**BITC 111 DIGITAL REVOLUTION**

**CHAPTER ONE**

What is Digital Revolution?

**What Was The Digital Revolution?**

In the second half of the 20th century, life was transformed around the world as digital technology rapidly advanced and became more accessible.

**The Digital Revolution Defined**

The Digital Revolution, often referred to as Third Industrial Revolution, began between the late 1950’s and 1970’s. It is the development of technology from mechanical and analog to digital. During this time, digital computers and digital record keeping became the norm. The introduction of digital technology also changed the way humans communicate, now via computers, cell phones, and the internet. This revolution led way to the Information Age.

**Historical Development of Digital Technology**

The 1947 invention of the revolutionary transistor is credited with sowing the seed for digital technology to come. By the 1950’s and 1960’s, many governments, military forces, and other organizations were already using computers. Soon after, the computer was introduced for household use and by the 1970’s, many families had computers for personal use. This occurred at around the same time that video games became popular, both for home systems and arcade use. The infiltration of digital technology even led to the invention of jobs. As businesses moved to digital records keeping, the need for data entry clerks grew. The 1980’s brought computer production to films, robots to industry, and automated teller machines (ATMs) to banks. By 1989, 15% of all households in the US owned a computer. Analog mobile phones made way to digital mobile phones in 1991 and the demand soared. This was the same year that the internet was made available to the public. By the end of the decade, the internet was so popular that many businesses had a website and nearly every country on earth had a connection. When the 21st century began, cell phones were a common possession and high-definition television became the most common broadcasting method, replacing analog television. By 2015, around 50% of the world had constant internet connection, and ownership rates of smartphones and commonness of tablet possession have nearly surpassed those of home computers. The ability to store information has grown exponentially with terabyte storage now being very accessible.

The Digital Revolution has also led to several inventions becoming obsolete. Some of these now antiquated devices include analogue radio, the fax machine, VHS tapes, typewriters, mail correspondence (with the exception of packages), telegrams, and even landline phones to a certain degree.

**What the Digital Future Holds**

While some experts claim that the world has moved out of the Digital Revolution, others believe that it has only just begun. The argument behind this is that these digital advances are now changing the industrial sector. Areas such as three-dimensional (3D) printing and computer design are constantly advancing contributions to science, particularly in the area of robot design. Some of these robots now work with humans and some organizations work with only robots! While that may sound as if robots could replace humans in the near future, this technological advancement has actually increased manufacturing output. With digital inventions, online retail has also become very common. People constantly buy from online retailers and that trend is expected to continue growing. The Digital Revolution has just recently begun to have an impact on the medical industry as well. This will be particularly important to genomic medicine, the use of genetic information for personalized treatment plans. One thing is certain, the Digital Revolution has changed human lives, bringing with it both positive and negative aspects. These changes are only expected to continue growing in the future.

With the help of the internet find out what these technologies mean.

* Internet of Things (IoT)
* Artificial Intelligence (AI)
* 3D printing
* Autonomous vehicles
* Nanotechnology
* Big Data

**Impact of the digital revolution**

|  |  |
| --- | --- |
| Digital natives | Digital immigrants |
| talk via chat, text or through social media | talk in person or on the phone |
| text more than call | don’t text or only sparingly |
| asynchronous communication | synchronous communication |
| receive information quickly and simultaneously from multiple sources | receive information slowly, linearly, logically, sequentially |
| process/interact with pictures, graphics, sound & video before text | prefer reading text (i.e. book) to processing pictures, videos and sounds |
| multitasking and parallel processing | focus on one task at a time |

**Impact on society and individuals**

The use of advanced technology has been changing the way we live, work and communicate. It has been reshaping almost every aspect of life – government, education, healthcare, commerce, etc.

**The Advantages of Technology**

• Thanks to the internet and mobile technologies, we can communicate with anyone in the world and form relationships with people who are some distance away, rather than being limited to people within our physical vicinity. This has some great positives for both work and home life.

• The increased automation of manufacturing and many other jobs, thanks to computers, means greater efficiency, less people doing boring repetitive jobs, and an increase in flexibility regarding work times. Many jobs can now be done remotely, thanks to the internet, with many workers increasingly being able to work from home at times of their choosing.

• The wealth of information that is now available is astonishing. In theory, at least, having access to the internet means having access to almost all of the world’s knowledge. Increasingly we don’t even need to be sat at a desk to access the information either, as mobile devices become more and more powerful.

• The entertainment industry has experienced a revolution. Consumers now have an incredible choice of movies, shows, games, music, and other entertainment available 24/7. The music and film industries have been democratized as artists are no longer reliant on companies to fund and promote them, as they can do it all themselves.

• Technology can now be used to advance itself. Science is benefiting massively from the lightning speeds that computers can perform calculations and investigate complex questions that would take humans many lifetimes to answer. Medical breakthroughs, chemical and astronomical discoveries have all been made due to computers.

• Modern technology saves us lots of time, whether it’s our computer regulated cars driving us to work, washing-machines to do our laundry, or automated banking to allow us to pay by credit card, use internet banking, or get cash out from the ATM.

• Computer regulation and automation means that many devices and machines now function much more efficiently and use less power, either because they are working at the most efficient rate, or they automatically switch themselves off when not in use. This provides benefits for the environment as well as being a cost saver,

**The Disadvantages of Technology**

• Human relations are diminished in the virtual world. As online social networking increasingly replaces real face-to-face and physical contact, alienation can increase, as well as problems such as cyber-bullying, online stalking and cyber crime, which are related to the anonymity of the internet.

• Human beings are less and less valued in the workplace as their roles are replaced by computers. Outsourcing has meant bigger profits for companies, but a decline in wages and conditions and more unemployment for ordinary workers, especially in Western nations. Multinational corporations are increasingly impossible to control by individual nation states.

• Issues of privacy have become huge, as it becomes increasingly difficult to control personal information in the digital and internet world. Financial details can be hacked into, candid photos or videos posted on the web, slurs and accusations made against people's characters, and personal identities can be stolen.

• Intellectual property theft and piracy have made it more and more difficult for creative people to make any money from their output. Media can be digitalized and then distributed across the internet very easily and the process seems impossible to control. Ultimately it will lead to a decline in artistic and creative quality as people no longer have the time and funds to pursue projects.

• Modern societies are increasingly dependent on technology. So much so, that many basic services such as hospitals, power grids, airports, rail and road transport systems, and military defenses can now be knocked out by cyber attack or a catastrophic failure. Humans would be almost helpless if the technology was taken away overnight.

• We are increasingly becoming overwhelmed by the information overload that modern technology brings, as we are bombarded by irrelevant emails, sales telephone calls, text messages, internet advertising etc. Rather than saving us time, new technology means that we are expected to process more and more information and work even more intensively.

• Technology brings with it all sorts of environmental problems. As well as machines and devices often being made from toxic, or non-biogradable materials, most technologies need a power source, which can often mean an increase in the consumption of electricity and fossil fuels.

• Technology has a general dehumanizing effect. As well as in the workplace, the military is increasingly becoming more technological. An example is pilotless drone aircraft, which can attack and kill people with the controller many thousands of miles away.

**DATA LIFECYCLE**

**7 phases of a data life cycle**

1. Data Capture

The first experience that an item of data must have is to pass within the firewalls of the enterprise. This is Data Capture, which can be defined as the act of creating data values that do not yet exist and have never existed within the enterprise.

There are three main ways that data can be captured, and these are very important:

* **Data Acquisition:** the ingestion of already existing data that has been produced by an organization outside the enterprise
* **Data Entry:** the creation of new data values for the enterprise by human operators or devices that generate data for the enterprise
* **Signal Reception:** the capture of data created by devices, typically important in control systems, but becoming more important for information systems with the Internet of Things

**2. Data Maintenance**

Once data has been captured it usually encounters Data Maintenance. This can be defined as the supplying of data to points at which Data Synthesis and Data Usage occur, ideally in a form that is best suited for these purposes.

**3. Data Synthesis**

This is comparatively new, and perhaps still not a very common phase in the Data Life Cycle. It can be defined as the creation of data values via inductive logic, using other data as input.

**4. Data Usage**

This is Data Usage, which can be defined as the application of data as information to tasks that the enterprise needs to run and manage itself.

**5. Data Publication**

In being used, it is possible that our single data value may be sent outside of the enterprise. This is Data Publication, which can be defined as the sending of data to a location outside of the enterprise.

**6. Data Archival**

Our single data value may experience many rounds of usage and publication, but eventually the end of its life begins to loom large. The first part of this is to archive the data value. Data Archival is the copying of data to an environment where it is stored in case it is needed again in an active production environment, and the removal of this data from all active production environments.

**7. Data Purging**

We now come to the actual end of life of our single data value. Data Purging is the removal of every copy of a data item from the enterprise.

**CHARACTERISTICS OF COMPUTERS**

The characteristics of computers that have made them so powerful and universally useful are speed, accuracy, diligence, versatility and storage capacity.

Speed

Computers work at an incredible speed. A powerful computer is capable of performing about 3-4 million simple instructions per second.

Accuracy

In addition to being fast, computers are also accurate. Errors that may occur can almost always be attributed to human error (inaccurate data, poorly designed system or faulty instructions/programs written by the programmer)

Diligence

Unlike human beings, computers are highly consistent. They do not suffer from human traits of boredom and tiredness resulting in lack of concentration. Computers, therefore, are better than human beings in performing voluminous and repetitive jobs.

Versatility

Computers are versatile machines and are capable of performing any task as long as it can be broken down into a series of logical steps. The presence of computers can be seen in almost every sphere – Railway/Air reservation, Banks, Hotels, Weather forecasting and many more.

Storage Capacity

Today’s computers can store large volumes of data. A piece of information once recorded (or stored) in the computer, can never be forgotten and can be retrieved almost instantaneously.

**COMPUTER ORGANIZATION**

A computer system (fig.1.1) consists of mainly four basic units; namely input unit, storage unit, central processing unit and output unit. Central Processing unit further includes Arithmetic logic unit and control unit, as shown in Figure 1.2.

A computer performs five major operations or functions irrespective of its size and make. These are

* it accepts data or instructions as input,
* it stores data and instruction
* it processes data as per the instructions,
* it controls all operations inside a computer, and
* it gives results in the form of output.

1.4.1 Functional Units:

a. Input Unit: This unit is used for entering data and programs into the computer system by the user for processing.

b. Storage Unit: The storage unit is used for storing data and instructions before and after processing.

Output Unit: The output unit is used for storing the result as output produced by the computer after processing.

d. Processing: The task of performing operations like arithmetic and logical operations is called processing. The Central Processing Unit (CPU) takes data and instructions from the storage unit and makes all sorts of calculations based on the instructions given and the type of data provided. It is then sent back to the storage unit. CPU includes Arithmetic logic unit (ALU) and control unit (CU)

* Arithmetic Logic Unit: All calculations and comparisons, based on the instructions provided, are carried out within the ALU. It performs arithmetic functions like addition, subtraction, multiplication, division and also logical operations like greater than, less than and equal to etc.
* Control Unit: Controlling of all operations like input, processing and output are performed by control unit. It takes care of step by step processing of all operations inside the computer.

1.4.2 Memory

Computer’s memory can be classified into two types; primary memory and secondary memory

a. Primary Memory can be further classified as RAM and ROM.

* RAM or Random Access Memory is the unit in a computer system. It is the place in a computer where the operating system, application programs and the data in current use are kept temporarily so that they can be accessed by the computer’s processor. It is said to be ‘volatile’ since its contents are accessible only as long as the computer is on. The contents of RAM are no more available once the computer is turned off.

ROM or Read Only Memory is a special type of memory which can only be read and contents of which are not lost even when the computer is switched off. It typically contains manufacturer’s instructions. Among other things, ROM also stores an initial program called the ‘bootstrap loader’ whose function is to start the operation of computer system once the power is turned on.

b. Secondary Memory

RAM is volatile memory having a limited storage capacity. Secondary/auxiliary memory is storage other than the RAM. These include devices that are peripheral and are connected and controlled by the computer to enable permanent storage of programs and data.

Secondary storage devices are of two types; magnetic and optical. Magnetic devices include hard disks and optical storage devices are CDs, DVDs, Pen drive, Zip drive etc.

* Hard Disk

Fig. 1.3 Hard Disk

Hard disks are made up of rigid material and are usually a stack of metal disks sealed in a box. The hard disk and the hard disk drive exist together as a unit and is a permanent part of the computer where data and programs are saved. These disks have storage capacities ranging from 1GB to 80 GB and more. Hard disks are rewritable.

Compact Disk

Compact Disk (CD) is portable disk having data storage capacity between 650-700 MB. It can hold large amount of information such as music, full-motion videos, and text etc. CDs can be either read only or read write type. · Digital Video Disk

Digital Video Disk (DVD) is similar to a CD but has larger storage capacity and enormous clarity. Depending upon the disk type it can store several Gigabytes of data. DVDs are primarily used to store music or movies and can be played back on your television or the computer too. These are not rewritable.

Flash Drive: It is a small, portable device that can be used to store, access and transfer data. Due to its small size, it is commonly called Pen drive. It is also called USB drive. We can read, write, copy, delete, and move data from computer to pen drive or pen drive to computer. It comes in various storage capacities of 2GB, 4GB, 8GB etc. It is popular because it is easy to use and small enough to be carried in a pocket. This device is plugged into the USB port of the computer and the computer automatically detects this device.

HARDWARE and SOFTWARE

Hardware: The physical components of the computer are known as ―Hardware‖. It refers to the objects that we can actually touch.

Ex: input and output devices, processors, circuits and the cables.

Software: Software is a program or set of instructions that causes the Hardware to function in a desired way. The basic difference between the Hardware and Software is just the same as that exists between TV and TV studio. Without TV studio (software) from where the programs are telecast, the TV (Hardware) is a dead machine.

There are five categories of software. They are:

1. Operating System 2. Translators 3. Utility programs 4. Application programs 5. General purpose programs

1. Operating System (OS) : The software that manages the resources of a computer system and schedules its operation is called Operating system. The operating system acts as interface between the hardware and the user programs and facilitates the execution of programs.

Generally the OS acts as an interface between the user and the Hardware of the computer.

i.e It is a bridge between the user and the Hardware.

The User interface provided by the OS can be character based or graphical.

CUI -- Character user Interface

GUI -- Graphical user Interface

CUI : It is operated with keyboard only. Ex: MS-DOS, UNIX

GUI : The system can be operated with mouse and keyboard. Ex: Windows 95, Windows XP etc · Disk Operating System (DOS): It was developed as early as 1980 by Bill Gates at the age of 19. It is suited for personal computers. Dos is a single user and single task operating system

· WINDOWS : It works with DOS and it supports single user and multitask system. It requires a powerful PC with a minimum RAM of 8 MB .

· UNIX AND XENIX: It is suited for multi-user and multi-task system

2. Translators : Computers can understand instructions only when they are written in their own language – the machine language . Therefore, a program written in any other language should be translated into machine language. The software that ―translates‖ the instructions of different languages is known as translators . There are two types of translators. They are compilers and Interpreters A Compiler checks the entire user – written program (known as the source program) and if it is error free, produces a complete program in machine language (known as object program). The source program is retained for possible modifications and corrections and the object program is loaded into the computer for execution. If the source program contains errors, the compilers produce a list of errors at the end of the execution of the program. i.e a compiler translates the whole program before execution.

An interpreter does a similar job but in a different style. The interpreter translates one statement at a time and if it is error – free, executes. This continues till the last statement. Thus an interpreter

translates or executes the first instruction before it goes to the second, while a compiler translates the whole program before execution.

The major difference between compiler and interpreter is

1. Error correction is very much simpler in the case of interpreter as it translates the statements in stages. The compiler produces an error list of the entire program at the end. 2. Interpreter takes more time for the execution of the program compared to compilers as it translates one statement at a time

Programming Languages: There are three types of programming languages.

1. Machine Languages: Computers respond only to machine language. This language is in terms of binary codes (0,1). i.e. all programs should be written with these codes, which is difficult, time consuming and leading to errors while writing the programs. There is no unique standard machine language. Rather there are many machine languages. These are machine dependent. These are referred as the first generation languages.

2. Assembly Languages : It uses mnemonic codes rather than numeric codes (as in machine languages). Ex. Add or A is used as a symbol for addition. It requires translators to convert into machine language. Like machine language, writing program in assembly language is also time consuming. These are also machine dependent.

3. High Level Languages (HLL): These are referred as problem oriented languages (POL). These are referred as third generation languages. The advantages of these languages are

· The high level languages are convenient for writing programs as they can be written without any codes. These languages follow rules like ―English‖ language.

· Because of their English like nature, less time is required to write a program.

· They are machine independent. A program written in any HLL can be run on computers of different types without any modifications.

Several High Level Languages which are in common use:

FORTRAN : FORmula TRANslation

COBOL : Common Business Oriented Language

BASIC : Beginner‘s All purpose Symbolic Instruction Code

PROLOG: PROgramming in LOGic

ALGOL : ALGOrithmic Language

3. Utility Programs: These are pre-written programs supplied by the manufacturer for maintaining day to day activities of computer system.

Example: COPY, SORT, MAILING, virus scanning software etc.,

4. Application Programs: These are user written programs to do a specific job which can be changed to meet the individual needs. These programs are written in different languages such as BASIC or C or by using database packages like dBASE, Oracle.

Example: Payroll, Billing, Railway Reservation etc.

5. General Purpose Packages: These packages are developed to suit the needs of research workers / scientists in different fields. These packages are categorized as :

i) Data Analysis ii) Word Processing iii) Spread Sheet iv) Graphics and v) Databases

Data Analysis Ex: SPSS (Statistical Package for Social Science), MSTAT, MICROSTAT, GENSTAT, SAS etc. Word Processing Ex: WORD PERFECT, WORDSTAR, MS-Word, CHIRATOR, NORTON EDITOR etc. Spread Sheet Ex: LOTUS, Qpro, VP-PLANNER, SYMPHONY, MS-Excel etc. Graphics Ex: LOTUS, STORY-BOARD, POWER-POINT etc. Databases Ex: dBASE, FOX-BASE, FOX-PRO, ORACLE, MS-Access etc.

**Functions of Operating System:**

Today most operating systems perform the following important functions:

1. Processor management: It manages the assignment of processor to different tasks being performed by the computer system.

2. Memory management: It manages the allocation of main memory and other storage areas to the system programmes as well as user programmes and data.

3. Input / Output management: It manages the co-ordination and assignment of different Input and Output devices while one or more programmes are executed.

4. File management : It allows all files to be easily changed and modified through the use of text editors or some other file manipulation routines.

5. Establishment and enforcement of a priority system : It determines and maintains the order in which jobs are to be executed in the computer system.

6. Interpretation of commands and instructions.

7. Facilitates easy communication between the computer system and the computer operator.

**1.4.3 Input / Output Devices:**

These devices are used to enter information and instructions into a computer for storage or processing and to deliver the processed data to a user. Input/Output devices are required for users to communicate with the computer. In simple terms, input devices bring information INTO the computer and output devices bring information OUT of a computer system. These input/output devices are also known as peripherals since they surround the CPU and memory of a computer system.

**a) Input Devices**

An input device is any device that provides input to a computer. There are many input devices, but the two most common ones are a keyboard and mouse. Every key you press on the keyboard and every movement or click you make with the mouse sends a specific input signal to the computer.

· Keyboard:

The keyboard is very much like a standard typewriter keyboard with a few additional keys. The basic QWERTY layout of characters is maintained to make it easy to use the system. The additional keys are included to perform certain special functions. These are known as function keys that vary in number from keyboard to keyboard. (see fig. 1.4).

Mouse: A device that controls the movement of the cursor or pointer on a display screen. A mouse is a small object you can roll along a hard and flat surface (Fig. 1.5). Its name is derived from its shape, which looks a bit like a mouse. As you move the mouse, the pointer on the display screen moves in the same direction.

3. Scanner: It is an input device that can read text or illustrations printed on paper and translate into digital form. The main advantage of these scanners is that the data need not be entered separately resulting in saving lot of time.

Scanners are of two types: i) optical scanners ii) MICR i) Optical scanners:

a. Optical character Recognition(OCR): In this, characters are read with the help of a light. This is used in office atomization, documentation in library etc.

b. Optical mark recognition(OMR): It is a technology where an OMR device senses the presence or absence of a mark such as a pencil mark. OMR is used in tests such as aptitude tests.

c. Optical barcode recognition(OBCR): Barcode readers are photoelectric scanners that read the bar codes or vertical zebra striped marks printed on product containers. This is used in super markets, book shops etc.

ii. MICR: This is widely used in banks to process the cheques. This allows the computer to recognize characters printed using magnetic ink.

4. Magnetic Ink Character Recognition(MICR): : It is a character recognition technology used primarily by the banking industry to facilitate the processing of the cheques. MICR characters ( cheque No., Acc.No.etc) are printed in special ink usually containing iron oxide. When a document that contains the ink needs to be read, it passes through a machine which magnetizes the ink and there will be a reader sorter unit which translates the magnetic information into characters. MICR provides a secure, high speed of scanning and processing information. It scans about 2600 cheques/min.

**Output devices**

Any device that is capable of representing information on a computer is called an Output device. Output devices receive information from the CPU and present it to the user in the desired form.

Some important Output devices are : Monitor, Printer

1 .Terminal/Monitor: It is similar to TV screen- either a monochrome (black & white) or colour – and it displays the output. It is also referred as Visual Display Unit(VDU). Several types of monitors are in use. Some of them are Colour Graphic Adapter(CGA), Enhanced Graphics Adaptor(EGA) , Video Graphics Adapter (VGA) and Super Video Graphics Adapter (SVGA). The screen sizes differ from system to system. The standard size is 24 lines by 80 characters. Most systems have provision for scrolling which helps in moving the text vertically or horizontally on the screen.

2 . Printer: A printer is used to transfer data from a computer onto paper. The paper copy obtained from a printer is often referred as ―printout‖. The different printers and their speeds are as follows:

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**INTRODUCTION TO INFORMATION SYSTEMS**

Introduction

• The first computers were as large as a room and used light -bulb -sized vacuum tubes for much of their circuitry

• Vacuum tubes were later replaced with transistors and chips made using silicon wafer technology • This change resulted in a dramatic and longterm lowering of costs of manufacturing leading to the high growth in the demand for computers

**HISTORY OF INFORMATION SYSTEMS**

• The earliest “mainframe” computers could only process a single task by a single user – 1946: ENIAC (Electronic Numerical Integrator and Calculator) was developed – 1951: first computer installed by the U.S. Census Bureau – 1954: first computer used by G.E.

• Over the last half century, hardware has seen many fold increases in speed and capacity and dramatic size reductions

• Applications have also evolved from relatively simple accounting programs to systems designed to solve a wide variety of problems

**Multitasking**

• IBM revolutionized the computer industry in the mid-1960s by introducing the IBM System/360 line of computers

• These computers were the first to perform multiple processing tasks concurrently

**Smaller Computers**

• The first small-scale systems, called minicomputers, were smaller and less powerful but could handle processing for small organizations more cheaply

• Even smaller microcomputers designed for individual use were later developed, first by Apple and Tandy Corp.

• In 1982, IBM introduced the first personal computer, or PC, in 1982, which has since become the standard for individual computing

**INTRODUCTION TO COMPUTER ARCHITECTURE**

• Most computers have similar architectures that combine software and hardware

• Software includes the operating system which controls the computer hardware and application software, such as word processing, spreadsheets, etc.

• Hardware includes, processors, memory and peripheral devices

**Computer Hardware**

• The processor manages the input and output devices, data storage devices, and operations on the data

• The central processing unit (CPU) controls all the other components

• Two types of memory are: – Random access memory (RAM) acts as the temporary workspace for the CPU – Permanent data storage devices such as CD/ROM, floppy and hard disk drives

**INTRODUCTION TO COMMUNICATIONS ARCHITECTURE**

• Modem: a hardware device that sends the computer’s digital signals by modulating an analog carrier wave

• Data rates for various communications systems: – Telephone lines: 56 kbps – Cable modem: up to 2 Mbps – WiFi: 11 Mbps – Local Area Networks: 10 to 100 Mbps

• Wireless has recently taken off because it’s cheap and easy to install

**THE EVOLUTION IN COMPUTER APPLICATIONS**

• An information system is a conceptual system that enables managers to control and monitor a firm’s physical systems used to transform input resources into output resources

**Transaction Processing Systems**

• A transaction processing systems is shown in Figure 1.8

• It gathers data from the firm’s physical system and environment and enters it into its database

• The software also transforms the data into information for the firm’s managers and other individuals in the firm’s environment

**Management Information Systems**

• Management information systems (MIS) transform the data in frontline systems, such as transaction processing systems into information useful to managers

• Typical MIS modules are report-writing software, and models that can simulate firm operations

• Information from the MIS is then used by organizational problem solvers as an aid in decisionmaking, as illustrated in Figure 1.9

• Firms can also interact with suppliers or others to form inter organizational information systems (IOS), in which the MIS supplies information to the other members of the IOS as well as the firm's users

**Virtual Office Systems**

• Office automation - the use of electronics to facilitate communication, began with word processing

• Subsequent applications include electronic mail, voice mail, electronic calendaring, and audio and video conferencing

• These personal productivity systems now account for a large portion of a firm's use of the computer as a communications vehicle

• With improvements in networking, the concept of a virtual office has developed, in which office activities can be performed without the need for an employee to be in a specific location