



**جامعة الفيوم**  
كلية الحاسوب والذكاء الاصطناعي  
مؤسسة تعليمية معتمدة

# الكتاب الجامعى

2025 - 2024



# *Foundations of Information Systems*

*2024 - 2025*



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# *Part 1*

## *Information systems*

## *Main Concepts*

## ***Data, Information, and Knowledge***

### **Data**

Raw data such as staff numbers, total hours worked in a week, inventory part numbers, and sales orders are all included. These facts can be represented by a variety of data types. Facts become information when they are organized in a meaningful way.

Data represents real-world things. Hospitals and healthcare organizations, for example, maintain patient medical data, which represents actual patients with specific health situations. In many cases, hospitals and healthcare organizations are converting data to electronic form. Some have developed electronic records management (ERM) systems to store, organize, and control important data. However, data—raw facts—has little value beyond its existence. The U.S. federal stimulus plan could invest as much as \$2 billion into helping healthcare organizations develop a medical records program to store and use the vast amount of medical data that is generated each year. Medical records systems can be used to generate critical health-related information, saving money and lives.

Data	Represented by
Alphanumeric data	Numbers, letters, and other characters
Image data	Graphic images and pictures
Audio data	Sound, noise, or tones
Video data	Moving images or pictures

(Types of Data)

## Information

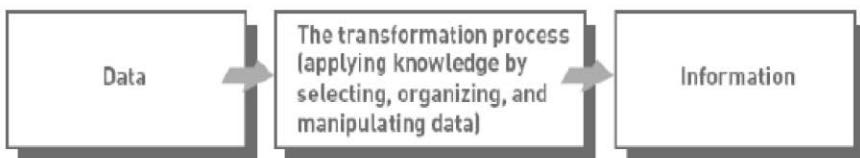
A collection of facts that have been structured, organized and processed to provide value beyond the worth of the individual facts. For example, sales managers might find that knowing the total monthly sales suits their purpose more (i.e., is more valuable) than knowing the number of sales for each sales representative. Customers can also help businesses increase revenue and profits by providing them with information.

## Process

Turning data into information, or a set of logically related tasks performed to achieve a defined outcome. Knowledge is required to define relationships among data in order to generate useful information.

## Knowledge

The awareness and understanding of a set of information and the ways that information can be made useful to support a specific task or reach a decision. Having knowledge means understanding relationships in information.



(The Process of Transforming Data into Information)

### ***The Characteristics of Valuable Information***

If information is not accurate or complete people can make poor decisions, costing thousands, or even millions, of dollars. Information can be of little value to the organization. If information is not relevant, not delivered to decision makers in a timely fashion, or too complex to understand. The value of information is directly linked to how it helps decision makers achieve their organization's goals.

Characteristics	Definitions
Accessible	Information should be easily accessible by authorized users so they can obtain it in the right format and at the right time to meet their needs.
Accurate	Accurate information is error free. In some cases, inaccurate information is generated because inaccurate data is fed into the transformation process. [This is commonly called garbage in, garbage out (GIGO).]
Complete	Complete information contains all the important facts. For example, an investment report that does not include all important costs is not complete.
Economical	Information should also be relatively economical to produce. Decision makers must always balance the value of information with the cost of producing it.
Flexible	Flexible information can be used for a variety of purposes. For example, information on how much inventory is on hand for a particular part can be used by a sales representative in closing a sale, by a production manager to determine whether more inventory is needed, and by a financial executive to determine the total value the company has invested in inventory.

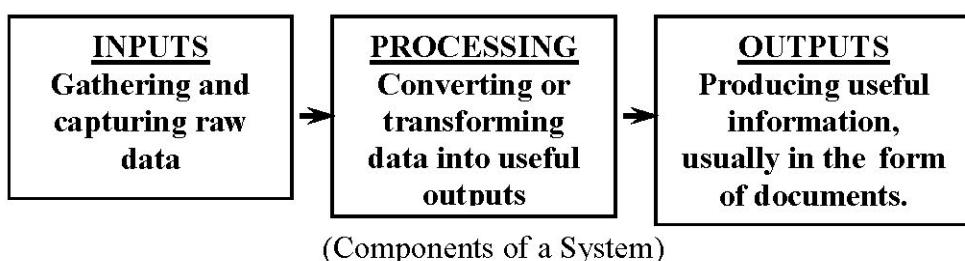
Relevant	Relevant information is important to the decision maker. Information showing that lumber prices might drop might not be relevant to a computer chip manufacturer.
Reliable	Reliable information can be depended on. In many cases, the reliability of the information depends on the reliability of the data-collection method. In other instances, reliability depends on the source of the information. A rumor from an unknown source that oil prices might go up might not be reliable.
Secure	Information should be secure from access by unauthorized users.
Simple	Information should be simple, not overly complex. Sophisticated and detailed information might not be needed. In fact, too much information can cause information overload, whereby a decision maker has too much information and is unable to determine what is really important.
Timely	Timely information is delivered when it is needed. Knowing last week's weather conditions will not help when trying to decide what coat to wear today.
Verifiable	Information should be verifiable. This means that you can check it to make sure it is correct, perhaps by checking many sources for the same information.

Value of information is directly linked to how it helps decision makers achieve their organization's goals. For example, value of information might be measured in:

- Time required to make a decision
- Increased profits to the company

## ***What is a System?***

Components that work together to achieve a goal by accepting input, processing it, and producing output in an organized manner.



## **Open vs. Closed Systems**

### **Closed System**

- Stands alone
- No connection to other systems

### **Open System**

- Interfaces and interacts with other systems
- Gets information from and provides information to other systems

## **System Performance**

### **Efficiency**

A measure of what is produced divided by what is consumed.

### **Effectiveness**

A measure of what is achieved divided by the stated goal.

## **System Variables and Parameters**

### **System Variable**

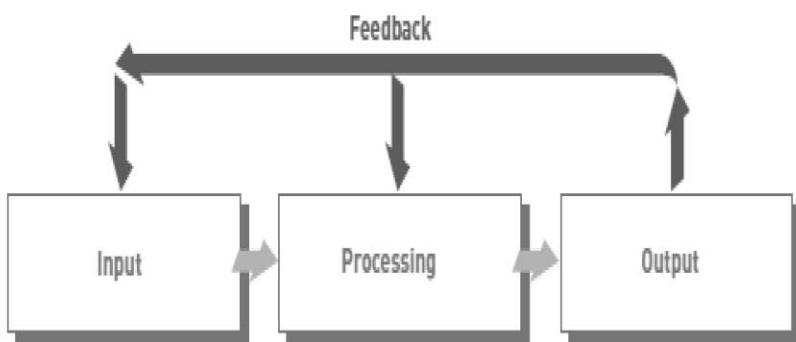
A quantity or item that can be controlled by the decision maker (controllable). e.g. selling price

### **System Parameter**

A value or quantity that cannot be controlled by the decision maker. e.g. raw material costs

## ***What is an information system?***

Information systems is a set of interrelated elements or components that collect (input), manipulate (process), store, and disseminate (output) data and information and provide a corrective reaction (feedback mechanism) to meet an objective. The feedback mechanism is the component that helps organizations achieve their goals, such as increasing profits or improving customer service



(The Components of an Information System)

## ***Input, Processing, Output, Feedback***

### **Input**

In information systems, input is the activity of gathering and capturing raw data. In producing paychecks, for example, the number of hours every employee works must be collected before paychecks can be calculated or printed. In a university grading system, instructors must submit student grades before a summary of grades for the semester or quarter can be compiled and sent to students.

## **Processing**

In information systems, processing means converting or transforming data into useful outputs. Processing can involve making calculations, comparing data and taking alternative actions, and storing data for future use. Processing data into useful information is critical in business settings.

Processing can be done manually or with computer assistance. In a payroll application, the number of hours each employee worked must be converted into net, or take-home, pay.

Other inputs often include employee ID number and department. The processing can first involve multiplying the number of hours worked by the employee's hourly pay rate to get gross pay. If weekly hours worked exceed 40, overtime pay might also be included. Then deductions for example, federal and state taxes or contributions to insurance or savings plans are subtracted from gross pay to get net pay. After these calculations and comparisons are performed, the results are typically stored.

## **Storage**

Involves keeping data and information available for future use, including output, discussed next.

## **Output**

Involves producing useful information, usually in the form of documents and reports. Outputs can include paychecks for employees, reports for managers, and information supplied to stockholders, banks, government agencies, and other groups. In some cases, output from one system can become

input for another. For example, output from a system that processes sales orders can be used as input to a customer billing system.

## **Feedback**

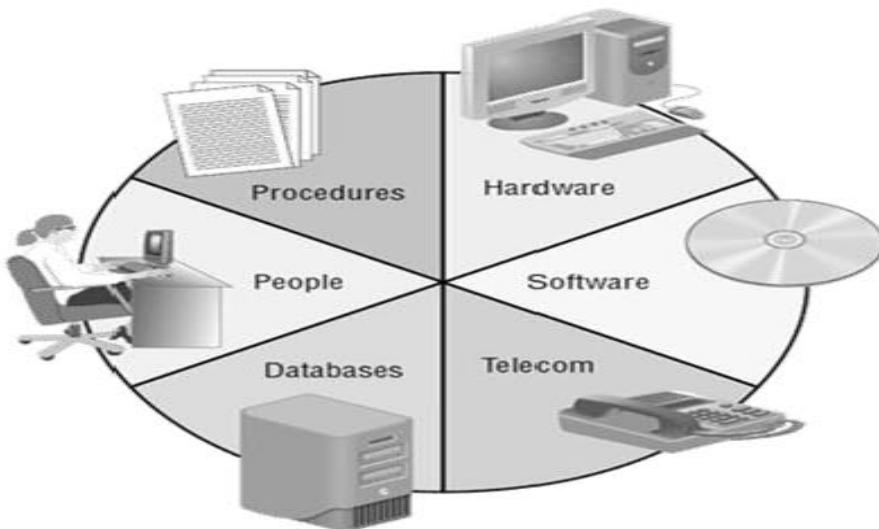
Information from the system that is used to make changes to input or processing activities. For example, errors or problems might make it necessary to correct input data or change a process. Consider a payroll example. Perhaps the number of hours an employee worked was entered as 400 instead of 40.

## ***Computer-Based Information Systems***

An information system can be Manual or computerized. An example for manual information system is developing patterns and trends on graph paper for stock analysis. Another example for computerized information system such as using program trading to track the market and trade large blocks of stocks when discrepancies occur.

## **CBIS (Computer Based Information Systems)**

A single set of hardware, software, databases, telecommunications, people, and procedures that are configured to collect, manipulate, store, and process data into information.



(The Components of a Computer-Based Information System)

## ***CBIS components***

### **Hardware**

Computer equipment used to perform input, processing, and output activities.

### **Software**

Computer programs that govern the operation of the computer.

### **Database**

Organized collection of facts and information.

### **Telecommunications**

Electronic transmission of signals for communications.

### **Networks**

Connect computers and equipment in a building, around the country, and around the world.

### **Internet**

World's largest computer network.

## **People**

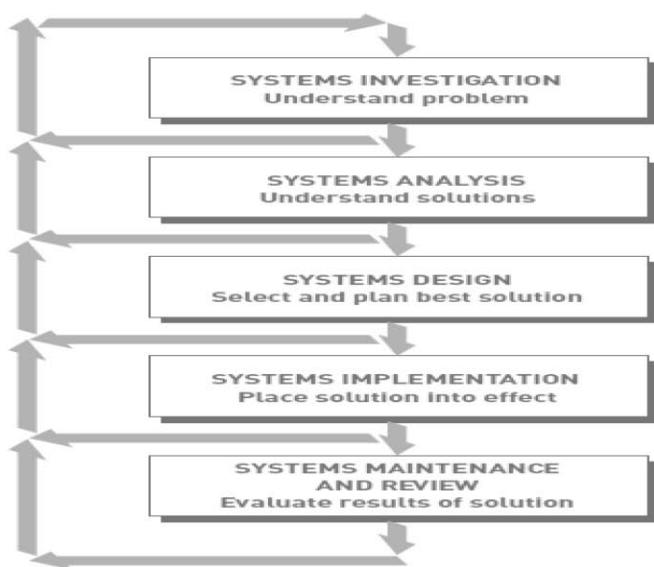
Manage, run, program, and maintain the system.

## **Procedures**

Strategies, policies, methods, and rules for using a CBIS.

## ***Systems Development***

Systems development is the activity of creating or modifying information systems. Systems development projects can range from small to very large and are conducted in fields as diverse as stock analysis and video game development.



(An Overview of Systems Development)

Systems development can be performed in-house or outsourced. To improve results of a systems development project, it is divided into several steps:

## **Systems investigation**

Gain understanding of the problem to be solved or opportunity to be addressed.

## **Systems analysis**

Defines problems and opportunities of the existing system.

## **Systems design**

Determines how the new system will work to meet the business needs defined during systems analysis.

## **Systems implementation**

Creating or acquiring the system components defined in the design step, assembling them, and putting the new system into operation.

## **Systems maintenance and review**

Checking and modifying the system so that it continues to meet changing business needs.

## ***Roles, Functions, and Careers in the IS Department***

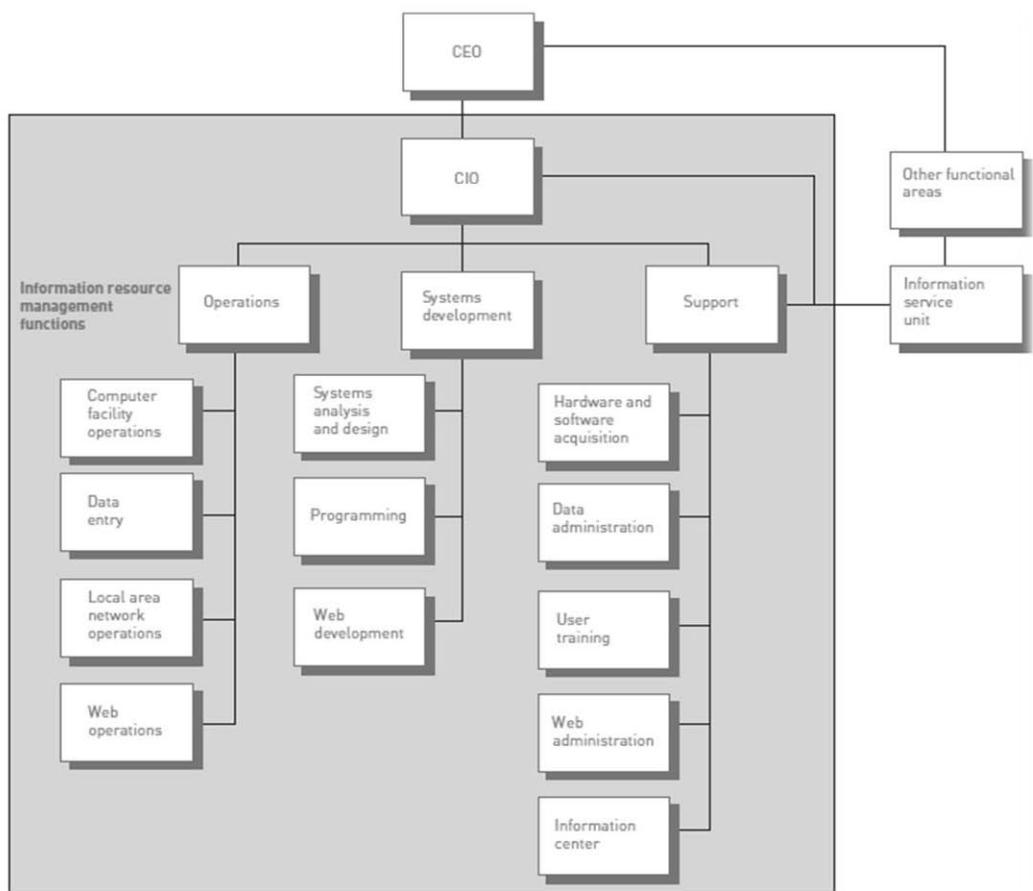
### **Degree programs**

- Information systems
- Computer information systems
- Management information systems

### **Primary responsibilities in information systems**

- **Operations:** focuses on the efficiency of IS functions
- **Systems development:** focuses on development projects and ongoing maintenance and review

- **Support:** provides user assistance, data administration, user training, and Web administration



(Careers in Information Systems)

## **Understanding Ethical and Social Issues Related to Information Systems**

### **Technology trends that raise the ethical issues**

TREND	IMPACT
Computing power doubles every 18 months	More organizations depend on computer systems for critical operations.
Data storage costs rapidly decline	Organizations can easily maintain detailed databases on individuals.
Data analysis advances	Companies can analyze vast quantities of data gathered on individuals to develop detailed profiles of individual behavior.
Networking advances	Copying data from one location to another and accessing personal data from remote locations are much easier.
Mobile device growth Impact	Individual cell phones may be tracked without user consent or knowledge.

### **Ethical Issues in Information Systems**

- Contribute to society and human well-being.
- Avoid harm to others.
- Be honest and trustworthy.
- Be fair and take action not to discriminate.
- Honor property rights including copyrights and patents.
- Give proper credit for intellectual property.
- Respect the privacy of others.
- Honor confidentiality.



## *Part 2*

# *Organizations and Information Systems*

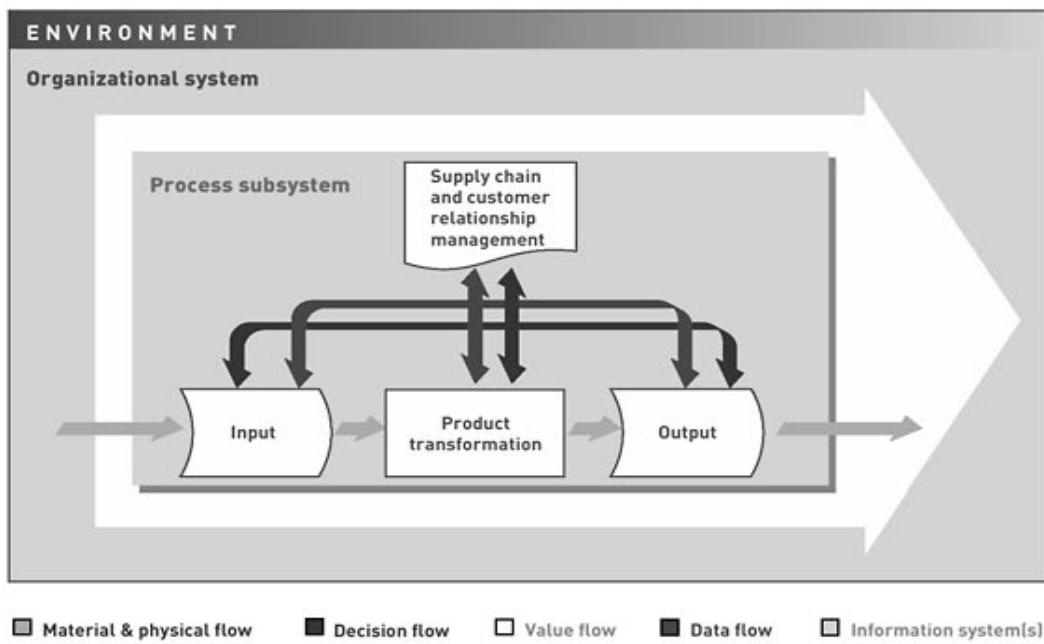
## **Organizations and Information Systems**

### **Organization**

Collection of people and other resources established to accomplish a set of goals.

An organization is a system:

- Inputs: resources (materials, people, money)
- Outputs: goods or services



(A General Model of an Organization)

### **Strategic Information Systems**

#### **Strategy**

A plan designed to help an organization gain a competitive advantage

## **Strategic Information Systems**

Information systems that help accomplish a strategy.

## **Achieving a Competitive Advantage**

The essence of strategy is innovation, so competitive advantage often occurs when an organization tries a strategy that no one has tried before. e.g. Dell was the first PC manufacturer to use the Web to take customer orders.

### **Ways to Achieve a Competitive Advantage**

#### **Reduce costs**

- Automation of a business process
  - Transaction processing
  - Online customer service
  - Factory robotics

#### **Raise barriers to entry**

- Legal protection of intellectual property
- High cost of entry

#### **Establish high switching costs**

- Penalties for terminating contracts
- Software re-training
- Create new products and services
- Copyright protection
- Continuous innovation

## **Differentiate products and services**

- Branding
- First to market
  - Enhance products and services
- Longer warranties, more information
- Better service
- Establish alliances
  - Bundling products
  - Rewards programs
  - Outsourcing
- Lock in suppliers or customers
  - Purchasing volume
  - Create a standard
- Potentially winning business moves plus ideas for harnessing technology to implement those moves

## **Organizational Structures**

An organization's structure can have an impact on how information systems are viewed and what kind are used:

### **Traditional organizational structure:**

Hierarchy of decision making and authority flows:

- From the strategic management at the top down to operational management and non management employees.
- Staff (legal council) or line (making, packing, shipping) positions

## **Flat organizational structure**

- Empowers employees at lower levels
- Empowerment: Gives employees and their managers more responsibility and authority to make decisions

## **Project organizational structure:**

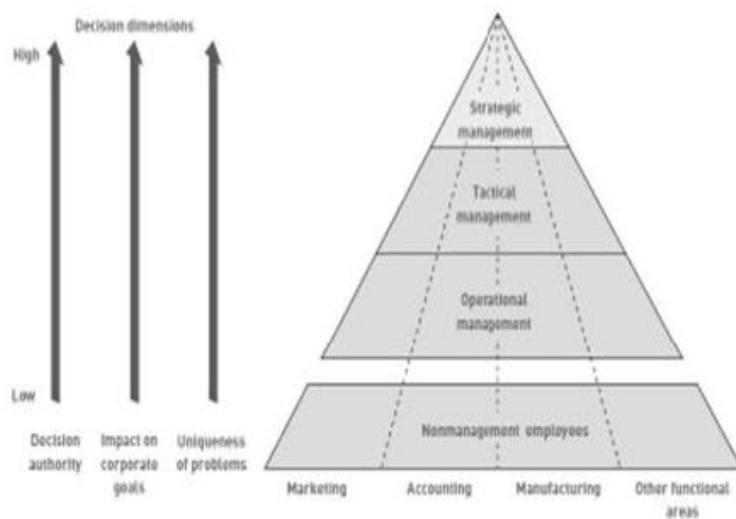
- Centered on major products or services
- Many project teams are temporary
- Example: Baby product company

## **Team organizational structure:**

- Centered on work teams or groups
- Team can be temporary or permanent, depending on tasks
- Example: Healthcare company

## **Virtual organizational structure and collaborative work**

- Virtual organizational structure
  - Uses individuals, groups, or complete business units in geographically dispersed areas.
  - Can reduce costs for an organization.
- Allows collaborative work
  - Managers and employees can effectively work in groups, even those composed of members from around the world.



(Organizational Structures)

## **Organizational Culture**

Set of major understandings and assumptions shared by a group influences information systems. Example: giving high value to understand customers.

## **Organizational change (sustaining or disruptive change)**

How organizations plan for, implement, and handle change (internal from employees, or external from competitors).

## **Change model**

Represents change theories by identifying phases of change and the best way to implement them.

## **Unfreezing**

Ceasing old habits and creating a climate that is receptive to change.

## **Moving**

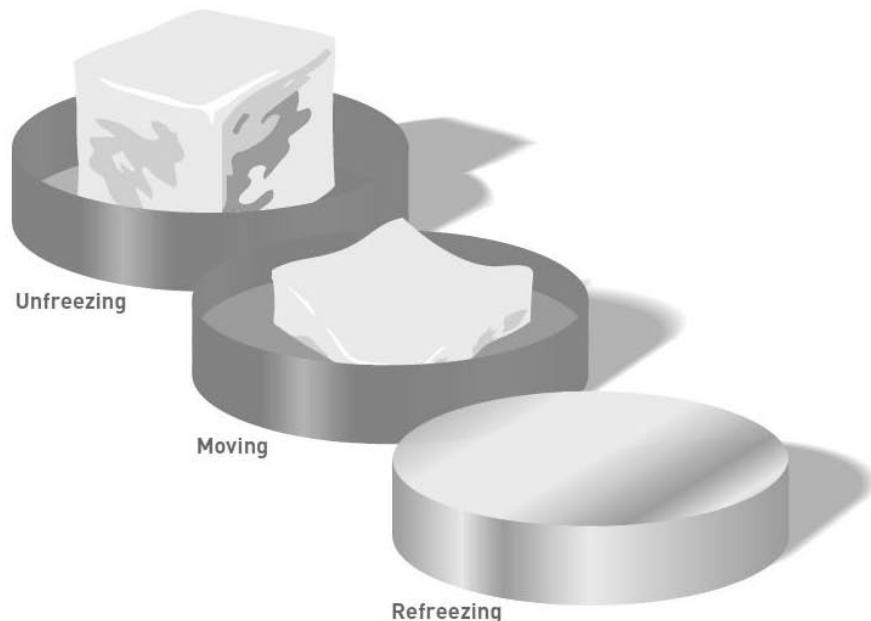
Learning new work methods, behaviors, and systems.

## **Refreezing**

Involves reinforcing changes to make the new process second nature, accepted, and part of the job. With new systems few members become agents of change to confront resistance to change.

## **Organizational learning**

The adaptations to new conditions or adjustments based on experience and ideas over time.



(A change Model)

## **Reengineering**

The radical redesign of business processes to achieve a significant breakthrough in business results. Such as:

- Delivery time
- Product & service quality
- Costs, revenue & productivity
- Employee resistance
- Employees must understand benefits
- Old rules must be challenged

## **Examples of reengineering initiatives**

- Simplifying work processes
- Combining several jobs into one
- Outsourcing ancillary processes
- Entering new business areas
- Establishing new management structures
- Renovating technology systems

## Reengineering vs. Continuous Improvement

Business Process Reengineering	Continuous Improvement
Strong action taken to solve serious problem	Routine action taken to make minor improvements
Top-down change driven by senior executives	Bottom-up change driven by workers
Broad in scope; cuts across departments	Narrow in scope; focus is on tasks in a given area
Goal is to achieve a major breakthrough	Goal is continuous, gradual improvements
Often led by outsiders	Usually led by workers close to the business
Information system integral to the solution	Information systems provide data to guide the improvement team

## Value chain

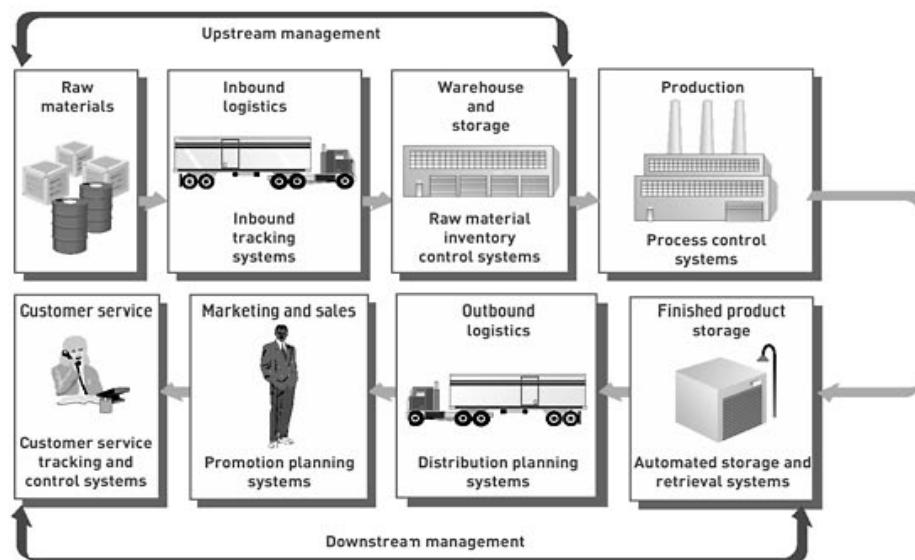
Series (chain) of activities that includes inbound logistics, warehouse and storage, production, finished product storage, outbound logistics, marketing and sales, and customer service.

### Upstream management

Management of raw materials, inbound logistics, and warehouse and storage facilities.

### Downstream management

Management of finished product storage, outbound logistics, marketing and sales, and customer service.



(The Value Chain of a Manufacturing Company)

## User Satisfaction and Technology Acceptance

### Technology Acceptance Model (TAM)

Specifies factors that can lead to higher acceptance and usage of technology.

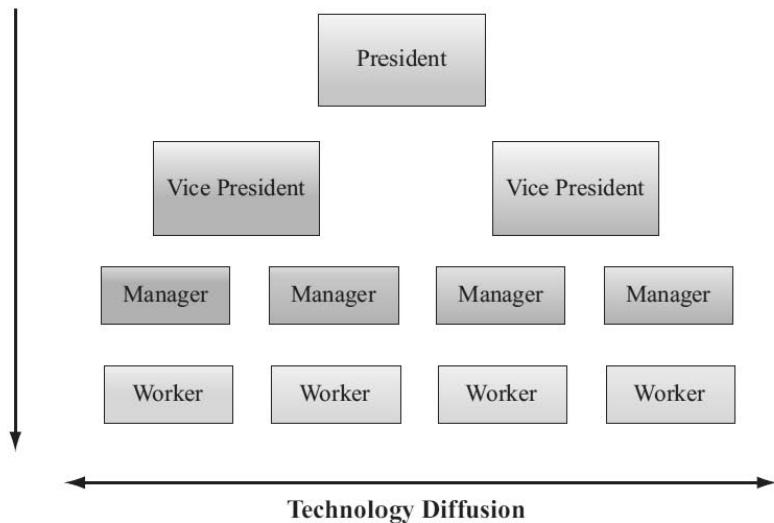
### Technology diffusion

Measure of widespread use of technology.

### Technology infusion

Extent to which technology permeates a department.

## Technology Infusion



(Technology infusion and diffusion)

## Performance-Based Information Systems

Major stages in the use of information systems:

- Cost reduction and productivity
- Competitive advantage
- Performance-based management

## Productivity

- A measure of output achieved divided by input required
- Higher level of output for a given level of input means greater productivity
- Lower level of output for a given level of input means lower productivity

- Productivity = (Output / Input) × 100%

## **Return on Investment and the Value of Information Systems**

### **Return on investment (ROI)**

One measure of IS value investigates the additional profits or benefits that are generated as a percentage of the investment in IS technology.

### **Earnings growth**

The increase in profit that the system brings.

### **Market share and speed to market**

The percentage of sales that a product or service has in relation to the total market

### **Customer awareness and satisfaction**

Performance measurement is based on feedback from internal and external users.

### **Total cost of ownership**

The sum of all costs over the life of the information system.



## *Part 3*

# *Common types of Information systems*

Systems that focus on executing business processes across the business firm, and include all levels of management. Enterprise applications help businesses become more flexible and productive by coordinating their business processes more closely and integrating groups of processes so they focus on efficient management of resources and improve customer service. Most common types of information systems used in business organizations:

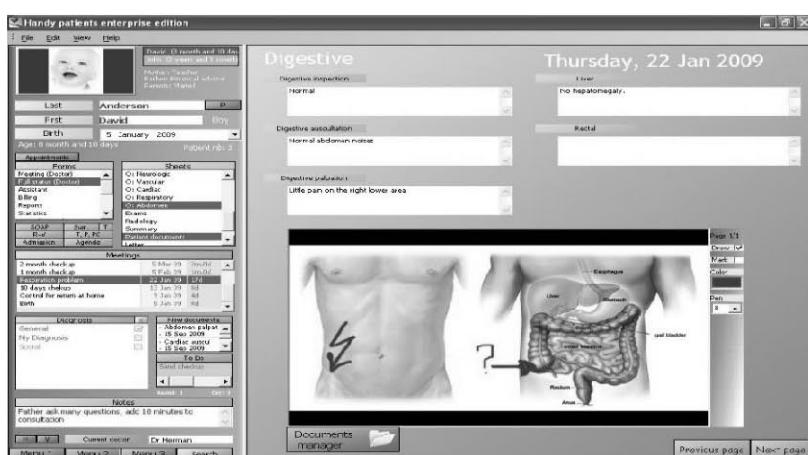
## **Transaction processing system (TPS)**

### **Transaction**

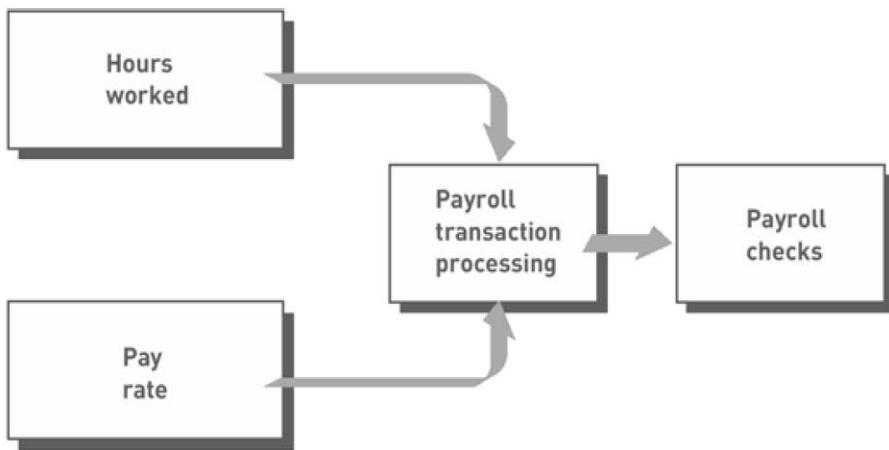
Any business-related exchange, such as payments to employees, sales to customers, and payments to suppliers.

### **TPS**

Organized collection of people, procedures, software, databases, and devices used to record completed business transactions. Such as sales order entry, hotel reservations, payroll, employee record keeping, and shipping.



(Electronic Health Record and Transaction)



(A Payroll Transaction Processing System)

## Function

Answer routine questions and to track the flow of transactions through the organization

Such as:

- How many parts are in inventory?
- What happened to Mr. Smith's payment?

## Managers need TPS to:

- Monitor the status of internal operations and the firm's relations with the external environment.
- TPS are also major producers of information for the other systems and business functions.

## Management information system (MIS)

An organized collection of people, procedures, software, databases, and devices that provides routine information to managers and decision makers.

Produce reports serving middle management by condensing information from TPS, and these are not highly analytical.

- MIS provide middle managers with reports on the organization's current performance.
- This information is used to monitor and control the business and predict future performance.

MIS summarize and report on the company's basic operations using data supplied by transaction processing systems. The basic transaction data from TPS are compressed and usually presented in reports that are produced on a regular schedule.

- Most MIS use simple routines, such as summaries and comparisons.

## **Information and Decision Support Systems**

The benefits provided by an effective TPS or ERP, including reduced processing costs and reductions in needed personnel, are substantial and justify their associated costs in computing equipment, computer programs, and specialized personnel and supplies. Companies soon realized that they could use the data stored in these systems to help managers make better decisions, whether in human resource management, marketing, or administration. Satisfying the needs of managers and decision makers continues to be a major factor in developing information systems.

### **Decision support system (DSS)**

An organized collection of people, procedures, software, databases, and devices used to support problem-specific decision making.

(DSS) support management decisions that are unique and rapidly changing using advanced analytical models.

Focus on problems that are unique and rapidly changing, for which the procedure for arriving at a solution may not be fully predefined in advance.

**They try to answer questions such as these:**

- What would be the impact on production schedules if we were to double sales in the month of December?
- What would happen to our return on investment if a factory schedule were delayed for six months?

Although DSS use internal information from TPS and MIS, they often bring in information from external sources, such as current stock prices or product prices of competitors.

These systems are employed by “super-user” managers and business analysts who want to use sophisticated analytics and models to analyze data.

### **Executive support systems (ESS)**

(ESS) for senior management that provide data in the form of graphs, charts, and dashboards delivered via portals using many sources of internal and external information.

They address non-routine decisions requiring judgment, evaluation, and insight because there is no agreed-on procedure for arriving at a solution.

ESS present graphs and data from many sources through an interface that is easy for senior managers to use.

Often the information is delivered to senior executives through a portal, which uses a Web interface to present integrated personalized business content.

ESS are designed to incorporate data about external events, such as new tax laws or competitors, but they also draw summarized information from internal MIS and DSS.

They filter, compress, and track critical data, displaying the data of greatest importance to senior managers. Increasingly, such systems include business intelligence analytics for analyzing trends, forecasting, and “drilling down” to data at greater levels of detail.

### **Specialized Business Information Systems**

In addition to TPSs, MISs, and DSSs, organizations often rely on specialized systems. Many use knowledge management systems (KMSs), an organized collection of people, procedures, software, databases, and devices, to create, store, share, and use the organization’s knowledge and experience. Advent, a San Francisco company that develops investment software for hedge funds, used a KMS to help its employees locate and use critical knowledge to help its customers.

### **Artificial intelligence (AI)**

A field in which the computer system takes on the characteristics of human intelligence.



(Artificial Intelligence in Health Sector)

### **Expert system**

A system that gives a computer the ability to make suggestions and function like an expert in a particular field.

### **Virtual reality**

The simulation of a real or imagined environment that can be experienced visually in three dimensions.

### **Systems for Linking the Enterprise**

#### **Enterprise resource planning (ERP)**

Programs that manage the vital business operations for an entire multisite, global organization.

#### **What is ERP software?**

The acronym ‘ERP’ stands for ‘Enterprise Resource Planning’. ERP software refers to an integrated business process management software system that is used to

consolidate all the functions of an organization into a unified system.

It helps automate and integrate your company's core business elements to increase efficiency and simplify operations. It also allows all collected data to be centralized and shared. This enables you to plan, manage and build a sustainable and scalable business in today's fast paced environment.

A comprehensive ERP system will cover all your basic business processes from financial accounting and supply chain management to inventory management and CRM (Customer Relationship Management).

Today's flexible, future-ready ERP systems enable you to establish one source of truth to gain real-time insights into the health of your business. With all departments connected in real-time, it encourages more collaboration, more informed decision-making and increases efficiency at all levels.

### **What does ERP software offer?**

ERP software offers complete visibility of your business. Unlike managing disparate systems that don't talk to each other, ERP software enables you to record, measure and control all your information on a centralized database.

It also readily integrates any niche solutions you currently use or may wish to use seamlessly with your ERP solution. By combining all the information from all departments in one centralized repository.

## **ERP software improves:**

- Productivity
- Increases accuracy
- Lowers cost
- Streamlines processes

Modern ERP software is based on open, flexible architecture that can seriously impact your business in a number of key areas.

- Data is available across all functions of your business from one central location giving real-time visibility and control.
- Productivity is increased by automating tedious back-office tasks which in turn frees up time.
- Maximize efficiency with personalized workspaces.
- Decision-makers and budget-holders can monitor operations in real-time.
- Decision-making at all levels of your business is greatly enhanced.

## **Types of ERP software**

SAP Enterprise and Oracle are designed to service the needs of large complex businesses that have many departments, a global presence and often complicated operational structures.

## **Supply Chain Management Systems**

Firms use supply chain management (SCM) systems to help manage relationships with their suppliers.

These systems help suppliers, purchasing firms, distributors, and logistics companies share information about orders, production, inventory levels, and delivery of products and services so they can source, produce, and deliver goods and services efficiently.

The ultimate objective is to get the right amount of their products from their source to their point of consumption in the least amount of time and at the lowest cost.

Enabling managers to make better decisions about how to organize and schedule sourcing, production, and distribution.

Supply chain management systems are one type of *interorganizational* system because they automate the flow of information across organizational boundaries.

### **Customer Relationship Management Systems**

Firms use customer relationship management (CRM) systems to help manage their relationships with their customers.

CRM systems provide information to coordinate all of the business processes that deal with customers in sales, marketing, and service to optimize revenue, customer satisfaction, and customer retention.

This information helps firms identify, attract, and retain the most profitable customers; provide better service to existing customers; and increase sales.

## **Knowledge Management Systems**

Some firms perform better than others because they have better knowledge about how to create, produce, and deliver products and services.

This firm knowledge is unique, difficult to imitate, and can be leveraged into long-term strategic benefits.

Knowledge management systems (KMS) enable organizations to better manage processes for capturing and applying knowledge and expertise.

These systems collect all relevant knowledge and experience in the firm, and make it available wherever and whenever it is needed to improve business processes and management decisions. They also link the firm to external sources of knowledge.

## **E-Business, E-Commerce, and E-Government**

### **Electronic business (E-business)**

Refers to the use of digital technology and the Internet to execute the major business processes in the enterprise. E-business includes activities for the internal management of the firm and for coordination with suppliers and other business partners.

Uses information systems and the Internet to perform all business-related tasks and functions.

## **Electronic and Mobile Commerce**

### **E-commerce**

E-commerce is the part of e-business that deals with the buying and selling of goods and services over the Internet.

Any business transaction executed electronically between:

- Companies (B2B)
- Companies and consumers (B2C)
- Consumers and other consumers (C2C)
- Business and the public sector
- Consumers and the public sector

### **Mobile commerce (m-commerce)**

Mobile commerce, also known as m-commerce, involves using wireless handheld devices like cell phones and tablets to conduct commercial transaction online, including the purchase and sale of products or services, online banking and paying bills.

### **E-government**

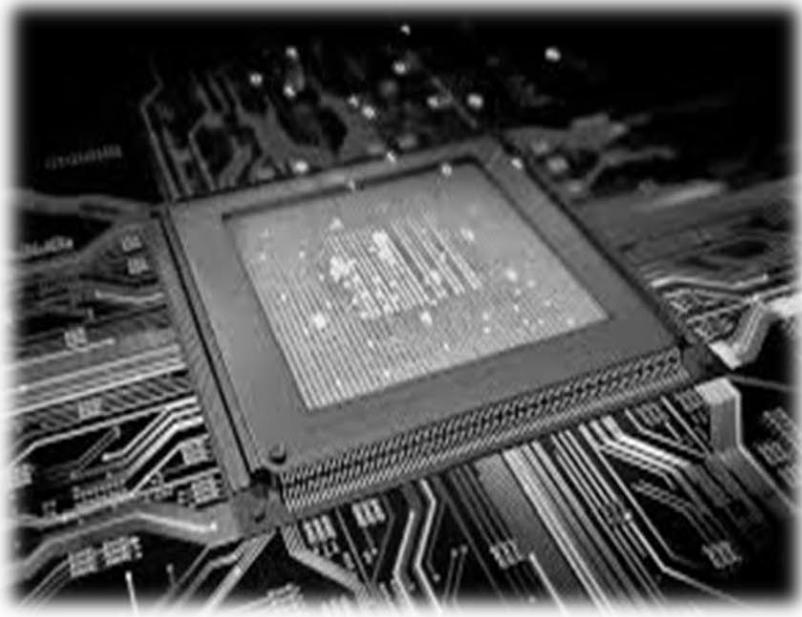
Refers to the application of the Internet and networking technologies to digitally enable government and public sector agencies' relationships with citizens, businesses, and other arms of government.



## *Part 4*

## *Technology*

*(Hardware – Software – internet and communication)*



# *Hardware*

## **Information technology (IT)**

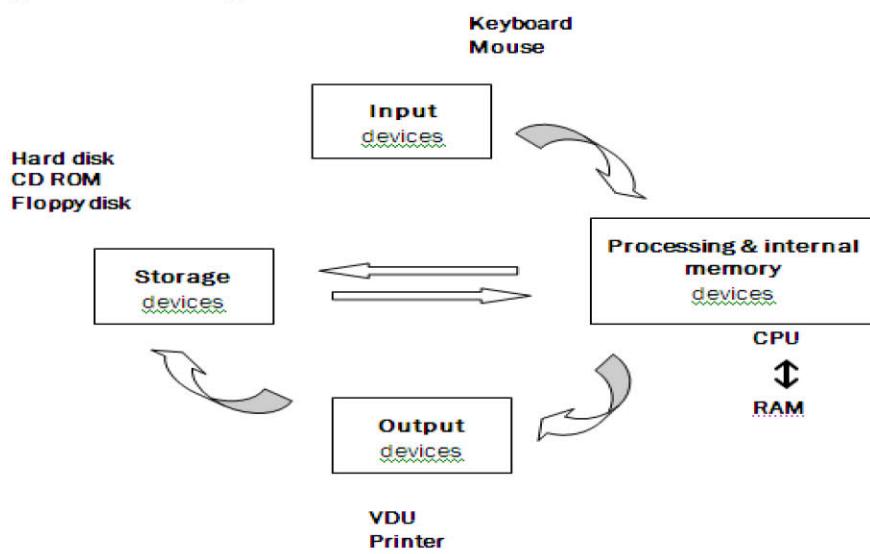
Consists of all the hardware and software that a firm needs to use in order to achieve its business objectives.

Employing information technology and providing additional processing capabilities can increase employee productivity, expand business opportunities, and allow for more flexibility. This part discusses the hardware and software components beginning with a definition of hardware.

### **Hardware**

Refers to the physical components of a computer that perform the input, processing, storage, and output activities of the computer.

When making hardware decisions, the overriding consideration of a business should be how hardware can support the objectives of the information system and the goals of the organization.



(Computer system hardware components)

## **Hardware Components**

These components include the input devices, output devices, communications devices, primary and secondary storage devices, and the central processing unit (CPU). The control unit, the arithmetic/ logic unit (ALU), and the register storage areas constitute the CPU.



(Hardware Components)

## **Input Devices**

These devices are the gateways to the computer system you use them to provide data and instructions to the computer and receive results from it. Input and output devices are part of a computer's user interface, which includes other hardware devices and software that allow you to interact with a computer system.

A keyboard and a computer mouse are the most common devices used for entry of data such as characters, text, and basic commands.

## **Speech-recognition technology**

Input devices that recognize human speech.

## **Digital camera**

An input device used with a PC to record and store images and video in digital form.

## **Touch-Sensitive Screens**

Advances in screen technology allow display screens to function as input as well as output devices. By touching certain parts of a sensitive screen, you can execute a program or cause the computer to take an action.

## **Output Devices**

Computer systems provide output to decision makers at all levels of an organization so they can solve a business problem or capitalize on a competitive opportunity. In addition, output from one computer system can provide input into another computer system. The desired form of this output might be visual, audio, or even digital.

## **Display Monitors**

The display monitor is a device used to display the output from the computer. Because early monitors used a cathode-ray tube to display images like a plasma display, LCD displays.

## **Printers and Plotters**

Hard copy is paper output from a device called a printer. Printers with different speeds, features, and capabilities are available.



(X-Ray Printer)

## **Digital audio player**

A device that can store, organize, and play digital music files.

## **Memory characteristics and functions**

### **Storage Capacity**

Like the CPU, memory devices contain thousands of circuits imprinted on a silicon chip. Each circuit is either conducting electrical current (on) or not (off). Data is stored in memory as a combination of on or off circuit states. Usually 8 bits are used to represent a character, such as the letter A. Eight bits together form a byte (B).

## **Bit**

Smallest piece of data a computer can work with. Either “on” or “off,” a 0 or a 1.

## **Byte**

A group of eight bits a single unit of storage and is the method of representing one character of data, such as the essential numbers (0-9), the basic letters and the punctuation symbols. A baseline unit to express the amount of information a computer’s storage device can hold.

## **Types of memory**

### **Random access memory (RAM)**

A form of memory in which instructions or data can be temporarily stored.

- Temporarily stores data and instructions for the CPU.
- Volatile, it is not permanent that contents erased after computer is shut off

The purpose of RAM is to:

- Receive and hold program instructions and data while being used by the system.
- Provide those instructions and data to CPU when needed.
- Hold the results of the CPU’s processing until an instruction is received to transfer it to a printer or permanent storage device.

### **Virtual memory**

Refers to section of the hard drive set aside to use when RAM gets full.

## **Cache memory**

Small unit of ultrafast memory built into or near the processor. Used to store frequently or recently accessed program instructions or data. It is faster than RAM and more expensive than RAM.

## **Read-only memory (ROM)**

Another type of memory, is usually nonvolatile. In ROM, the combination of circuit states is fixed, and therefore its contents are not lost if the power is removed. ROM provides permanent storage for data and instructions that do not change, such as programs and data from the computer manufacturer, including the instructions that tell the computer how to start up when power is turned on.

- Contains prerecorded instructions to start the computer.
- Nonvolatile, contents stored when CPU power off.
- Some of the programs stored in ROM:
  - Basic input/output system (BIOS)

First code run when the system is powered on.

- Complementary metal-oxide semiconductor (CMOS)

Starts the power-on self-test and verifies other system components are operating correctly.

- Power-on self-test (POST)

Checks circuitry and RAM, marking defective locations.

## **Secondary storage**

Compared with memory, secondary storage offers the advantages of non-volatility, greater capacity, and greater economy. Most forms of secondary storage are considerably less expensive than memory.

## **Magnetic tape**

A type of sequential secondary storage medium, now used primarily for storing backups of critical organizational data in the event of a disaster.

## **Magnetic disk**

A direct access storage device, with bits represented by magnetized areas.

## **Hard Disk**

Hard disks provide direct access to stored data. The read/write head can move directly to the location of a desired piece of data, dramatically reducing access times as compared to magnetic tape.

## **CPU and processing techniques**

### **Central processing unit (CPU)**

The part of the computer that consists of three associated elements: the arithmetic/logic unit, the control unit, and the register areas.

### **Arithmetic/logic unit (ALU)**

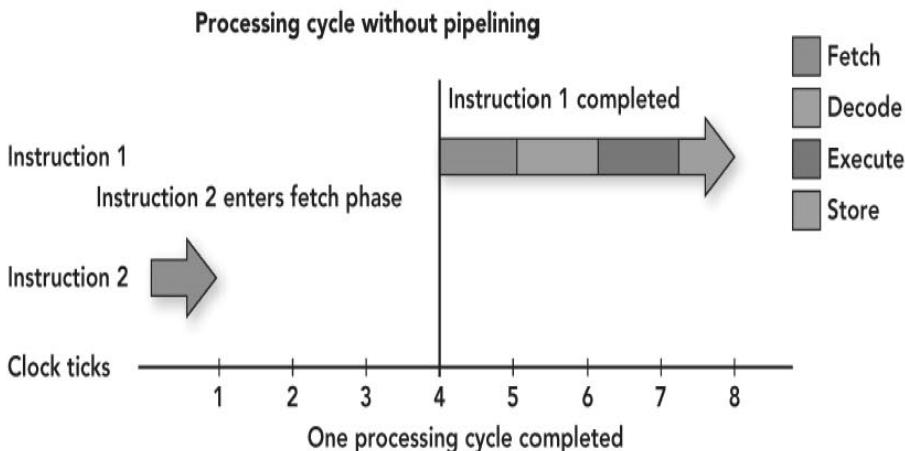
The part of the CPU that performs mathematical calculations and makes logical comparisons.

### **Control unit**

The part of the CPU that sequentially accesses program instructions, decodes them, and coordinates the flow of data in and out of the ALU, the registers, the primary storage, and even secondary storage and various output devices.

## Pipelining

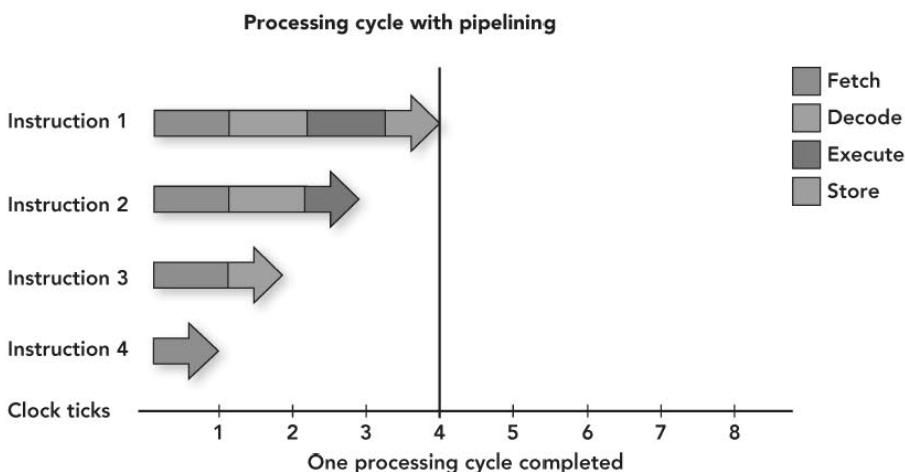
A technique that enables the CPU to process more than one instruction at a time improving performance.



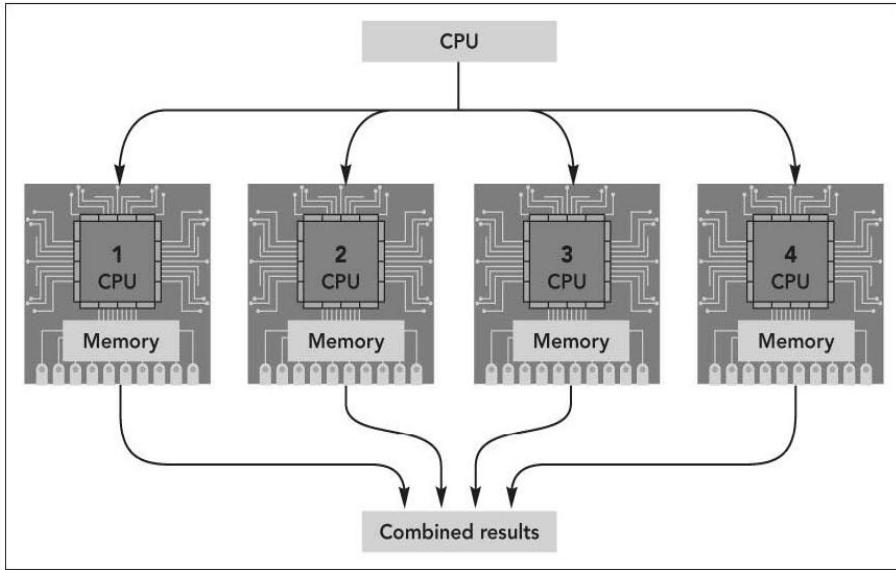
(Processing cycle without pipelining)

## Parallel processing

A technique that uses more than one processor to execute a program faster processing.



(Processing cycle with pipelining)



(Parallel Processing)

## Computer System Types

Computer systems can range from desktop (or smaller) portable computers to massive supercomputers that require housing in large rooms.

### *Single-user computer systems*

Can be divided into two groups: portable computers and non-portable computers.

#### **Portable computer**

A computer small enough to carry easily.

#### **Handheld computer**

A single-user computer that provides ease of portability because of its small size.

### **Smartphone**

A phone that combines the functionality of a mobile phone, personal digital assistant, camera, Web browser, e-mail tool, and other devices into a single handheld device.

### **Laptop computer**

A personal computer designed for use by mobile users; it is small and light enough to sit comfortably on a user's lap.

### **Notebook computer**

Smaller than a laptop computer, an extremely lightweight computer that weighs less than 6 pounds and can easily fit in a briefcase.

### **Netbook computer**

The smallest, lightest, least expensive member of the laptop computer family.

### **Tablet computer**

A portable, lightweight computer with no keyboard that allows you to roam the office, home, or factory floor carrying the device like a clipboard.

## ***Non-portable Single-User Computers***

Non-portable single-user computers include thin client computers, desktop computers, and workstations.

### **Single-user computers**

#### **Thin client**

A low-cost, centrally managed computer with essential but limited capabilities and no extra drives (such as CD or DVD drives) or expansion slots.

## **Desktop computer**

A relatively small, inexpensive, single-user computer that is highly versatile.

## **Workstation**

A more powerful personal computer used for mathematical computing, computer-aided design, and other high-end processing, but still small enough to fit on a desktop.

## **Multiple-User Computer Systems**

Multiple-user computers are designed to support workgroups from a small department of two or three workers to large organizations with tens of thousands of employees and millions of customers. Multiple-user systems include servers, mainframe computers, and supercomputers.

## **Server**

A computer used by many users to perform a specific task, such as running network or Internet applications.

## **Blade server**

A server that houses many individual computer motherboards that include one or more processors, computer memory, computer storage, and computer network connections.

## **Mainframe computer**

A large, powerful computer often shared by hundreds of concurrent users connected to the machine via terminals

## **Supercomputers**

The most powerful computer systems with the fastest processing speeds.



# *SOFTWARE*

Software consists of system software (computer programs that control the workings of computer hardware) and application software (a computer programs to give individuals, workgroups, and the entire enterprise the ability to solve problems and perform specific tasks).

### ***Systems software***

The set of programs designed to coordinate the activities and functions of the hardware and various programs throughout the computer system. Each type of systems software is designed for a specific CPU design and class of hardware. Application software consists of programs that help users solve particular computing problems. In most cases, application software resides on the computer's hard disk before it is brought into the computer's main memory and run. Application software can also be stored on CDs, DVDs, and even flash or key chain storage devices that plug into a USB port.

Controlling the operations of computer hardware is one of the most critical functions of systems software. Systems software also supports the application programs' problem-solving capabilities. Different types of systems software include operating systems and utility programs.

### **Operating Systems**

An operating system (OS) is a set of computer programs that control the computer hardware and act as an interface with application programs. Operating systems can control one computer or multiple computers, or they can allow multiple users to interact with one computer.

The collection of programs that make up the operating system performs a variety of activities, including the following:

- Performing common computer hardware functions
- Providing a user interface and input/output management
- Providing a degree of hardware independence
- Managing system memory
- Managing processing tasks
- Providing networking capability
- Controlling access to system resources
- Managing files

Personal	Workgroup	Enterprise
Microsoft Windows , Microsoft Windows Mobile	Microsoft Windows Server 2008	Microsoft Windows Server 2008
Mac OS X, Mac OS X iPhone	Mac OS X Server	
Linux	Linux	Linux
Google Android, Chrome OS		
Palm Web OS		
	UNIX	UNIX
	IBM i5/OS and z/OS	IBM i5/OS and z/OS
	HP-UX 11i	HP-UX 11i

(Current Operating systems)

### User Interface and Input / Output Management

One of the most important functions of any OS is providing a user interface, which allows people to access and interact with the computer system. The first user interfaces for

mainframe and personal computer systems were command based.

## User interface

The element of the operating system that allows you to access and command the computer system.

### Command-based user interface

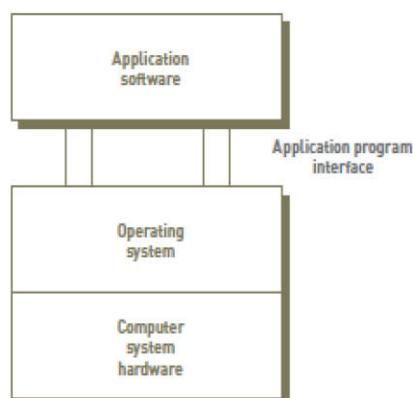
A user interface that requires you to give text commands to the computer to perform basic activities.

### Graphical user interface (GUI)

An interface that displays pictures (icons) and menus that people use to send commands to the computer system.

### Application program interface (API)

An interface that allows applications to make use of the operating system.



(Application Program Interface (API))

## **Utility Programs**

Program that helps to perform maintenance or correct problems with a computer system.

Personal	Workgroup	Enterprise
Software to compress data so that it takes less hard disk space	Software that maintains an archive of changes made to a shared document	Software to archive contents of a database by copying data from disk to tape
Software that assists in determining which files to delete to free up disk space	Software that monitors group activity to determine levels of participation	Software that monitors network traffic and server loads
Antivirus and antispyware software for PCs	Software that reports unsuccessful user logon attempts	Software that reports the status of a particular computer job

(Examples of Utility Programs)

## ***Application Software***

Application software applies the power of a computer to give individuals, workgroups, and the entire enterprise the ability to solve problems and perform specific tasks. Application programs interact with systems software, and the systems software directs the computer hardware to perform the necessary tasks.

Applications help you perform common tasks, such as creating and formatting text documents, performing calculations, or managing information, though some applications are more specialized. Application software is used throughout the medical profession to save and prolong lives. For example, Swedish Medical Center in Seattle,

Washington uses content management software from Oracle to access patient records when and where they are needed.

### **Proprietary software**

One-of-a-kind software designed for a specific application and owned by the company, organization, or person that uses it.

### **Off-the-shelf software**

Software mass-produced by software vendors to address needs that are common across businesses, organizations, or individuals.

### **Software Bugs**

A software bug is a defect in a computer program that keeps it from performing as it is designed to perform.

### **Software Licenses**

A document that provides legally guidelines on the use and distribution of software.

## Personal Application Software

Hundreds of computer applications can help individuals at school, home, and work.

Type of Software	Explanation	Example
Word processing	Create, edit, and print text documents	Microsoft Word Corel WordPerfect Google Docs Apple Pages Sun Writer
Spreadsheet	Provide a wide range of built-in functions for statistical, financial, logical, database, graphics, and date and time calculations	Microsoft Excel IBM Lotus 1-2-3 Google Spreadsheet Apple Numbers Sun Calc
Database	Store, manipulate, and retrieve data	Microsoft Access IBM Lotus Approach Borland dBASE Sun Base
Graphics	Develop graphs, illustrations, and drawings	Adobe Illustrator Adobe FreeHand
Project management	Plan, schedule, allocate, and control people and resources (money, time, and technology) needed to complete a project according to schedule	Microsoft Project Symantec On Target Scitor Project Scheduler Symantec Time Line
Financial management	Provide income and expense tracking and reporting to monitor and plan budgets (some programs have investment portfolio management features)	Intuit Quicken
Desktop publishing (DTP)	Use with personal computers and high-resolution printers to create high-quality printed output, including text and graphics; various styles of pages can be laid out; art and text files from other programs can also be integrated into published pages	Quark XPress Microsoft Publisher Adobe PageMaker Corel Ventura Publisher Apple Pages

(Examples of Personal Application Software)

## Mobile Application Software

Recall that operating systems designed for smartphones include OS X iPhone, Android, and Web OS. The APIs and software development kits designed for these mobile operating systems have given software developers the opportunity to develop applications specifically for mobile use on a small display and develop.

Category	Description
Books and reference	Access e-books, subscribe to journals, or look up information in Webster's or Wikipedia
Business and finance	Track expenses, trade stocks, and access corporate information systems
Entertainment	Access all forms of entertainment, including movies, television programs, music videos, and local night life
Games	Play a variety of games, from 2D games such as Pacman and Tetris to 3D games such as Need for Speed, Rock Band, and The Sims
Health and fitness	Track workout and fitness progress, calculate calories, and even monitor your speed and progress from your wirelessly connected Nike shoes
Lifestyle	Find good restaurants, select wine for a meal, record workout progress, and more
Music	Find, listen to, and create music
News and weather	Access major news and weather providers, including Reuters, AP, the New York Times, and the Weather Channel
Photography	Organize, edit, view, and share photos taken on your camera phone
Productivity and utilities	Create grocery lists, practice PowerPoint presentations, work on spreadsheets, synchronize with PC files, and more
Social networking	Connect with others via major social networks including Facebook, Twitter, and MySpace
Sports	Keep up with your favorite team or track your own golf scores
Travel and navigation	Use the GPS in your smartphone to get turn-by-turn directions, find interesting places to visit, access travel itineraries, and more

(Mobile Application Software)

## Workgroup Application Software

Workgroup application software is designed to support teamwork, whether people are in the same location or dispersed around the world. This support can be accomplished with software known as groupware. Such as: group scheduling software, electronic mail, and other software that enables people to share ideas such as Lotus Notes from IBM. Google Forms.

## Enterprise Application Software

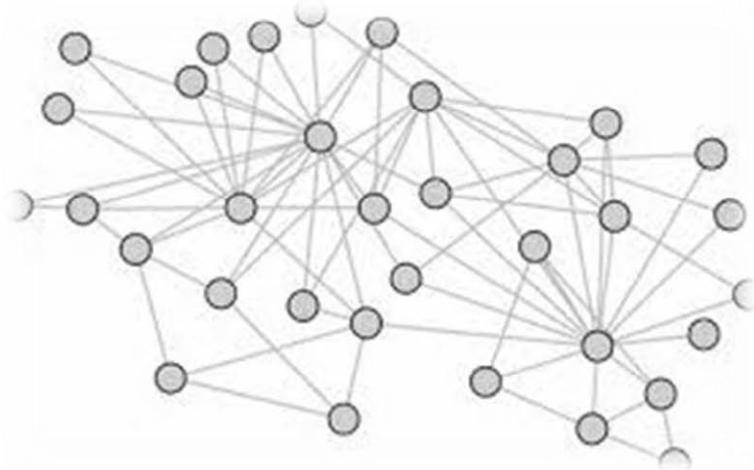
Software that benefits an entire organization enterprise application software can also be developed specifically for

the business or purchased off the shelf. Some software vendors, such as SAP.

## **PROGRAMMING LANGUAGES**

Sets of keywords, symbols, and rules for constructing statements that people can use to communicate instructions to a computer.

Example: Cobol, Visual basic, C#, C++



# *Internet and Communication*

# The Internet and the Web

## World Wide Web

It introduced in 1991 at the Center for Educational Nuclear Research (CERN) before 1991 the Internet was all text based. Web made it possible to include multimedia resources.

- *First generation* of the Web, Web 1.0 – focused on linking existing information.
- *Second generation* of the Web, Web 2.0 – evolved to support more dynamic content creation and social interaction. Facebook is a Web 2.0 application.
- *Third generation* of the Web, Web 3.0 – focuses on computer generated information requiring less human interaction to locate and to integrate information such as traffic reports and delays.
- Can get Internet and Web confused, they are not the same thing.

## Internet

ARPANET – Advanced Research Project Agency Network Launched in 1969 Network infrastructure connects computers around the world.

The physical network. Made up of wires, cables, satellites, and rules for exchanging information between computers connected to the network.

Web is a multimedia interface to the resources available on the Internet.

## **Uses of the Internet and the Web**

- Communicating
- Education (e-learning)
- Shopping
- Searching
- Entertainment

## **Access Providers**

Most common way is through Internet Service Providers (ISP). Already connected to the Internet and provide a path or connection for individuals to access the Internet.

Commercial Internet providers - Provide access through telephone lines, cable, and/or wireless connections.

## **Browsers**

Provide access to web resources - Connects to remote computers, opens and transfers files, displays text images, and multimedia in one tool. Examples: Apple Safari, Google Chrome, Microsoft Internet Explorer, and Mozilla Firefox.

Allow connections to remote computers. Location/address – URL (Uniform Resource Locator). URL's have two basic parts; many have additional parts.

## **Protocol**

- Rules for exchanging data between computers.
- Http is used for web traffic and is the most widely used Internet protocol.

## **Domain name**

Specific address where the resource is located.

## **Communication**

The most popular Internet activity. Family, friends, businesses all use electronic communication.

### **E-mail**

The transmission of an electronic message over the Internet. Can contain graphics, photos, and file attachments. To send and receive e-mail you need a computer with an Internet connection and an e-mail account.

### **Instant Messaging (IM)**

- Allows two or more people to contact each other via direct live communication.
- To use, register with an instant messaging service provider.
- Specify a list of friends.
- IM notifies you when your friends are online
- Includes video conferencing, file sharing, and remote assistance.

### **Social networking**

- Connecting individuals to one another.
- One of the fastest-growing and most significant Web 2.0 applications.
- Focus is on connecting people and organizations that share a common interest or activity.
- Typically provide a wide array of tools that facilitate meeting, communicating, and sharing.

### **Blogs, Microblogs, Webcasts, Podcasts, and Wikis**

- These sites help ordinary people communicate across the web.

- Many individuals create personal websites, called web logs or blogs, to keep in touch with friends and family.
- Used by individuals, groups and businesses to share information.
- Microblogs – publishes short sentences that only take a few seconds to write. Twitter is an example of a microblog.
- Webcasts and podcasts – deliver media content such as music and movies over the Internet to your computer.
- Webcasts use streaming technology – after a Webcast has been completed there are no files remaining on your computer.
- Podcasts do not use streaming technology – before a podcast can be run it must be downloaded and save on your computer.
- Wikis - a Web site specially designed to allow visitors to fill in missing information or correct inaccuracies.
- Wikis support collaborative writing for a community of interested people.
- Wikipedia is an example of a wiki.
- Blogs and wikis are examples of web authoring.

## **Search engines**

Specialized programs that help locate information on the web and the Internet. Searches for information based on keywords and phrases.

## **Cloud computing**

Cloud computing where the Internet acts as a “cloud” of servers that supply applications as a service rather than a product.

- These servers provide cloud storage, also known as online storage
- No installation on local computer, only need Internet ready device to display results
- Google docs

### **Benefits of cloud computing**

- Maintenance - the cloud service will take care of disk defragmentation, back-ups, encryption and security.
- Hardware upgrades - the cloud service will never run out of disk space, can replace failed hard disks without interruption to the user, and handles RAID disk issues for the user.
- File sharing and collaboration - users can share documents, spreadsheets, and files with others from anywhere with an Internet connection.

There are some disadvantages of cloud storage. Two primary concerns are:

- *Access speed* - the data transfer rate is dependent upon the speed of your Internet connection which most likely is not as fast as a user's internal network.
- *File security* - users are dependent upon the cloud service's security procedures which may not be as effective as your own.

### **Communications systems**

Electronic systems that transmit data from one location to another. Four basic elements of a communication system include:

## **Sending and receiving devices**

These are often a computer or specialized communication device originate (send) as well as accept (receive) messages in the form of data, information, and/or instructions.

## **Connection devices**

Acts as an interface between the sending and receiving devices and communication channel converts outgoing messages into packets that can travel across the communication channel and reverse the process for incoming messages.

## **Data transmission specifications**

Rules and procedures that coordinate the sending and receiving devices by physically defining how the message will be sent across the communication channel.

## **Communication channel**

Transmission medium that carries the message. Medium can be a physical wire or cable, or it can be wireless. It is Essential element of every communication system. It carry the data from one computer to another. There are two categories of communication channels that connect sending and receiving devices include physical and wireless connection.

## ***Physical connections***

Solid medium to connect sending and receiving devices. These connections include:

### **Twisted pair**

Pairs of copper wires twisted together. Connections include twisted pair, coaxial cable and fiber-optic cable. Ethernet cables are often used in networks and to connect a variety of components to the system unit.

### **Coaxial cable**

High-frequency transmission cable consisting of a single, solid copper core. Used to deliver television signals as well as to connect computers in a network.

### **Fiber-optic cable**

Transmits data as pulses of light through tiny tubes of glass. It is lighter, faster, and more reliable than coaxial cable. Rapidly replacing twisted-pair cable telephone lines.

## ***Wireless connections***

It does not use a solid substance to connect sending and receiving devices. Data is moved through the air. Primary technologies used for wireless connections are Bluetooth, Wi-Fi, microwave, WiMax, LTE, and satellite connections.

### **Bluetooth**

A short-range radio communication standard that transmits data over short distances of up to approximately 33 feet. Bluetooth is widely used for wireless headsets, printer connections, and handheld devices.

### **Wi-Fi (wireless fidelity)**

Uses high frequency radio signals to transmit data. A number of standards for Wi-Fi exist, and each can send and receive

data at a different speed. Most home and business wireless networks use Wi-Fi.

## **Connection devices**

At one time nearly all computer communication systems used standard telephone lines and analog signals. Computers use digital signals. A modem is required to convert the digital signals to analog signals and vice versa.

### **Modems (modulator-demodulator)**

- Connect computers over analog phone lines.
- Modems convert the computer's digital signal to an analog transmission to send over the phone line (modulation) and then re-convert it to digital when receiving information from the phone lines (demodulation).
- Transfer rate is in bits-per-second; typically measured in millions of megabits per second (Mbps).

***Four commonly used types of modems include:***

#### **Telephone**

Used to connect a computer directly to a telephone line; either internal or external.

#### **DSL (digital subscriber line)**

Uses standard phone lines to create a high-speed connection directly to the phone company's offices; external and usually use USB or Ethernet port to connect to system.

### **Cable**

Uses the same coaxial cable as a television to create a high-speed connection. Connect using USB or Ethernet port.

### **Wireless**

Known as a WWAN- wireless wide area network modem. Commonly a USB or Express Card device that provides very portable high-speed connectivity from virtually anywhere.

### **Connection service**

#### **Dial-up**

Uses existing telephones and telephone modems to connect to the Internet. It is very slow and has been replaced by other higher-speed connection services.

#### **Digital subscriber line (DSL)**

Uses existing telephone lines to provide high-speed connections. Much faster than dial-up.

#### **ADSL (asymmetric digital subscriber line)**

One of the most widely used types of DSL.

#### **Cable**

Use existing television cables to provide high-speed connections. Usually faster than DSL.

#### **Fiber Optic Service (FiOS)**

A new technology in some areas but not widely available. Current providers of FiOS include Google and Verizon with speeds faster than cable or DSL.

## **Satellite connection services**

Use satellites to provide wireless connections. Slower than DSL and cable modem but higher availability.

## **Cellular services**

Cellular service providers including Verizon, AT&T, Sprint, and T-Mobile support voice and data transmission to wireless devices. Cellular services have gone through different generations.

- **1G (first generation mobile telecommunications)** started in the 1980s using analog radio signals to provide analog voice transmission service.
- **2G (second generation mobile telecommunications)** started in the 1990s using digital radio signals. This generation focused on voice transmission and was too slow for effective Internet connectivity.
- **3G (third generation mobile telecommunications)** started in the 2000s providing services capable of effective connectivity to the Internet and marked the beginning of smartphones.
- **4G (fourth generation mobile telecommunications)** have begun to replace 3g with providers using WiMax and LTE connections to provide faster transmission speeds. A user's experience with 4G will depend on several factors including carrier, geography, and proximity to cell towers. 4G technologies can provide speeds up to 10 times faster than 3G.

## **Networks**

A computer network is a communication system that connects two or more computers so they can exchange information and share resources. Number of specialized terms that describe computer networks include:

### **Node**

Any device that is connected to a network.

### **Client**

A node that requests and uses resources available from other nodes. Typically, a client is a user's personal computer.

### **Server**

A node that shares resources with other nodes. Dedicated servers specialize in performing specific tasks.

### **Directory server**

Specialized server that manages resources such as user accounts for an entire network.

### **Host**

Any computer system that can be accessed over a network.

### **Router**

A node that forwards or routes data packets from one network to their destination in another network

### **Switch**

Central node that coordinates the flow of data by sending messages directly between sender and receiver nodes. A hub previously filled this purpose by sending a received message to all connected nodes, rather than just the intended node.

### **Network interface cards (NIC)**

Expansion cards located within the system unit that connect the computer to a network. Sometimes referred to as a LAN adapter.

### **Network administrator**

A computer specialist responsible for efficient network operations and implementation of new networks.

## **Network Types**

### **Local Area Networks (LANs)**

It is a networks with nodes that are in close physical proximity, typically spanning less than a mile and are owned and operated by individual organizations.

### **Network gateway**

Device that allows one LAN to be linked to other LANs or to larger networks. The most common standard in which nodes in a LAN can be connected to one another is known as Ethernet.

### **Home networks**

Networks being used by individuals in their homes and apartments. Allow different computers to share resources, including a common Internet connection.

### **Wireless LAN (WLAN)**

It uses radio frequencies to connect computers and other devices. All communications pass through the network's centrally located wireless access point or base station. This access point interprets incoming radio frequencies and routes communications to the appropriate devices. In public

places wireless access points are known as hotspots and typically use Wi-Fi technology. Most mobile computing devices have an internal wireless network card to connect to hotspots.

### **Personal area network (PAN)**

Type of wireless network that works within a very small area your immediate surroundings. PANs connect cell phones to headsets, PDAs to other PDAs, keyboards to cell phones, and so on. Most popular PAN technology is Bluetooth, with a maximum range of around 30 feet.

### **Metropolitan Area Networks (MANs)**

Span distances up to 100 miles. Frequently used links between office buildings that are located throughout a city. MANs are typically owned by a group of organizations who jointly own and operate the network or by a single network service provider who provides network services for a fee. Microwave relays and satellites are used to reach users over long distances.

### **Wide Area Networks (WANs)**

Countrywide and worldwide networks. Provide access to regional service (MAN) providers and typically span distances greater than 100 miles. They use microwave relays and satellites to reach users over long distances. The widest of all WANs is the Internet, which spans the entire globe.



## *Part 5*

# *Data Hierarchy and Management*

Without data and the ability to process it, an organization could not successfully complete most business activities. It could not pay employees, send out bills, order new inventory, or produce information to assist managers in decision making. As you recall, data consists of raw facts, such as employee numbers and sales figures. For data to be transformed into useful information, it must first be organized in a meaningful way.

### ***Hierarchy of data***

Bits, characters, fields, records, files, and databases.

#### **Character**

A basic building block of most information, consisting of uppercase letters, lowercase letters, numeric digits, or special symbols.

#### **Field**

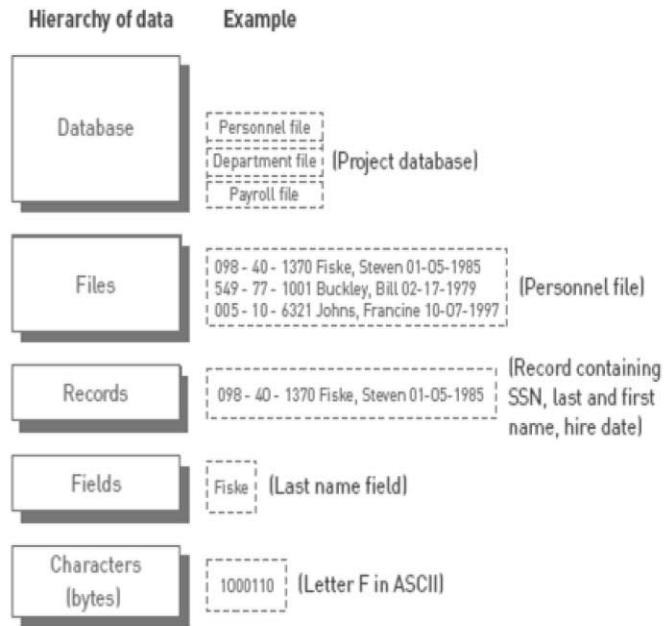
Typically a name, number, or combination of characters that describes an aspect of a business object or activity.

#### **Record**

A collection of data fields all related to one object, activity, or individual.

#### **File**

A collection of related records and fields for specific entity.



(The Hierarchy of Data)

## Data Entities, Attributes, and Keys

Entities, attributes, and keys are important database concepts. An entity is a general class of people, places, or things (objects) for which data is collected, stored, and maintained. Examples of entities include employees, inventory, and customers. Most organizations organize and store data as entities.

### **Entity**

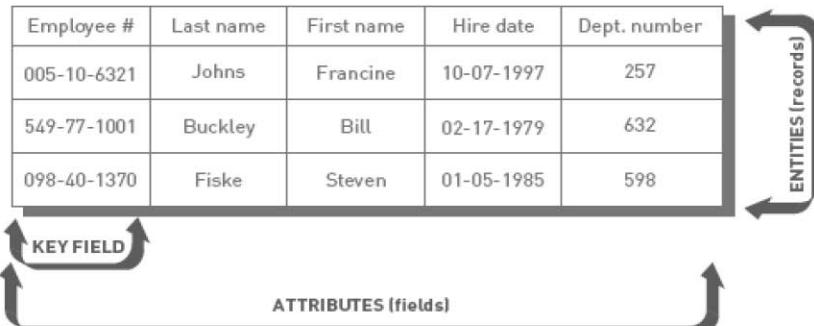
A general class of people, places, or things for which data is collected, stored, and maintained.

### **Attribute**

A characteristic of an entity.

## Data item

The specific value of an attribute.



(Keys and Attributes)

## Key

A field or set of fields in a record that is used to identify the record.

## Primary key

A field or set of fields that uniquely identifies the record.

## ***Data Management***

### **The Database Approach**

At one time, information systems referenced specific files containing relevant data. For example, a payroll system would use a payroll file. Each distinct operational system used data files dedicated to that system. This approach to data management is called the traditional approach to data management.

A huge amount of data is entered into computer systems every day. Where does all this data go, and how is it used? How can it help you on the job? If you become a marketing manager, you can access a vast store of data on existing and potential customers from surveys, their Web habits, and their past purchases. This information can help you sell products and services. If you become a corporate lawyer, you will have access to past cases and legal opinions from sophisticated legal databases. This information can help you win cases and protect your organization legally. Regardless of your field of study in school, using database systems and business intelligence tools will likely be a critical part of your job.

Today, most organizations use the database approach to data management, whereby multiple information systems share a pool of related data. A database offers the ability to share data and information resources.

Federal databases, for example, often include the results of DNA tests as an attribute for convicted criminals. The

information can be shared with law enforcement officials around the country.

To use the database approach to data management, additional software a database management system (DBMS) is required.

### **Database management system (DBMS)**

A group of programs that manipulate the database and provide an interface between the database and the user of the database and other application programs.

DBMS consists of a group of programs that can be used as an interface between a database and the user of the database. Typically, this software acts as a buffer between the application programs and the database itself.

### **Database administrator (DBA)**

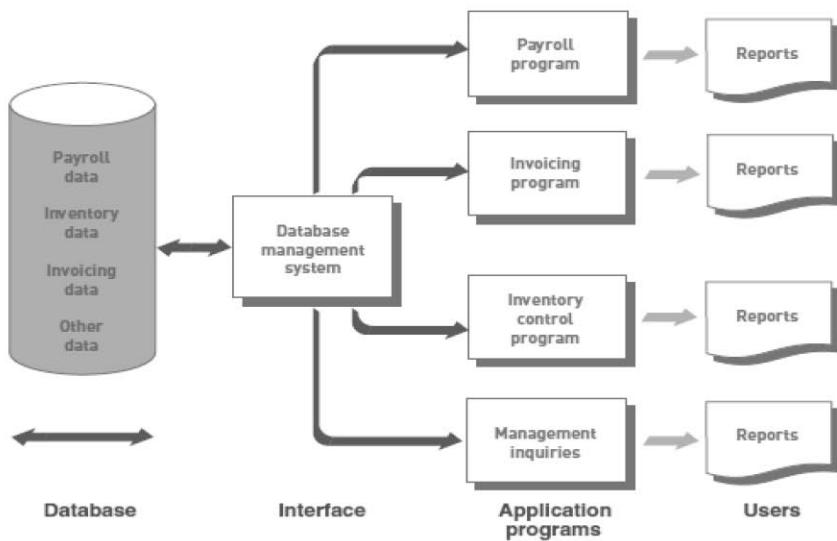
A skilled IS professional who directs all activities related to an organization's database

### **Traditional approach to data management**

An approach to data management whereby each distinct operational system used data files dedicated to that system.

### **Database approach to data management**

An approach to data management whereby a pool of related data is shared by multiple information systems.



(The Database Approach to Data Management)

### **Advantages:**

- Improved strategic use of corporate data
- Reduced data redundancy
- Improved data integrity
- Data and program independence

### **Schema**

A description of the entire database.

### **Data definition language (DDL)**

A collection of instructions and commands used to define and describe data and relationships in a specific database.

### **Data manipulation language (DML)**

A specific language, provided with a DBMS, which allows users to access and modify the data, to make queries, and to generate reports.

## **When building a database, consider**

- **Content:** What data should be collected, at what cost?
- **Access:** What data should be provided to which users and when?
- **Logical structure:** How should data be arranged to make sense to a given user?
- **Physical organization:** Where should data be physically located?

## **Building a database requires two types of designs**

- **Logical design:** Abstract model of how data should be structured and arranged to meet an organization's information needs.
- **Physical design:** Fine-tunes the logical database design for performance and cost considerations.

## **Database types**

### **Distributed Databases**

Data may be spread across several smaller databases connected via telecommunications devices and give corporations and other organizations more flexibility in how databases are organized and used.

### **Replicated database**

Holds a duplicate set of frequently used data.

### **Object-oriented database**

Database that stores both data and its processing instructions

## **Object-oriented database management system**

Programs that manipulate an object-oriented database and provide a user interface and connections to other application programs and capable of manipulating audio, video, and graphical data.

## ***The Relational Database Model***

Although there are a number of different database models, including flat files, hierarchical, and network models, the relational model has become the most popular, and use of this model will continue to increase. The relational model describes data using a standard tabular format; all data elements are placed in two-dimensional tables, called relations, which are the logical equivalent of files. The tables in relational databases organize data in rows and columns, simplifying data access and manipulation. It is normally easier for managers to understand the relational model than other database models.

### **An Entity-Relationship (ER)**

Development of ER diagrams helps ensure that the logical structure of application programs is consistent with the data relationships in the database.

### **Relational model**

A database model that describes data in which all data elements are placed in two-dimensional tables, called relations, which are the logical equivalent of files.

In the relational model, all data elements are placed in two dimensional tables, or relations. As long as they share at least

one common element, these relations can be linked to output useful information.

Data Table 1: Project Table

Project	Description	Dept. number
155	Payroll	257
498	Widgets	632
226	Sales manual	598

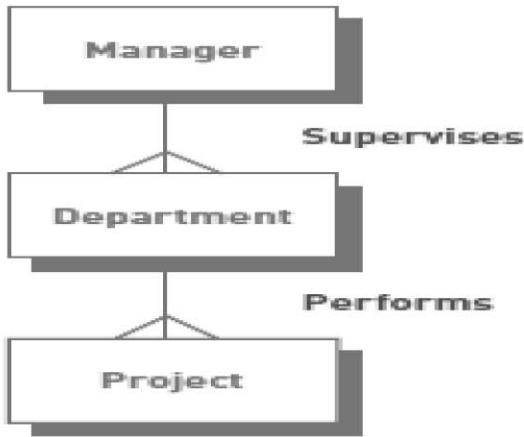
Data Table 2: Department Table

Dept.	Dept. name	Manager SSN
257	Accounting	005-10-6321
632	Manufacturing	549-77-1001
598	Marketing	098-40-1370

Data Table 3: Manager Table

SSN	Last name	First name	Hire date	Dept. number
005-10-6321	Johns	Francine	10-07-1997	257
549-77-1001	Buckley	Bill	02-17-1979	632
098-40-1370	Fiske	Steven	01-05-1985	598

(A Relational Database Model)



(A Simplified ER Diagram Showing the Relationship between the Manager, Department, and Project Tables)

### **Linking Data Tables to answer an Inquiry**

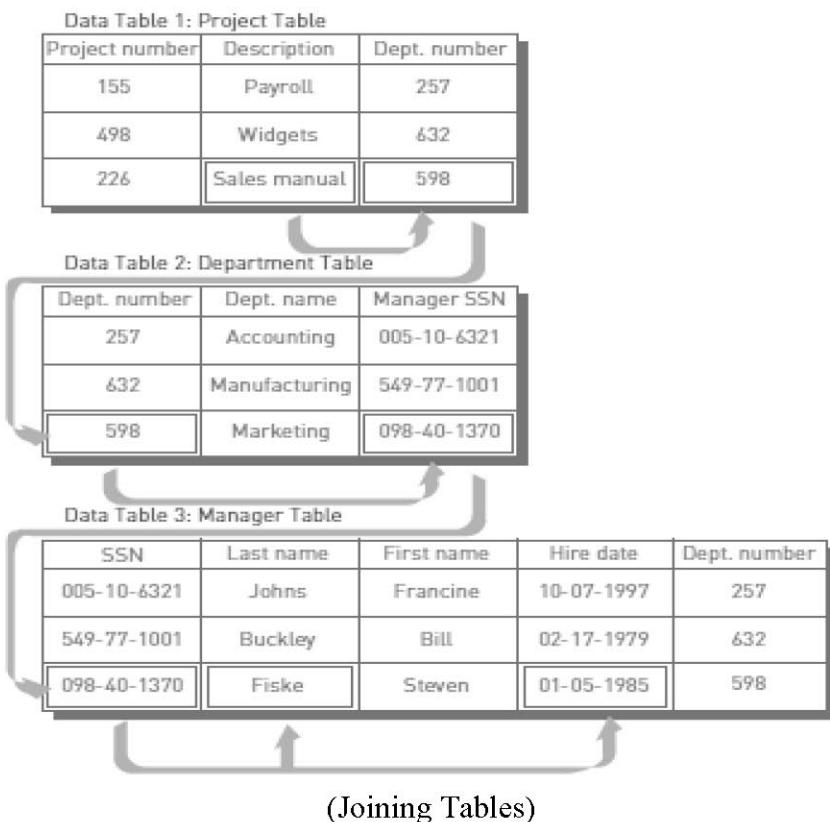
In finding the name and hire date of the manager working on the sales manual project, the president needs three tables: project, department, and manager. The project description (Sales manual) leads to the department number (598) in the project table, which leads to the manager's SSN (098-40-1370) in the department table, which leads to the manager's name (Fiske) and hire date (01-05-1985) in the manager table.

### **Query by Example**

Some databases use Query by Example (QBE) to generate reports and information.

### **Database Output**

A database application offers sophisticated formatting and organization options to produce the right information in the right format.



(Joining Tables)

Field	Table	Sort	Criteria	Format
Price Total	Order Price Totals		>2000	
Order Date	Orders			
Customer ID	Orders			
Company	Customers			
Last Name	Customers			
First Name	Customers			

Price Total	Order Date	Customer	Company	Last Name	First Name
\$13,800.00	3/10/2006	Company BB	Company BB	Raghav	Amritansh
\$13,800.00	3/24/2006	Company G	Company G	Xie	Ming-Yang
\$3,690.00	4/5/2006	Company I	Company I	Mortensen	Sven
\$3,690.00	4/5/2006	Company I	Company I	Mortensen	Sven
\$4,200.00	4/8/2006	Company F	Company F	Pérez-Olaeta	Francisco
\$3,520.00	4/22/2006	Company D	Company D	Lee	Christina
\$3,520.00	4/22/2006	Company D	Company D	Lee	Christina
\$2,250.00	6/5/2006	Company Z	Company Z	Liu	Run
\$2,490.00	6/23/2006	Company F	Company F	Pérez-Olaeta	Francisco
\$2,490.00	6/23/2006	Company F	Company F	Pérez-Olaeta	Francisco

(Database Query Results)

The screenshot shows a Microsoft Access application window titled "Monthly Sales Report". The report displays monthly sales data for June 2006. The data is presented in a table with two columns: "Product" and "Sales". The table includes a total row for "June Sales Total". The report is dated Sunday, July 29, 2007, at 5:36:07 PM.

Product	Sales
Northwind Traders Boysenberry Spread	\$2,250.00
Northwind Traders Dried Apples	\$1,590.00
Northwind Traders Fruit Cocktail	\$1,560.00
Northwind Traders Chocolate	\$1,020.00
Northwind Traders Dried Pears	\$900.00
Northwind Traders Cajun Seasoning	\$660.00
Northwind Traders Coffee	\$230.00
Northwind Traders Clam Chowder	\$96.50
June Sales Total	\$8,306.50

Page 1 of 1

(Database Output - Reports)

## Using Databases with Other Software

Database management systems are often used with other software packages or the Internet. **Front-end application** directly interacts with users where **Back-end application** interacts with applications.

## Data Warehouses, Data Marts, and Data Mining

### Data warehouse

Holds business information from many sources in the enterprise.

### Data mart

Subset of a data warehouse

### Data mining

Information-analysis tool for discovering patterns and relationships in a data warehouse.

### **Predictive analysis**

Combines historical data with assumptions about future conditions

### **Business Intelligence**

Gathering the right information in a timely manner and usable form and analyzing it to have a positive impact on business.



## *Part 6*

# *Business intelligence Applications*

## **Business intelligence (BI)**

Business intelligence (BI) can be defined as a set of processes and technologies that convert data into meaningful and useful information for business purposes. While some believe that BI is a broad subject that encompasses analytics, business analytics, and information systems, others believe it is mainly focused on collecting, storing, and exploring large database organizations for information useful to decision-making and planning.

One function that is generally accepted as a major component of BI involves storing an organization's data in computer cloud storage or in data warehouses. Data warehousing is not an analytics or business analytics function, although the data can be used for analysis.

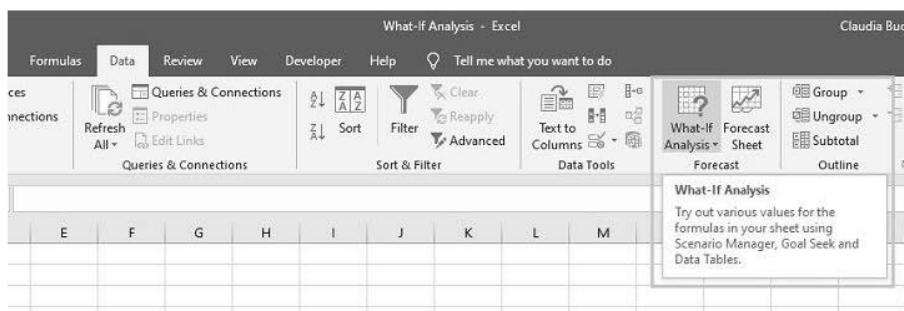
In application, BI is focused on querying and reporting, but it can include reported information from a BA analysis. BI seeks to answer questions such as what is happening now and where and also what business actions are needed based on prior experience.

Most businesses start with ***descriptive analytics***: the use of data to understand past and current business performance and make informed decisions. ***Predictive analytic***: seeks to predict the future by examining historical data, detecting patterns or relationships in these data, and then extrapolating these relationships forward in time while ***Prescriptive analytics***: uses optimization to identify the best alternatives to minimize or maximize some objective.

# Business Intelligence Using MS Excel

## What if analysis

What-If Analysis in Excel allows you to try out different values (scenarios) for formulas. Most what if analyses are really mathematical calculations, and that is Excel's specialty. To help you do a what if analysis, Excel uses commands from the Forecast command group on the Data tab to prepare simple forecasts or advanced business models.



The following example helps you use what-if analysis quickly and easily.

Assume you own a book store and have 100 books in storage. You sell a certain % for the highest price of \$50 and a certain % for the lower price of \$20.

C8 : X ✓ f<sub>x</sub> =B4\*(1-C4)

	A	B	C	D	E
1	<b>Book Store</b>				
2					
3	total number of books		% sold for the highest price		
4		100		60%	
5					
6			number of books	unit profit	
7	highest price		60	\$50	
8	lower price		40	\$20	
9					
10			total profit		\$3,800
11					

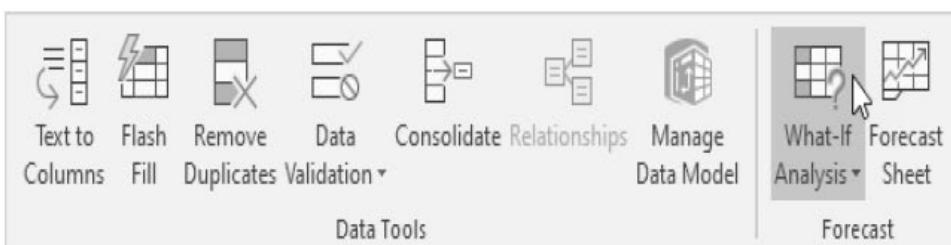
If you sell 60% for the highest price, cell D10 calculates a total profit of  $60 * \$50 + 40 * \$20 = \$3800$ .

## Create Different Scenarios

But what if you sell 70% for the highest price? And what if you sell 80% for the highest price? Or 90%, or even 100%? Each different percentage is a different scenario. You can use the Scenario Manager to create these scenarios.

You can simply type in a different percentage into cell C4 to see the corresponding result of a scenario in cell D10. However, what-if analysis enables you to easily compare the results of different scenarios.

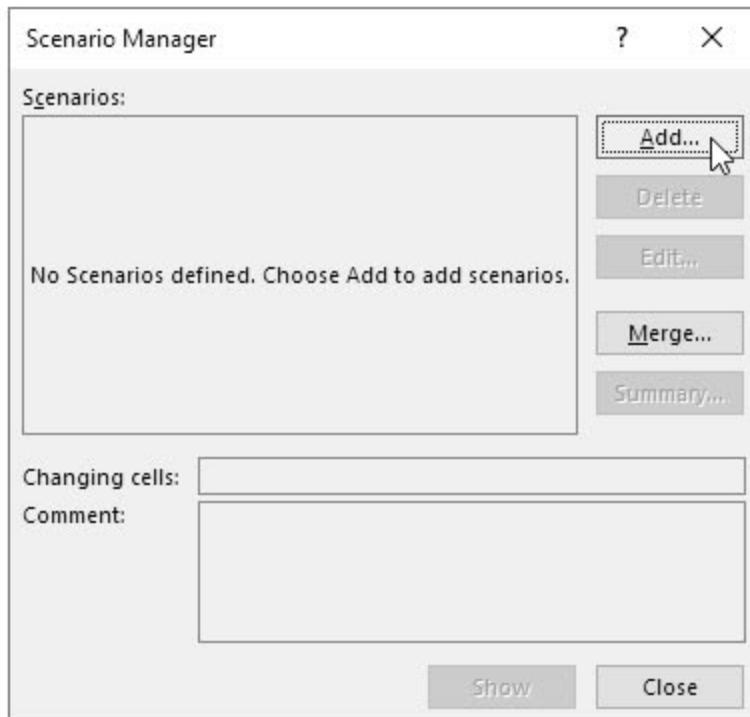
- On the Data tab, in the Forecast group, click What-If Analysis.



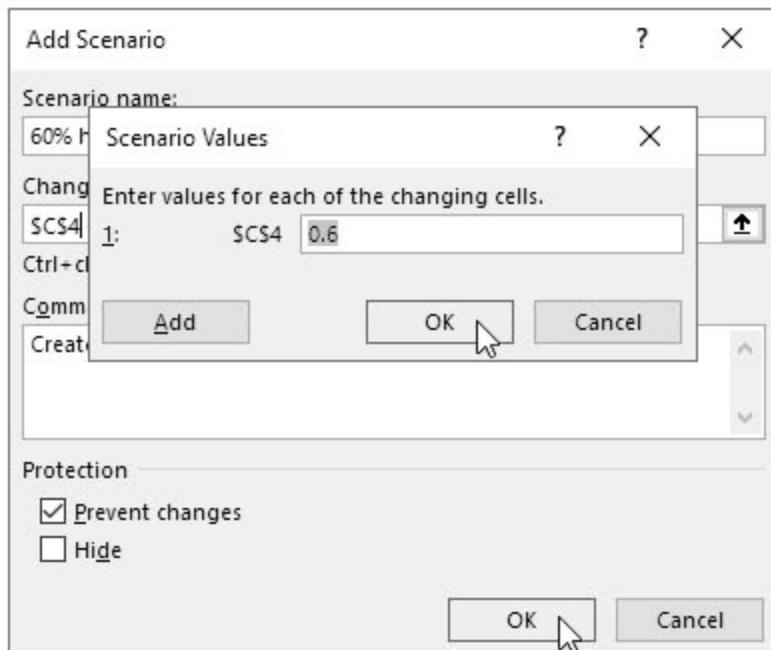
- Click Scenario Manager.



- Add a scenario by clicking on Add.

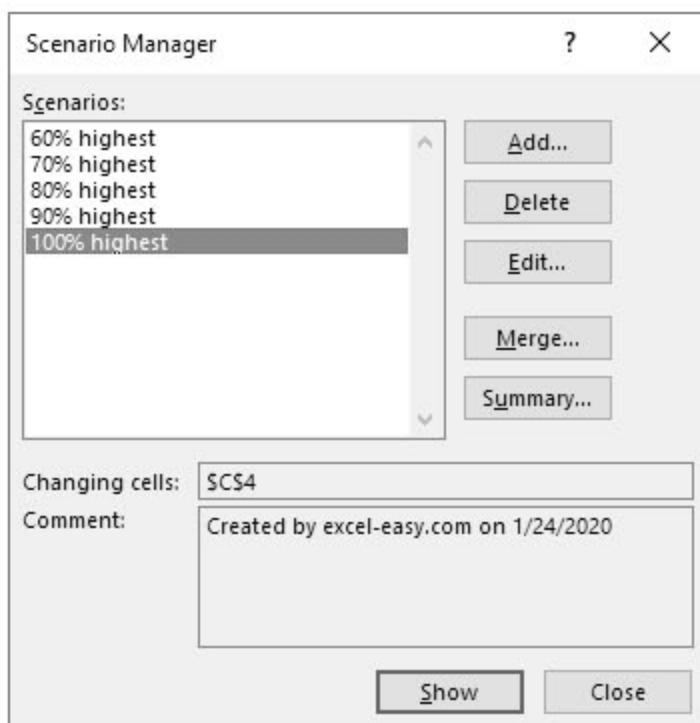


- Type a name (60% highest), select cell C4 (% sold for the highest price) for the Changing cells and click on OK



- Enter the corresponding value 0.6 and click on OK again
- Next, add 4 other scenarios (70%, 80%, 90% and 100%).

- Finally, your Scenario Manager should be consistent with the picture below:

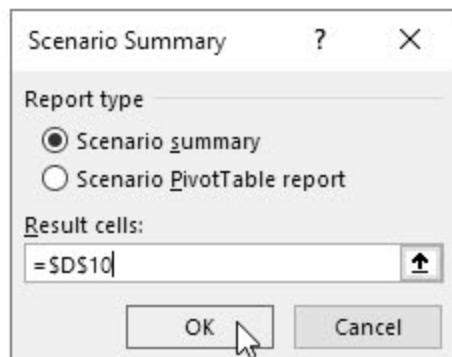


- Select the scenario and click on the Show button. Excel will change the value of cell C4 accordingly for you to see the corresponding result on the sheet.

## Scenario Summary

- To easily compare the results of these scenarios, execute the following steps.
- Click the Summary button in the Scenario Manager.

- Next, select cell D10 (total profit) for the result cell and click on OK.



- Result

Scenario Summary						
	Current Values: 60% highest 70% highest 80% highest 90% highest 100% highest					
Changing Cells:	\$1 \$4	60%	70%	80%	90%	100%
Result Cells:	\$D\$10	\$3,800	\$3,800	\$4,100	\$4,400	\$4,700
Notes: Current Values column represents values of changing cells at time Scenario Summary Report was created. Changing cells for each scenario are highlighted in gray.						

## Pivot Tables

Pivot tables are one of Excel's most powerful features. A pivot table allows you to extract the significance from a large, detailed data set.

Our data set consists of 213 records and 6 fields. Order ID, Product, Category, Amount, Date and Country.

	A	B	C	D	E	F	G	H
1	Order ID	Product	Category	Amount	Date	Country		
2	1	Carrots	Vegetables	\$4,270	1/6/2015	United States		
3	2	Broccoli	Vegetables	\$8,239	1/7/2015	United Kingdom		
4	3	Banana	Fruit	\$517	1/8/2015	United States		
5	4	Banana	Fruit	\$8,384	1/10/2015	Canada		
6	5	Beets	Vegetables	\$2,526	1/10/2015	Germany		
7	6	Orange	Fruit	\$1,510	1/11/2015	United States		
8	7	Broccoli	Vegetables	\$9,002	1/11/2015	Australia		
9	8	Banana	Fruit	\$6,306	1/16/2015	New Zealand		
10	9	Apple	Fruit	\$2,117	1/16/2015	France		
**	**	**	**	**	**	**		

## Insert a Pivot Table

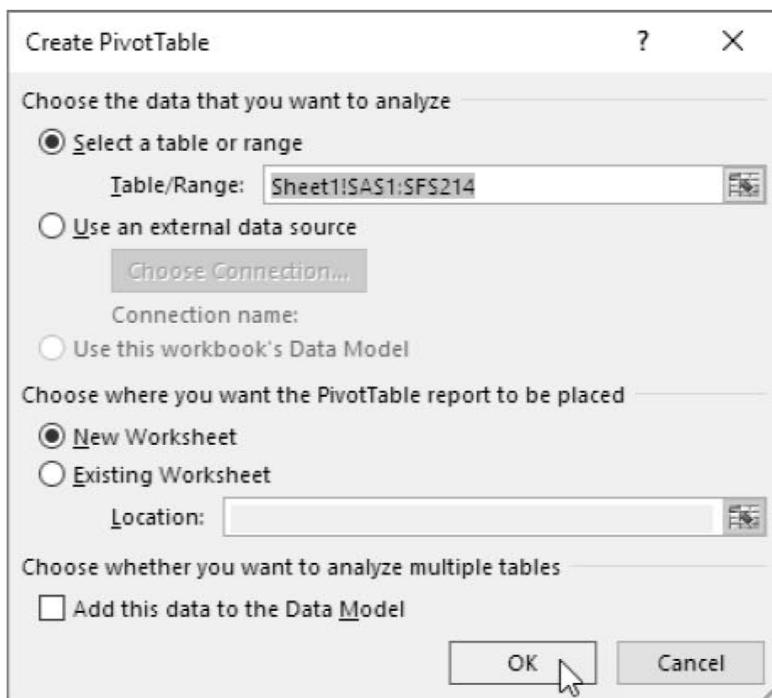
To insert a pivot table, execute the following steps.

- Click any single cell inside the data set.
- On the Insert tab, in the Tables group, click PivotTable.



The following dialog box appears. Excel automatically selects the data for you. The default location for a new pivot table is New Worksheet.

- Click OK.



## Drag fields

The PivotTable Fields pane appears. To get the total amount exported of each product, drag the following fields to the different areas.



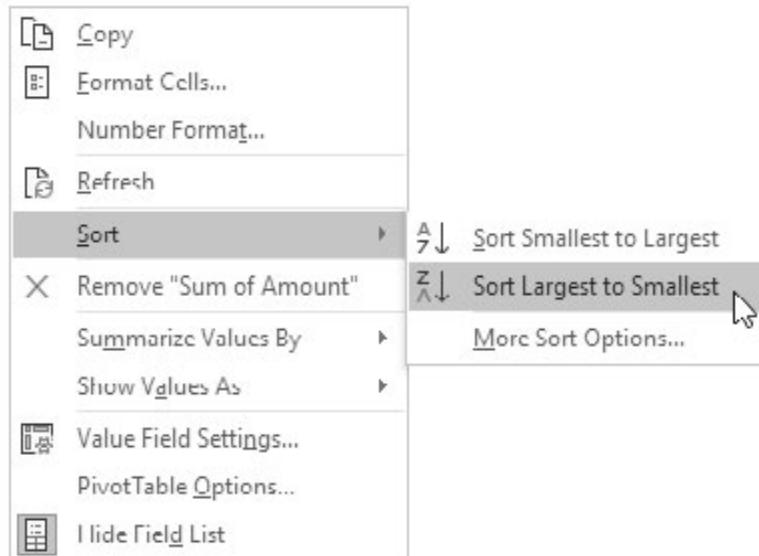
- Product field to the Rows area.
  - Amount field to the Values area.
  - Country field to the Filters area.
- 
- Below you can find the pivot table. Bananas are our main export product.

	A	B	C
1	Country	(All)	▼
2			
3	Row Labels	Sum of Amount	
4	Apple	191257	
5	Banana	340295	
6	Beans	57281	
7	Broccoli	142439	
8	Carrots	136945	
9	Mango	57079	
10	Orange	104438	
11	Grand Total	1029734	
12			

## Sort

To get Banana at the top of the list, sort the pivot table.

- Click any cell inside the Sum of Amount column.
- Right click and click on Sort, Sort Largest to Smallest.



## Result

	A	B	C
1	Country	(All)	▼
2			
3	Row Labels	Sum of Amount	
4	Banana	340295	
5	Apple	191257	
6	Broccoli	142439	
7	Carrots	136945	
8	Orange	104438	
9	Beans	57281	
10	Mango	57079	
11	Grand Total	1029734	
12			

## Goal Seek

If you know the result you want from a formula, use Goal Seek in Excel to find the input value that produces this formula result.

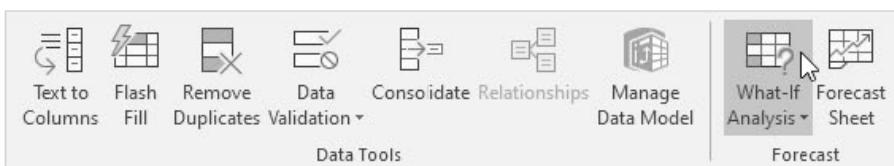
Use Goal Seek in Excel to find the grade on the fourth exam that produces a final grade of 70.

- The formula in cell B7 calculates the final grade.

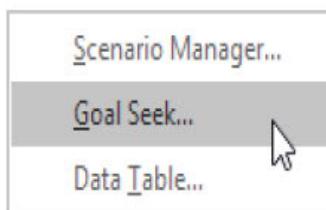
B7		⋮	X	✓	f <sub>x</sub>	=AVERAGE(B2:B5)			
A	B	C	D	E	F	G	H	I	
1 Exam	Grade								
2 Exam 1	50								
3 Exam 2	80								
4 Exam 3	60								
5 Exam 4									
6									
7 Final Grade	63.33333								
8									

- The grade on the fourth exam in cell B5 is the input cell.

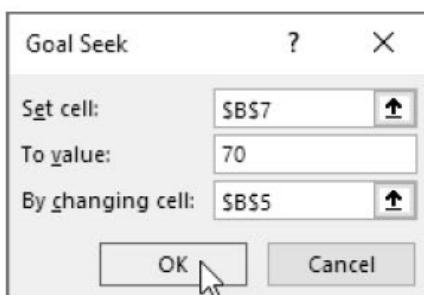
B5		⋮	X	✓	f <sub>x</sub>				
A	B	C	D	E	F	G	H	I	
1 Exam	Grade								
2 Exam 1	50								
3 Exam 2	80								
4 Exam 3	60								
5 Exam 4									
6									
7 Final Grade	63.33333								
8									



- On the Data tab, in the Forecast group, click What-If Analysis.
- Click Goal Seek.



- The Goal Seek dialog box appears.
- Select cell B7.
- Click in the 'To value' box and type 70.
- Click in the 'By changing cell' box and select cell B5.
- Click OK.



- Result. A grade of 90 on the fourth exam produces a final grade of 70.

	A	B	C	D	E	F	G	H	I
1	Exam	Grade							
2	Exam 1	50							
3	Exam 2	80							
4	Exam 3	60							
5	Exam 4	90							
6									
7	Final Grade	70							
8									

# Business Intelligence Using MS Power BI

## Power BI Components

### Datasets

Your data, like CRM. You set up a data set, which is a connection to your data, and you can use that over and over again.

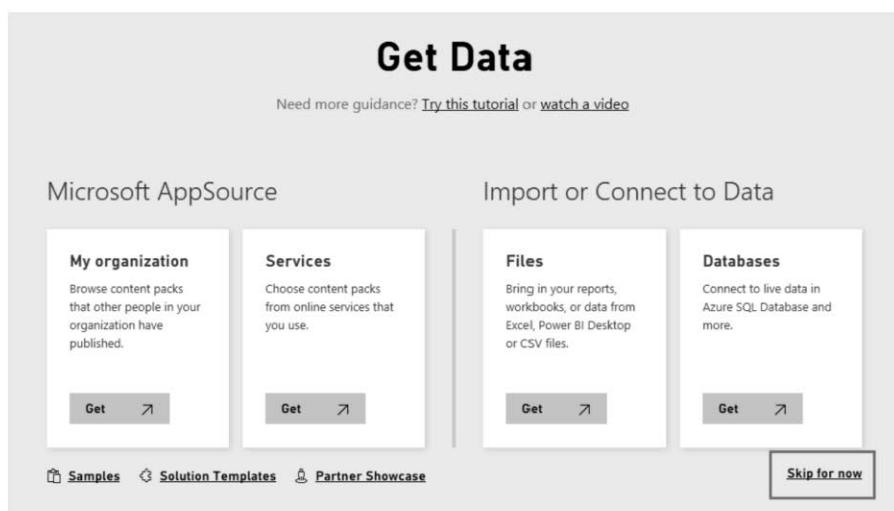
### Reports

A visual way of showing your data – lists, charts, & graphs.

### Dashboards

A screen that has different sections (widgets) on it. Usually these widgets pull in a report.

First, when you open the Power BI service (online version), you will probably get prompted to get data.





1. Navigation bar
2. Dashboard with tiles
3. Q&A question box
4. Help and feedback buttons
5. Dashboard title
6. Office 365 app launcher
7. Power BI home buttons
8. Additional dashboard actions

## **Getting Data**

First, you need to specify some data to use. This means connect to a data source.

### **Setting up a Data Connection**

You can Import data or Connect to data from other sources:

**Excel (.xlsx, xlsm)** – Lots of people use Microsoft Excel. Either you have manually entered data into a spreadsheet or you possibly queried and loaded data from an external data source. You can easily connect and use a spreadsheet as your data source.

**Comma Separated Value (.csv)** – CSV files are similar to Excel but without the formatting. They are simple text files with rows of data. Each row can contain one or more values, each separated by a comma.

**SQL Server instance.** There are on-premise and cloud connections, depending on where your data is located. You might need to contact your IT department for proper access and assistance with these connections.

### **Choose a Dataset**

Once you've figured out where your data is coming from and set up a connection, you'll need a dataset.

Dataset and Data Source are used a lot in Power BI. They're often use synonymously, but they really are two different things, albeit related.

A **dataset** is automatically created in Power BI when you use Get Data to connect to and import data from a content pack, file, or you connect to a live data source. A dataset contains information about the data source, data source credentials, and in many cases, a sub-set of data copied from the data source. In most cases, when you create visualizations in reports and dashboards, you're looking at data in the dataset.

A **data source** is where the data in a dataset really comes from. For example, an online service like Dynamics CRM online or Acumatica, a database in the cloud like Azure SQL Database, or a database or file on a local computer or server in your own organization like SQL Server.

**Data refresh** is a super important part of Power BI, and much too deep to cover here. Most of the time, the refresh will happen automatically once you have your data connection set up. However, if you set up a connection to files on your local drive or a network location, the computer where the file is saved must be on for the refresh to happen.

## Making & Understanding Reports

Once you have your Power BI account and have added a data connection, you're ready move on to the next steps. In the simplest of terms, you will:

1. Make a report or multiple reports
2. Then, use your report(s) in a dashboard

## **Reports**

A Power BI report is one or more pages of visualizations (charts and graphs like line charts, pie charts, tree maps, and many more). These visuals all come from a single dataset.

Reports can be created from scratch or there are pre-built reports you get when you use content packs.

## **Working with Your Report Data**

Below visualizations is the place to adjust and work with your data. This column has three icons at the top:

- Fields
- Formats
- Analytics

In here, you can adjust almost everything data related.

## **Dashboards**

A dashboard is a screen with multiple tiles on it. Each tile then can display a report. It is something you create or someone else can and then you share it.

A dashboard can:

- Can display visualizations from many different datasets
- Can display visualizations from many different reports
- Can display visualizations pinned from other tools (e.g., Excel)

## *Resources and References*

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- Power BI Support  
<https://powerbi.microsoft.com/en-us/search>