Supply Chain Systems I: Enterprise Resource Planning

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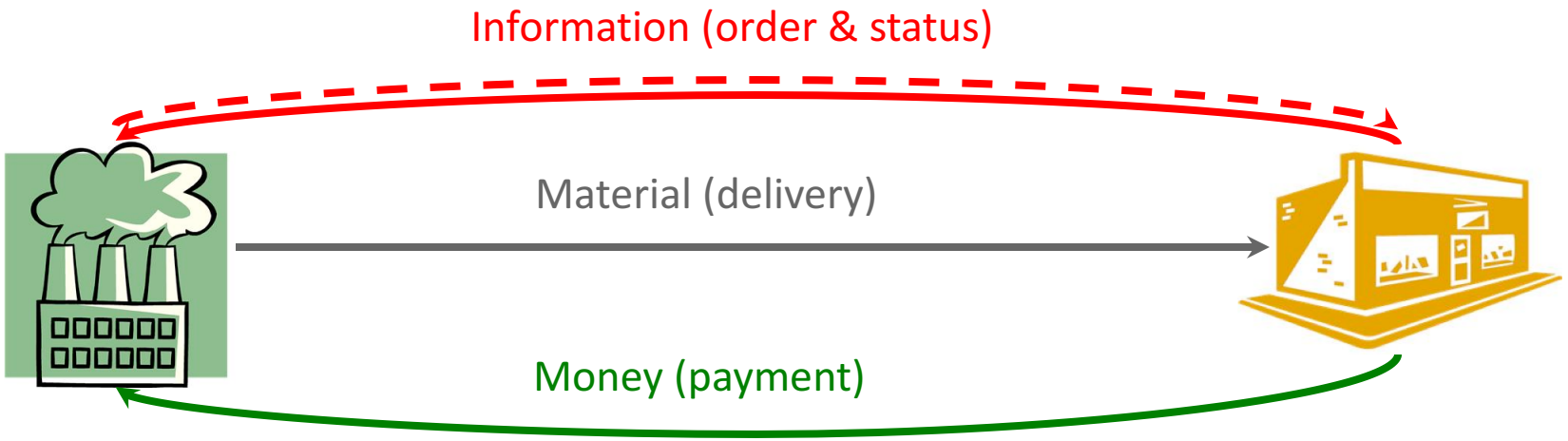
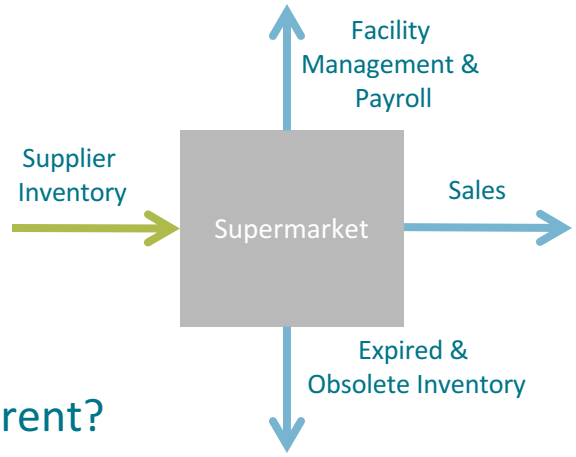
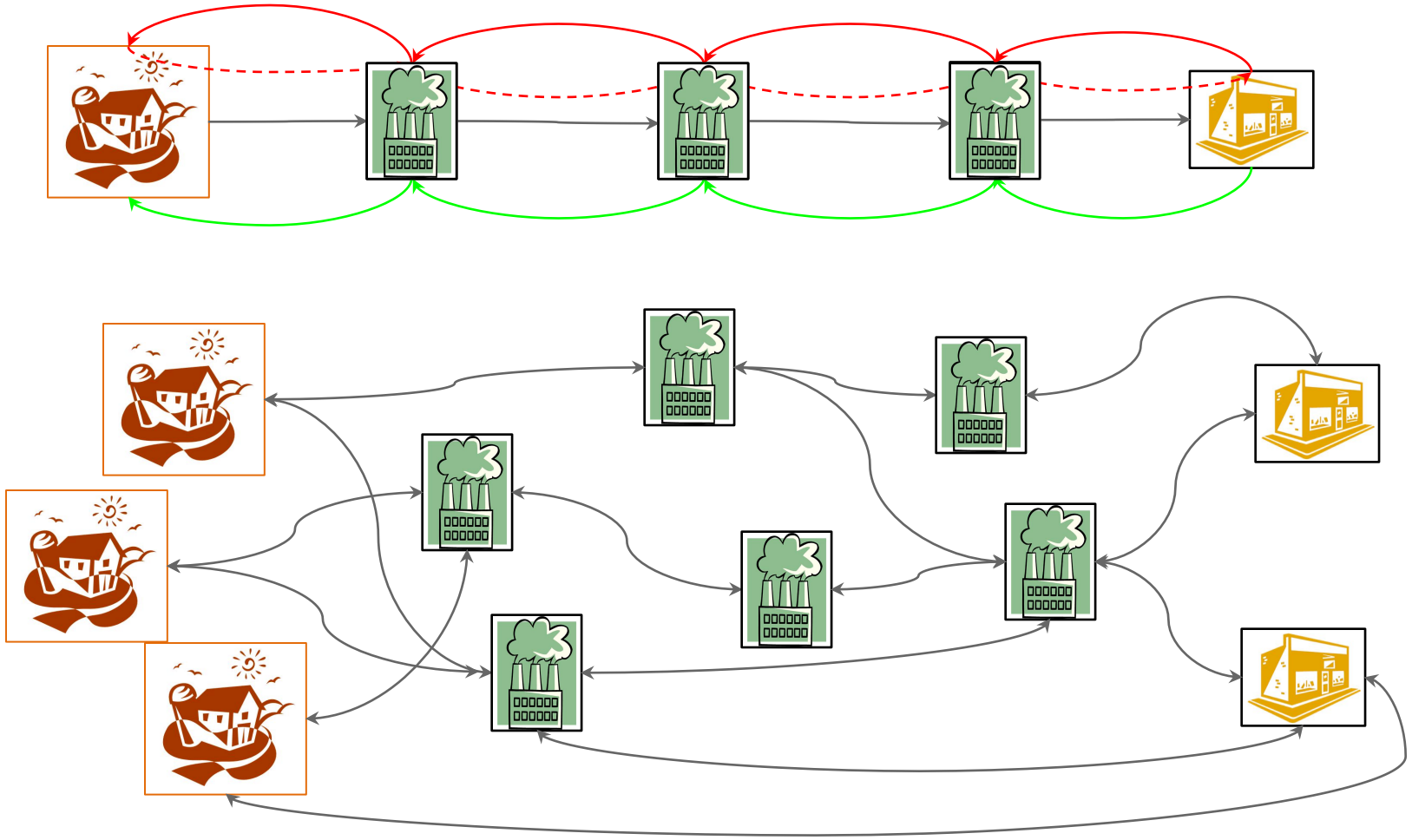
Why do supply chains need IT systems?





- Let's focus on this single supermarket.
  - How many daily transactions take place?
  - How do you accurately capture them?
  - How do you ensure the information is consistent and current?
  - How can you use that information to make business decisions?
  - How can these objectives be achieved efficiently?
- At one store, in one week, millions of transactions can occur.

Why do supply chains need IT systems?



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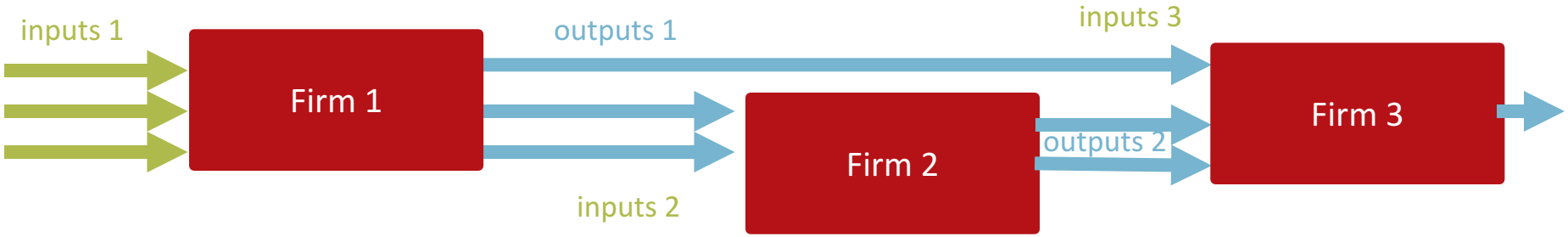
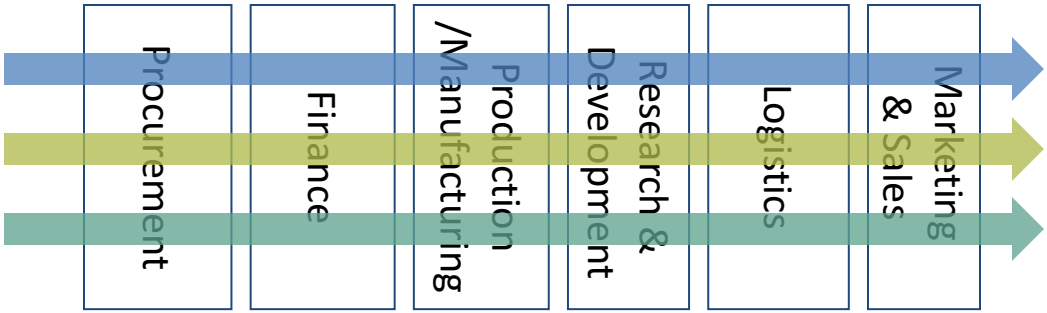




Why do supply chains need IT systems?

B2B = business to business
B2C = business to customer
M2M = machine to machine

- Supply chains . . .
  - are large, complex, and involve multiple players,
  - have become intertwined - where individual actions impact others,
  - need to make decisions with common data (one version of the truth), ,
  - interact with other functions in a firm, and
  - require seamless, instantaneous communication for B2B, B2C, M2M, etc..
- Information Technology Systems
  - Enterprise Resource Planning (ERP)
    - General ledger and central database/repository for all firm activity
  - Supply Chain Planning
    - Production Planning and Scheduling, Demand planning, Product Lifecycle Management
  - Supply Chain Execution
    - Transportation and Warehouse Management Systems and Manufacturing Execution Systems

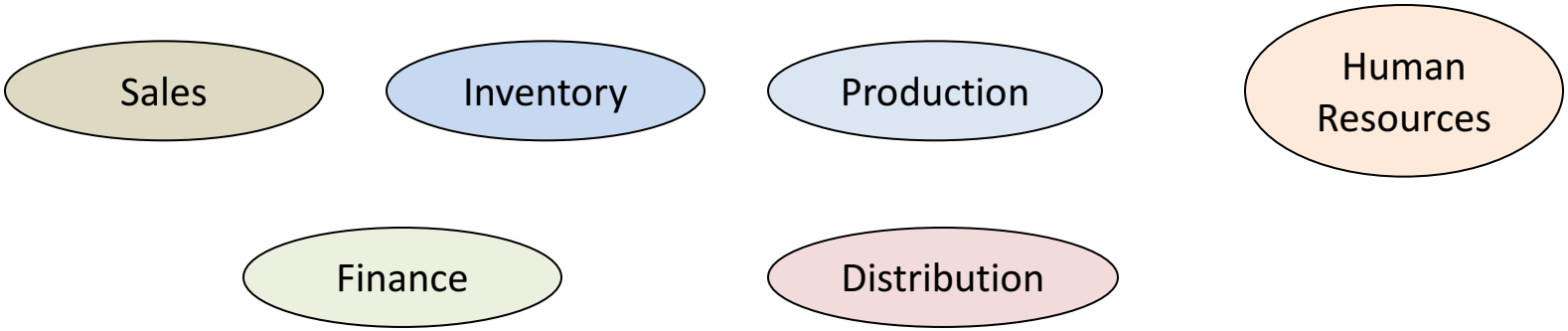
Key Points

- Why do firms use ERPs?
- What are the core functions in an ERP?
- What data is needed?
- How do systems communicate?
- What are some strategic benefits of an ERP?

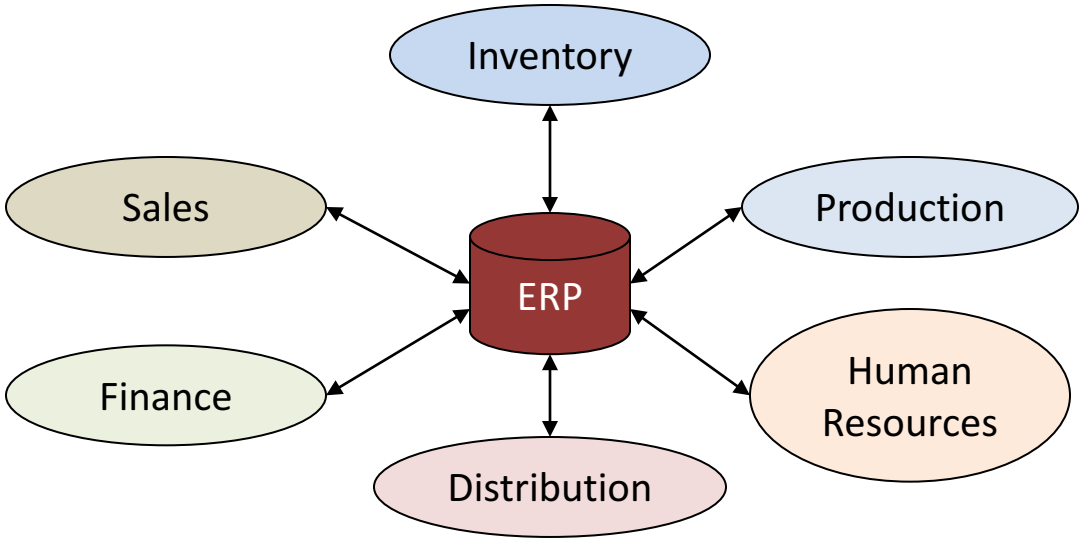
ERP Basics – Benefits & Drawbacks

Why do most firms have an ERP?

Suppose each function within a firm had a siloed database . . .



How would this look with a centralized ERP?



ERP Benefits & Drawbacks

"Standardization can lead to increased flexibility"
Thomas Davenport
Mission Critical (2000)

- Benefits – an ERP allows an enterprise to . . .
  - organize, codify, and standardize processes and data structure,
  - integrate "pockets of information" into unified repository,
  - make data instantaneously visible and available across functions for immediate decision making,
  - eliminate redundant/alternative management systems and data,
  - reduce the amount of non-value-added tasks (e.g., data entry),
  - take advantage of "best practice" standardized process designs, and
  - be more flexible!
- Drawbacks – Adopting and using an ERP can . . .
  - require costly and time consuming implementation and maintenance
  - allow data errors to ripple and be replicated throughout the system,
  - can limit competitive advantage by forcing use of standard processes,
  - make a firm reliant on a single vendor to support mission critical systems,
  - lead to a shortage of personnel with technical knowledge of system, and
  - result in very high cost of system down-time due to wide impact.

ERP Basics – Core Functionality

What do ERPs do?

- ERP System:
  - A complex software system that ties together and automates all enterprise-wide basic business processes – from taking orders and processing requisitions, to monitoring inventory levels, to financial accounting and human resource management.
  - Records every business transaction, in an enterprise wide data format, and updates the right connected systems to reflect each transaction.

Core ERP Components

Customer Management	Product Data
Manufacturing	Finance
Procurement	Asset Management
Logistics	Human Resources

Adapted from Ross, D.F., (2011) *Introduction to Supply Chain Management Technologies*, CRC Press.

Core ERP Components

Customer Management	Product Data
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- Customer Management – the face to customers
  - enables order entry, order promising, open order status
  - allows marketing to set pricing schemes, promotions, and discounts
  - provides real-time profitability analysis, and
  - permits order configuration, customer delivery schedules, customer returns, tax management, currency conversion, etc.
- Manufacturing – the face to production
  - is the original role of most early ERP systems,
  - includes MRP processing, manufacturing order release, WIP management, cost reporting, shop floor control etc.,
  - provides real time linkage of demand to supply management enabling real time Available-to-Promise (ATP) & Capable-to-Promise (CTP), and
  - serves as primary interface to "bolt-on" advanced planning and scheduling optimization modules.

Adapted from Ross, D.F., (2011) *Introduction to Supply Chain Management Technologies*, CRC Press.

Core ERP Components

Customer Management	Product Data
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- Procurement – the face to suppliers
  - integrates procurement with supplier management,
  - facilitates purchase order processing, delivery scheduling, open order tracking, receiving, inspection, and supplier performance reporting, and
  - creates requests for quotation (RFQ)
  - manages negotiation and pricing capabilities.
- Logistics – the face to internal and external supply chain
  - runs the internal supply chain for enterprise,
  - provides connectivity to remote trading partners (3PLs, carriers, etc.),
  - handles distribution channel configuration, warehouse activity management, channel replenishment, planning, distribution order management, etc., and
  - serves as primary interface to "bolt-on" warehouse and transportation management systems (WMS and TMS).

Adapted from Ross, D.F., (2011) *Introduction to Supply Chain Management Technologies*, CRC Press.

Core ERP Components

Customer Management	Product Data
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- Product Data – the face to all material
  - describes products enterprise makes and/or distributes,
  - contains proprietary data on costs, sources, engineering details, dimensions, weight, packaging, etc.,
  - interfaces with inventory, manufacturing, and product lifecycle management, and
  - sometimes included in partner collaborations in order to compress time to market of new products.
- Finance – the face to the CFO
  - strong suit of most ERPs (but also a double edged sword!),
  - provides real-time reporting of all transactions resulting from inventory movement, accounts receivable, accounts payable, taxes, foreign currency conversions, and any other journal entries, and
  - supports detailed reporting and budgeting capabilities.

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Core ERP Components

Customer Management	Product Data
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- Asset Management – controlling key assets
  - controls enterprise's fixed assets,
  - establishes and maintains equipment profiles, diagnostics and preventive maintenance activities, and depreciation tracking.
- Human Resources – face to employees
  - manages all aspects of human capital within enterprise,
  - monitors performance of transaction activities to include time, payroll, compensation, expenses, recruitment, etc.,
  - supports employee profiles, skill development, career planning, performance evaluations, and retention.

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Core ERP Components

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ERP Basics – Data

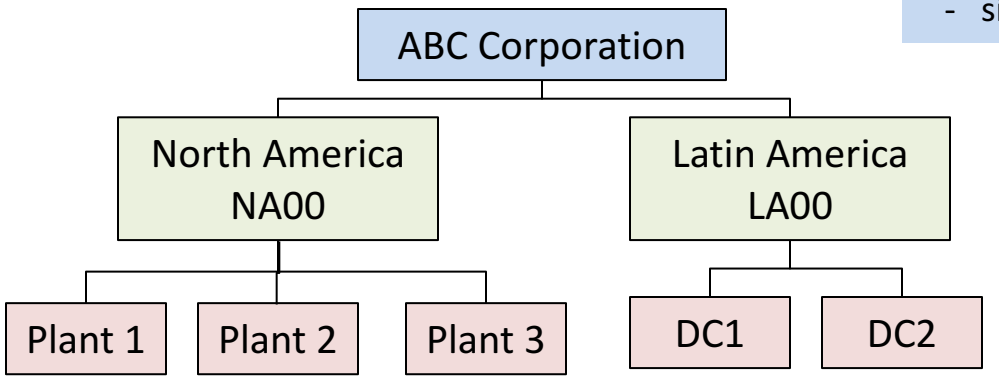
Data in an ERP System

- Three General Types
  - Organizational Data
    - represents the structure of an enterprise
  - Master Data
    - represents entities (customers, vendors, material, etc.) associated with specific processes
  - Transaction Data
    - reflect the consequences of executing process steps

- Tied to business processes:
  - Processes are executed in the context of organizations, using master data, that results in transaction records or data.

Organizational Data

- Captures organizational structure of enterprise
- Examples include companies, subsidiaries, factories, warehouses, storage areas, sales regions, etc.



Client/Enterprise Level
- highest level
- single enterprise of ≥1 companies or subsidiaries

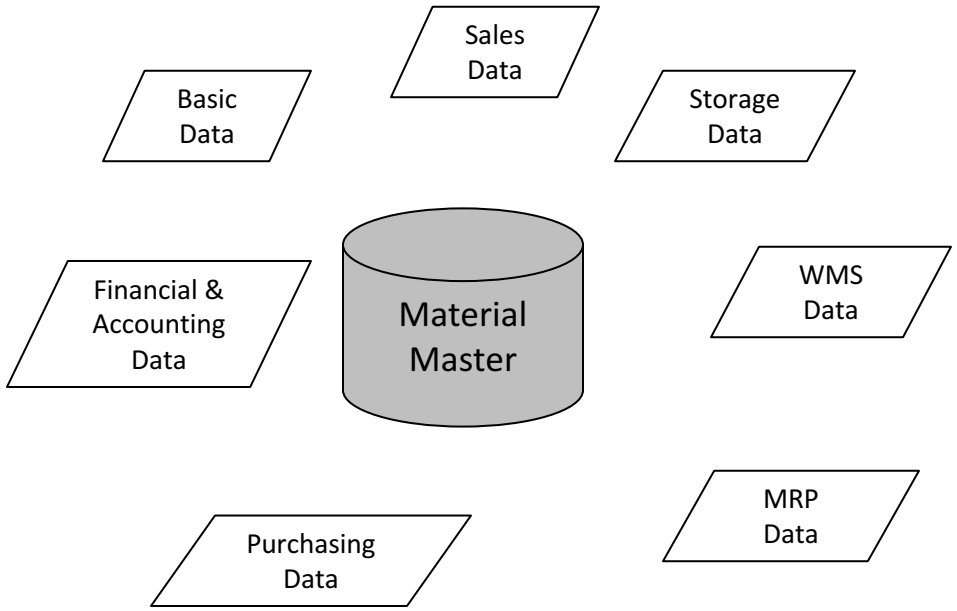
Company Level
- separate legal entity
- can only belong to a single client/enterprise

Plant/Facility Level
- a specific facility, or set of facilities, where:
  - products are created
  - material is stored for distribution
  - production planning occurs
  - service or maintenance is performed
- a single facility may have multiple plant codes
- can only belong to a single company

Adapted from Magal, S. and J. Word (2012), *Integrated Business Process with ERPs*, Wiley.

Master Data

- Represents all entities used in processes
- Material Master is the most commonly used
  - Different processes use materials differently - adds to complexity
  - Specific data needs differ by process – different views
  - Multiple material types (raw materials, semi-finished, finished goods)
  - Material groups – collections of similar or similarly used items



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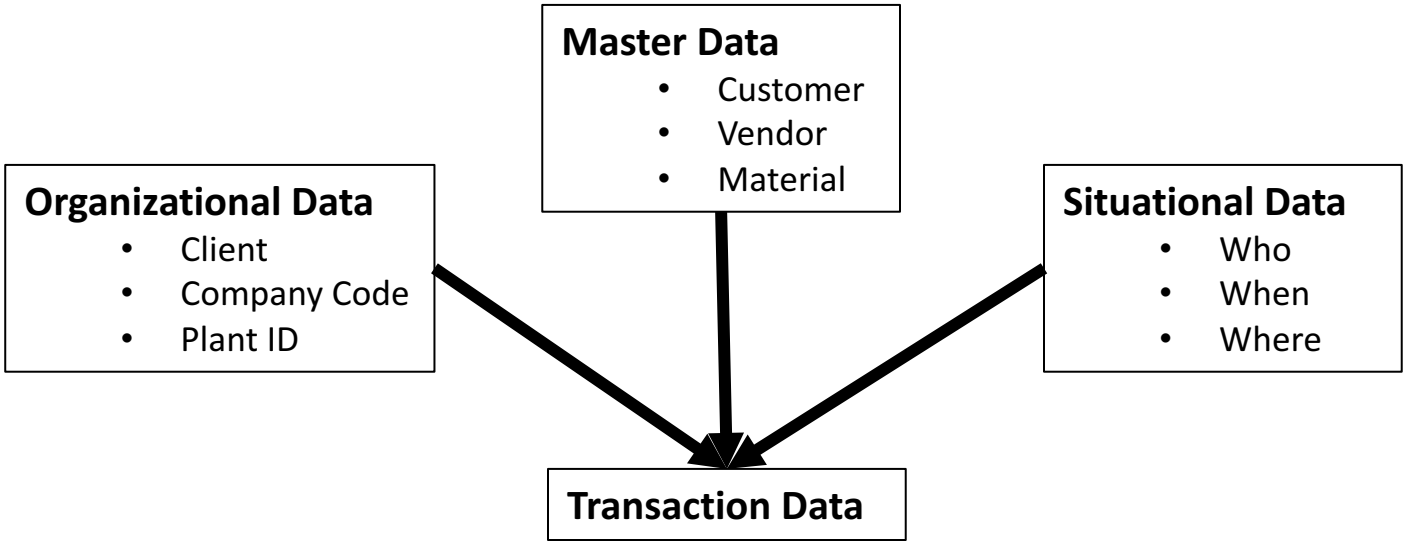
Transaction Data

- Reflect the consequences of executing business processes
- Combination of organizational, master and situational data
- Transaction documents – e.g., purchase orders, invoices, etc.
- Virtual documents – internally generated and used within ERP



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ERP Basics – Communication

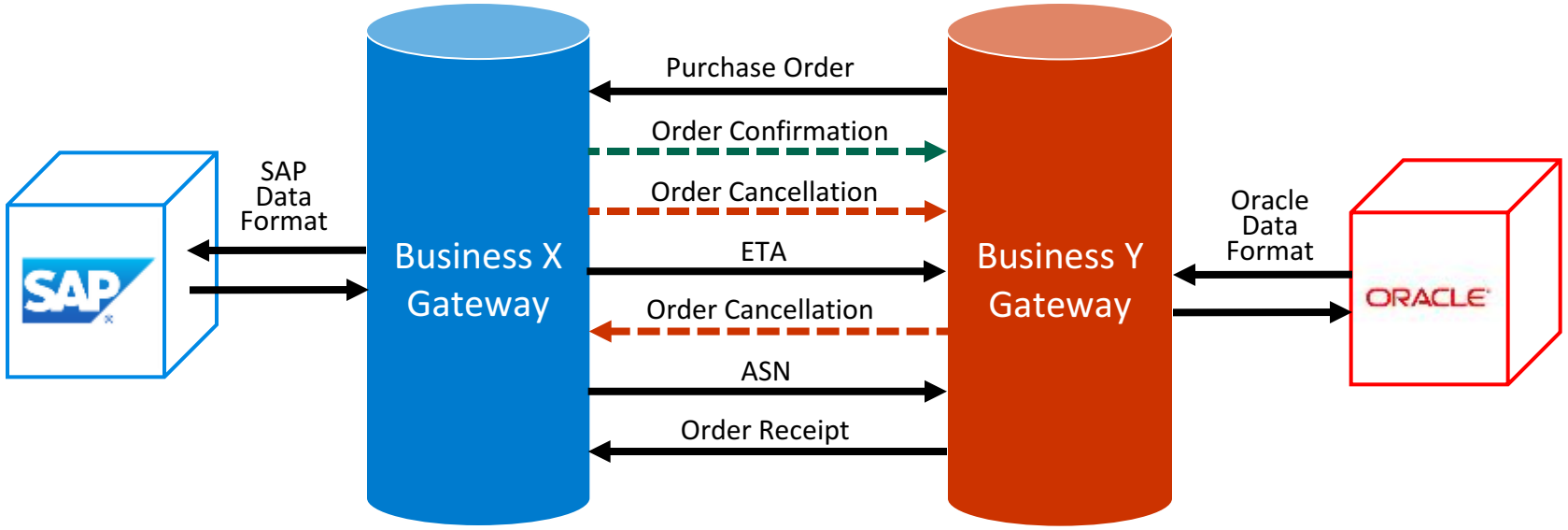
ERP Communication

- Business-to-Business (B2B):
  - Commerce transactions between manufacturers, wholesalers, retailers.
  - Each business represents a link in the supply chain.
- Business-to-Customer (B2C):
  - Sale transactions between firms and end-customers.
  - The volume of B2B transactions is much greater than B2C.
- Accelerating and validating B2B and B2C transactions.
  - For B2B this is achieved through Electronic Data Interchange (EDI).
  - For B2C this is achieved through a website and email.
- Electronic Data Interchange (EDI):
  - "The computer-to-computer interchange of strictly formatted messages that represent documents other than monetary instruments."
  - There is no human intervention in the process.

Adapted from Omar Elwakil (2016)

ERP Communication

- **B2B EDI example:**

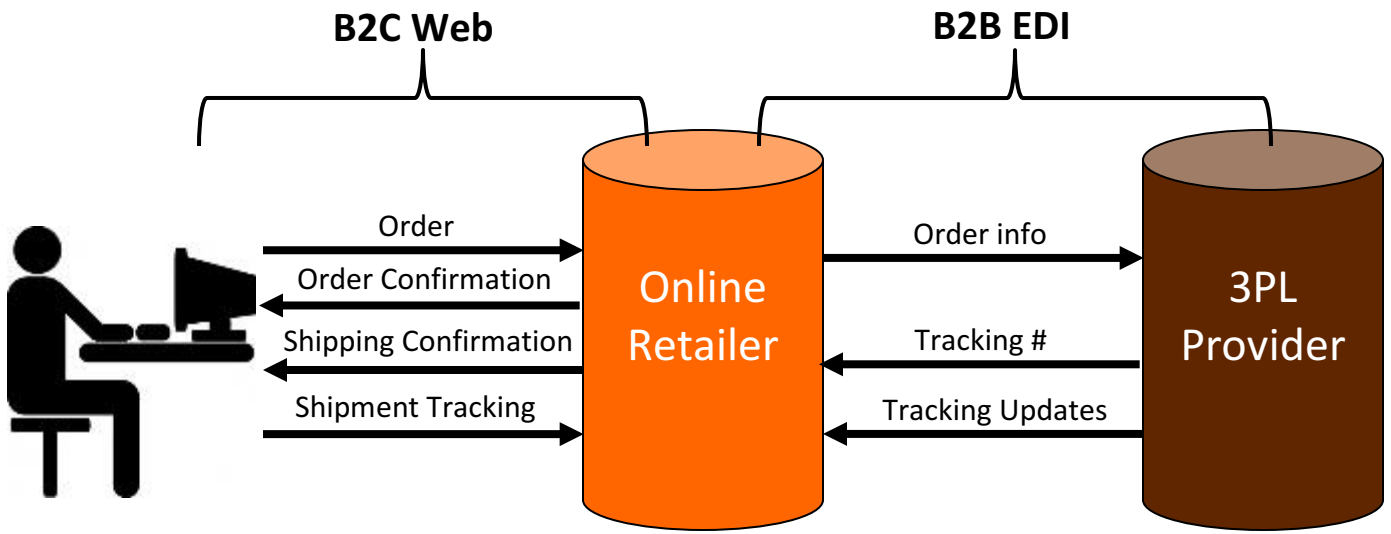


- ERP systems can "communicate" via EDI, sharing near real-time information.
- The data is usually translated and validated to be imported into an ERP system.
- Any info file can be shared given appropriate ERP fields to capture and display its content.
- What other info would businesses want to share?

Adapted from Omar Elwakil (2016)

ERP Communication

- **B2C EDI example:**



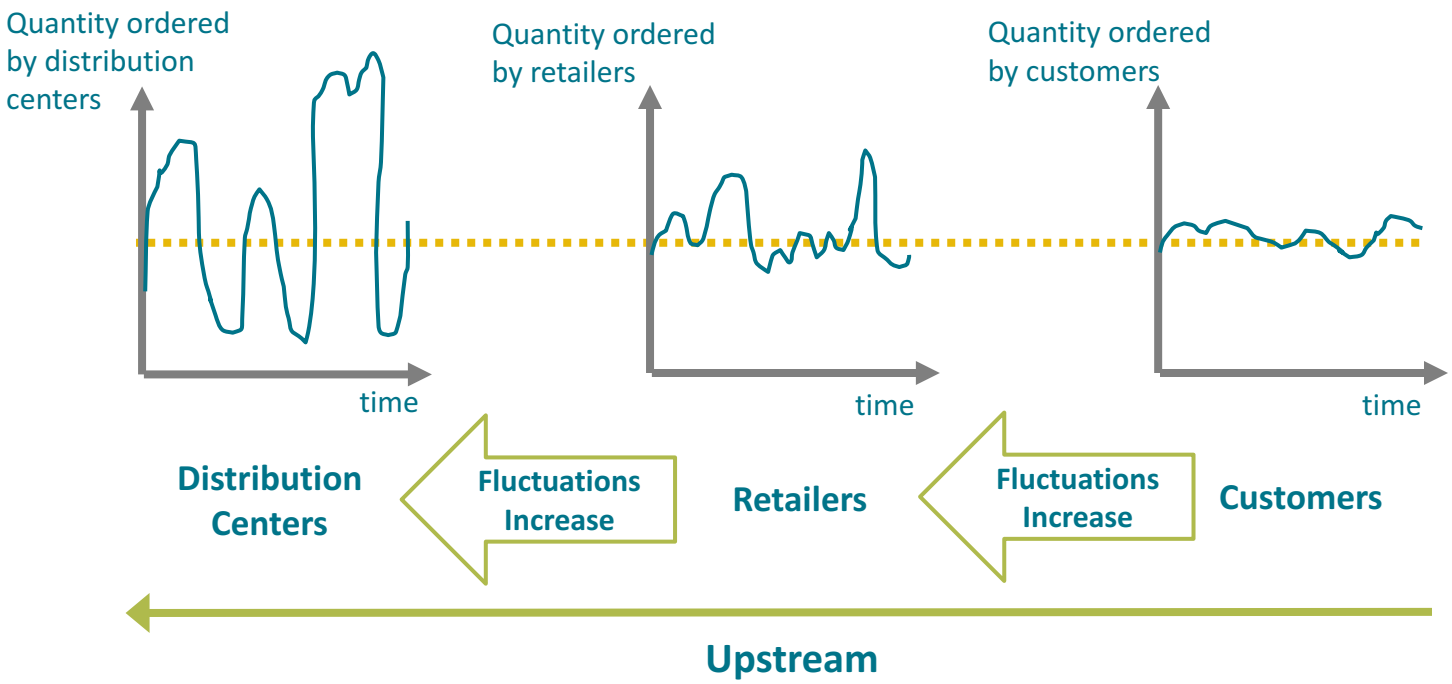
- Imagine this order fulfillment process without the B2B integration:
  - Potential for errors in data entry.
  - Extra cost of customer contact for updates.
  - The coordination cost with the 3PL.

Adapted from Omar Elwakil (2016)

ERP Strategic Value

ERP SCM Strategic Value – Reducing Bullwhip

- **The Bullwhip Effect:**
  - A phenomenon where information distortion leads to increasing order fluctuations in the upstream supply chain (forecast-driven supply chains).



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ERP SCM Strategic Value – Reducing Bullwhip

- **Causes of the Bullwhip Effect:**
  - Behavioral Causes:
    1. Overreaction to backlogs – panic ordering
    2. Miscommunication and lack of transparency
  - Operational Causes:
    1. Demand forecasting errors – errors are amplified as information flows.
    2. Lead time variability – delays and forecasting errors.
    3. Lot-sizing/order batching – consolidation of demands to reduce order costs through transportation scale economies and quantity discounts.
    4. Shortage gaming – ordering more than required during periods of short supply.
    5. Promotions – forward buying to benefit from lower prices.

ERP SCM Strategic Value – Reducing Bullwhip

- **Causes**
  - Behavioral Causes:
    1. Overreaction to backlogs
    2. Miscommunication and lack of transparency
  - Operational Causes:
    1. Demand forecasting errors
    2. Lead time variability
    3. Lot-sizing/order batching
    4. Shortage gaming
    5. Promotions

- **ERP Countermeasures**

  The key is to extend visibility of downstream customer demand to upstream participants:

  - Trustful collaboration
  - Point of Sale (POS) data capturing
  - Information Sharing
  - Reduce batch sizes and demand variability through smaller and more frequent orders.

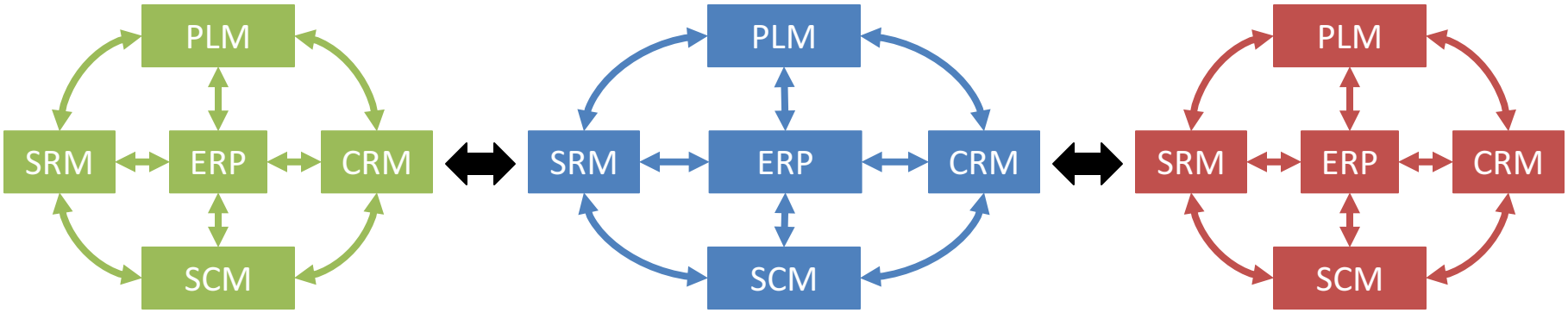
ERP SCM Strategic Value – Enabling Analytics

- ERP systems are primarily retrospective or backwards looking
  - General ledger of the firm
  - Captures historical data
  - Provides the CFO with financial snapshots at particular moments in time
- Are there other uses for the data that ERP systems contain?
  - Business Intelligence (BI) transforms raw data into meaningful information to improve business decision-making.
  - **Descriptive** – "What has happened?" e.g., Reporting, scorecards, etc.
  - **Predictive** – "What could happen?" e.g., Statistics, modeling, data mining, machine learning.
  - **Prescriptive** – "What should we do?" Combines rules, algorithms, simulation, and optimization.
- ERPs enable advanced business analytics within firms

ERP SCM Strategic Value – Extending Enterprise

- ERP systems are primarily used intra-firm process management
  - Connects various departments within a firm
  - Instantaneous access to all relevant data
- However, companies increasingly rely upon their trading partners to help them create value for their customers
- How can ERPs be used to connect End-to-End Supply Chains?
  - Form larger business networks by connecting all supply chain participants
  - Provide them with a shared understanding of the state of the world ("one version of the truth")
  - Reduces the needed coordination and monitoring costs
  - Able to respond quickly to market feedback and supply and demand volatility, with signals from the edges of the network

ERP SCM Strategic Value – Extending Enterprise



PLM - Product Lifecycle Management
CRM - Customer Relationship Management
SRM - Supplier Relationship Management
SCM - Supply Chain Management

Questions, Comments, Suggestions?
Use the Discussion Forum!

"Blas – patiently waiting for his ERP to be implemented"
photo courtesy of Lucas Velencoso

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