Kingdom of Saudi Arabia
Ministry of Higher Education
Al-Imam Muhammad Ibn Saud Islamic University
College of Computer and Information Sciences

Chapter 1

Introduction to

Enterprise Resource Planning Systems

Objectives

- Understand the essentials of ERP systems
- Be familiar with the various ways **professionals** interact with ERP systems
- Recognize the advantages and disadvantages of ERP systems
- Be aware of what tiers mean in the ERP marketplace

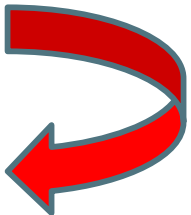
ERP Background

- Introduction of PC to business environment led to narrowly focused information systems serving a specific, single function. (So What?)
- Duplicate data across the enterprise not shared between departments
- Mid – late 1990's many large companies implemented (ERP) which would integrate the data across the enterprise and replace outdated systems (legacy systems).

1 data store
1 source of truth
Focus on process

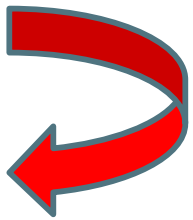
Legacy Systems: (standalone, disparate systems The case **for not** changing (1/4)

- The system works fine and the company sees no reason for changing it.
- The costs of redesigning or replacing the system are prohibitive (↑expensive) because it is large, complex.
- Retraining on a new system would be costly in lost time and money, compared to the anticipated appreciable benefits of replacing it (which may be zero).



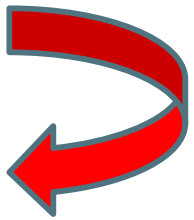
Cont. (2/4)

- The system requires near-constant availability, so it cannot be taken out of service, and
- the **cost** of designing a new system with a similar availability level is **high**.



Cont (3/4)

- **Examples include systems to:**
  - handle customers' accounts in banks,
  - computer reservation systems,
  - air traffic control,
  - energy distribution,
  - nuclear power plants,
  - military defense installations.



Cont (4/4)

- The way that the system works is not well understood.
- Such a situation can occur when the designers of the system have left the organization, and the system has either not been fully documented or documentation has been lost.

What is ERP?

- An ERP system is an integrated suite of **IT** applications that support the operations of an enterprise from a process perspective.
  - **Cross-Functional** – serves many functions
  - **Process-Centered** – organized around processes

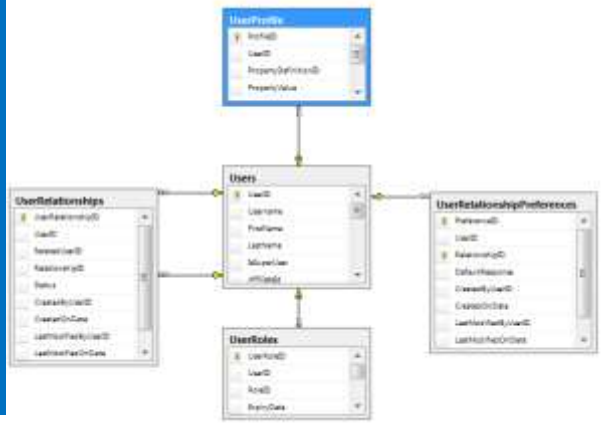
Set of activities Purchasing, Human resources, Production, and Sales

Well structured database

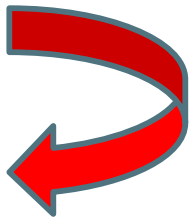
BP: Span across multiple departments, traverse the boundary of Org., sharing info. with partners, supplier, & customers

Cont.

The relational model has relationship between tables using **primary keys**, **foreign** keys and **indexes**. Thus the fetching and storing of data become **faster** than the old Navigational model. So RDBMS is widely used by the enterprises and developers for storing **complex and large amount of data.**



- Built upon relational database systems
  - There is one data store, one source of the truth
- Sold in modules (groups of related programs)
  - Don’t need to purchase/implement all modules
  - More modules implemented leads to more integration and **ROI**



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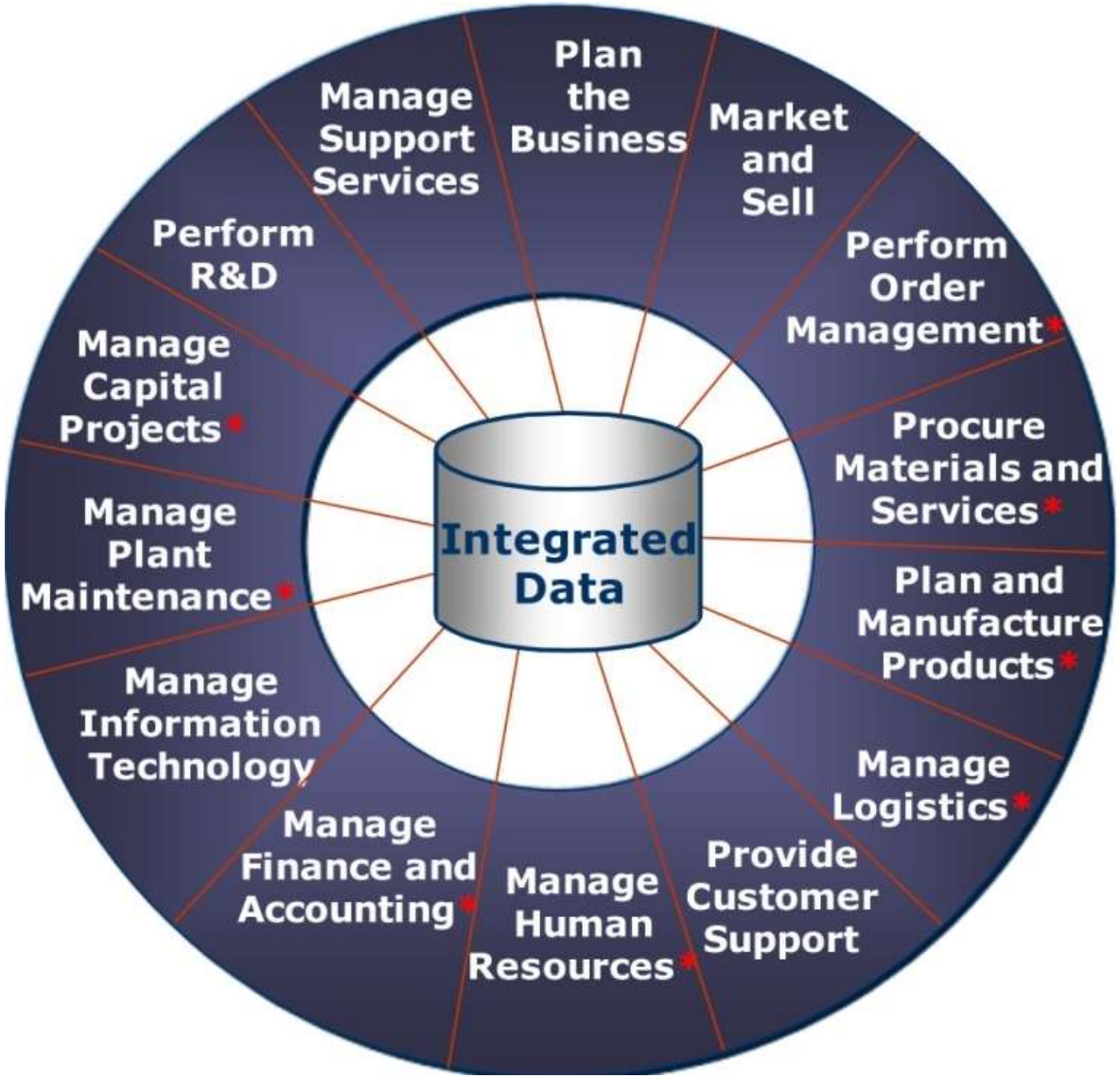
Activity: Statistics and cost

- Can cost millions of dollars
- Take years to implement (for larger companies – less for smaller – **cloud** makes faster)

ERP-Supported Business Processes



* Core ERP Processes

Typical Modules in an ERP System

Operations (Core)		
· Engineering	· Bills of Material	· Scheduling
· Capacity	· Process Manu.	· Quality Control
· Cost Management	· Discrete Manu.	· Shop Floor Mgmt.
· Inventory	· Order Entry	· Purchasing
· Product Configuration	· Supply Chain Planning	· Supplier Scheduling
· Quality Control	· Demand Management	· Sourcing
Financials (Core)		
· General Ledger	· Cash Management	· Accounts Payable
· Accounts Receivable	· Fixed Assets	· Controlling

Cont.

Projects		
· Project Costing	· Project Billing	· Time and Expense
· Activity Management	· Resource Availability	· Project Contracts
Human Resources (Core)		
· Human Resources	· Payroll	· Training
· Time & Attendance	· Benefits	· Recruiting
Customer Relationship Management		
· Sales and Marketing	· Commissions	· Service
· Customer Contact	· Call Center Support	· Analytics

Who Uses/Needs to know about ERP?

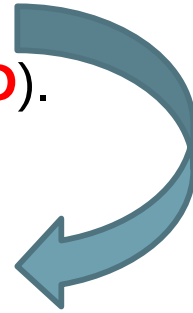
1. End User

- Purchasing
- Manufacturing
- Sales
- Accounting/Finance
- Human Resources
- etc

2. Internal/external auditor

- Verify that the ERP system is secure and maintains privacy over individuals. Also has proper **S**egregation **o**f **D**uties (**SoD**).

To reduce the **risk of fraud** and **unauthorized transactions**, no single individual should have control over two or more parts of a process. This is a segregation (or **separation**) of duties.



Who Uses/Needs to know about ERP?

3. Consultant

- Assist in implementation and or maintenance of ERP systems
- Offer business process analysis
- Offer maintenance contracts
- Offer project management
- Offer hosting services

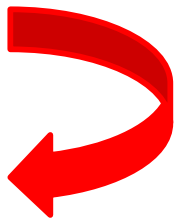
4. Developers

- Customize the system

- **E.g. [End User] shipping personnel use ERP to:**
  - Logistic information
  - Purchasing personnel maintain vendor data
  - Close the book at the end of the month
  - HR staff maintain employee record

ERP Value – Integration

- The **value** of ERP is the opportunity to **integrate** an entire organization by having a
  - single point of entry and
  - sharing of data across the enterprise.
- ERP becomes the **authoritative data source**:
  - Official data production source with a designated mission statement to publish reliable and accurate data for subsequent use by users.

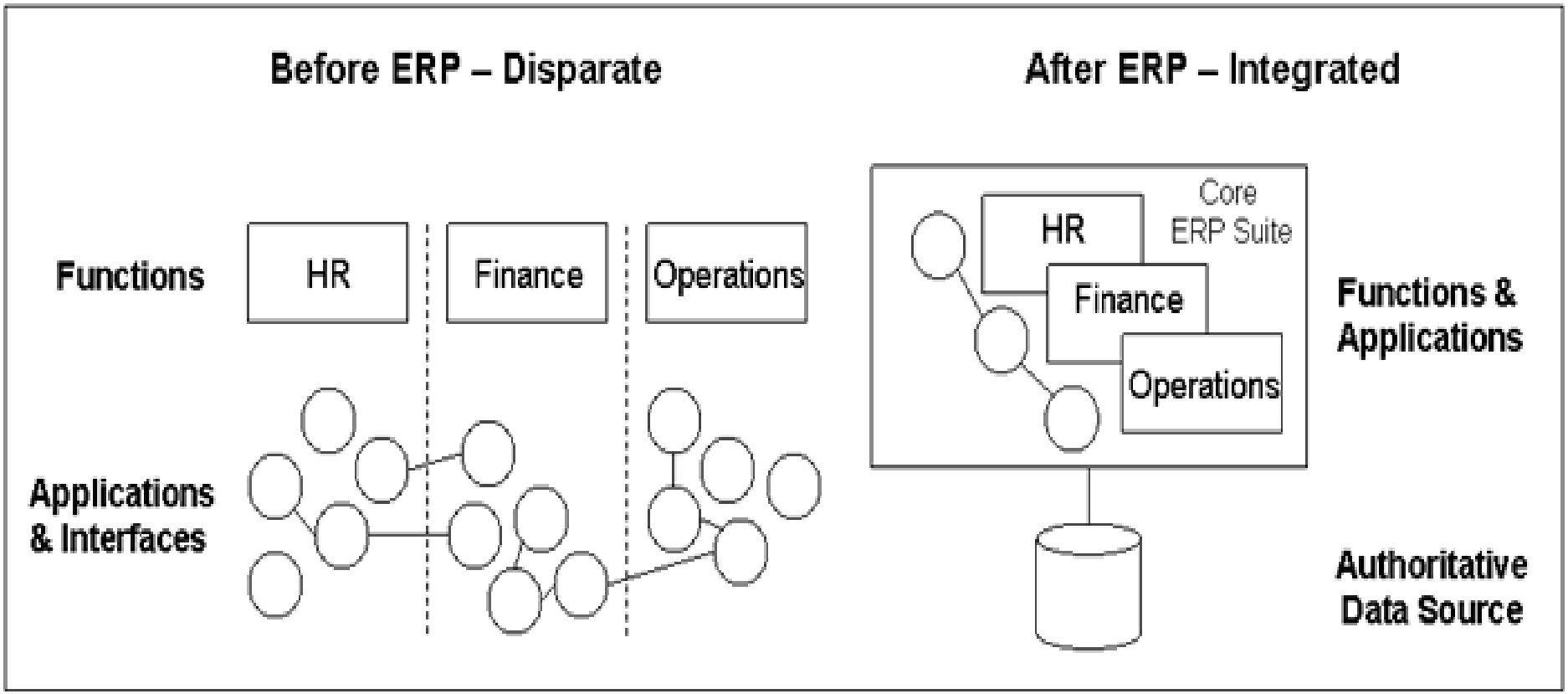


- Creates less need to:
  - reconcile data and
  - rekey which causes **inefficiencies and delays**

(Data Reconciliation) used to describe a verification phase during a **data** migration
Why?
the target **data** is compared against original source **data.**
Obj: to ensure that the migration architecture has transferred the **data** correctly.

Before and After ERP

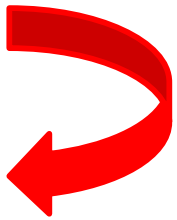
Figure 1 - Before and After ERP



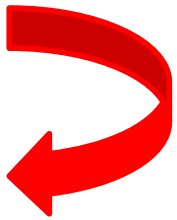
- **Legacy systems** (islands of automation) may be connected with **enterprise application integration (EAI)** - the process of linking such applications within a single organization together in order to simplify and automate business processes.
- At the same time avoiding having to make sweeping changes to the existing applications or data structures.
- Not as optimal as having an integrated system, common database, and common technical infrastructure.

ERP Diffuses Best Practices

- ERP systems are based on best practices
- For instance, **SAP** has thousands of best practices embedded in their applications.
  - This means that **any firm** that installs has access to a wide range of best practices.



- Further, **business practices** are being added all of the time.
- As **new best practices** are found and embedded in particular applications, they can become available for inclusion in new versions of software.



- As a result, there is a cycle of finding best practices, building them into the software and diffusing them out to new users.
  - **Vertical solutions – industry specific** version of software (e.g. insurance, retail, public sector …etc)

Table 1-2: Oracle's Vertical Solutions

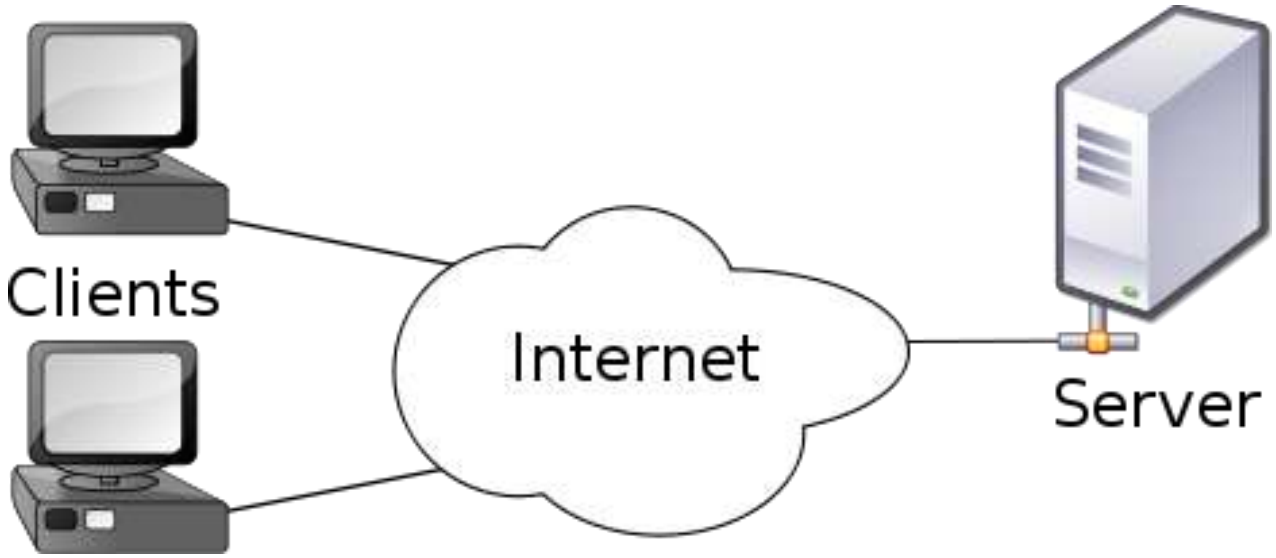
Industry	
Aerospace and Defense	Industrial Manufacturing
Automotive	Insurance
Chemicals	Media and Entertainment
Communications	Natural Resources
Consumer Goods	Oil and Gas
Education and Research	Professional Services
Engineering and Construction	Public Sector
Finance Services	Retail
Health Sciences	Travel and Transportation
High Technology	Utilities

Source: Oracle.com

ERP Facilitated Adoption of Client Server Computing

- In the early 1990's ,client server computing became available and offered many advantages over existing mainframe solutions.
- **Client/server** describes the relationship between two computer programs in which one program, the client, makes a service request from another program, the server, which fulfills the request.

- ERP became one of the **dominant,** initial corporate applications of client server computing.



Technical ERP System Benefits

- **Integrated** processes and information systems
- More effective and efficient business processes
- Enables organizational standardization (BP)
- Eliminates information asymmetries
- ERP help prevent human error

- Provides **on-line** and real-time information
- Facilitates intra- and inter-organization communication and collaboration
- Can reduce complexity of application and technology portfolios

- Give **stakeholder** the ability to gain an accurate and consistent view of the business
- Customer: see real time the status of their orders
- Management: notified in real time about performance and problems

ERP System Benefits

Business process Add value

- Integrate financials
- Have one view of the customer
- Standardize manufacturing processes
- Reduce inventory/better visibility into inventory
- Standardize information such as HR and Customer data

there are others……depends on company

ERP System Disadvantages

- Standardized way of conducting business can be a disadvantage too because levels the playing field somewhat between companies
- Lack of employee/user acceptance
- Complex solution
- Maintenance of hardware and software
- Costly and time consuming implementations

e.g. employee can find: System difficult to use, Too restrictive, Inflexible.

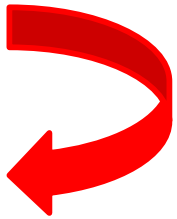
Implementation Issues

- Employee resistance
  - They develop "work around"
  - Sabotage (damage) implementation process
  - Caused by lack of training ("how") or understanding of organization's motivation adoption ("why")
  - Need Change Management to lower resistance

- Technical Issues
  - Complex system to implement – configuration issues and possible customization issues
  - Sometimes need expensive external consultants to assist implementation

ERP Evolution

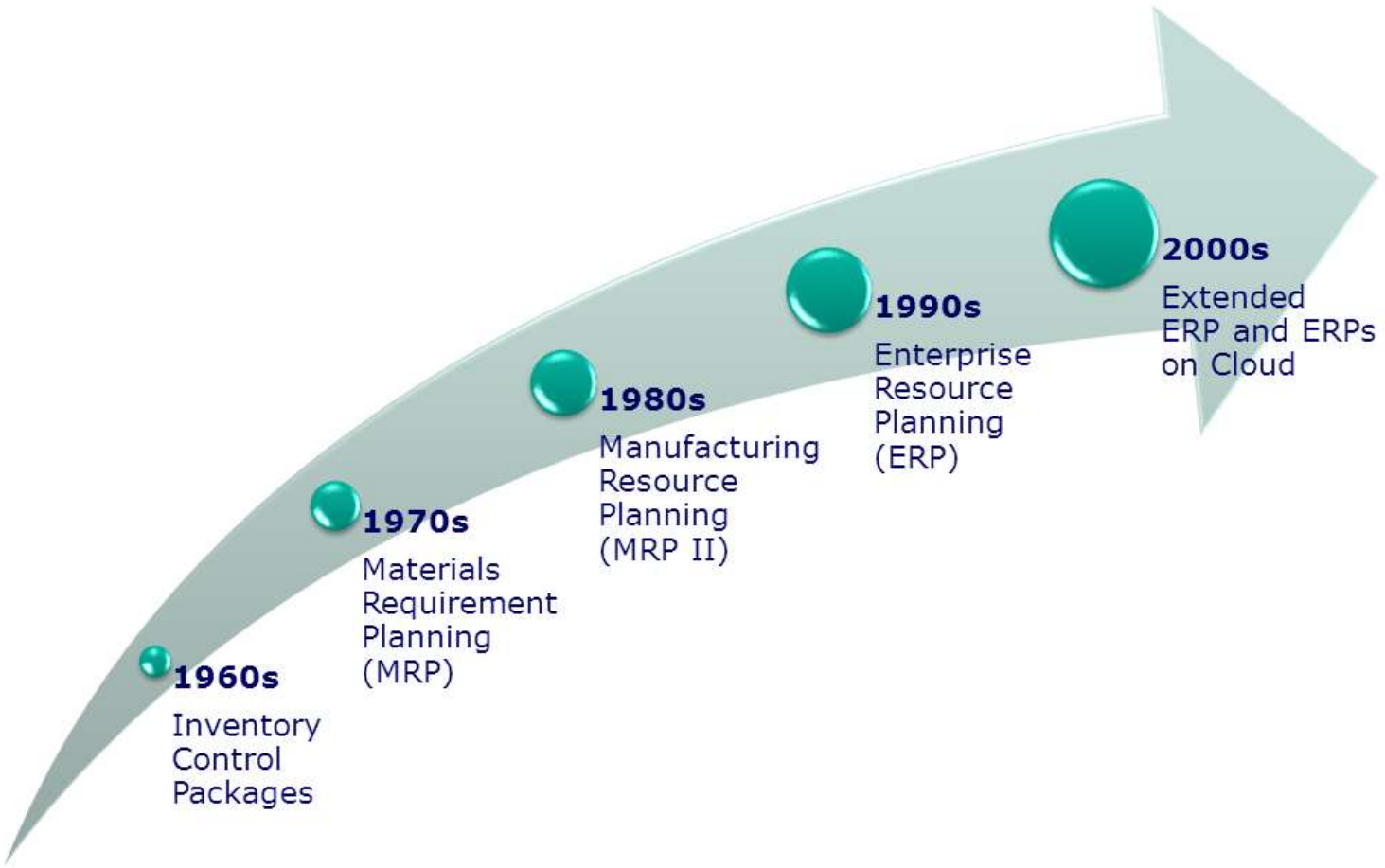
- Roots are in Manufacturing Requirements Planning (**MRP)** & Manufacturing Resource Planning (**MRP II**)
  - Addressed needs of just the manufacturing environment – ERP manages resources for entire enterprise
- With Y2K looming, companies began implemented new state of the art systems (ERP) that ran on client server technology



- Now many companies outsource called Software as a Service (SaaS)
  - Multi-tenancy – serve many clients from a single instance via the Internet
- Open Source ERP systems are evolving – where's the help desk though!?

The firm access the ERP sys a vendor's site through internet

ERP Evolution



ERP Market

Activity?
ERP market

- **Billion** dollar industry and growing
  - 10% growth rate through 2012
- Growth drivers
  - Globalization
  - Centralization
  - Competition
  - Performance management
  - Best practices etc

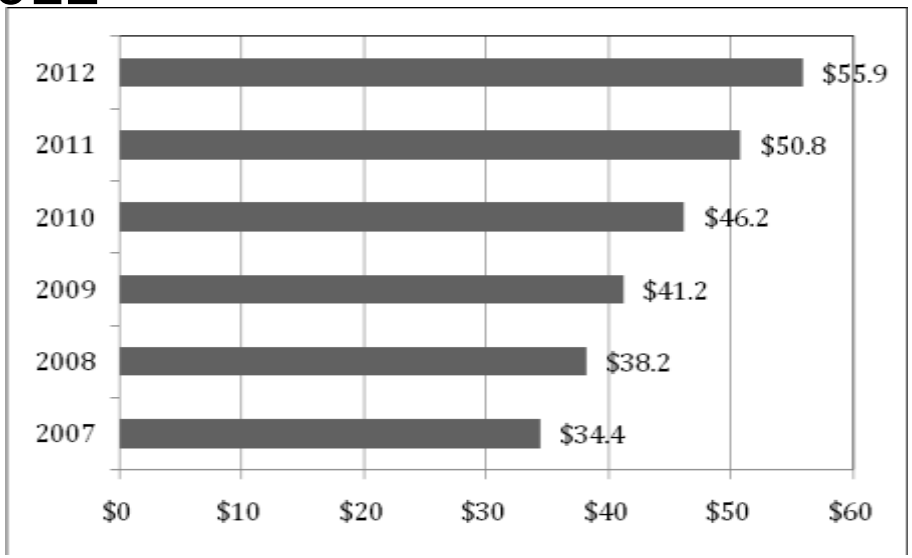


Figure 1-2: ERP Application Revenue Estimate 2007-2012 in Billions

Source: AMR research

ERP Tiers

- **Tier 1 Vendor** – “Enterprise Space” - multi-site, multi-national corporations, government entities with ***1000*** *or more employees, company with sale over $250 million*
  - **#1 SAP**
    - Stands for **S**ystems, **A**pplications and **P**roducts in **Data processing**
    - Formed by 5 former IBM engineers in 1972 in Walldorf Germany
    - SAP AG, SAG UK, SAP North America etc
    - Nearly 200,000 customers, over 50,000 employees
    - Service over 20 different industries

- #2 **Oracle (expertise in database)**
  - Sell ERP system
  - Oracle E-business suite
  - More than **380,000** customers—including 100 of the Fortune 100—and with deployments across a wide variety of industries in more than 145 countries around the globe,
  - In 2003 acquired PeopleSoft, Hyperion and Siebel

ERP Tiers

- **Tier 2 Vendors**
  - Market towards medium sized companies, few sites, 100-999 employees
  - Largest of all ERP tiers in number of potential customers
  - Tier 1 vendors moving into this area and below by reducing prices , simplifying product, offering hosting
  - Less time and cost to implement
  - Some vendors – QAD and SSA

- **Tier 3 Vendors**
  - Market towards small, single site, family run corporations, sales under $40 million and less than 100 employees
  - Vendors – Microsoft Dynamics GP, NetSuite, Made-2-Manage.

- **Tier 4 Vendors**
  - Market towards small companies that can manage with basic accounting software
  - Vendors – **Peachtree**, Accpac, Quickbooks,

Characteristics of ERP vendor Tiers

Tier 1	Tier 2	Tier 3
High complexity	Medium complexity	Limited functionality
Highest cost of ownership	Medium cost of ownership	Lower cost of ownership
Many industry solutions	Fewer industry solutions	Fewest industry solutions
Large companies	Mid-market companies	Small to mid-sized companies
Global functionality	Global functionality	Few locations

Source: Ultra consultants

Sample ERP vendors

Tier 1	Tier 2	Tier 3
Oracle	abas	Consona
SAP	CDC Software	exact Americas
Microsoft AX	Epicor	Expandable
	Fujitsu	SYSPRO
	Infor	Microsoft NAV
	NetSuite	SAP Business All-in-One

Source: Ultra Consultants

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Chapter 2: ERP Technology

Objectives

- Understand the three-tiered client server architecture.
- Be familiar with relational databases and related terms
- Identify the different types of database relationships and examples of each
- Distinguish between customization and configuration of ERP software

Introduction (1-2)

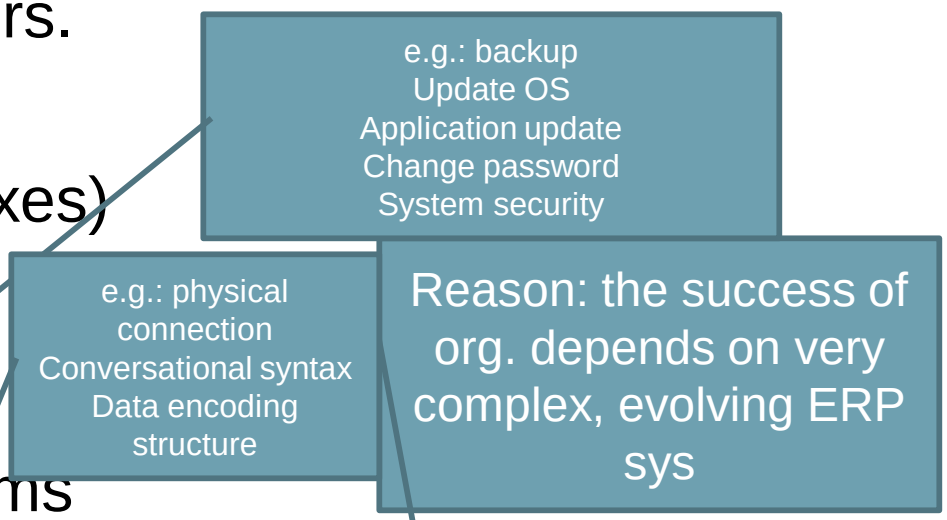
- ERP huge impact on organization, customers, suppliers, and partners.
- Most important requirement:

➢ ERP must be available to users and properly functioning without unscheduled service outages.

Operation can quickly shut down with disaster results, if ERP is not available

Intro (2-2)

- Issues: Supporting thousands with different needs require:
  - **Sophisticated** and **flexible** software running on multiple distributed servers.
  - **Frequent** upgrades,
  - **patches** and fixes (bugfixes)
  - **Configuration** changes
  - Server **maintenance**
  - **Interface** between systems
- Understanding the technology of ERP is critical



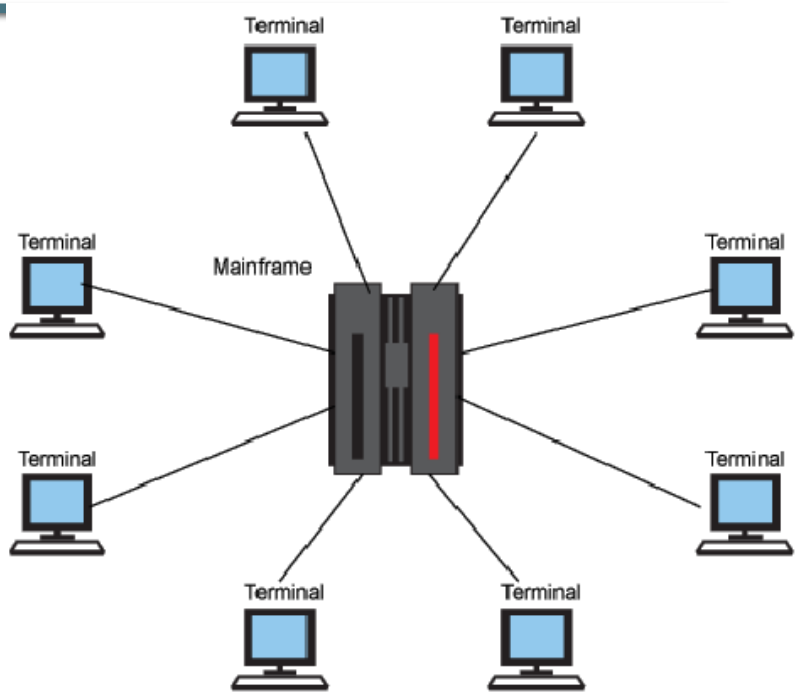
EVOLUTION OF INFORMATION SYSTEMS

The problem with Legacy systems (1-

- Older information systems that do not easily “talk” to each other.
- Lack of integration created inefficiencies in the organization such as:
  - duplicate data entry and
  - fragmentation of business processes.

(2-

- Legacy systems were built on mainframe architecture which means that all **computing intelligence** is within central host computer.
- User connected via terminals that captured keystrokes and send it to host computer.



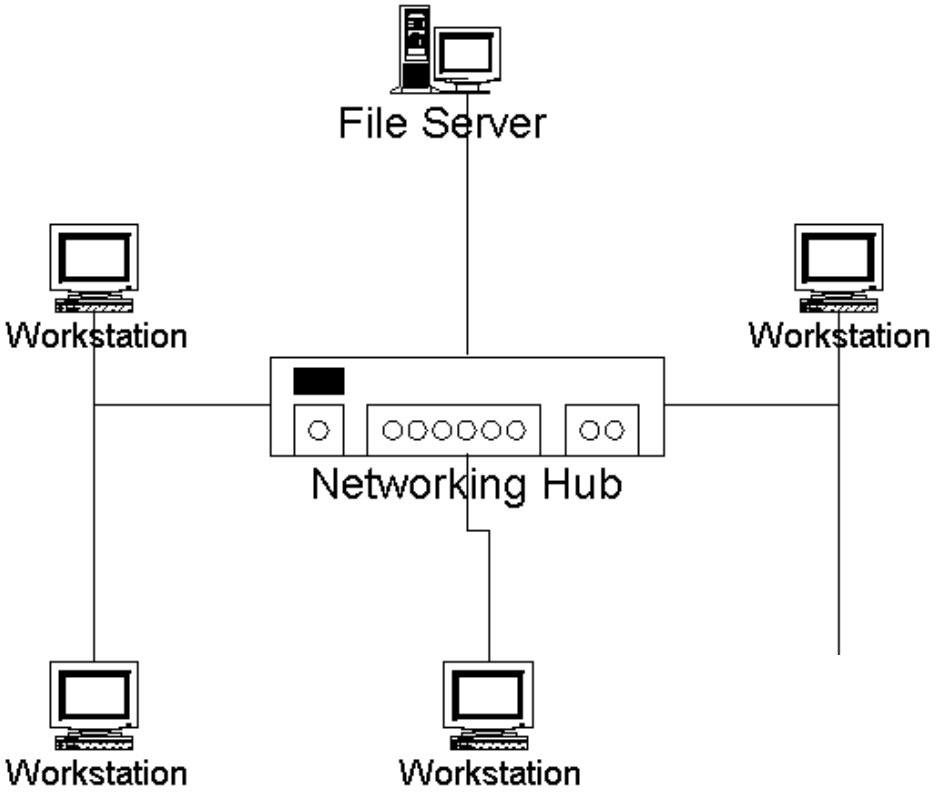
File server architecture using LAN (3-

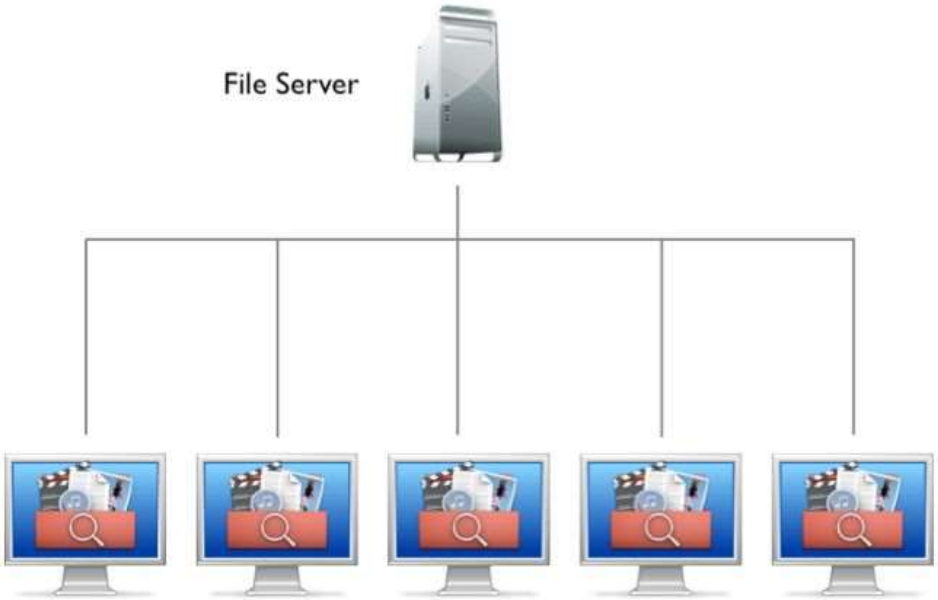
- Late 80's , Local area network (LAN) helped in sharing file among computers in **close proximity**
- Files were stored on File Server.
- PCs performed computational jobs.
- Problems :
  - Limit for amount of data ;
  - Solution for limited number of users.
- Solution not scalable.

Computer on the network that stores files shared b/w other computers

Not able to be changed in size or scale

(4-


File Server
Workstation
Workstation
Networking Hub
Workstation
Workstation


File Server

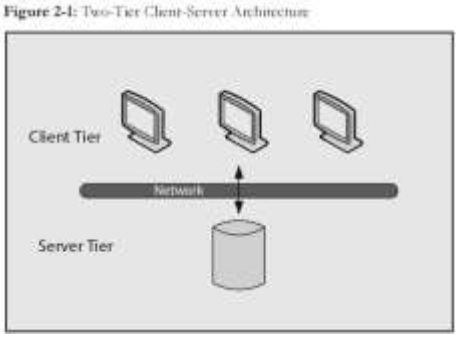
Client Server Architecture (the next step on the evolution of IS) (5-

- Known as Two-tier architecture.
- Database server (program running on dedicated computer, which provide a standardized way to store and retrieve data)
- Client : Provides GUI and business logic for application
- Problem:
  - Each client need dedicated connection to database server resulting in limited number of clients;
  - Business logic running on every client computer. (e.g. loan, and vacation)

Copy file

File sharing vs **Database** server Results

Program running on dedicated computer provide standardized way to store and retrieve data. Finding right data, format data, & return results to users



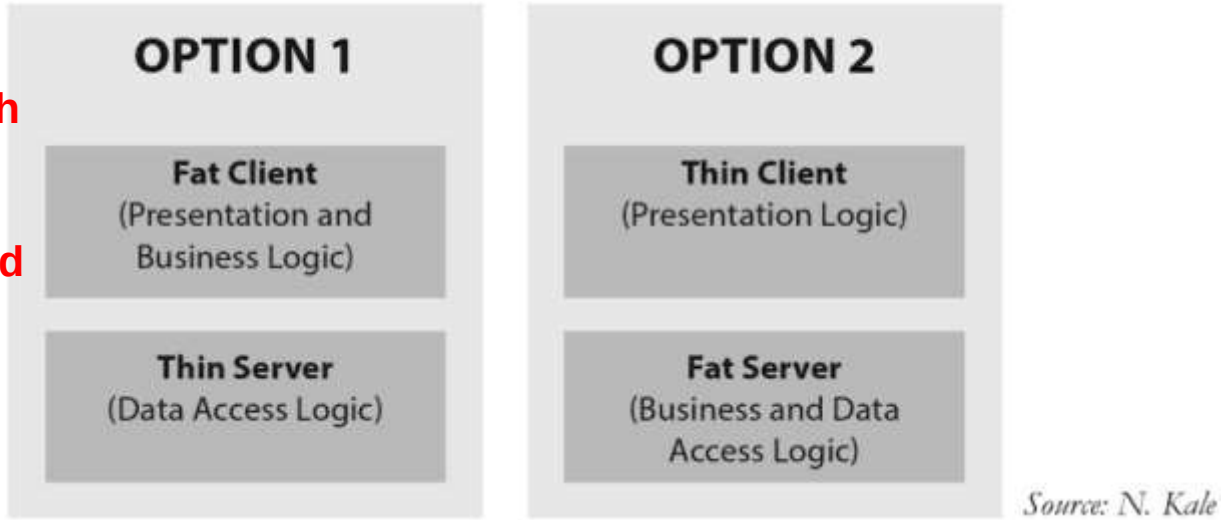
- ***Presentation logic*** is the software logic that displays data to the user and accepts input from the user.
- ***Business logic*** specifies ***how*** business transactions are processed and ***what*** data needs to be accessed from the data storage device.

- ***Data access logic*** refers to the communication with the database, which is responsible for data storage and retrieval on the physical storage device.
- **Option 1**: **Fat Client handles presentation logic and business logic**.
  - Fat client: running as application on **user's PC**, offer the richest interface.

- **Option 2**: **Thin client** handles only **presentation logic**.
- Thin client: simpler interface, don't require any additional software to be install on the client.
- **Web browser**: program used to display the contents of web pages and images.

➢ used for **thin clients** because they widely available and work identically on many different computers.

Figure 2-2: Options for Two-Tier Client-Server Architecture



Source: N. Kale

FC: a networked computer system with most resources installed locally, rather than distributed over a network. E.g. PCs, software apps, can work offline, no need to have continuous server communication

More on Client-Server

- It is **service-oriented**, and employs a **request-response protocol**.

uses a set of rules to send

and receive messages at

the Internet address level

Transmission **C**ontrol **P**rotocol

TCP/IP

Internet services include HTTP, FTP, DNS

Client-Server

1. in a client-server system architecture, the terms clients and servers refer to computers (e.g., relational database management system--DBMS)

2. in a client-server distributed computing paradigm, the terms clients and servers refer to processes.

Three-tier architecture

- 1
  tl
  -
  -

FIGURE F.14 APPLICATION LOGIC COMPONENTS

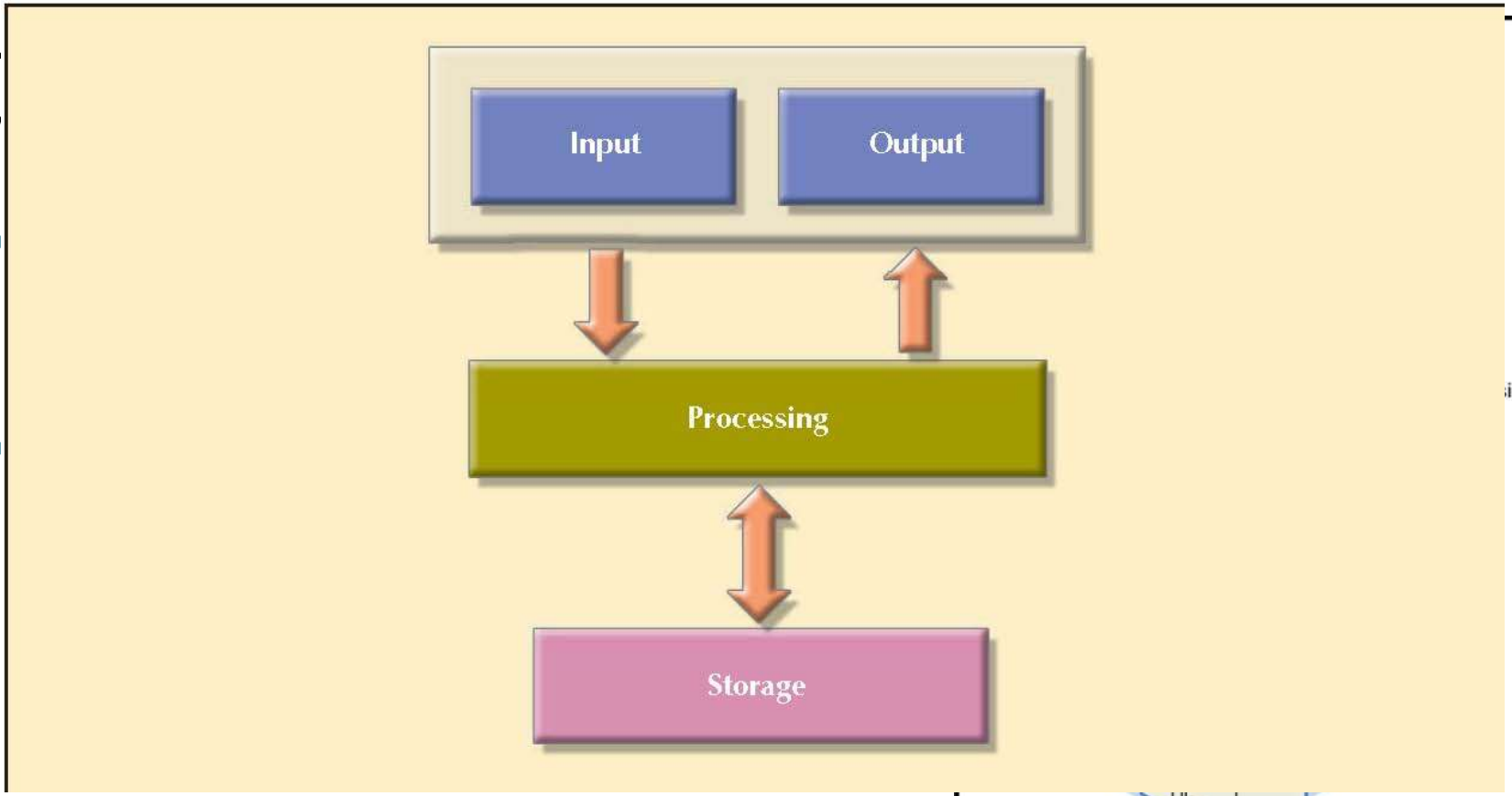
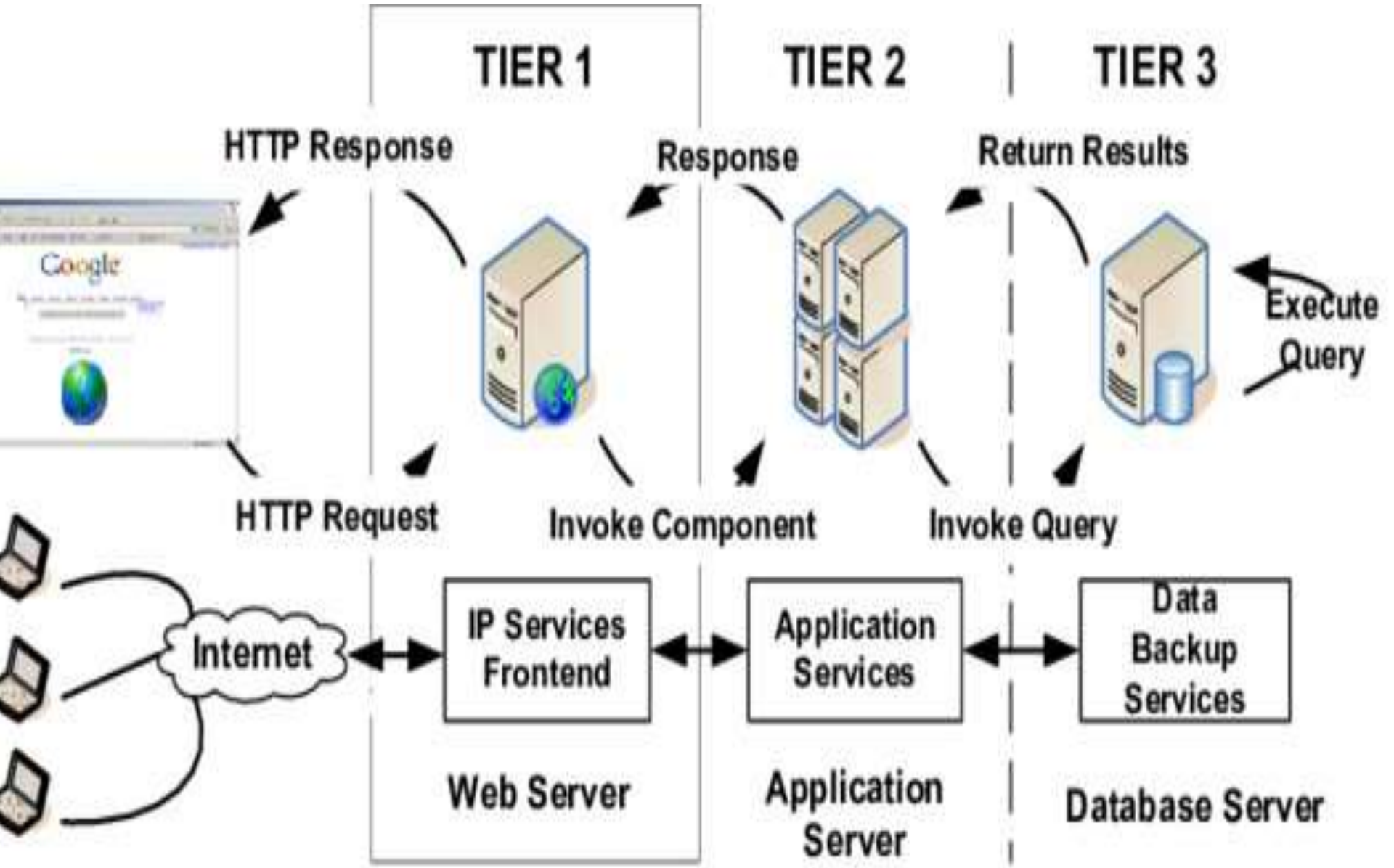


Figure 2-1: Three-Tier Architecture

Three-tier architecture

- **Tier 1**: the client contains the presentation logic, including simple control and user input validation. This application is also known as a thin client.
- **Tier 2**: the middle tier is also known as the application server, which provides the business processes logic and the data access.
- **Tier 3**: the data server provides the business data.

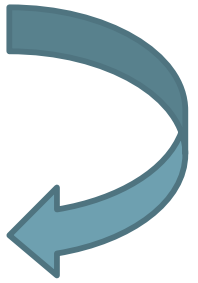
http://www.linuxjournal.com/article/3508


TIER 1
TIER 2
TIER 3
HTTP Response
Response
Return Results
Google
Execute Query
HTTP Request
Invoke Component
Invoke Query
Internet
IP Services Frontend
Application Services
Data Backup Services
Web Server
Application Server
Database Server

PRESENTATION tier: ERP Interface

Uses GUI to request info.

- With ERP software, the GUI can take the form of a **dashboard** customized to suit the needs and preferences of a set of users or a specific user.
- Dashboard include:
  - **Business process activity** based on production or logistics information, and KPIs.
  - **Tasks**, reminders and other notifications.
  - **Calendaring** and **scheduling** resources.



- **Messaging** including email, instant messaging and telephone traffic.
- Official **communications** from designated sources.

Can serve as portal or homepage

SAS Portal

Activity
To visit SAS portal

Source: SAS Institute, Inc.

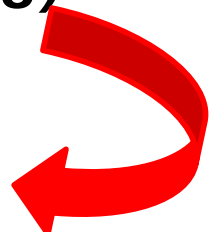
Figure 2-2: SAS Institute Dashboard

Application tier: Back Office/Front Office

- **Back-office software** (**Core ERP**)–HR, Financials, and Operations
- **Front-office software** integrates with customers and suppliers – supply chain management and customer relationship management
- **Bolt-ons** are used to integrate more functionality to Core ERP (**e.g. Order Tracking**)

ERP software is the business logic or application tier

SCM
CRM



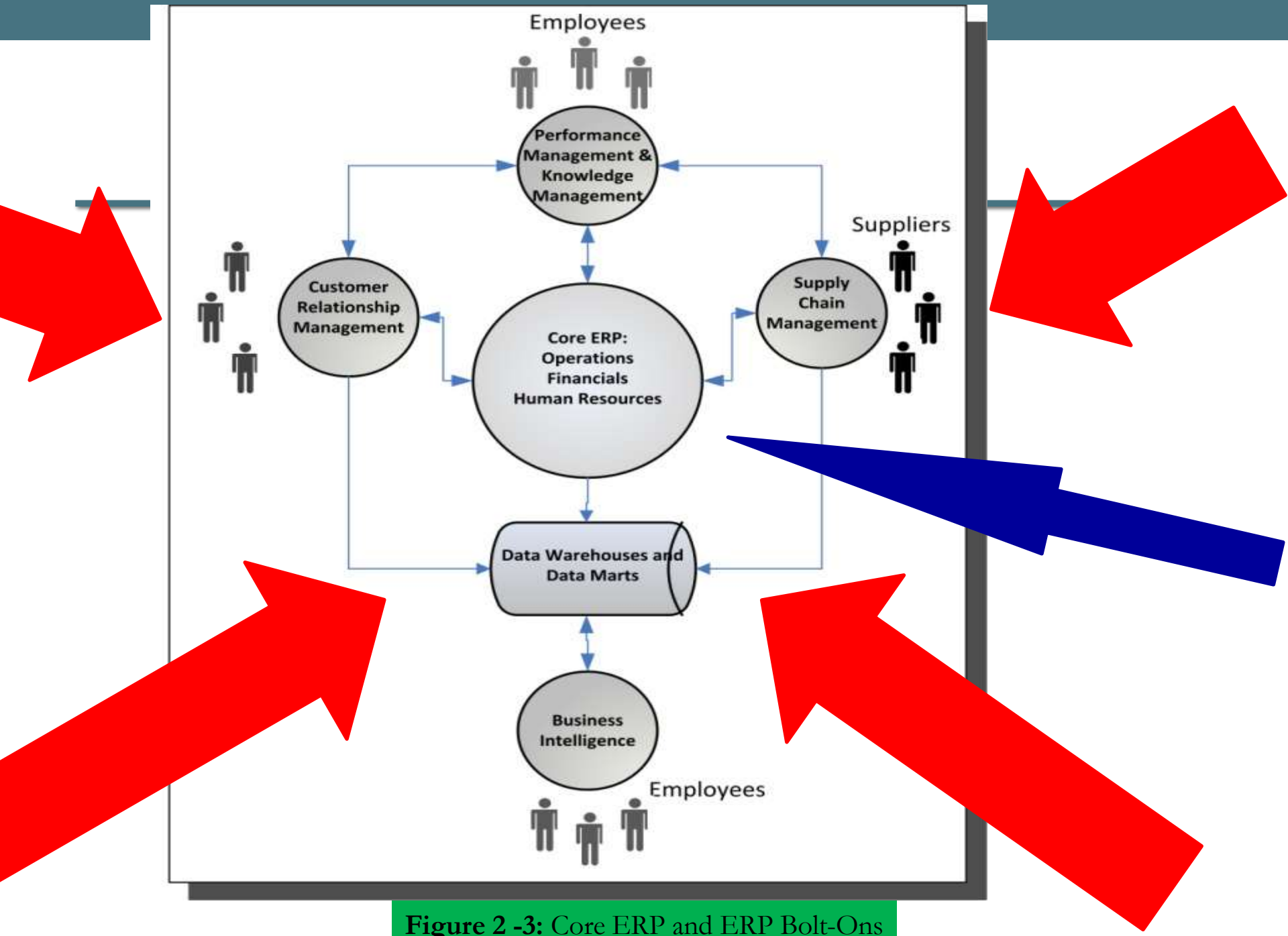
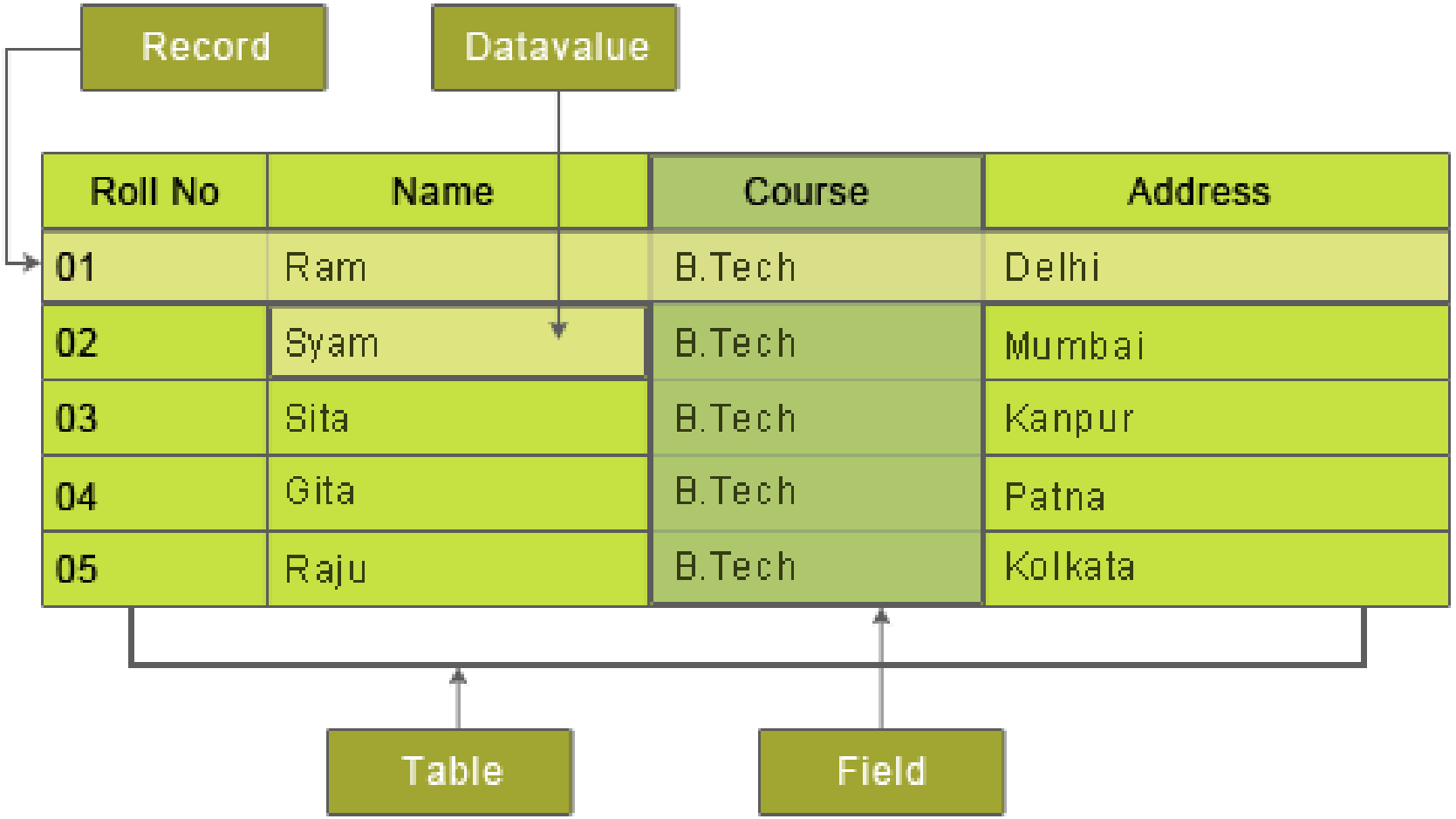


Figure 2 -3: Core ERP and ERP Bolt-Ons

Databases Tier: Relational Database Terminology

Type of database in which data is stored in two dimensional tables, known as relations.

- **Tables** are **relations**
- Tables and forms (visuals of tables) show up on screens in ERP menus.
- **Fields** are **attributes** in the table (in columns) (customer name, zip code)
- **Records** are **instances** in the table (in rows)
- Each table has a **primary key** that is the unique.
  - Usually the primary key is some sort of code.
  - Can not be null or empty
  - **Entity integrity rule** (e.g. part weight is greater than Zero)


Record
Datavalue
Roll No
Name
Course
Address
01
Ram
B.Tech
Delhi
02
Syam
B.Tech
Mumbai
03
Sita
B.Tech
Kanpur
04
Gita
B.Tech
Patna
05
Raju
B.Tech
Kolkata
Table
Field

- The primary key in one table becomes the **foreign key** in another table so the tables can connect and querying can take place.
  - **Referential integrity rule**: **foreign key** must have a matching primary key or it must be null

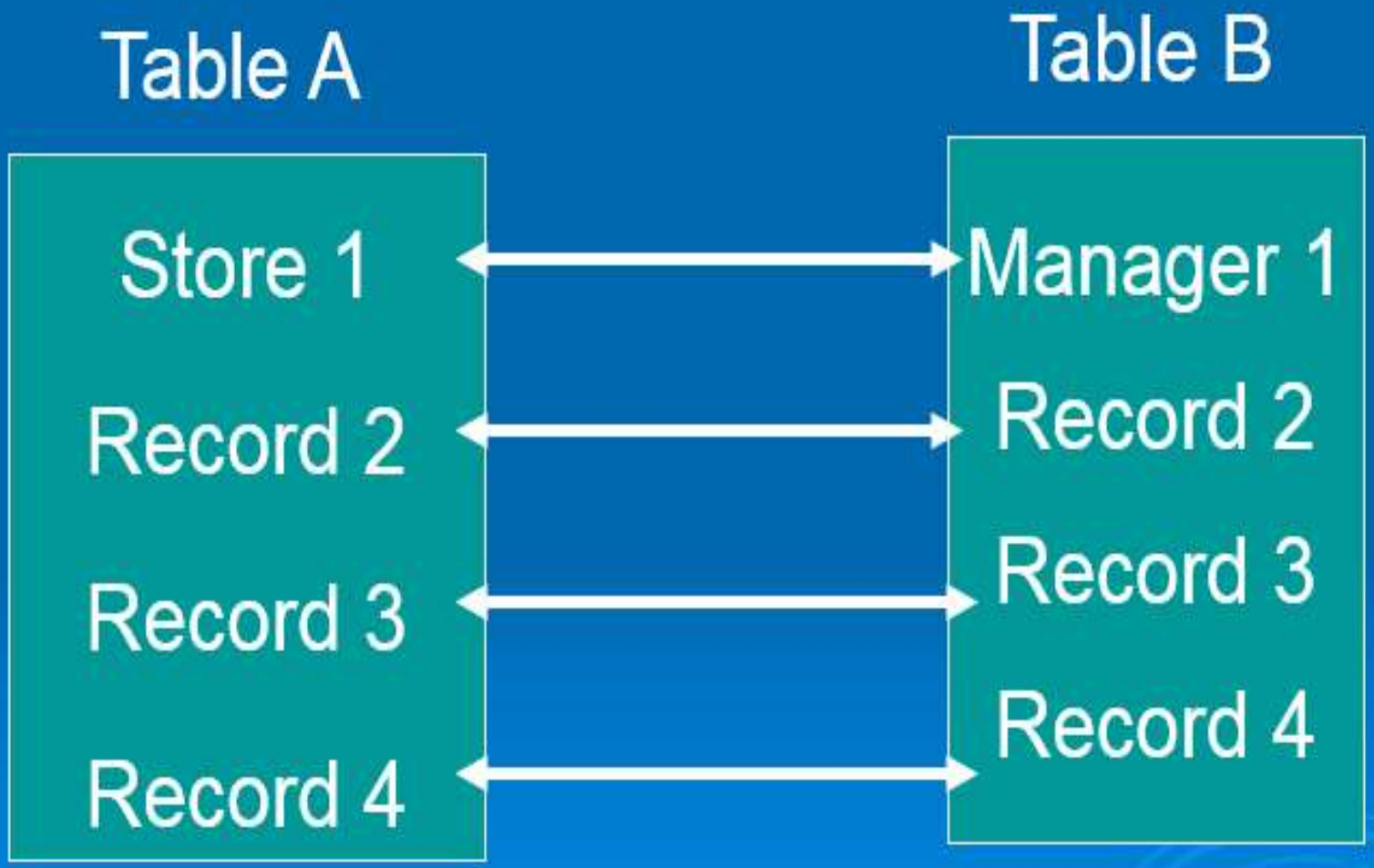
Customer(CustID, CustName) Order(OrderID, CustID, OrderDate)

Entity-Relationship Diagram

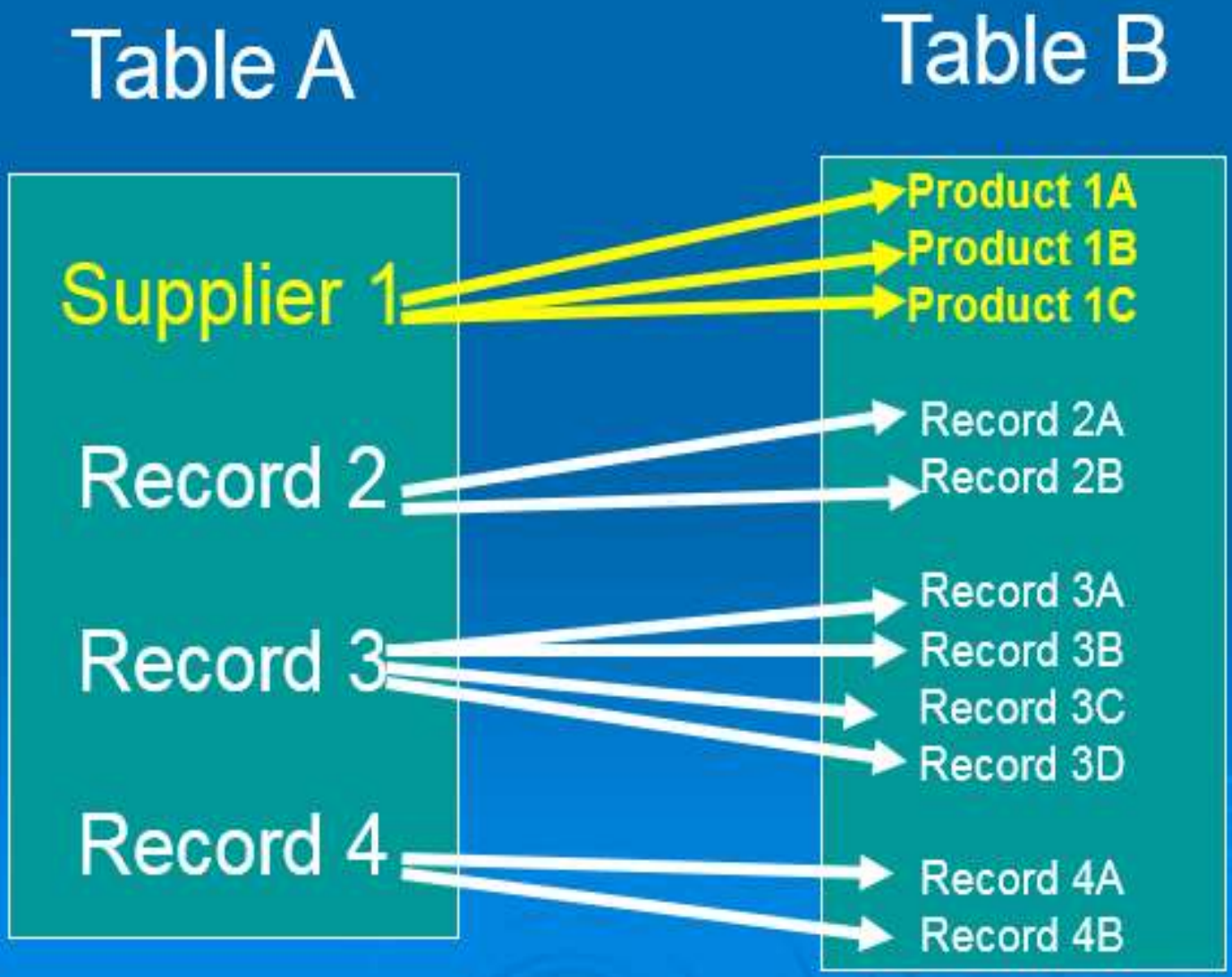
- ERDs are a type of system diagramming that show relationships between tables.
  - Relationships are rules that show how tables relate to one another.
- Types of relationships
  - **One-to-one:** the primary key of one table is associated with only one record in another table (Dep. & Boss 1:1)

- **One-to-many:** the primary key of one table is associated with more than one record in another table (Customer & Order 1:M)
- **Many-to-many:** the primary key in one table is associated with more than one record in a second table *and* the primary key in the second table is associated with more than one record in the first table (**Books & Authors**)

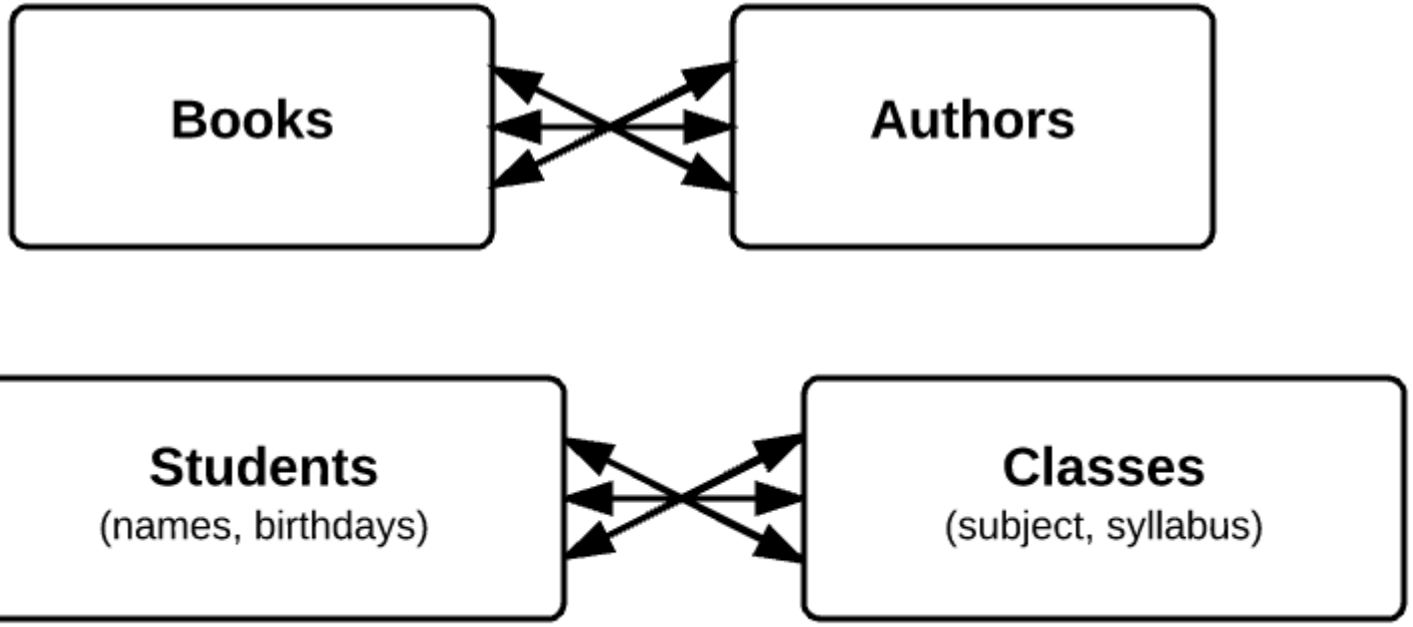
One-to-One Relationship

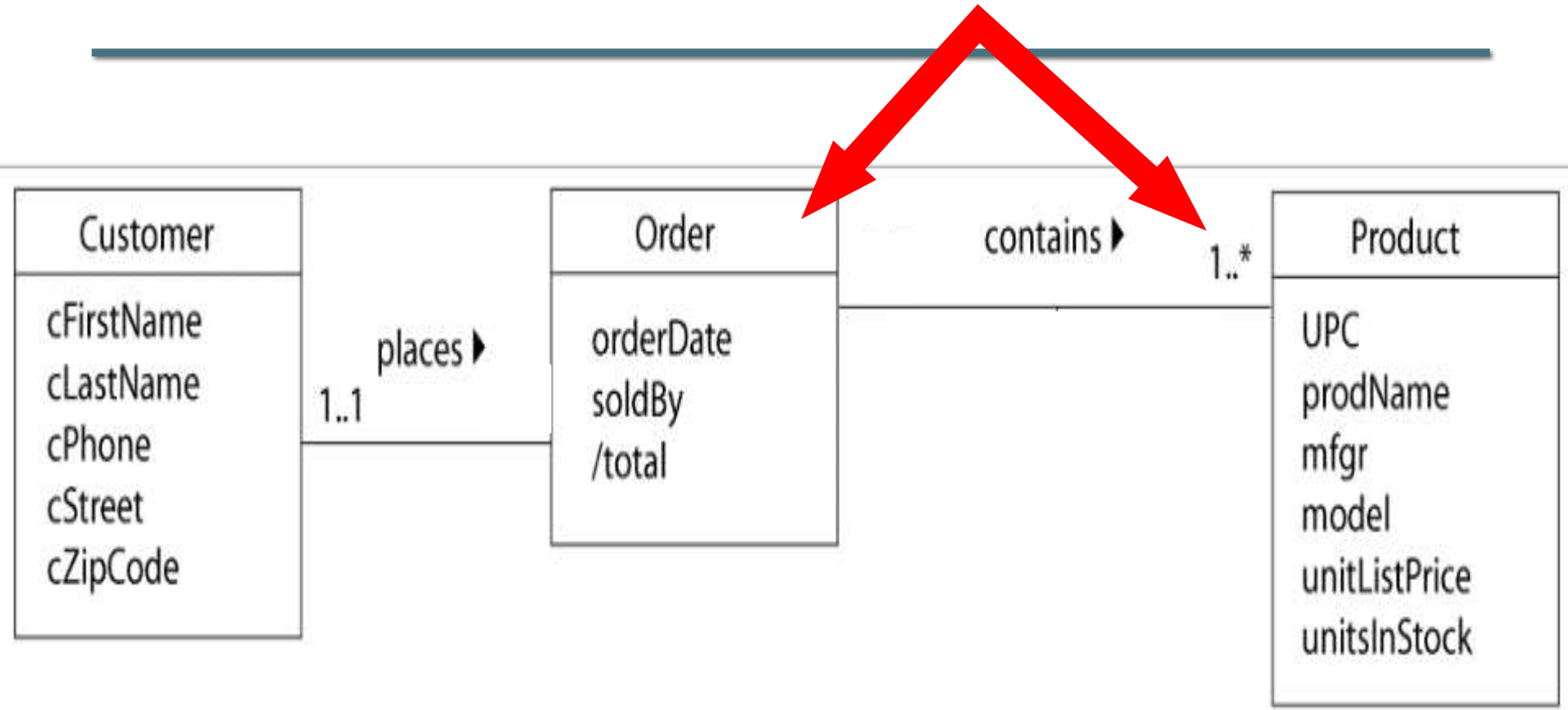


One-to-Many Relationship



Many-to-Many Relationship




Customer
cFirstName
cLastName
cPhone
cStreet
cZipCode
places
1..1
Order
orderDate
soldBy
/total
contains
1..*
Product
UPC
prodName
mfgr
model
unitListPrice
unitsInStock

Relational Database Example

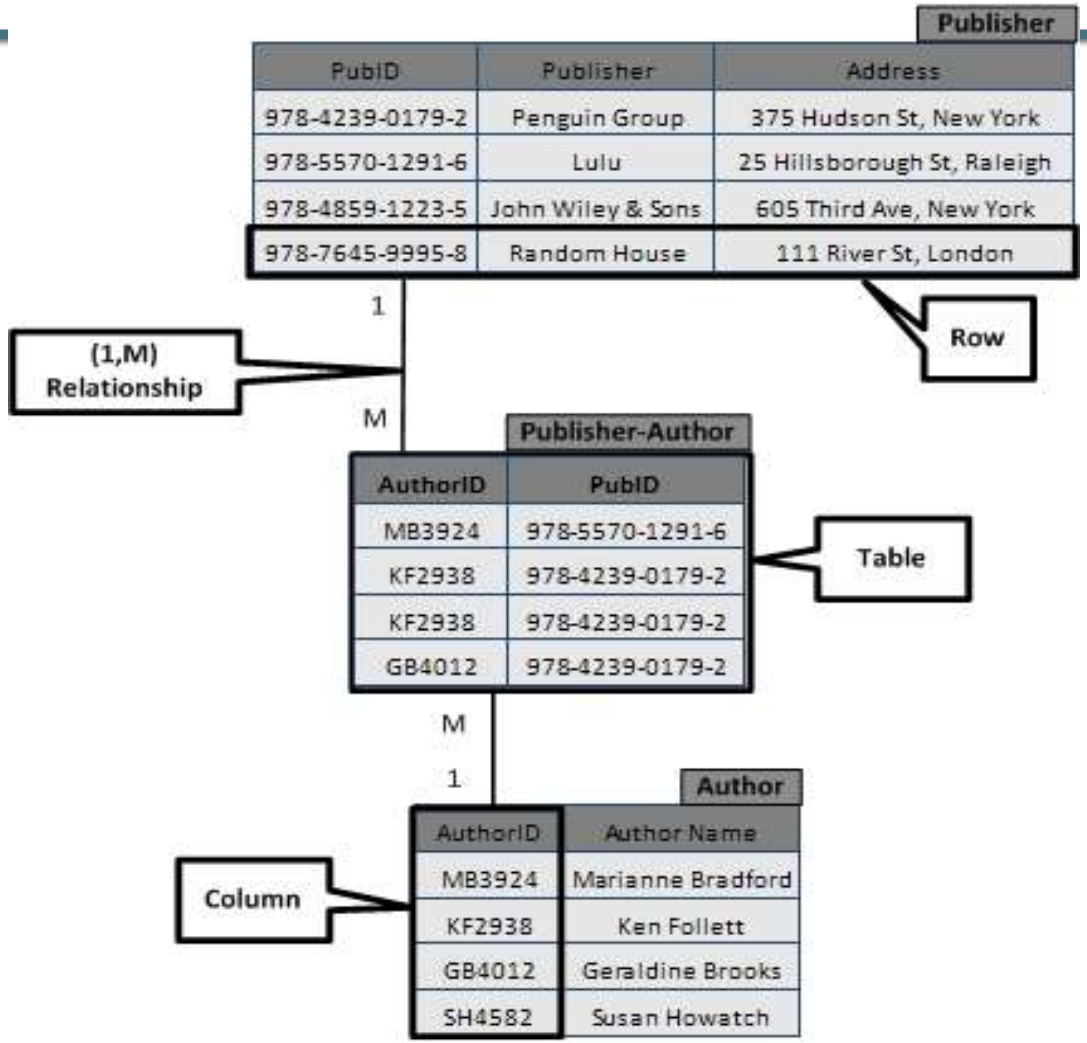


Figure 2-4: Relational Database Overview

Database Normalization

- Process of efficiently organizing data in database

Objectives:

Eliminating redundant data (e.g. same name in more than 1 table)

Ensuring data dependencies make sense (e.g. storing related data)

Reduce the amount of space a database consumes
Possibility that data inconsistent

- Data Symmetry vs. Data Asymmetry

Consistent vs inconsistent

Database Query and Manipulation

- A **query** is a question asked of the database. Again, ERP systems have many standard queries coded into the software in the form of menus. Menus can be customized to **add/change/delete** queries.
  - **Structured Query Language (SQL)** is a database querying language
    - **Simple Query** – returns a response without changing the database
    - **Update Query** – changes records in a database

Shipping clerk makes sure that a shipment was sent express
Salesperson analyze customer purchases

- **Data Manipulation** – operations alter the database
  - Inserting new rows into tables
  - Updating existing rows
  - Deleting rows from tables

Configure vs. Customize ERP

- **Configuration** involves “setting switches” during implementation that determine how the system will execute business processes.
  - Example of configuring:

    Reporting relationships,

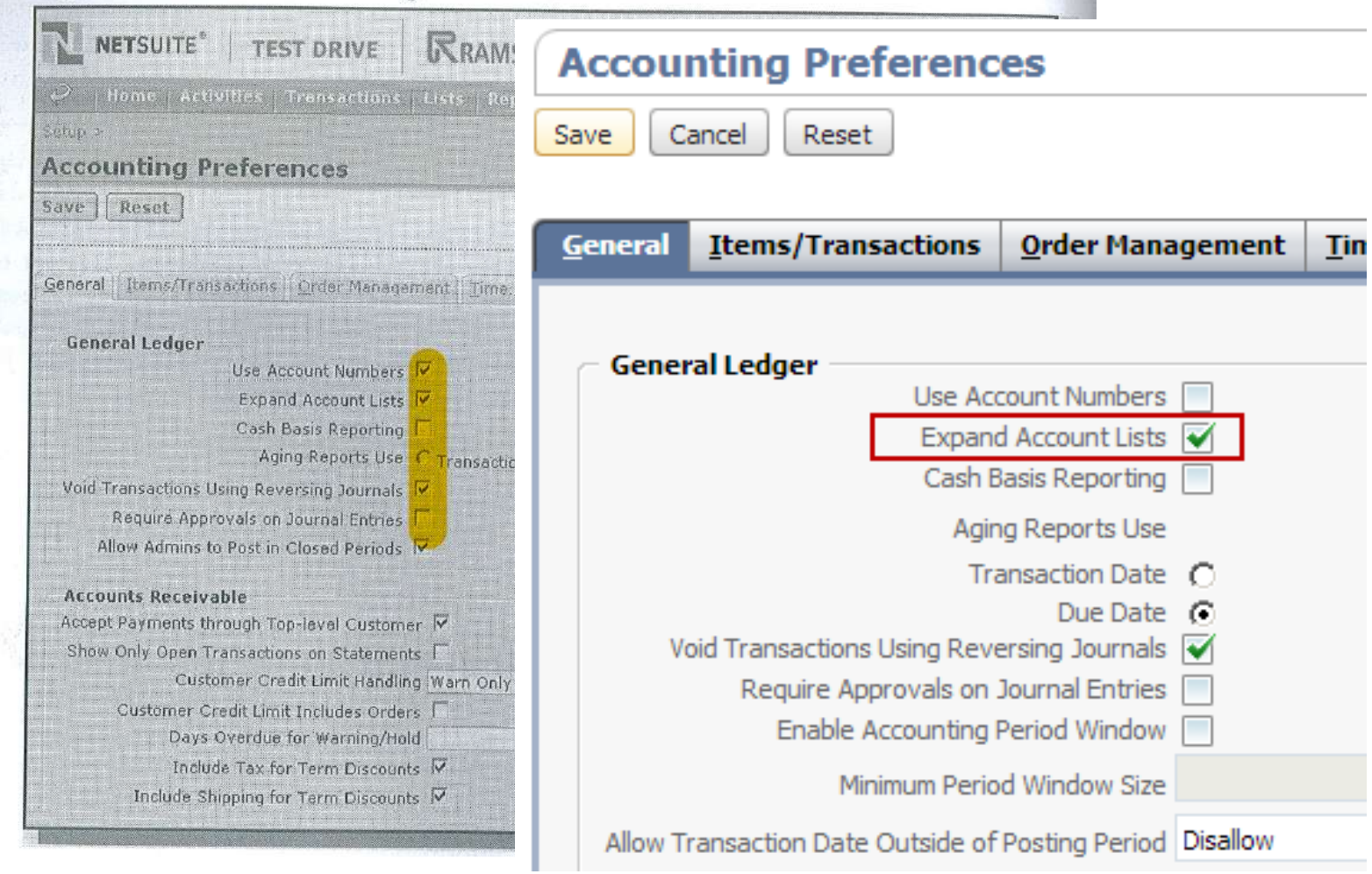
    Options having to do with how business processes work,

    Auditing mechanisms,

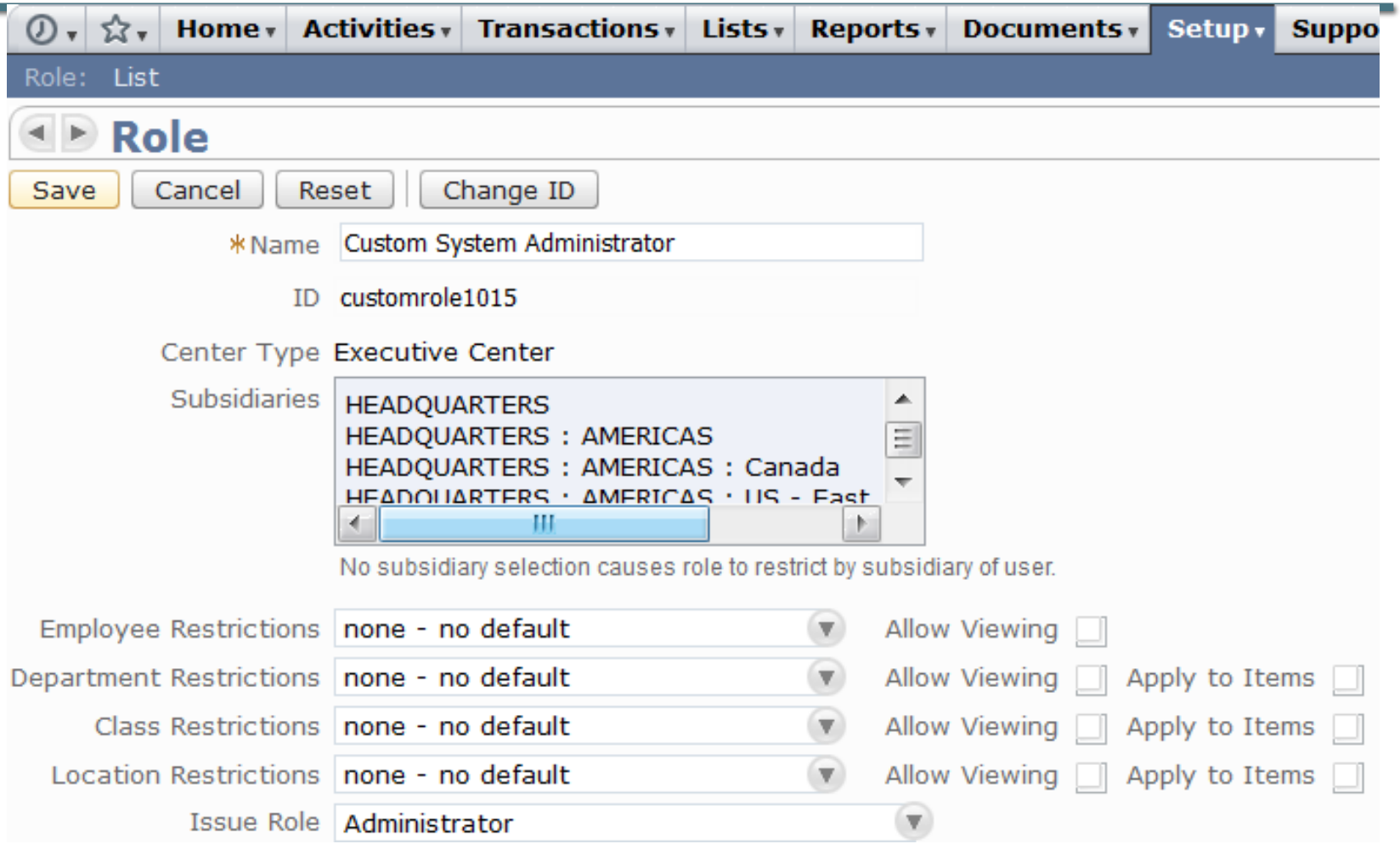
    Organizational structure.

Configuring the system is necessary to support IS security
Level to access to the data

Figure 2–5: NetSuite Accounting Preferences



Configuring user roles in Netsuite



- **Customization** is changing software code.
  - This is expensive and time consuming.
  - Only do if necessary and believed to lead to a competitive advantage.
  - Don't customize because you feel your employees will resist a new way of work….that is the point of ERP!

Rewriting or adding programming code (analysis, design, programming, and testing)

- **Vanilla** is not customizing the software.
- **Best of Breed**: selection of “mix and match” modules from different ERP vendors