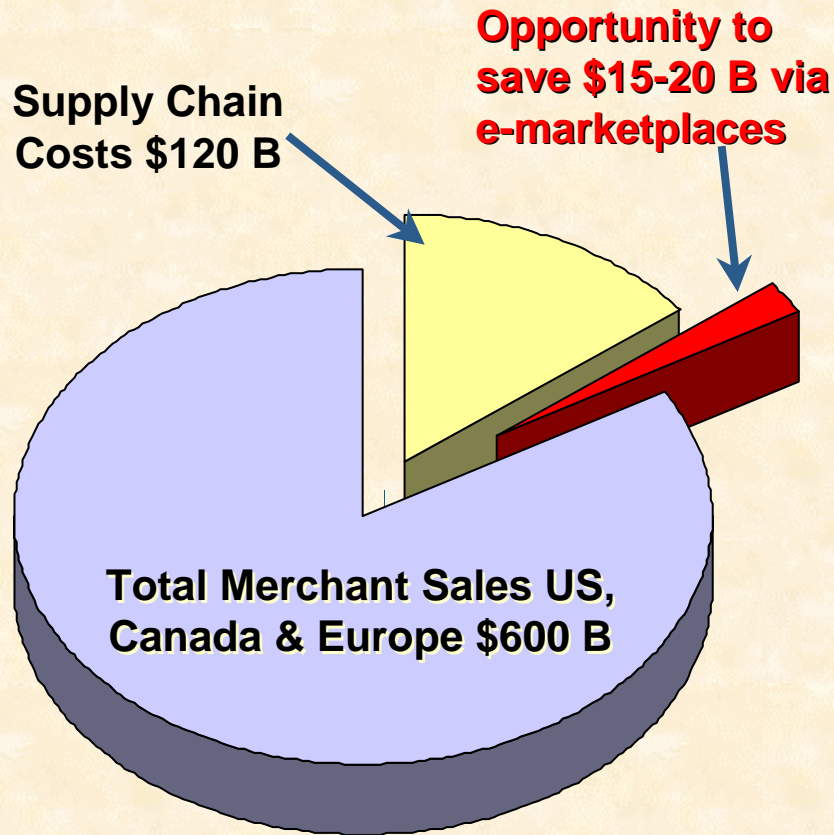
Vince Hutchinson

BP Amoco Global Procurement Manager

Distributors' main challenges

- Old, disparate and obsolete legacy systems
- No ERP system in place
- Limited funds available for large IT investments
- No knowledgeable “in house” IT staff
- Wide customer and product mixes
- Vertical organisations, no lateral thinking
- Interactivity with many suppliers and customers
- Complex range of logistic services like SSP, VMI returnable containers, Drumming, Formulation

Supply Chain Savings from a Chemical e-Marketplace Are Large

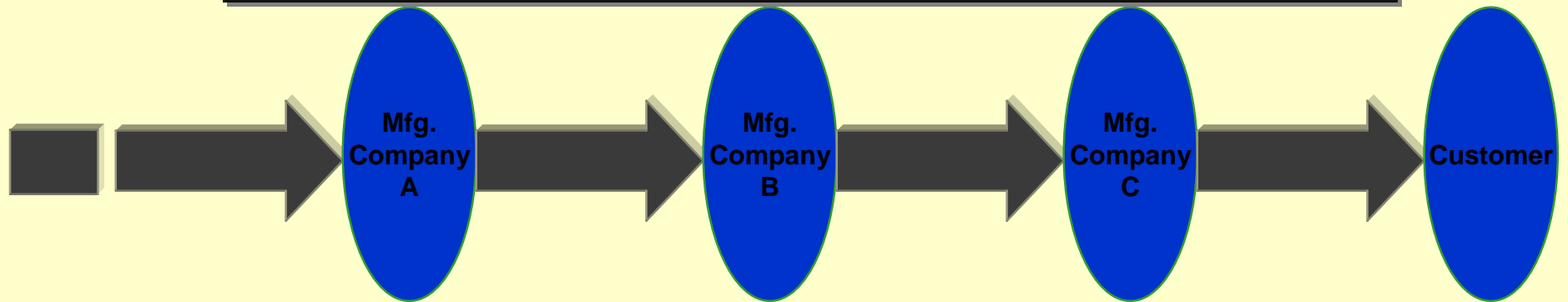


Savings may result from:

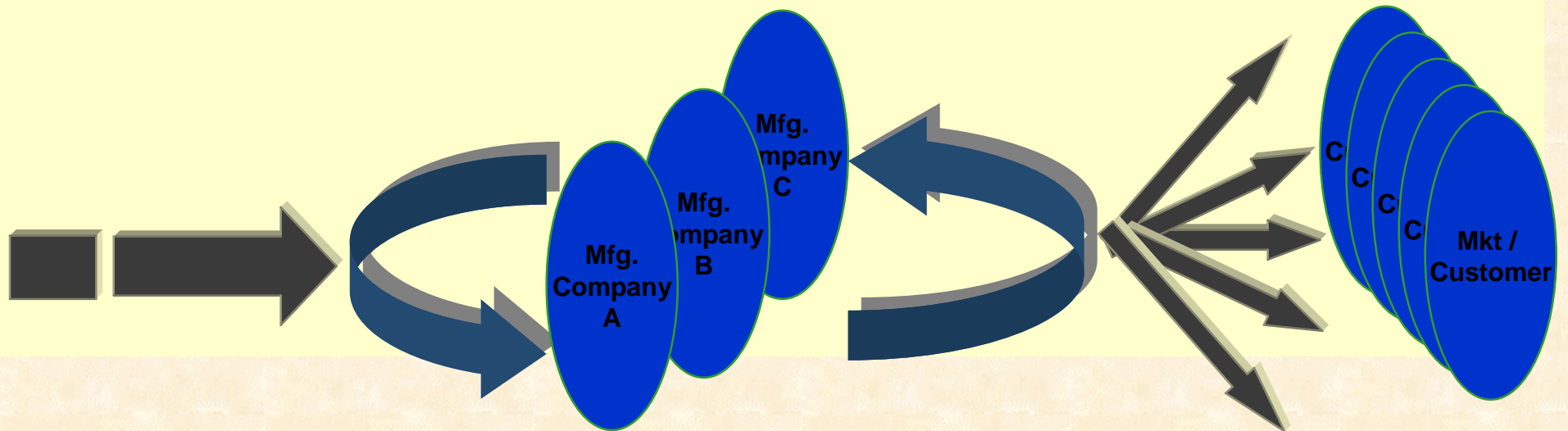
- Elimination of redundant inventories
- Automated transaction processing
- Lower transportation costs
- Improved document flow
- Electronically facilitated contract management

What is unique about Chemicals?

Typical Manufacturing Linear Value Chain



Chemical Industry Supply Chain



This generates a lot of buying and selling within the Industry

What Elemica Is



Elemica is

- A global solution for the industry and it's customers
- An open environment embracing all chemical buyers and sellers
- A standalone, neutral company
- Supported by both buyers and sellers in the chemical industry
 - Financial stability
 - Liquidity
 - Global reach with capability to scale quickly
- Secure: Information is protected
- An e-commerce solution to reduce supply-chain costs for participating companies
- A catalyst for strengthening the relationship between buyer and seller

Elemica is better characterized as a NETWORK than a MARKETPLACE

... What is Elemica not?

- An aggregator of chemical purchasing
- A buyer, seller or 'owner' of products
- A middleman getting between buyers and sellers

.... Savings from automation and Standards on 3 counts ...



COST

Order management → Reduce \$50 (to 90\$/try)
Contract management → Selling & legal hours
Transportation & logistics → 5% of transportation costs



CASH

Supply chain planning → Inventory turns +20%;
>10% inventory reduction

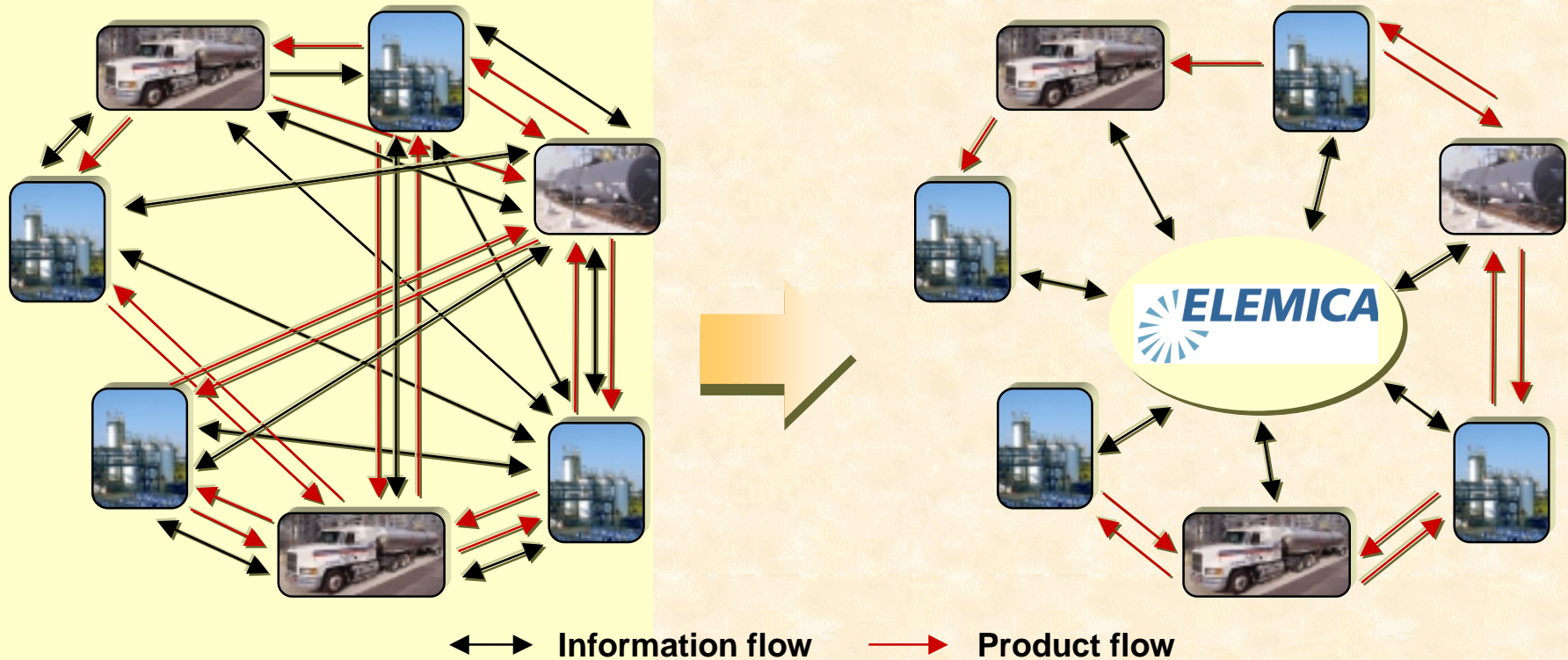


CAPITAL

ERP connectivity → Eliminate the need to develop and maintain redundant technology

Elemica's end-to-end solution should reduce costs, reduce working capital requirements and greatly simplify ERP connectivity.

The Hub Minimizes Chaos



Elemica expects to serve as a single point of contact for sharing information between contract buyers and sellers

Value added beyond internal Process Automation

VALUE derived for the customer from an unique Industry HUB



Customer could “VIEW” into ELEMICA as one industry Network ...

- Look at order status for all shipments
 - for the scheduled arrival and status for next few days (tracking)
 - with filter (“only those delayed by more than 2 hours”)
- Maintain *Customer logistic file globally*
 - “From now on, Friday deliveries stop at 4 pm”
- And more ...

Value added beyond internal Process Automation

... for the Logistic provider from an unique Industry HUB



In



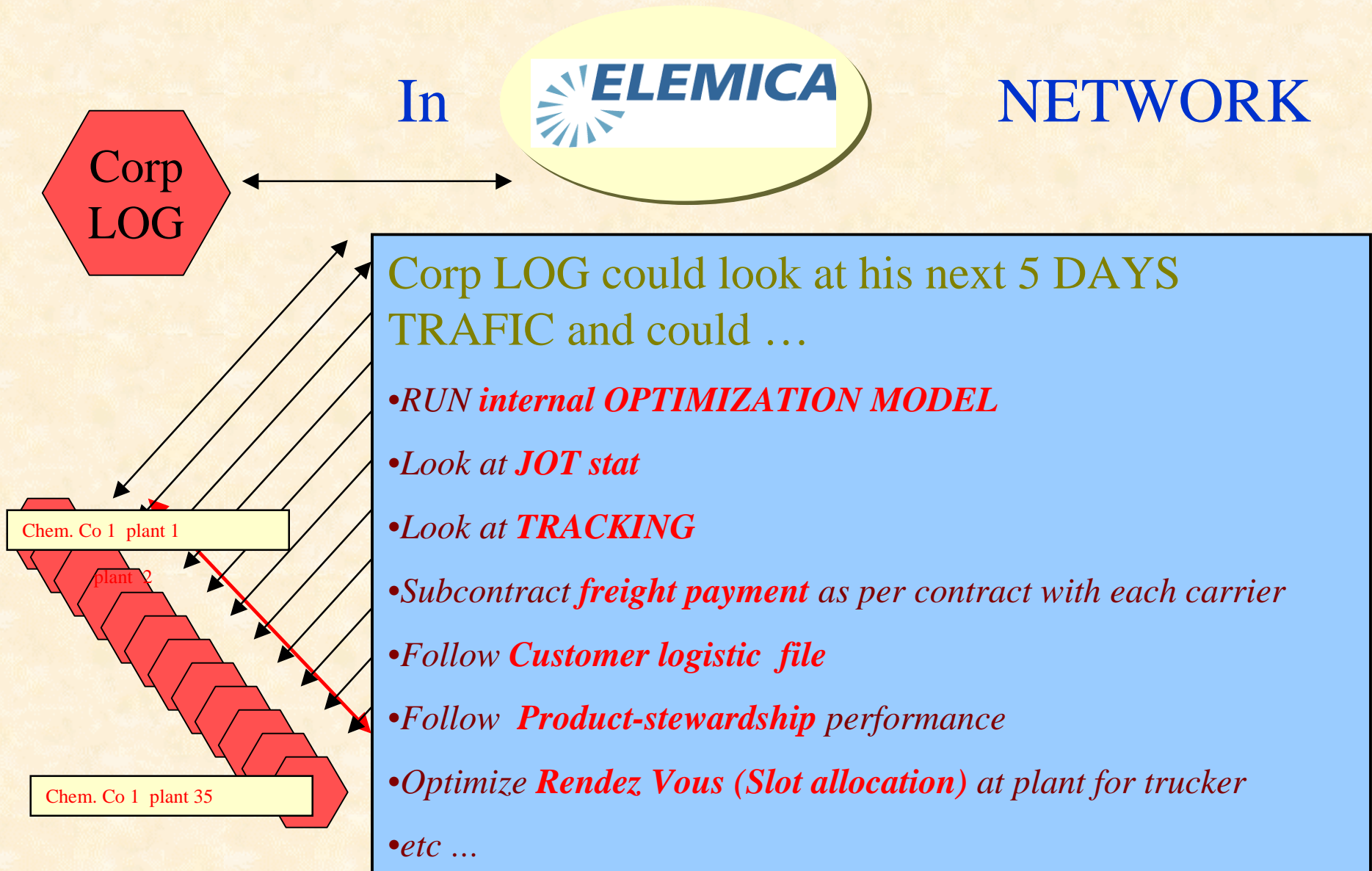
NETWORK

Log Provider could have a “VIEW” into ELEMICA as one industry Network ...

- See all his traffic with the industry
- Communicate through one Channel with one Standard
- Can consolidate invoice and order settlement
- Feed JOT and Tracking info
- Can optimize internally his movement
- ... and more

Value added beyond internal Process Automation

... for the *Chemical CO LOG* from an unique Industry HUB



Elemica's timing for Release ... and **JARGON**

3 Elemica product offerings :

1. **ERP to ERP connectivity or connected Solution**
2. **Web access or Hosted solution**
3. **Supply Chain and Logistics or e4pl**

Elemica Case Analysis:

- Functions as true MFAP
- facilitates dynamic switching of actors
- separates information flows from product flows in industry and optimizes them
- allows dramatically different coordination

ERP to ERP or Connected Solution :

April 2001

- Clearly the highest priority for the Industry !
 - *Point to Point is too expensive !!!*

- Application processing logic will primarily reside in the member current host systems

- They will perform the validations, host the data

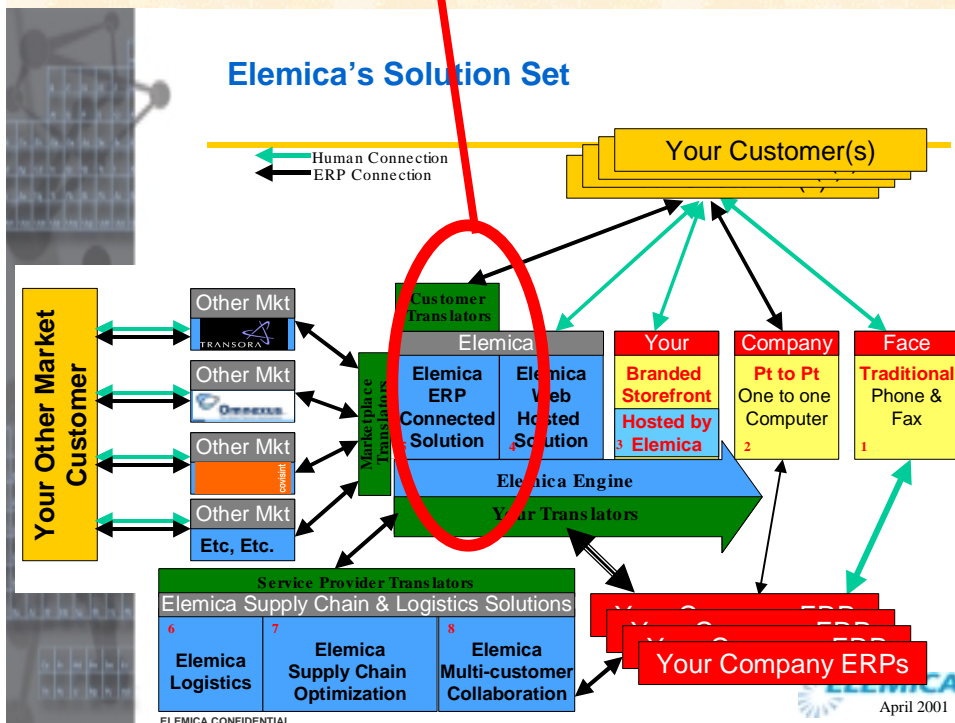
- Elemica's task is to

- Provide a single point of connectivity (the digital dial-tone) **XML, IDOCS, EDI ...**

- Translate the transactions into formats readily processed by the receiver

- Properly route and track the transactions

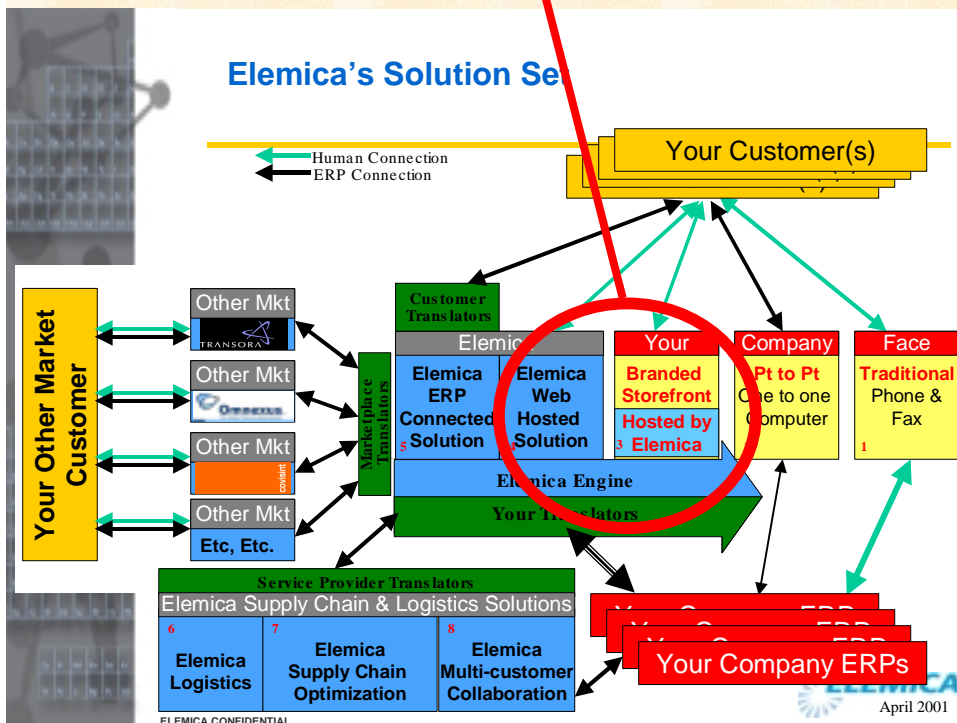
- Save its members from having to develop and maintain hundreds of trading pairs per facility



Branded Store Front and Hosted Solution :

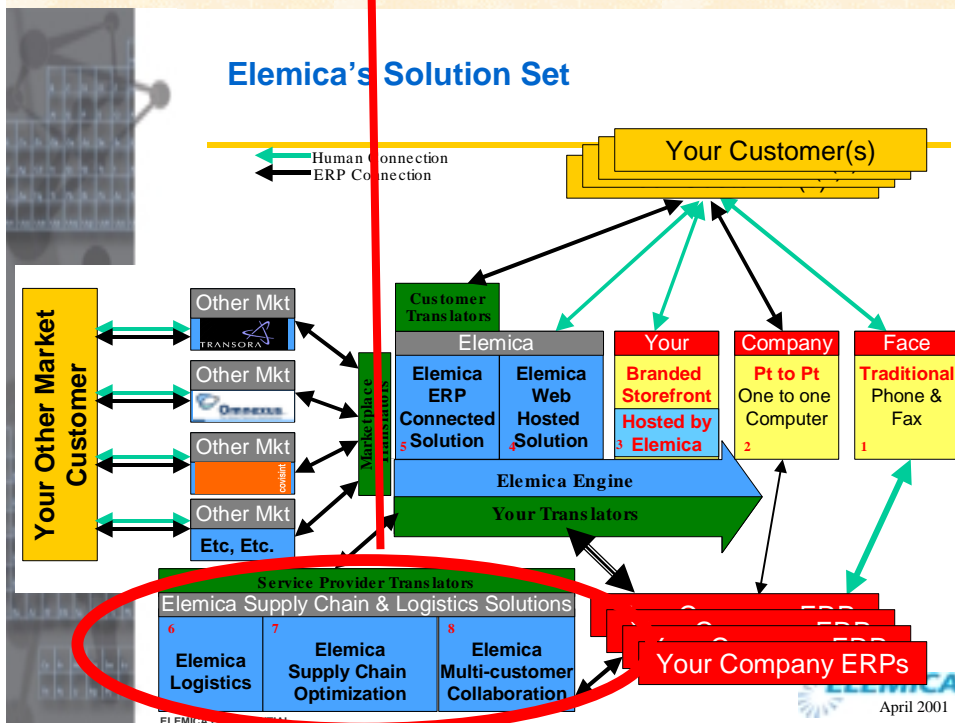
3rd Quarter 2001

- Branded Storefronts offer significant value for our members
 - Preserves and extends the individual member company brand equity
 - Provides a lower cost of ownership
 - › For development
 - › For continuing maintenance
 - Leverages and extends the ERP Connected Solution
 - Leverages Elemica's value-added services



Logistics & Supply Chain: 3rd Q 2001

- Logistics Support Services
 - Transportation arrangement
 - Tracking and tracing
 - Settlement
- Supply Chain Optimization
 - Integrated planning
 - Collaborative forecasting
 - Vendor managed inventory
 - Supply chain modeling
- Multi-customer collaboration
 - Logistics and Supply Chain network optimization



Prediction

- Most distributors will soon offer *on line* order entry.
- Many distributors will join “**Portiches**” rather than large industry portals.
- Distributors link up to the order management sites of their strategic suppliers.
- Leading bulk distributors will offer “on line” integrated supply chain solutions to their customers and suppliers.
- Speciality distributors will display their catalogues and services to support direct and on line sales efforts.
- Distributors will have more on line purchasing choices.
- **Chemical distributors are transforming and adapting, not disappearing**
- **Supply chains are radically redesigning themselves!**

Summary

- Using Logicalization and Essential Modeling makes it possible to identify the essential customer-value steps in the chain
- Hubs and B2B marketplaces are basically MFAP's that make it possible to select the most appropriate actors to meet the essential requirements
- Chain's Physical Structure and governance can be quickly re-engineered and optimized
- Elemica effects all Design Variables :
 - Choice of Set of Actors - Fixed or Changing
 - Governance - Vertically Integrated vs. Markets
 - Structure of the Chain
 - structure of how the actors are connected to each other (order or sequencing)
 - fixed vs. variable
 - Structure of Coordinating Information Flows
 - sequential dyadic vs. varying flow topologies

Next Steps:

- Before the end of the year we will have obtained data from the implementation of Elemica to see if above lead to:
 - reduction of supply chain costs
 - Faster response times
- Test the effects of e-channels on chains
- Other empirical studies will follow.....

THANK YOU

Questions????

Dr. Ellen Christiaanse
echristiaanse@xs4all.nl