# Data management

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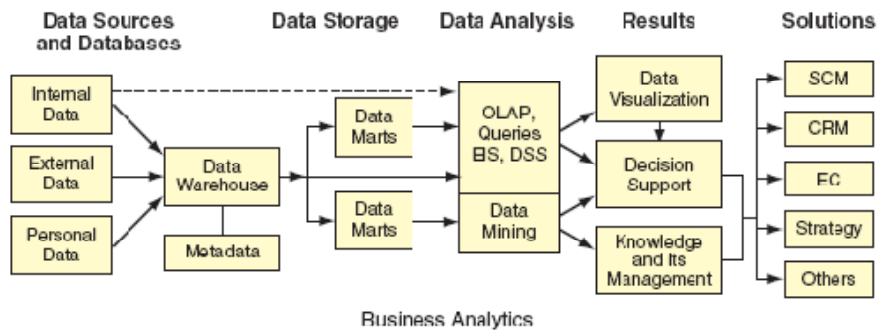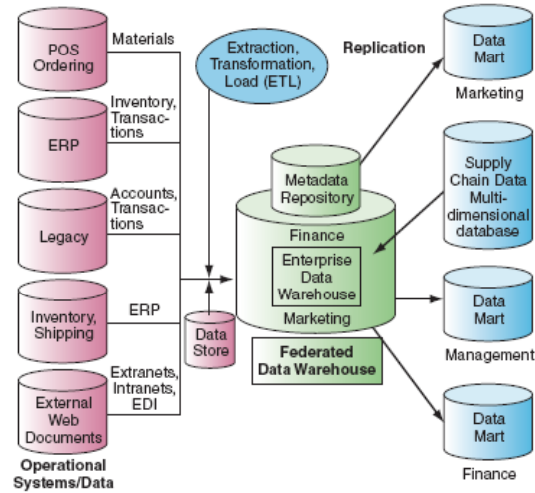
# Data Life Cycle Process

## The Data Warehouse & Data Management



3

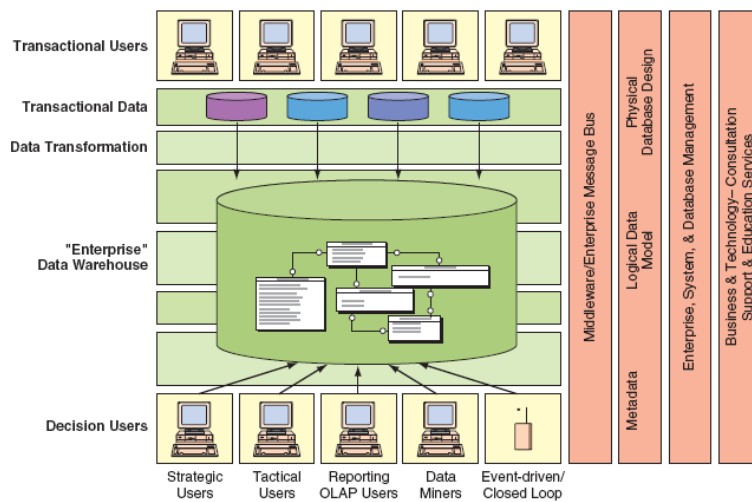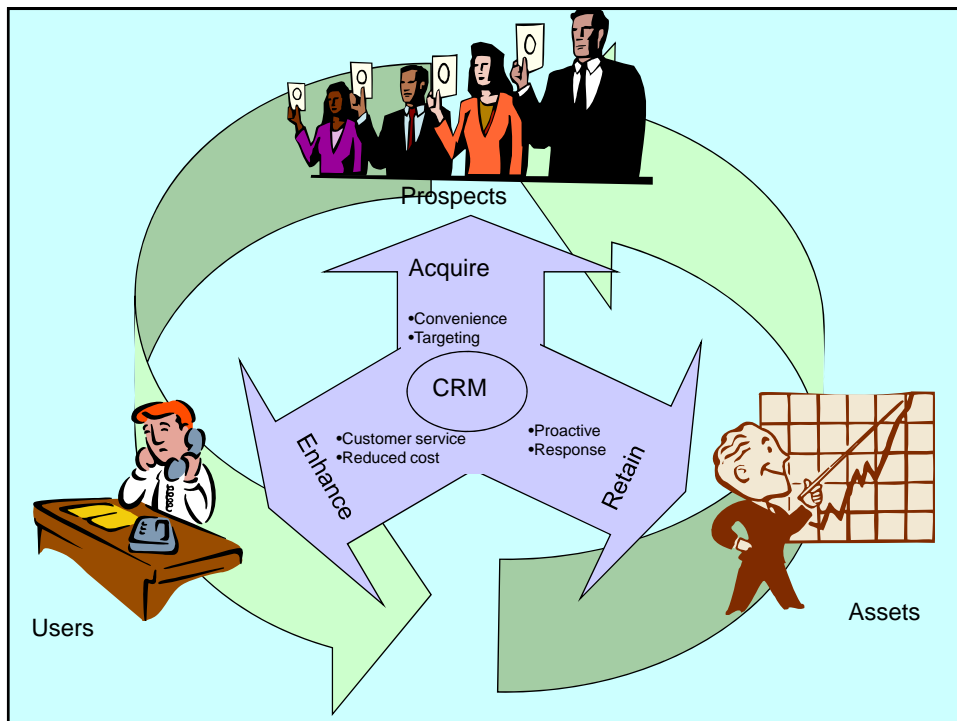## Web-based Data Management Systems – content and information



**Figure 3.14** Teradata Corp.'s enterprise data warehouse. (*Source:* Teradata Corporation [*teradata.com*], with permission.)

# Operations Support Systems:
## CRM Systems

# Customer Relationship Management (CRM)

CRM recognizes that customers are the core of a business and that a company's success depends on effectively managing relationships with them. It focuses on building long–term and sustainable customer relationships that add value both for the customer and the company.

- Types of CRM
  - Operational CRM
  - Analytical CRM
  - Collaborative CRM

7

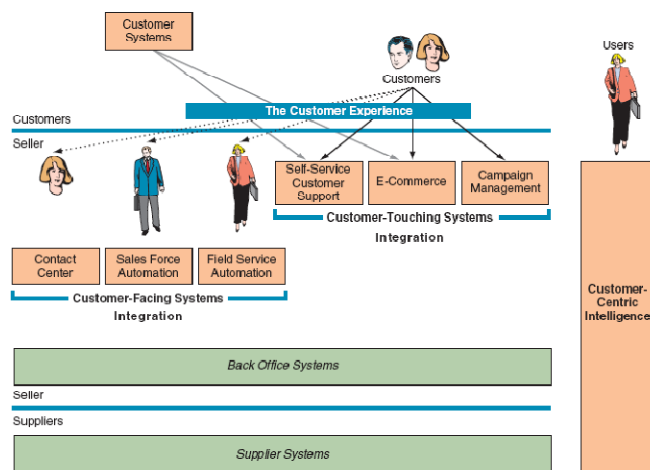# Customer Relationship Management (CRM) (Continued)



**Figure 8.10** CRM applications. (*Source:* Patricia Seybold Group, *An Executive's Guide to CRM*, March 21, 2002.)

8

# Customer Relationship Management (eCRM)

- CRM has been practiced manually by corporations for generations. However, Ecrm (electronic CRM) started in the mid-1990's ,when customers began using Web browsers, the Internet, and other electronic touch points.
  - THE SCOPE OF E-CRM. We can differentiate three levels of e-CRM:
    - Foundational service. This includes the minimum necessary services such as Website responsiveness (e.g., how quickly and accurately the service is provided), site effectiveness, and order fulfillment.
    - Customer-centered services. These services include order tracking, product configuration and customization, and security/trust. These are the services that matter the most to customers.
    - Value-added services. These are extra services such as online auctions and online training and education.

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# Customer Relationship Management CRM Activities

- Customer Service on the Web
  - Search and Comparison Capabilities
  - Free Products and Services
  - Technical and Other Information and Service
  - Allowing Customers to Order Products and Services Online
  - Letting Customers Track Accounts or Order Status
- Tools for Customer Service
  - Personalized Web Pages
  - FAQs
  - Chat Rooms
  - E-Mail and Automated Response
  - Call Centers
  - Troubleshooting Tools
  - Wireless CRM

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# CRM Systems

- Basic principle: centrality of the **customers'** role

- Goals: make decisions according to the customers' needs; build a **personalized** relationship with the customers (one-to-one marketing)

- Tools for the filing of customers' information: **data warehouse** and **data mart**

| | DBMS | Data Warehouse |
|---|---|---|
| *Aim* | Daily operational management | Decisional support (in the future) |
| *Managed information* | Real-time information | Historical and temporal decisions |
| *Users and their profiles* | Many users, middle/low level | Few users, typically managers |
| *Requirements* | Performances | Analytical power and ease of use |

---

# BI Infrastructure

Users through a web interface can view 45 measures on claims and prescription.

MIM Health Plans, Inc.

Adobe needed the ability to quickly perform sophisticated analysis: "What were PhotoShop revenues for May in Spanish-speaking countries in South America?" or "Which partners generate the highest sales?"

Adobe Systems, Inc.
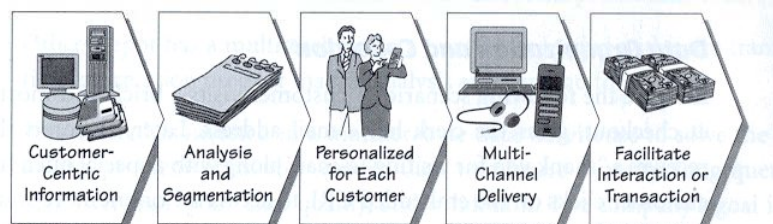


Kalakota and Robinson, 2001

6

# CRM IT infrastructure
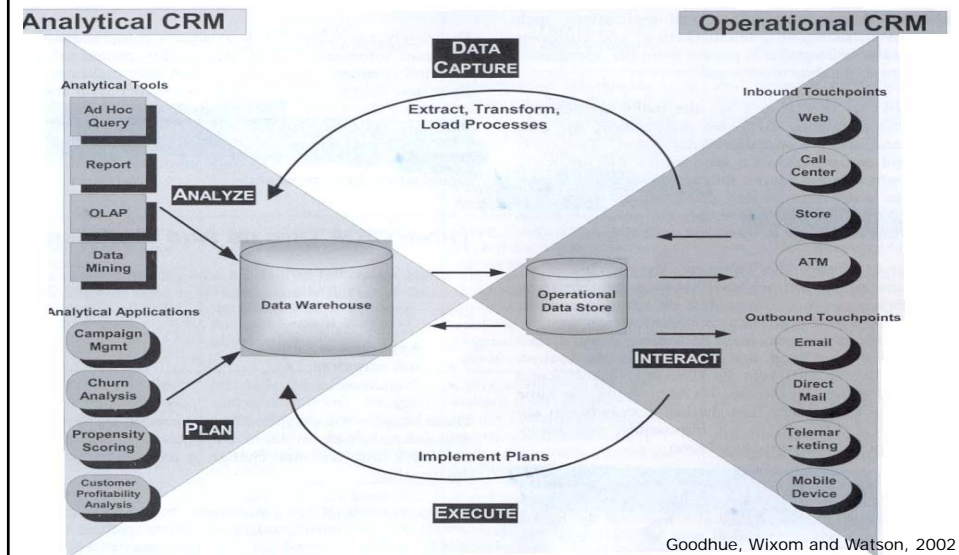


Goodhue, Wixom and Watson, 2002

# CRM Systems

- Order management
  - Order collecting and invoicing, post-sales assistance (sell-side processes of the value chain)
- Sales channel management
  - Sales force automation (pc for offers and demo)
  - Toll free numbers, call centers
  - Catalogues, offers on the Web (since '95)
- Management of advertising campaigns

# CRM Systems

- Order management
  - order collecting and invoicing, post-sales assistance (sell-side processes of the value chain)
  - in the seventies, online systems for the informatization of the cycle of registration, execution, shipping and invoicing
  - make the order input executable, breaking down the customer's order into production orders and keeping track of the progress
  - direct interaction with the customers is occasional or absent

# CRM Systems

- Sales force automation (SFA)
  - Starting from the half of the eighties, used in pharmaceutical industry by informers and, more in general, by sellers of complex products
  - sellers and informers are equipped with a portable personal computer (the "electronic case"), with a software which supports the setting-up of offers, with informational cards and product demonstrations, and gives information on the orders.
  - The activity of the sellers, who periodically transmit the reports of their visits to the headquarters, is planned and controlled by a central system

# CRM Systems

- Toll free numbers, Call centers

  - Starting from the nineties, the growing diffusion of toll free numbers multiplies the telephone interaction between user-customer and companies.
  - A wide range of support centers have developed, generically known as *call centers o contact centers*, which:
    - offer information and reservation services to customers (airlines, medical services and other);
    - provide services of general assistance (*help desk)* and of breakdown reporting, typical but not exclusive of telephone, electrical, water-supplying companies, etc.);
    - operate as sales points of products or services (for example, requests for telephone subscriptions, prepaid cell phone cards, and the like) in substitution of shops.

# CRM Systems

- Web Technology
  - Starting from 1995, the internet becomes the standard information channel for customers
  - Customers have access to big quantities of information directly available online and can make use of a wider and wider variety of internet transactions (customers' *self-service*, that is, the possibility, for example, to have access to the statement of account of one's credit card online, or to book a flight, directly via internet)
  - Companies open their information system towards the outside, allowing the customers to have autonomous access to information and services
  - Modern CRM systems must give an integrated and real-time view of the customers, which includes all the relevant information about past purchases, previous service requests, consumer's profile

# Evolution of CRM Systems

- In the seventies, online systems for order management computerize registration, execution, shipping, invoicing, but without direct interaction with the customers.
- In the eighites, Sales Force Automation (SFA) systems are based on the "electronic case" and a periodical interaction with the headquarters.
- In the nineties, toll free numbers through call centers or contact centers become popular for information, reservation, assistance services
- Starting from 1995 WEB becomes the standard channel for
  - Information (i.e. product catalogue)
  - Self-service sales transactions for consumer customers (see Amazon.com) - B2C paradigm
  - Sales transactions for companies (see CISCO case) - B2B paradigm
- Result of this evoluzion is the present architecture of CRM systems which are:
  - multichannel
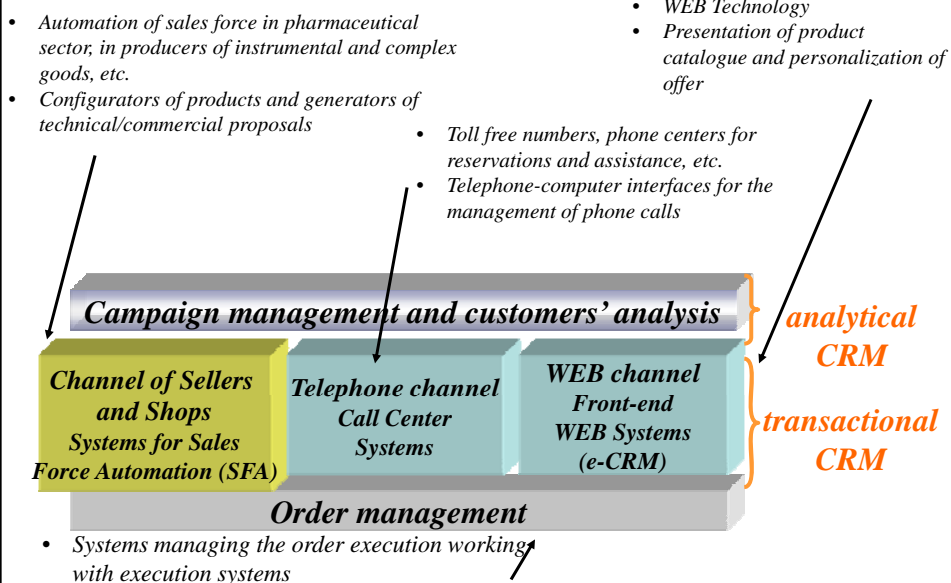  - with one only customers' database

# Management of advertising campaigns

- Supporting planning, execution and results analysis
- Contact with customers

  - Normal mail and e-mail
  - Telemarketing, Call centers
  - Web sites and company's portals
  - Customers' portals

# Activity of campaign management

- Preparation: definition of goal, expected results, target customer (business intelligence system)
- Planning: definition of target criteria, offer, channels, operational planning
- Execution: target extraction, contact with customers
- Evaluation: Analysis of results in terms of effectiveness and efficiency (costs) and of customers' behaviour (analysis of customers' surfing on the web) – analytical CRM

# CRM systems: functional modules

- *Automation of sales force in pharmaceutical sector, in producers of instrumental and complex goods, etc.*
- *Configurators of products and generators of technical/commercial proposals*

- *WEB Technology*
- *Presentation of product catalogue and personalization of offer*

- *Toll free numbers, phone centers for reservations and assistance, etc.*
- *Telephone-computer interfaces for the management of phone calls*

**Campaign management and customers' analysis**

*analytical CRM*

**Channel of Sellers and Shops**
**Systems for Sales Force Automation (SFA)**

**Telephone channel**
**Call Center Systems**

**WEB channel**
**Front-end WEB Systems (e-CRM)**

*transactional CRM*

**Order management**

- *Systems managing the order execution working with execution systems*

## Order and administrative management

- Breakdown of customers' request into related work orders
- Check of order progress
  - workflow management
- Solutions for specific segments of customers, i.e. mobile/fixed telephony
  - consumptions, rates, contracts, payment check, management of credits and takings

## Order execution and service delivery

- Operations Support Systems in telecom

  - Real-time management of telephone procedures
  - Survey of traffic and usage data for billing
  - Planning and installation of plants
  - Maintenance and fixing of plants

# Sales Force Automation

- Support to planning and sales
  - Opportunity management system, planning and control of sales cycle
  - Mktg encyclopedia system, knowledge base management for sales (competition, demos, advertising)
  - Geographical information system, territory analysis and mapping of opportunities
  - Configuration of product for offer
  - Sales analysis

# SFA: IT support
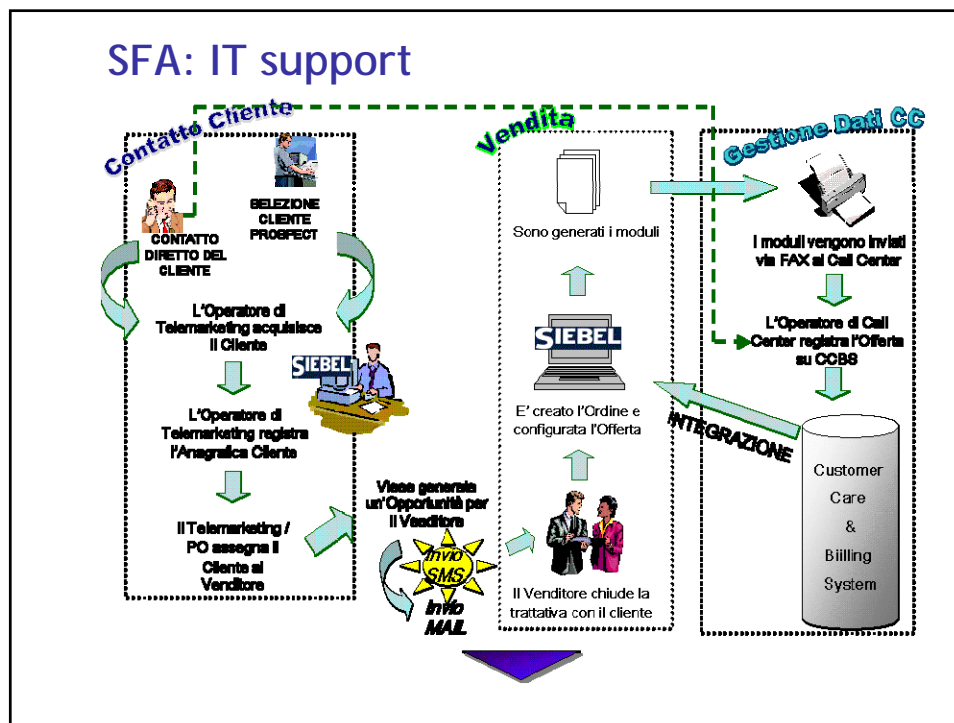
# Call centers and customer management systems

- DB management of customers, products, services
- Support to contact with customers
- Registration of orders and requests for intervention
- Development of executive guides for the operator (scripts) and telemarketing inbound (call from customer) and outbound (call to customer) campaigns

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# Call Center – Phone-based Front End
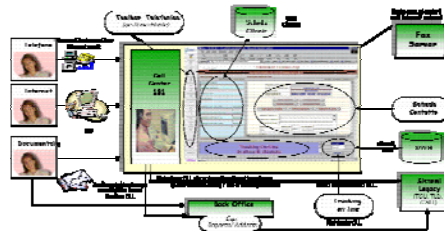


- The system of telephone contact combines various functions:
  - Management of telephone traffic
  - Information on customers-users **shared with all channels**
    - Demographics
    - Customer history
    - Status of complaints, orders, etc.
    - Profile indicators
  - Istructions for iter-questions (script)
  - Opening and ending of orders and cards

# Front end Web

- Business to Customer portal
  - Proactivity and profiling, assisted surfing on the catalogue, order collecting, order progress, click stream)
- Business to Business portal
  - Customers can configure orders, check availability, check purchased services, request interventions
- Personal service portal
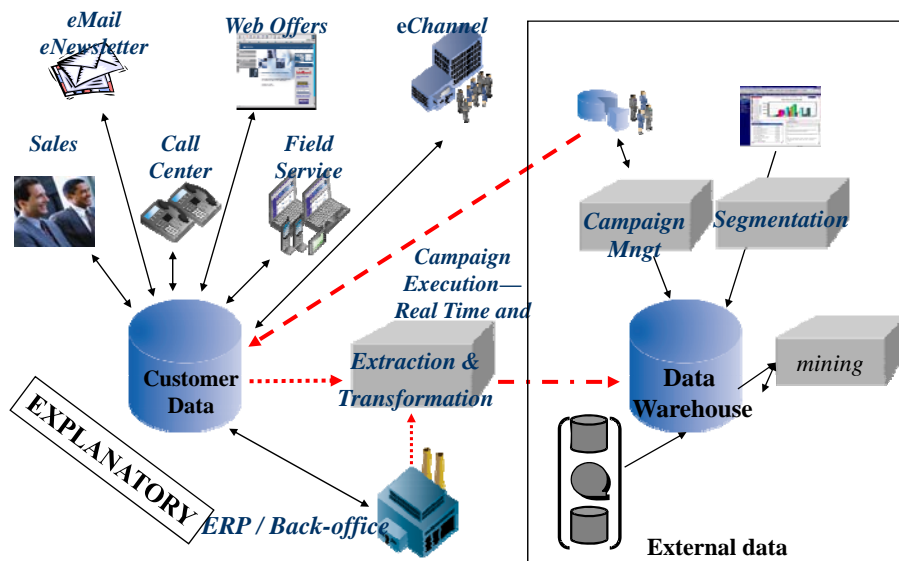  - Consumers can check bills, consumes, contracts

# Front end WEB: general characteristics

- It supports transactions between customer and company on the internet
- Included in the portal
- Different for Business customers and Consumer customers
- The system for Consumers:
  - presents a catalogue with products and offers (surfing or "shop window function")
  - suggests the most suitable product to the customer according to her/his previous choices (proactivity and profiling)
  - assists the customer in the purchase transaction (shopping cart function)
  - offers information on the progress of orders and possible complaints (order progress function)
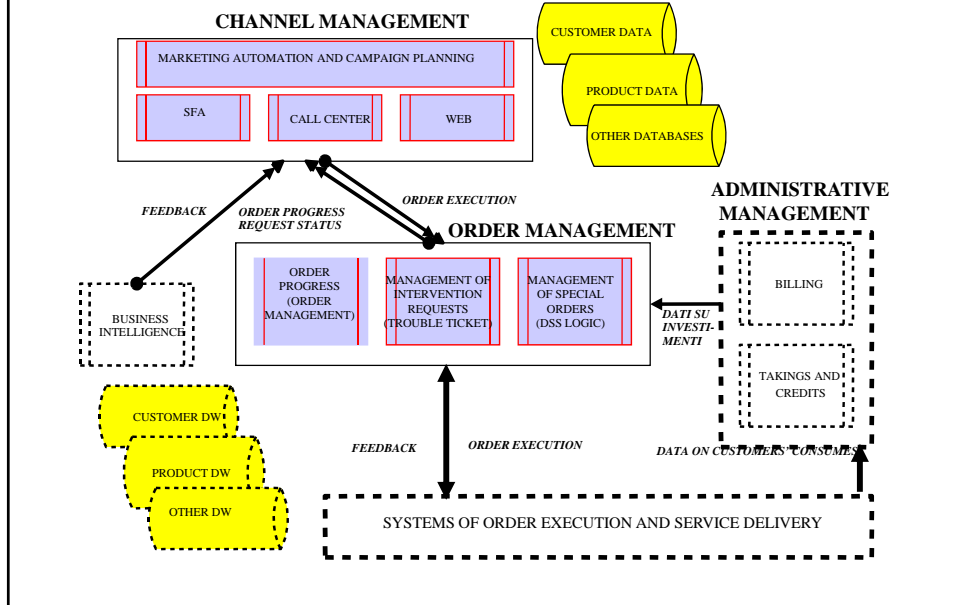  - memorizes data on the customers' surfing (clickstream analysis)

# Analytical CRM : Business Intelligence

- Analysis of customers' behaviour (used services, called numbers)
- Price comparison (cheap fares)
- Abandonment forecasting (probability calculus)
- Campaign analysis (customers' reactions)
- Clickstream analysis (customers' surfing on products and services)
- Datawarehouse with information at various aggregation levels
- Datamart with structured information according to segmentation used by analysis engines
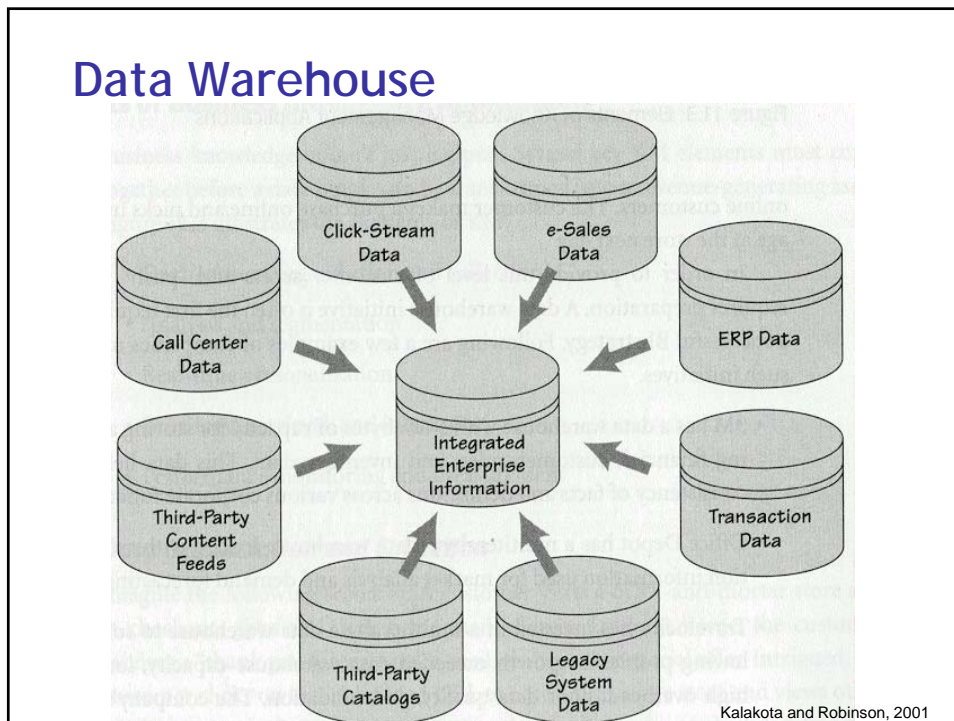
# Analytical CRM : architecture



*eMail eNewsletter*

*Web Offers*

*eChannel*

*Sales*

*Call Center*

*Field Service*

*Campaign Execution— Real Time and*

*Campaign Mngt*

*Segmentation*

*Extraction & Transformation*

**Customer Data**

EXPLANATORY

*ERP / Back-office*

**Data Warehouse**

*mining*

**External data**

## CRM: GENERAL ARCHITECTURE- EXAMPLE OF A PHONE PROVIDER

**CHANNEL MANAGEMENT**

MARKETING AUTOMATION AND CAMPAIGN PLANNING

SFA | CALL CENTER | WEB

CUSTOMER DATA

PRODUCT DATA

OTHER DATABASES

FEEDBACK | ORDER PROGRESS REQUEST STATUS | ORDER EXECUTION

**ADMINISTRATIVE MANAGEMENT**

**ORDER MANAGEMENT**

ORDER PROGRESS (ORDER MANAGEMENT) | MANAGEMENT OF INTERVENTION REQUESTS (TROUBLE TICKET) | MANAGEMENT OF SPECIAL ORDERS (DSS LOGIC)

BILLING

*DATI SU INVESTI-MENTI*

BUSINESS INTELLIGENCE

TAKINGS AND CREDITS

CUSTOMER DW

PRODUCT DW

OTHER DW

FEEDBACK | ORDER EXECUTION | *DATA ON CUSTOMERS' CONSUMES*

SYSTEMS OF ORDER EXECUTION AND SERVICE DELIVERY

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# Data Warehouse



Click-Stream Data | e-Sales Data | Call Center Data | ERP Data | Integrated Enterprise Information | Third-Party Content Feeds | Transaction Data | Third-Party Catalogs | Legacy System Data

Kalakota and Robinson, 2001

# BI Infrastructure concepts

- OLTP
- OLAP
- Data Marts
- Data Mining

# Integration: Data Warehouse

Source System

RDBMS

Source System

RDBMS

Source System

RDBMS

Data Warehouse

Data Mart → OLAP → **Business Intelligence**

Data Mart → OLAP → **Business Intelligence**
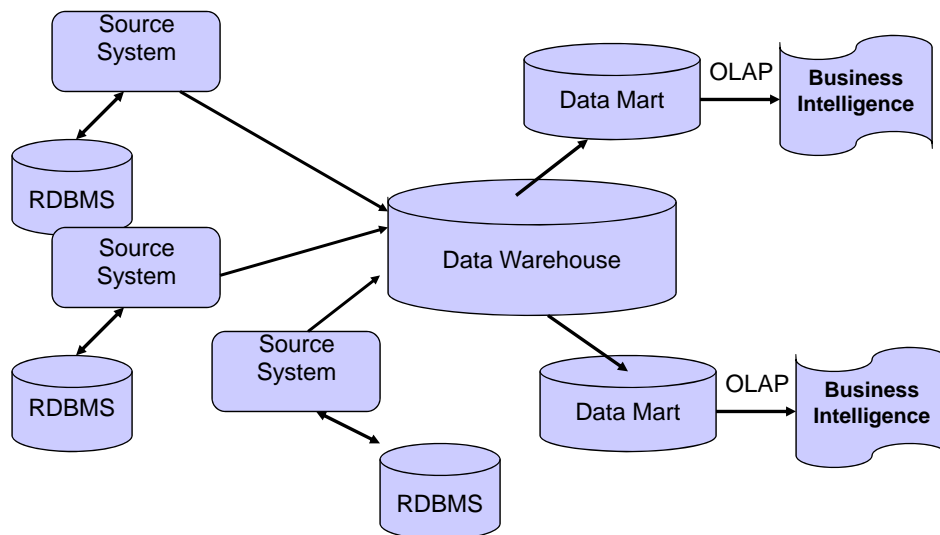
## Multidimensional analysis: an example

```
                    ┌──────────┐
                    │ Product  │
                    └──────────┘
                         ↕
┌──────────────┐    ┌──────────┐    ┌──────────────────┐
│ Supermarket  │ ↔  │  Sales   │ ↔  │ Geographical area│
└──────────────┘    └──────────┘    └──────────────────┘
                         ↕
                    ┌──────────┐
                    │   Time   │
                    └──────────┘
```
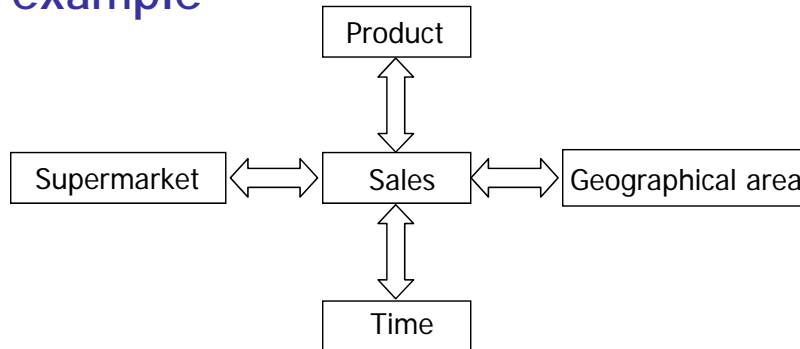
- The complexity of the scheme is directly proportional to the number of dimensions

- Data redundancy is admitted to facilitate analysis procedures

## CRM systems: data mining activities

- Data analysis to identify information "hidden" in big archives

  - **Association rules**: identification of behavioural rules (i.e. products often purchased together, sequentially, only in a specific time of the year, in a specific geographical area, …)

  - **Discretization**: classification of the values of a quantity in a finished whole of classes (i.e. high, middle, low) to analyse the data using association rules

  - **Classification**: automated catalogation of customers in classes of importance dependant upon pre-arranged priority criteria (i.e. total expenses or purchase frequency)

# Output of data mining activities

- Hypothesis of rules on the customers' profile and behaviour which should guide the choice of information or custom services to be offered to the customers

- They can be based on:
  - The customers' past behaviour
  - The past behaviour of other customers belonging to the same profile

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## ERP SYSTEMS AND DATAWAREHOUSE

REPORTING INFORMATION

Business Intelligence Applications

DATAWAREHOUSE

DATA LEGACY

ERP

DATA EXTERNAL
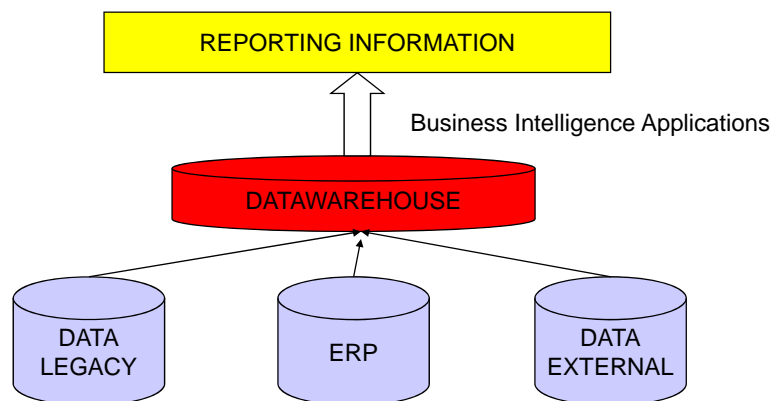
## Managerial Issues

- **Ethical issues**
- **How much to integrate?**
- **Role of IT**
- **Organizational adaptability**
- **Going global**
- **The Customer is king/queen**
- **Set CRM policies with care**

# *Business Intelligence*

## Learning Objectives

- Understand the drivers for BI
- Understand the structure and components of BI
- OLAP, querying, multidimensional analysis
- Data visualization and BI
- Real time BI and competitive Intelligence

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## BI components

- Data warehouse

- Business analytics

- Business Performance Management

- User Interface

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# BI components and Architecture
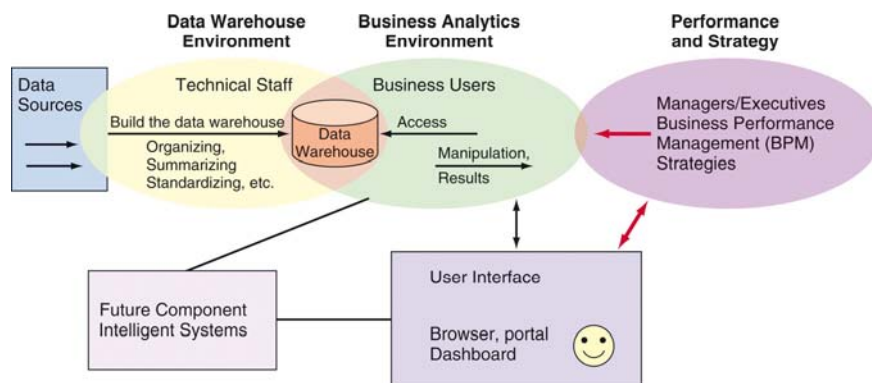
# Business Value of BI

| TABLE 11.1 | Business Value of BI Analytical Applications | |
|---|---|---|
| **Analytical Application** | **Business Question** | **Business Value** |
| Customer segmentation | What market segments do my customers fall into and what are their characteristics? | Personalize customer relationships for higher customer satisfaction and retention. |
| Propensity to buy | Which customers are most likely to respond to my promotion? | Target customers based on their need to increase their loyalty to your product line. Also, increase campaign profitability by focusing on the most likely to buy. |
| Customer profitability | What is the lifetime profitability of my customers? | Make business interaction decisions based on the overall profitability of customers or customer segments. |
| Fraud detection | How can I detect which transactions are likely to be fraudulent? | Quickly detect fraud and take immediate action to minimize cost. |
| Customer attrition | Which customers are at risk of leaving? | Prevent loss of high-value customers and let go of lower-value customers. |
| Channel optimization | What is the best channel to reach my customers in each segment? | Interact with customers based on their preference and your need to manage cost. |

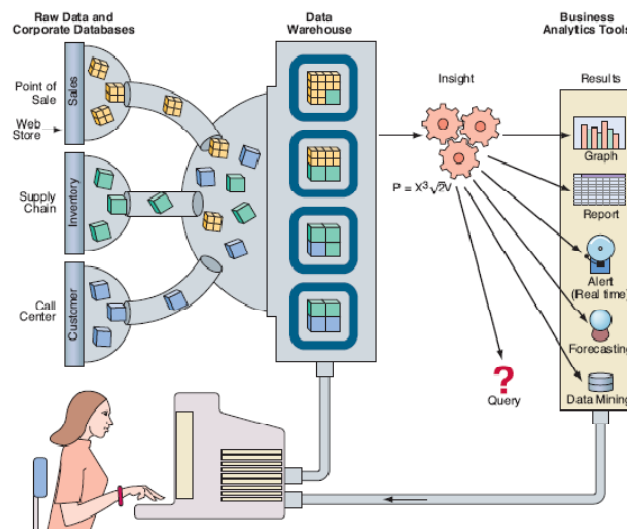*Source:* Ziama and Kasher (2004). Courtesy of Teradata, divison of NCR Corp.
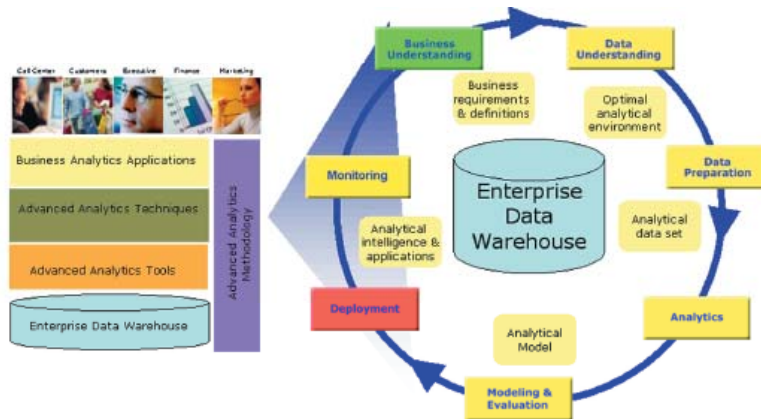
# BI, Data, and the Warehouse

**BUSINESS ANALYTICS**

| Information and Knowledge Discovery | Decision Support and Intelligent Systems | | Visualization |
|---|---|---|---|
| OLAP | DSS | Management Science and Statistical Analysis | Visual Analysis |
| Ad-hoc Queries and Reports | Group DSS Virtual Groups | Data Mining and Predictive Analysis | Scorecards |
| Data Mining | Executive and Enterprise Support | Applied Artificial Intelligence | Dashboard |
| Text Mining | Automated Decision Support | Metrics, Performance Management, BPM | 3D Virtual Reality |
| Web Mining | Web Analytics | | |
| Search Engines | | | |

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# Business Intelligence



$P = X^3 \sqrt{2V}$

# Analytics in Example

# Knowledge Discovery

| TABLE 11.3 | Stages in the Evolution of Knowledge Discovery | | |
|---|---|---|---|
| **Evolutionary Stage** | **Business Question** | **Enabling Technologies** | **Characteristics** |
| Data collection (1960s) | What was my total revenue in the last five years? | Computers, tapes, disks | Retrospective, static data delivery |
| Data access (1980s) | What were unit sales in New England last March? | Relational databases (RDBMS), structured query language (SQL) | Retrospective, dynamic data delivery at record level |
| Data warehousing and decision support (early 1990s) | What were the sales in region A, by product, by salesperson? | OLAP, multidimensional databases, data warehouses | Retrospective, dynamic data delivery at multiple levels |
| Intelligent data mining (late 1990s) | What's likely to happen to the Boston unit's sales next month? Why? | Advanced algorithms, multiprocessor computers, massive databases | Prospective, proactive information delivery |
| Advanced intelligent system | What is the best plan to follow? | Neural computing, advanced AI models, complex optimization, Web Services | Proactive, integrative; multiple business partners |
| Complete integration (2000–2004) | How did we perform compared to metrics? | | |

# Data Visualization



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# GIS Functions



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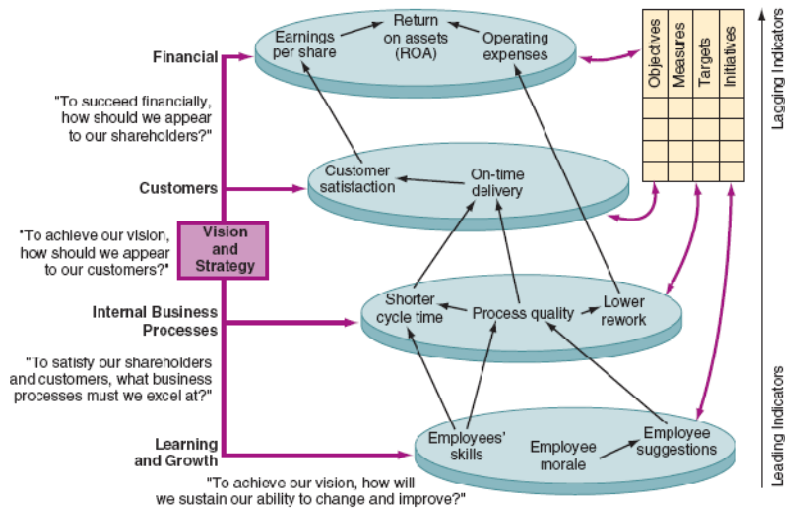# Real Time BI
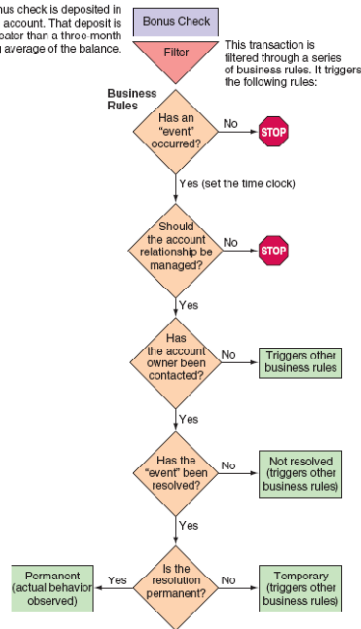


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# BI monitoring and Evaluation
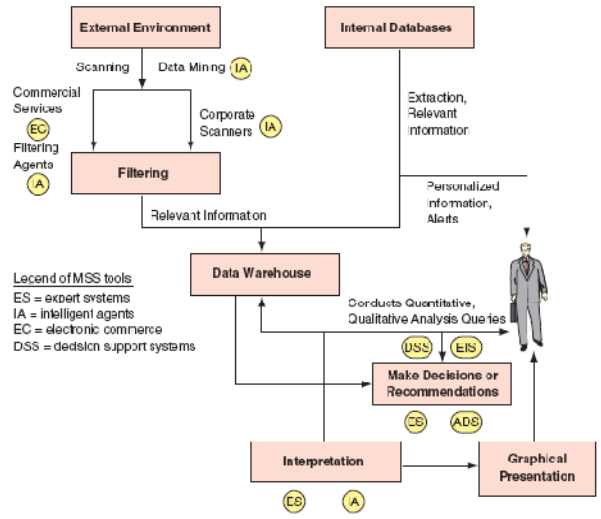


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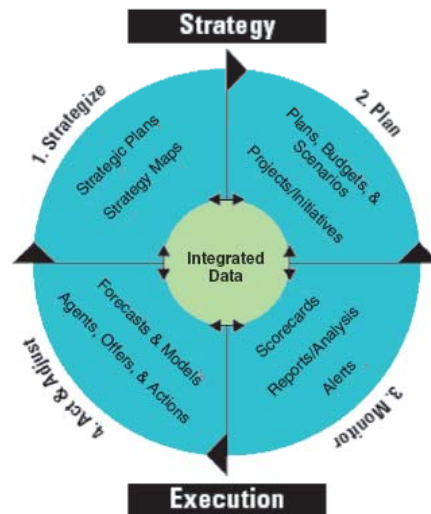
# BI monitoring and Evaluation
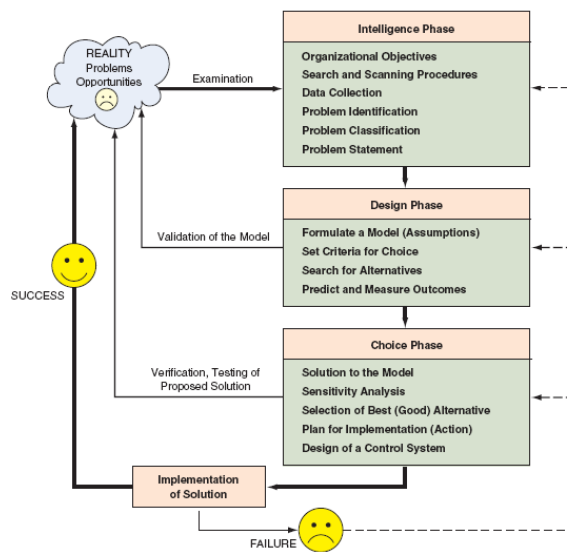## (Continued)

# Decision support systems

# Decision Process



# Decision Complexity

## Characteristics and Capabilities of DSSs

- **Sensitivity analysis** is the study of the impact that changes in one (or more) parts of a model have on other parts.
- **What-if analysis** is the study of the impact of a change in the assumptions (input data) on the proposed solution.
- **Goal-seeking analysis** is the study that attempts to find the value of the inputs necessary to achieve a desired level of output.

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## Structure and Components of DSSs

- **Data management subsystem** contain all the data that flow from several sources.
- **Model management subsystem** contains completed models and the building blocks necessary to develop DSS applications.
- **User interface** covers all aspects of the communications between a user and the DSS.
- **Users** are the persons faced with the problem or decision that the DSS is designed to support.
- **Knowledge-based subsystems** provide the required expertise for solving some aspects of the problem.

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# DSS Process
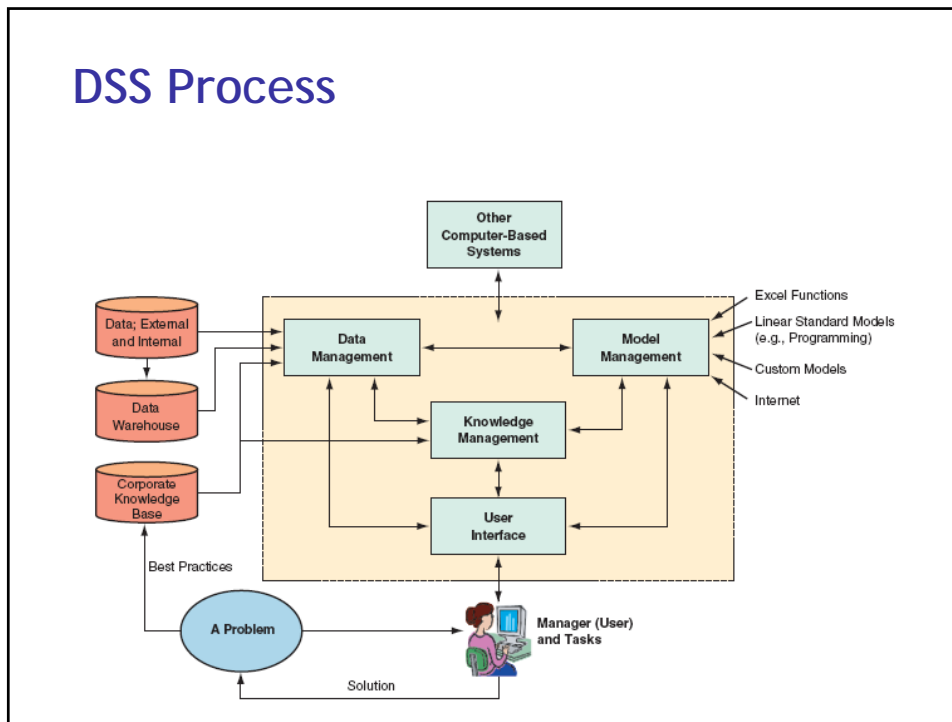


# Organizational Decision Support System (ODSS)

- **Organizational Decision Support System (ODSS)** is a DSS that focuses on an *organizational* task or activity involving a *sequence* of operations and decision makers and provides the following:
  - It affects several organizational units or corporate problems;
  - It cuts across organizational functions or hierarchical layers;
  - It involves computer-based and (usually) communications technologies.

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## Executive Information (Support) Systems

- **Executive information system (EIS)** also known as an **executive support system (ESS)**, is a computer-based technology designed specifically for the information needs of top executives and provides for:
  - Rapid access to timely information;
  - Direct access to management reports;
  - Very user friendly and supported by graphics.
  - *Exception reporting* – reporting of only the results that deviate from a set of standards.
  - *Drill down reporting* – investigating information in increasing detail.
  - Easily connected within online information services and e-mail.
  - Include analysis support, communications, office automation and intelligence support.

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## Enterprise Decision Simulator

- Technology that supports the informational needs of executives in the so-called "corporate war room".
- Management Cockpit is a strategic management room that enables top-level decision makers to pilot their businesses better.
- The environment encourages more efficient management meetings and boosts team performance via effective communication.

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## Enterprise Decision Simulator
### (Continued)

- Key performance indicators and information relating to critical success factors are displayed graphically on the walls of the meeting room.
- The cockpit environment is integrated with SAP's ERP products and reporting systems.
- External information can be easily imported to the room to allow competitive analysis.

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## Intelligent Systems

Expert systems (ESs) are attempts to mimic human experts. It is decision-making software that can reach a level of performance comparable to a human expert in some specialized and usually narrow problem area. The idea is simple: expertise is transferred from an expert or other source of expertise to the computer.

- The transfer of expertise from an expert to a computer and then to the user involves four activities:
  - Knowledge acquisition (from experts or other sources)
  - Knowledge representation (organized as rules or frames in the computer)
  - Knowledge inferencing is performed in a component called the inference engine of the ES and results in the recommendation.
  - Knowledge transfer to the user (the expert's knowledge has been transferred to users).

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# Intelligent Systems (cont'd)



70
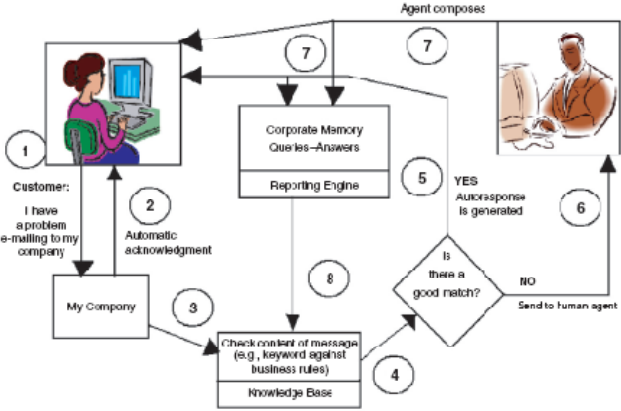
# The Benefits of Expert Systems

| Benefit | Description |
|---|---|
| Increased output and productivity | ESs can configure for each custom order. Increasing production capabilities |
| Increased quality | ESs can provide consistent advise and reduce error rates. |
| Capture and dissemination of scarce expertise | Expertise from anywhere in the world can be obtained and used. |
| Operation in hazardous environments | Sensors can collect information that an ES interprets, enabling human workers to avoid hot, humid, or toxic environments. |
| Accessibility to knowledge and help desks | ESs can increase the productivity of help – desk employee, or even automate this function. |
| Reliability | ESs do not become tired or bored, call in sick or go on strike. They consistently pay attention to details. |
| Ability to work with incomplete or uncertain information | Even with answer of ' don't know ' an ES can produce an answer, though it may not be a definite one. |
| Provision of training | The explanation facility of an ES can serve as a teaching device and knowledge base for novices. |

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## Natural Language Processing & Voice Technologies

- **Natural language processing (NLP):** Communicating with a computer in English or whatever language you may speak.
- **Natural language understanding/speech (voice) recognition:** The ability of a computer to comprehend instructions given in ordinary language, via the keyboard or by voice.
- **Natural language generation/voice synthesis:** Technology that enables computers to produce ordinary language, by "voice" or on the screen, so that people can understand computers more easily.

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## Neural Networks

- **Neural networks** are a system of programs and data structures that approximates the operation of the human brain.
- **Neural networks** are particularly good at recognizing subtle, hidden, and newly emerging patterns within complex data as well as interpreting incomplete inputs.

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# Fuzzy Logic

- **Fuzzy logic** deals with the uncertainties by simulating the process of human reasoning, allowing the computer to behave less precisely and logically than conventional computers do.
  - Involves decision in gray areas.
  - Uses creative decision-making processes.

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# Simulation Systems

Simulation generally refers to a technique for conducting experiments (such as "what-if") with a computer on a model of a management system. Because DSS deals with semi structured or unstructured situations, it involves complex reality, which may not be easily represented by optimization or other standard models but can often be handled by simulation. Therefore, simulation is one of the most frequently used tools of DSSs.

- Advantages of Simulation.
  - Allows for inclusion of the real-life complexities of problems.
  - Is descriptive.
  - Can handle an extremely wide variation in problem types.
  - Can show the effect of compressing time.
  - Can be conducted from anywhere.

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# Why Managers Need IT Support

- A key to good decision making is to explore and compare many relevant alternatives. The more alternatives that exist, the more computer-assisted search and comparisons are needed.
- Typically, decisions must be made under time pressure. Frequently it is not possible to manually process the needed information fast enough to be effective.

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# Why Managers Need It Support
### (Continued)

- It is usually necessary to conduct a sophisticated analysis in order to make a good decision. Such analysis requires the use of modeling.
- Decision makers can be in different locations and so is the information. Bringing them all together quickly and inexpensively may be a difficult task.

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# Managerial Issues

- **Cost justification, intangible benefits.** While some of the benefits of management support systems are tangible, it is difficult to put a dollar value on the intangible benefits of many such systems.
- **Documenting personal DSS.** Many employees develop their own DSSs to increase their productivity and the quality of their work. It is advisable to have an inventory of these DSSs and make certain that appropriate documentation and security measures exist.
- **Security.** Decision support systems may contain extremely important information for the livelihood of organizations. Taking appropriate security measures, especially in Web-based distributed applications, is a must.
- **Ready-made commercial DSSs.** With the increased use of Web-based systems and ASPs, it is possible to find more DSS applications sold off the shelf, frequently online. The benefits of a purchased or leased DSS application sometimes make it advisable to change business processes to fit a commercially available DSS.

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# Managerial Issues (Continued)

- **Intelligent DSS.** Introducing intelligent agents into a DSS application can greatly increase its functionality.
- **Organizational culture.** The more people recognize the benefits of a DSS and the more support is given to it by top management, the more the DSS will be used.
- **Embedded technologies.** Intelligent systems are expected to be embedded in at least 20 percent of all IT applications in about 10 years. It is critical for any prudent management to closely examine the technologies and their business applicability.
- **Ethical issues.** Corporations with management support systems may need to address some serious ethical issues such as privacy and accountability.

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